

Adaptive capacity-building and sustainable development in Canadian rural and remote communities: The role of information and communication technologies

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1. Introduction

Governments at all levels increasingly recognize that a digital divide exists between urban/suburban communities and rural and remote communities (Sciadis 2002, Noce & McKeown 2007, Ramirez 2007, Statistics Canada 2007). In spite of federal and provincial programs and initiatives, unequal access to digital economy resources appears to be accelerating. 3G wireless communications and high-speed broadband internet have become standard in urban Canada, while rural communities are often still lobbying governments and industry for simple radio transmission and highway-side cellphone transmission towers.

This rural/urban digital divide has considerable local, regional and national implications for Canadians. A 2008 study funded by Natural Resources Canada found the consequences of unequal information and communications technology (ICT) access include:

- an inability to attract new businesses and services beyond the peri-urban area;
- high rates of out-migration by younger members from rural and remote communities, who seek and expect the social and economic opportunities of the digital economy;
- increased vulnerability among rural populations to extreme events and the impacts of climatic variability and change;
- the potential for social and economic fracturing within regions between groups with access to ICTs and those without (McLeman 2008).

Canada's rural and remote communities are tremendously diverse in their cultural, demographic, economic and social makeup (Bryant and Joseph 2001). Their sheer diversity – from fly-in aboriginal settlements to Newfoundland outports to farming and ranching areas to mining and mill towns – presents considerable challenges to bridging the digital divide and ensures that solutions are not one-size-fits-all.

There is a considerable body of scholarly literature from Canada and abroad that is directly relevant to the role ICTs play in the development of rural and remote communities, which has been systematically reviewed and forms the basis of the knowledge synthesis report (see Box 1: Methodology). Considerable research has

Rural experts comment on this report

Prior to publication, this report was reviewed by ten Canadians who live in rural areas with poor or no access to broadband internet and wireless services. Each comes from a different walk of life, and provided detailed descriptions of how access to ICTs (or lack thereof) shapes life in their communities.

Selections of their comments are provided in sidebars throughout this report, illustrating how the findings in each section relate to their own experience.

been done on the potential benefits of ICTs for rural and remote communities in terms of economic development, provision of health care services, emergency preparedness, education, and social cohesion. Scholars have, however identified a range of barriers to the accessibility and uptake of ICTs in rural and remote areas, including the difficulty in persuading the private sector to build digital infrastructure in low-population density areas, the need for training to facilitate the uptake of new technologies, and broader socio-economic challenges related to rural demographics and household incomes. While such factors present challenges for governments at all levels, research is available in terms of potential roles for government, opportunities for enhancing the diffusion and accessibility of ICTs, and how to build rural community engagement with the digital economy. Existing provincial and federal government programs and initiatives take into account these barriers, challenges and opportunities to varying degrees. National governments in other developed nations tend to have more detailed strategies for addressing the rural-urban digital divide, highlighting the importance of the Government of Canada's Digital Economy Consultation initiative (www.digitaleconomy.gc.ca).

Box 1: Methodology

This study is based on a systematic literature review and meta-analysis that used procedures modified from those commonly used in the health sciences to study the effectiveness of medical treatments and diagnostic procedures. The research team conducted a sequential search via Google Scholar of peer-reviewed research publications addressing the study goals. Various combinations of search terms such as <rural+development+internet+Canada> were repeatedly used and refined to identify relevant study reports. Reference lists from these study reports were in turn searched for additional studies. This process continued until additional modifications of the search string uncovered no new relevant publications. The publications were then entered into an electronic database, reviewed and coded according to key categories such as ICT benefits, barriers, and so forth. A choice was made to focus on research reports from North America, Europe and Australia. Although studies on rural ICT use are also commonly found in international development literature, these were excluded on the basis of the different socio-economic and geographic challenges developing countries face compared with Canada (there may nonetheless be many useful insights to be gained by further studies comparing situations in Canada and developing nations). The study team reviewed information concerning rural ICT policies and programs obtained from websites for provincial and federal governments in Canada, Australia, the UK and the US to enable a general comparison of scholarly research findings with government activities. A draft report was compiled and circulated to ten reviewers, from various walks of life, who live in areas with poor or no wireless or broadband service. Their reactions are found in sidebar boxes throughout the report and provide detailed illustrations of how ICTs influence rural and remote communities in Canada.

This review found strengths and weaknesses in the existing scholarly literature. The subject of using ICTs to deliver health care services to rural and remote communities (generally known as “telehealth”) has been studied in considerable detail from a wide variety of different disciplinary perspectives. Similarly, there is a large amount of general research available on the economic opportunities and benefits associated with ICTs at local and national scales, although more research

What are ICTs?

Information and communication technology (ICT) is a broad term covering a range of technologies. This report focuses primarily on broadband internet and wireless communications technologies – the ICTs most commonly absent from rural and remote areas – although other ICTs are also important to community sustainability. These include global positioning systems (GPS), geographic information systems (GIS), satellite-based communications devices, and traditional radio-television transmissions and land-line telephones.

quantifying the long-term benefits is warranted. Social and economic well-being are key components of sustainable development in Canada's rural and remote communities. The role of ICTs in contributing to the third pillar of sustainability – environmental well-being – tends to be less well integrated into the existing literature. This does not mean that research into the application of ICTs in environmental management issues does not exist; rather, there are few examples of that research being explicitly linked to questions of sustainable development and adaptive capacity-building in rural and remote Canada. This suggests an important area where further research should be encouraged in the future.

The remainder of this report begins with an overview of sustainable development and adaptive capacity-building challenges in Canadian rural and remote communities, followed by a detailed synthesis of available research and comparison with existing Canadian government programs, concluding with an elaboration of future research needs and opportunities. These findings are complemented by text boxes containing observations made by residents of rural and remote communities who served as expert reviewers of this report and were asked to describe their experience with Canada's rural-urban digital divide. Their observations are illuminating.

2. Sustainable development and adaptive capacity in Canada's rural and remote communities

The concept of sustainable development has become widely incorporated into government policies in Canada and internationally since being described in the 1987 report of the World Commission on Environment and Development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987, p.43). Any number of interpretations of this definition have since emerged, most of which contain three common elements:

- integrating economic, social and environmental concerns in policy- and decision-making;
- ensuring fair and equitable access to resources, livelihood opportunities and well-being (also described as *intra-generational equity*);
- recognizing the right of future generations to enjoy no lesser access to resources and opportunities than we presently do (also described as *inter-generational equity*)¹

Beginning with Natural Resources Canada, formal sustainable development strategies have spread across federal government departments and Canadian provincial and territorial governments since the mid-1990s (Plummer 2006), and

¹ Adapted from Mirovitskaya, N. and Ascher, W. (Eds), 2001. Guide to sustainable development and environmental policy. Duke University Press, Durham, NC

What is “rural”?

For census purposes, Statistics Canada presently describes rural areas and small towns (RSTs) as being areas outside of urban centres with populations larger than 10,000. RSTs also do not include municipalities where 50% or more of the workforce commutes to urban centres. “Remote” communities fall into the same statistical category as rural communities.

the federal government is presently engaged in creating an updated national sustainable development strategy (Environment Canada 2010). In rural Canada, sustainable development research and initiatives have expanded from an early focus on agriculture and food production systems to consideration of other economic sectors (including forestry, mining and tourism), public participation in resource development, local government restructuring, and a variety of other directions (Smit and Brklacich 1989, Butler 1991, Macrae et al 1993, Hilson and Murck 2000, Douglas 2005, Sheppard 2005). Despite the widespread adoption of sustainable development as a guiding principle for rural development in Canada, results have been mixed.

Approximately 7.6 million Canadians live in rural areas and small towns (Statistics Canada 2008). Although the population of rural Canada as a whole remains stable, demographic trends vary considerably from province to province. Proximity to urban centres, economic diversification and high average levels of education are key attributes of rural and remote communities that have stable or growing populations, while those that lack such attributes tend to have aging and slow-growing or declining populations (Statistics Canada 2010a). The gap between rural and urban household incomes declined in most provinces in the last decades of the twentieth century (Statistics Canada 2004) but on many other social, economic and environmental indicators Canadians living in rural and remote communities have fallen behind their urban counterparts (Alasia et al 2008). Livelihoods in Canada's rural and remote communities are strongly tied to agriculture, fishing and extracting and processing natural resources (Statistics Canada 2010b) and are consequently highly sensitive to changes in global market prices and changes in environmental conditions, a situation described in scholarly literature as "double exposure" (O'Brien 2000 and Leichenko 2000).

Canada's aboriginal and resource-dependent communities are also particularly vulnerable to anthropogenic (human-induced) climate change (Lemmen et al 2008). Impacts are already being experienced by small communities across Canada, from forest-dependent communities in the BC interior confronting the decimation of forests due to bark beetle infestations, to northern communities losing access to traditional hunting and fishing grounds due to changes in snow and ice conditions, to the impacts of milder conditions on winter tourism in smaller Eastern Ontario communities (Ford et al 2006, Kurz et al 2008, McLeman 2008). Researchers and governments have identified a growing need to incorporate or "mainstream" climate change adaptation considerations into sustainable development planning in rural Canada (Yin et al 2000, Wall et al 2006, Lemmen et al 2008). Building future adaptive capacity and sustainable development in rural Canada in the face of the combined effects of economic, demographic and climate change will necessitate the removal of many existing barriers to development, and taking advantage of emergent technologies to generate new opportunities (Lemmen et al. 2008, McLeman 2010, Sander-Regier et

Rural vulnerability

"In 2004 there were only two dial-up providers in our area. One of them used the community's desire for high speed and our lack of choice to run a scam. Their sales pitch: 'Send us \$250 so we can put up a wireless tower near you. Get your neighbours to do the same and as soon as we have enough interest and money, we will erect the tower'. Many residents had been with this company for a few years and trusted them. Six years on, no towers have been erected and there is a criminal investigation in progress. Remote communities such as ours are vulnerable."

F.M., Local food producer

al 2010). These include harnessing the potential of ICTs, which have long been identified in international literature as being potentially important tools for facilitating rural sustainable development (Mansell and Wehn 2000, Chapman and Slaymaker 2002).

This presents a significant challenge, for ICT access and use in Canada's rural and remote communities lags behind that in urban centres. According to the 2006 Census (the latest available at time of this report), Canadians living in rural areas and small towns were less likely to use the internet for business or personal reasons than their urban counterparts (58% vs. 68%) (Statistics Canada 2007). According to their corporate websites, Canada's three main wireless telephone providers – Bell, Rogers and Telus – claim to provide basic voice and messaging service to between 90 and 95% of potential subscribers as of October 2010. High speed wireless service is less widely available (typically to less than 90% of potential subscribers). The ability to use such devices outside areas of high population density is variable and large rural areas of Canada are without service, particularly in the case of high-speed wireless (Annex I). Improving the access and availability of ICT services in rural and remote communities is an important priority for Canada's Digital Economy Strategy, given the substantial research demonstrating their considerable potential to contribute to sustainable development and adaptive capacity building.

3. Potential benefits of ICTs

3.1 Economic development

It is widely accepted that access to ICTs fosters economic growth, development and opportunity for all types of communities, and rural and remote communities are no exception (Bandias and Vemuri 2005, Leatherman 2000, Picot and Wernick 2007). It is also generally the case that residents of rural and remote areas have less access to ICTs and the resulting economic advantages than their urban counterparts (Teppayayon and Bohlin 2009). This is not a phenomenon new or unique to the internet age; Hudson observed in 1990 that rural businesses were being held back by lack of access to private telephone lines and reliable fax transmissions. Even where ICT access is available, there may be fewer competing service providers, meaning that prices may be higher and quality of service lower; Grimes (2000) suggested the greater economic advantage may go to the service provider than to the user community.

Stern et al (2009) suggest that the ability to access and make use of ICTs should be viewed as “digital capital” that conveys advantages and opportunities similar to those that result from access to more traditional forms of economic capital. Warren (2007) suggests that rural communities should simply accept the fact that there will be disparities in access to this digital capital, and that it is more important to

ICTs and rural businesses

“Many more of our guests at the motel now inquire if we have Wi-Fi than in the past, and we notice most, if not all of them have a cell phone.”

L.P., Rural business operator

“Many local businesses and a few residents have installed satellite internet, incurring sizable installation, equipment and monthly charges. Some have found the service unreliable and gone back to dial up.”

A.B., Parent & community leader

“Last week Bell started offering internet access in my community. People were so keen to get connected they stayed home from work, foregoing a day's pay to meet the technician and get connected.”

J.H., Rural educator

therefore accurately quantify and cost this disparity to facilitate the pursuit of radical and economically efficient methods to reduce the gap. Qiang (2010) suggests the present economic downturn provides an appropriate opportunity for governments to become actively involved in stimulating rural economic growth through ICT infrastructure investments.

Beyond the general economic benefits associated with ICTs, there are particular areas where rural and remote communities and their residents stand to benefit. One is in agriculture, where ICTs can improve farmers' access to timely agrometeorological information, enabling them to better plan and prepare their production methods to suit changing conditions (Weiss et al 2000). Farmers may also benefit from getting greater, timelier and more accurate access to commodity market and price information (Colle 2005). ICT access can particularly benefit rural manufacturing businesses by helping them achieve efficiency gains associated with being distant from urban markets and improving their ability to provide training and learning opportunities to their employees (Baldwin and Sabourin 2001, Grimes 2000). First Nations communities can take advantage of videoconferencing to overcome distances and work with other communities to generate their own economic development and planning initiatives (O'Donnell et al 2008). Research from Australia by Singleton et al (2009) suggests ICT access also helps aboriginal communities by empowering aboriginal youth, giving them the tools and ability to generate their own economic opportunities, which may be more effective than top-down youth empowerment initiatives. Wilkinson (2010) suggests the psychological sense of community grows whenever rural and remote populations gain access to e-mail and other communications technologies, and this may translate directly into enhanced economic opportunity and development, although additional research is needed.

In addition to studies looking at the benefits of bringing ICTs to rural communities are those that look at bringing ICT businesses, particularly call-centres, to rural settings. Richardson and Gillespie (2003) suggest that call-centres not only create jobs but also stimulate the development of new types of skills and competencies in rural communities, a finding also noted in other countries (Soriano 2007). In a study based in Newfoundland, Sheppard (2001) found that governments can work with communities to create multi-purpose call centres that can serve multiple clients and thereby enhance their potential success.

Other ways that government can facilitate economic growth in rural and remote areas through ICTs is through the creation of community technology centres, thereby overcoming many of the barriers associated with providing ICTs in poorer and less densely populated areas (O'Neill 2002). Schools and libraries provide potential locations for community ICT centres, and the benefits potentially realized relate not only to creating economic growth but helping to encourage young residents to remain in the community (Schafft et al 2006). The US Department of

ICTs and farming

“We were an early adopter of ICTs. In 1995 we created a website and began selling farm products all over the world. Now there are hundreds of other sites, and we have moved on to other uses of ICTs. We provide on-line maps and GPS coordinates for visitors to our farm, and have a blog about our seasonal activities for repeat visitors. ICT helps our farm business in other ways. We keep an online map of our farm and the various activities taking place. We use the web to find service manuals for equipment and stay abreast of government regulations. I can't imagine running our business without ICT.”

S.G., Farm operator

“Going online to see the weather forecast is the first thing we do in the morning and the last thing we do at night.”

F.M., Local food producer

Agriculture has operated a broadband loan program to help rural communities acquire ICT access, and the overall impacts have been positive in terms of increasing employment, incomes and number of rural businesses (Kandilov and Renkow 2010). The researchers did, however, still observe the persistent challenge of overcoming the effect of distance from markets, as the gains from this program were higher in rural areas situated closer to urban centres than in more remote ones.

3.2 Social development

3.2.1 Health

In the past decade much scholarly literature has emerged regarding the benefits of using ICTs in providing health services to rural and remote communities, a process described generically in the literature as “telehealth”. ICTs are widely believed by researchers to have the potential to generally reduce the inequities between rural and urban areas in terms of access to health care services, and to improve levels of health and well-being in First Nations communities (Jennett et al 2004, 2005; Lemelin et al 2010; Shore and Manson 2005). The ICTs most often connected with telehealth are internet-based videoconferencing and general broadband internet access to informative websites, although there are studies looking at the role of “smart home” technologies to monitor the health of elderly residents while enabling them to remain in their own homes (Schopp et al 2006). Young & Ireson (2003) note that in the rush to adopt broadband video communications, it is important not to overlook the proven effectiveness of regular voice telephone services as part of telehealth delivery.

Rural areas face particular challenges with respect to health care that telehealth seeks to overcome. Foremost is the overall quality of health and longevity of rural populations, which are often noticeably poorer as compared with urban populations, especially for women (Wathen and Harris 2007). Residents of rural and remote communities often have to travel long distances to visit a health care provider, and specialized health care services may not be available at all (Watanabe 1999, Gagnon et al 2006). Access to a nurse for general health and home-care advice may also be lacking (Dimmick et al 2003). The general lack of out-patient rehab services in rural areas has a particular impact on the rural elderly, increasing their rates of readmission after treatment and potentially hastening their entry into institutional care settings (Savage et al 2009). Lack of pediatric care and neo-natal services have a negative impact on women, infants and young children (McGregor et al 2007). A number of studies identify a significant lack of psychiatric, psychological and emotional counselling services in rural and remote areas, which may have a particular impact on rural adolescents (Bischoff et al 2004, Cornish et al 2003, Grubaugh et al 2008, Schopp et al 2006, Shore and Manson 2005, Sulzbacher et al 2006, Miller 2005).

ICTs & rural health

“Being able to videoconference with health care providers would provide a world of change to our community. Our family has used the regular telephone telehealth service in the past, but this could provide a better diagnosis and peace of mind. We might be able to avoid trips in the middle of the night to emergency rooms at least an hour away, which would also help reduce wait times in the ER. My only fear would be that our ambulance service would be taken away if videoconferencing were to cause the number of calls to drop.”

A.B., Parent & community leader

“It will be a real challenge for our medical centre to switch to electronic records. This is probably due to the older age of our doctors; they didn't learn with computers and had no broadband at home either.”

K.H., Rural business operator

A considerable number of studies exist that identify types of services that are potentially deliverable to rural and remote communities through telehealth ICTs; these are summarized in Table 1.

Table 1: Services potentially deliverable to rural & remote communities by telehealth

Service type	Study authors
emotional counselling	Bischoff et al 2004, Cornish et al 2003 Grubaugh et al 2008, Miller 2005, Schopp et al 2006 Shore and Manson 2005, Sulzbacher et al 2006
general health and wellness information	Hale et al 2010
genetic services	Lea et al 2005
hearing screening for children	Lancaster et al 2008
in-home health counselling for elderly	Nesbitt et al 2006
neo-natal advice & support	McGregor et al 2007
nursing advice	Dimmick 2003
pre-operative assessment and counselling	Thomas et al 2004
rehabilitation services	Demiris et al 2005
rheumatology service	Jong and Kraishi 2004
services for children with special needs	Marcin et al 2004
strokes - rapid assessment & intervention	Hess et al 2006
suicide risk assessment	Jong 2004
women's health advice	Wathen and Harris 2007

Rural health care practitioners also experience challenges different from those faced by their urban counterparts. Rural-based health care professionals often lack support in terms of having specialists to consult with, peers and counterparts to collaborate and share duties with, and simply getting time off. These combined stresses result in high levels of practitioner burnout and make it difficult to retain qualified staff in rural areas (Cornish et al 2003, Curran 2006, Duplantie et al 2007, Elder and Clarke 2007, Gagnon et al 2005, Sergeant 2005, Taylor and Lee 2005). Young health care practitioners located in rural and remote communities may face the additional difficulty of working without sufficient supervision or mentorship, and may have difficulty accessing continuing education and training (Wood et al 2005). ICTs are seen by all authors cited in this paragraph as being potential vehicles for addressing these challenges.

Users of ICT-based telehealth services report a general level of satisfaction (Dimmick et al 2003, Marcin et al 2004) as do health care service providers and practitioners (Gagnon et al 2005). Collins and Wellman (2010) found that residents of Chapleau, Ontario, perceived telehealth services as contributing to a generally higher quality of life. Grubaugh et al (2008) found that patients dependent on telepsychiatry services report that videoconferencing is not as preferable as in-person counselling, but is far preferable to having no telehealth option at all. Gibson et al (2009) find that satisfaction with telehealth services increases as users become accustomed to them. In Australia, which faces similar challenges in delivering health services to rural and remote areas, research also reports a general satisfaction with telehealth (McClelland et al 2003).

However, telehealth initiatives are not universally successful, and face particular challenges beyond those associated with having the necessary ICT infrastructure in place. Groups that are often most in need of healthcare services – elderly, women, and residents of First Nations communities – are also those who tend to have lower rates of ICT-literacy and general literacy, making them difficult to integrate into telehealth use (Lemelin et al 2010, Wathen and Harris 2007). The sensitivity of health information makes patient privacy an ongoing issue for telehealth generally, and not just in remote communities (Gibson et al 2009). Getting participation from practitioners (particularly specialists) and questions of appropriate compensation for service providers may become issues (Grigsby 2008), and the success of telehealth implementation has much to do with the organizational culture of the delivering agency (Whitten and Adams 2003). Although they may compensate for the inability to place health care practitioners in low-population density areas, telehealth services are not a cheap alternative (Smith 2005), and Saqui et al (2007) warn of the perils of simply patching telehealth on to a wider health care delivery system instead of integrating the two. In reviewing the implementation of telehealth service in Labrador, Peddle (2007) identified a wide variety of challenges including technical problems, privacy issues, high rates of staff turnover, and financial constraints.

3.2.2 Emergency preparedness & response

The geographical setting and distance of rural and remote communities present challenges in terms of emergency preparedness and response that are distinctive from those faced by urban populations. Rural livelihoods and daily activities are inherently sensitive to variable and changing environmental conditions (McLeman 2010). Rural communities typically face a high degree of exposure to loss or harm caused by wildfires and extreme events such as excessive precipitation. ICTs including satellite imagery, geographical information systems (GIS), meteorological stations and remote sensing technologies offer the ability to monitor for and detect such events and provide early warning to management officials and emergency responders (Auld et al 2004, Han et al 2003, Trainor et al

Emergency preparedness

“Urban visitors seem unable to grasp the idea of being completely inaccessible to emergency services. They may believe that bringing a GPS and cell phone makes them safe. We had an unfortunate incident here recently. An elderly couple became lost on an ATV trail, likely relying too heavily on their GPS. There was no cell phone service in the area, which may only seem inconvenience to most, but it cost them their lives.”

E.S., Rural IT/GIS specialist

“My partner is a volunteer firefighter. Because of the rugged terrain his pager doesn’t always get calls. A lot was spent to improve communication systems, but a phone tree is still often needed to ensure all available firefighters have been called and given direction to the scene.”

F.M., Local food producer

2009), although the ability for rural and remote communities to access such data may be constrained by limited internet connectivity (McLeman 2008). GIS may also be beneficial in helping agricultural communities plan and prepare for the impacts of climatic variability and change over the longer term (Loevinsohn et al 2002), although such techniques are often still very developmental (McLeman et al 2010). The slow penetration of mobile phone service into Canada's rural areas remains an ongoing impediment to emergency response (Thakur and Cozzens 2008, McLeman 2008), but remote communities show a strong ability to adopt these and other ICTs as a means of reducing risks when given the opportunity (Ford et al 2006).

3.2.3 Education

ICTs are broadly recognized as having a range of potential benefits for the delivery of education and training to rural and remote communities, which have their own particular needs and challenges in this domain (Collins and Wellman 2010; Crow and Longford 2000, Grimes 2000, Sheppard 2001). Early research found that the use of ICTs in rural education showed mixed results, but with time ICTs have shown to be beneficial, especially when they appropriately target the particular needs of a given remote community (Ungerleider 2002, Jacobs and Herselman 2006).

A number of key potential benefits particular to rural and remote communities have been identified by researchers. The first of these consists of benefits to students. ICTs enable rural and remote schools to offer a broader range of courses and learning options than would otherwise be possible (Stevens 2006). Things such as internet chat rooms, when appropriately targeted, can provide rural students additional opportunities for informal learning and collaboration with their peers in other schools (Bruce et al 2007), thereby overcoming the implications of inherently small class sizes in rural schools. In remote communities, ICTs enable primary schools to extend their teaching capacity to include higher grades, thereby reducing the need for students to relocate to other communities to obtain their secondary school education (Walmark 2005). ICTs have been found to be especially useful in delivering higher level math courses to students (Ungerleider 2002).

A second set of benefits accrues to rural and remote communities as a whole. The creation of ICT infrastructure allows schools to become technical resource centres for the entire community (Scaffit et al 2006). The availability of ICTs helps communities attract and keep professionals, such as health care workers and teachers, who require ongoing training and learning opportunities (Curran 2006, Jamtsho and Bullen 2007, Sargeant 2005). ICTs help overcome the effects of distance by enabling communities to mobilize their intellectual and cultural capital and share it with other communities (Stevens 2006).

Rural schooling

“At the small school where I teach, students can take courses online. They can study what interests them and get prerequisites for college or university. Before online courses were offered, some students would have to attend a high school 1-2 hours away from home. The students don't have high speed access at home, so they complete e-learning assignments during class time. This reduces the amount of time I can spend teaching curriculum.”

J.H., Rural educator

“High-speed internet would have been very valuable, but my school didn't have it. The computer skills of the older teachers were very limited. When I came to university, my own research skills were limited to searching the Yahoo website and waiting at least 10 minutes to find a not-so-scholarly article to use as evidence in a project.”

M.N., Rural youth/urban student

Rural and remote communities face particular challenges with respect to adopting ICTs in education. The first relates to infrastructure; rural areas have tended to lag behind urban ones in terms of getting their schools upgraded to broadband internet access and in terms of home computer use (Pelgrum 2001, Plante 2004). In a study of ICTs in rural Newfoundland schools, Brown et al (2002) found that a well-funded government program to support service delivery is essential, and provision of technicians to support schools is preferable. Ensuring the compatibility and connectivity of systems and having a reliable high-speed network is also essential to providing ICT-based educational content, especially if rural schools are to provide students better-than-basic ICT skills training (Porscense et al 2006, Singleton et al 2009).

Even once ICT systems are in place, uptake may suffer in rural and remote communities for other reasons. Without active support and training/mentoring for teachers on ICT use in the classroom, ICTs can go under-utilized, especially where teachers have other competing demands on their time (Cuckle and Clarke 2002). Professionals who require ongoing education must also have the necessary resources to be freed up from their day-to-day duties to participate in training, and to have the ability to travel for complementary in-person training (Sargeant 2005, Curran 2006). Once in place, ICT-based learning is generally received positively by rural students and community members, especially as they become more familiar with the systems (Ungerleider 2002, Collins and Wellman 2010). This includes First Nations communities, where aboriginal youth have shown themselves to be very receptive to adopting ICTs (Lemelin et al 2010, Singleton et al 2009).

3.2.4 Social networks

ICTs are widely seen as potentially enhancing social connectivity, although it should not be assumed that this is automatically or universally the case (Pigg 2001, Pigg and Crank 2004). Ramirez (2007) found there is a lack of evidence and research to show that ICTs have lasting social or economic benefits for rural communities. Even so, it is widely believed by researchers that ICTs may play a potentially important role in helping rural and remote communities overcome the effects of distance and isolation and enhance their social vitality.

One of the key research findings is that ICTs can help foster in rural and remote communities the development and maintenance of social capital (i.e. social connections, linkages and networks that provide benefits to participants (Wall et al 1998)). E-mail and internet chat rooms enable greater ongoing contact and socialization with friends and relatives within the local community and those who live at a distance (Bruce et al 2007, Collins and Wellman 2010). Internet access provides rural residents the ability to find and connect with others who share

Rural social networking

“I really appreciated the tight-knit community we had in our small town school. We all knew each other, we all socialized with one another in the hallways. So many people I know now, including myself at times, spend far too much time on the computer social networking. This causes us to lose out on other opportunities that we would have otherwise experienced.”

M.N., Rural youth/urban student

“I do feel housebound some days, but in no way regret living here. The internet does help me feel more connected. It has also provided some work opportunities. I feel very blessed to be able to stay at home to raise our children and earn some money at the same time.”

A.B., Parent & community leader

similar occupations and interests, to acquire greater information on health and wellness, and to communicate with governments and public officials (Jacobs and Herselman 2006). It may also reduce the need for residents of small, remote communities from having to relocate elsewhere to pursue education and training (Walmark 2005). For young women living in rural areas, ICTs may help with overcoming geographic isolation and the sometimes conservative traditions that may impede their ability to socialize outside the household (Campbell 2005). Some studies have suggested that greater access to ICTs may reduce disparities in social welfare in rural areas and may reduce reliance on social safety nets, although further research is needed on these topics (Bandias and Vemuri 2005, Qiang 2010).

Videoconferencing has been adopted by many First Nations communities, with Ontario's K-Net and Atlantic Canada's First Nation Help Desk cited as examples of successes in helping improve the social wellbeing of aboriginal populations (Milliken et al 2009). Mignone (2009) suggests that ICTs generally help build social capital within and among aboriginal communities, but Lemelin et al (2010) suggest more research is needed on how this increased social connectivity will influence aboriginal communities. Although the emphasis in recent literature is on internet and wireless-based ICTs, the importance of older ICTs such as community-run radio in maintaining social interactions and connectivity should not be forgotten, especially in remote areas where newer ICTs are unreliable or lacking (Gurstein 2007).

In a case study of residents of a small rural New Brunswick town that acquired broadband access, Selouani (2007) found that many daily activities were made easier, and that residents acquired better access to information from their governments. Although some changes in people's attitudes and social behaviours were observed, overall the research found no negative or adverse social impacts on the community. More Canadian studies of this type are warranted. In a study of rural American communities, Stern and Adams (2010) found that e-mail plays an important social role in enhancing connections with other local residents and those farther afield, helps rural people get updated on local news and events, and facilitates local volunteerism and social capital – resources that are especially critical in rural and remote communities (McLeman 2010). Wilkinson (2010) found similarly positive benefits from e-mail & internet use.

4. Barriers to ICT incorporation

Despite the many potential benefits of ICTs, residents of Canada's rural and remote areas are often unable to participate in their use. Two general categories of barriers to ICT use are described in existing research, access barriers and uptake (or adoption) barriers. *Access barriers* for this report refer to situations where the infrastructure does not exist to provide broadband and/or wireless connectivity, or

Radio is still important

“A community radio station was attempted here with an eye to music, local events, some news, some instructional information on various topics and weather. There was a Board of Directors established, used equipment and expertise found and a broadcast frequency assigned. Unfortunately, CRTC regulations and red tape made the project disappear.”

I.B., Rural ISP associate

“We are waiting for new technology and more FM wave length before proceeding with a community radio station. We only get weekly newspapers here, and radio would be used for our businesses to advertise, and to provide emergency info like road construction, closings, accidents, dangerous weather, etc.”

L.P., Rural business operator

where such access is provided only at specific or limited locations. For example, some communities may have broadband internet access at a particular library or community centre but no broadband access within the home; other communities may have only dial-up access, which is increasingly inadequate to stream digital content. *Uptake barriers* refer to situations where ICT infrastructure is in place, but individuals or households are unable to make use of the technology for socioeconomic reasons such as age, household income, language, and education levels.

Often, access and uptake barriers go hand-in-hand in rural and remote areas and reinforce one another in a cyclical fashion (Bandias and Vermuri 2005, Brown et al 2002). Poor access to ICTs makes it difficult for communities to attract businesses and investment and leaves residents without the skills needed to participate in the digital economy. This situation helps push young and mobile residents out of rural areas to seek opportunities in places where they do have ICT access, leaving their communities less skilled and less able to attract ICT services. Research therefore points to the need to address access and uptake barriers simultaneously if rural and remote communities are to fully realize the benefits of ICTs.

4.1 Access to Infrastructure

Rural and remote communities often have limited access to ICT infrastructure and/or significantly lower service quality than their urban counterparts, which is reflected in lower rates of internet use by rural populations (Boase 2010, Hale et al 2010, Jamtsho and Bullen 2007, Malecki and Boush 2003, Symons 2000, Teppayayon and Bohlin 2009). Infrastructure provision outside urban areas faces economic challenges associated with long distances and large areas of low population density (Labrianidis and Kalogeressis 2006, Savage et al 2009). Universal provision of terrestrial broadband and wireless communications in Canada would necessarily entail creation of a geographically extensive network of telecommunications infrastructure. In some regions the physical geography makes it more expensive to install and maintain telecommunications infrastructure (Grimes 2003, Thakur and Cozzens 2008).

Under market-based models, telecommunication infrastructure is paid for and maintained by telecommunications companies seeking to generate revenues and profits for shareholders. While revenues and profits are inherently linked to the number of individuals and businesses subscribing to ICT services and the quality of service they receive, the additional revenues from extending service to rural and remote areas is typically low compared with the additional costs. ICT services may therefore be prohibitively expensive or, in some areas, essentially unavailable at any price (Zhang and Wolff 2004). The lack of potential for profit in rural and remote areas means that ongoing investments and upgrading of ICT is greatest in

Rural youth and ICTs

“The desire to gain access to ICTs and develop digital economy skills has pushed many young residents out of our rural community to learn elsewhere. Many will leave but they will always come back! Therefore, they will be bringing their new acquired skills with them and perhaps can help the other, less skilled, residents.

When I am at home, after being in the city at university, I fall behind on Facebook because I refuse to sit in front of the computer for hours waiting on the dial-up connection. When I get back to the city I have to take a few minutes to catch up, but that makes me appreciate my hometown even more. Being there forces me to physically visit my friends and family that I have only been able to talk to via computer or telephone”

M.N., Rural youth/urban student

areas with high population density and demand for service. (Gabe 2003, Khatiwada and Pigg 2010, Ramirez 2001, Symons 2000, Whitacre 2010).

Some researchers suggest market factors over the long term may improve ICT access in rural and remote areas (Kaufmann and Techatassanasoontorn 2005, Teppayayon and Bohlin 2009). Under this theory, a well-developed telecommunications infrastructure in conjunction with a minimally-related telecommunications market will generate continually increasing competition to provide service, lowering ICT network access costs and gradually extending the reach of service into areas that were previously less profitable. Other research points to the fact that in practice, competition in telecommunications markets tends to be low, meaning that ICT service invariably has low rates of penetration into high-cost/low-density areas under market-based models (Birdsall 2000, Thakur and Cozzens 2008).

Research identifies four types of options for rural and remote communities seeking to overcome the barriers to access created under the market model. One option is to aggregate demand for potential ICT suppliers (Malecki 2003, Simpson et al. 1999). An example of this is where a community makes a contractual agreement with a broadband service provider that a set number of households will purchase certain service packages over a given time period, thereby guaranteeing a minimum revenue stream to the provider in exchange for service. Another option is the creation of a local company to bring service into the community, which may be operated on a not-for-profit or co-operative basis (Cameron et al 2005). A third option is the public-private partnership model, in which governments or other public agencies agree to assume some of the costs associated with extending infrastructure into otherwise unprofitable areas. A fourth option is where public agencies undertake the full cost of service delivery. Examples of these various options are described in greater detail in subsequent sections of this report.

4.2 Uptake barriers

4.2.1 Socio-economic factors

Disparities in ICT use between rural and urban areas are only partially accounted for by variations in infrastructure access (Hindman 2000, Labrianidis and Kalogeressis 2006). Even within a community enjoying access to ICT infrastructure, differences in income, education, age, gender, attitude, and occupational class may be related to different levels of use (Boase 2004, Chinn and Fairlie 2007, Cullen 2001, Donnermeyer 2003, Middleton and Sorenson 2005, Weiss et al 2000, Willis and Tranter 2006). Most influential among these are income and education level (Hale et al. 2010, Rice 2003).

Physical barriers to ICT networks

“Our township recently tendered out the installation of a wireless broadband network. Many revisions had to be made to the original plan, and the vast majority of the network was eliminated because the terrain is so rough in our area. This would also be true for a cellular network, so we must postpone the creation of these infrastructures until they are more viable.”

E.S., Rural IT/GIS specialist

“The hills and forests in our area are a serious impediment. However, for decades we have had a number of high TV and communications towers which could have been used to provide service to the vast majority of our region.”

I.B., Rural ISP associate

Statistical analyses show that absolute cost is the foremost barrier to computer and wireless phone usage (Chinn and Fairlie 2007, Kalba 2008). The relationship is straightforward, in that individuals or households with lower incomes tend not to spend money on electronics, particularly if these technologies are perceived as being non-essential. In general, rural and remote communities tend to have lower average household incomes than urban communities. Within rural and remote communities, lower income families, youths, minorities and single-parent households are least likely to own a computer or take up the use of ICTs (Chinn and Fairlie 2007, Gilleard and Higgs 2008, Kastsinas and Moeck 2002, Tookey et al 2006).

Educational level has the second most important effect on ICT uptake, and is often closely linked to household income (Gilleard and Higgs 2008). Having access to technology at a young age increases the likelihood of uptake as an adult (Ching et al 2005). Since their parents often have lower levels of education and ICT use, young people in rural areas are less likely to have access to a personal computer in the home as compared to urban youths (Looker and Thiessen 2003). Because firms that develop or make use of ICT infrastructure and content tend to be concentrated in urban settings, individuals with digital expertise are less likely to live in rural or remote communities. Given their lower exposure to home computers and ICT-literate adults, rural young people have less opportunity to develop digital literacy skills, and are less likely to benefit from online resources, including telehealth and tele-education (Looker and Thiessen 2003). A lack of training and continuing education in computer skills for teachers in rural area (which is exacerbated by lack of bandwidth) may present a further barrier to developing ICT skills in young people (Frieden 2005, Kastsinas 2002, Stern et al 2009).

Lack of exposure to ICTs at younger ages in rural areas means that older adults also tend to be late adopters or non-adopters of ICTs and report higher rates of difficulty with using internet technologies (Ching et al. 2005, Schopp et al 2006, Whitacre 2010). This is particularly problematic in rural and remote areas of Canada, given the increasing age of non-aboriginal rural populations and the desire of governments to overcome the limited availability of health services through telehealth.

ICT uptake may also vary between men and women in rural areas (Ching et al 2005, Cooper 2006, Looker and Thiessen 2003, Oushoorn et al 2004). Although there is no innate difference in the ability of males and females to learn and use computers, attitudinal approach to ICTs may vary (Cooper 2006, Looker and Thiessen 2003). Females may tend to perceive themselves as less competent in the use of technologies and experience more anxiety when using them (Cooper 2006, Looker and Thiessen 2003). The design of ICT content may inhibit the interest or ability of women to make use of them (Oudshoorn et al 2004). Traditional gender roles and workload divisions within the household may mean that women doing

A changing demographic

“Rural areas are also home to many educated retirees and urban folks wanting to live in the country. ICT suppliers will have missed the boat if they assume all rural residents are older, late adopters.”

I.B., Rural ISP associate

“There are wealthy people in my rural area who do spend money on ICTs, but they tend to be a lot more skilled on the computer – many came from elsewhere, and acquired their skills in urban areas. There are also many older people who are ‘old fashioned’. They have the money to spend on computers but consume only things they absolutely need. The poorer residents I know are less educated and don’t own a computer, they simply cannot afford them.”

M.N., Rural youth/urban student

childcare, housework, and similar duties may have less time for using computers than males, who may also be using ICTs at work outside the home (Kennedy et al 2003). Women may also tend to use ICTs for different purposes than men, with women tending to focus on social networking and men on information gathering and recreation (Kennedy et al 2003).

Other potential social barriers to ICT uptake may exist. In areas where home computer ownership is sparse, households with access may simply be unable to communicate with others as much as they would like (Boase 2010). Because the dominant language for ICT content is English, people with reduced English skills may perceive the internet as a place where they do not feel welcome (Chen and Wellman 2004). For some people, reluctance to use ICTs may be the result of their being unaware of potential benefits or simple lack of interest (Gilleard and Higgs 2008, Warren 2002).

Poor access and low socio-economic levels are self-reinforcing barriers to ICT use in rural and remote communities (Aitkin 2002, Hollifield and Donnermeyer 2003). Low levels of digital literacy mean that even if infrastructure becomes available, rural inhabitants may have lower uptake levels (Whitacre 2010). Lower uptake levels reduce market demand, thereby reducing the likelihood new services will be provided, meaning that rural populations are less likely to improve their digital literacy (Hollifield and Donnermeyer 2003). A troubling outcome of this situation is that research shows that low-income, less-educated individuals who do decide to use the internet actually spend above-average amounts of time using it (Goldfarb and Prince 2008). In other words, those who would both highly benefit from ICTs and make great use of them are confounded by the lack of uptake by others – a lost opportunity to develop human capital.

4.2.2 Lack of support

A lack of locally based skilled personnel to provide user training and technical support may also affect uptake of ICTs in rural and remote communities or lead to content being underused (Alverson et al 2004, Anderson et al 2007, Chen and Wellman 2004, Cullen 2001, Jamtsho and Bullen 2007, Rooksby et al 2002, Taylor and Lee 2005). There is a need to raise awareness of the existence of service and content and its appropriate use (Tookey et al 2006). Such observations have been made, for example, with respect to telehealth content such as telepsychiatry, where people may be sceptical or suspicious of using technology to discuss mental health issues (Lea et al 2005, Shore and Manson 2005, Schopp et al 2006).

ICTs and rural ways

“For us, and many other rural users, the web is still a tool and not a lifestyle. I have yet to see any Blackberries at meetings of agricultural people. I’m just back from an international meeting of 300 producers and Blackberries and cell phones were not in noticeable use among the delegates. The chairman did not have to say ‘turn off your phones’. This is very different from a similar meeting of urban business people.

By the way, we turn off the computer when we go to the cottage or on family trips and we and the business survive. Breaking the link is another aspect that does not appear to have been covered or even considered in the research.”

S.G., Farm operator

5. Implementation challenges and opportunities

5.1 Diffusion of ICTs into rural and remote communities

There is a strong connection between access to ICTs and the capacity to innovate (Drori 2010), and so the different rates of diffusion between urban and rural areas create and deepen digital divides and innovation divides. It is inevitable that new and emergent technologies and their supporting infrastructures are typically introduced first into urban areas and spread later to rural areas, and ICTs are no exception (Augureau and Greenstein 2001). Rates of diffusion for broadband and wireless technologies into rural and remote communities are following similar patterns as older ICTs like radio, telephone and television (Sciadas 2002). ICTs are continually becoming more user-friendly, and in some instances there may be the possibility to leapfrog over intermediate technologies to newer ones (Gray and Sanzongi 2004).

Rural and remote communities are not all the same, and so the rates of diffusion of ICT into them will vary and different strategies to promote uptake will be required (Noce and McKeown 2007). Both supply-side and demand-side barriers must be overcome to speed the diffusion of ICTs into rural and remote communities (Whitacre 2010). To expand the supply of infrastructure in rural and remote areas, it may be possible to find ways of aggregating demand in low population-density areas, or getting the public sector more actively involved (Chinn and Fairlie 2007, Holliefield 2003, Qiang 2010).

On the demand side, broadband internet adoption rates have been slowing in North America, and certain groups, particularly the rural poor, the elderly and the less-educated remain very slow adopters of ICTs (Hopligh Tapia et al 2009). Addressing these demand side barriers to diffusion requires flexibility, a combination of top-down incentives, and enhancing ICT use for local content and local media (Whitacre 2010). Getting ICTs more widely used in workplaces where colleagues can help with training may be an effective way of encouraging their more general use, especially for people with low ICT user skills or lower general education levels (Hollifield 2003). Taking advantage of existing community resource centres and harnessing local networks of social capital to encourage ICT use may also speed diffusion (Huggins 2002, Simpson 2005). In some instances women may lag behind in ICT access and adoption, and consequently warrant special attention (Huyer and Carr 2002). Getting ICTs into hands of young people is especially important to ensure their use of ICTs as adults, and in rural areas this can be done by ensuring early penetration of ICTs into schools, libraries and community centres (Ching et al 2005).

The successful diffusion of ICT-delivered services, like telehealth and tele-education, into rural and remote areas is highly dependent on the presence of

Not all get the signal

“In September, Rogers established a cell presence on the local TV tower, which will service a very large area in our community. Unfortunately, this tower only appears to accept 3G signals, so many older mobiles won’t work.”

I.B., Rural ISP associate

“I completely agree that access barriers and uptake barriers reinforce one another. These issues are apparent in the community in which I live and work.”

E.S., Rural ICT/GIS specialist

“For retirees who want to use ICT, it can be very frustrating. Local service providers have fewer clients, provide slower service, and if your email backs up, it's almost impossible to get on the system. Retirees rely on television news to stay current.”

C.W., Rural entrepreneur

planned diffusion strategies (Gagnon et al 2006). Prior consultation with local participants and users who understand their region's needs helps ensure efficient and effective diffusion (Bahaadini et al 2009). Particular factors that influence the success of such systems in rural areas include ease of use, ability to practice, compatibility with existing systems and that proof that it provides clear advantages over alternatives, existence of local social networks, the amount of time involved in learning them, and rapid achievement of a critical mass of users (Helitzer et al 2004).

5.2 Roles for government

5.2.1 Improving access to ICTs and their uptake

Researchers identify several key roles for government with respect to ICT use in rural and remote communities. The first of these is in ensuring that the necessary ICT infrastructure reaches these communities. The private sector alone will be slow to extend ICT infrastructure to low-population density areas, so strategic public-private partnerships may need to be struck to deliver services to many areas (Chinn and Fairlie 2007, Grimes 2003). Given the many differences across rural and remote communities, plans to bring in ICT infrastructure often need to be site specific (Zhang and Wolff 2004). Governments should see investments in ICT infrastructure and delivery of social services like telehealth as long term economic benefits (Hailey 2005). One potential model, the Alberta SuperNet project, consists of public-private partnerships designed to provide basic internet service to rural and remote areas, and allows for purchase of value-added services such as videoconferencing (Mitchell 2003). Videoconferencing has become an important resource for many Canadian First Nations communities, and governments need to ensure First Nations communities are active members in public-private delivery partnerships and that such partnerships have reliable funding (Milliken et al 2009, O'Donnell et al 2008).

Home computer access in rural communities tends to lag behind national and urban averages, attributable to lower than average household incomes and lower average education levels among rural parents (Kastsinas 2002, Looker and Thiessen 2003). Many researchers highlight the consequent importance of investing heavily in providing ICTs at schools, libraries, community centres and community colleges and other government-operated facilities to overcome access challenges (Brown et al 2002, Kastsinas 2002, Looker and Thiessen 2003, Muir and Oppenheim 2002, Pelgrum 2001, Sheppard 2001, Simpson et al 2003). However, simply providing internet and computers at rural libraries and schools does not necessarily ensure everyone in the community will consequently have access and make use of them (Strover et al 2004). Governments need to maintain an active role advertising and promoting ICT use, encouraging rural businesses to adopt their use, and harnessing local social agencies and community groups to help

Rural demand for connectivity

“When I was Township Reeve I thought it was a disgrace that a community 2 hours from our nation's capital could not have cell phone coverage. In 2006 our municipality offered \$50,000 to Telus, Rogers or Bell to provide cell service in our region and collected 10,000 names in support. All three looked at our offer, but none provided service.”

K.H., Rural business owner

“Those who choose to operate a small home-based business here often opt for satellite service, or they buy the high-speed phone option if it is available. I had a tenant whose only reason for renting in my building was to have phone & high-speed service for her work.”

C.W., Rural entrepreneur

spread interest and uptake (Brown et al 2002, Dimmick et al 2003, Grimes 2003, Mason 2004, Strover et al 2004).

5.2.2 Policy and regulation

A second role for government concerns policy and regulation. Governments need to champion the widespread creation of ICT infrastructure as a national priority (Frieden 2005). Over the long term, market forces may lead to greater access to ICTs in rural and remote areas, but regulation may be necessary to speed or force the extension of service to some communities or areas (Bright 2001, Crow and Longford 2007). Another area of particular interest to rural and remote communities is that of markets and price setting, especially in areas where competition or choice among ICT service providers does not exist to help regulate prices (Cave 2006, Picot and Wernick 2007). In both situations, flexibility in regulations to allow adaptation to local conditions is important (Hoplight Tapia et al 2009). In addition to general regulatory interests in internet privacy, rural users of telehealth services have particular concerns that need to be taken into account (Schopp et al 2006). Federal policies should also ensure that the cultural interests of First Nations communities are protected and supported as ICT use becomes more common in their communities (Alexander 2001).

5.2.3 Local community involvement

Given the absence of one-size-fits-all solutions, rural community members and leaders need to actively participate in ICT programs and initiatives (Bright 2001, Jacob and Herselman 2006, Ramirez 2003). Local institutions and structures play an important role in shaping both ICT access and uptake, and in some instances communities may form their own organizations or businesses to develop their own services (Cameron et al 2005, Hollifield 2003). This is particularly important in First Nations communities, where ICT services need to be delivered in a culturally sensitive way (Jennett et al 2004). Understanding how local users perceive and are likely to use ICT programs designed for them will increase their chances of successful implementation (Poscente 2006, Ramirez et al 2005). Communities with strong local leadership and vocal champions for ICT programs tend to be those most successful in obtaining and taking advantage of them (Leatherman 2000). Active involvement of the local community helps reduce the potential for households or groups to be left out or marginalized by new technologies (Mansell 1999). It should be noted that these findings about the importance of rural community engagement are not unique to North America, but have been observed in Europe and Australia as well (Bahaadini et al 2009, Hearn 2005, Huggins 2002, Lennie 2005, Prestona 2007, Richards 2004, Rooksby et al 2002, Simpson 2005, Watson et al 2001).

Government partnerships

“Several years ago, the local municipalities started to lobby senior government about the need for economical ICTs. In the past year, through infrastructure funding and local government insistence, an out-of-province company was contracted to install an affordable Wi-Fi system though the area. They have done a good job providing a higher speed access than previously available through the use of satellite.”

I.B., Rural ISP associate

“Until 2008 we were restricted to dial-up service. Our county government has undertaken a program to provide broadband across the county in partnership with a private company. Without this initiative we would still be on dial-up or very expensive satellite service.”

S.G., Farm operator

6. Survey of government activities relating to ICT access and uptake in rural and remote communities

A survey of government reports from Canada and abroad reinforces the need for a national strategy on the digital economy. Australia, the UK and the US already have well-established national strategies, policies and programs to provide high-speed internet and wireless services to all residents, including those residing in rural and remote areas. In Canada, similar statements of intent and plans of action have been developed by provincial governments, but at the federal level a coherent and consistent policy for delivery of ICTs to rural and remote areas is not evident. The survey of government reports also found that the benefits, barriers and opportunities identified in the preceding sections of this synthesis report have been recognized or experienced by provincial and federal governments to varying degrees.

6.1 Provincial and territorial governments

All provincial governments in Atlantic Canada have published documents providing clear policy statements to deliver ICTs to all rural and remote communities as part of broader provincial social and economic development strategies. The preferred model for delivering infrastructure in the Atlantic provinces appears to be public-private partnerships. Newfoundland and Labrador has been the source of a number of well-researched academic and government reports consulted in this knowledge synthesis review. The Newfoundland government summarizes its keys to successful ICT implementation in rural and remote areas as strong leadership at the provincial level, strategic planning to meet particular regional or local needs, and federal government participation and funding partnership.

The governments of Ontario and Quebec have also initiated programs to deliver rural broadband and wireless, although not with the clear intent of universal access that has been set out in Atlantic Canada. Ontario seeks public-private partnerships where possible, and aims to provide ICT infrastructure in northern Ontario while improving existing ICT service in rural southern and eastern Ontario. The Ontario government casts these as both improvements to provincial infrastructure and investments in building skills and literacy. The government of Quebec has in recent years published studies on the potential role of ICTs in rural business and on the ability to deliver medical health care specialty services such as psychiatry, rehabilitation and pathology via broadband.

Manitoba and Saskatchewan have set provincial goals of providing broadband/high-speed internet service to all residents; Saskatchewan also targets providing 98% of its residents with wireless service. Again, these strategies are cast within more broadly stated provincial innovation and development plans. Alberta, with its

More on quality of life...

“In the last 6 months we bought an iPhone and got access to the internet through the phone. This has meant that we can check email from home. It has allowed my spouse increased communication with family and friends, as we live a few hours from them. This increased connection has meant a lot to us.”

J.H., Rural educator.

“We use e-mail to stay in touch with family and friends far and wide. This is no different than for urban people but it does seem to reduce the feeling of being isolated in a rural setting, particularly if you come from an urban setting.”

S.G., Farm operator

SuperNet program to connect rural schools and community centres, was an early leader in bringing internet services to rural and remote communities using public-private partnerships. Alberta is also the province with the greatest emphasis on developing human capital in addition to building infrastructure as part of its stated ICT strategy. The British Columbia government is pursuing a variety of public-private partnerships involving multiple stakeholders to bring ICTs to rural areas through its Connecting Communities and Bridging the Digital Divide and Network BC initiatives. The Network BC initiative specifically targets small communities by providing grants of up to \$50,000 to build local broadband infrastructure. In an October 2010 press release, the BC government reports 93% of its residents have access to high-speed internet.

While most provincial governments have published strategies and identified particular ministries/organizations to guide the expansion of ICT access, the public information readily available suggests Canada's three territorial governments are less advanced in this regard. The territories have, however, been a focus of the federal government's Broadband for Rural and Northern Development Pilot Program and the National Satellite Initiative launched in 2002-2003. Internet access across the north varies by territory; with 90% of Yukon households having had access to the Internet by 2003, while only 50% of Nunavut households had access as of 2008 (Christopher and Fast 2008). The Yukon and Northwest Territories have high rates of school computers connected to the Internet (96%), comparable to rates in leading provinces, while Nunavut's school connection rates have lagged at 88% (Ertl and Plante 2004).

6.2 Federal governments: Canada, Australia, UK, US

At the national level, Industry Canada has been the lead department for policy and federal funding for ICT development in Canada. In 2006 statements on the digital economy, Industry Canada emphasized the importance of relying on market forces to provide ICT infrastructure to Canadians, and the importance of using regulation and public involvement judiciously. Industry Canada's Community Access Program (CAP) helped support partnerships in bringing internet service to Canadian communities, and one reviewer of this report observed that CAP support was important to the initial establishment of a local internet service provider (ISP) in his rural area. Such an approach has helped many provide many Canadians with high quality ICT service, but has not ensured their delivery to all rural and remote communities. In 2010 Industry Canada announced more targeted funding opportunities for rural and remote communities through its Connecting Rural Canadians program. Those eligible for support from this new program include private sector companies and consortia, not-for-profit organizations, and provincial and territorial agencies. Other federal departments and agencies, such as Heritage Canada and the Office for Official Languages, play significant roles in ICT policy. The Canadian Radio-television and Telecommunications Commission (CRTC) has

Partnerships across governments

“Since 2004, with assistance from the Industry Canada CAP a local organization has been able to provide higher speed, wireless access to large parts of the community through the use of satellite technology and metered routing at four access points in our county.

A partnership between the local school board and the nearest large city has provided higher speed Wi-Fi access to several schools in our area. The plan also provided Wi-Fi access to the local population adjacent to the schools, and has been expanded through federal infrastructure funding to include intermediate antennas which push the internet signal to a potential of 85% of the local residents.”

I.B., Rural ISP associate

regulatory authority for communications technologies in Canada, and at time of writing is conducting public hearings into provision of broadband services to rural and remote communities.

Federal ICT policies and programming in Canada are considerably different from those in other developed nations facing similar challenges in engaging rural and remote communities in the digital economy. Australia has a well-developed, cohesive national strategy to deliver ICTs to all Australians, and established a dedicated federal Department for Broadband, Communications and the Digital Economy. The Australian government identified eight federal programs critical to its national digital economy strategy, and through an umbrella program supports infrastructure development, frontline services, and corporate systems and information. State governments are actively involved in developing the ICT-based delivery of critical services such as telehealth. A national Indigenous Connections Program within the Department for Broadband is dedicated to providing broadband service and computer training to aboriginal communities. The Australian strategy recognizes the barriers and opportunities described in the previous sections of this synthesis, and provides a useful place to look for comparative public policy analysis in the future.

The United Kingdom, through its Digital Britain strategy, seeks universal broadband internet access within the UK by 2012, with an aim to upgrade bandwidth and digital radio service by 2015. The UK government's strategies also include initiatives to accelerate wireless coverage and services and laws to combat digital piracy. These objectives are seen as part of a broader strategy to create a favourable climate for investment and innovation in digital content applications and services, provide a high range of public service content, and to better develop the nation's digital skills at all levels.

The United States National Broadband Plan seeks to bring internet to tens of millions of Americans who lack access at home and contains detailed strategies for achieving affordability and maximizing the use of broadband. The US Department of Agriculture is heavily involved in delivering programs that target rural residents lacking broadband access and skills. In addition to broader goals of social and economic development, the US program includes objectives not found in those of other governments, such as advancing consumer welfare, public safety, and homeland security.

7. Research needs and gaps

The authors and studies cited previously in this synthesis report identify a number of directions for future research relevant to rural and remote communities. The first of these is the need to develop better ways of quantifying the actual economic and social benefits generated by the introduction of ICTs into rural and remote

ICTs and tourism economies

“Visitors and seasonal residents often have to rush back to their urban workplaces during the summer months because they can't work from the cottage. Satellite broadband is often the only option, and it's too expensive and too unreliable to be an option for work. Some go to local libraries to check email because cell networks haven't been available. Often it's just easier to hop in the car and head back to the city. Shorter stays mean less income for local businesses and restaurants.”

K.H., Rural business owner

communities (Pigg and Crank 2004, Ramirez 2005, Ungerleider 2002). There is a clear tendency in scholarly literature and in government reports to offer very normative and sweeping descriptions of the benefits of ICTs that are not directly supported by empirical research. Parkinson and Ramirez (2006) observed that ICT programs are often pursued and implemented using simple assumptions that predictable, positive benefits will inevitably follow. Indeed, it is possible not all impacts on a given community will be positive, further underlying the importance of quantifying results and finding standardized procedures for doing so (O'Neill 2002, Ramirez 2005). Particular attention should be given to the cultural impacts of ICTs in First Nation communities (Lemelin et al 2010). A related issue that warrants greater measurement and quantification is the social and economic impacts on communities that fail to acquire ICTs (Sciadas 2002, Selwyn 2003, Warren 2007).

A second area where future research is encouraged relates to the processes of implementation and adoption of ICTs in rural communities. Based on research in Alberta, Jennett et al (2005) suggest that more research is needed to identify the differences in e-readiness of various sectors of the economy and society, a suggestion Mutula and van Brakel (2006) feel warrants more attention in the field of information science generally. Donnemeyer (2003) notes that studies need to better incorporate the range of characteristics of potential adopters and the multiple types of economic structures possible at the community level. Duffy-Deno (2003) notes that more research is needed on price elasticity with respect to broadband service; this review did not encounter any studies that have done this in the context of rural and remote communities. Middleton and Sorensen (2005) note that statistics about ICT use are often based on household level data, which masks differences in adoption and use within households. More study is needed on how best to incorporate ICTs into participatory planning in rural communities (Ramirez 2007). Research continues to be done on delivering tele-education and telehealth to rural and remote areas, including very detailed applications such as using the internet to conduct hearing tests (Lancaster et al 2008). Sawada et al (2006) found that GIS can be used to identify broadband and wireless service and needs in remote communities; in other words, one type of ICT can be used to identify needs with respect to other ICTs.

In conducting the research for this literature review, two particular knowledge gaps stood out to the authors. The first of these relates to sustainable development. As identified in section 1 above, sustainable development is traditionally considered to be based on the integration of economic, social and environmental considerations into decision-making, policies and programming. The studies we uncovered tended to focus on broad-brush economic considerations with respect to ICT connectivity in rural and remote communities and /or the social implications. Some studies were framed in the context of sustainable development, others in the context of the broader context of rural development. With the exception of studies involving

ICTs & sustainable farm businesses

“High-speed internet at home increases my access to more affluent urban customers for my higher-end food products. This enables me to continue producing food and raising rare breed livestock in a way that is sustainable, promotes biodiversity, and benefits my community by allowing me to sell my products at my local market at prices keeping with the socio-economic reality of our community.”

F.M., Local food producer

“In the early 1990s we were asked if we would be interested in a website to showcase some of our new farm products. We were just starting to use email on a regular basis and the web was new to us. A week later we got an email order from Los Angeles. We knew at that point we had found a wonderful tool in the Internet.”

K.H., Rural business owner

Ramirez (2003; with Parkinson 2006), our knowledge synthesis research did not uncover examples of research that explicitly considered the environmental implications of ICT connectivity in rural and remote communities in Canada. This was somewhat unexpected, given that ICTs play an important role in agriculture and in the exploration, extraction, production and sale of natural resource products, on which the economies of rural and remote communities are often based (Ramirez 2003, Wang et al 2006). ICTs are also increasingly used in environmental management applications, such as watershed management, forestry, hazard detection and so forth, subjects again of particular importance to rural and remote communities (Lee et al 2007, Pahl-Wostl 2007). Yet, the linkages and interconnections between ICTs and the economic, environmental, and social components of sustainable development are clearly under-explored in the Canadian context. Given the Government of Canada's recent launching of a new Federal Sustainable Development Strategy for Canada, this would appear to be an important opportunity for targeted public policy research to potentially link it with the Digital Economy strategy.

A second gap in existing knowledge concerns the incorporation of ICTs in the building of adaptive capacity in Canadian rural and remote communities with respect to global environmental changes. In international literature, potential opportunities for ICTs in adaptation are already starting to be identified (Cooper et al 2008, Ospina and Heeks 2010). Natural Resources Canada has explicitly identified the need for Canadians to begin developing tools for adaptation given the emerging impacts of climate change in many regions of Canada (Lemmen et al 2008). Some examples exist of rural and remote communities deliberately harnessing new ICTs as part of their adaptation strategies, most notably the incorporation of satellite phones, global positioning systems devices and other ICTs into Inuit hunting practices (Ford et al 2006). Research is clearly needed to explicitly identify the role ICTs may play in adaptive capacity building, and the processes by which ICTs may be incorporated into rural adaptation planning.

The reviewers of this report also had useful observations about future research needs. One reviewer, an agricultural producer who markets and sells his products directly to urban consumers, observed that additional research is warranted into the ways in which linkages between rural producers and urban populations are enhanced through on-line shopping, web sites, web-based mapping, You Tube, Twitter and so forth. This same reviewer also suggested more detailed research be done on the micro-economic costs to rural users of ICT services and their role as a deterrent to access and uptake. Other reviewers made comments along similar lines.

A reviewer who was raised in a rural area and now attends university in an urban centre questioned the accuracy of research findings that women are often disadvantaged in terms of ICT access in rural areas or are slow adopters. In her

Are we ready to adapt?

“As a prosperous country with high levels of education, access to technology, and strong and effective institutions, Canada is well positioned to take action on adapting to climate change. However, there are significant differences in the ability to adapt among different subregions and population groups...”

Natural Resources Canada report on adapting to climate change in Canada (Lemmen et al 2008, 13)

“It amazes me when I see on TV people in a village somewhere in Africa using their laptops and cellphones. I don't begrudge them, I just wonder why we can't have that here.”

A.B., parent & community leader

community she observes the opposite trend, and that men are more typically engaged in outdoor jobs while women have high rates of employment in office and service industry environments where computer use is common. She also suggests caution about research findings that suggest ICTs are positive in terms of rural social connectivity, and that there is an opportunity costs when individuals increase their amount of time spent on-line. Given that social capital in rural and remote communities is strongly dependent on ongoing personal contact between residents, this does indeed seem a good area for future research. The comments of this reviewer about women and ICTs, along with comments from her and other reviewers that not all rural communities are the same in their demographic characteristics, serve as an important reminder to researchers and policymakers to be cautious about making broad-based assumptions about rural and remote communities.

A reviewer who works as an IT specialist and planner for a rural municipality indicated he is not surprised that the relationship between ICTs and environmental sustainability has not been studied in rural Canada, partly because of the inadequate penetration of ICTs in rural areas to study, and that understanding of the economic, environmental, and social implications will be speculative until more comprehensive ICT access throughout Canada is established.

8. Conclusions

ICTs have a significant role to play in building sustainable communities in Canada's rural and remote areas through enhancing the economic and social well-being of individuals, households and businesses and facilitating the building of capacity to adapt to rapidly emerging environmental changes. Existing research shows that providing rural and remote communities access to latest-generation ICTs generates significant economic benefits by providing agricultural producers with timely information for operational planning, increasing the efficiency of rural manufacturing and connecting small businesses to a wider range of potential suppliers and markets. These in turn translate into greater employment and incomes, enhancing local, regional and national economic well-being and innovation. Significant social benefits are also realized through the delivery of ICT-tailored content such as telehealth and tele-education, and emergency preparedness and response in rural and remote areas are enhanced. Social relations and social capital are strengthened, and particular benefits emerge through the empowerment of aboriginal and rural youth, providing them with valuable workforce skills and social connectivity. The combined economic and social benefits strengthen the quality of life and attractiveness of rural and remote communities.

Despite these benefits, many rural and remote communities lack access to ICTs, particularly terrestrial broadband and wireless networks. Low population densities

ICTs and environmental sustainability

“In terms of the environmental implications of ICT connectivity, at first I had a hard time identifying examples. But since my entire lifestyle is based on interacting with the natural environment and on sustainable community development, I quickly saw there were a variety of benefits. Being able to use the internet to carry out such functions as banking, library loan requests, and gathering information for our rural tasks and home-schooling, means that I no longer have to burn fossil fuels on a 2 hour round trip to town to carry out such tasks.”

F.M., Local food producer

and diffuse demand make broadband and wireless service provision to rural and remote areas less profitable for private companies than are urban and suburban markets. A variety of options exist for expanding access into underserved areas, including demand aggregation, regulation, public-private partnerships, and publicly built infrastructure. Research suggests that employing a mixture of options may be necessary to achieve universal access. Once access is provided, measures need to be in place to facilitate the adoption and use of new technologies and ICT-based content. Rural and remote populations have lower levels of ICT-readiness and ICT-literacy than urban populations, and may therefore require higher levels of technical training, support and ongoing promotion to achieve levels of uptake comparable to those in urban centres.

Governments have important roles to play in expanding both ICT access and uptake in rural and remote areas of Canada. Unlike key international competitors such as Australia, the UK and the US, Canada has lacked a coherent national strategy for extending the benefits of the digital economy to all citizens. Provincial governments in Atlantic Canada and the Prairies have established explicit goals of providing broadband to all residents, and have been working toward this through a range of public-private initiatives. Canada's three largest provinces in size and population – BC, Ontario and Quebec – do not have explicit targets of universal access, but have undertaken various public and public-private initiatives to expand ICT services substantially in rural and remote communities.

Additional future research is needed to quantify the long-term economic and social effects that ICT access has on rural and remote communities, and to develop appropriate implementation strategies to ensure that benefits are maximized. There is also a need for research that makes more direct connections and linkages between ICTs and environmental sustainability and adaptive capacity building in rural and remote communities. Readers of this knowledge synthesis interested in more details on the impacts of ICTs on Canada's First Nations communities, many of which are located in remote or rural areas, are encouraged to consult a companion knowledge synthesis *Toward an Aboriginal Connectivity Strategy (TACS)*, available at <http://www.sfu.ca/cprost/tacs.html>

The net result

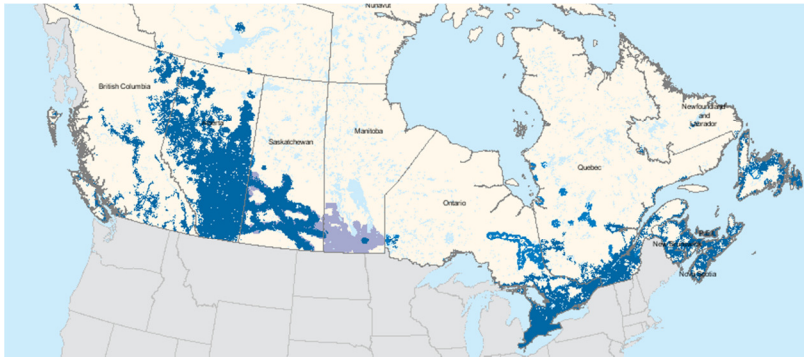
“Encouraging more businesses here will require more ICT access. Until it's solidly in place, I anticipate no change in development in this area. Even though this area is less expensive to live in, no organization would consider re-locating here because we are so disconnected from the rest of the province, the country & the world.”

C.W., Rural entrepreneur

“I strongly believe the benefits of ICTs far outweigh any negative impacts. Sure new technology is sometimes misused, but I think that is a separate issue. I am certain that technology increases the efficiency and ability for an individual or team to perform a tremendous amount of tasks that are highly beneficial to society and economies. Overall, this positively reinforces innovation and further develops our economy.”

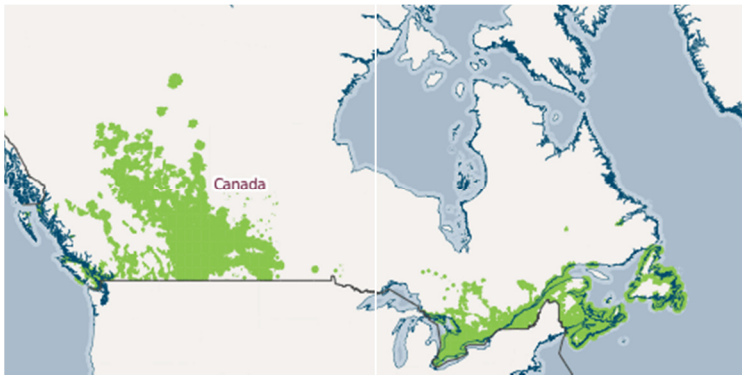
E.S., Rural ICT/GIS specialist

Appendix I: High-speed wireless telephone service in Canada
Bell 3G/high-speed wireless telephone service as of October 2010



Source: [http://support.bell.ca/en-on/Mobility/Network_coverage/What is the Bell network coverage in Canada](http://support.bell.ca/en-on/Mobility/Network_coverage/What_is_the_Bell_network_coverage_in_Canada)

Telus 3G/high-speed wireless telephone service as of October 2010



Source: <http://www.telusmobility.com/en/AB/coverage/index.shtml>

Rogers 3G/high-speed wireless telephone service as of October 2010



Source: http://www.rogers.com/web/content/wireless_network

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