

Planning for climate change in Canadian rural and resource-based communities

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Abstract

This article describes various forces that influence the ability of Canadian rural and resource-dependent communities to manage, plan for and respond to future risks and uncertainties resulting from climate change. Taking as a case study the municipality of Edwardsburgh/Cardinal in eastern Ontario, the article illustrates the context in which local decision-making with respect to climate-related risks occurs, and how these decisions are linked to historical development trajectories, interactions with higher levels of government, and macro-level economic structures and processes. The success of future capacity building and planning will be strongly influenced by such factors as improved coordination across different levels of government, the provision of locally geared information about environmental and climate change, economic diversification, and the ability to adjust to and take advantage of rapidly changing demographic patterns in such communities.

Résumé

Cet article décrit les forces diverses qui influencent la capacité des communautés canadiennes rurales, et celles qui dépendent des ressources, à gérer, prévoir, et réagir aux risques et incertitudes futurs relatives aux changements climatiques. Notre étude de cas se déroule autour de la municipalité d'Edwardsburgh/Cardinal en Ontario Est. Cet article illustre le contexte dans lequel la prise de décision et la planification autour du développement des capacités locales ont lieu, et la façon dont ils sont liés aux trajectoires d'évolution historique, aux interactions entre plusieurs niveaux

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gouvernementaux, et aux structures et processus à l'échelle macro. Le succès de la planification communautaire et du développement des capacités futurs sera fortement influencé par des facteurs tels que la coordination améliorée parmi divers niveaux gouvernementaux, la provision de renseignements concernant l'environnement et les changements climatiques orientés vers les intérêts locaux, la diversification économique, et l'aptitude de pouvoir adapter aux changements démographiques et d'en bénéficier.

Key words

Climate change, rural communities, resource-based communities, adaptation planning, social capital

Introduction

Rural and resource-dependent communities are dynamic entities continually responding to a range of social, economic, demographic and environmental stresses – to which the impacts of climate change must now be added (Adger and Kelly 1999, Leichenko and O'Brien 2002, Thomas and Twyman 2006, McLeman 2010). In Canada these non-climatic stresses include, but are not limited to, changes in policies and priorities dictated by higher levels of government; macro-economic forces that influence local-level economic and demographic restructuring; and extreme environmental events and conditions that can impose considerable pressure on community resources, infrastructure and safety nets (Brklacich et al. 1997, Bryant et al. 2000, Diaz et al. 2003, McLeman and Smit 2006, Reid et al. 2007). Canadian beef cattle producers, for example, have for several years been confronted with the combined effects of increased global competition from producers elsewhere, and cattle import restrictions in the United States and other destination markets as a consequence of 'mad cow disease' outbreaks (Goddard and Unterschultz 2004). At the time of writing, China has imposed restrictions on the importation of canola from Canada ostensibly due to fears of importing the 'blackleg disease' that harms canola (rapeseed) plants (Reuters 2009). As the Canadian forestry industry contracts in the face of falling market demand and increased competition from foreign producers, rural communities in many provinces have had to cope with mill closures, uncertain employment, and highly variable economic performance (Patriquin et al. 2007). Stresses such as these have occurred during a period when Canadian rural communities are aging and, in many regions, ex-

community resources, infrastructure and safety nets (Brklacich et al. 1997, Bryant et al. 2000, Diaz et al. 2003, McLeman and Smit 2006, Reid et al. 2007). Canadian beef cattle producers, for example, have for several years been confronted with the combined effects of increased global competition from producers elsewhere, and cattle import restrictions in the United States and other destination markets as a consequence of 'mad cow disease' outbreaks (Goddard and Unterschultz 2004). At the time of writing, China has imposed restrictions on the importation of canola from Canada ostensibly due to fears of importing the 'blackleg disease' that harms canola (rapeseed) plants (Reuters 2009). As the Canadian forestry industry contracts in the face of falling market demand and increased competition from foreign producers, rural communities in many provinces have had to cope with mill closures, uncertain employment, and highly variable economic performance (Patriquin et al. 2007). Stresses such as these have occurred during a period when Canadian rural communities are aging and, in many regions, ex-

perencing a steady decline in population numbers as birth rates fall and younger residents migrate elsewhere in search of higher education and employment opportunities (McLeman 2010).

The future impacts of climate change in Canada are expected to vary from one region to another, presenting a range of additional challenges to rural and resource-based communities. In British Columbia, the rapid spread of the mountain pine beetle and the resulting loss of coniferous forests has been attributed to rising temperatures in that region (Kurz et al. 2008). On the Canadian prairies, scientists warn of changes in precipitation patterns and an increased severity and frequency of drought conditions (Sauchyn et al. 2005). In eastern Ontario, the region of interest in this article, night-time temperatures have been warming since 1950, and the number of days with precipitation has been increasing (Vincent and Mekis 2006, Chiotti and Lavender 2008). General circulation models suggest that both average precipitation and average temperatures in Ontario will continue to increase in coming decades (IPCC 2007). Because of their very nature, livelihoods in rural and resource-dependent communities in these and other regions are often inherently sensitive to variations and changes in local climatic and environmental conditions, and are therefore seen as being particularly sensitive and potentially vulnerable to the impacts of climate change (Bryant et al. 2000).

The future capacity of Canadian rural and resource-dependent communities to adapt successfully to climatic and non-climatic stresses is linked to their local economic trajectories, social vitality, and to the ways in which local institutions, organizations and social structures interact with one another and with higher-level actors (Lemmen et al. 2008). These structures and institutions are in turn anything but static entities; they are the continually evolving products of changing economic and cultural processes and arrangements, and are often heavily influenced by historical socio-economic pathways. Climate change and its impacts should therefore be seen as nested within (and not apart from) the broader range of externally driven stresses that influence the overall wellbeing of rural and resource-dependent communities and their residents (Brklacich and Bohle 2005, Adger 2006, Smit and Wandel 2006).

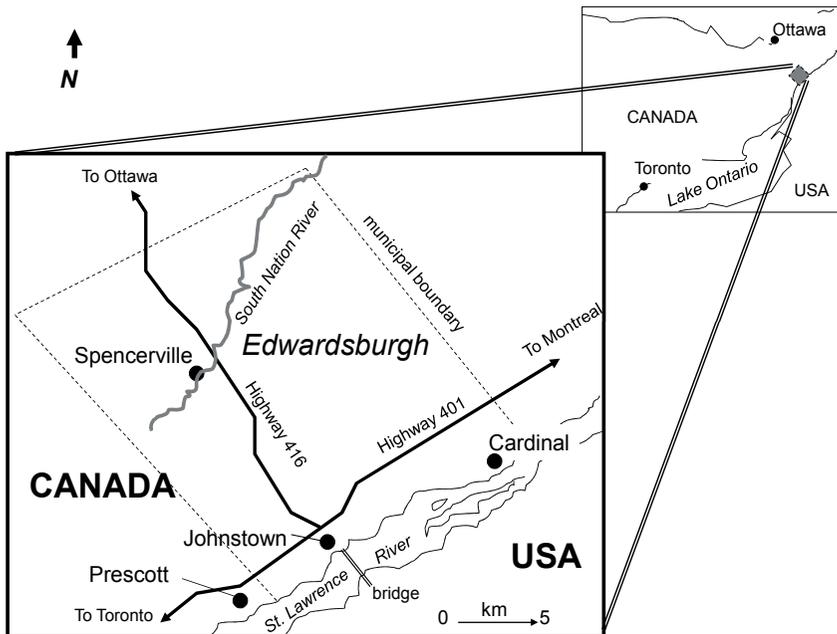
This article describes the findings from one community case study that took place as part of a multi-year empirical research project that explored the various forces that influence the ability of decision-making and institutional structures in Canadian rural and resource-dependent communities to manage, plan for, and respond to future risks and uncertainties resulting from climate change. The community in question, Edwardsburgh/Cardinal (Figure 1), is a rural township of approximately 6,500 people in southeastern Ontario where livelihoods in many households are linked to small scale agriculture and forestry, and where the largest single employer is a company that manufactures an agricultural end-product, corn starch. As in other rural communities, residents and decision-makers are becoming generally aware that climatic variability and changes may bring attendant risks to community livelihoods and wellbeing (Brklacich et al. 1997, Bryant et al. 2000, Reid et al. 2007).

A national study of climate change impacts and adaptation suggests com-

munities such as this would benefit from targeted models to guide them as they seek to develop adaptation strategies to respond to such risks and/or to mainstream climate change adaptation processes into their ongoing planning and resource management activities (Lemmen et al. 2008). However, much of the work carried out to date on climate change adaptation in Canada tends to focus on broad-scale adaptation needs at national and regional levels, and on impacts on particular attributes of specific systems or sectors, such as food and agriculture (Brklacich et al. 2007), tourism (e.g. Scott and McBoyle 2007), and forestry (e.g. Spittlehouse and Stewart 2003), among others. In its environment ministry's annual reports, the Government of Ontario has also stated its intent to move toward a more active policy of promoting and fostering adaptation in rural areas. It has commissioned an expert panel to make recommendations in this regard (Ontario Ministry of the Environment 2009, Pearson and Burton 2009). The expert panel made numerous recommendations relevant to rural and resource-dependent communities, and encouraged policymakers to pursue inclusive, vulnerability-based assessments to better understand adaptation needs in such communities.

The research project described here was completed prior to the release of the expert report, but was consistent with many of its recommendations. This project was deliberately participatory in nature, bringing together researchers and local decision-makers to not only identify the risks, barriers and opportunities for adaptation planning and policy-making, but to help stimulate greater discussion and reflection on how to incorporate climate change adaptation strategies

Figure1. Location of Edwardsburgh-Cardinal



into broader planning and programming activities at the rural municipality level. While some details are necessarily specific to Edwardsburgh-Cardinal's particular context, this article describes broader insights that were generated, emphasizing those which may be relevant and applicable to implementing local adaptation policy and planning in rural and resource-based communities elsewhere.

Vulnerability and adaptation to climate change

Climate change impact and adaptation research uses the concept of vulnerability as a basis for understanding the consequences of climate change for societal well-being. Vulnerability has been defined as "The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC 2007: 883). The nature and characteristics of vulnerability vary considerably across geographic and ecological regions; differentials in vulnerability characterize distinctions between social systems and households within particular systems. These differentials are shaped by a variety of factors including the particular nature of climate impacts in a given area and the degree of exposure to such impacts; the sensitivity of human systems to such changes; and the capacity of the exposed population and its socio-economic systems to adapt (Adger 2006, Smit and Wandel 2006, IPCC 2007). In general, vulnerability tends to have a positive relationship to exposure (e.g. vulnerability rises as social systems experience greater exposure to impacts resultant from climate change) and a negative relationship with adaptive capacity (e.g. social systems with greater ability to adapt to climate impacts are generally less vulnerable) (Ford and Smit 2004).

Adaptive capacity in relation to climate change impacts represents "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" (IPCC 2007: 869). Adaptations are specific adjustments made to offset the effects or impacts of climate-related risks and may be undertaken by actors at many levels or scales (O'Brien and Leichenko 2003). Adaptation in rural areas and systems has been explored in a variety of contexts and regions across Canada (e.g. Brklacich et al. 1997, Bryant et al. 2000, Belliveau et al. 2006, Wall and Marzall 2006, Reid et al. 2007). In considering farm-level adaptations, Smit and Skinner (2002) offer a typology that reflects the various scales at which adaptation may be undertaken, and the actors potentially involved. The typology includes examples of individual- or household-level adaptations such as adjusting the choice of agricultural crops to be planted during drought conditions, and seeking off-farm employment to diversify income sources. Other examples in the typology foresee participation from government and institutional actors on an ongoing basis (e.g. federal-provincial crop insurance programs), or an ad hoc basis (e.g. government assistance to the forestry industry). Adaptation initiatives may also be undertaken at much larger, even global scales, such as the 2008 UN Food and Agricultural Organization conference that sought to create a coordinated international response to threats posed to global food security by climate change (UNFAO 2008).

Climate change is in many regions expected to exacerbate existing climate-related risks that already present potential hardships for rural and resource-de-

pendent communities. These include sudden-onset events, such as flooding that damages infrastructure and extreme storms that can destroy crops, as well as slower developing changes in conditions, such as droughts and the spread of forest damage due to pests like the mountain pine beetle (see Lemmen et al. 2008 for a review of these risks by Canadian region). Because rural and resource-dependent communities are already exposed to and forced to cope with such risks on an ongoing basis due to the inherent natural variability of climate, such communities have typically developed a range of adaptive strategies to minimize the impacts of variability within a certain range or limits (Bryant et al. 2000, Smit and Skinner 2002). However, when climatic conditions deviate from the expected range for prolonged periods, these adaptive strategies may become exhausted and widespread hardship may ensue. The most severe such case in Canada in living memory occurred in Alberta and Saskatchewan in the 1930s, when the combined effects of economic recession, depressed commodity prices, and successive droughts led thousands of households to migrate from their rural Prairie homes to the Aspen parklands, urban centres, and to British Columbia (McLeman et al. 2010).

Because anthropogenic climate change is expected to exacerbate many of the existing climatic risks that rural and resource-dependent communities already face, important considerations that emerge include assessing the extent to which existing adaptive capacity may be sufficient to manage such exacerbations, identifying the potential limits of this capacity in the face of new risks that could conceivably emerge, and identifying potential barriers and opportuni-

Figure 2: Conceptual framework of vulnerability to environmental change used in the research

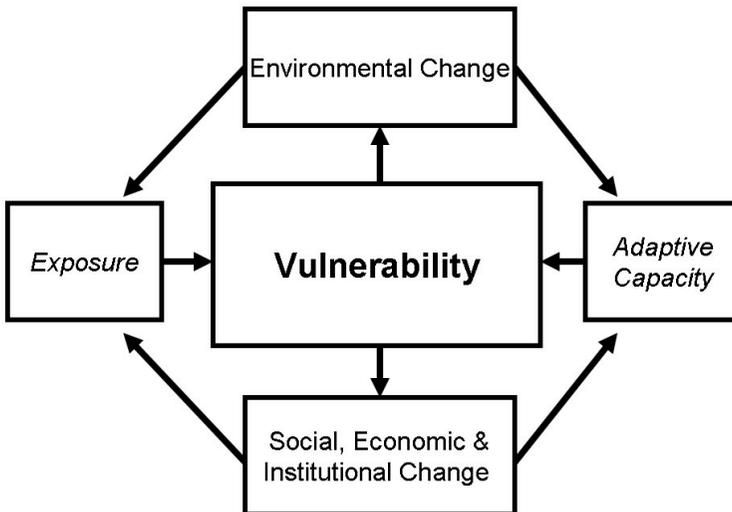


Figure 2 suggests that global environmental changes and societal changes interact to create exposure within a given community to particular environmental risks, and to influence the capacity of the community to adapt to those risks.

Adapted from Brklacich and Bohle (2005) and Gregory et al. (2005).

ties for enhancing such capacity to go forward (Reid et al. 2007, Lemmen et al. 2008, Pearson and Burton 2009). In order to work toward such ends, this project sought to better understand the ways in which sample Canadian rural communities experience climate-related risks, the extent to which they are able to incorporate planning for changes to these risks within their broader planning and management activities, and to identify their information needs. To situate these research objectives within the broader conceptual understanding of vulnerability and adaptation to climate change, the conceptual guide shown in Figure 2 helped shape the development of this project (Figure 2). Accordingly, vulnerability to climate change in specific Canadian rural and resource-dependent communities was treated as a function of exposure to particular environmental change-related stressors and a function of the concurrent and ongoing processes of adapting to changes in environmental, social, economic and cultural systems, conditions and norms, more generally.

Methods

The overarching goal of the project was to identify barriers to and opportunities for adaptation within several study communities – including the one that is a focus of this article, Edwardsburgh-Cardinal – and to document specific challenges associated with making climate change adaptation an ongoing consideration in planning efforts. Edwardsburgh/Cardinal was selected for inclusion in the broader project because of factors such as its general fit with the types of rural and resource activities the project sought to capture, the pre-existence of contacts with decision-makers in the local conservation authority, and its proximity to the research team's base in Ottawa. Since project methods were designed in accordance with the underlying philosophies and practices associated with community-based research (Murphy et al. 1997, Flicker et al. 2008), collaboration with community members and organizations was considered central to the success of the study.

Research was carried out in two phases, beginning in 2006 and continuing into 2008. In the first stage of the project, a local resident was engaged as a research assistant to facilitate cooperation between the research team and community members. The aim of the first phase was to engage local residents, particularly those individuals actively involved in local planning and governance activities, on an ongoing basis to generate a baseline understanding of how climate change and other environmental and societal changes affected livelihoods and activities in their community, and to identify how future development trajectories and livelihood opportunities may be affected. Participating individuals included local government council members, conservation authority staff, municipal planning staff, community group organizers, service club members, local activists, and interested residents. Following preliminary meetings and familiarization visits to the study area, the research team organized day-long focus group sessions in Edwardsburgh/Cardinal in April and September 2006 attended by 10-12 participants each. Information gathered at these sessions was supplemented by follow-up communications and interviews. A report outlining the findings was then prepared by the research team and circulated to all participants for their comments, on the basis of which it was revised and made available to the public

generally (Wilson 2006).

The second phase of the project commenced in 2007 after additional funding was received. It sought to work with the same community members to study the degree of sensitivity of existing planning structures and practices to climate change-related risks identified in the first phase; to identify community institutions critical in building future adaptive capacity; and to understand potential barriers to incorporating climate change risks and concerns into community-level planning activities. Two more focus group sessions were held as part of the research process in the second phase. The first of these was held in Edwardsburgh-Cardinal, again with twelve community participants; the second, a two-day community-to-community learning exercise held in Ottawa, brought two representatives from Edwardsburgh/Cardinal to meet with representatives of the other participating communities to share experiences and ideas on best practices moving forward. A report on the second stage of the project was prepared, circulated, revised and disseminated in a fashion similar to the first (Wilson 2006).

In designing the study, conscious choices were made to seek out local individuals with past or present experience in community governance and planning, given our interest in studying these particular aspects of adaptation processes. One consequence is that the views of the participants may not necessarily be representative of all groups within the Edwardsburgh/Cardinal population, and that the views of those with an active interest in community governance and planning may be over-represented. Participants in the focus group sessions were selected on a snowball-style basis, in which interested individuals were asked to identify other community individuals or groups they felt should be represented at the table. Representation at the sessions was typically balanced in terms of gender, but not all demographic components of the population were captured. For example, the research team was not able to capture participation by community youth, nor did we capture representation from those members of the population who use the study area as a bedroom community (e.g. who live there but commute elsewhere to work) and who consequently tend not to participate in local governance or planning. Some changes in membership on the focus groups occurred over the course of the project; for the most part, these did not affect focus group dynamics, but there were exceptions. The most noticeable change resulted from a municipal election held during the project period, which resulted in a new reeve joining the last two focus group sessions, and the former reeve continuing to participate. These two individuals generally agreed on the issues warranting attention, but did have differing views in terms of the breadth of opportunities and barriers to future adaptation – differences that may not have emerged had no election taken place during the project period, or had the election outcome been different. The size of the focus groups was large enough, and the dynamics sufficiently amicable, that individual differences of opinion such as these tended, with discussion, to converge on common ground.

The findings that follow should therefore be read as a picture of risks, needs and opportunities with respect to climate change that are generally agreed upon by residents interested and knowledgeable in rural community planning challenges in Edwardsburgh-Cardinal. This does not necessarily mean that individual views voiced but subsequently modified or winnowed out through discussion

were invalid, but simply that the study design deliberately sought out broadly held views. Drawing upon the broader set of findings and detailed reports to community and funding agencies (which are publicly available; see Wilson 2006, Brklacich et al. (2008) as well as <http://http-server.carleton.ca/~mbrklac/rural-communities>), we focus here on the findings considered to be recognizable and relevant to Canadian rural and resource-dependent communities more generally on the basis of the community-to-community learning sessions that formed the final focus group workshop.

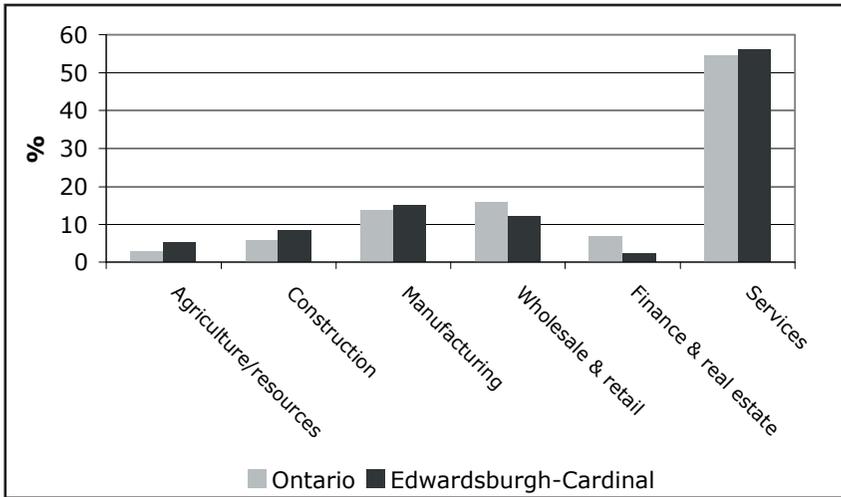
Overview of the study area

The township of Edwardsburgh/Cardinal was created in 2001 through the amalgamation of the village of Cardinal, located on the St. Lawrence Seaway, and the inland rural township of Edwardsburgh. Located at the junction of highway 401, Ontario's primary east-west road transportation corridor, and highway 406, the expressway to Ottawa, the township is centrally positioned along Ontario's main transportation networks. A bridge to the United States spans the seaway from nearby Johnstown, Ontario to Ogdensburg, New York. The township owns and operates a seaway port that provides inland deepwater dockage for shipping and receiving dry bulk cargo; in 2008 it processed over 500,000 tonnes of waterborne traffic (Port of Prescott 2008). The municipality is also served by a functioning freight railhead. A large corn-milling and processing facility first established in Cardinal 150 years ago is the largest industry and key employer in the municipality. In 2008 an ethanol production plant opened in Johnstown, its location drawing on the existing supply networks that bring raw corn into Cardinal and on accessibility of eastern US markets.

The economy of inland Edwardsburgh has been strongly tied to agriculture since the late 18th century. Its agricultural traditions are strongly guarded by the local agricultural society that has organized a large annual agricultural fair for over 150 years. Nonetheless, agricultural production in the area has decreased over recent decades, with marginally productive land in Edwardsburgh/Cardinal allowed to return to wetlands and forest cover. The area once supported a small private forestry sector, but recent low market prices have reduced it to a few firewood cutting operations. Some areas of the municipality are part of the Eastern Ontario Model Forest initiative, which promotes sustainable forestry practices and ecofriendly forest products.

The political amalgamation of the service- and manufacturing-oriented communities along the St. Lawrence (known locally as "The Front") with the agriculture- and small-scale forestry-oriented inland economy means that the political jurisdiction of Edwardsburgh/Cardinal as a whole features elements of both the traditional rural and resource-based areas of Ontario and of the newer socio-economic trends emerging in peri-urban areas of Ontario. For example, the township has double the provincial average of people employed in the agricultural/resource sector (Figure 3), but even so, this level is lower than rural areas more distant from urban centres. At the same time, employment levels in sectors common in urban centres, such as finance, real estate, and wholesale and retail trades, are much lower than the provincial average but higher than in other rural jurisdictions.

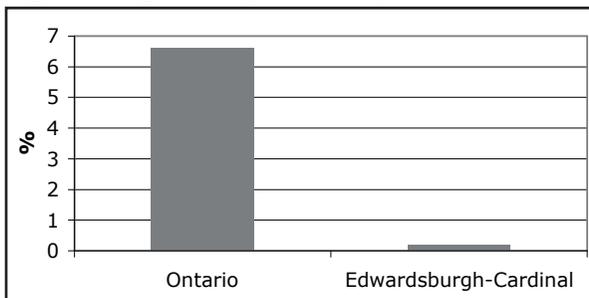
Figure 3. Workforce employment, by sector



Source: Statistics Canada 2006, Community profiles: Edwardsburgh-Cardinal

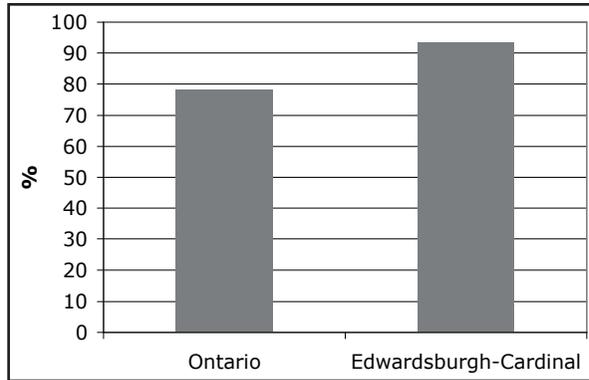
Unlike rural areas more distant from large urban centres, Edwardsburgh/ Cardinal has a relatively stable population, but the rate of population increase is still far below the provincial average (Figure 4). This stability in numbers masks a fairly significant degree of movement in and out of the jurisdiction (Figure 5). Younger residents often leave for urban areas to pursue higher education and other economic opportunities; their departure is offset by the arrival of “rurban-ites” – people working in neighbouring cities who move to the township for a rural quality of life. The median age of the population has become higher than the provincial average (Figure 6) and will likely continue to climb as the largest part of the population, characterized by long-established families of Anglophone origin, ages (Figure 7).

Figure 4. Population growth rate, 2001-2006



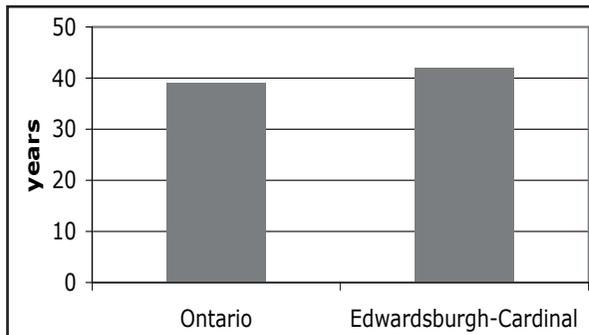
Source: Statistics Canada 2006, Community profiles: Edwardsburgh-Cardinal

Figure 5. Percentage of population residing in same jurisdiction five or more years



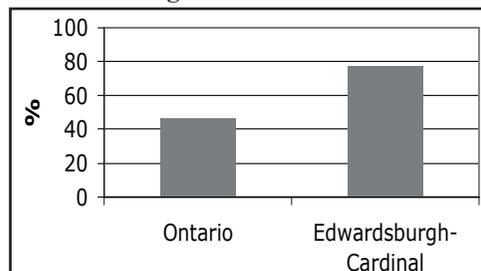
Source: Statistics Canada 2006, Community profiles: Edwardsburgh-Cardinal

Figure 6. Median age of population



Source: Statistics Canada 2006, Community profiles: Edwardsburgh-Cardinal

Figure 7. Percentage of population residing in jurisdiction, third-generation Canadians or greater



Source: Statistics Canada 2006, Community profiles: Edwardsburgh-Cardinal

A variety of socio-economic challenges face this jurisdiction. Although residents, old and new, claim to value the rural way of life, the village of Cardinal has experienced store and business closures as both new- and long-time inhabitants increasingly shop in larger urban centres outside the jurisdiction. Currency exchange rates, Canada-US relations, energy policies and security at the bridge to the US all have direct impacts on residents and business operators. The increased value of the Canadian dollar, American security fears in the wake of the September 11th attacks, and the 2003 outbreak of Severe Acute Respiratory Syndrome (SARS) in Ontario combined to reduce the number of visitors from the US and raise the relative cost of goods produced on the Canadian side of the St. Lawrence.

The well-organized local government of Edwardsburgh/Cardinal sits at the lower end of a hierarchy of county, provincial and federal departments and agencies that develop and administer policies and programs that directly affect the daily life of residents and business operators. A decade ago the provincial government began downloading responsibility for service provision to municipalities without an accompanying transfer of revenue streams. The fallout from this process continues to overburden the resources of local government. Community organizations play an active role in the organization and wellbeing of the community. They include the Land Stewardship Council, the Business Association, the Agricultural Society, the Spencerville Mill Foundation, the Development Corporation, Lions Clubs and other service and interest groups. While these organizations remain robust and active, the volunteerism on which such groups depend is being stretched, and residents fear that relying too often on the same groups and individuals will lead to participant burn-out and donor fatigue. While Edwardsburgh/Cardinal has many locational, institutional and economic assets in its favour, a concern is that erosion of community social capital may handicap the ability to adapt to climate change and other stressors in the future.

Findings

Local concerns about environmental conditions and climate change

Anthropogenic climate change is expected to place a range of pressures on Ontario communities. Average temperatures in Ontario have risen by up to 1.5° C in the past fifty years, with general circulation models projecting further increases in average temperatures, as well as higher amounts of average precipitation (Chiotti and Lavender 2008). Extreme precipitation and heat events are expected to become increasingly frequent in coming decades. Higher temperatures are expected to contribute to increased rates of evaporation with the potential to affect Great Lakes water levels. While higher average temperatures could extend the growing season for agricultural crops, they may also facilitate the spread of crop pests and diseases (Chakraborty et al. 2000). These and other climate change-related pressures will necessitate adaptation measures to be implemented at a variety of scales, including the local community level.

Ontario is expected to experience impacts related to climate change in almost all economic sectors (Chiotti and Lavender 2008, Pearson and Burton 2009). In certain sectors (e.g. agriculture and warm-season tourism), the chang-

ing climate may present opportunities that will require a certain measure of adaptation to realize the full benefits. Five particular concerns have been identified for the province:

1. disruptions to critical infrastructure,
2. more frequent water shortages,
3. health risks related to extreme weather, heat waves and smog, as well as changing ecological conditions encouraging certain diseases,
4. acute sensitivity of remote and resource-based communities to climate variability,
5. increasingly stressed ecosystems and species (Chiotti and Lavender 2008).

In the case of Edwardsburgh-Cardinal, participants felt that the impacts of climate change in their community are most likely to be experienced through its effects on water resources, agriculture, forests, and weather pattern extremes. Residents and businesses along the seaway are concerned about the impacts of falling water levels on large vessel traffic and port facilities. While the quality and quantity of both surface and groundwater sources are believed to be generally good throughout rural Edwardsburgh, climate change information will need to be incorporated into provincially legislated water-quality management and source water protection initiatives that are ongoing in this region, which will complicate an already challenging public policy process. Residents hope that regional warming trends may lead to higher future crop yields and generally increased production, but worry that any gains may be offset by damage caused by extreme weather events and/or invasive species. Residents engaged in forest-based industries are concerned that climate change may affect the health of commercially important tree species such as oaks, beeches, and sugar maples, or stimulate the northward spread of these trees.

Characteristics of community vulnerability in Edwardsburgh-Cardinal

Participants in the study identified a number of key factors, processes and examples of events that influence their vulnerability in terms of community livelihoods and development. These can be summarized according to the following themes.

Climate change is experienced and perceived in the context of broader environmental pressures

Participants believe aspects of various environmental changes, of which climate change and its impacts are but one subset, are presently being experienced in their community. In particular, they identified invasive species, urban encroachment, wetlands loss, and periodic droughts and extreme weather events. Although the study was framed to ensure attention to climate and climate change-related risks, discussions revealed that community members do not necessarily separate climate-related risks from the broader range of environmental stressors to which they currently adapt. Rather, variability in environmental conditions, including climatic variability, is typically expected and seen as normal. There is no assumption that environmental conditions are ever entirely predictable or stable; the natural environment is viewed as inherently dynamic. It is also recognized that human actions at scales well beyond the influence of the community have

the potential to transform environmental conditions observed in the community. For example, residents were aware that water stewardship practices across the whole Great Lakes basin influence seaway-based economic activities in Edwardsburgh-Cardinal.

Historical trajectory shapes current vulnerability

It was also seen that societal change, in terms of changes in institutions, resource accessibility, and economic conditions over time interact with environmental change to generate exposures and influence adaptive capacity. It is clear that past histories have helped shape current societal trajectories, and will continue to do so into the future. Edwardsburgh/Cardinal residents have inherited important agricultural legacies and retain, to this day, a particular commitment to maintaining a strong rural identity. They do this through celebrations, including one of Ontario's oldest and largest fall agricultural fairs, and through new activities that revive past rural traditions, such as the annual recreation of a traditional rural village Christmas celebration. Residents see the future success of their community as being tied directly to such traditions.

Current institutional arrangements influence future trajectories

The institutional context within which communities are situated has a strong influence on a community's ability to adapt and plan for future change, and this context is itself continually changing. For example, with respect to managing water resources, local government and community organizations have been coping with increasingly strict provincial water quality regulations imposed on all municipalities, even in jurisdictions such as Edwardsburgh/Cardinal where no significant local water quality problems have been reported. Implementing more stringent regulations places significant burdens on local planning resources, and compliance can have negative impacts on community resources and small businesses. The administrative costs of compliance, along with capital costs for upgrading treatment equipment in area schools, churches and similar establishments have already resulted in the closure of one children's day care centre.

Interactions across scales help drive vulnerability and opportunity

The combined interaction of environmental change and social change at various scales influences the type and degree of climate change-related risks a rural community faces; it can also generate opportunities. For example, the recent establishment of a corn-based ethanol production plant in Edwardsburgh/Cardinal (and its likelihood of future success) is a function of pre-existing transportation networks that have long brought corn into the community for the production of corn starch, along with recent developments in North American energy policies, which are in turn being influenced by international policies related to energy security, greenhouse gas emissions mitigation, and global food security. Comparing this example with that of new provincial water regulations described above illustrates how both negative pressures and opportunities for community development can be transferred to local communities from higher-level institutional and socio-economic processes.

Adaptive capacity is linked to economic diversification and innovation

Study participants emphasized that reliance on a small number of economic sectors for community livelihoods increases their vulnerability to both socio-eco-

conomic and environmental changes. Losses of key services are a related and ongoing challenge in rural Ontario communities. Residents cited as an example the recent case of the only local bank branch in Cardinal announcing it was closing, thereby leaving the community with no banking facilities. In response, local business development groups came together and worked with the municipal government to bring a credit union branch to the community. Interestingly, the community has found that the credit union provides better access to and security of financial services and credit than the previous institution. This ability of private sector groups and local governments to work together to bring new businesses and services to the area was seen by participants as critical to ensuring future community development.

Current demographic conditions influence vulnerability

Demographic makeup and trends within a community have a noticeable influence on the social networks and social capital that are a key element in all the previous examples. Participants want to see newcomers continue to settle in their community, but they also report challenges of bridging the gap between established residents and recently arrived groups, and of incorporating the latter into community social networks. This is not always straightforward, for newcomers often do not share the cultural values or past livelihood experiences of established residents. Community groups describe the difficulty of drawing newcomers to community organizations or of getting them to participate in local governance. There have been instances where attempts to attract newcomers have become a source of friction; for example, residents in northern parts of Edwardsburgh recently organized to block the development of a rural subdivision intended to appeal to suburbanites, for fear it would transform their rural quality of life.

Changing climatic conditions can present new opportunities under the right conditions

Changes in local climatic conditions may present both threats and opportunities for livelihoods and wellbeing, depending on the nature of a community's particular set of exposures and adaptive capacity at the point when the change emerges. After the local winter fair that once focused on outdoor sporting activities was discontinued due to successive years of mild winter conditions, two local groups came together to create a new, annual three-day celebration of historical rural holiday traditions called "A Country Christmas Remembered". This new event has been "weather-proofed" through a critical mass of indoor activities to supplement low-cost, low-impact outdoor activities such as horse-drawn sleigh rides. The new celebration, which has exceeded the attendance of the one it replaced, attracting new visitors to the community from greater distances, provides an example of how a climate-related challenge was transformed into an opportunity to support community social and economic development. Doing so, however, was heavily contingent on the presence of strong social networks with the capacity to take the necessary risks and undertake the significant preparatory work required to organize a new event.

Rural adaptive capacity is tied to social capital and local leadership

Strong informal organizations in a community, such as those responsible for the creation of "A Country Christmas Remembered", help in the formation of social capital that facilitates trust and cooperation, and that can be mobilized to achieve

social and economic objectives (see Wall et al. 1998, Castle 2002, Piazza-Georgi 2002 for further discussion of the formation of social capital). Informal institutions both supplement local government capacity and in many instances take on tasks that governments, for reasons of institutional structure or limits on resources, are unable to perform. In Edwardsburgh/Cardinal, for example, the agricultural fair committee is a critical resource for the community, its membership composed of long-term residents who are active in many community initiatives well beyond the fair itself. The committee provides organizational support for new community activities, promotes the community's interests in agriculture and tourism at regional and provincial levels, and mobilizes support for vulnerable members of the population in times of need.

Residents worry that their community's social capital may erode as its demographic makeup changes. They also see that adaptive capacity is tied strongly to local leadership. Certain individuals were regularly pointed to as providing disproportionate amounts of service to the community; these individuals are often involved in both local government institutions and community organizations. To facilitate succession in community leadership and to avoid volunteer burnout and donor fatigue, residents recognize they must find ways to involve participants from new social and demographic groups, but have yet to find ways of doing so.

Discussion

The above findings suggest a number of barriers and opportunities that affect adaptive capacity and the ability to plan for climate change and other future challenges in Edwardsburgh/Cardinal. Three particular themes emerge that are likely to resonate with rural and resource-dependent communities in other areas.

The importance of coordination among and across community institutions and governance

Certain key ingredients are needed to foster the sort of adaptive capacity building in rural and resource-dependent communities foreseen in the Government of Ontario's climate change strategy. One key ingredient critical to ongoing wellbeing and good governance is the presence of a mixture of formal and informal institutions that are able to work together. Short- and long-term planning for climate change also requires the ability for rural and resource-dependent communities to interact with any number of other agencies associated with more senior levels of government. Co-ordination among these various interacting levels of government can either support or impede a community's capacity to adapt to uncertain futures. Yet while higher levels of government tend to have the resources, expertise and dedicated staff to administer and manage policies and programs, and to continuously engage in forward planning, people engaged at the local community level must wear many hats. Often, those engaged in local planning are not formally employed to do so, but are instead volunteers or individuals who ordinarily perform a somewhat related administrative task in local government, and must "learn the file" as they go along. This places the local community at a significant disadvantage in terms of the potential to engage in long-term planning and to manage relations with higher levels of government.

In Edwardsburgh/Cardinal, for example, one local government employee has the lead responsibility for managing the process of reviewing and revising the official plan – in addition to numerous other important but unrelated responsibilities. The official planning process must therefore draw heavily on voluntary participation from local residents and representatives of local organizations to determine what actually ought to be reflected in the official plan. In other words, the formal planning process must compete for and draw upon that heavily used resource of social capital on which future wellbeing and capacity is heavily based. Even in prosperous, tightly knit communities such as Edwardsburgh/Cardinal, social capital is not in infinite supply. The risk of long-term fatigue among those individuals and groups that are continually being drawn upon becomes especially pronounced in communities with a rapidly aging population. In this context there is a clear need for additional support and resources if informal institutions are to participate as partners in climate change adaptation planning.

Co-ordination and communication between local governments, more senior levels of government, and municipal agencies is often inadequate and can be an impediment to adaptive capacity-building at the local level. For example, new provincially imposed water quality regulations apply to all Ontario communities, even ones such as Edwardsburgh/Cardinal where there is no identified risk, and where no health concerns were experienced under the previous regulatory standards and practices. Yet small municipalities have little ability to influence large regulatory schemes as they unfold; they are left to deal with the outcomes to the best of their abilities. Unfortunately, the cost of inefficiency in regulatory compliance is disproportionately high in rural communities. While it may be argued that any system of institutional arrangements will have its inherent inefficiencies, at higher levels of government the costs of such inefficiencies are distributed across a wider base of population, resources and revenues. Climate change adaptation planning at the local level will necessitate innovation and, in many cases, favor locally specific solutions over one-size-fits-all policies.

The importance of environmental information for monitoring and planning

A second theme in future adaptation planning concerns the availability of the information rural communities need about the potential impacts of climate change if they are to plan for it. Edwardsburgh/Cardinal residents report that the climate change information readily available from Canadian government agencies is not especially useful for their planning purposes. There are several reasons for this mismatch between the current generation of information available from the climate science community and rural planning needs. The spatial scale of climate change information generated by general circulation models is too large to capture local details. The types of scenarios being used by the climate science community, which typically deal in average temperature and, to a lesser extent, precipitation trends over large geographical scales, are not terribly relevant or meaningful at the local community level, where risks are experienced in deviations from norms and in locally specific interactions of climate with critical resources. Extreme events, such as the frequency and timing of hail or the potential for above-average accumulations of snow, are more pressing concerns for rural communities than changes in long-term average conditions, but climate

science tends not to produce more specific analyses regularly or reliably.

Rural communities often lack the resources or expertise to translate existing climate change information into forms that can be used in a practical or quotidian sense at the rural community planning level. For example, local experience in Edwardsburgh/Cardinal is consistent with scientific studies that suggest winter temperatures in eastern Ontario are becoming milder (Chiotti and Lavender 2008). For a local government where maintenance and replacement of roadways, culverts and bridges forms a large component of municipal budget and planning activities, an important but as yet unanswered question is how and to what extent winter temperature trends should be incorporated into future planning and budget forecasts. This gap in knowledge of how to apply broad-based climate change information to local-level planning priorities represents an important avenue for future research.

Capacity building is inherently linked to progress in economic diversification

Edwardsburgh/Cardinal residents recognize their community's future cannot be based upon an over-dependence on a limited set of resources, a belief that is hardly unique to that community. Focus group discussions of how to build future adaptive capacity regularly returned to this theme. Participants strongly believe that while diversification of the local economic base is critical, it should not lead to the abandonment of the community's traditional economic activities and its rural identity and heritage. They see the process of diversification as involving a leveraging of existing assets such as the restored grist mill that serves as both a symbol for marketing the community culture, and as a physical centre for community events. Residents see rural tourism as one potential avenue for economic growth and diversification that can build upon the community's rural tradition, culture and assets. One factor that limits this pursuit is that the financial capital needed to expand events and facilities to encourage extended stays by tourists is in limited supply in Edwardsburgh/Cardinal, as it so often is in rural communities.

These discussions about the role of rural heritage are reminders that every rural community has its own particular historical trajectory and its own particular current socio-economic and institutional environment. Consequently, simple "one-size-fits-all" approaches to the economic diversification that underlies adaptation planning may not be possible across communities. Nonetheless, this study suggests that certain common factors may exist. These include building multiple partnerships such as joint private-public sector programs and ventures, co-operation among neighbouring communities, and improved communications between municipal and more senior levels of government. Such partnerships would enhance the access of rural communities to capital, expertise and information that cannot be generated locally, but which are crucial to long-term success in diversification. For example, numerous Ontario government programs and funds already exist to assist economic diversification in rural areas. One key barrier discussed at the community workshops is that information about such programs does not always filter down to the community level. Small communities lack the resources to engage individuals solely for the purpose of liaising

with higher-level governments, researching available funding programs, and organizing, creating and submitting the inevitably complex sets of applications and supporting documentation needed to access such programs. This imperfect communication between higher levels of government and local communities may also be expected as federal and provincial governments seek to roll out climate change adaptation planning and initiatives in coming years.

Conclusions

National and provincial studies of climate change adaptation identify the importance of building capacity in rural and resource dependent communities given the nature of their vulnerability to environmental and socio-economic and demographic changes. Planning for future climate change adaptation is tied to more general rural community planning which, in places like Edwardsburgh-Cardinal, is at a crossroads. Residents believe that a broader, more comprehensive and inclusive approach to rural planning, one that includes consideration of the potential impacts of climate change, will enhance their capacity to respond positively to future challenges and opportunities, climate-related or otherwise. In this context, comprehensive and inclusive planning includes:

- concurrently supporting and coordinating a wide range of economic, social and environmentally based planning initiatives,
- finding ways to involve all legitimate voices in community planning and governance, including youth and newcomers who are often excluded from current planning activities,
- improving co-ordination and communication across sectors and government and building partnerships between government and community organizations, and
- balancing the interests of future economic diversification with the need to preserve community heritage and maintain the strength of social capital.

Achieving this type of future will entail moving away from traditionally less flexible planning approaches that require firm predictions of the likelihood of future events, and moving towards contingency management of risks and capacity building to adapt to known and unknown risks, one of which would be climate change and its impacts. The lack of resources available to local government is a clear barrier to moving in this direction, and it is not unique to Edwardsburgh/Cardinal. Given the reality that many rural communities may never have the resources needed to make planning activities as comprehensive as described above, a challenge for scholars and policymakers concerned about climate change adaptation therefore becomes how best to capture information about climate change and its impacts in ongoing rural planning activities. Can the climate change research community move from “story lines” based on broad, global scenarios to ones that are compatible with and applicable to the ways in which rural communities interact with the environmental, socio-economic and institutional conditions within which they are situated?

This study offers some suggestions. One first step is to expand interactions between climate change researchers (including physical and social scientists) and rural communities to generate climate change information consistent with spatial and temporal scales employed in rural community planning – information

which can be applied to local decision-making, as described in the previously mentioned example of road infrastructure. Rural residents would clearly be receptive to such initiatives. This should not be surprising, given that the very nature of daily life in rural and resource-dependent communities makes residents cognizant of changes in environmental conditions and the risks associated with them. In our experience, rural residents are pragmatic in their attitudes toward climate change: if it is something that can be planned for, then it should be. However, they also see climate change as just one of many factors that must be considered in long-term rural community planning, with climate-change-related risks needing to be weighed in relation to (and not in isolation from) other risks to be managed over the long term.

If given the necessary support, residents of Canadian rural communities can be expected to be willing and eager participants in climate change adaptation planning more generally. The continued existence of these communities today is a fortunate outcome of history, geography and development trajectories. Until the Second World War, most Canadians lived in rural or resource-dependent communities and regions. Today, relatively few do, and their numbers are continually diminishing. Residents increasingly see themselves falling behind larger Canadian municipalities in terms of the availability and accessibility of critical services and infrastructure. Any phenomenon that might threaten to further undermine the quality or viability of life in these communities, including climate change, is one that will be taken seriously. A critical question for the majority who do not live in rural or resource-dependent communities is whether we want such communities to continue to exist and to thrive, and if we wish to partner with them in climate change adaptation planning and programming. For it will ultimately be urban residents who determine if the critical needs identified above – building linkages across levels of government, adapting constrictive institutional structures and regulations, and providing small communities the resources to act as full partners in planning – will be met.

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