

Climate Change and Adaptation Policy



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ABSTRACT ► The impacts of climate change are inevitable and raise issues of adaptation. Although climate change will affect virtually every sector and region, this paper looks at three sectors of Canadian society to illustrate the nature of adaptation problems and policy research needs: human health, agriculture, and northern communities and infrastructure. Research is necessary to reduce the uncertainties associated with the magnitude, timing and consequences of climate change. Adaptation policies should be implemented to enhance and facilitate actions that will reduce Canada's vulnerability and improve our resilience to climate change. For adaptation measures to be successful, leadership is required to inspire confidence and agreement among all levels of government, the private sector and civil society.

RÉSUMÉ ► Les impacts des changements climatiques sont inévitables et soulèvent la question de l'adaptation. La faculté d'adaptation des êtres humains dépend de facteurs tels que la richesse, la technologie, l'éducation, l'information, les compétences, les infrastructures, l'accès à des ressources et les capacités de gestion. Bien que les changements climatiques toucheront vraisemblablement tous les secteurs et toutes les régions du Canada, le présent article porte sur trois secteurs de la société canadienne qui ont été choisis à titre d'exemples illustrant la nature des problèmes d'adaptation ainsi que les besoins à satisfaire en recherches sur les politiques: la santé, l'agriculture ainsi que les collectivités nordiques et leurs infrastructures. Des travaux de recherche sont nécessaires afin de réduire les incertitudes concernant l'ampleur, le rythme et les conséquences des changements climatiques. Des stratégies d'adaptation doivent être mises en œuvre de façon à améliorer et à faciliter les mesures visant à réduire la vulnérabilité du Canada et à renforcer notre résilience aux changements climatiques. Pour que les mesures d'adaptation soient efficaces, il faut faire preuve de leadership afin d'inspirer la confiance et d'obtenir l'accord de l'ensemble des différents paliers de gouvernement, du secteur privé et de la société civile. (Traduction : www.isuma.net)

MOST OF THE ARTICLES in this issue of *ISUMA* focus on the question of mitigating, or controlling the growth of, greenhouse gas (GHG) emissions (Figure 1). However, even the most optimistic scenarios suggest that concentrations of GHG will continue to increase. Inevitably, therefore, climate change raises issues of adaptation. “Climate adaptation” refers to the adjustments in ecological, social or economic systems in response to climatic stimuli, their effects or impacts.¹ Adaptations vary according to the system in which they occur, who undertakes them, and the rate and timing of the climatic stimuli which prompt them. They depend greatly on the adaptive capacity of an affected system, region or community to cope with the impacts and risks of climate change. The adaptive capacity of human systems depends on such factors as wealth, technology, education, information, skills, infrastructure, access to resources and management capabilities.

“Vulnerability” can be defined as “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 variation to which a system is exposed, its sensitivity, and its adaptive capacity.”²

One can argue that Canadians and their ecosystems are fairly well adapted to the current climate. However, there is recent evidence that we are not well prepared for extreme events, e.g., the impacts of the Red River and Saguenay floods, the 1998 ice storm in eastern Ontario and western Quebec, and recurring droughts in the Prairies. Human-induced climate change will present even greater challenges for human and natural systems, given the magnitude and rate of change in climate projected by the Intergovernmental Panel on Climate Change (IPCC), and the increase in extreme events that is likely to result. To prepare effectively for these events, an assessment of vulnerability and adaptive capacity is needed to determine which

regional area, natural or human systems are most at risk.

In this paper, examples of sectors and regions in Canada that are vulnerable to climate change are examined and possible adaptation strategies in those sectors discussed. These examples form the basis upon which existing adaptation policies for Canada are critically examined in the context of international research on adaptation. Adaptation strategies need to be considered in conjunction with mitigation strategies to help Canada thrive now and in the future.

Adaptation in Canada

Although climate change will have consequences all over the world, not all regions will be affected equally, nor are all regions equally as vulnerable to those impacts. The warming associated with climate change is projected to be more rapid in northern countries such as Canada. Due to Canada’s size, diverse landscape and ocean boundaries, climate change is also expected to vary within Canada, with different regions experiencing varying levels of impacts. Temperature changes are projected to be greatest in the North. The central area of the country, including the Prairie Provinces, Ontario and Quebec, is

likely to experience more frequent and intense heat. Low-lying coastal areas face risks associated with a rise in sea level including increased flooding and coastal erosion, particularly on the Atlantic coast.³

Under the Canada Country Study (CCS) and the more recent Climate Change Action Fund (CCAF), the federal government has funded research on impacts on particular regions and sectors, and on adaptation actions. There have also been significant adaptation activities at other levels of government, and it should be acknowledged that much of the adaptation in the future will have to be developed and take place at the community level.

Although climate change will affect virtually every sector and region, this paper focuses on three sectors of Canadian society as examples of adaptation problems and policy research needs.

Human health

Health Canada recently developed a policy primer on health and climate change in an effort to develop a policy research network for health.⁴ Climate change has the potential to have wide-ranging impacts on human health and safety. These impacts would occur through both direct pathways (e.g.,

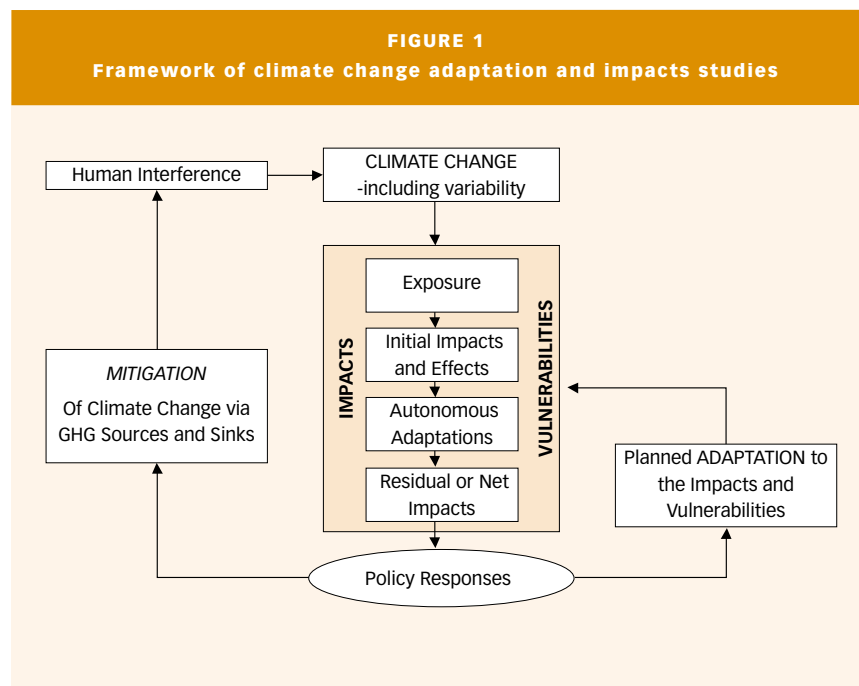


TABLE 1
The impacts of climate change and variability on Canada's health

Health concerns	Examples of health vulnerabilities
Temperature-related morbidity and mortality	<ul style="list-style-type: none"> - Cold- and heat-related illnesses - Respiratory and cardiovascular illnesses - Increased occupational health risks
Health effects of extreme weather events	<ul style="list-style-type: none"> - Damaged public health infrastructure - Injuries and illnesses - Social and mental health stress due to disasters - Occupational health hazards - Preparedness and population displacement
Air pollution-related health effects	<ul style="list-style-type: none"> - Changed exposure to outdoor and indoor air pollutants and allergens - Asthma and other respiratory diseases - Heart attacks, strokes and other cardiovascular diseases - Cancer
Water- and food-borne contamination	<ul style="list-style-type: none"> - Enteric diseases
Vector-borne infectious diseases	<ul style="list-style-type: none"> - Changed patterns of diseases caused by bacteria, viruses and other pathogens carried by mosquitos, ticks and other vectors
Stratospheric ozone depletion and increased exposure to ultraviolet radiation	<ul style="list-style-type: none"> - Skin damage and skin cancer - Cataracts - Disturbed immune function
Population vulnerabilities in rural and urban communities	<ul style="list-style-type: none"> - Seniors - Children - Poor health - Low income and homeless - Traditional populations - Disabled - Immigrant populations
Health and Socio-Economic Impacts on Community Health and Well-being	<ul style="list-style-type: none"> - Changed determinants of health and well-being - Global burden of disease - Vulnerability of community economies - Health co-benefits and risks of GHG-reduction technologies

exposure to changes in thermal stress and to changes in extreme events) and indirect pathways (e.g., increases in some atmospheric pollutants, pollens and mould spores, malnutrition, increases in the potential transmission of vector-borne and water-borne diseases and stresses on the general public health infrastructure). Additional health impacts might result from changes in water quality, nutritional health (e.g., dietary changes resulting

from shifts in migratory patterns and abundance of indigenous food sources), weather-related accidents and increased numbers of environmental refugees. Refer to Table 1 for a more detailed description of how health will be affected by climate change.

Adaptation to the health effects of climate change and variability involves the management of an inter-related set of risks. Of particular im-

portance for decision makers is an assessment of how vulnerable specific communities and regions of Canada are to the possible effects of climate change. This is a function of existing sensitivities (e.g., vulnerable populations) and the adaptive capacity (e.g., resources, technology, knowledge, institutions, etc.) of the communities.

The risk management process that Health Canada uses for assessing health issues provides a framework for selecting adaptation strategies which are best suited for a community's infrastructure, operations, economy or populations. The wide range and potential magnitude of the effects of climate change on human health and well-being mean that both public and private decision makers should now begin integrating such considerations into public health promotion and protection activities through targeted adaptation initiatives. Experience suggests that adaptive measures and policies sensibly and consistently applied over the long term can produce excellent results and enhance health and well-being.⁵

Although the climate is changing at an unprecedented rate and scientific uncertainty about the various processes exists, progress can be made in a manner that is affordable and protective of human health and well-being. Adaptation planning and policy development must be informed by a clarification of what types of persons are vulnerable to particular risks. The use of the precautionary principle, or no-regrets actions, can help public health decision makers identify policy options which respond to concerns about the costs of action, possibility of maladaptation and scientific uncertainty. These might include increased monitoring and surveillance of vector-borne infectious diseases, the use of climate forecasting in water infrastructure planning, or improved housing and sanitation practices to protect vulnerable populations. Some communities in Canada have already begun integrating climate change considerations into their public health activities, and decision makers would benefit from the sharing of knowledge and experiences in this regard. For

example, Toronto has developed two extreme weather alert plans: Extreme Cold Weather Alerts and Heat-Health Alerts.

Agriculture

Agriculture is inherently sensitive to climate conditions. In Canada, an important dimension to dealing with the impacts of climate change on agriculture is the wide range of conditions for agricultural production across different regions. Estimates of economic cost and benefits to Canadian agriculture under climate change scenarios vary greatly depending on region and whether adaptation occurs. It appears that changes in average conditions can bring both risks and opportunities.⁶ For example, the estimated impacts on agricultural incomes in the Prairies range between plus and minus seven

percent. In Ontario, agricultural losses might be as high as 12 percent if no adaptation occurs. With adaptation, however, agricultural incomes in some locations in Ontario may increase significantly under climate change scenarios. Agriculture is generally fairly well adapted to average conditions. Greater impacts are likely to be associated with future climate variability and extreme weather events. This is readily apparent in the crop and insurance losses, and in federal and provincial government aid or compensation payments associated with droughts, floods and untimely frost.⁷

Many different types of adaptation measures might be employed in the agricultural sector.⁸ These range from farmers changing management practices, timing of operations or crop choice, to public agencies investing in

technological developments or irrigation schemes, or modifying support programs, information sharing or early warning systems (Table 2).

Table 2 provides an indication of the various types of adaptation possible on agriculture, but there exists little information on the conditions under which adaptation measures are likely to be adopted. The limited research to date indicates that producers rarely respond to climatic stimuli alone, and that adaptation to climate change risks would be undertaken as part of ongoing production and risk management decision making.

Northern communities and infrastructure

The effects of climate change are already being experienced in the western Canadian Arctic. This region has warmed by about 1.5°C over the past 40 years while the central Arctic has warmed by about half a degree.⁹

- Changes are manifest in the decreased extent of Arctic sea ice, permafrost thawing, coastal erosion and altered distribution and abundance of some animal species;
- Banks Island residents report more open water in winter and spring, making hunting more hazardous;
- permanent snow packs in Yukon are melting; and
- traditional knowledge research cites the appearance of southern species such as Pacific salmon and robins in the Arctic for the first time in memory.¹⁰

Canada’s indigenous communities are vulnerable to climate change. A distinct land-based subsistence and commercial economy exist in the Canadian North for which there are no short-term alternatives. Northern indigenous peoples are already being affected by ecosystem shifts that may be greater than any in historical memory¹¹. While adapting to environmental change is integral to the daily lives of northern peoples, and a capacity to adapt is part of their livelihood systems, extreme events and unusual fluctuations in temperature can hinder their ability to maintain a subsistence lifestyle and can also create safety hazards.

TABLE 2 Adaptation options in Canadian agriculture: Examples from impact and adaptation studies	
Type	Key agent/Level
Technological	
Water Management	
Irrigation	Governments, industry
Reservoirs, recharge	Governments
Land contouring	Governments
Water transfer	Governments, industry, producers
Crop development	Governments, industry, producers
Early warning systems	Governments, industry
Management	
Timing of operations (e.g., planting)	Producers
Use and scheduling of irrigation	Producers, governments
Conservation tillage	Producers
Crop substitution	Producers
Land use, production shifts	Producers, governments
Substitution of resources, inputs	Producers
Rotation grazing of livestock	Producers
Financial	
Establish subsidy, support programs	Governments
Ad hoc assistance, compensation	Governments
Programs, policies re land, water use	Governments
Private insurance	Industry, producers

The design of much of the infrastructure in northern communities relies on the strength of frozen materials for stability. Regional studies suggest that permafrost will partially or completely disappear over large areas of the North in the event of projected climate change. Where substantial thinning of permafrost occurs, we may expect an increased likelihood of extensive ground subsidence, slope failures, and significant and occasionally catastrophic changes to surface and ground water flows locally. These impacts in turn may have serious implications for the stability of engineered structures, the reliability of transportation routes, and the viability of traditional hunting and fishing practices in northern terrain supported by permafrost. There have already been problems with roads, foundations, utilities and embankments in northern communities caused by both natural and anthropogenic changes.

Results of recent investigations in the communities of Norman Wells and Tuktoyaktuk, and others along the Mackenzie Valley Transportation Corridor, indicate that permafrost-related infrastructure problems currently exist in both communities, but evolving construction and maintenance practices have minimized the impacts to date. The long-term stability of permafrost cannot be assumed, especially in areas of thaw-sensitive, ice-rich permafrost. Potential adaptation measures include careful monitoring of infrastructure problems, minimizing terrain disturbance, using adjustable shallow foundations for small buildings and moderately thaw susceptible materials, placing insulation materials under buildings or within fill, altering design practices in favour of those that do not rely upon permafrost stability, increasing fill thickness to compensate for thicker active layer development, avoiding ice-rich terrain for infrastructure projects, preventing snow accumulation and drifting around buildings (even snow clearance), installing thermosyphons, increasing strength of foundations, and other forms of retrofitting or artificial refrigeration.

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*Adaptation in
the international context*

The discussion above suggests that assessments of risk and the development of adaptation responses should be tailored to specific regions or sectors and involve those who live and work in those regions or sectors. The common tools identified in these three cases are risk assessment and analysis, and monitoring systems. These tools and approaches can be an effective means for dealing with uncertainty.

The Intergovernmental Panel on Climate Change (IPCC) produced the Third Assessment Report in 2001 on Impacts, and Adaptations and Vulnerability, with a specific chapter on adaptation to climate change in the context of sustainable development. Many of these findings are applicable in the Canadian context as indicated above:

- Adaptation can significantly reduce adverse impacts of climate change.
- In the absence of planned adaptation, communities will adapt autonomously to climate change but not without cost and residual damages.
- The key features of climate change for vulnerability and adaptation are those related to variability and extremes, not simply changed average conditions.

- Implementation of adaptation policies, programs and measures will usually have immediate benefits as well as future benefits.
- Adaptive capacity varies considerably among regions, countries and socio-economic groups.
- Development decisions, activities and programs play an important role in modifying the adaptive capacity of communities and regions, yet they tend not to take into consideration the risks associated with climate change.
- Enhanced adaptive capacity is necessary to reduce vulnerability to climate change.
- Current knowledge of adaptation and adaptive capacity is limited, especially in terms of the evaluation of adaptation options.

**Adaptation policy:
What are we doing now?**

For the most part, the federal government has supported the development of institutional arrangements and research activities in support of adaptation to climate change. For example, in 2000, Canada released its *National Implementation Strategy on Climate Change* (NIS). The strategy supports the need for research to reduce the uncertainties associated with the magnitude, timing and consequences of impacts and the need to take timely and progressive action to adapt. Whatever decisions are taken, or policies developed, they must be based upon good science. The NIS also supports capacity building in impacts and adaptation research. Under the NIS, the Canadian Climate Impacts and Adaptation Research Network (C-CIARN) is being developed in partnership with provincial and territorial governments, universities and stakeholders. When complete, the network will consist of six regional and seven sectoral nodes, and will provide a forum for researchers, stakeholders and decision makers to share information and co-ordinate activities. Health Canada is currently establishing a policy research network, mentioned earlier, on climate change and health with the assistance of C-CIARN.¹²

A number of other adaptation research activities are supported at the

federal level. The primary goals of the Adaptation and Impacts Research Group (AIRG), of Environment Canada, are to ensure that information is available to Canadian decision and policy makers on the environmental, social and economic impacts caused by vulnerabilities to atmospheric change, variability and extremes, and viable adaptive responses.¹³

Several provinces and territories have also identified impacts and adaptation research as a priority within departmental programs. For example, British Columbia is pursuing research on adaptation in the fisheries sector, and Saskatchewan is pursuing research on impacts and adaptation strategies for biodiversity, the forestry sector and northern regions.

Adaptation policy: What should we be doing in the future?

The purpose of adaptation policies should be to enhance and facilitate actions that will reduce Canada's vulnerability, and improve our resilience, to climate change. Given the magnitude of emerging and potential impacts, the need for action is steadily becoming more compelling. There is, however, a risk of overreacting, and therefore adaptation investments must be made prudently and be guided by sound research.

This is not to deny that developing countries are far more vulnerable to climate change than Canada, or to downplay our responsibility and self-interest to assist those more vulnerable countries. While adaptation is largely place-based and confined to policies at federal and provincial levels, there are two ways in which adaptation considerations do transcend national boundaries. As a Party to the UNFCCC, Canada has accepted with other developed countries an obligation to help the most vulnerable developing countries adapt. In considering its own adaptation policy and measures therefore, Canada may wish to reflect on the ways in which Canadian skills and technology (both "hard" and "soft") can most effectively be deployed to help others in need.

The second international dimension of adaptation concerns the indirect

effects that adaptation measures taken in Canada may have upon other countries, and vice versa. This applies especially in contiguous countries where adaptation measures adopted in one country may affect the environment or social circumstances of a neighbouring country. Adaptation measures in any one country, may also affect other countries, contiguous or not, though trade links. Canada has committed some funds through CIDA to assist developing countries, with seven projects aimed at helping developing countries cope.¹⁴

Toward a Canadian strategy for adaptation

Since climate change is so pervasive and may have an impact on all economic activities, it is clear that everyone is potentially involved in the development and implementation of adaptation measures. Thus a first question is: Who adapts? If adaptation is left to everyone the probability is that it will be left to no one. The more pertinent question therefore concerns the distribution of responsibility for adaptation.

How is a nationwide effort to be organized? Clearly a program of action that requires the involvement of

everyone including all levels of government, the private sector and civil society will not happen unless leadership is provided. And such leadership must be sufficiently clear to inspire confidence and agreement. The simple admonition "Adapt!" will hardly suffice. On the other hand, a strongly directed, top-down approach is not likely to be acceptable to Canadians.

International research on adaptation policy provides some insights into this question.¹⁵ It is widely accepted that planned adaptations to climate risks are most likely to be implemented when developed as components of existing resource management programs, or as part of regional or national programs for sustainable development. For example, studies in the United States dealing with the water resources sector suggest that regional adaptive management is the most appropriate venue for developing strategies for coping with climate change. Adaptive management is essentially learning by doing, by conducting management experiments in consultation with resources users from economic, social and environmental perspectives. Other considerations are the development of risk management tools to help develop and evaluate adaptation options.

Conclusion

Although the federal government has made efforts to identify the regions and sectors most vulnerable to climate change, it is only recently that activities to identify actions to cope with climate change have been initiated. It is clear that extreme events and variability associated with climate change will have greater impact than will changes in mean climate. As a result, the use of risk, in the context of management of many issues (i.e., sustainable development), as a concept for developing adaptation measures, can be very helpful.

It is also clear that policy and management decisions in sectors subject to climate risk are rarely made in isolation from other risks faced by decision makers. If adaptations to climate change are to be adopted and effective, they will need to be integrated

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into the ongoing policy development and risk management undertaken in the private and public sectors.

The examples of health, agriculture and the North suggest that specific measures need to be developed by those who are most familiar with the problems they face. The role of a national strategy is best suited for providing co-ordination, information and tools to these regions and sectors, such as that provided by the Canadian Climate Impacts and Adaptation Research Network (C-CIARN), to regions and sectors within Canada.

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Notes

1. IPCC 2001. B. Smit and O. Pilifosova, "Adaptation to climate change in the context of Sustainable Development and Equity." Chapter 18, Contribution of Working Group II to the *Third Assessment Report of the Intergovernmental Panel on Climate Change* (New York: Cambridge University Press, 2001).
2. *Ibid.*
3. Canada Country Study. www.ec.gc.ca/ccs
4. Health Canada, *Policy Primer*, First Annual Climate Change and Well-Being National Policy and Planning Conference (September 5-7, 2001). www.hc-sc.gc.ca/cc
5. *Ibid.*
6. C.R. Bryant, B. Smit, M. Brklacich, T. Johnston, J. Smithers, Q. Chiotti and B. Singh, "Adaptation in Canadian Agriculture to Climatic Variability and Change," *Climatic Change*, Vol. 45 (2000), pp. 181-201.
7. B. Smit, E. Harvey and C. Smithers, "How is Climate Change Relevant to Farmers?" in D. Scott, B. Jones, J. Audrey, R. Gibson, P. Key, L. Mortsch and K. Warriner (eds.), *Climate Change Communication: Proceed-*

ings of an International Conference, Kitchener-Waterloo, Canada, June 22-24, (Hull: Environment Canada, 2000), F3.18-F3.25; B. Smit, "Climate, Compensation and Adaptation," in J. McCulloch and D. Etkin (eds.), *Improving Responses to Atmospheric Extremes: The Role of Insurance and Compensation*, Workshop Proceedings (Toronto: Environment Canada/The Climate Institute, 1994), pp. 2.29-2.37.

8. M. Skinner, B. Smit, A.H. Dolan and B. Bradshaw, *Adaptation Options in Canadian Agriculture to Climate Change* (Guelph, Ontario: Department of Geography, University of Guelph, 2001).

9. <http://www.msc.ec.gc.ca/ccrm/bulletin/>

10. Proceedings from the *Elders Conference on Climate Change*, Cambridge Bay (Nunavut March 29-31, 2001). See the article by T. Fenge in this volume for further discussion of these issues.

11. *Ibid.*

12. Health Canada. *Policy Primer*, *op. cit.*

13. <http://www.msc.ec.gc.ca/airg/airg.htm>

14. www.acdi-cida.gc.ca

15. Smit and Pilifosova, *op. cit.*

