CHAPTER 8

The Future of Open Data is Rural

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Abstract

Open data advocates and businesses looking to capitalize on open government data envision a seamless data layer interoperable across subnational levels of government. Most research into open data has focused on urban centres because cities represent significant sources of government data. That same research is not conducted in rural areas. We argue that an urban vision of open data has shaped rural open data and look at four areas of urban–rural difference regarding open data: technical capacity (from relatively fewer government resources and availability of local skills), motivations (e.g., related to hazards and emergency preparedness), datasets and analysis (largely due to remotely sensed imagery), and jurisdictionality. A better understanding of issues would allow rural communities to anticipate challenges and opportunities. By advancing the conversation around open data, we can increase the likelihood that rural communities, and those interested in rural issues, can access open data to similar extents as in urban areas.

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We are enmeshed in an "open" culture, whether applied to science, software, or government data. Open government data promise to spur economic development, ensure accountability of government practices, and induce government-to-government collaboration (Sieber & Johnson, 2015). The rhetoric is also seamlessly geographic. In other words, government data should be available across the entirety of the landscape whether federal or municipal, urban or rural.

Most research into open data has focused on large urban centres because cities represent significant sources of government data and because cities claim the largest concentrations of populations. That same research is not conducted in rural areas; the notion of open data, then, has been shaped by how we know urban data. This means we have a particular lens through which we understand technical capacity, motivations for opening data, required datasets and analysis, as well as the role of local vis-à-vis other levels of government. As the European Data Portal Consortium (2020, p. 6) reminds us, we need to resist the perception that all that is required is to transplant urban open data practices to rural areas. An urban open data lens may be inappropriate for rural areas.

Canada is ideal for exploring the differences in a developed economy in terms of rural and urban open data provision because of the country's large size and steep population gradient. When compared to Canadian urban centres, rural and remote communities have a much lower population density, with mountains, forests, and farmland taking the place of buildings and tightly packed road networks. Rural is defined by Statistics Canada as those parts of the country "that remain after the delineation of population centres using current population data" (du Plessis et al., 2002; cf. Statistics Canada, 2019). Aside from those gaps compared to the urban or metropolitan region "fabric," lower population densities in rural jurisdictions result in fewer resources financed through taxes, which in turn make it difficult to adopt the same level of data-management technology as found in large, densely populated communities, such as metro Vancouver or Toronto. We argue that, whereas some layers of spatial data used for planning or decision-making are common to rural communities and larger urban regions such as parcel fabric data or road network data, a much more significant non-residential part of rural regions requires different types of data than urban areas. This includes data about resources, including ecosystems, fish and wildlife, forests, soils, and

minerals; it also includes data about threats, including terrain hazards and forest fuel loads (Schaffers et al., 2011). Although some Canada-wide datasets exist in open formats, the data often cover the entire country at a coarse spatial scale: smaller (i.e., higher) resolution data are required for local decision-making or research within rural towns or regions.

Relative to rural areas, urban centres often have the resources and capacity to experiment with different methods for providing open data (Gurstein, 2011; Ruijer & Meijer, 2020). By understanding which issues may be specific to making data open in rural communities, rural government/agencies can better anticipate issues when following urban models and develop successful and efficient data-collection and -sharing platforms. Rural open data policies and programs are not yet well developed, and little information is available on the successes and challenges of communities that have taken on this task. By advancing the conversation around open data, supporting the development of a governance structure and finding ways to reduce costs of open data delivery through standardization and process optimization, we can increase the likelihood that rural communities can one day have access to open data in the same way that citizens in larger urban centres do today.

We will discuss how differences between rural and urban places lead to differences in how open data are produced and consumed. This in turn challenges government policy that seeks to provide equivalent levels of service across the nation or province/state. Since most people in Canada live in urban areas, these differences may be overlooked in assessments of open data policy or practice. For instance, most research into open data has focused on the national, subnational, or large metropolitan levels of government, with little consideration of the unique characteristics of rural areas like those in Canada. In this chapter we will introduce important rurally specific issues to the future of open data, with examples drawn from experiences in rural British Columbia.

1. Explicating the Assumptions of Open Data

Before we begin unearthing the assumptions of urban open data and their impacts on rural open data, it is important to affirm the difficulty in arriving at a single definition of rural. The delineation between urban and rural areas in Canada has been defined in many

ways, including at least six by Statistics Canada (2015), the organization responsible for statutory national demographic information. Rural areas can be defined by distance from a population centre, population size or density, and also sociologically, for instance, by people or places that have a rural culture. According to a more recent Statistics Canada (2019) definition, rural includes small towns and villages with a population of fewer than one thousand, agricultural lands, wilderness, and remote areas. "Rural" even includes relatively unpopulated regions within metropolitan areas and census agglomerations. Statistical definitions of rural effectively can be antonymic: rural becomes the opposite of urban and we discuss the effects of this framing later. Rurality can also be expressed as a site of imagination, "connected with all types of cultural meanings, ranging from the idyllic to the oppressive, and as a material object of lifestyle desire for some people—a place to move to, farm in, visit for a vacation, encounter different forms of nature, and generally practise alternatives to the city" (Cloke, 2006, p. 18).

Rural areas can be distinguished from urban areas by their landscape. Whereas the urban landscape is dominated by the built environment, such as road networks, buildings, and utility lines, the rural landscape is dominated by relatively natural features, like fields, forests, lakes, and mountains. A rural region may have cities or towns embedded within it, and most people may live in these centres; however, it is the matrix around and between these communities that for the most part defines rurality. This is reflected in the English term "countryside" for rural areas (McCarthy, 2008). Rural communities require similar data as larger urban centres for community planning and service delivery but also need information about the matrix around communities, for instance about natural resources.

Rurality suggests a dormant or static resource-based economy like agriculture or forestry. However, rural areas have experienced considerable economic restructuring (Ryser & Halseth, 2010; Halseth & Ryser, 2018). Restructuring has been led by increased mobility of capital and diseconomies of scale that penalize large industries (e.g., with rising energy costs), labour-shedding technologies that enable short-term or "on demand" work, and upskilling of resource jobs (for "tech-enabled resource industries"). Halseth and Ryser (2018) argue that this restructuring has led to a declining tax base and a decline in responsiveness to innovation and change more generally, precisely what is required to create the infrastructures necessary for open data.

Rural governments also rely heavily on government revenue. This "reliance on government support can create inefficiencies and dependence . . . as well as false expectations surrounding the viability of some rural economies" (Ryser & Halseth, 2010, p. 514). All this, as we will argue, does not bode well for rural open data.

Ultimately, where it concerns rurality, we find du Plessis et al.'s (2002, p. 4) argument persuasive. Rural-policy analysts often start with the question: "What is the size of the rural population?" We suggest that an appropriate response is: "The answer depends upon the issue you are addressing. Why are you asking?" This is supported by research using several open data sources in Tanzania to define "rural" that showed different definitions could change the value of economic-development indicators for some places and, consequently, affect policy decisions (Wineman et al., 2020).

For us, the "why are you asking" provokes three questions specific to open data. Do the characterizations of rurality align with open data? Do the assumptions, which largely originate within urban areas, fit with rural experiences? And can the conditions of rural areas support and benefit from open data?

1.1 Technical Capacity Limits Rural Open Data Development and Sustainability

Open data is recognized for its potential to create new jobs as part of the knowledge economy and increase data literacy. Probably the most evident difference between rural and urban areas concerns access to technical capacity. Lack of technical capacity represents a long-standing problem in rural areas, characterized by stark income differentials, lack of formal education, comparatively lower literacy and numeracy levels, out-migration of individuals with skills, inability of governments to match salaries for jobs requiring technical expertise, the lack of specialization and professionalization (which may mean governments must hire non-professionals in these roles), and the workload on government employees that may limit time for training in new technologies (Brown, 1980; Zarifa et al., 2019). Contrast the gaps with an increasing digitization of government services, a development for which rural people are disadvantaged relative to the skills and access required to use tools such as e-government. Conversely, technological innovations can reduce physical travel time, isolation, and lack of awareness, which historically have been barriers to ICTs

(Huggins & Izushi, 2002; Spicer et al., 2021). Rural areas are realizing that they need to overcome this technical divide and become digital. Open data is one pathway to this transformation.

It is possible for rural areas to marshal the skills necessary to open up data. The county of North Frontenac, Ontario, with a population of fewer than 2,000 people as of Canada's 2016 census, implemented an open data portal. Should a region acquire the skills necessary for implementation, they may still lack the skills for sustainability. North Frontenac's portal went through a period of two years without updates, although the site was revived in 2020. Timeliness (or the lack of) of open data updates represents an important indicator of the viability of a government's open data initiative (Zuiderwijk et al., 2012).

Technical capacity assumes that all the activities involved in opening the data (e.g., data standardization, privacy protection, database handling, portal construction, firewalls, backups) must be handled in-house. Regions can rely on open data-portal firms like Socrata; North Frontenac relies on Esri. Reliance on the private sector could speed up or increase access to rural open data so the demand-side benefits would likely accrue earlier than through developing in-house supply capacity (Johnson et al., 2017). Although this removes technical barriers, it comes at the expense of paying for an ongoing subscription or a supplier's understanding of local regulations.

Prerequisites for open data include not only data handling but the infrastructure needed to support the data, like Internet broadband. Rural access to broadband has long lagged behind urban access, despite being considered a key driver of sustainable economic growth (Lennie et al., 2005; Grimes, 1992). Indeed, much of the literature on ICTs in rural economic development continues to focus on broadband access. The rollout of broadband Internet by the private sector has disadvantaged rural communities, since denser populations provide richer paybacks to broadband investors (Salemink et al., 2017). This was recognized and partially addressed in Canada by programs like Industry Canada's "Connecting Canadians" initiative (Government of Canada, 2020); yet as of 2020, 16% of rural Canadians, or approximately 6 million people, still lacked sufficient broadband access (Canadian Internet Registration Authority, 2020). Since the COVID-19 pandemic, when individuals, governments and firms needed greater access, the gap between urban and rural in Canada has widened. Speeds for rural download were 12 times slower compared to urban areas and upload speeds were 10 times slower (Canadian Internet

Registration Authority, 2020; Carra 2020). Like many others, Malecki (2003) notes that broadband costs far more in rural areas and methods are lacking to accommodate that cost. In Canada, the minimum price for broadband can be twice as much in rural versus urban areas (CRTC, 2020).

The nature of open data actually makes identifying end users quite difficult. A dataset may be downloaded once from a government data portal yet used in an app by thousands of consumers (Chan et al., 2016). Less is known about rural users of open data. The Regional District of East Kootenay reports that the largest users of their open data catalogue are hunters seeking information on private versus Crown land during the fall hunting season, as hunting is generally only permitted on public land (Nicole Jung, personal communication, 2017). In many cases, these users are coming from more urban places and so their usage is not necessarily indicative of the needs of rural users. Lacking knowledge of users' abilities renders capacity building quite difficult.

Technical capacity for data handling and making sense of the data are not necessarily resolved in urban areas. Information intermediaries, hackathons, and open data "book clubs" have emerged to increase open data literacy (Johnson & Robinson, 2014; Chan et al., 2016; Montes & Slater, 2019). These initiatives, which are often homegrown, also serve to create value from the data by developing applications or performing simple statistics (e.g., bivariate comparisons, averages, and counts). Whether due, for example, to lack of local technical knowledge or sheer lack of numbers of people, these initiatives are far less likely in rural areas. It should be noted that rural areas are not completely bereft of tech innovation and skills. Farming, with its use of drones, precision agriculture, and artificial intelligence for pest and drought detection, certainly challenges our stereotypes of technology deficits in rural areas (Shearmur et al., 2020).

A neoliberal strain runs through the rhetoric of technical capacity, which urban areas may be better equipped than rural areas to accommodate. Namely, digital literacy is the responsibility of the citizen or is downloaded from higher to lower levels of government. Open data embeds assumptions of the citizen as do-it-yourself technical entrepreneur, where digital divides suggest these might be lacking. It also suggests a method for higher levels of governments to relieve themselves of responsibility for capacity development. As Ryser and Halseth (2010, p. 518) report:

> Once grounded in top-down planning and support, bottom-up approaches to rural economic development have emerged since the 1980s. . . . A concern about the shift to bottom-up approaches is that they are driven by government preferences to off-load responsibilities to rural places with limited capacity and inadequate funding.

This is accompanied by similar neoliberal goals of replacing government functions with the private sector. Rural areas may be more vulnerable to corporate capture than urban areas.

Finally, we often forget that open data assumes an abstraction of government data as an end in itself and not merely a means to an end (e.g., in support of a specific policy). Pinto and Onsrud (1995) wrote about the evolution in thinking about government data produced by geographic information systems (GIS). Increasingly, valuation of that data shifted from evidentiary material to support decision-making to an end product that could be sold or repurposed. Cities, in their GIS departments, likely have greater awareness that they are creating data-as-product because they have customers for that data; for example, other municipal departments or the private sector. A rural community may encounter this abstraction less often; instead, the focus may be on the production of reports limited to a single instance. This may explain the higher percentage of less usable formats such as PDF files in rural open data portals compared to urban data portals (European Data Portal Consortium, 2020). It is not until data are realized as an end product that they can be reused or revalued to become the basis for a new-economy value chain.

1.2 Motivations/Goals Underlying Opening Data Are Different for Rural Areas

In this chapter, we primarily consider open data for rural areas in the Global North. Most literature on open data for rural areas covers the developing world—the Global South (e.g., Davies & Perini, 2016; Schaap et. al., 2019). That literature begins with the assumption that open data is a natural good, where the primary motivations for open data emphasize greater transparency, with the goal of improving the lives of people and reducing corruption (Leone, 2015; Verhulst & Young, 2017). In this regard, the literature reflects some degree of paternalism and colonialism, in the sense that open data proponents

in the Global North (e.g., developers of open data standards and apps) believe that transparency of data in the Global South can both reveal and reduce rampant corruption (Serwadda et al., 2018). For rural areas in the Global North, the motivation for open data is less focused on detecting corruption and more on addressing power imbalances between citizen groups and extractive industries, or on economic development. Rather than lofty rhetoric linking open data to democratic principles of transparency or government accountability, the goals tend toward evening the playing field in land-use decisions or the transactional on the economic-development side. Motivations also include assisting other levels of government, like provincial agencies to enhance forestry management, ensure emergency preparedness, increase biological conservation, improve agricultural practices. A goal of open data could also be in assisting international firms to decide on, for example mining operations.

Our research on Canadian cities found that internal business intelligence is listed as an important motivation for opening up urban data (Sieber & Johnson, 2015). That is, data structured to be available to the private sector and the general public can be just as easily used by units within the public sector. Use by units in government, however, implies a certain degree of extant professionalization, including knowledge of privacy protection—especially as data fusion allows for considerable opportunities for reidentification. Utility by other governmental units implies understanding of licensing, use of standardized classification systems, and even file-naming and data organization. Huggins and Izushi (2002, p. 113) argue that "[t]his leaves most [rural] employees reliant upon 'teach-yourself' practices," an ad hoc and fragmented form of professionalization. Open data as business intelligence could help identify needs for data-handling expertise elsewhere in the organization. Open data becomes an entree for rural areas to conversations about data management and improved opportunities for data-driven or evidence-based policy.

The motivation for open data on the supply side can be as simple as efficiency and effectiveness gains, which are particularly crucial for low-resource rural governments. This could be reducing workloads in answering information requests at regional government offices or developing spatial data handling capacity at smaller municipalities (Tom Dool, personal communication, 2017). Initiatives aimed at building capacity in small communities can help identify whether the regional government should become the central service provider.

Tom Dool, a rural GIS expert, spoke about the multiple roles played by small community staff. The same person may be chief administrative officer, chief financial officer, and also be the entire Department of Public Works. He was concerned about the ability of individual communities to build capacity for GIS and other data systems while performing mission-critical activities like addressing aging roads and water infrastructure. Standardized open data across the region represents an additional hurdle for rural communities; at the same time, it can enhance regional integration of administrative effort, capacity building at all levels, and delivery of shared services.

Economic development represents a strong motivation in urban areas but the rhetoric plays out differently; in the case of urban areas, it is often driven by firms developing new data products, processes, or services. By contrast, rural open data seems to be a means to an end—the data serves a thematic purpose. The adoption (i.e., the usage) of open data we have seen in urban areas is driven in part by hackathons, where entrepreneurial individuals with the time, energy, and passion to play with data chase an end result that can be a product, like an app. Rural areas may see the hackathon as a luxury: economic development via entrepreneurs may be an existential need for rural areas. Malecki (2001, p. 61) recognized that "[s]uccess in the digital economy will depend on the role of entrepreneurs. . . . We cannot look at entrepreneurship in isolation from the demographics of rural America. In essence, it is a human capital issue—and a social capital issue."

1.3 Rural Areas Require a Different Mix of Data Sources and Different Methods of Analyses

Rural areas require a different mix of data from urban areas. Some data needs are common in all areas, including transportation, cadastre (parcel boundaries), flood, fire and debris-flow hazards, air and water quality, and utility data. Rural areas may rely even more than urban areas on these types of data––for example, bus or ride-sharing information—due to the infrequency of rural transit and the distance between home and services (Skerratt, 2018). In contrast to urban areas, rural areas show a greater need for environmental data, including rare and endangered biota, agriculture, and extractive resources, like timber, minerals, and oil and gas. Urban areas have been associated with increased rates of faunal and floral extinction (McKinney, 2002);

however, relatively natural rural and remote areas are identified as sites for conservation (Samson et al., 2004; Light, 2004). Jobs urban to rural differ as well: resource extraction, resource-based manufacturing, and resource trade comprise most rural employment in Canada (Bollman, 2000; Zarifa et al., 2019).

As we have indicated throughout the chapter, compared to urban areas, rural areas have less open data. Remote-sensing technologies like high-resolution multi- or hyper-spectral imagery, and lidar (light detection and ranging remote sensing) can be used along with image processing software to fill this gap. Lidar, in particular, has revolutionized terrain hazard mapping, forest-development planning, and forest inventories. The Internet of Things (IoT), a predominant feature of smart cities (Zanella et al., 2014), could play a role in improving rural information; for example, in generating more comprehensive data about climate, streamflow, or snowpack. A significant barrier to implementation of IoT in rural regions, especially mountainous regions, is connectivity. Data from IoT and lidar are often patchwork (e.g., when collected with drone- or airplane-based rather than satellite-based sensors). Adding to this patchwork is spatial scale (i.e., resolution). Data often cover the entire rural region at a coarse resolution; higher resolution data are required for local decision-making or research within towns and villages. The difference with urban-rural contexts is that data for urban areas tend to be offered at the same resolution ("scale"). In rural areas, a patchwork of data collected at different scales is more common, thereby increasing analysis costs.

Policy-making relies on multiple sources of data, like remote sensing and IoT, which suggests the need for open data originating from private sources, especially those datasets funded by government or captured on public land (in commonwealth countries, Crown lands). Even data originally collected by government, which have been the domain of national-level public-sector organizations like NASA for satellite imagery, are increasingly being produced by numerous private companies. Davies and Perini (2016, p. 153) observe that there is an

> embedded assumption … that the kinds of data that might be used to deliver on the promise of open data will be held by governments. Whilst strong and well-resourced states may have historically played an important role as nodal powers, with a

> monopoly on comprehensive data collection … a wide range of government, NGOs, international agency and private actors may be involved creating and holding relevant data.

The patchwork of potential rural open data persists even as more data becomes plentiful because imagery and IoT data are collected by firms for their own strategic purposes, are likely sold under restrictive data licences, or are simply too expensive to acquire.

Discussions of open data increasingly include data that are crowdsourced unofficially by non-experts. There is growing interest in harnessing the field knowledge and experience of hunters, ranchers, and other rural people to collect data about species (Boyce, 2017), ecosystems (Launspach & Bolgrien, 2016), or land use (Fritz et al., 2017). Given low population densities in rural areas, however, volunteer data monitoring and non-government-led data portals may not be sustainable over the long term. Conversely, crowdsourcing, especially if it is paid, is seen as attractive to rural residents because crowdsourcing can provide extra income, afford flexible hours, and allow for continued maintenance of a healthy work–life balance (Vasantha et al., 2014).

Skills related to open data provisioning emphasize analytics, standards, and data handling geared toward types of datasets used in cities or at national levels. Remote sensing poses very different data-handling requirements from urban data. These high-resolution point-cloud and pixel-based datasets generate very large files. By contrast, city datasets (e.g., budgeting, parks) tend to be quite compact (Currie, 2013). A rural region may necessitate hundreds of terabytes of lidar, for instance, which involve large data storage and high bandwidth transmission rates. Rural geographic datasets often require spatial simulation modelling and big data and machine-learning techniques to extract value. This data handling differs from the suite of technical skills typically acquired by open data staff. If they have any prior training, they likely have learned spreadsheets, markup languages (e.g., HTML, XML), or data-science techniques. Overall, the open data community focuses on these methods over remote sensing and pixel-based methods.

Differing motivations and data needs emerge when one examines types of portals for rural areas compared to urban areas. The Mackenzie Data Stream (https://mackenziedatastream.ca/) is an example of an open data portal developed around the theme of water

quality rather than developed around a jurisdiction like a city or province. This portal includes open data for the Northwest Territories as well as parts of northern British Columbia. Government standards and protocols like those from the Canadian Aquatic Biomonitoring Network (Environment Canada, 2021) help non-experts contribute to monitoring; the water portal then aggregates this standardized data so researchers or agencies can compare water quality across large areas and identify water-quality concerns. Rural sites rarely offer services beyond data aggregation. Edmonton's Citizen Dashboard is an instance of a portal now combined with analytics: their urban tool provides a range of real-time analytics related to the city's services (https://dashboard.edmonton.ca/). We anticipate that rural portals will take a trajectory similar to Edmonton's in expanding capacity.

1.4 Rural Open Data is More Likely to be Trans-Jurisdictional

We argue that rural open data is much more likely to be trans-jurisdictional than in urban areas. The concept of trans-jurisdictionality refers to activities that consistently engage multiple levels of government. These are situations in which the boundary between jurisdictions is blurred, for example in terms of responsibility of shared resources. Issues do not solely reside within a single jurisdictional boundary but cross "physical, administrative, discipline, social and political boundaries at all levels" (Gray et al., 2016, p. 4).

Much of the data used by urban areas are generated by those same urban areas, whether from surveys or other forms of data collection (cf. Currie, 2013). Even as urban areas in the developed world are considered the epitome of open data, there can still be variations across and within jurisdictions (e.g., in poor urban neighbourhoods; see Stephens, 2017). Compared to urban areas, rural areas depend upon an aggregation of data from multiple levels of government. This reflects interactions that are more likely to be vertical—unincorporated areas interacting with villages; villages with regional/municipal councils, provincial, and federal levels of government. In the Canadian province of British Columbia, rural regional councils rely on the province to supply datasets on, for example, land cover and "desirable or useful" amenities (e.g., libraries, schools, and hospitals). Outside of small, urbanized centres in rural areas, data required for planning are generated by other jurisdictions. Data control (e.g., in terms of licensing, standards, and updates) is retained by other jurisdictions.

Rural areas also are sites where the countryside occupies much more of the overall land base, and plays a larger role in economics, recreation, and in an identity more rooted in nature (Haartsen et al., 2003; Bell, 1992). Individuals regularly interact with other governmental levels, so rural areas need data from other levels of government. Rural jurisdictions tend to be physically large, and they often lack the resources to collect the data themselves; the data they need, of natural resources, say, are under the regulatory control of the province or the federal government.

Trans-jurisdictionality can benefit a rural community. Trans-jurisdictionality recognizes distinct roles for government data collection, including differential resources needed to collect those datasets; it reduces unnecessary duplication in data collection and publishing (Parfitt, 2017). Benefits are coupled with concerns. Open data is predicated on the principle that the data are open irrespective of their use and users. However, there is no guarantee that, for example, multiple jurisdictions share the same open data licence or terms of service. The Canadian Chamber of Commerce (2017) proposed that subnational governments (i.e., provinces, cities, villages) adopt a common open data licence because "the current landscape is marred by a patchwork of different and non-interoperable licenses, inconsistent adoption, and jurisdictional open data policies that, ironically, violate the key principles of open data." The patchwork will impede rural areas reliant on vertical trans-jurisdictionality. As stated above, even knowing the licences does not guarantee a dataset's release; a government may control the data but not own them, inducing "not only uncertainty as to the applicability of the license, but also ambiguity as to who has the final word in releasing the data" (Conradie & Choenniab, 2014, p. S14).

Beyond negotiating licensing agreements, a higher level of government may not wish to cede control. Ryser and Halseth (2010, p. 519) review the research that finds quite durable concentrations of power at higher levels of government: "Many senior governments seem reluctant to decentralize power to rural regions, and governments at a number of levels." To that end, "some governing bodies have removed the legislative tools that provided rural communities leverage to negotiate with corporations over local benefits or diversification opportunities" (Ryser & Halseth, 2010, p. 519). This questions the assumption among open data proponents that a locality has control over all the data it needs to function (e.g., for emergency preparedness or for natural-resources planning). The comparable example in urban

areas is with public-transportation data, which is held by a separate administrative entity or, increasingly, privately held by ride-sharing entities like Uber. Compared to rural areas, if data are necessary then the city collects and manages those data.

Parker (2000) wrote about rural broadband but the findings could just as easily apply to rural open data. As Parker (2000, pp. 286–287) observed: "Many Federal and state government agencies have data networks that reach into rural communities, but are dedicated exclusively to government use. . . . Those networks do serious harm to the economic health of rural communities." This suggests federal and state/provincial entities could consume any local capacities built for rural open data; for example, by hiring away skilled employees.

Simultaneously with limits imposed on rural communities' authority to tap into technical and other resources (Brown, 1980), cost-cutting at the federal and state/provincial levels since the 1980s has resulted in a downloading of responsibilities to the local level. In British Columbia, for instance, "wildland–urban interface" (where homes are built next to wilderness) wildfire planning now resides with local and regional government. The second author has experienced situations of jurisdictional confusion that were life-threatening: in one case of flooding, regional government looked to the province's river forecast centre to issue evacuation orders while the province argued that issuing evacuation orders was not its responsibility. Trans-jurisdictionality can also effect a delegation without resources to manage these new responsibilities, a situation that urban areas might be better equipped to absorb or counter.

A related challenge is one of "distantiation," in which decision-making, data production, and publishing are removed from the locality. This makes sense from a fiscal and expertise perspective—ICTs coupled with broadband can make centralized decision-making cheaper and more attractive (Halseth & Ryser, 2018). Centralization is promoted as a key metric of success in open data publishing in the Global South (Linders, 2013). While distantiation can reflect efficiency, it also can allow higher levels of government to divert resources more effectively to populous urban areas, for instance in an emergency. Even if individuals from different jurisdictional levels work alongside each other in an emergency, they are still subject to different organizational cultures, career trajectories, and reporting hierarchies. If local engagement and control of open data are prioritized, then open data production should not be distantiated.

Horizontal trans-jurisdictionality—relations among adjacent entities of approximately the same level of authority (e.g., city–city, city–village)—occurs in both urban and rural areas. Horizontal integration, where communities of similar size coordinate data provision and publishing, is especially crucial in rural areas due to extensive fragmentation of local authorities. It has long been noted that rural communities exhibit considerable fragmentation of authority, with the proliferation of non-school special districts, boards, commissions, and bureaus (Brown, 1980; Dolan, 1990; Carter, 2008). Presumably each is collecting its own data. Regional governance to support and maintain a regional open data portal may benefit each community. Trans-jurisdictionality requires new policy and management structures, but they "will only be effective if they are accompanied by sufficient resources to conduct their tasks and allowed sufficient time to develop mature leadership, trust, and structures" (Ryser & Halseth, 2010, p. 518).

The Kootenays region exemplifies the complicated web of relations and services in rural areas that can impact open data provision. The Kootenays have an à la carte service provision reflected in taxation in unincorporated rural areas, where one rural electoral district, town, hamlet, or subdivision can choose from a menu of services, ranging from official community planning or wildfire planning to libraries or recreation facilities, street lighting, or sidewalks (Tom Dool, personal communication, 2018). Each proposed new service or facility is typically approved via a referendum rather than imposed by a regional government. This fragmentation of services can present considerable challenges to regional or other authorities wishing to create seamless and interoperable open datasets.

Complicating trans-jurisdictionality is that, in countries like Canada, Australia, New Zealand, and the United States, nations exist within nations. In Canada, First Nations fall under the jurisdiction of the federal government, creating vertical trans-jurisdictionality where horizontal trans-jurisdictionality may be more efficient (e.g., collaborating on local economic development). Town interactions with Indigenous communities may require the former interact with the federal government, which then interacts with the First Nation(s). Indigenous Peoples regard open data quite differently and view their data as a matter of sovereignty, toward protecting community and cultural information (Phillips, 2015; Kukutai & Taylor, 2016). Data about Indigenous Peoples have historically been collected to

"primarily servic[e] government requirements rather than support . . . indigenous peoples' development agendas" (Kukutai & Taylor, 2016, p. 3). Consequently, Indigenous Peoples may resist definitions that, according to the Open Knowledge Foundation (n.d.), open their community data so that they are "free to use, re-use and redistribute, without any legal, technological or social restrictions." Additionally, Indigenous communities may still be in land-claims/treaty processes so opening data may run counter to their interests. Open data in the aforementioned countries therefore resembles government-to-government data sharing, not open data publishing.

2. Conclusion and Recommendations

Rural open data exists at the intersection of population density, human capital, ICTs, and socio-economic goals. These features interact with one another. A low population density over a large spatial extent correlates with a lack of government resources. Lower government resources combined with lower levels of technical skills equals a human-capital gap; low population density combined with lower incomes can generate less market incentive to develop services like broadband or open data. Rural is also defined by the goals to which open data will be directed. Unlike urban applications (e.g., sidewalks and urban trees), rural open data often focus on land usage for recreation, resource extraction and agriculture, and landscape-level hazards like wildfire, flooding, and landslides. Overlapping jurisdictions among the province/state, the regional district, and the municipality also present a problem. Crown land furthers this complex matrix of ownership. Crown land is the responsibility of the province/federal government and often comprises natural resources so it represents a significant part of rural economy and identity.

In response to these challenges, building capacity in rural areas is frequently considered a national priority, including building broadband and data-handling infrastructures and developing human capital through education, employment, and entrepreneurial opportunities (e.g., Skerratt, 2018). Developing human capital is challenging when few guideposts exist in urban contexts, with out-migration of skills and young people, and with the need to create or recruit new leaders comfortable with technological change. Digital literacy, including the ability to use software, to code, and to build computerized devices, should be an important outcome for the primary and post-secondary

education system or in extra-curricular clubs and maker spaces. Many remote areas do not have post-secondary institutions; however, distance education or self-directed learning via forums can partially fill this gap where broadband is available. Dabson (2001) argues that, for success in rural areas, an entire entrepreneurial infrastructure of intermediaries, trade associations, and resource networks (e.g., training, targeted financing) must be built. As suggested above, rural areas could take advantage of infomediaries like libraries (cf. Robinson & Ward Mather, 2017) to strengthen open data capacity and literacy.

The need to diversify rural economies through developing the service sector is aligned with building technology capacity, so many policy interventions are likely to include building capacity for open data. Developing open data capacity can strengthen community resilience in the face of macro-economic trends like globalization, climate change, and urbanization (Roberts et al., 2017). Beyond education, community-development approaches that include participatory action research and participatory evaluation methodologies can offer effective methods for building community capacities and increasing the sustainability of rural ICT projects (Lennie et al., 2005). Ruijer and Meijer (2020) used a living-labs approach to argue for an intensive support system to teach rural users on various aspects of open data handling: their interventions revealed that significant managerial resources and data standards were needed for open data use to meet its potential. Leadership in the adoption of new technologies is critical (Murray & Dunn, 1995). Empowering women, in particular, is key as women play significant leadership roles in rural community development and as women use many forms of technology more often than men (Hay & Pearce, 2014). Conversely, technology leaders can entrench existing power dynamics or inequalities (Ashman et al., 2017). Overall, collaboration across communities—horizontal trans-jurisdictionality—plays an important role (Eastwood et al., 2017); for instance, by enabling the development of a threshold level of standardized data or by pooling resources in regional offices to provide services for smaller communities.

Entrenchment of power can hide a form of a paternalism, as suggested from an evaluation of rural open data within the EU (European Data Portal Consortium, 2020, p. 21): "Our interviewees agreed that the greatest potential of rural open data was to impact rural rather than have rural users. This is because the skills, knowledge and connections to ideas and innovation were most often found in urban

areas with exposure to the quadruple helix of business, government, academia and citizenry."

The EU findings imply that, while information about rural areas may increase in availability, skill building and other resources can occur outside rural areas. As long as availability improves, there may be less motivation to develop capacity to create, sustain, and make use of open data within rural areas. Ruijer and Meijer (2020) characterize open data usage as a process of innovation; continued exogenous production can limit the opportunity to internalize innovation. Ultimately, we can have increasing amounts of rural open data; we can even have increasing use of rural open data. Open data may be "innovated" *for* rural people but not created or used *by* rural people to the same degree as urban.

To embed innovation, place-based economic development is recommended by many investigators (Markey et al., 2012; Markey et al., 2008; Gadsby & Samson, 2016). Their approaches focus on the unique resources, assets, and amenities of each place. This may result in a development road map customized for each community, although open data provision may not be a top priority in every case. Place-based economic development suggests that a one-size solution for rural open data or "smart tech" issues is unlikely (Spicer et al., 2021). Instead, approaches that link specific actors with local resources, amenities, and development priorities at the community level are recommended (Markey et al., 2012; Ashman et al., 2017; Ruijer & Meijer, 2020). These in turn reinforce the need for fine-resolution open data that are useful for local decision-making.

Tools developed for urban open data applications could benefit rural areas as well. Urban areas have extensive best (and worst) practices regarding open data standards, licences, and web portals that provide search-and-discover tools as well as free downloading. Some are directly transferable to rural communities where capacity and funding exist. Cities have harnessed the entrepreneurial spirit through hackathons; for rural places to create a critical mass of interoperable data, it is necessary to attract application development. However, agreement among more jurisdictions would be required. When Canadian cities like Vancouver or Montréal create a data standard, a developer can build a tool with a large potential market. In a rural region, agreement must be reached by several communities to create similar business opportunities. Standards adopted by the province or the nation for its purposes may not suit local needs, especially

when jurisdictional scale and data update schedule are considered. This issue is amplified in rural settings, where much more of the land is managed by other jurisdictions. A committed and responsive regional governance structure is required to develop and adopt standards.

Emerging technologies may help or hinder rural open data production and use. Affordable satellite communications could solve issues with broadband access. When we consider satellites as data sources, satellite imagery is increasingly offered at finer spatial resolutions. This could improve the spatial resolution of a region while decreasing the cost of data collection over large rural areas. Cloud-based services could largely eliminate the need for in-house ICT capacity. Conversely, even large changes in the availability of rural open data may fail to produce significant changes on the ground. Indeed, they may lead to more labour-shedding for the tech-intensive industries, say in terms of optimization or scaling-up services. Increased efficiency as a result of available open data may come at the cost of increased employment and upskilling of employees.

Our investigation of the rural dimensions of open data suggests open data practice exhibits both similarity and difference vis-à-vis urban open data. Rural agencies should evaluate each urban practice for local use before adoption. If the goal of open data policy is to benefit all citizens equally, then different interventions may be required in urban and rural contexts. Current market forces tend to favour the development of urban open data capacity, so compensatory public investments should be made in rural capacity. Participatory and place-based rural economic development that accounts for specific characteristics and community assets offers the greatest hope in equipping small towns and rural areas with the skills and tools needed to open up data. Shearmur et al. (2020, p. 311) reveal a paradox (here translated from the French) should rural areas choose to adopt technologies that make them smart: "The intelligent rural area therefore begins to be considered, even if, paradoxically, it forms part of a contest that promotes the smart city. That is, the rural world will become intelligent only if it urbanizes." Rural areas should not have to sacrifice their uniqueness, their rurality, to create, sustain, and find productive uses for open data.

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