

Confronting Climate Change in the Great Lakes Region

Technical Appendix Climate Change Solutions

MANAGING THE IMPACTS OF CLIMATE CHANGE

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Even if our local, regional, and global societies are successful in relieving human pressures on ecosystems and minimizing climate change by reducing heat-trapping greenhouse gas emissions, our climate will still change in the future. The change already set in motion will continue for decades or more even if all emissions were stopped immediately because the heat-trapping gases remain in the atmosphere for years to centuries. This is precisely the reason why emission reductions should not be postponed. Because of the difficulties associated with reducing emissions drastically in the short term, the concentration of greenhouse gases is likely to increase for several more decades. This fact means that planning and preparing to manage the future impacts cannot be avoided.

In managing the impacts several key questions should be kept in mind:

- What strategies will best minimize the impacts of predicted climate or ecological change?
- What strategies are robust in preventing large losses in the face of unforeseen climate or ecological change?
- What should we do now to plan for future consequences?
- How can we best take advantage of opportunities that may arise from climate change?

Managing the impacts of global warming is one of three complementary and necessary strategies to comprehensively deal with climate change (note this list aims not to be comprehensive, but illustrative).

Opportunities for Managing Impacts on Fisheries

The histories of aboriginal, commercial, and sport fisheries provide many examples of the adaptability of fishers. When traditionally exploited stocks fail, effort is quickly re-directed and fishing methods are adjusted to other stocks and species. It may well be possible for fisheries to adapt to a new mix of fish species, such as switching to catching warm water fish rather than cold water fish as the regions waters warm, without significant overall losses. Although managing the impacts of climate change in the fashion may be possible, this does not mean that individual fishers or specific fishing communities will necessarily avoid serious negative effects and cultural preferences are typically slow to change

Examples of Adaptive Measures for Mitigating Impacts of Climate Change on Fisheries

Adaptation Strategy	Specific Option	Limitations
Choose/Change:		
<i>Location</i>	Encourage fishers to move fishing grounds as locations of preferred fish habitat change	Most stocks of desirable fish species are heavily exploited already
<i>Use</i>	Exploit previously unused or underused resources	Local aquatic ecosystems will become generally overexploited as the focus of fishers extends to all levels of the food web
Reduce Losses:		
<i>Prevent effect</i>	Not possible	-
<i>Modify effect</i>	Artificially accelerate natural rates of range extension for warm-water species	Careless actions will exacerbate problems
	Reduce impacts from other agents of stress; particularly relevant for fisheries located in areas of high human population density	Resistance to limit destructive environmental impacts of industry and other human activities
	Remove potential barriers to migration and range extension	
Accept Losses:		
<i>Share loss</i>	Compensation / insurance programs for fishers	Such actions provide only short-term mitigation, if the precipitating environmental changes are permanent
<i>Bear loss</i>	Do nothing to save species or stocks	-

Robust management practices grounded in understanding of the processes that drive ecosystem responses to both climate impacts and human reactions to those impacts in the fisheries sector should be guided by some basic principles, including:

- Ensuring that no practice applied for a short time could produce extreme outcomes;
- Reducing the negative impacts of other anthropogenic stressors, such as acidification and habitat destruction;
- Maintaining exploitation rates at levels that include a safety margin based on a cumulative appreciation of historical uncertainties in fish stocks; and
- Initiating concerted efforts to reduce over-capitalization in a fishery when it becomes apparent that the capability to exploit certain species exceeds the capacity of the population to sustain exploitation.

Opportunities for Managing Impacts on Aquatic Ecosystems, Resources and Wildlife

To help protect our region's aquatic resources and ecosystems, efforts should focus on several areas:

(1) *Riparian zones of rivers*

Riparian zones are relatively easily protected and restored, and therefore can provide a large return on investment in terms of managing the impacts of a changing climate. The species chosen to do so should be evaluated in light of the new temperature and precipitation regime and their ability to withstand extremes such as frequent floods and droughts.

(2) *Existing wetlands, headwater streams, and lakes*

Protecting existing wetlands, particularly those in wetland complexes, could be significantly more challenging in warmer and ultimately drier conditions. Thus, efforts to increase water retention and maintaining connections (or removing barriers) to surface water bodies will increase the chance for wetlands to survive. Only when wetlands are recognized as a community resource – helping with flood control, drought mitigation, and as valuable recreational areas, rather than as a nuisance, can we expect there to be sufficient support to sustain these ecological treasures.

Similarly, protection of vulnerable headwater streams also provides cost-effective flood storage and habitat. This may involve changing current human uses of vulnerable ecological areas in ways that will act to protect or promote the buffering capacity of the existing ecological communities (e.g., through establishing no-use areas or no-use seasons).

(3) *Groundwater resources*

Increased demand-driven withdrawal of waters from surface and groundwater (i.e., provide water as needed from limited reservoirs) is likely to further reduce ecological values and services. Demand-side management is less likely to have negative ecological consequences, but will require changes in human behavior, including changes in households, on farms, and in industries. While water conservation would result in cost and ecological benefits immediately, an additional approach is to review water management policies, rules and institutions for their flexibility, capacity and adequacy to deal with both more floods and drought conditions. Ongoing policy debates about cross-boundary water management and water retention (as e.g., in the 2001 Annex 1 to the Great Lakes Water Quality Agreement) would benefit from taking the scenarios of climate change into account in long-term considerations.

Opportunities for Managing Impacts on Agriculture and Livestock

Trends in agriculture tell a story of intensification, declining farm labor, and increasing crop yields since the end of World War II. Many factors other than climate – e.g., changes in world agricultural markets, changes in technology, availability of resources, subsidies and management policies – will heavily influence the ease, degree, direction and success of adaptation in this sector, especially for individual regions and farmers. These global changes could feedback on our ability to manage change in numerous and complicated ways. Stresses within the U.S. might likewise be expected to be more challenging to

limited-resource farmers or enterprises that are less mobile in the face of a changing climate.

Typically, macro-scale assessments of agriculture's adaptation capacity to climate change produce relatively favorable predictions, especially for scenarios of relatively small warming, at a broad regional or national scale, because they assume farmers – being used to having to make adjustments every season – have the ability to adapt or change multiple factors to optimize response.

Farm-level management of climate change impacts depends on technological options, resource status, infrastructure, market pressures and signals, and the producer's ability and desire to change. For example, changes in crop varieties or choice of genetically better adapted crops, improved irrigation methods, and advances in pest management may all help deal with climate change, though environmental impacts of such adaptation measures have to be considered carefully before application. Adaptation in highly concentrated and industrialized livestock systems will require additional cooling and other management response to reduce heat stress, i.e., increased expense to farmers.

Macro-scale assessments typically fail to capture the cost of impacts and of adaptations on individual operations or the influence of agricultural industries on the local community. These costs and changes, however, are likely to occur and may change the character of the Great Lakes rural landscape.

Opportunities for Managing Impacts on Forestry

Forestry is an economically important industry across the northern portion of the great Lakes region. Managing the impacts of climate change may involve any of the following mechanisms:

- Shift of the genetic stock (species and genotypes) and silvicultural systems in order to increase water use efficiency of tree species;
- Improved soil management, spacing, and tree rotation length to enhance the success of forests under new, variable and changing climate regimes;
- Movement towards greater production of sawtimber and less pulp production in order to help sequester carbon in long-lived products;
- Creation of biologically diverse (as opposed to monoculture) plantations to enhance and hasten species dispersal;
- A greater investment in prevention, management and containment of large forest fires, especially during dry periods, while developing improved fire management strategies for relatively small fires.

Many of the best practices common in sustainable forestry today, especially adaptive strategies that retain management flexibility in the face of uncertainty, together with improved land use planning and pest management could help ensure the resilience of biologically diverse forests and habitat protection for birds and other wildlife under future climate stresses. As in the agricultural sector,

however, many market-related and industry-wide changes occurring outside the Great Lakes region will impact the economic viability, technological changes and productivity of our forestry.

Opportunities for Managing Impacts on Infrastructure and Built Environments

In the past, people have responded to climate variability and weather extremes by shielding themselves through structural measures – such as bulkheads along varying shorelines, levees and flood retention basins in floodplains – but also through non-structural measures such as insurance coverage, warning systems, emergency management plans or land use planning. These same tools are available for adapting to climatic changes, but frequently, they do not yet include a long-term perspective or if they do, they do not yet consider climate change.

For example, as infrastructure is being upgraded or replaced, sole reliance on historical frequencies of extreme events, lake level fluctuations, or groundwater recharge rates may not suffice anymore. In general, infrastructure improvements that maintain or improve sanitation, sewage treatment, waste disposal, and water supply and removal after heavy precipitation events will all help reduce health risks. Urban renewal and other smart growth measures being implemented today often do not take into account such as needs as tree shading and cooling to mitigate the urban heat island effect in an even warmer climate. Current trends in the insurance industry – ever more expensive coverage and withdrawal from high-risk areas – also suggest that this risk-sharing tool needs to be complimented with progressive relocation out of the most hazardous areas and other improvements in zoning, planning, and building codes to avoid creating greater societal vulnerability and liability in the future.

Opportunities for Managing Impacts on Health

Coordinated health management plans specifically taking climate change into account are a first step in managing climate-health impacts.

Example from Ontario: For a health-related adaptation plan for the Toronto-Niagara

Region see: Chiotti, Q. et al. (2002): Towards an Adaptation Action Plan: Climate Change and Health in the Toronto-Niagara Region. Pollution Probe. Available at:
<http://www.pollutionprobe.org/Publications/Air.htm>

In general, the manner in which public health agencies might prepare for changing patterns of disease threats that could result from climate change will depend on the factors that cause each condition.

Extreme Events

Extreme heat events are generally easily forecasted and resulting morbidity and mortality should be easy to prevent. As the frequency or intensity of extreme heat events increases in the future, earlier forecasting, better public education and information distribution, and assistance directed at high-risk populations must be implemented to address the increased health risk. Critical to reducing heat-stress mortality will be improved economic well-being and health care coverage and education of the elderly and low-income populations so that they may better cope through increased use of fluids and air conditioning.

Some of the effects of other extreme weather events such as tornadoes or floods also might be lessened if there were better forecasting and advance warning. Such knowledge can allow people to take actions to reduce risk and allow disaster relief to prepare timely responses. Obviously, limiting construction of dwellings on flood plains and improving house construction could reduce risk of flood damage and deaths. Improved storm drainage systems, and warnings to avoid high-risk areas might also reduce infectious disease agent contact.

Air Pollution

Education related to efforts aimed at reducing the impacts of air pollutants on health could provide susceptible people with earlier warning of severe conditions. The elderly or others with preexisting respiratory conditions can then reduce outdoor time during periods of increased ground level air pollution.

Infectious Diseases

Links between climate variability and infectious disease risk are different for each disease, but for some diseases can be very important. Many infectious diseases are highly seasonal such that it could be possible to anticipate periods of elevated risk as research improves our understanding of the link with unusual weather. Although vaccines are available for some such diseases (e.g. influenza, rabies, Lyme disease), they cannot be considered as protection for everyone since the vaccines carry their own risks and cannot be administered to everyone. Moreover, particular behaviors place some people at higher or lower risk, suggesting that education and behavior changes could result in effective prevention. For example, risk of many vector-borne diseases of the region (e.g., Lyme disease, Eastern Equine Encephalitis, West Nile fever, etc.) can be reduced significantly by modifying outdoor activity, clothing, or housing. Thus, the actual effect of climate change on risk of many infectious diseases depends on diverse behavioral and economic factors, besides those that are biophysical.

Many of the suggested health-related adaptations point to the need for continued maintenance of medical vigilance, prevention, maintenance of our health care system, improvements in our fast response capability, and broad education of both the general and specific target populations as well as of physicians.