PURDUE EXTENSION

Adjusting to Climate Change: Adaptation and Mitigation Strategies

Mitigation vs. Adaptation Strategies

The Intergovernmental Panel on Climate Change (IPCC), the leading expert on climate change today, is charged with three general responsibilities:

- compile and analyze past and current climate data to glean any trends (working group 1)
- research adaptation strategies that would reduce the effects of a warming, less predictable climate on local populations (working group 2)
- research mitigation strategies that would reduce the underlying cause of climate change such as greenhouse gases (GHGs) (working group 3)

The IPCC has more precisely defined adaptation and mitigation as follows:

"Mitigation is an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases while adaptation is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities."

Mitigation strategies frequently have a global impact on climate change. In the case of total concentrations of GHGs, the atmosphere is a relatively well-mixed system where greenhouse gases are not confined by national borders; what is emitted on one side of the world can affect the atmosphere on the other side of the world. Therefore, mitigation strategies generally include collaborative efforts by and between national governments. In addition to being wide-reaching, GHGs are retained for a long time in the atmosphere. It can take decades or centuries to reduce GHG levels through mitigation strategies. As a result, to determine the effectiveness of mitigation strategies, researchers measure concentrations of GHGs in the atmosphere over time.

Adaptation strategies are much more localized and focus on specific changes observed in a localized climate. These strategies are more often used by individuals or local governments and can have an effect more quickly—in years, months, or even days. However, the effects of adaptation can be harder to measure and implementation can be affected by local customs and laws. Further, depending on the adaptation strategy, effectiveness could be measured any number of ways.

Table 1. Mitigation vs. Adaptation Strategies

	mitigation	adaptation
effects/benefits	global	regional/local
timeframe	decades/centuries	days/months/years
implementers	UN/national governments	individuals/local and state governments
effectiveness	measurable	hard to measure

Mitigation Strategies

Mitigation of climate change is an attempt to reduce climate-caused changes on the environment by trying to affect the root cause. The main focus is generally reduction of GHGs in the atmosphere either by reducing emissions or increasing "sinks" (things that absorb more carbon that they release as carbon dioxide).

Agriculture affects the amount of greenhouse gases emitted each year.

As the global population grows and as the climate

"Agriculture is not only a fundamental human activity at risk from climate change, it is a major driver of environmental and climate change itself," according to the Food and Agricultural Organization (FAO) of the United Nations. "Overall, agriculture is responsible for 25 percent of carbon dioxide (largely from deforestation), 50 percent of methane (rice and enteric fermentation), and more than 75 percent of N2O (largely from fertilizer application) emitted annually by human activities."

continues to change, food supply has become a focal point for mitigation strategies. Sustaining agricultural activities while incorporating mitigation strategies into food production is a focus of the third working group of the IPCC.

Mitigation strategies put into place to reduce the impacts of agricultural GHGs on climate change range from reduced deforestation and degradation of tropical forests to afforestation. The mitigation strategies used to reduce the amount of greenhouse gases emitted by agriculture worldwide range from improving crop and livestock management to changing tillage practices. While these strategies are successful and do show significant potential to reduce the effects of climate change, in the long term, mitigation alone is not enough. Governments have to also enforce adaptation policies for the human population to sustain agriculture and thrive.

Table 2. Mitigation potential in agriculture and forestry in 2030*

	Gigatons CO_2-e/yr		Gigatons CO_2-e/yr
Global	15 - 25	**Forests**	2.5 - 12
Agriculture	1.5 - 5.0	**REDD**	1.0 - 4.0
Methane, N2O	0.3 - 1.5	**SFM**	1.0 - 5.0
Agroforestry	0.5 - 2.0	**FR**	0.5 - 3.0
Soils	0.5 - 1.5	**Bioenergy**	0.1 - 1.0

Global reductions (CO2-equivalents/year) in 2030 correspond to those needed to achieve stabilization of atmospheric concentrations between 450–550 ppm CO2, under a mid-range IPCC SRES. Sources: IPCC AR4, WGIII Chapters 8 and 9

* Food and Agriculture Organization of the United Nations. "Climate Change Adaptation and Mitigation: Challenges and Opportunities in the Food Sector". http://www.fao.org/docrep/016/i2855e/i2855e.pdf (accessed March 9, 2014). Page 13.

Adaptation Strategies

Adaptation strategies differ from mitigation strategies in that they are short-term or long-term adjustments to a system that immediately help reduce present or future impacts of climate change.

Agricultural Adaptation: Impacts on Crops

Changes in temperature, amounts of carbon dioxide (CO2), and the frequency and intensity of extreme weather can all significantly affect crop growth and yields. Typically, crops grow faster in warmer conditions, but this warmth can also increase competition and so reduce the amount of time that seeds have to grow and mature. Oddly, recent studies have shown that an increase in CO2 may increase crop yield and thus help keep pace with the population increase. However, this may be the only good news in what farmers see as an otherwise difficult predicament.

As they experience extreme temperatures, weather events, and precipitation, many agricultural businesses and farmers will need to adapt. Farmers will need new hybrid seeds engineered to withstand high heat and drought. Many farmers may have to start planting earlier to maintain crop yields and to continue to meet the

Despite technological improvements that increase corn yields, extreme weather events have caused significant yield reductions in recent years. (Photos courtesy Purdue University)

ever-growing demand for food. Different pesticides and integrated pest management strategies are already needed as more pests survive the milder winters. Farmers are also reducing tillage to maintain the integrity of both soil and water—important sinks in the carbon cycle.[1]

Municipal Adaptation

Many cities are creating adaptation plans for climate change. Twenty-six of the 50 states have either completed adaptation plans, have plans in progress, or have an adaptation plan recommended in their climate action plan. (Currently, Indiana is not one of the 26 states.) Some of these plans include policies or recommendations for water supply, human health, and coastlines. Municipalities are recognizing the importance of preemptive action to address their vulnerabilities to climate change impacts. Many have begun to address adaptation concerns either within broader climate action plans or through separate efforts.[1]

Human Health and Adaptation

Climate change can affect human health in more ways than one. Many communities are implementing early warning systems and emergency response plans to prepare for changes in the frequency, duration, and intensity of extreme weather events. These communities are also improving climate-sensitive disease surveillance and control. Moderating heat increases by planting trees and expanding green spaces in urban settings is one of the more common ways to help. Improving safe water and sanitation are other key steps.

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[1] For more information on New York State municipal examples: Chatrchyan, A.M. "Addressing Climate Change at the Municipal Level." http://climatechange.cornell.edu/addressing-climate-change-at-the-municipal-level/. Accessed December 20, 2016.

Resources

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June 2017