ARCTIC
VOL. 73, NO. 4 (DECEMBER 2020) P. 433–449
https://doi.org/10.14430/arctic71586

Frequent Flooding and Perceived Adaptive Capacity of Subarctic Kashechewan First Nation, Canada

Muhammad-Arshad K. Khalafzai,[1,2] Tara K. McGee[1] and Brenda Parlee[3]

(*Received 13 February 2020; accepted in revised form 16 June 2020*)

ABSTRACT. Perceived (socio-cognitive) capacity is as important as objective (material resources) capacity in assessing the overall adaptive capacity of people at the community level. Higher perceived and objective capacities generate greater total adaptive capacity. This article assesses the perceived adaptive capacity of the Kashechewan First Nation, located in the flood-prone southwestern James Bay (Subarctic) region in Canada. The community is frequently disrupted by the elevated risk of spring flooding and has experienced five major floods since its establishment in 1957. Residents have been evacuated 14 times since 2004 because of actual flooding or flooding risk and potential dike failure. We surveyed 90 residents using 21 indicators to assess the community's perceived adaptive capacity. The results indicate that residents' risk perception and perceived adaptive capacity are high and are reshaping their adaptive behavior to the hazard of spring flooding. The strong positive interrelationships between human capital, social capital, governance, and other determinants, such as migration, personal resilience, and experience, also suggest high perceived adaptive capacity. Human capital and the other determinants are relatively higher contributors to the perceived adaptive capacity, followed by social capital and governance determinants. The results also indicate that residents' disaster preparedness has also improved. The elevated flooding risk and frequently occurring emergencies have motivated the First Nation to modify their spontaneous and proactive adaptation responses for disaster risk reduction at the individual, household, and band levels. Planning to adapt to natural hazards to mitigate their impacts also requires a nuanced understanding of the perceived adaptive capacity that contributes to overall adaptive capacity. Translating the high perceived adaptive capacity into greater total adaptive capacity would contribute to enhancing community resilience.

Key words: Indigenous peoples; Kashechewan First Nation; remoteness and isolation; Subarctic; Canada; frequent flooding; adaptation; perception; adaptive capacity; resilience

RÉSUMÉ. La capacité perçue (sociocognitive) est tout aussi importante que la capacité objective (ressources matérielles) quand vient le temps d'évaluer la capacité d'adaptation générale des gens à l'échelle communautaire. La capacité perçue et la capacité objective plus grandes engendrent une capacité d'adaptation totale plus grande. Cet article évalue la capacité d'adaptation perçue de la Première Nation de Kashechewan, située dans la zone inondable du sud-ouest de la baie James (subarctique), au Canada. Cette collectivité est souvent perturbée par le risque élevé d'inondation printanière. Depuis son établissement en 1957, elle a connu cinq inondations majeures. Ses résidents ont été évacués 14 fois depuis 2004, soit en raison d'inondations, soit en raison de risques d'inondation et de défaillances potentielles de la digue. Nous avons sondé 90 résidents en nous aidant de 21 indicateurs afin d'évaluer la capacité d'adaptation perçue de la collectivité. Selon les résultats, la perception qu'ont les résidents du risque et la capacité d'adaptation perçue sont grandes, et elles refaçonnent leur comportement d'adaptation vis-à-vis du risque d'inondation printanière. La forte interdépendance positive entre le capital humain, le capital social, la gouvernance et d'autres déterminants comme la migration, la résilience personnelle et l'expérience, suggère également une grande capacité d'adaptation perçue. Le capital humain et les autres déterminants sont des contributeurs relativement plus grands à la capacité d'adaptation perçue, suivis des déterminants du capital social et de la gouvernance. Les résultats indiquent également que l'état de préparation des résidents aux catastrophes s'est également amélioré. Le risque d'inondation élevé et les urgences fréquentes ont motivé la Première Nation à modifier ses interventions spontanées et proactives en matière d'atténuation des risques de catastrophes sur le plan de l'individu, du ménage et de la bande. La planification de l'adaptation aux dangers naturels dans le but d'en atténuer les incidences nécessite également une compréhension nuancée de la capacité d'adaptation perçue qui contribue à la capacité d'adaptation générale. Le transfert de la grande capacité d'adaptation perçue en capacité d'adaptation totale plus grande contribuerait à une résilience communautaire accrue.

[1] Human Geography Program, Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta T6G 2E3, Canada
[2] Corresponding author: khalafza@ualberta.ca
[3] Agricultural Life and Environmental Sciences, Resource Economics and Environmental Sociology, University of Alberta, Edmonton, Alberta T6G 2P5, Canada

Mots clés : peuples autochtones; Première Nation de Kashechewan; éloignement et isolement; subarctique; Canada; inondation fréquente; adaptation; perception; capacité d'adaptation; résilience

Traduit pour la revue *Arctic* par Nicole Giguère.

INTRODUCTION

This paper presents the results from survey research with Kashechewan First Nation. Indigenous peoples in Canada include Inuit, Metis, and First Nations. First Nations identify themselves by the nation to which they belong, such as Cree. The isolated and remote Kashechewan community is located in the flood-prone southwestern James Bay (Subarctic) region of northern Ontario in Canada. Lacking an all-season road, Kashechewan is a fly-in community, which is only accessible by air during spring, summer, and fall. An ice road constructed every winter remains operational between January and March.

The community is regularly affected by the elevated risk of spring flooding. Kashechewan residents have been evacuated 14 times to at least 22 different host communities in urban centers across Ontario since 2004 because of actual flooding or flood risk and potential failure of the dike. This article explores the community's perceived adaptive capacity and adaptive behavior (adjusting to adapt to the change), which are influenced by the perception of risk amid the frequent and considerable disruption of the daily life of residents. Perceived adaptive capacity is people's perception of the availability and suitability of material resources, including technical and institutional, required to facilitate adaptation (Gardezi and Arbuckle, 2019). In other words, people's capacity to act in response to their perception.

Using survey research, we explore the community's perceived adaptive capacity through the lens of individual residents. The individual lens is used because community resilience-building focuses on the adaptive capacity of individuals, households, and communities—such as people's collective strategic action(s), knowledge, skills, and learning—and is interwoven with and connected to individual resilience at the community level (Cutter et al., 2008; Miller, 2012; Berkes and Ross, 2013; Boon, 2014). We quantitatively analyzed perceived capacity using the subjective perceptions of residents about their adaptive capacity. Three research questions guided this study: 1) How do residents perceive the risk of flooding in Kashechewan? 2) How do individuals' flood risk perceptions influence their disaster preparedness and adaptive behavior? 3) What is the perceived adaptive capacity of Kashechewan First Nation?

Engagement with the Kashechewan First Nation was initiated in November 2015 when the first author visited the community for about a week to meet with the Chief and Council about a proposal for this collaborative research project, including the purpose, proposed research design, potential research questions, procedures for data collection, and the desire to incorporate community feedback into the research design and research questions. The research objectives and questions were revised based on the input received during this meeting. The initial community engagement also helped in building rapport and trust with the First Nation leadership and understanding the community's needs and priorities. This initial engagement with the First Nation leadership contributed to the formulation of the research objectives and research questions as well as to planning pre- and post-fieldwork activities. The First Nation leaders provided much guidance and feedback, particularly on the research questions and methods of data collection, including survey research. Five weeks were spent in Kashechewan to collect data from the end of October to early December 2016, which further facilitated the building of rapport with the larger community.

The major floods in the area took place in 1966, 1972, 1976, 1985, 2006, and 2008 (McCarthy et al., 2011; Abdelnour, 2013). Kashechewan residents were evacuated every year between 2004 and 2008 and then consecutively from 2012 to 2019. Although some of these evacuations were due to actual floods or flooding risk, others were precautionary, due to substandard community infrastructure, mainly a deteriorating, deficient, and inadequate dike (Barei, 2012). The community infrastructure is considered substandard in comparison to the rest of Canada because of the lack of building codes and minimum standards. Built in 1995–97 to protect Kashechewan, the 5.3 km long by 3.5 m high dike consists only of gravel and sand (Pope, 2006; Donnelly et al., 2015; Bhagwandass, 2016). Studies conducted since 2005 showed that the construction had not been completed according to specifications; as a result, the dike does not meet Canadian safety standards (Donnelly et al., 2015). The First Nation has coped with the increased flooding risk by repeatedly evacuating during the past decade. In the past, the Cree First Nations of the region adapted to spring flooding by moving several dozen kilometers inland (Newton, 1995; McCarthy et al., 2011). The absence of permanent settlements and their nomadic way of life made this relocation easy, cost-effective, and efficient; they would return and remain in the area during other seasons. Thus, the First Nations historically had a better strategy to adapt to the spring flooding hazard.

Community Context

Kashechewan is located on the north channel of the Albany River (at the river's mouth) in the southwestern James Bay region (Fig. 1). The Albany is the second-longest river (982 km) in Ontario and flows from northwest to

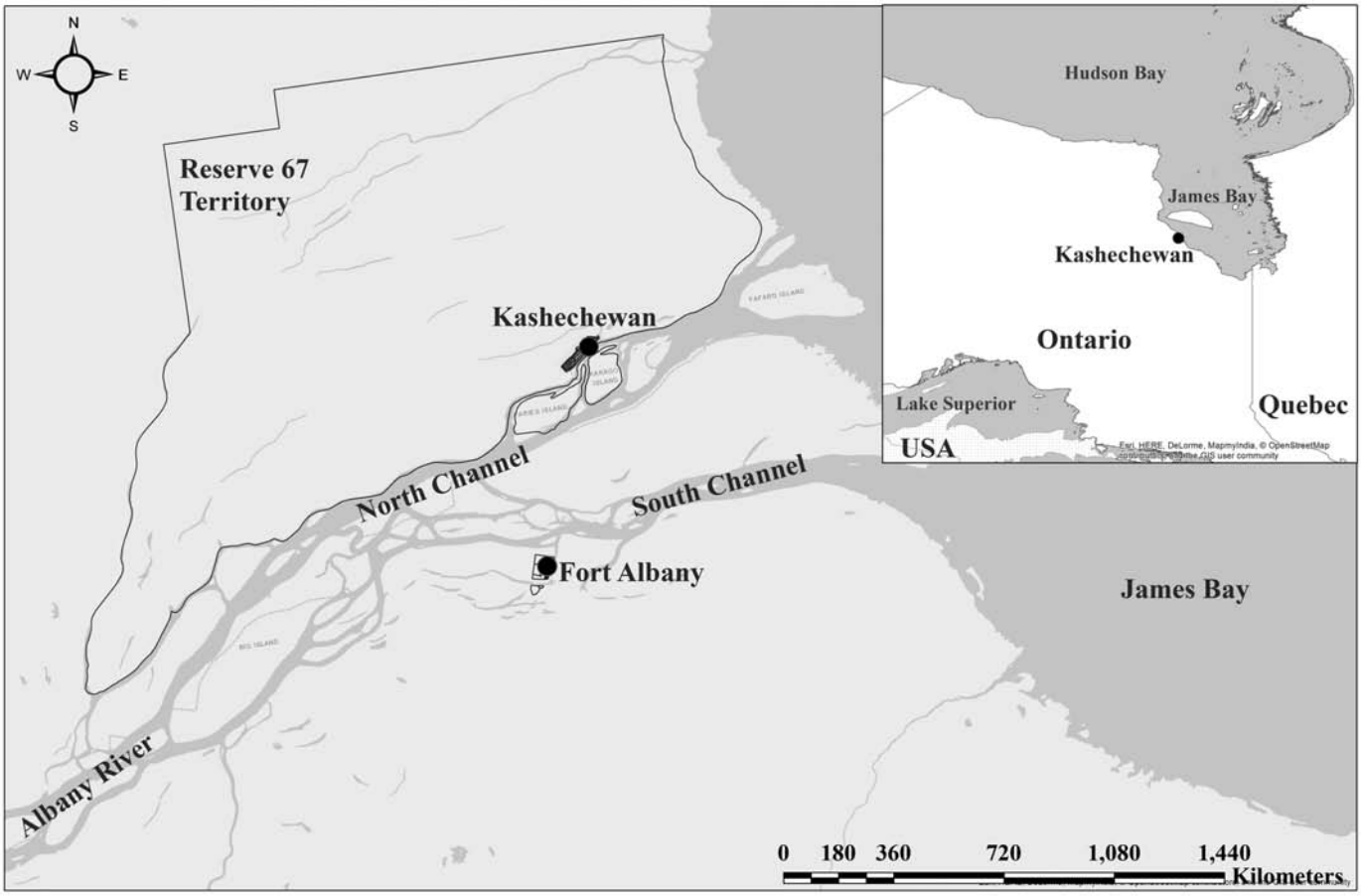

FIG. 1. Location of Kashechewan First Nation Fort Albany Reserve 67 on the west side of James Bay, northern Ontario.

northeast. Its Cree name is "Chichewan" meaning "several rivers form one that flows towards the ocean" (Kudelik, 2015). In Cree, Kashechewan is called "Kakiigachiwan," meaning "water flows forever: as long as the sunshine, as long as grass grows, and as long as the river flows" (L. Friday, pers. comm. 2019).

Kashechewan is one of the eight Cree First Nations of the Mushkegowuk Tribal Council. It is in Treaty 9 territory, which was defined in the James Bay Treaty signed in 1905. The Albany First Nation Reserve 67 with 225 km^2 of total area was created in 1910. Kashechewan, a small, isolated, and remote fly-in community, is about 12 km upstream from James Bay and approximately 13 km from the nearest community of Fort Albany, which is at the river's south channel. The nearest major town is Moosonee, 150 km to the south of Kashechewan. Fort Albany and Moosonee are accessible to Kashechewan residents in winter via the ice road and during other seasons by boat and barge. The quickest access to and from Kashechewan is by air, however air travel is expensive.

The First Nation's local economy is based mostly on band and government jobs, a few small businesses, and sales of fish, meat, and traditional handicrafts. The Reserve, which includes the community, offers access to abundant wildlife, including whitefish, trout, northern pike, geese, ducks, moose, beavers, bears, wolves, rabbits, and otters. The Kashechewan community has a main grocery store and gasoline station in addition to a few shops that sell daily use items. In comparison to the rest of Canada, the cost of living is very high in Kashechewan, particularly for food such as vegetables, fruit, and dairy products. The price of gasoline is at least double, and the prices of vegetables, fruits, and other grocery items are three to four times higher in Kashechewan than in southern Canada. The high cost of living negatively affects residents, particularly their health, in terms of their access to and consumption of a nutrition-rich and healthy diet. Kashechewan has basic infrastructure such as a health clinic, elementary school, high school, emergency medical service, a partially functional fire station, an electricity grid station, a telecommunication tower, and a police station.

The schools' academic activities are disrupted for extended periods of time because of the yearly evacuation. Students could not, for example, complete their full academic year for four successive years (Bhagwandass, 2016). The negative impacts of repeated academic disruptions and subsequently revised schedules included disturbed sleep patterns, which affected the mental health of students (Harries, 2008; McNeill et al., 2017). Frequent evacuation and dispersion of family members to different locations (22 different host communities in urban centres) across Ontario cause significant emotional distress among

residents (Bhagwandass, 2016; McNeill et al., 2017). While residing in evacuation centers away from home, Kashechewan residents suffered additional emotional stress caused by the fear of loss of property and belongings (ICI-Radio-Canada, 2016). The cultural activities of hunting and harvesting of goose meat in spring are also affected by the disruption, causing the loss of traditional livelihoods (Bhagwandass, 2016). In brief, the flooding risk and repeated evacuations have resulted in inconsistent and uncertain living conditions for residents, which is emotionally traumatic and socio-culturally disruptive (Bhagwandass, 2016; McNeill et al., 2017).

Kashechewan has 2000 band members (L. Friday, pers. comm. 2016), approximately 75% of whom speak Cree (O. Wesley, pers. comm. 2019). About 1250 band members are under the age of 25, and half are in schools. The community has been dealing with numerous challenges (see Khalafzai et al., 2019) such as poverty, expensive food, boil water advisories, overcrowded and inadequate housing, and deteriorating community infrastructure, particularly the dike (Pope, 2006; Bhagwandass, 2016; McNeill et al., 2017). The community has high unemployment (over 80%) (Pope, 2006; L. Friday, pers. comm. 2019). Kashechewan often experiences boil water advisories because of the operational deficiencies of the obsolete water treatment plant (Pope, 2006). Most of the houses are substandard, too small to accommodate large families (9 – 10), and do not adhere to building or fire codes (Pope, 2006; Barei, 2012). Over 300 residents stayed in Kapuskasing (300 km away) for about three years (2014 – 17) because 38 houses located in the low-lying northeast part of Kashechewan were rendered uninhabitable by mold contamination. Triggered by sewage backup due to high spring river flows, the mold also contaminated the health clinic and school buildings, causing evacuation of the community.

Adaptive Capacity and Traditional Ecological Knowledge

The adaptive capacity of a social-ecological system comprises the social and ecological elements, including traditional ecological knowledge (TEK) of Indigenous communities. TEK is usually an integral part of an Indigenous culture and has a large social context (Berkes, 1999). TEK is specific to a location and includes relationships between all living beings, natural phenomena (e.g., spring flooding), landscapes, and timing of events (such as spring hunting and harvesting of meat) that form a traditional way of life. TEK of a social-ecological system includes social institutions and social networks that encompass the collective memory of a community and promote (communal) social cohesion (Berkes, 1999; Berkes et al., 2000). Social capital, including communal resources, traditional knowledge, collective action, reciprocity, and social cohesion, contributes to enhancing the adaptive capacity of Indigenous communities. Therefore, TEK is a component of and is considered a key resource to enhance adaptive capacity (Berkes et al., 2000).

The First Nation's community characteristics, such as Indigenousness, remoteness, and isolation, and their dependence on natural resources also highlight the relationship and complementarity of adaptive capacity and TEK. In addition, socio-cognition and traditional knowledge of the ecological phenomenon of spring flooding are crucial to assess total adaptive capacity, keeping in mind the First Nation's socio-cultural context, particularly reliance on the traditional livelihoods of hunting, harvesting, and fishing. The perceived adaptive capacity is essential from the socio-ecological viewpoint because many northern Indigenous peoples' livelihoods do not depend on formal agrarian economies, such as agricultural and farming activities, including the cultivation of land, dairy farming, or livestock.

Literature Review

The concept of adaptation applied in many fields, including climate change and natural hazards research, is the manifestation of adaptive capacity (Smit and Wandel, 2006; Nelson et al., 2007). Adaptation represents ways and means of increasing the ability of a community to adapt at the local level within their demographic and socio-cultural context, transforming capacities into actions (Adger et al., 2005; Smit and Wandel, 2006; Nelson et al., 2007). The reactive and proactive adaptation actions are often viewed through a narrow technical lens that undermines the role of various local actors and social institutions involved in the process at the community level (Smit et al., 2000; Nelson et al., 2007; Engle, 2011). Adaptive capacity represents potential adaptation options, spontaneous or planned, to be implemented to minimize vulnerability and mitigate hazards risks (Smit and Pilifosova, 2001; Brooks, 2003; Smit and Wandel, 2006). Both perceived and objective adaptive capacities are the precondition of people's access to their available resources, such as institutions networks, that help them in coping with and recovering from disasters; they are also the prerequisite of a community's ability to recognize and activate these resources to adapt (Smit and Pilifosova, 2001; Brooks and Adger, 2004; Grothmann and Patt, 2005; Nelson et al., 2007). Adaptive capacity changes over time, for example, in the socio-ecological system in response to actual or expected events, such as natural hazards (Smit and Wandel, 2006). It can be measured at different scales ranging from an individual to a family, a community, a region, or a nation (Wall and Marzall, 2006; Engle and Lemos, 2010). Adaptive capacity can be assessed by measuring or characterizing a people's ability to adapt (Engle and Lemos, 2010; Engle, 2011). Measuring adaptive capacity is intended to build theory by identifying and understanding the factors that determine adaptive capacity based on people's response to events and the extent to which their resources are mobilized (Engle, 2011). Characterizing adaptive capacity involves an assessment using the determinants and indicator provided in the climate change literature (Grothmann and Patt, 2005; Engle and Lemos,

2010). In this paper, we assess the perceived adaptive capacity of the First Nation by characterizing it.

Various approaches have been developed and applied to study and understand the adaptive capacity of socio-ecological systems facing social, environmental, and climate change challenges (Whitney et al., 2017; Gardezi and Arbuckle, 2019). We employed the indicators of the integrated socio-ecological system approach, one of 11 approaches developed by Whitney et al. (2017). This approach focuses on a systems-based, integrated, social-ecological understanding of adaptive capacity. The strengths of this approach include the analysis of both social and ecological drivers of change and their interdependencies; the main drawback is that it is data intensive, which makes it often time-consuming and expensive (Grothmann and Patt, 2005). The social indicators of the approach include willingness to change, community infrastructure, risk perception, learning and knowledge, ability to anticipate change, level of trust and participation in decision-making, and quality of governance. The ecological indicators include behavioral change and learning, migration and anticipation capacities, and self-organization of community. The temporal scale focuses on learning from past experience to respond to present challenges and plan for future adaptation. The spatial scale is local because it includes community perspectives, preferences, and traditional knowledge. Traditional knowledge is contextualized as a body of cumulative knowledge, which evolves by the adaptive process, passed on through generations, and is associated with a specific place for a long time (Berkes, 1999; Berkes et al., 2000; Dei et al., 2000). The socio-ecological system approach focuses on existing socio-ecological change, and the scale of analysis is from individual households to the entire community. The approach helps in rendering a nuanced understanding of relevant indicators and determinants and offers ample data when dealing with change (Whitney et al., 2017). The approach has also helped in identifying and assessing the determinants that contribute to adapting or reacting to socio-ecological change. They include social capital, human capital, infrastructure, governance, and other determinants (Yohe and Tol, 2002; Brooks et al., 2005; Eakin and Lemos, 2006; Wall and Marzall, 2006; McClanahan et al., 2008; Cinner et al., 2010; Engle and Lemos, 2010; Boon, 2014; Maldonado and del Pilar Moreno-Sánchez, 2014; Lockwood et al., 2015; Siders, 2019).

Socio-cognitive or psychological factors, such as the perception of risk, are important for perceived capacity because they influence individuals' motivation and reshape their adaptive behavior, including disaster preparedness (Grothmann and Patt, 2005; Henly-Shepard et al., 2015). In addition, subjective perceptions can be very different from objective capacities or material resources (Grothmann and Patt, 2005; Seara et al., 2016; Gardezi and Arbuckle, 2019). Using multiple indicators is recommended, for example, by Tol and Yohe (2007) in the public health context. Their use is also consistent with the climate change adaptation literature, such as Brenkert and Malone (2005), who used multiple indicators of human capital, economic resources, and environmental capacity in their study of resilience to climate change, and Grothmann and Patt (2005), who focused on several socio-cognitive indicators.

The literature reviewed, related to assessing adaptive capacity, focuses on a range of aspects and determinants. For example, Paton et al. (2008) measured the collective efficacy of Thai citizens affected by the 2004 tsunami, but focused on the provincial scale based on the role of religious affiliation and ethnicity. Keskitalo et al. (2011), in a review of studies undertaken in the Nordic countries and Russia, highlighted how adaptive capacity determinants play out in the northern, industrialized regional context. Their study focused on the importance of economic resources in a market-based system, technological competition, and infrastructure. López-Marrero (2010) analyzed the adjustment strategies for risk reduction implemented by two Puerto Rican flood-prone communities. She studied how the adaptation of adjustment strategies within a wider context of other multiple risks influenced the communities' future adaptive capacity. Juhola et al. (2013) assessed adaptive capacity at the regional scale in Europe using determinants including technology, infrastructure, institutions, and economic resources. Del Pilar Moreno-Sánchez and Maldonado (2013) estimated the adaptive capacity of the fishing community of Bazan on the Colombian Pacific coast by focusing on its dependence on the natural resource extraction using socioeconomic, institutional, and socio-ecological determinants. Henly-Shepard et al. (2015) studied the perceived preparedness, differential coping capacity, and objective adaptive capacity of the Pacific Island community of Hanalei, Hawaii, which was prone to climate change-related hazards including droughts, floods, and hurricanes. Their study used household characteristics such as financial comfort, access to savings, homeownership, and use of farmland and livestock.

In the Canadian Arctic and Subarctic context, researchers have assessed the adaptive capacity of Indigenous communities by focusing specifically on the physical (material resources) aspects of capabilities. Those studies differ from our research because they primarily engaged government officials and agencies at different levels of government, and used qualitative interviews or employed the survey method. For example, Andrachuk and Smit (2012) and Ford and Smit (2004) used the exposure-sensitivities approach to assess the adaptive capacity of the Tuktoyaktuk Inuit community in the western Canadian Arctic and employed the qualitative interview method and secondary data (e.g., government reports and census data). Their study used current and future vulnerabilities and adaptive strategies for adaptation amid climatic risks. Adaptive capacity was also assessed within the Government of Nunavut "to synthesize the level of knowledge on climate change adaptation held collectively within Nunavut

departments and agencies and identify possible gaps in this knowledge" (CIER, 2009:1). Newton (1995) examined the community-level flood preparedness and coping strategies of northern Indigenous peoples in Canada. His research focused on how the individual, community, and government levels interrelate when responding to floods.

There is a lack of literature on the perceived adaptive capacity assessment of the remote and isolated Arctic and Subarctic Indigenous communities in northern Canada, including the James Bay region, particularly literature involving individuals at the community level that uses an integrated socio-ecological system approach. Our research is different from others in many ways. First, this is the only study that assesses the perceived adaptive capacity of Kashechewan First Nation, which has been affected by elevated flooding risk more than any other First Nation in the region and in Canada. Second, we employed an integrated approach to explore how the socio-ecological system uncovers different aspects of perceived adaptive capacity. Third, this research involves a remote and isolated Subarctic First Nation community using quantitative survey research involving community members to assess perceived adaptive capacity, which is the first application of the method in the region. Finally, this study contributes to the literature on the perceived adaptive capacity of a First Nation that depends on cultural spring hunting and harvesting as a source of traditional food, which is threatened by the challenges of spring flooding due to warming temperatures and climate change.

This paper presents results from survey research discussed in detail in the Materials and Method section. The qualitative results from the associated in-depth interviews and the participatory flood mapping workshops—which examined the elevated flood risk (see Khalafzai et al., 2019), its impacts on the community, and the effects of recurring evacuations on their vulnerability and resilience, including emergency preparedness—are presented elsewhere.

MATERIALS AND METHOD

Fieldwork

Fieldwork for this study was conducted over five weeks in October–December 2016 when most residents would be in the community. At the time of this fieldwork, an estimated 1600–1650 residents were in the community because 300–350 residents were in Kapuskasing, Ontario as long-term evacuees. We employed the face-to-face survey method conducted with the assistance of a community research assistant (CRA) for translations when needed. Ninety surveys were completed at locations convenient for respondents, with most completed at the coffee shop within the Northern Store. This coffee shop opened in the winter of 2016 and has become a social hub for residents in Kashechewan; consequently, the interviewer was able to survey residents with a range of characteristics (Table 1).

TABLE 1. Demographic information on the 90 respondents to the research survey.

Variable	Number	Percent
Gender:		
Male	46	51
Female	44	49
Marital status:		
Married[1]	52	58
Unmarried	38	42
Employment status:		
Employed	59	66
Unemployed	31	34
Age group:		
18–29	29	32
30–39	20	22
40–49	19	21
50–59	12	13
60–69	6	4
70+	4	4
Education:		
None	7	7.8
Grades 1–9	14	16
Grades 10–12	39	43
Above Grade 12	30	33
Income (Cdn$):		
Up to $10 000	28	31
10 001–30 000	26	29
30 001–50 000	19	21
50 001+	17	19

[1] Married includes common-law partners, widows, and widowers.

The other surveys were completed at the band office, health clinic, high school, police and paramedic stations, the social welfare office, and respondents' houses. The CRA and the interviewer recruited 70% of survey respondents; the other 30% approached us to participate in the study.

All residents above age 18 were potential respondents for the survey. The sample size of 90 is 7.5% of the targeted population of 1200 at the time of the fieldwork. We employed convenience sampling to select respondents because the respondents were readily available, and the response rate is generally very high compared to other sampling techniques (Bryman and Bell, 2016). However, the sampling technique used may not include all segments of the community. We addressed this issue by involving residents from all age groups above 18, with an equal participation of males and females, and representation of respondents from diverse subgroups, such as socioeconomic and professional backgrounds. Involving all subgroups of the target population in the sampling frame helped the researchers avoid undercoverage, which minimized selection bias. Indeed, we focused more on the sample sources while designing the data collection method by ensuring that all the subgroups were included, reaching out in person to all subgroups of individuals in the community; we also ensured the selection criteria reflected the target population without excluding any useful socio-economic, sociocultural, and demographic subgroup. A wide range of people completed the survey, including individuals working for many local agencies, female and male community

leaders and elders, those working in small businesses (such as grocery stores and gasoline stations), entrepreneurs, single mothers, students, people with disabilities, and a few of those staying in Kapuskasing (long-term evacuees). The statistical goodness-of-fit test also established that the sample data represented the data that was expected in the actual population. The results of this research can only apply to the First Nation's natural socio-ecological settings (generalized to empirical theory) and cannot be applied to wider theory (analytic generalization). Adaptive capacity, which is essentially context- and location-specific and dynamic, cannot therefore be generalized to broader contexts because of socio-economic, political, institutional, and demographic factors (Smit and Wandel, 2006; Engle and Lemos, 2010; Engle, 2011).

Development of the Survey Instrument

The relevant literature, such as Maldonado and del Pilar Moreno-Sánchez (2014), Whitney et al. (2017), and Siders (2019) provides a range of determinants, such as social capital and human capital, and socio-cognitive indicators to assess social, ecological, or integrated (socio-ecological) adaptive capacity, particularly at the community level. Furthermore, the community characteristics of Indigenousness, remoteness, and isolation led to the use of socio-cognitive indicators. Table 2 provides detail of the determinants, indicators, and measures applied along with the academic sources. The literature also offers a set of dimensions for the determinants and indicators to assess adaptive capacity across scales, including individual households and the whole community, while focusing on perceived capacity (Grothmann and Patt, 2005; Whitney et al., 2017). The factors of perception, such as whether the risk can be reduced and protection from the dike failure, were included to examine the adaptive behavior of residents. We selected the socio-ecological indicators keeping in mind the First Nation's sociocultural community-specific context. Assessing perceived adaptive capacity is a challenging task because of its latent nature, which is shaped by diverse and dynamic context-based factors (Grothmann and Patt, 2005; Engle, 2011; Berman et al., 2012). The determinant of economic capital was not included because of a high unemployment rate, overdependence on government social assistance, and reliance on traditional hunting and harvesting for food and livelihood. In addition, economic capital was not included because the community members' livelihoods do not depend on agricultural and farming activities, including the cultivation of land, orchards, dairy farming, and livestock. Their major sociocultural activities and sources of traditional food are hunting, fishing, and harvesting of meat. Nonetheless, according to Grothmann and Patt (2005), the socio-cognitive model involving factors of risk perception and perceived adaptive capacity is better suited to explain individual proactive adaptation than the socio-economic model. Adaptive capacity also is assessed in a specific context, at the scale of the events and at the scale of analysis, and therefore, it lacks an absolute measure (Grothmann and Patt, 2005).

In social capital, the indicators of reciprocity, expectation, and participation in decision-making by the band and by the federal government were included. They were used because the First Nation is a close-knit community that also is dependent upon natural communal resources (the reserve is communal property); residents help each other in times of need. The higher levels of trust, community involvement, expectation, and norms of cooperation act as valuable resources for individuals and facilitate collective action (Adger et al., 2004; Henly-Shepard et al., 2015). In terms of human capital, the indicators of awareness of flood mitigation measures, flood-related traditional knowledge and other knowledge systems, and information using local FM radio and the Internet social media platform were included. Different sources of information, knowledge systems, and technologies are required to access and obtain reliable flood-related knowledge and information. The indicators of availability and functioning of a healthcare facility, schools, and a water treatment plant were included in the infrastructure determinant. The governance determinant included help and support provided by the band and by the government during floods and evacuations and the timely flood- and evacuation-related information provided by the band. Both the availability of essential community infrastructure and the ability of a local government to deliver adequate basic civic services play an important role in assessing perceived capacity vis-à-vis the quality of governance at the local level. We combined the indicators of infrastructure and governance determinants (collectively named governance) to analyze individual levels of happiness or satisfaction concerning the delivery of public services. Similarly, the other determinants comprise the indicators of anticipation, migration/organization (individuals' willingness to relocate or capacity to organize relocation), personal resilience, flexibility or the ability to learn, experiences of past flooding and evacuation events, and emergency preparedness. These six indicators helped in assessing perceived capacity by examining the community-specific pertinent issues associated with the determinants. For example, the more an individual had experienced flooding, the higher would be their perceived adaptive capacity.

The indicators and their respective questions used in the survey form were transformed into a Likert scale, which is usually a five- or seven-point scale that measures positive and negative responses to a statement (Wall and Marzall, 2006). Using Likert-scale based survey research is culturally appropriate when researching Indigenous peoples. For example, Kant et al. (2013) employed Likert-scale survey research involving two First Nations in Canada. They explored the contribution of social, cultural, and land-use factors to Indigenous well-being and health. The use of structured interviews (Likert-scale questions) in this study also shows that survey research involving northern Indigenous communities can be culturally

TABLE 2. Determinants and indicators of perceived adaptive capacity.

Determinant	Indicator or factor	Description and source	Perceived adaptive capacity measure
Social capital (4 indicators)	Reciprocity	Individuals' perception that they will be provided help by other community members when needed (del Pilar Moreno-Sánchez and Maldonado, 2013; Maldonado and del Pilar Moreno-Sánchez, 2014; Henly-Shepard et al., 2015; Lockwood et al., 2015)	Perception/Satisfaction Measure (PSM)
	Expectation	Individuals' perception that they can and will support themselves, their families, and anyone who needs help (del Pilar Moreno-Sánchez and Maldonado, 2013; Maldonado and del Pilar Moreno-Sánchez, 2014; Henly-Shepard et al., 2015)	
	Participation in decision-making by the band	Individuals' perception that the band involves them in solving the floods and evacuation problems (Eakins and Lemos, 2006; Cinner et al., 2010; Whitney et al., 2017)	
	Participation in decision-making by the federal government	Individuals' perception that the federal government involves them in solving the floods and evacuations problems (Eakins and Lemos, 2006; Cinner et al., 2010; Whitney et al., 2017)	
Human capital (5 indicators)	Awareness	Individuals' perception that they are aware of the flooding problem and the flood control measures taken by the band and federal government (Wall and Marzall, 2006; del Pilar Moreno-Sánchez and Maldonado, 2013; Maldonado and del Pilar Moreno-Sánchez, 2014)	Awareness/Access/Utilization/Satisfaction Measure (AAUSM)
	Knowledge (Cree)	Individuals' perception of use of flood-related Cree traditional knowledge and other knowledge systems for risk reduction/mitigation (Yohe and Tol, 2002; Engle and Lemos, 2010; Cinner et al., 2010)	
	Knowledge (other)	Individuals' perception of use of flood-related other knowledge systems for risk reduction/mitigation (Yohe and Tol, 2002; Engle and Lemos, 2010; Cinner et al., 2010)	
	Information (FM)	Individuals' perception of receiving information on floods and evacuations from the local FM radio (Brooks et al., 2005; Wall and Marzall, 2006; Swanson et al., 2009; Engle and Lemos, 2010; Whitney et al., 2017)	
	Information (social media platform)	Individuals' perception of receiving information on floods and evacuations from the internet (social media), access to the required technology, and equipped with skills to receive the information (Brooks et al., 2005; Wall and Marzall, 2006; Swanson et al., 2009; Engle and Lemos, 2010; Whitney et al., 2017)	
Governance (6 indicators)		Individuals' satisfaction level about the availability, provision, support or help, and quality of:	Availability/Provision/Satisfaction Measure (APSM)
	Health	Healthcare services provided by the community health clinic	
	Education	Education provided by the elementary school and high school	
	Tap water	Safe tap water supplied by the local water plant (Brooks et al., 2005; Wall and Marzall, 2006; McClanahan et al., 2008; Engle and Lemos, 2010)	
	Band support	The band provided support or help during floods and evacuations	
	Government support	The federal government provided support or help during floods and evacuations	
	Information	The band provided timely information on floods and evacuations (Brooks et al., 2005; Wall and Marzall, 2006; Engle and Lemos, 2010)	
Other Determinants (6 indicators)	Anticipation	Individuals' ability to anticipate (change) in the event of future flooding (Maldonado and del Pilar Moreno-Sánchez, 2014; Whitney et al., 2017)	Socio-cognitive/Recognition Measure (SCRM)
	Migration/organization	Individuals' willingness to relocate from existing location (Cinner et al., 2010; Whitney et al., 2017)	
	Resilience	Individuals' perception of the degree to which they oppose or prevent impacts and their ability to recover from impacts (Boon, 2014; Lockwood et al., 2015; Whitney et al., 2017)	
	Flexibility	Individuals' recognition or perception of the degree to which they are compliant or their willingness to invest in change to adapt (Engle and Lemos, 2010; Whitney et al., 2017)	
	Experience	Individuals' capacity to learn from past experiences (both individual and ancestral) of events and perception of being resilient (Engle and Lemos, 2010; Whitney et al., 2017)	
	Preparedness	Individuals' perception of risk, improved preparedness, and ability to mitigate losses (Henly-Shepard et al. 2015; Whitney et al., 2017)	
Perception (4 factors)			Socio-cognitive/Recognition Measure (SCRM)
	Risk	Individuals' risk perception from very high to very low	
	Risk reduced	Individuals' perception of risk reduction (Can the risk be reduced?)	
	Dike safety	Individuals' perception of protection from the potential dike failure	
	Traditional knowledge	Individuals' perception of the usefulness of flood-related traditional knowledge (Grothmann and Patt, 2005; Henly-Shepard et al., 2015)	

appropriate. However, there can be the following five areas of differences in responses based on the respondents' diverse cultural backgrounds that might be found in Likert-type scales. They are "difficulty in responding, out-of-range responding, varied patterns of responding, scale reliability, and construct validity" (Lee et al., 2002:296).

In this study, all indicators are ordinal variables comprised of five Likert scale options: strongly agree, agree, neutral, disagree, and strongly disagree. For example, the study included the statement "the band involves me in solving the flooding and evacuation problems in Kashechewan" for the indicator of participation in decision-making to measure the level of satisfaction or happiness of residents. The average value of all indicators in each determinant was used to conduct inferential statistical analysis. The survey form also included several questions on the demographic characteristics of respondents, including age, gender, marital and employment status, and education and income levels. During the fieldwork, the survey form was shared with the community advisory committee (CAC) and community leaders and revised based on their input to ensure that the wording of questions was appropriate given the common language used by community members. The CAC was formed on the recommendation of Chief Leo Friday to guide the fieldwork. The CAC members comprised three knowledgeable elders and hunters who had been observing changes on the land, in the river, and the local environment and ecology. The survey form was also tested by interviewing the CRA before commencing interviews of respondents.

Data Analysis

We used descriptive and inferential statistics to analyze data. The risk perception and adaptive behavior data were analyzed using SPSS descriptive statistics. The skewness and unsuitability of data determined the use of specific statistics (Paten et al., 2007). For inferential statistics, we employed the nonparametric one-sample chi-square (χ^2) to determine which indicators have a greater effect (size of the contribution) than others. We employed Spearman's (rho) correlation coefficient to test if there was a significant, monotonic relationship between ordinal (rank-ordered) variables. We also performed Friedman's χ^2 two-way ANOVA (analysis of variance) to measure two or more comparable indicators from the same sample to compare their distributions. Kendall's W (coefficient of concordance) test was conducted to calculate the effect size estimates. The formulas used to calculate effect size are provided in Appendix S1.

To interpret the effect size, we followed the guidelines of Gignac and Szordorai (2016), which recommend considering the correlations of 0.10, 0.20, and 0.30 as relatively small, moderate, and relatively large based on statistical power analysis and the interpretation of results from a normative viewpoint. We decided not to use Cohen's (1988) guidelines because they are too exigent (Gignac and Szordorai, 2016). Furthermore, we conducted a principal component analysis (PCA) to reduce the four determinants ("with as much of the variability in the data as possible") to a smaller number ("for as much of the remaining variability as possible") while containing their maximum of the information (Awal et al., 2016:285).

Ethical Considerations

Before commencing fieldwork, official approval for this research project was obtained from the Research Ethics Board (REB) at the University of Alberta and adhered to its ethical guidelines, including the guidelines outlined in the Tri-Council Policy Statement-2 (TCPS-2) document, particularly referring to ethical conduct for research involving First Nations in addition to the principles of respect, relevance, reciprocity, and responsibility (TCPS-2, 2014). The research process was well appreciated by the community leaders because the First Nation's interests, needs, and concerns were well taken into account right from the start and at every stage (Bishop, 2005). In short, the research was completed with the community as a collaborative project, which was based on mutual respect, trust, and good relationship rather than research done to or in Indigenous communities.

In line with the REB approval, the free, prior, and ongoing informed consent of each participant was obtained before conducting surveys. The introduction letter was read in a manner that each participant fully understood. Then, each participant was asked to sign the consent form before commencing the data collection process. Participants were also informed that withdrawing from this research during the interview was completely voluntary. They were also provided information concerning their withdrawal from or stopping the interview if they felt uncomfortable.

The surveys were kept under lock and key and only the researchers had access. While presenting results, respondents' names and identity were not disclosed but kept confidential and separate from the survey forms. Digital data were stored confidentially on a password-protected disk (for electronic information) and the hard copies of surveys were kept in a locked filing cabinet. Identifiable information of the survey respondents was destroyed after completion of the research. The results were shared with and cross-validated by the research participants for their input during a follow-up community visit in November 2018.

RESULTS

Perception of Flood Risk

The survey data shown in Table 3 indicate that the community's flood risk perception is high. Age influenced survey respondents' risk perceptions, with older respondents having higher flood risk perceptions. Out of 65% of the total

respondents who perceive that it is very high or high, 90% were over 40 years old. Risk perception among older (40–59 years) and elder (60 and above) respondents is higher than among younger (18–39 years) respondents: 77% of older and 80% of elder respondents perceive that the risk is very high or high as compared to 53% of younger respondents. Risk perceptions were also higher for those with higher levels of formal education. However, out of 69 respondents with Grade 10 education and above, 18 (26%) respondents perceive that the risk is moderate.

The results indicate that the risk perception increases with an increase in residents' age over 40 years, particularly in elders 60 years and older. Also, the higher the education of residents, the higher the flood risk perception. Perception of flood risk of women respondents is slightly higher (33%) as compared to men (31%) who think that it is very high or high. About 17% of men and 11% women perceive that the risk is moderate. Among male respondents, 26% think that the flood risk in Kashechewan can be reduced, while only 18% of women thought that it could. However, 12% men and 14% women perceive that the flood risk cannot be reduced. The perception of women and men who strongly agree or agree that the dike is helping a lot in protecting Kashechewan is almost the same (i.e., 29% and 28% respectively).

Although many respondents acknowledge that the dike has saved the community in the past, most of them perceive that the desired solution to the frequent flooding risk and recurring evacuation problems is to relocate. A higher number of men (43%) than women (39%) respondents strongly agree or agree that they will be willing to be relocated from Kashechewan because of the increased flooding risk. A significant majority (over 82%) are willing to relocate to Site Five, 30 km upriver from Kashechewan.

Perception of Emergency Preparedness

Over 82% of respondents strongly agree or agree that they are prepared for future flooding and evacuation as opposed to only 6% who disagree, and 12% who are not sure. More than 77% of respondents perceive that flood experiences have better prepared them to avoid or mitigate damage in comparison to only 2% who think otherwise, and 20% who are not sure. None of the respondents strongly disagreed in both cases. The results indicate that the community's emergency preparedness and coping capacity have increased, and residents perceive that they are better prepared for the future mainly because of frequent flood emergencies.

The perception of emergency preparedness between women and men who strongly agree or agree that they are prepared for future flooding and evacuation is the same (41%). Surprisingly, the perception of women and men is also the same (39%) that flood experiences and stories helped better prepare them to reduce flood losses. A higher percentage of men (35%) than women (28%) strongly agree or agree that they have become better at adapting to flooding as a result of frequent flooding risk and evacuation every year. Appendices S2 and S3 provide the descriptive statistics of all the 21 indicators or questions.

TABLE 3. Perceptions of the 90 respondents of flood risk and protection from dike failure.

	Number	Percent
Risk level:		
Very high	43	48
High	15	17
Moderate	25	28
Low	4	4
Very low	3	3
Can risk be reduced?		
Yes	39	43
No	24	27
Don't know	27	30
Perception of protection from dike failure:		
Strongly agree	14	16
Agree	37	41
Not sure	19	21
Disagree	13	14
Strongly disagree	7	8
Willingness to relocate:		
Strongly agree	52	58
Agree	22	24
Not sure	10	11
Disagree	6	7
Strongly disagree	0	0

Contribution of Indicators to Perceived Adaptive Capacity

In social capital, the indicators of expectation (21%) followed by reciprocity (11%) are relatively greater contributors to perceived adaptive capacity than participation in decision-making by the band and the federal government. The effect size is relatively large and medium for expectation and reciprocity, respectively. The effect size implies that the variability in the mean rank scores of expectation and reciprocity are accounted for by their corresponding categories (strongly agree to strongly disagree). The human capital indicators of information (social media), other knowledge, and traditional knowledge contribute to the perceived capacity more than the remaining two indicators with a relatively large and medium effect size of 20%, 15%, and 11%, respectively. In the determinant of governance, support and help during flood and evacuation (22%) and information on flooding and evacuation (22%) provided by the band contribute more to the perceived capacity than support and help provided by the federal government (19%) and education provided by schools (16%) in Kashechewan. The effect size is relatively large for the first indicator (Information [social media]) and medium for the remaining two (Knowledge [other] and Knowledge [traditional]). In the other determinants, indicators of migration/organization (16%), preparedness (13%), personal resilience (12%), and experience (11%) contribute more to the perceived capacity than the other two indicators, with relatively moderate effect size. Among the perception factors, flood risk (17%) plays a more major role

TABLE 4. One-sample chi-square (χ^2), effect size, and contribution of indicators.

Category	Indicator	One-sample χ^2	Effect size (%)
Relatively high contributors:			
	1. Support or help (by Band)	80.667	22
	2. Information (by Band)	78.333	22
	3. Expectation	73.889	21
	4. Information (social media)	73.333	20
	5. Support or help (by government)	66.444	19
Relatively medium contributors:			
	6. Organization (migration)	57.733	16
	7. Educational services	57.444	16
	8. Knowledge (other)	52.778	15
	9. Preparedness	47.067	13
	10. Health care services	44.444	12
	11. Resilience (personal)	42.111	12
	12. Experience (flooding)	40.667	11
	13. Reciprocity	39.689	11
	14. Knowledge (traditional)	39.000	11
Relatively small contributors:			
	15. Participation (Band)	28.111	8
	16. Awareness (strategies)	27.956	8
	17. Anticipation (future)	26.889	8
	18. Information (FM radio)	26.600	7
	19. Participation (government)	26.444	7
	20. Flexibility	20.489	6
	21. Safe tap water	18.222	5
Perception:			
	22. Flood risk	61.333	17
	23. Cree knowledge value	33.444	9
	24. Safety by dike wall	29.111	5

in reshaping adaptive behavior and emergency preparedness than does the perception of safety from dike failure (5%) and usefulness of traditional knowledge (9%), while risk reduction was found to be statistically insignificant. Table 4 divides all the 21 indicators into three categories based on the values of one-sample χ^2 (p-value = 0.000; except for expectation and tap-water p-value = 0.001) and effect size. In Table 4, the indicators are listed in order of highest value to lowest value in terms of contributing more in perceived capacity than others, and in the contribution of the variables in determining perception of residents. The first category indicators are relatively high contributors followed by the second and third categories with a relatively medium and small contribution, respectively. The Kendall's W value (0.19) indicates the 19% effect size of all the 21 indicators of the four determinants.

Interrelationship of Determinants of Perceived Adaptive Capacity

The average values of all the associated indicators were taken for the corresponding determinants. All indicators were weighted equally to analyze the perceived adaptive capacity using four determinants. We explored the interrelationship between the determinants to measure the perceived adaptive capacity based on the average values/scores of all related indicators within each determinant. The stronger the relationship, the higher the perceived adaptive capacity of individuals. Correlation is a useful statistic because it estimates the strength as well as the direction, positive or negative, of the association between variables. The statistical analyses allowed this study to make comparisons and rank perceived adaptive capacity (Siders, 2019). In other words, the determinants that are perceived to be associated with lower flood losses, for example, due to the timely provision of early warnings, imply that these determinants rank higher in perceived adaptive capacity because of the nature of the strength of their interrelationship.

Table 5 presents the statistically significant correlation between the four determinants with p-value $\leq$ 0.004 (2-tailed). There is a strong positive relationship between social capital and human capital with an effect size of 13%. In other words, a 13% increase in the variance of social capital will have a corresponding 13% increase in the variance of human capital, indicating the size of the relationship in percentage between the two. The estimated effect size (13%) is because of the impact of the known variables between the two determinants and the remaining 87% impact is due to unknown variables. Similarly, the positive correlation between social capital and governance is strong, with an effect size of 12%. Social capital is also positively and strongly correlated with the other determinants with a 22% effect size. Human capital and governance are also positively and strongly correlated and have a 22% effect size. Human capital is positively correlated with the other determinants and has the strongest strength of all with an effect size of 23%. Finally, governance and the other determinants are positively correlated but with medium strength and an effect size of only 9%. Notably, the average of all the correlations (rho = 0.403) indicates a large, strong relationship with a decent average effect size (16%). In social and behavioral sciences, the effect sizes generally "tend to be small or medium," however, small, medium, or large refers to the size of the effect, but not necessarily to its importance or impact (Murphy et al., 2014:8). For example, a flood prevention measure might lead to a small change, but if the change translates into saving the lives of many people, the effect will be considerable. The positive, stronger interrelationship between the determinants implies higher perceived adaptive capacity, which enables individuals to activate their objective adaptive capacity while utilizing their material resources. In brief, the results indicate that the respondents' perceived adaptive capacity to floods is high as demonstrated by the positive, strong interrelationship between the determinants. As stated earlier, the Kendall's W indicates the 19% effect size of all the 21 indicators. The inferential statistical results are also consistent with the descriptive results of high perception of risk, and increased emergency preparedness and coping capacity.

Contribution of Determinants to Perceived Adaptive Capacity

The results indicate a 29% effect size and very good agreement between the four indicators of human capital

TABLE 5. Bivariate correlation of determinants and effect size.

Determinant	rho	Effect size (%)
Human capital and Others	0.476	23
Social capital and Others	0.467	22
Human capital and Governance	0.467	22
Social capital and Human capital	0.356	13
Social capital and Governance	0.352	12
Governance and Others	0.299	9

TABLE 6. Friedman's ANOVA (Analysis of variance) and effect size of determinants.

Determinants	Friedman's (χ^2)	Kendall's W effect size
Human capital	104.569	29% (0.290)
Others	19.760	27% (0.256)
Social capital	52.163	19% (0.193)
Governance	49.687	11% (0.110)
Perception	104.620	39% (0.386)

TABLE 7. Principal component analysis (component matrix) of determinants.

Determinant	Component load (weight)	Communality extraction
Perceived Adaptive Capacity:		
Social capital	0.750	0.563
Human capital	0.793	0.629
Governance	0.710	0.504
Others	0.770	0.594
Variation collectively explained: 57%		

(Table 6). Similarly, we found a 27% effect size with very good agreement between the indicators of the other determinants. The results show a 19% effect size with good agreement between the indicators of social capital. The data revealed a fair agreement between the indicators of governance with an effect size of 11%. The results indicate that the indicators of human capital followed by the other determinants are relatively high contributors to the perceived adaptive capacity. The contribution of the indicators of social capital and governance to perceived adaptive capacity is relatively small compared to the indicators of human capital and governance. Table 6 provides detail of Friedman's χ^2 (p-value = 0.000).

The PCA results with one component solution for the determinants and the variation they collectively explain in the overall perceived adaptive capacity support the results of Friedman's χ^2. The PCA with one component solution loads (weights) for each determinant are positive, with human capital (0.793) and the other determinants (0.770) contributing more to perceived adaptive capacity than social capital (0.750) and governance (0.710). The strong component loadings of the determinants suggest that there is a strong relationship among the determinants. The minimum acceptable component loading (absolute value) is higher than 0.3. Overall, the proportion of variation collectively explained (common variance) by all determinants is 57% (Table 7).

DISCUSSION

Siders (2019) identified and listed 158 indicators and determinants after reviewing 274 studies. We used 21 socio-cognitive indicators of four determinants and the integrated socio-ecological system approach to determine the community's perceived adaptive capacity. The approach used is the most appropriate having regard to the First Nation's unique context concerning Indigenous social and cultural way of life, and their physical vulnerability to the ecological phenomenon of spring flooding.

The findings of high perception of risk and increased emergency preparedness are similar to those of Lo (2013), Henly-Shepard et al. (2015), and Shao et al. (2017) who found that individuals with a high perception of risk are more likely to adapt their behavior in comparison to those with low risk perceptions. Adaptive behavior also is influenced by people's perception of the availability and capability of mitigation measures and available adaptation options to deal with hazards risks (Yohe and Tol, 2002; Henly-Shepard et al., 2015; Gardezi and Arbuckle, 2019). The high perception of risk is likely due to the frequent experiences of dealing with flooding risk, including recurring evacuations, ice jam events, and warming spring temperatures. In addition, Rehman (2012**)** found that frequent experiences of hazards risks shift the approach from traditional relief and recovery to preparedness, particularly at the community level.

The research finding that there is a strong interrelationship between the determinants of social capital, human capital, governance, and the other determinants is also seen in the literature on adaptive capacity to climate change (e.g., Adger et al., 2004; Walls and Marzall, 2006; Posey, 2009; Engle and Lemos, 2010; Gupta et al., 2010), in which a positive correlation between determinants of adaptive capacity was found to exist at varying scales. These positive, monotonic relationships between the determinants also are supported by the disaster risk management literature (e.g., Buckland and Rahman, 1999; Haque, 2000; Nakagawa and Shaw, 2004; Kawachi et al., 2008; Reininger et al., 2013; Seng, 2013).

The conclusion that human capital, particularly the contribution of indicators of awareness, knowledge, and access to and use of information, contributes to adaptive capacity is similar to the findings of Alberini et al. (2006), Engle and Lemos (2010), and Shao et al. (2017). Similarly, the conclusion that the other determinants—such as experience, flexibility, and resilience—contribute to improved adaptive capacity are consistent with the climate change literature, such as Smit and Pilifosova (2001) and Engle and Lemos (2010).

The finding that social capital acts as an enhancer of adaptive capacity is also consistent with the findings of

Henly-Shepard et al. (2015) and Paton et al. (2008). The relationships between community members promote social cohesion through community networks and strengthen the social system through sharing and accessing available resources, which result in higher social capital (Pelling, 1998; Wall and Marzall, 2006). In contrast, loss of access to communal resources increases people's vulnerability and results in reduced adaptive capacity (Adger et al., 2004). The traditional knowledge of community elders (e.g., on climate and weather conditions and changes in the timing of spring season) and cultural spring activities, such as hunting and harvesting of meat, help to strengthen the community relationships by providing the opportunity to spend ample time together on the land and in the bush. These activities also provide an opportunity for elders to train the younger generation and pass on traditional knowledge, particularly concerning the spring flooding risk and hunting and harvesting of goose meat. The results of the indicators of governance determinant are supported by the findings of Gupta et al. (2010) who found that the level of adaptive capacity is enhanced with the availability of adequate infrastructure, the quality of civic services, and good governance of local institutions.

The elevated flooding risk and frequent emergencies have considerably influenced the risk perception and emergency preparedness of residents of Kashechewan. Particularly after the 2006 flood and the recurring emergencies every spring, residents' perception of risk has significantly increased, which, in turn, has changed their adaptive behavior. It has motivated residents to adopt adaptation responses, such as improving emergency preparedness and being willing to relocate from the existing flood-prone site. The high perception of risk and improved emergency preparedness and the reshaped adaptive behavior of residents have also resulted in their high perceived adaptive capacity. Having to deal every spring with an elevated flooding risk and recurring emergency experiences has improved the community's emergency preparedness and coping capacity at both the individual and band levels. For example, individuals pack their bags, shift their households to the upper floor, manage their grocery supplies, and protect their property against vandals by sealing doors and windows with plywood. In addition, the incidences of family members being separated have been considerably reduced.

The statistical analysis of the quantitative survey data, which showed that the community's emergency preparedness and coping capacity have increased because of frequent emergencies, was supported by the qualitative interview data. The finding of a significant change in the adaptive behavior of residents was verified by the qualitative data as well as quantitative data. Furthermore, the finding that flood-related traditional knowledge is useful as indicated by the quantitative data was illustrated by the qualitative interview data in which participants provided detailed accounts of this knowledge was and how it was used. The finding from the quantitative data that residents frequently use the social media platform to get information on flooding and evacuation was elaborated in narrative form during the qualitative interviews. Similarly, the finding in the quantitative data of the perception of protection from the dike failure was enhanced by qualitative interview data in which participants clarified why the First Nation believed that the dike would breach if there were to be severe flooding in the future.

The findings suggest that the elevated flooding risk and frequently occurring emergencies have motivated the First Nation to modify their spontaneous and proactive adaptation responses for disaster risk reduction at the individual, household, and band levels. Our research contributes to the literature on adaptive capacity by focusing on the perceived capacity of the First Nation. The adaptive capacity literature mainly focuses on objective capacity. This research shows that perceived capacity is as important as the objective capacity in determining total adaptive capacity.

The work of Grothmann and Patt (2005) focuses on the importance of perceived adaptive capacity, which has been largely neglected in climate change research. The integrated socio-ecological system framework developed by Whitney et al. (2017) was useful for assessing the adaptive capacity of a resource-dependent, remote, and isolated First Nation community while focusing on human cognition and psychological factors in the face of social, environmental, and climate change.

Based on theory and empirical evidence, we suggest that policymakers should consider the psychological aspects of adaptation by adding perceived capacity into the assessment of total adaptive capacity. We recommend that the academic and practitioner communities consider both perceived and objective capacities when measuring and characterizing total adaptive capacity, particularly of remote and isolated Indigenous communities.

ACKNOWLEDGEMENTS

Special thanks to Kashechewan Chief Leo Friday, the Kashechewan First Nation community leaders and members, and to those who participated in the survey research. Financial support for this project was provided by the Northern Scientific Training Program and by UAlberta North and the Human Geography Program, Earth and Atmospheric Sciences Department, University of Alberta.

REFERENCES

Abdelnour, R. 2013. Albany River 2008 ice breakup: Forecasting the flood event, observations of the river during the spring breakup and the potential for mitigating the flooding risk of the Kashechewan and Fort Albany First Nation. CGU-HS Committee on River Ice Processes and the Environment, 17th Workshop on River Ice, 21–24 July 2013, Edmonton, Alberta.

Adger, N.W., Brooks, N., Bentham, G., Agnew, M., and Eriksen, S. 2004. New indicators of vulnerability and adaptive capacity. Technical Report 7. Norwich, England: Tyndall Centre for Climate Change Research, University of East Anglia. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.112.2300&rep=rep1&type=pdf

Adger, N.W., Arnell, N.W., and Tompkins, E.L. 2005. Successful adaptation to climate change across scales. Global Environmental Change 15(2):77–86. https://doi.org/10.1016/j.gloenvcha.2004.12.005

Alberini, A., Chiabai, A., and Muehlenbachs, L. 2006. Using expert judgment to assess adaptive capacity to climate change: Evidence from a conjoint choice survey. Global Environmental Change 16(2):123–144. https://doi.org/10.1016/j.gloenvcha.2006.02.001

Andrachuk, M., and Smit, B. 2012. Community-based vulnerability assessment of Tuktoyaktuk, NWT, Canada to environmental and socio-economic changes. Regional Environmental Change 12:867–885. https://doi.org/10.1007/s10113-012-0299-0

Awal, M.A, Harun-Ar Rashid, M., Tariqul Islam, A.F.M., Farouq Imam, M., and Rouf Sarkar, M.A. 2016. Measuring climate change vulnerability and its adaptive capacity: Policies and planning for Bangladesh. British Journal of Environment and Climate Change 6(4):279–298. https://doi.org/10.9734/BJECC/2016/27382

Barei, A. 2012. Where the river flows fast. MArch thesis, University of Waterloo, Ontario. UWSpace. http://hdl.handle.net/10012/6459

Berkes, F. 1999. Sacred ecology: Traditional ecological knowledge and resource management. Philadelphia, Pennsylvania: Taylor & Francis.

Berkes, F., and Ross, H. 2013. Community resilience: Toward an integrated approach. Society & Natural Resources: An International Journal 26(1):5–20. https://doi.org/10.1080/08941920.2012.736605

Berkes, F., Colding, J., and Folke, C. 2000. Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications 10(5):1251–1262. https://doi.org/10.1890/1051-0761(2000)010[1251:ROTEKA]2.0.CO;2

Berman, R., Quinn, C., and Paavola, J. 2012. The role of institutions in the transformation of coping capacity to sustainable adaptive capacity. Environmental Development 2:86–100. https://doi.org/10.1016/j.envdev.2012.03.017

Bhagwandass, S. 2016. Seeking higher ground: Riparian vulnerability and the annual evacuations of Kashechewan First Nation. In: Gemenne, F., Zickgraf, C., and Ionesco, D., eds. The state of environmental migration 2016: A review of 2015. Liége, Belgium: Presses Universitaries de Liége. 52–73.

Bishop, R. 2005. Freeing ourselves from neocolonial domination in research: A Kaupapa Maori approach to creating knowledge. In: Denzin, N.K., and Lincoln, Y.S., eds. The SAGE handbook of qualitative research, 3rd ed. Thousand Oaks, California: Sage. 109–138.

Boon, H.J. 2014. Disaster resilience in a flood-impacted rural Australian town. Natural Hazards, 71:683–701. https://doi.org/10.1007/s11069-013-0935-0

Brenkert, A.L., and Malone, E.L. 2005. Modeling vulnerability and resilience to climate change: A case study of India and Indian States. Climatic Change 72:57–102. https://doi.org/10.1007/s10584-005-5930-3

Brooks, N. 2003. Vulnerability, risk and adaptation: A conceptual framework. Working Paper 38. Norwich, England: Tyndall Centre for Climate Change Research, University of East Anglia.

Brooks, N., and Adger, N.W. 2004. Assessing and enhancing adaptive capacity. In: Lim, B., Spanger-Siegfried, E., Burton, I., Malone, E.L., and Huq, S., eds. Adaptation policy frameworks for climate change: Developing strategies, policies and measures. Cambridge: Cambridge University Press. 165–182.

Brooks, N., Adger, W.N., and Kelly, P.M. 2005. The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. Global Environmental Change 15(2):151–163. https://doi.org/10.1016/j.gloenvcha.2004.12.006

Bryman, A., and Bell, E. 2016. Social research methods, 4th Canadian ed. Don Mills, Ontario: Oxford University Press.

Buckland, J., and Rahman, M. 1999. Community-based disaster management during the 1997 Red River flood in Canada. Disasters 23(2):174–191. https://doi.org/10.1111/1467-7717.00112

CIER (Centre for Indigenous Environmental Resources). 2009. Climate risks and adaptive capacity in Aboriginal communities: An assessment south of 60 degrees latitude. Final report. Winnipeg, Manitoba: CIER. https://www.cakex.org/sites/default/files/documents/climate_risks_and_adaptive_capacity_in_aboriginal_communities-2.pdf

Cinner, J.E., McClanahan, T.R., and Wamukota, A. 2010. Differences in livelihoods, socioeconomic characteristics, and knowledge about the sea between fishers and non-fishers living near and far from marine parks on the Kenyan coast. Marine Policy 34(1):22–28. https://doi.org/10.1016/j.marpol.2009.04.003

Cohen, J. 1988. Statistical power analysis for the behavioral sciences, 2nd ed. Hillsdale, Mahwah, New Jersey: Lawrence Erlbaum Associates.

Cutter, S.L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., and Webb, J. 2008. A place-based model for understanding community resilience to natural disasters. Global Environmental Change 18(4):598–606. https://doi.org/10.1016/j.gloenvcha.2008.07.013

Dei, G.J.S., Hall, B.L., and Rosenberg, D.G., eds. 2000. Indigenous knowledges in global contexts: Multiple readings of our world. Toronto, Ontario: University of Toronto Press.

Del Pilar Moreno-Sánchez, R., and Maldonado, J.H. 2013. Adaptive capacity of fishing communities at marine protected areas: A case study from the Colombian Pacific, Ambio 42:985–996. https://doi.org/10.1007/s13280-013-0454-y

Donnelly, R.C., Stephen, D., Jamieson, K., Perkins, S., and Hinchberger, S.A. 2015. A description of the application of a new quantitative dam safety risk assessment tool for risk-informed decision making. 2015 Hydrovision International Conference, 14–17 July 2015, Portland, Oregon.

Eakin, H., and Lemos, M.C. 2006. Adaptation and the state: Latin America and the challenge of capacity-building under globalization. Global Environmental Change 16(1):7–18. https://doi.org/10.1016/j.gloenvcha.2005.10.004

Engle, N.L. 2011. Adaptive capacity and its assessment. Global Environmental Change 21(2):647–656. https://doi.org/10.1016/j.gloenvcha.2011.01.019

Engle, N.L., and Lemos, M.C. 2010. Unpacking governance: Building adaptive capacity to climate change of river basins in Brazil. Global Environmental Change 20(1):4–13. https://doi.org/10.1016/j.gloenvcha.2009.07.001

Ford, J.D., and Smit, B. 2004. A framework for assessing the vulnerability of communities in the Canadian Arctic to risks associated with climate change. Arctic 57(4):389–400. https://doi.org/10.14430/arctic516

Fritz, C.O., Morris, P.E., and Richler, J.J. 2012. Effect size estimates: Current use, calculations, and interpretation. Journal of Experimental Psychology: General, 141(1):2–18. https://doi.org/10.1037/a0024338

Gardezi, M. and Arbuckle, J.G. 2019. The influence of objective and perceived adaptive capacity of midwestern farmers' use of cover crops. Weather, Climate, and Society 11(3):665–679. https://doi.org/10.1175/WCAS-D-18-0086.1

George, P., Berkes, F., and Preston, R.J. 1996. Envisioning cultural, ecological and economic sustainability: The Cree communities of the Hudson and James Bay Lowland, Ontario. The Canadian Journal of Economics 29(Special issue: Part 1):S356–S360. https://doi.org/10.2307/136016

Gignac, G.E., and Szodorai, E.T. 2016. Effect size guidelines for individual differences researchers. Personality and Individual Differences 102:7478. https://doi.org/10.1016/j.paid.2016.06.069

Greenland, S., Senn, S.J., Rothman, K.J., Carlin, J.B., Poole, C., Goodman, S.N., and Altman, D.G. 2016. Statistical tests, *p* values, confidence intervals, and power: A guide to misinterpretations. European Journal of Epidemiology 31:337–350. https://doi.org/10.1007/s10654-016-0149-3

Grothmann, T., and Patt, A. 2005. Adaptive capacity and human cognition: The process of individual adaptation to climate change. Global Environmental Change 15(3):199–213. https://doi.org/10.1016/j.gloenvcha.2005.01.002

Gupta, J., Termeer, C., Klostermann, J., Meijerink, S., van den Brink, M., Jong, P., Nooteboom, S., and Bergsma, E. 2010. The adaptive capacity wheel: A method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. Environmental Science & Policy 13(6):459–471. https://doi.org/10.1016/j.envsci.2010.05.006

Haque, C.E. 2000. Risk assessment, emergency preparedness and response to hazards: The case of the 1997 Red River Valley flood, Canada. In: Papadopoulos, G.A., Murty, T., Venkatesh, S., and Blong, R., eds. Natural Hazards: State-of-the-art at the end of the second millennium. Dordrecht, The Netherlands: Kluwer Academic Publishers. 225–245.

Harries, K. 2008. Crees flown out as Albany River rises. The Indian Country, May 5.

Henly-Shepard, S., Anderson, C., Burnett, K., Cox, L.J., Kittinger, J.N., and Ka'aumoana, M. 2015. Quantifying household social resilience: A place-based approach in a rapidly transforming community. Natural Hazards 75:343–363. https://doi.org/10.1007/s11069-014-1328-8

ICI-Radio-Canada. 2016. 400 evacuees from Kashechewan still in Kapuskasing 2 years later. February 26. https://www.cbc.ca/news/canada/sudbury/northern-ontario-first-nation-evacuees-kashechewan-kapuskasing-1.3461523

Juhola, S., Peltonen, L., and Niemi, P. 2013. Assessing adaptive capacity to climate change in European regions. In: Schmidt-Thomé, P., and Greiving, S., eds. European climate vulnerabilities and adaptation: A spatial planning perspective, 1st ed. Hoboken, New Jersey: John Wiley & Sons, Ltd. 113–130. https://doi.org/10.1002/9781118474822.ch7

Kant, S., Vertinsky, I., Zheng, B., and Smith, P.M. 2013. Social, cultural, and land use determinants of the health and well-being of Aboriginal peoples of Canada: A path analysis. Journal of Public Health Policy 34(3):462–476. https://doi.org/10.1057/jphp.2013.27

Kawachi, I., Subramanian, S.V., and Kim, D., eds. 2008. Social capital and health. New York: Springer.

Keskitalo, E.C.H., Dannevig, H., Hovelsrud, G.K., West, J.J., and Swartling, Å.G. 2011. Adaptive capacity determinants in developed states: Examples from the Nordic countries and Russia. Regional Environmental Change 11:579–592. https://doi.org/10.1007/s10113-010-0182-9

Khalafzai, M.-A.K., McGee, T.K., and Parlee, B. 2019. Flooding in the James Bay region of northern Ontario, Canada: Learning from traditional knowledge of Kashechewan First Nation. International Journal of Disaster Risk Reduction 36: 101100. https://doi.org/10.1016/j.ijdrr.2019.101100

Kraemer, H.C., Morgan, G.A., Leech, N.L., Gliner, J.A., Vaske, J.J., and Harmon, R.J. 2003. Measures of clinical significance. Journal of the American Academy of Child & Adolescent Psychiatry 42(12):1524–1529. https://doi.org/10.1097/00004583-200312000-00022

Kudelik, G. 2015. Albany River. The Canadian Encyclopedia. https://thecanadianencyclopedia.ca/en/article/albany-river

Lee, J.W., Jones, P.S., Mineyama, Y., and Zhang, X.E. 2002. Cultural differences in responses to a likert scale. Research in Nursing & Health, 25(4):295–306. https://doi.org/10.1002/nur.10041

Lo, A.Y. 2013. The role of social norms in climate adaptation: Mediating risk perception and flood insurance purchase. Global Environmental Change 23(5):1249–1257. https://doi.org/10.1016/j.gloenvcha.2013.07.019

Lockwood, M., Raymond, C.M., Oczkowski, E., and Morrison, M. 2015. Measuring the dimensions of adaptive capacity: A psychometric approach. Ecology and Society 20(1): 37. https://doi.org/10.5751/ES-07203-200137

López-Marrero, T. 2010. An integrative approach to study and promote natural hazards adaptive capacity: A case study of two flood-prone communities in Puerto Rico. The Geographical Journal 176(2):150–163. https://doi.org/10.1111/j.1475-4959.2010.00353.x

Maldonado, J.H., and del Pilar Moreno-Sánchez, R. 2014. Estimating the adaptive capacity of local communities at marine protected areas in Latin America: A practical approach. Ecology and Society 19(1): 16. https://doi.org/10.5751/ES-05962-190116

McCarthy, D.D., Crandall, D.D., Whitelaw, G.S., General, Z., and Tsuji, L.J.S. 2011. A critical systems approach to social learning: Building adaptive capacity in social, ecological, epistemological (SEE) systems. Ecology and Society 16(3): 18. https://doi.org/10.5751/ES-04255-160318

McClanahan, T.R., Cinner, J.E., Maina, J., Graham, N.A.J., Daw, T.M., Stead, S.M., Wamukota, A., et al. 2008. Conservation action in a changing climate. Conservation Letters 1(2):53–59. https://doi.org/10.1111/j.1755-263X.2008.00008.x

McNeill, K., Binns, A., and Singh, A. 2017. Flood history analysis and socioeconomic implications of flooding for Indigenous Canadian communities. The Canadian Society for Bioengineering, Paper No. CSBE17137. Presented at the CSBE/SCGAB 2017 Annual Conference Canada, 6–10 August 2017, Winnipeg, Manitoba. http://www.csbe-scgab.ca/docs/meetings/2017/CSBE17137.pdf

Miller, J.L. 2012. Psychosocial capacity building in response to disasters. New York: Columbia University Press.

Murphy, K.R., Myors, B., and Wolach, A. 2014. Statistical power analysis: A simple and general model for traditional and modern hypothesis tests, 4th ed. New York: Routledge. https://doi.org/10.4324/9781315773155

Nakagawa,Y., and Shaw, R. 2004. Social capital: A missing link to disaster recovery. International Journal of Mass Emergencies and Disasters 22(1):5–34.

Nelson, D.R., Adger, W.N., and Brown, K. 2007. Adaptation to environmental change: Contributions of a resilience framework. Annual Review of Environment and Resources 32:395–419. https://doi.org/10.1146/annurev.energy.32.051807.090348

Newton, J. 1995. An assessment of coping with environmental hazards in northern Aboriginal communities. The Canadian Geographer 39(2):112–120. https://doi.org/10.1111/j.1541-0064.1995.tb00406.x

Paton, D., Gregg, C.E., Houghton, B.F., Lachman, R., Lachman, J., Johnston, D.M., and Wongbusarakum, S. 2008. The impact of the tsunami 2004 on coastal Thai communities: Assessing adaptive capacity. Disasters 32(1):106–119. https://doi.org/10.1111/j.1467-7717.2007.01029.x

Pelling, M. 1998. Participation, social capital and vulnerability to urban flooding in Guyana. Journal of International Development 10(4):469–486. https://doi.org/10.1002/(SICI)1099-1328(199806)10:4<469::AID-JID539>3.0.CO;2-4

Pope, A. 2006. Report on the Kashechewan and its people. Special Representative of the Minister of Indian and Northern Affairs Canada. https://central.bac-lac.gc.ca/.item?id=kfnp_e&op=pdf&app=Library

Posey, J. 2009. The determinants of vulnerability and adaptive capacity at the municipal level: Evidence from floodplain management programs in the United States. Global Environmental Change 19(4):482–493. https://doi.org/10.1016/j.gloenvcha.2009.06.003

Rehman, A.B. 2012. Issues of disaster management preparedness: A case study of Directive 20 of National Security Council Malaysia. International Journal of Business and Social Science 3(5):85–92.

Reininger, B.M., Rahbar, M.H., Lee, M., Chen, Z., Alam, S.R., Pope, J., and Adams, B. 2013. Social capital and disaster preparedness among low income Mexican Americans in a disaster prone area. Social Science & Medicine 83:50–60. https:/doi.org/10.1016/j.socscimed.2013.01.037

Seara, T., Clay, P.M., and Colburn, L.L. 2016. Perceived adaptive capacity and natural disasters: A fisheries case study. Global Environmental Change 38:49–57. https://doi.org/10.1016/j.gloenvcha.2016.01.006

Seng, D.S.C. 2013. Tsunami resilience: Multi-level institutional arrangements, architectures and system of governance for disaster risk preparedness in Indonesia. Environmental Science & Policy 29:57–70. https://doi.org/10.1016/j.envsci.2012.12.009

Shao, W., Xian, S., Lin, N., Kunreuther, H., Jackson, N., and Goidel, K. 2017. Understanding the effects of past flood events and perceived and estimated flood risks on individuals' voluntary flood insurance purchase behavior. Water Research 108:391–400. https://doi.org/10.1016/j.watres.2016.11.021

Siders, A.R. 2019. Adaptive capacity to climate change: A synthesis of concepts, methods, and findings in a fragmented field. WIREs Climate Change 10(3): e573. https://doi.org/10.1002/wcc.573

Smit, B., and Pilifosova, O. 2001. Adaptation to climate change in the context of sustainable development and equity. Chapter 18. Climate change 2001: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press. 877–912.

Smit, B., and Wandel, J. 2006. Adaptation, adaptive capacity and vulnerability. Global Environmental Change 16(3):282–292. https://doi.org/10.1016/j.gloenvcha.2006.03.008

Smit, B., Burton, I., Klein, R.J.T., and Street, R. 1999. The science of adaptation: A framework for assessment. Mitigation and Adaptation Strategies for Global Change 4(3-4):199–213.

Smit, B., Burton, I., Klein, R.J.T., and Wandel, J. 2000. An anatomy of adaptation to climate change and variability. Climatic Change 45:223–251. https://doi.org/10.1023/A:1005661622966

Swanson, D.A., Hiley, J.C., Venema, H.D., and Grosshans, R. 2009. Indicators of adaptive capacity to climate change for agriculture in the prairie region of Canada: Comparison with field observations. Working paper for the Prairie Climate Resilience Project. Winnipeg, Manitoba: International Institute for Sustainable Development. www.iisd.org/pdf/2007/climate_adaptive_cap.pdf

Tol, R.S.J., and Yohe, G.W. 2007. The weakest link hypothesis for adaptive capacity: An empirical test. Global Environmental Change 17(2):218–227. https://doi.org/10.1016/j.gloenvcha.2006.08.001

Tri-Council Policy Statement. 2014. Ethical conduct for research involving humans. Ottawa, Ontario: Secretariat on Responsible Conduct of Research, Government of Canada.

Wall, E., and Marzall, K. 2006. Adaptive capacity for climate change in Canadian rural communities. Local Environment 11(4):373–397. https://doi.org/10.1080/13549830600785506

Whitney, C.K., Bennett, N.J., Ban, N.C., Allison, E.H., Armitage, D., Blythe, J.L., Burt, J.M. et al. 2017. Adaptive capacity: From assessment to action in coastal social-ecological systems. Ecology and Society 22(2): 22. https://doi.org/10.5751/ES-09325-220222

Wilk, P., Maltby, A., and Cooke, M. 2017. Residential schools and the effects on Indigenous health and well-being in Canada—a scoping review. Public Health Reviews 38: 8. https://doi.org/10.1186/s40985-017-0055-6

Wilkinson, L. 1999. Statistical methods in psychology journals: Guidelines and explanations. American Psychologist 54(8):594–604. https://doi.org/10.1037/0003-066X.54.8.594

Yohe, G., and Tol, R.S.J. 2002. Indicators for social and economic coping capacity—moving toward a working definition of adaptive capacity. Global Environmental Change 12(1):25–40. https://doi.org/10.1016/S0959-3780(01)00026-7