Unit 9: Responses to Climate Change: Adaptation

Learning Objectives

How can adaptation impact the climate?

After studying this unit, you should be able to:

- Identify the climate change-related challenges faced by developing countries that can be addressed through adaptation.
- Define the terms and concepts used to describe adaptation initiatives.
- Describe how climate models, downscaled scenarios and socioeconomic data are used when developing adaptation measures and approaches.
- Identify examples of adaptation measures.

Introduction and Overview

This unit provides an overview of adaptation, which can be viewed as managing risk from climate change and as an integral part of development. It introduces some key concepts, terms and tools that are used as part of climate risk management.

What is Adaptation?

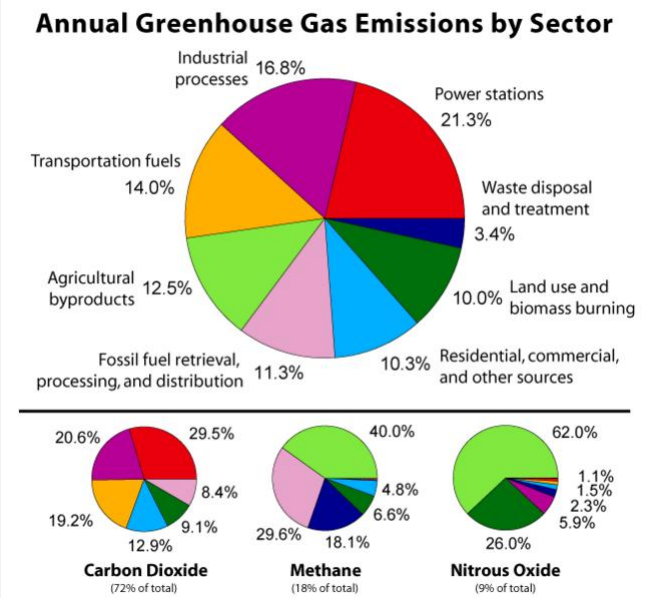
Adaptation is any adjustment in societies and ecosystems in response to actual or expected climate change. It is intended to either minimize the harm or to exploit the beneficial opportunities (IPCC 2002, 2007, Noble and Watson 2007 – "Confronting climate change") and can be viewed as climate risk management that emphasizes minimizing the risks and maximizing the benefits from a changing climate. Adaptation aims to increase the resilience of

societies and countries to change in the climate and, thus, cannot be isolated from the need to address other pressures, such as land degradation, water scarcity and urbanization.

Why is Adaptation Necessary?

Ecological and socioeconomic systems have already been impacted by climate change. For many developing countries, these impacts are adverse, making adaptation a necessity, and parliamentarians in a position to influence the level of attention adaptation efforts receive. Given the current greenhouse gas emission rates, the world should brace itself for significant climate change. With limited emission reduction actions in developed countries and the rapidly increasing energy requirements of developing countries, the greenhouse gases in the atmosphere will likely increase substantially and lead to even higher temperature increases.

Box 20: Where Adaptation Efforts can be Made



Greenhouse gas concentrations in the atmosphere are already approaching levels that are projected to lead to at least a 2°C increase in average global temperatures. Many believe this is a critical threshold beyond which impacts may rapidly increase, or the point at which dramatic changes/breakdowns in ecosystems are likely.

Links between Adaptation and Development

Many developing countries are already impacted by climate variability and climate change. The GDP of many developing countries depends on agriculture and its underlying natural resources. For example, Ethiopia's GDP comes mainly on agriculture and is highly dependent on rainfall

patterns. Increased variability in rainfall and climate would affect the entire economy.

Box 21: Adaptation to Climate Change in the Caribbean

At the Adaptation to Climate Change in the Caribbean Disaster Risk Management Brainstorming Workshop in 2002, participants recognized the need to incorporate disaster management concerns into regional Climate Change initiatives, and are openly discussing emerging issues and the potential strategies for adapting to climate change impacts on the disaster risk management sector in the Caribbean, in the context of the Mainstreaming Adaptation to Climate Change (MACC) Project. Considering the policy perspective, participants concluded that climate variability and change interventions in disaster management should be developed within the broader Comprehensive Disaster Management framework, and that climate variability in the region needs to be studied more thoroughly in order to prepare for a better understanding of climate change and its potential impacts.

Source: oas.org

An additional challenge is for countries to deal with impacts from multiple parameters, such as increased temperatures, decreased water availability, floods, droughts, storm surges, etc, which will disproportionately burden developing countries, but even some OECD countries. The importance of adaptation to climate change is illustrated by the number of people affected by climate-related disasters in Sub-Saharan Africa.

Given the links between development, adaptation and disaster risk management, there is merit in linking national and regional disaster risk management with adaption at the policy and institutional level, something particularly relevant to parliamentarians. For many countries, the challenges and costs of adaptation will increase with increased warming, posing even greater challenges for climate risk management. There may be limits to adaptive capacity of both ecological and socioeconomic systems, but more importantly, once thresholds are crossed, climate-related changes in the ecosystems may alter the livelihoods of some societies and species. This is likely to be the case in the Arctic, where many indigenous peoples have been forced to change their lives and cultures, and in small island states, where some are facing forced migration due to sea level rise and storm surges, *(see the case here)*. However,

Adaptation alone is not alone. Without action on mitigation, the challenges of managing the risk from climate change will increase and may become unmanageable.

Climate Change, Practically Speaking

In this part of the unit we take a look at climate change and adaptation for climate change as practitioners and legislators who aim to make a long term impact on how climate change is treated in our nations and regions.

Terms and Concepts

As climate change becomes a bigger legislative priority throughout the world, a number of terms will take on more scientific meanings in policy discussions of climate change. Here we define these ordinary terms from the scientific perspectives.

Exposure includes the spatial and temporal extent of the system being affected by climatic stimuli including extremes.

Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, variability and other pressures. Vulnerability is determined at specific spatial and temporal scales and is a dynamic property that changes depending on the local conditions. For example, a system may be vulnerable at a particular time (e.g. the dry season), but may not be vulnerable at other times. Vulnerability has four components: i) the hazard as the probability of an event occurring; ii) the risk being the likelihood of that event leading to adverse change; iii) the response needed to manage that change; and iv) a formulation of the desired outcome. As is often the case with adaptation, the response is articulated but the desired outcome is not specifically stated.

Planned adaptation is a well thought out, detailed and, in some cases, comprehensive action to adapt to both present variability and future changes. These actions will increases the overall resilience of local populations and assets over the long term. However, they still must be within a flexible and dynamic framework so they are able to respond to changes in projected conditions.

Win-win adaptation actions will directly or indirectly improve system resiliency. The term co-benefits is usually employed to determine additional benefits that support or stimulate the implementation of the adaptation actions. Sometimes adaptation options will only be chosen based on these additional benefits when assessing cost-benefits. If the associated uncertainties regarding their success are high, it might limit the number of implemented adaptation options needed to increase overall resilience to a particular climate threat.

An **Adaptation deficit** refers to the amount of adaptation required to cope adequately with the current climate and climate variability. An **Adaptation gap** is the amount of adaptation required to cope with climate change, including changes in climate variability. In practical terms, the difference between an adaptation deficit and an adaptation gap is not important – more that, e.g. for farmers, it might be of interest to know that the problems they are facing are likely to get worse rather than better in many parts of the world.

Autonomous adaptation refers to coping activities to spontaneously cope with climate impacts. No further planning for future events is considered. There is no doubt that human societies and ecosystems do adapt to changes and have done so in the past in response to a changing climate. However, given the rate and magnitude of change, and the adaptation deficit and gap that do exist in many countries and societies, can and should countries rely on autonomous adaptation?

Adaptive capacity is largely determined by the human, financial, technological and institutional resources available. Richer societies (with generally good information systems, infrastructure and institutions) generally have better adaptive capacity with the same exposure than poorer societies, and are generally able to manage climate risk better. There are thus synergies between development and adaptive capacity. Hence for adaptation, one of the main messages is that good development is the best way to adapt to the risks of climate change.

Maladaptation refers to faulty or inadequate adaptation, or, more specifically, any planned change in natural or human systems that inadvertently increase the risks of adverse effects to climatic stimuli. For example, building cities in areas with limited water availability is likely to lead to water shortages with increasing temperatures. In addition, building sea walls that are then destroyed by storm surges is likely to have more devastating impacts than if the sea wall had not been built in the first place.

Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. Climate-related stimuli include the following elements of climate change: mean climate characteristics, climate variability, and the frequency and magnitude of extremes.

Example of Applying These Terms

Exposure: Annual fruit and vegetable crops are located across a wide range of environments, but are primarily restricted by topography, access to irrigation water and quality soils, and a decrease in annual rainfall. The industry is exposed to lower rainfall, increased temperature, increased frequency of droughts, a reduction in frost days and increased frequency of extreme events, especially hail, very hot days and summer rainfall.

Sensitivity: Annual fruit and vegetable crops are particularly sensitive to an increase in diseases and pests following summer rainfall, and are thus highly susceptible to the impacts of climate change where summer rainfall is likely to increase. These crops are also sensitive to extreme events such as hailstorms and drought, although where there is access to irrigated water, the impacts of climate change are substantially reduced. The impact of elevated CO_2 on plant growth together with reduced rainfall and increased temperature may provide opportunities in some regions, but is more likely to increase the reliance on nitrogen fertilizer to maintain current production rates.

Adaptive capacity: This industry has a high capacity to adapt to the impacts of climate change and is therefore not nearly as exposed as other sectors. For instance, the high returns per hectare obtained from annual fruits and vegetables place them quite favorably to pay for higher water costs than other sectors. The industry is intensively managed and is well placed to handle outbreaks of pests and diseases. The short-term nature of the crop cycles for this industry allows it to be more adaptable to climate change and take advantage of out-of-season market demands.

Adverse implications: Annual fruit and vegetable crops are worth about US $2 billion of export and domestic earnings annually. Climate change impacts may have wide reaching affects on the viability of secondary food production that relies on fresh annual fruits and vegetables for domestic and export markets.

Potential to benefit: The intensive nature and high value return from annual fruit and vegetable crops provide this industry with the capacity to secure water or improve shade protection, as well as provide protection from hailstorms, pests and diseases, more so than other sectors. Access to new varieties that are tolerant to drought or have a shorter growing season will allow the industries to adapt to climate change in the short to medium term. This industry also has a high capacity to improve water-use efficiency through improved soil management and irrigation management.

From Knowledge to Action on Adaptation

A first step to consider when integrating adaptation into any development plan is to get as much information as possible about the historical and current conditions, and the likely future changes. Much of this effort tends to be on climate-related data; however, other socioeconomic information is just as useful. Downscaled climate scenarios are another useful tool. Here, we look at what types of information are used and why.

Climate Model Outputs

Climate models project temperature, precipitation, etc., and use both mean changes and climate extremes for the specific region being modeled. It is important to understand where models agree, and particularly where certain general circulation models (GCMs) perform better than others in a particular area or region.

Climate models are a valuable source of information for scientists and policymakers, despite the uncertainties and assumptions they make. Some of the uncertainties are due to our limited understanding of some biophysical processes, and some are due to our inability to have precise estimates of development and thus greenhouse gas emissions. Downscaled climate projections at the regional scale are useful, but limited in resolution, and are not generally available for many areas in the developing world. It is widely accepted that our ability to forecast the weather will always be limited to a few weeks, and general forecasts of climate will be uncertain. Some of this uncertainty arises from the chaotic weather processes and some from

our lack of understanding of the processes. However, much of it arises from the uncertainty about how high greenhouse gas emissions will be in the coming decades.

For example, even though the Global Circulation Model and the Regional Model shown below show apparent differences, the message is the same – "Almost all of India will become 2.5 to 5 degrees hotter". This is enough information to act on now.

Higher resolution models are useful when making rainfall projections. For example, when predictions of the current climate from three model runs with different resolutions are done, a 20 km grid shows more details in the rainfall patterns that are important for decision making. However, the GCMs that underlie all of the regional models differ significantly in making projections. Major advances are not expected in the near future (5-10 years). Trends in observed rainfall over the past 20-30 years are probably as good a predictor as GCMs, as basic changes in precipitation are fairly consistent for most parts of the world.

Socioeconomic Data

Agricultural Data - Spatially-varying data on crop yields, soil degradation, and groundwater recharge and drawdown. Coping strategies (e.g. diversification), cultivars and varieties (e.g. drought resistant), soil, water and crop management practices, etc.

Water Management Data - Spatiotemporal distribution of river discharge/hydrology. Water demand and scarcity.

Ecosystem Data - Biodiversity, species ranges and ecosystem function baselines. Spread of invasive species. Deforestation Rate.

Health Data - Changes in incidence of climate-related, vector-borne diseases and shifts in vector ranges.

Changes in population size and structure are also important and can be part of the planning process for future changes.

Using climate information along with socioeconomic data is another starting point for a signification amount of adaptation work. Effective use of existing (high quality) data is

important, and effort is needed to try to bring this type of information into a common and accessible platform (see the Unit on Climate Change Tools for examples). The World Bank (WB) climate portal, other knowledge bases (such as UNDP's Adaptation Learning Mechanism (ALM)), Stockholm Environment Institute (SEI) tools linked with Google Earth, and Servir are part of this effort. In most cases, these types of data sources include historical records of particular regions.

Data Collection

Keep in mind that data collection can itself end up being an immense task. Prioritizing information being collected is essential, as is the ability to analyze the data and maintain it for illustrating long-term changes. Data that is simple, reliable and easy to collect, interpret and analyze can be just as effective in helping to plan for risk management as complex data sets that may not be as easy to collect, aggregate and use. Coordinating data collection, such as through building on existing efforts, can serve multiple purposes, especially for long-term development, and is likely preferable over shorter-term, disconnected efforts.

Adaptation Approaches

A major issue confronting development agencies, including the World Bank, is whether to allocate funding specifically for adaptation activities, or whether to begin ensuring all climate-sensitive development activities are resilient to climate change. This would mean integrating policies and responses to climate change into existing development plans and programs. Putting activities into discrete projects would delink them from development, increase the risk of creating disjointed and competing policies, programs and organizations, and increase the likelihood for maladaptation. The right incentives, removing perverse incentives and the right price for scarce natural resources can be part of both development and adaptation. Another areas of debate is whether adaptation should occur autonomously or be a deliberate and planned response. Questions to address include "Can resources be allocated to help ecosystems and societies to adapt?" and "What type of adaptation-friendly development policies and actions might be relevant and beneficial at various scales?" The adaptation approach taken will have

implications for achieving adaptation goals, relations between donors and recipient countries, earmarking of funds, and feasibility of calculating incremental adaptation costs. (See the Units on Policies and Frameworks, and Financial Instruments).

Examples of Planned Adaptation Approaches

The following are some examples of planned adaptation approaches:

- Drought-mitigation programs being implemented in Vietnam.
- Changing water-use strategies and imposing tariffs to encourage conservation and wise use of scarce resources.
- Public health services, such as providing vaccinations, to deal with water- and vector-borne diseases.

Box 22: An Example of Autonomous Adaptation

In Vietnam, communities identified a number of adaptation strategies in agriculture, animal husbandry, water resources, and food and economic security. Growing new crop varieties and formulating seasonal calendars helped to address the impacts of drought on agriculture.

In the mountainous regions, alternative livestock breeds were introduced, and new feed and fodder sources found. Growing fodder crops in the coastal regions has also become an important adaptation strategy. Coastal communities adopted a wider number of animal husbandry strategies than mountain communities, a fact which could reflect their level of development.

The major planned option in agriculture in areas of Vietnam exposed to drought conditions is to extend irrigation facilities by establishing deep and open wells. Other adaptation strategies included:

- Provision by governments and NGOs of the latest seed varieties at low prices, as well as vaccines for animals during drought periods,
- Digging of wells by governments and NGOs.
- Provision by NGOs of water-storage tank facilities, such as portable tanks and jars.
- Supplying of food grains and provision of loans by governments and NGOs during stressful times.

One issue affecting the need for adaptation is that male and female respondents from the mountainous region have fewer migration opportunities, due to their limited education and lack of knowledge and skills, which may be useful elsewhere. Most mountainous people are ethnic minorities, which are often deprived of education facilities.

Case Study: Planned adaptation strategies (in coastal and mountainous regions in Vietnam)

In many cases, policies and plans to deal with present climatic extremes will help in the future, whether in rich or poor countries. Planned adaptation incorporating disaster risk management is a pragmatic way forward. For example, the death toll from future heat waves in Europe is not likely to be as high as it was in the early 2000s, since people will be warned and organizations will be able to suggest measures that individuals (such as young and elderly) should take. Development professionals should strive to identify what types of adaptation-friendly

development policies and actions might be relevant and beneficial at the community, national and regional scales.

Incorporating Adaptation into Development Efforts

What gains can be expected from incorporating adaptation into development efforts? Adaptation should be an integral part of development since climate change, on its own or in addition to other pressures, is affecting development and eroding development gains made over the last few decades. Hence, many gains can be realized from incorporating adaptation into development efforts. For example, dealing with an existing adaptation deficit as a start will in itself be a gain. It is also a pragmatic start for any country trying to balance between short-term needs and long-term risks.

Examples of Other Gains: Developing countries could "buy" the capacity to withstand the impacts of increasing variability and extreme weather events by investing in adaptation. In the case of agriculture, adaptation investments could help farmers determine what and when to plant so that they can keep maximizing crop revenues. In the case of infrastructure, considering adaptation issues could help ensure that a dam, road or bridge does not wash away after 5 years because the storms that are classed as occurring every 20 years have become more frequent. What gains can be expected from incorporating adaptation into development efforts? Overall, adaptation provides the ability to enjoy a continued flow of benefits, from land, infrastructure, etc. This flow is not interrupted by a lack of preparedness in facing increased variability due to climate change.

Unit 9 Questions

Please answer each of the following questions. If you are taking this course in a group you may then meet to discuss your answers.

1. Should adaptation to climate change focus on developing new varieties of crops and putting in sea walls?
2. What challenges does your country currently face in managing the present risk of climate change?
3. Can communities become climate resilient simply by investing in greater amounts of development?
4. Is mainstreaming climate risk in development all that is required?
5. Can adaptation only be truly achieved by ultimately going beyond project-based development to rethinking policies, institutional linkages and international cooperation
6. What is the nature and extent of current and future climate risks in your country? What is the degree of uncertainty?
7. What are the non-climate-related drivers of risk in your country (e.g. land-use change, soil degradation, lack of basic rural infrastructure, lack of income diversification opportunities, distortion in agricultural subsidies, etc.)?
8. What are the uncertainties involved? What is the importance of climate-related risk vs. the other pressures/stresses (e.g. market volatility, infrastructure, health, etc.)? prioritized?

Internet Resources

http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTENVMAT/0,,menuPK:3011413~firsttime:true~pagePK:64168427~piPK:64168435~theSitePK:3011351,00.html

http://imagebank.worldbank.org/servlet/WDSContentServer/IW3P/IB/2006/09/28/000090341_20060928112135/Rendered/PDF/374620Managing0Climate0Risk01PUBLIC1.pdf

http://climatechangeblog.worldbank.org