Climate Change Adaptation to Local Transportation Risks Related to Climate Change in the Canadian Arctic

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Abstract

The Arctic is experiencing profound climatic transformations warming faster than the rest of the world. In the Canadian Arctic, the impact of climate change is affecting local mobility, particularly travel over sea ice with cascading sociocultural, economic and health effects for Inuit communities. Although, Indigenous people have a history of adapting to both climatic and environmental change, effective adaptation has become imperative for those living in the coastal communities as future change in climate will further disrupt local travel activities with negative implications for Indigenous livelihood and cultural practices. Using community-based participatory research with the Indigenous community of Pond Inlet and a quantitative approach to data collection, this research examined from local perspectives the cascading impacts of climate change for local travel in Arctic Canada. The research further assessed the potential adaptation strategies to reduce risk and examined the feasibility and effectiveness of adaptation practices to reduce risk to future changes in climate. Inuit observation of the cascading impacts of climate change for local travel include challenges with safe travel on ice, fewer days available to access hunting and fishing grounds and loss of traditional culture and skills. Impacts are further exacerbated by non-climatic factors such as increasing cost of fuel and traveling equipment. Findings show that there are adaptation practices that have high feasibility and effectiveness and are significant to cushion individuals within the community to reduce risk to future change in climate. This study therefore provides an opportunity to expand study on the implementation and risk reduction potential of adaptation practices related to local mobility in the Arctic. The research recommends strengthening local adaptation efforts by integrating traditional knowledge and cultural perspectives with Western science to foster effective adaptation to current impacts and reduce risk to safe travel among Inuit.

Keywords: Arctic, climate change impacts, local mobility, Indigenous communities, Inuit, feasibility, effectiveness, adaptation.

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Chapter 1

1.0 Introduction

1.1 Problem statement

It is now well known that the Arctic is experiencing one of the most rapid changes in climate globally, by warming at a rate that is four times the global average– a phenomenon known as Arctic amplification (Rantanen et al., 2022; McCrystall 2021; Box et al., 2019). Many of the changes are projected to increase in the future (McCrystall, 2021) with cascading direct and indirect risks for local transportation options and related services for people residing in the coastal Canadian Arctic communities (Vogel & Bullock, 2021; Dawson et al., 2020).

The consequences of climate change for local travel conditions in the Canadian Arctic, which include reduced access to and safety during travel over ice, lakes, and land, are likely to lead to profound implications on the mental health, physical, cultural, social and economic aspect of livelihood for Inuit communities (Wilson et al., 2021; Ford et al., 2008). For instance, change in ice conditions and snow cover are reducing trail access both on land and water, changing the seasonal hunting and fishing activities in Inuit Nunangat as traveling routes to traditional hunting grounds, cultural sites and between settlements are increasingly becoming inaccessible; affecting access to food, cultural identity and well-being (Ford et al., 2019). Similarly, the reduction in Arctic sea ice extent due to climate change has expanded open water areas largely contributing to the increase in maritime ship traffic in some Canadian Arctic communities such as Pond Inlet (Dawson et al., 2020; Dawson et al., 2018). While this provides opportunities for enhancing economic development (Weller, 2005), also presents significant risk for safe sea ice travel for Inuit (Wilson et al., 2021). Thus, the impact of climate change on local mobility for coastal communities in the Canadian Arctic poses both opportunities and challenges which demands effective adaptation planning. For the purpose of this research, local

mobility refers to any travel outside of a community over land, water, and ice. It thus excludes travel by plane and within a community.

Despite the challenges presented by climate-related conditions for local mobility, Canada's coastal communities are increasingly adapting through experience and practice to make safe travel decisions and reduce risks (Vogel & Bullock, 2021; Wilson et al., 2021; Ford et al., 2019). However, over the years, there is the increasing unpredictability of weather conditions even for experienced hunters due to climate change making safe travel over frozen grounds, open waters or sea ice more dangerous (Lemmen et al., 2016; Ford 2008). Responding to the challenges and opportunities that climate change may present, demands that coastal communities in the Arctic are able to plan effectively in order to meet both current impacts and predicted future risks (Intergovernmental Panel on Climate Change, IPCC 2021; Government of Nunavut, 2010). Effective adaptation is thus imperative to enhance the resilience and sustainability of Canada's coastal communities as they do not only face an increasing threat of climate change on local travel conditions but also the subsequent effects on local livelihoods.

Changes in the Arctic are having immense implications for local mobility (Ford et al., 2019), and the impacts currently being observed in the Arctic are expected to persist into the future as projections indicate continuous warming of temperatures (Council of Canadian Academies, CCA, 2019; Meredith et al., 2019; Lemmen et al., 2016; IPCC, 2013). This research aims to understand how climate change impacts local mobility, what (future) risks may exist and what are the most effective adaptation practices possible for reducing risk in the Canadian Arctic community of Pond Inlet. In direct response to the challenges associated with climate change and local mobility in Arctic Canada, the following research questions were established and include; (a) What are the observed direct and indirect impacts of climate change on local mobility and the subsequent potential cultural, social, economic and environmental effects, (b) What are the current effective adaptation practices and risk reduction options available in the

research community, and (c) How feasible and effective are the potential adaptation practices in reducing impacts and risks?

1.2 Research aim and objective

The overarching aim of this research is to '*better understand local perspectives on the cascading impacts of climate change for local travel in Arctic Canada and to assess potential adaptation* practices *to reduce future risk'*. This research focuses on individual adaptation practices to climate change impact but not governance or policy. This research contributes to increasing understanding of community perspectives on climate change impacts on local mobility over frozen grounds, open waters and sea ice, the subsequent sociocultural, economic, and environmental implications for the community of Pond Inlet. The specific research objectives include to:

a) Identify the perceived impact (current) and risk (future) of climate change on local mobilities (direct and indirect) including any cascading implications (that is access to food, human security, culture, safety etc), currently and based on future projections.
b) Identify the adaptation practices that maybe effective in reducing climate change induced impacts on local mobilities and cascading effects.
c) Assess the feasibility and the effectiveness of potential adaptation practices in reducing impacts (current) and risks (future).

For this study, direct impact of climate change is used to mean widespread change on the environment due to changes in climatic conditions such as flood, storms, wind intensity and extreme heat. Indirect impact of climate change refers to the consequences of climate change which influence how individuals and communities utilize the environment. For example, unstable ice conditions, reduction in sea ice area and thickness, muddy, slushy or damaged trails which determine when and how trails are accessed. Cascading impact of climate change refers to the series of secondary events that arise due to the occurrence of climate events leading to a natural, social or economic disruption (IPCC, 2022). The study thus explores the cascading

implications of climate change impact for local mobility within the research community. By exploring both the direct and indirect impacts of climate change, the research can expand knowledge on the degree to which climate change affects the research community and ways to direct interventions aimed at addressing climate change impacts on local mobilities. Assessing the feasibility and effectiveness of an adaptation practice serves as an important guide in recognizing responses that minimize risk to climate change (Williams et al., 2021). According to IPCC (2019, p.685), feasibility of an adaptation option is the "degree to which climate goals or response options are considered possible and/or desirable". Effectiveness assesses the outcome of an adaptation option in reducing risk based on achieving specified outcome (Williams et al., 2021).

1.3 Literature Review

This section focuses on and provides a brief discussion on themes that are relevant to climate change impacts on local mobility or local travel conditions, current adaptation practices and risk in the Arctic drawing on the perspectives, concepts and findings of other studies.

1.3.1 Impact of climate change in the Arctic

The Arctic climate is currently undergoing profound transformations as it is rapidly changing and warming faster than the rest of the world (World Meteorological Organization, WMO, 2022). Evidence shows that there has been significant increase in surface land temperatures in the Arctic since the 20th century with future warming rate projected to exceed the global rate (Rantanen et al., 2022). In North America, sea ice extent and thickness have decreased in the summer, snow cover duration and depth are also decreasing while increasing in Eurasia, permafrost temperature have also increased between 0.5 and 2.0 degrees since 1970 (IPCC, 2014a). The Arctic oceans are also warming rapidly with the highest warming in the Eurasian sector of the Arctic Ocean, the temperature trend over 1979–2021 locally exceeds 1.25^{0}C decade^{-1} (Rantenan et al., 2022). Precipitation has also significantly increased across all

seasons and datasets in the Arctic since the 1950s, especially in the North Atlantic subarctic (WMO, 2022).

In Canada, warming has already been recorded with surface land temperature increase by approximately 1.7^0C nearly doubling the global average rate (CCA, 2019) accompanied by frequent heat weaves, reduced snow and ice cover, thawing of permafrost and shrinking of Arctic Sea ice both in thickness and extent, glacier retreat and change in streamflow and patterns of precipitation (CCA, 2019; Lemmen et al., 2016; IPCC, 2014a). Across the northern coast of Canada, rapidly warming temperatures and increased precipitation have been documented with the rate of sea ice decline ranging from 2.9% to 10.4% per decade (Ford et al., 2018). Many of these changes are projected to increase in the future (McCrystall, 2021; Lemmen et al., 2016), with more than 8^0C warming in winter possible under a high-emission scenario by 2081–2100 (Ford et al., 2018).

Rising temperatures in the Arctic resulting in accelerated thawing of permafrost, changing precipitation patterns, changing sea dynamics, seal level rise and storms have the potential to destabilize physical infrastructure and related services particularly travel on sea ice and winter roads or land (Vogel & Bullock, 2021; CCA, 2019; IPCC, 2014a). The disruption caused due to climatic hazards may pose substantial challenges for Canadian Arctic communities that depend on ice to access trails both overland and by sea. It is therefore important to understand how current and future changes in climate potentially affects local mobility in the Canadian Arctic.

1.3.2 Climate change induced impacts for local mobility

Local transportation in the Arctic's coastal areas is considered highly sensitive to variabilities in climate. (Ford et al., 2023; Lemmen et al., 2016). Evidence from climate change impacts in the Arctic indicates that climate change can significantly increase risk to local travel (Vogel & Bullock, 2021; CCA, 2019; Ford et al., 2019; Larsen et al., 2014), over sea ice, which provides a main platform for culturally valued and important harvesting activities with associated effects

on local livelihood (Ford et al., 2018). The disruption, damages, delays, and risk caused across both land (such as ice roads) and water-based routes can disrupt conditions for local mobility which may significantly affect food security, health, culture, economic activities and traditional lifestyles of Indigenous communities in the Arctic (Ford et al., 2019; Ford et al., 2008).

For instance, impacts from extreme weather events, storms, flooding, or change sea ice conditions may create risks particularly for Indigenous communities to safely travel or engage in subsistence activities such as accessing hunting and fishing grounds (IPCC, 2014a). As indicated by Vogel and Bullock (2021), sea-ice instability may pose significant risk to the lives of Indigenous communities who are reliable on sea-ice formation to safely travel to hunt wildlife or gather traditional foods for sustenance, which have implications for food security for the communities.

Relatedly, extreme climatic conditions in the Arctic may increase exposure to coastal waves and erosion, flooding from extreme precipitation, sea level rise, high winds, storms and permafrost thaw exposes coastal infrastructure, travel equipment and routes to damages which can cause delay or reduce local mobilities in the form of less sea ice or land travel on winter roads and subsequently reduce hunting and fishing activities of community members (Vogel & Bullock, 2021; CCA, 2019; Auditor General of Canada, 2018; Warner, 2012; Weller, 2005). As explained by Inuit, traveling on land or ice trails in certain temperatures particularly in 0^{o}C margin or above, or under more changing ice conditions caused by climatic hazards can be dangerous (Ford et al., 2019). This is because, it poses discomfort for travellers, affects the functioning of snowmobiles or its use, causes difficulty in driving of all-terrain vehicle (ATV) (ibid), or use of dog team transportation of which alternative and more safe routes must be identified to ensure the continuation of traditional hunting activities (Government of Nunavut, 2010).

The disruption caused by extreme weather events increases risk and reduces reliability in accessing overland and marine trails causing significant changes in local mobilities as decision must be made to determine when and how to travel or access hunting grounds. This is particularly true for Inuit communities in the Canadian Arctic. According to Ford et al. (2008), climate change is exposing Inuit communities to hazards resulting in the alteration of their hunting and harvesting behaviour, social network and subsistence livelihood as all activities which require travel across land and sea is dependent on the exposure to climate risk which affects individual practice and decision making. For example, according to the authors, Inuit in the Arctic Bay hunted for traditional Narwhal from open waters in August and September, however, exposure to climate change and the use of snowmobile among other factors resulted in hunting for Narwhal from the floe edge in late spring (June and July). The increasing unpredictability of weather conditions and changing ice regimes makes travel across ice more dangerous compromising traditional hunting and harvesting activities which have negative implication for health and food security (Wilson et al., 2021; Lemmen et al., 2016). Inuit are forced to access new routes both on land and sea which could affect for example access to traditional food (Ford et al., 2019). Climate change which affects sea ice travel also have immense impact on the mental well-being of people as unstable sea ice conditions restrict being on the land, which is a way of healing, and experiencing calmness for Inuit (Cunsolo Willox et al., 2012; Wilson et al., 2021).

Warming of Arctic waters is also increasing maritime shipping traffic along the coast which presents new economic opportunities, but also increases the risk and vulnerability of coastal people and environments (Dawson et al., 2018; Ford et al., 2018; IPCC, 2012). A study by Dawson et al. (2018), shows that between the year 1990 and 2015, ship traffic in the Arctic has nearly tripled. Similarly, the satellite record between 2009 to 2018 confirms an increase in maritime ship traffic in the Northwest Passage and Northern Sea Route as sea ice reduces (WMO, 2022). For instance, in Canada due to reduced sea ice thickness and extent, there has

been an increase in shipping activities in Nunavut, which offers economic opportunities to community members; but also presents increased risk (Dawson et al., 2020; Auditor General of Canada, 2018) for local travel conditions over sea ice or open waters such as harm local boaters (Dawson et al., 2020).

The changing climatic conditions mean accessing trails on frozen grounds, sea ice and open waters are becoming more risky and less reliable with a large potential cascading effect on Arctic communities such as impact on hunting activities or travel. Hence, current observed impact of climate change (both direct and indirect) on local mobilities in the coastal Canadian Arctic requires equal adaptation response efforts in the transport-related sector (Vogel & Bullock, 2021) to ensure the long term-sustainability of coastal communities as well as the environmental resources on which they depend (Government of Nunavut, 2010).

1.3.3 Future climate projections and risks for local mobility

Climate change projections in the Arctic indicate that the region will continue to experience an increase in temperature (CCA, 2019; Meredith et al., 2019; IPCC, 2013). This will continue to pose travel-related challenges for coastal communities in the Arctic with severe consequences for Indigenous livelihoods. According to IPCC 4th assessment report (Meehl et al., 2007), the Arctic's climate is projected to experience continuous warming with a projected accelerated reduction in sea ice cover with some models projecting a complete disappearance of sea ice in summer towards the later part of the century as well as a projected increase in thaw depth and reduction in snow cover due to warming across the century. An earlier projection by Dumas et al. (2006), based on climate change scenarios and global climate model, specified a reduction in sea ice thickness of 30cm and 50cm and a decrease in the period of ice cover of 1 and 2 months by 2041-2060 and 2081-2100 respectively. A recent study by Ford et al. (2023), further projects a significant decrease in sea ice trail access across all regions in Inuit Nunavut from an average of about 146 days per year (currently) to 105 and 65 days under different projection

models due to increase in temperature making sea ice trail less dependable by the end of the century.

According to Ford et al. (2008), such changes will have significant influence on local mobilities over both land and sea as hunting on sea ice is dependent on the stability, thickness and extent of the ice while over land travel to access camps, hunting areas or visit neighbouring communities is dependent on the depth and type of snow; where for example, less snow could cause damage to snowmobiles while excessive snow slows snowmobiles and increases fuel cost. This will affect accessibility to hunting and fishing areas which may lead to food shortages, reduce social connectivity as well as affect the use of snowmobiles and boats on mainland and over waters respectively.

Future warming of Arctic Ocean will also expand navigability of some land and water-based routes (Ford et al., 2023), however, the subsistence economy might be negatively affected as change in sea ice conditions will make it more challenging to access and hunt for marine mammals (Larsen et al., 2014). The change will be more devastating for people who are more reliant on hunting for sustenance such as food, clothes and money as access to hunting areas become riskier and travel to hunting grounds at certain periods would be reduced (Ford et al., 2008). The projected increase in warming could result in the opening of Arctic waters for shipping (Lemmen et al., 2016), which will likely lengthen shipping season, increase shipping activities along shipping corridors, shorten shipping routes and disrupt other marine routes with potential increase in environmental and social impacts in coastal marine environments and shipping corridors (Weller, 2005). As posited by Prowse et al. (2009) the impact of future climate change on transportation will continue to increase across the Arctic coastal areas as the duration of summer ice is expected to reduce between 20 to 30 days by the year 2080, which will increase ship traffic and change the course of marine transportation.

The increase in ship traffic may disrupt local mobility on ice which provides community members access to hunting areas and damage small boats or harm smaller local boaters (Dawson et al., 2020). In the long run, warming in the Arctic will shift local mobility patterns and the dependence on frozen marine and freshwater routes may shift to open waters or land-based route (Larsen et al., 2014). However, changing to land-based routes may negatively affect some communities whose access to traditional food sources, wellbeing, and cultural identity is closely related to their ability to utilize ice routes (Ford et al., 2019).

There is no doubt that continuous warming in the Arctic climate will continue to pose substantial risk to both land and water-based areas used for local travel with potential subsequent impact on cultural, social and traditional activities (associated with hunting and fishing) for coastal Arctic communities. The risk necessitates the need for adaptation planning importantly addressing the current impacts and risks of climate change on local mobilities and the subsequent cultural, social and economic effects as indigenous coastal communities have increasingly depended on semi-permanent frozen grounds over land and water for sustenance, culture, and traditional way of life.

1.3.4 Adaptation practices for climate change induced impacts and risks to local mobility.

Indigenous communities in the Arctic have a record of being highly adaptable to new environmental conditions which has fostered the continuation of traditional ways of life. (Kumar et al., 2019, Larsen et al., 2014; McLean, 2010). Research has documented adaptation responses to climate change impacts on local transportation; increasing the knowledge and understanding of how Indigenous communities in the Arctic have managed to navigate travel even with the instability of travel routes under climate change (Carreta et al., 2022; Ford et al., 2019; Ford et al., 2008). Adaptation is the process of responding to climate change impacts to reduce risk and vulnerability, enhance adaptive capacity as well as take advantage of the opportunities (IPCC, 2019; Mohner, 2018; Lemmen et al., 2016; Reddy et al., 2015; Tompkins

et al., 2010). Adaptation practices on the other hand are a range of actions and measures that are available and suitable for addressing adaptation (IPCC, 2019).

Local adaptation efforts have been observed among Indigenous communities in the Canadian Arctic that are experiencing extreme climatic changes to manage the current and anticipated risk on local mobility. This includes technological approaches such as the use of VHF radio, GPS for safe travel and snowmobiles to travel long distance quickly without the use of dog team (Ford et al., 2008). Inuit hunters also use indigenous knowledge, skills and experience to adapt to changing conditions and make decisions to carefully travel over ice, navigate new travel and hunting routes and avoid hazards despite the decreasing ice stability; detect safe sea ice or hunt marine species in open water under different sea ice conditions. (Wilson et al., 2021; Pearce et al., 2015; McLean, 2010). Social networks are another adaptive measure through sharing of knowledge by experienced hunters and sharing of equipment such as GPS, VHF radios and other safety equipment for travel with those who cannot afford or do not have the time or the knowledge to travel and hunt for food during certain climatic exposures (Ford et al., 2008). Local communities also adapt to changing climatic conditions by switching routes to one that is deemed less risky to the prevailing climatic conditions, for example, from water to land routes (Ford et al., 2019). Pearce et al. (2015), explains that switching route also involve using alternative means of transportation for example, ATV or boats as a replacement for snow machines to unfamiliar hunting grounds or access hunting locations at different times of the year.

Adaptation plans and practices includes close collaborations between local communities and organizations in recognizing priorities and thematic areas that need to be addressed. As such territorial, federal, academic, industry, and non-profit organizations have worked on creating climate change adaptation information (on ice and weather conditions) to enhance the safety of sea ice travel for Inuit communities (Wilson et al., 2021). For example, (a) the Inuit Sea Ice

and Occupancy Project (ISIUOP) whose objective is to document and map local sea ice expertise including changes in patterns of sea ice use due to social and climate change; (b) the Nunavik Communities and Ice: Environmental change and community safety (Kativik) project which involves both Inuit and scientific knowledge to document climate change impact on winter trail networks that provide access to traditional harvesting grounds and resources in Nunavik and (c) the Polar View's Floe Edge Monitoring Service which provides assistance to Inuit communities in Nunavut and Northwest Territories to adapt their travel and hunting under changing sea ice conditions to plan safe and efficient travel across the frozen sea. (McLean, 2010). The Government of Canada is likewise making efforts to reduce risk of maritime transportation traffic impacts on local communities by developing a network of low-impact shipping corridors in the Arctic (Carter et al., 2018). This initiative may also reduce the impacts that increase in maritime traffic may pose for accessing local travel over open waters or sea ice Thus, adaptation measures among Indigenous people in the Arctic are facilitated by institutional support, strong social networks, land-based skills, access to resources and extensive traditional knowledge and cultural repertoire to enhance capacity (Ford et al., 2019; Kumar et al., 2019; Larsen et al., 2014; Ford et al., 2008).

Although indigenous communities in the Arctic have shown persistent resilience and adaptability to environmental change, climate change is a highly complex and dynamic phenomena which cannot be addressed in isolation as the ability to adapt is influenced by other interconnected socio-economic and institutional factors which determines one's adaptive capacity to current and future climatic exposure (Sanchez; 2020; CCA, 2019; Meredith et al., 2019; IPCC, 2014b; Government of Nunavut, 2010; Moser & Ekstrom, 2010). In this respect, not all adaptation practices may be accessible to everyone as adaptation among Indigenous people in the Arctic is partly determined by availability of financial or social capital (Pearce et al., 2015), which may exacerbate the problem of ensuring safe sea ice travel for Inuit (Wilson et al., 2021). For instance, adaptation measures which involves cost such as GPS, snowmobile

or VHF radio is dependent on one's ability to afford the cost or access such equipment from family members to safely travel (Ford et al., 2008). Therefore, those who are unable to access the equipment either by purchase or through family members are more at risk to unpredictable exposure which will impact how and when they travel in certain climatic condition, affecting the ability to sustain daily needs, work or engage in outdoor activities. Similarly, there has been the potential erosion of the transmission of traditional knowledge and skills which are relevant for safe sea ice travel and navigating hunting routes due to the shift to wage employment (Wilson et al., 2021) and younger generations shifting towards a more western lifestyle due to current socio-economic and cultural trends in certain communities (McLean, 2010).

Although local adaptation to climate change exists, the complex socioeconomic and political factors as well as the rapidity of climate change in the Arctic and its impacts may exceed the adaptive capacity of local residents to successfully adapt; as the decline in Arctic Sea ice conditions is happening at a rate that surpasses most of the earlier generation model projections (IPCC, 2014a; Larsen et al., 2014).This is particularly true for Inuit where climate change is particularly eroding the predictability of weather conditions for safe sea ice travel (Pearce et al., 2010; Ford et al., 2008).

With warming in the Arctic significantly affecting local mobility and the cascading potential effect on local livelihood, addressing climate change and obtaining the anticipated results require commitments and strong collaboration between governments, private actors and individuals at various levels. For this reason, effective adaptation efforts and planning requires incorporating traditional knowledge and Indigenous cultural perspectives which is considered significant in addressing climate related issues to advance effective institutional collaboration with traditional people and produce knowledge aimed at addressing the adaptation needs, enhancing adaptive capacity and resilience of Indigenous communities in the Arctic (Vogel & Bullock, 2021; Ford et al., 2019; Larsen et al., 2014; McLean, 2010.)

1.3.5 Measuring adaptation

Although there are many water-related adaptation responses (that is if the hazard involves flood, extreme rainfall events, melting and thawing of cryosphere), the effectiveness of these responses as well as their benefits in reducing future climate risk are not clear (Carreta et al., 2022). Adaptation research and negotiation seems to fall behind mitigation efforts as international bodies, NGO's, governments and adaptation and development specialists face difficulties in clearly describing what constitutes effective adaptation, how to monitor its implementation and effectiveness or how to differentiate it from effective development (IPCC, 2014b). Unlike mitigation, the task to measure adaptation is not straightforward due to the local and context-specific nature of adaptation as well as the strong links and overlaps with development (UNEP, 2018). The benefits of adaptation in quantitative terms are mostly difficult to model because it involves reducing impacts that are sector, location and context specific as well as involving a blend of interventions such as capacity building that are very challenging to model but which are significant for effective adaptation (Watkiss, 2022).

According to IPCC (2007), measuring what constitutes effective adaptation is highly dependent on specific geographical and climate risk factors as well as institutional, political and financial constraints. Moser and Ekstrom (2010), also argue that adaptation is government, context and problem specific. Hence, adaptation does not encompass a single quantitative target and it will be difficult to measure the progress with a single adaptation metric pertaining to all risk and sectors or at the global level (United Nations Environment Programme, UNEP, 2018; Leiter et al., 2017). Adaptation assessment should therefore encompass the broader policy context and other non-climatic factors whilst addressing multiple objectives (Watkiss, 2022).

Despite the challenges in tracking and measuring adaptation progress, or the lack of consensus on what constitutes effective adaptation, the demand to enhance adaptation assessment and tracking is growing gradually (Singh et al., 2022; Berrang-Ford et al., 2019). Being aware of the degree to which adaptation responses have contributed to reducing climate risk is crucial

in evaluating the effectiveness of adaptation responses and inform future decision (Berrang-Ford et al., 2021). Adaptation metrics focuses on measuring and comparing the result of adaptation responses to climate change (Christiansen et al., 2018). Adaptation metrics although at the early stages of development and application (Leiter et al., 2019) are being used by researchers to track and assess climate change adaptation actions, needs and progress (Tubiello & Rosenzweig, 2008). Adaptation metrics are important as they deepen understandings of what works and what does not, why and under what circumstances and serve as a guide for future adaptation efforts (Leiter et al., 2019). For this research, it is significant to assess the effectiveness of the various adaptation practices used over the years among Indigenous Arctic communities in dealing with exposure to climatic hazards. This is helps to enhance adaptation practices that addresses adaptation needs for safer travel to future risk and vulnerability to changes in climate.

1.4 Conceptual framework

Building on the literature reviewed above, the conceptual framework developed for this research is based on the premise that climate change indirectly creates risk for both water and land-based routes (such as muddy and unstable ice trails), through the direct effect of melting of ice, flooding, thawing of permafrost which affects safe travel for coastal Arctic communities as shown in Figure 1. Besides the effect of climate change, anthropogenic activity such as the increase in maritime traffic due to climate change further increases the risk for safe travel on sea ice or open waters exposing Arctic communities to double impact of climate change. The impact presents risks to local mobility on land, open water and sea ice in diverse ways with cascading effects on the social, cultural and traditional way of life. Coastal communities must not only adapt to the effect of climate change in restricting access and local mobility on land, water and sea ice but also the sociocultural, economic or environmental patterns of change.

The impact of climate change on local mobility initiates adaptation response to reduce risk (such as choosing alternative routes) for safe travel. The adaptive response of indigenous

coastal communities is facilitated by socioeconomic and institutional factors such as income, government policies which determines how people can adapt to and effectively manage the challenges of climate change for safe travel (Figure 1). Local adaptation response may lead to various outcomes such as reduced risk to safe travel. Analysing adaptation responses helps to assess progress or effectiveness to reduce current impact or ability to reduce risk in a changing climate through rigorous research and practices. This can initiate a change in prevailing conditions that impacts local mobility or influences local adaptation and subsequently the outcome creates a feedback loop as indicated with the purple arrow.

The structure of the conceptual framework takes into consideration 3 key components. a) *Understanding,* which involves identifying and understanding the problem in other to make key decisions; b) *Planning,* which involves identifying adaptation options, challenges, the structures involved (example, government, social networking) and selection of options; and c) *Analysing* the outcome of the implemented adaptation response options to access the effectiveness or feasibility (Moser & Ekstrom, 2010).

The advantage of this framework in answering and driving the research objective is that it allows for comparison between both the direct and indirect impact of climate change on local mobility and provides insight into the adaptation process. The framework is also appropriate for this research as it identifies the various factors that facilitate the adaptation process. Additionally, the framework is outcome-oriented and therefore does not only take into consideration the adaptation process but allows for assessing the response outcome in adapting to the impact of climate change on local mobility.

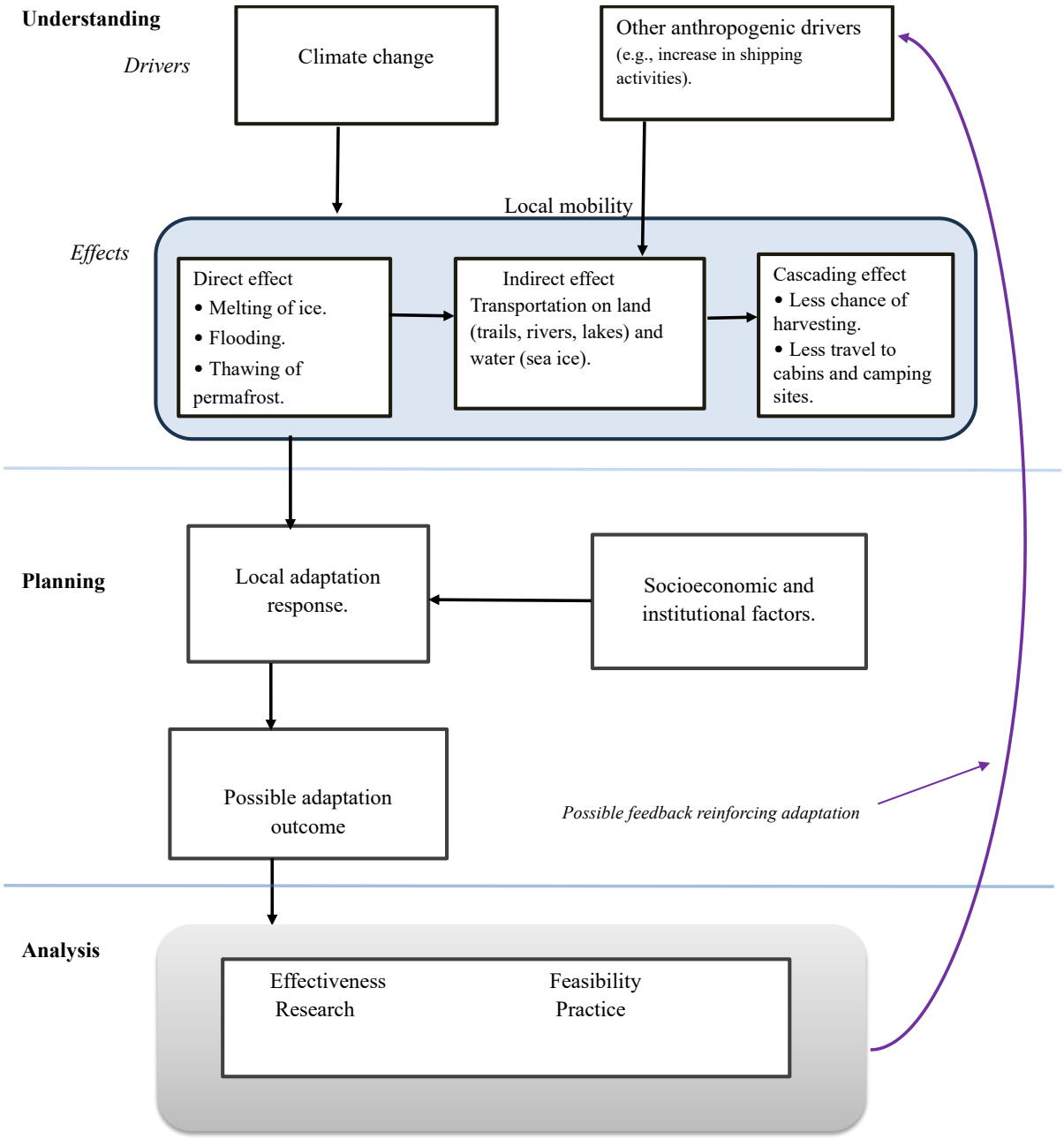

Fig 1: A framework conceptualising climate change impact on local mobility, local adaptation response and outcome. (Partially adopted from Brosse et al., 2022).

1.5 Methodology

Pond Inlet was selected for the research due to its location in Nunavut which is reported to experience current and projected severity of climate change in the territory (Ford et al., 2008). The community falls within the category of high-risk area being both a coastal community and its location in Northern Canada (CCA, 2019). Also, the community experiences high ship

traffic in the area (Dawson et al., 2018) and is dependent on sea ice, lakes, rivers, ocean and frozen grounds as a means of transportation of which climate change is posing significant risk (Ford et al., 2023; 2019). Thus, Pond Inlet is particularly relevant to this research as it provides a better perspective of current observed impact of climate change on local mobility and process of adaptation.

This research built on a community-based participatory approach. It involved a collaboration with Ikaarvik a local organization in Pond Inlet. Ikaarvik assisted with the research process such as the developing of questions, recruiting of participants and validation of results[1]. The research used a survey design approach to data collection through a questionnaire. The questionnaire was structured into themes and questions were developed based on the research objectives. Participants were asked questions to identify climate change impact and risk to local mobility, adaptation practices employed to reduce vulnerability and the feasibility and effectiveness of the adaptation practices. Questions also explored participant perspective on the impact of ship traffic to local mobility around the community[2]. Collection of data involved fieldwork, which involved a visit to the research community where I directly engaged with community members and pursued to understand the realities and experiences of the community. Ikaarvik, however directly recruited participants for the survey by engaging with participants and posting the link to the survey on the community's Facebook page to reach a wide range of people. Participants involved in the survey were 18 years and above with different genders and from diverse work industries and educational background. Both purposive and snowball sampling were employed to ensure that participants recruited were significant representation of different demographic groups within the community. Data collection lasted for 6 weeks.

[1] Refer to Appendix for detailed information on methods.
[2] This survey was conducted in a different time period within the community.

Data was analysed using both qualitative and quantitative methods of analysis. Integrating both qualitative and quantitative analysis, allowed the findings of this research to be presented by transitioning from individual narratives to the broader community perspective resulting in a more comprehensive and robust understanding of how climate change impacts local mobility in the community (Cunsolo Willox et al., 2012). Quantitative analysis was done with the assistance of the software program Qualtrics and then data was also transferred to Excel for a better graphic view. Inclusion and exclusion analysis was done to distinguish major responses from minor responses and final trends discussed. Qualitative data was analysed by transcribing and coding to deductively identify emerging themes as well as differences in responses.

1.6 Organisation of thesis

The thesis is divided into four chapters. Chapter one is the introductory section which provides the problem statement of the research, specific research objectives, review of literature relevant to the research and the conceptual basis of the study. Chapter 2 is the article section of the thesis which provides the abstract, a short introduction to the study, a brief literature review, empirical methods used for the study, discussion of results and conclusion. Chapter 3 discusses the empirical findings of the research relating it to other literature and contribution of the research to policy and academia. Chapter 4 provides the conclusion of the research highlighting the limitations of the study and recommendations for future research needs. These chapters are followed by the appendix which provides detailed information about the empirical tools used in the data collection process, analysis of data as well as a brief description of the research community and ethics and glossary.

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Chapter 2

Climate change adaptation for local transportation risks in the Canadian Arctic town of Pond Inlet, Nunavut.

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To be submitted to: *Arctic* or another similar journal.

Abstract

Climate change in the Arctic is significantly impacting local mobility among Inuit. Despite the documented literature on adaptation practices among Inuit the effectiveness and feasibility of local adaptation practices in reducing risk to future climate is not clearly defined in scholarly literature. Moreso, are the concerns raised about the feasibility and effectiveness of current adaptation practices to future climate change. This paper focuses on Indigenous perspectives and local observations of climate change impact and risk to local mobility in the Canadian Arctic. This research uses community-based participatory research with the Indigenous community Pond Inlet and a quantitative approach to data collection to understand local perspectives on the cascading impacts of climate change for local travel in Arctic Canada. The study examined adaptation practices used to navigate safe travel in the changing climate. This paper also assessed the feasibility and effectiveness of 19 adaptation practices employed in the community. Findings illustrate that climate change is negatively affecting local mobility through change in ice dynamics which is disrupting access to hunting and fishing grounds resulting in sociocultural, economic and health implications. Evidence from this research shows high implementation and risk reduction potential for 7 adaptation practices. Our results further highlight the need to strengthen regional and institutional adaptation plans and implementation and integrate traditional knowledge into institutional plans. We acknowledge that the ability of Inuit to address current challenges and risk associated with the rapidly changing climate will depend on whether current adaptation practices are presently feasible and effective and able to meet future extreme events.

Key words: Arctic, Climate change impacts, local mobility, adaptation, effectiveness, feasibility, Indigenous communities.

2.0 Introduction

There is consensus that Arctic climate has gone through unprecedented and rapid changes over the last few decades with extreme events resulting in loss of sea ice, snow cover on land and permafrost thaw (Intergovernmental Panel on Climate change, IPCC, 2022; World Meteorological Organization, WMO, 2022; Council of Canadian Academies, CCA, 2019; IPCC, 2019; Pearce et al., 2015; IPCC, 2013). Climate models and instrumental observations shows that warming is happening at a rate that is four times the global average– a phenomenon known as Arctic amplification (Rantanen et al., 2022; McCrystall 2021; Box et al., 2019). Many of the changes are projected to increase in the future (McCrystall, 2021; Lemmen et al., 2016) with cascading direct and indirect risks for local travel for people residing in the coastal Canadian Arctic (Ford et al., 2023; Vogel & Bullock, 2021; Dawson et al., 2020; CCA, 2019; Ford et al., 2019; Ford et al., 2018; Larsen et al., 2014).

For Indigenous communities in the coastal areas of Arctic Canada who are reliant on sea ice, lakes, rivers, open water and frozen ground as the main form of travel, current changes in climatic conditions are already having profound impact for local travel conditions through changes in temperature, increased frequency and intensity of extreme events, changing patterns of precipitation and sea ice dynamics (Wilson et al., 2021; Pearce et al., 2010). These events have intensified hazards associated with safe travel affecting access to hunting and fishing grounds and posing significant risk to lives with cascading sociocultural, economic and health implications (Vogel et al., 2021; Wilson et al., 2021; Ford 2019; Pearce et al., 2015; Ford et al., 2012; Warner, 2012; Pearce et al., 2010; Ford et al., 2008). For instance, change in ice conditions and snow cover have been reported to reduce trail access both on land and water, changing the seasonal hunting and fishing activities of Inuit as travel routes to traditional hunting grounds, cultural sites, and between settlements are increasingly becoming inaccessible, affecting access to food, cultural identity and well-being (Ford et al., 2019).

Climate change projections further suggests that the Arctic will continue to experience increase in temperature (IPCC, 2022; CCA, 2019; Meredith et al., 2019; IPCC, 2013; Meehl et al., 2007). Projected increase in Arctic temperature will result in continuous loss of sea ice both in thickness and extent and snow cover on land especially towards the later part of the century (IPCC, 2019; IPCC, 2013; Meehl et al., 2007; Dumas et al., 2006). These events are expected to decrease sea ice trail access across all regions in Inuit Nunavut making sea ice trail less dependable by the end of the century (Ford et al., 2023). With these projections, current hazards associated with travel on ice will continue into the future with significant implications for subsistence activities (Ford et al., 2023; IPCC 2022; Pearce et al., 2015; Ford et al., 2012; Larsen et al., 2014; Ford et al., 2008)

Even with these challenges, Inuit have been reported to have a history of adapting to environmental changes including climate change and have managed to navigate travel even with the instability of ice conditions compromising travel routes (Carreta et al., 2022; Wilson et al., 2021; Ford et al., 2019; Pearce et al., 2015; Pearce et al., 2011; McLean, 2010; Ford et al., 2008). Present day Inuit societies are known to adapt to extreme events by incorporating both traditional experiences and observations and modern technologies to reduce risk and make safe travel (Wilson et al., 2021; Pearce et al., 2015; Ford et al., 2018; McLean, 2010; Ford et al., 2008). Despite these efforts, challenges may exist as the ability to adapt at the individual or household level is influenced by other interconnected sociocultural, economic and institutional factors which determines one's adaptive capacity to current and future climatic exposure (Sanchez; 2020; CCA, 2019; Meredith et al., 2019; IPCC, 2014b; Government of Nunavut, 2010; Moser & Ekstrom, 2010). Reported factors that influence the adaptive capacity of Indigenous communities to climatic exposures that affect local mobilities include financial or social capital (e.g., fuel, hunting equipment); colonialism (shift towards wage employment); availability of time; Inuit knowledge, experience and land-based skills; access to technological options such as GPS, satellite phones; social network (sharing equipment and food); emergency

preparedness capability (Ford et al., 2023; Wilson et al., 2021; Pearce et al., 2015; McLean, 2010; Ford et al., 2008).

Although there are extensive documented adaptation practices across Arctic Canada, there is limited understanding and information regarding how effective and feasible the adaptation practices have been over the years. Concerns have been raised about the feasibility of current adaptation practices to future climate change in the Arctic Canada (Ford et al., 2023). Moreso, is the growing recognition of the significance in assessing the effectiveness and feasibility of adaptation practices in minimizing risk to climate change (Singh et al., 2022; Berrang-Ford et al., 2021; Williams et al., 2021; Owen, 2020; Ford et al., 2013). Additionally, there is the concern that current socioeconomic and institutional factors combined with the rapidity of climate change and its impacts may exceed the adaptive capacity of Indigenous communities to successfully adapt as the decline in Arctic Sea ice conditions is happening at a rate that surpasses most of the earlier generation model projections (IPCC, 2014a; Larsen et al., 2014).

Based on the understanding above, this paper examines from local perspectives and understanding, climate change impacts and risks for local mobility in the Inuit community of Pond Inlet. We use local mobility to refer to any travel outside of the community over land, water, and ice. It thus excludes travel by plane and within the community. The paper identified current adaptation practices used to reduce climate change impact and finally assessed the feasibility and effectiveness of the various adaptation practices. This paper draws insight from the effectiveness and feasibility assessment illustrated by IPCC (2022), Singh et al., (2022) and Owen (2020) and Williams et al. (2021) to assess the effectiveness and feasibility of adaptation practices to climate change impacts on local mobility in the research community.

2.1 Conceptualising climate change impact and risk for local mobility

We conceptualise climate change impacts and adaptation for local mobility taking insight from Moser and Ekstrom's (2010) barriers to climate change adaptation framework and Brosse et

al.'s (2022) proposed direct and indirect effect of climate change framework to understand the process and degree to which climate change impacts local mobility and the cascading effect. We describe the conceptual framework of this research paper by drawing on knowledge from research conducted across Arctic Canada on climate change impacts and adaptation.

This paper characterizes that climate change indirectly creates risk for both water and land-based routes through the direct effect of melting of ice, flooding, thawing of permafrost, change in snow and ice conditions which affects safe travel over ice and open waters (Ford et al., 2023; Wilson et al., 2021; Ford et al., 2019) as shown in Figure 1. Besides the effect of climate change, anthropogenic activity such as the increase in maritime traffic due to climate change further increases the risk for safe travel on sea ice or open waters exposing Arctic communities to double impact of climate change (Dawson et al., 2020; Prowse, 2008). The impact of climate change presents risks to local mobility over land, open water (lakes, rivers, sea water) and sea ice during certain seasons in diverse ways with cascading effects on the social, cultural and traditional way of life (Pearce et al., 2015). Inuit in the Arctic must not only adapt to the effect of climate change in restricting access and local mobility on land, open water and sea ice but also the sociocultural, economic or environmental patterns of change.

The impact of climate change on local mobility initiates adaptation responses such as choosing alternative routes to reduce risk for safe travel. Adaptive responses among Indigenous coastal communities are facilitated by socioeconomic and institutional factors such as income or government policies which determine how people can adapt to and effectively manage the challenges associated with climate change impacts for safe travel (Figure 1). Local adaptation responses may lead to various outcomes such as reduced risk to safe travel and are improved by analysing the feasibility and effectiveness of adaptation practices. Assessing the implementation and risk reduction potential and progress of existing adaptation practices through monitoring/research and practice can initiate a change in prevailing conditions that

impacts local mobility or influences local adaptation and subsequently the outcome creating a feedback loop (as indicated by the purple arrow).

The structure of the conceptual framework takes into consideration 3 key components. a) *Understanding,* which involves identifying and understanding the problem in other to make key decisions; b) *Planning,* which involves identifying adaptation options, challenges, the structures involved (example, government, social networking) and selection of options; and c) *Analysing* the outcome of the implemented adaptation response options to access the effectiveness or feasibility (Moser & Ekstrom, 2010). The advantage of this framework in answering and driving the research objective is that it allows for comparison between the direct, indirect and cascading effect of climate change on local mobility and provides insight into the adaptation process. The framework is outcome-oriented and does not only take into consideration the adaptation process but allows for assessing the response outcome.

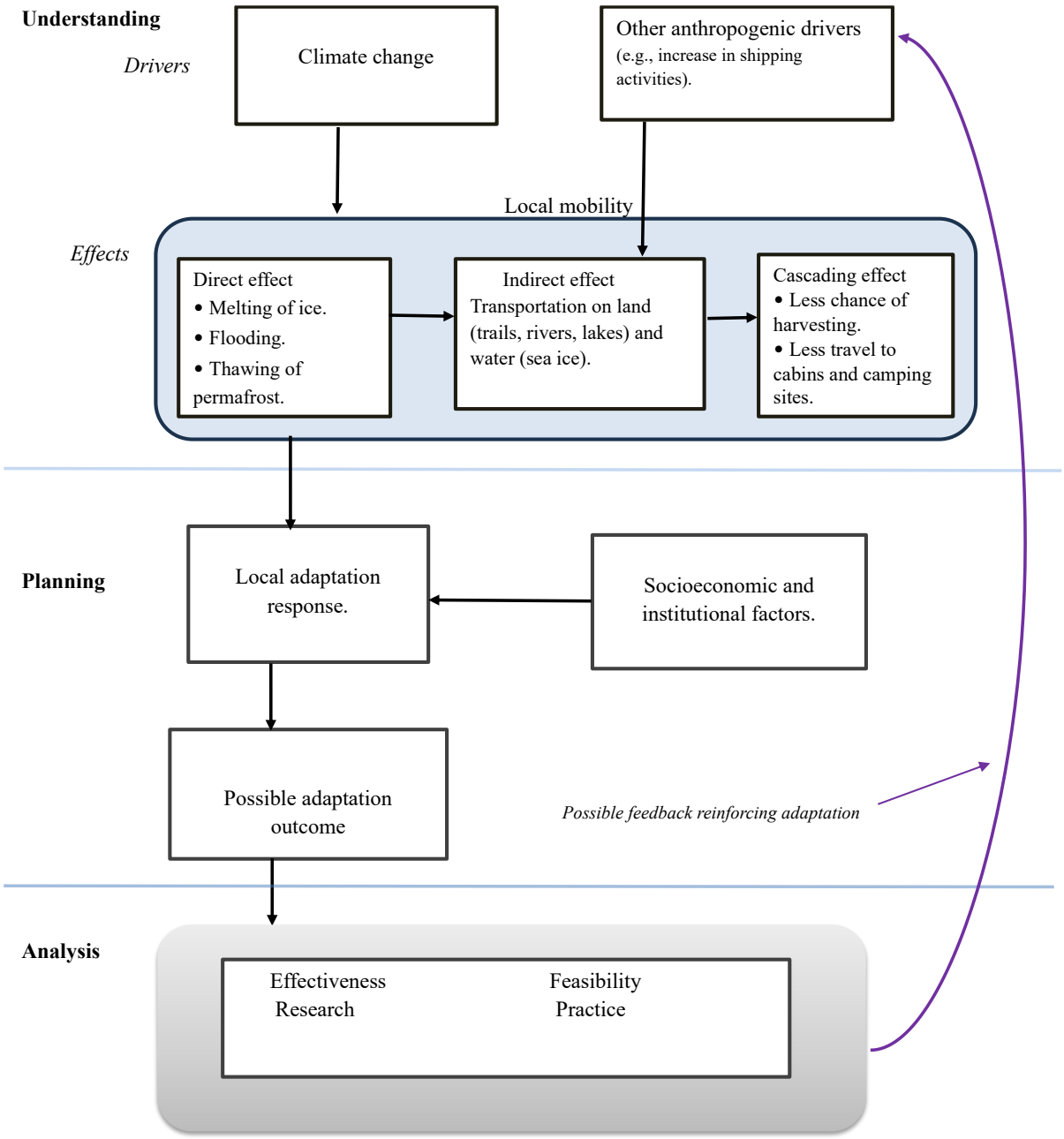

Fig 1: A framework conceptualising climate change impact on local mobility, local adaptation response and outcome. (Partially adopted from Brosse et al., 2022).

2.2 Methodology

2.2.1 Study area: This research focuses on the Pond Inlet, located in the Qikiqtaaluk Region of the Canadian Nunavut Territory (Figure 2). The community covers a land mass of 170.83 km^2 with 95% of the population predominantly Inuit and is undergoing rapid changes in climate. Pond Inlet is a remote coastal community and like other communities located along the coast is highly dependent on sea ice and open waters for travel and hunting making it very sensitive to changes in climatic conditions (Cunsolo Willox et al., 2012; Ford et al., 2012; Ford

et al. 2008). The community is characterized by a mixed economy of traditional subsistence activities including hunting, fishing and gathering and formal wage-based activities including administration, business finance, government services, tourism and businesses relating to arts, crafts and wildlife harvesting (Aarluk Consulting Inc. 2011).

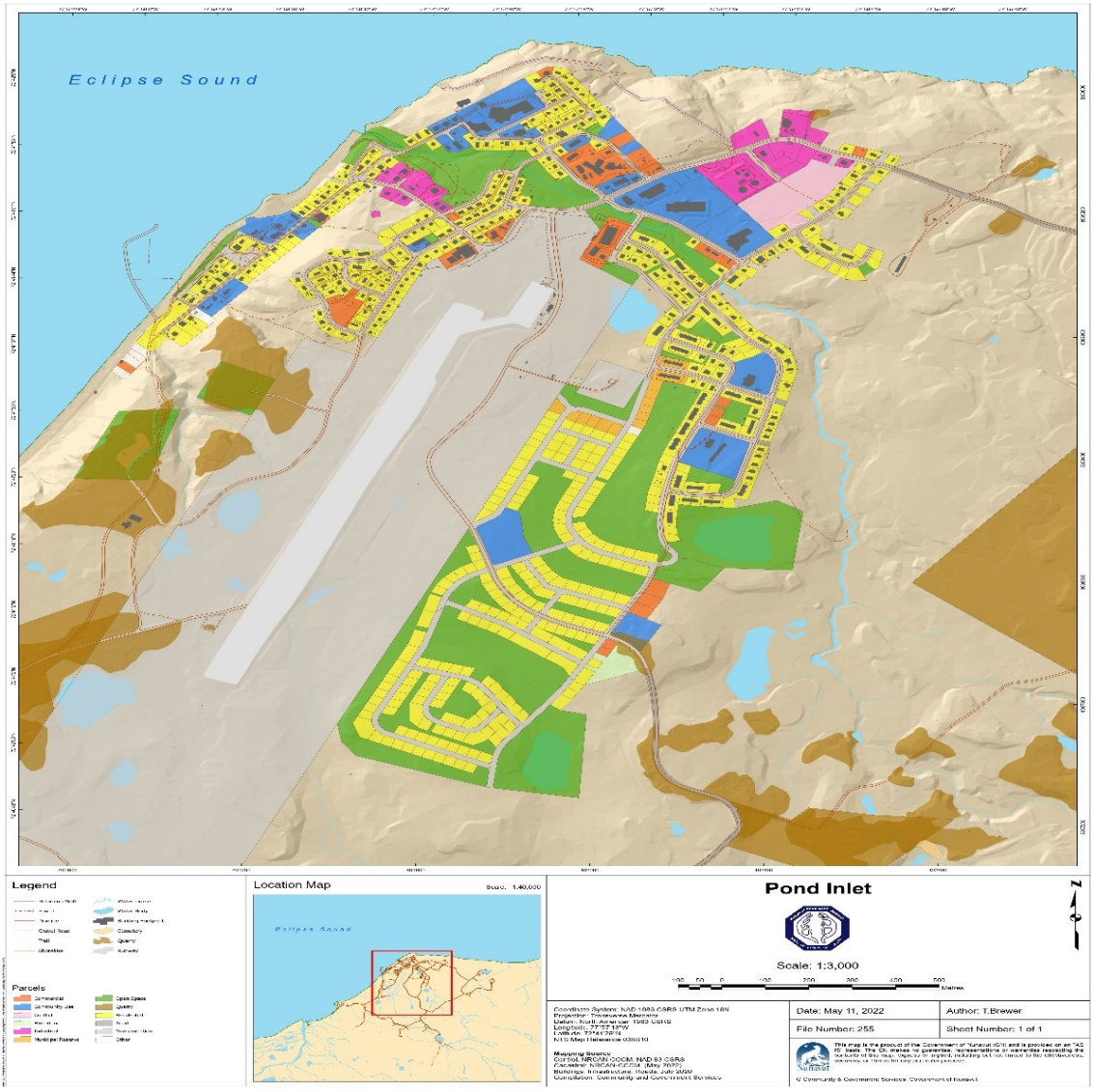

Figure 2. Community base map of Pond inlet.
Source: Government of Nunavut, Community and Government Services Planning and Lands Division. Accessed on 16 June, 2023.

2.2.2 Data collection: The research builds on a community-based participatory approach where we actively involved community stakeholders help to identify and address the research priorities of the community (Israel et al., 1998; Baum et al., 2006). For this research, it involved a collaboration with Ikaarvik a local organization in Pond Inlet which assisted in co-designing this research process to ensure relevancy of the research for both the research team and the community. Through constant dialogue, the research needs of the community were identified and were incorporated into this research. Ikaarvik was involved in developing the research questions, recruiting participants and validation and dissemination of results. The research used a survey design approach to data collection which involved a survey of residents. The survey questionnaire was structured by themes where questions were developed based on the research objectives. Questions captured the background of respondents, observations, experience and opinions on climate change and impacts for local mobility. Participants were asked to identify adaptation practices employed to reduce vulnerability, and the feasibility and effectiveness of the adaptation practices to reduce risk. Questions also explored participant perspective on the impact of ship traffic to local mobility around the community[3]. Climate models were employed to explore participant perceptions and opinions regarding the implications of projected changes in climate on ice conditions and local mobility, their exposure sensitivity and adaptive capacity to future anticipated changes in climate (Pearce et al., 2010). Primary data collection involved a visit to the research community where the first author who being a new settler and had no previous research experience with an Indigenous community in the Arctic pursued to interact with community members and get involved in the experiences of the community. Ikaarvik, recruited participants for the survey by directly engaging with participants and also posted the link to the survey on the community's Facebook page to reach a wide range of participants. Purposive sampling was used to ensure that the opinions of participants of different age cohort (specifically 18 and above), gender, education

[3] This survey was conducted in a different time period within the community.

and occupation were included. In other to reach the desired group of people, snowball sampling method was also used, where recruited participants referred other individuals who were willing to participate in the survey.

The survey was administered online to allow flexibility thus majority of the survey was done in the residential homes of the participants. The survey was conducted in English as majority of participants spoke English. However, participants who were not comfortable to take the survey in English were given an option to be assisted by the research partners or a family member using Inuktitut. In this case, the assistant identifies as a witness to the survey. The questionnaire took approximately 30 to 45 minutes to complete. Questions were both in closed and open-ended format to ensure that participants were able to provide information in their own words which better reflected their perspectives and opinions. Data collection lasted for 6 weeks from the month of February to March after which data analysis begun. Data was supplemented by a review of relevant literature such as government reports, journal articles, books and websites focusing on observed and projected climate change, impacts and information on adaptation practices in the Arctic. The series of data methods allowed for rigour in the data collection process which aided in analysing extremely diverse findings.

2.2.3 Ethics approval and participant consent

Ethics approval was obtained from the University of Ottawa Research Ethics Board to ensure that the research followed all applicable guidelines. As part of conducting this research with Ikaarvik, the research ensured that the code of ethics of the organization was respected. License was also obtained from Nunavut Research Institute (NRI) prior to data collection. Participants provided individual consent before participating in the research.

2.2.4 Data analysis: Incomplete answers were excluded from the final analysis resulting in 33 complete answers. Quantitative data was analysed using descriptive statistics with the assistance of the software program Qualtrics. For each question, percentages were created for each variable (for example major impact, moderate impact less impact etc.) and

overall were trends assessed. Data was then exported to Excel to allow for effective visual representation of overall findings of participant responses using bar graphs for further analysis. Inclusion and exclusion analysis was then used to determine majority and minority of participant views from a list of questions that were asked. In this case, response category for most of the questions were collapsed into two major variables for mapping to identify overall trends in response. The idea is to provide information that most represent majority of participant views which are then presented in the final discussion. For example, very significant and significant were combined into a single variable of "significant" while moderately significant, somewhat significant and not significant were combined into a single variable of "not significant". From this, the majority of participant response are then discussed in the final findings.

Feasibility and effectiveness of adaptation practices were analysed taking insight from the studies of Singh et al., (2022), Owen (2020), Williams et al., (2021) and IPCC (2022). To determine the feasibility and effectiveness of adaptation practices, variables were collapsed into three main categories that is high feasibility or effectiveness (high potential to implement or reduce risk), medium feasibility or effectiveness (some potential to implement or reduce risk) and low feasibility or effectiveness (no/less potential to implement or reduce risk). Using the highest percentage of participant evidence (from the highest to the lowest), an adaptation practice was then determined to have either high, medium or low feasibility and effectiveness. Cross tabulation was further used to analyse the relationship between the feasibility and effectiveness of adaptation practices and further highlight adaptation practices that fell within both high feasibility and effectiveness.

Qualitative data obtained were transcribed and coded based on themes as well as emerging themes that were not anticipated from the questionnaire. Responses relevant to the research objective were presented using direct quotation to allow for a better understanding of

participants opinions. For the purpose anonymity, either the age, gender or status of quoted participants were used. The first author handled majority of the analysis however, interpretation of results was discussed with the research team and was therefore approved. Findings were verified by consulting Ikaarvik to ensure validity and reliability of research. It involved one formal discussion with Ikkarvik to have additional insight into research findings and to facilitate in-depth understanding of findings. Results areto be included in a workshop the following summer in Pond Inlet.

2.3 Results and discussions

2.3.1 Demographic characteristics of participants.

From the field survey, the majority (62.2%) of participants were males, 35.1% were females and 2.7% were unidentified. Participants identified themselves as either community member/resident, Elder, Community council/board member, or head of local organization. About 60% of the participants had lived in the community for more than 20 years and therefore had extensive knowledge on the change in climatic conditions in the area. A significant number of the participants (93.9%) identified as Inuit. This reflects the general pattern of the vast majority of Inuit population in Nunavut[4]. A Majority of participants spoke both Inuktitut (97%) and English (84.8%), while only 3% spoke Inuinnaqtun. With regard to educational background, an equal number of participants had completed secondary/high school education (39.4%), and college/bachelor's or professional or graduate, education (39.4%). Few of the participants (9.0 %) had only elementary or no education while the remaining 12.1% of the participants did not identify their educational background. This implies that majority of the participants have had basic formal education and were likely to provide in-depth knowledge about the research. The majority of participants were actively employed (78.8%) or engaged in

[4] https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?=Nunavut

voluntary work (6%) while the remaining number of participants (15.1%) were either unemployed or preferred not to disclose their employment status.

2.3.2 Climate change impact and risk for local mobility

All participants had knowledge about change in climatic conditions in the area. Such knowledge was derived from individual experience or observation of changes in local climate and environmental conditions over the years. The most common climatic hazards observed by participants include extreme heat, permafrost thaw, increased average temperature, ice storm, severe storm, and extreme winds. These hazards were reported to have resulted in alterations in ice conditions such as less snow on land trails, decreased sea ice, thinner ice, more slush over ice, late and longer freeze up of sea ice and early break up of ice. These reports largely support other studies about the changes in climate and environmental conditions in the Arctic (Wilson et al., 2021; Ford et al., 2019; Ford et al., 2008).

The changes in ice conditions were described by participants to increase challenges for safe travel on land or ice and restrict accessibility outside the community by either ATVs, boats, vehicles (truck, car, SUV), by foot or dog teams. Local observations of how climate change is impacting travel conditions includes fewer days available to access hunting and fishing grounds, difficulty in accessing locally known hunting grounds, limited access with neighbouring communities, restricted access to cabins and camping sites and inability to travel far away from the community. The unstable ice conditions have disrupted hunting and fishing and compromised other subsistence activities. Participant observations of the impact of climate change in restricting access to trails and travel routes have also been reported in other studies in Arctic Canada (Pearce et al., 2015; Cunsolo Willox et al., 2012; Pearce et al., 2011).

Participants reported observed sociocultural, economic, and health implications of alterations to travel conditions and restricted access to hunting trails. Sociocultural and economic implications identified include less connectivity with neighbouring communities, less travel to

cabins, and camping sites for fun, relaxation and spending time with family; less chance of harvesting or gathering country food; increase in the purchase of store-bought food due to shortage of country food which increases financial burden and loss of traditional culture and skills due to reduction in hunting activities. As explained by participants, sometimes country foods such as caribou are ordered from other communities to supplement store-bought food. This emphasises the importance and preference of country foods for Inuit. However, the dependence on store food may shifts traditional taste and preference for country foods. The inability to access country foods is documented to increase food insecurity and change in dietary preference from traditional foods to store-bought food which is extremely expensive in the north (Kenny et al., 2018; Cunsolo Willox et al., 2012).

Physical, mental, and emotional health impacts were strongly emphasised by participants. Such impacts are manifested in the form of sickness and tiredness from not consuming country foods; nervousness, anxiety, and worry due to less connectivity with other communities, less time "spent out on land" and "with nature" and being "stuck" in town for longer periods than expected. Participants also experienced "cabin fever" which is associated with the inability to access camping sites and cabins for relaxation and uncertainty about traditional knowledge of ice and weather conditions. As shared by a female community board member "*sometimes I am scared or nervous to travel, sometimes I do not trust in the traditional skills and knowledge gained. Unsure if timing of usual cycle of sea ice and weather patterns will be "normal" or different. I experience cabin fever, from being in town, when we normally would be out on the land*". The sociocultural, economic and health implications are leading to changes in the traditional lifestyle and subsistence activities of individuals in Pond Inlet. The sociocultural, economic and health implications identified are consistent with other studies in the Arctic. (Wilson et al., 2021; Ford et al., 2014; Ford et al., 2012; Cunsolo Willox et al., 2012; Laidler et al., 2009; Ford et al., 2008).

Based on current climate projections and effect on ice thickness, majority of the participants perceived a general negative impact of future change in climate on ice travel. Risks identified with future changes in travel on land or ice are shorter time available for spring camping due to thinner ice; reduced safe travel on ice; restricted outings and hunting for food, especially in late spring and fall; increased challenges associated with hunting; late hunting; navigating longer travel routes which will demand better and expensive travel equipment and increased use of gas; increased incidents of accidents such as hunters falling through thin ice; increase loss of traveling equipment as they fall through thin ice, loss of culture and traditional skills due to the increasing inability to engage subsistence activities and high possibilities of getting sick from not being able to consume country food.

There was also the general concern that the risk for safe travel will further have potential implications for subsistence livelihood and hunting activities in the future. In addition, there was the recognition among participants that future climate change may lead to a shift in patterns of local mobility from frozen grounds to open waters and mode of travel. This finding is supports other discussions on future climate change and implication for local travel in the Arctic (Ford et al., 2023; Pearce et al., 2015; Larsen et al., 2014). Inuit in Pond Inlet are thus getting increasingly concerned that current traditional knowledge about ice and weather conditions may not be enough for future travel on ice. Participants could not perceive any positive impact with changes in future climatic conditions. Despite the negative perceptions, there was the belief that “Inuit will adapt”. The perceived risk expressed by participants are summarised in table 1.

Table 1: Common perceived risks expressed by participants in Pond Inlet to change in future sea ice conditions and their implications for local mobility, hunting activities and sociocultural, economic and health impact.

Risks	Specific risk
Increased travel risk	• Reduce safe travel on ice especially in the spring and fall. • Shift in local mobility pattern and mode from ice to open water. • Longer transition from one season to the other. • Increased incident of accident.
Increased risk for subsistence hunting	• Late hunting. • Navigation of longer travel routes. • Increased cost of travel equipment/gas • Increased challenges associated with hunting. • Reduce opportunities for hunting country food.
Sociocultural risk	• Loss of cultural identity and traditional skills. • Increased food insecurity. • Restricts and limits time available to engage in camping and other outdoor activities.
Economic risk	• Increased the purchase of expensive store food. • Increased the use of gas. • Increased the need to purchase new traveling machines.
Health risk	• Mental and emotional stress and anxiety from being "stuck" in town. • Increased chance of physical sickness of not being able to consume country food.

Regarding how anthropogenic factors such as shipping affects local mobility, a majority (81.8%) of participants believe that climate change has contributed to increase in shipping activities in the area. The increase in ship traffic as indicated by a majority of participants (95.5%) negatively affects the sea ice environment and the ability to access hunting locations, causes early break up of sea ice which affects safe travel and disrupts mobility over sea ice. A

majority (84.1%) of the participants agreed that increase in temperature may lengthen shipping season and this will significantly disrupt marine transportation routes. Participants perceived that future increase in shipping activities in the area will significantly reduce local accessibility to sea-based transportation over ice or open water (sea-based transport), present risk to the lives of local boaters and increase incidents of shipping disasters (such as oil spill) and accidents. Although a majority of participants agreed that the increase in ship traffic may provide new economic activities in the area, the general perception is that it will present higher risks both social and economic to the community and environment than benefits.[5]

2.3.3 Adaptation practices to climate change impact

In Pond Inlet, several adaptation practices were adopted among participants to reduce risk for safe travel. Common adaptation practices already being employed are relying on local and traditional knowledge, relying on weather information, sharing Inuit knowledge and experience, taking extra supplies, waiting for favourable weather conditions, bringing extra gas, hunting in groups, using communication devices such as satellite phones and adjusting hunting and fishing times. Other adaptation practices reported are avoid going out if unsure of ice or weather condition to stay safe, making travel location known to family members and learning from knowledgeable people especially Elders and hunters. These adaptation practices were acknowledged to be significant in reducing vulnerability and ensuring safety and were thus adopted by the majority of participants. These findings have also been observed in other studies about Inuit adaptation practices (Ford et al., 2019; Pearce et al., 2015; Pearce et al., 2011; McLean, 2010; Ford et al., 2008)

Inuit are known to rely on social networks such as family and friends for food, equipment, and other necessities in coping with the changing environment to reduce vulnerabilities (Ford et al, 2012; Ford et al., 2008). Interestingly, the findings of this research show that the majority of

[5] Response rate for this section of the survey (climate change and marine shipping) is 44 participants.

participants (78.8%) did not often rely on family and friends as a primary adaptation practice. In this situation, adaptations are autonomous to the individual (Pearce et al., 2011). Studies have indicated that strong social networks such as extended family and friends help to reduce risk by facilitating the sharing of resources (Ford et al., 2008). It is thus reasonable to assume that this category of participants may then be more at risk to unpredictable exposure as how and when they travel in certain climatic conditions will be affected. Further discussion with Ikaarvik revealed that community members may prefer the term "share" rather than "rely" which may also have accounted for this response. However, other studies have also indicated that social networks such as sharing among family and friends are under constant stress which is changing the intra-family relationship among Inuit (Ford et al., 2008). The findings of this research thus reflect participants opinion and adaptation decisions. The low dependence on family and friends as an adaptation practice may also be a contribution of the ongoing effect of colonialism (Wilson et al., 2021); and the shift towards a more Western lifestyle (McLean, 2010) which is changing Inuit behaviour.

Similarly, a majority of participants (about 63%) tend not to adopt institutional or organizational support or utilize workshop and training programs as part of their main adaptation practice. Research indicates that the cost of various adaptation practices tends to exceed the financial capabilities of many communities, regional governments, and regional institutions and this may be a barrier to maintaining or implementing climate adaptation projects (Pearce et al., 2011). However, further discussion with Ikaarvik, revealed that residents in Pond Inlet consider government supports and projects as the duty of the government for using their land. For this reason, participants did not consider themselves as reliant on governmental support. This finding thus reveals a different mindset of participants compared to other research on climate change adaptation conducted in urban areas and other regions with limited to no Indigenous peoples. Nevertheless, this research stresses the need to strengthen regional institutions and local organizational plans and implementation in fostering adaptation

to reduce vulnerabilities to future climatic exposure as institutional support has been identified by other studies as important in reducing climatic exposures (Ford et al., 2008).

Results from the research indicate that, adaptation is influenced by a combination of sociocultural, economic, and institutional factors which interact with existing climatic conditions to influence the adaptive capacity of participants. Locally observed non-climatic factors influencing adaptation among over 58% of participants are Inuit knowledge, land-based skills, availability of equipment, ability to follow knowledgeable people, access to information and education, access to technology, individual experience, social network (sharing among family and friends), monetary resources, availability of time, and ability to take risks. These factors were found to facilitate or limit the adoption of an adaptation practice in Pond Inlet as also reported in other studies in Arctic Canada (Ford et al., 2012; Pearce et al., 2011; Pearce et al., 2010; Ford et al., 2008). For example, participants expressed the importance of monetary resources as the rising cost of the economy which makes it difficult to purchase traveling equipment to ensure safe travel as well as the rising cost of fuel which limits the ability to travel to far locations to hunt. As expressed by a male community council member "*The biggest impact for hunting today is cost of everything. It is just the cost to get a machine, the gas, the grubs, the bullets, and the next trips expenditures. Hunters are stuck like in a fishing weir due to the economy"*. This finding is consistent with other studies in the Arctic (Pearce et al., 2011, 2010; Laidler et al., 2009). In addition, government and organizational support was considered not significant in influencing the adaptive responses by majority of participants (67.7%). This finding may reflect reasons for minimum dependence on government and organizational support as an adaptation practice by majority of participants. Adaptive capacity should therefore not be taken lightly as it will vary among individuals and households (Ford et al., 2012).

Information regarding current climatic and environmental conditions were found to be necessary in ensuring safe travel outside the community. Participants relied on multiple sources of information to make safe travel decisions. Notably among these are information from friends and family, Elders, recent travellers, active land users, personal observation, local community organizations, social media, NGOs, and government services. Information from these sources were considered significant as access to good reliable information is vital for safe travel.

2.3.4 Feasibility and effectiveness of adaptation practices

This research assessed the feasibility and effectiveness of 19 adaptation practices to climate change impacts on local mobility in Pond Inlet. For feasibility, 9 adaptation practices were identified to have high implementation potential, 5 adaptation practices have medium potential of implementation, and 2 adaptation practices have low implementation possibilities. However, 3 adaptation practices fell within both medium and low implementation potentials. Interestingly, relying on institutional and organizational support, and utilizing workshop and training programs fell within medium/low and low feasibility respectively as an adaptation practice. As stated earlier, this may be due the high cost of implementing or maintaining climate projects which surpasses the financial capabilities of communities, regional government and regional institutions (Pearce et al., 2011). It is therefore important to identify what major barriers exist for the adoption and implementation of institutional and organizational programs as an adaptation practice in the research community.

Table 2 shows the feasibility assessment of observed adaptation practices in the study community. The size of a circle in each category indicates the percentage of participant evidence. Shading is used to distinguish one category from the other for easy visibility. The assessment score is the final evidence for the adaptation practice.

Table 2: Feasibility assessment of adaptation practices to climate change impact on local mobility in Pond Inlet.

Adaptation practices	**Feasibility**			
	High	Medium	Low	Assessment score
Share Inuit knowledge and experience				High
Rely on local and traditional knowledge				High
Bring extra gas				High
Rely on weather information.				High
Take extra supplies or preparations during travel				High
Wait for favourable weather conditions				High
Adjusting hunting and fishing times				High
Don’t go hunting alone				High
Choose different routes				High
Develop new hunting trails				Medium
Change hunting location				Medium
Choose different traveling equipment.				Medium
Take up full/part-time work.				Medium
Rely on family and friends for food and information				Medium
Avoid traveling or hunting at certain times.				Medium/low
Rely on institutional/organisational support for money, gas vouchers and safety equipment				Medium/low
Purchase new equipment				Medium/low
Develop new routes				Low
Utilize workshops and training programs				Low

Index	Description	Assessment score
High feasibility	High level of being implemented/low or no implantation barrier.	High
Medium feasibility	Moderate level of being implemented/presence of some barriers	Medium
Low feasibility	Low/no evidence of being implemented/multiple implementation barrier.	Low

For effectiveness, 8 adaptation practices were identified to have high-risk reduction potential, 5 adaptation practices were identified to have medium risk reduction potential and 6 adaptation practices were identified to have low risk reduction potential. With 8 adaptation practices showing high effectiveness implies that, participants can successfully adjust to future climate change impacts, reduce vulnerabilities, and sustain subsistence activities. However, with majority of adaptation practices falling within medium and low effectiveness means there can be high level of exposure to climatic hazards leaving individuals severely vulnerable.

Table 3 shows the effectiveness assessment of observed adaptation practices in the study community. The size of the circle in each category indicates the percentage of participant evidence for that category. Shading is used to distinguish one category from the other. Assessment score is the final evidence for the adaptation practice. Further information about the assessment is found under methods in the appendices.

Table 3: Effectiveness assessment of adaptation practices to climate change impact on local mobility in Pond Inlet.

Adaptation practices	**Effectiveness**			
	High	Medium	Low	Assessment score
Rely on local and traditional knowledge.				High
Bring extra gas				High
Wait for favourable weather conditions				High
Take extra supplies or preparations during travel.				High
Rely on weather information				High
Share Inuit knowledge and experience				High
Don’t go hunting alone				High
Rely on institutional/organisational support for money, gas vouchers and safety equipment				High
Adjust hunting and fishing times				Medium
Develop new hunting trails				Medium
Purchase new equipment				Medium
Avoid traveling or hunting at certain times				Medium
Rely on family and friends for food and information.				Medium
Take up full/part-time work.				Low
Choose different routes				Low
Change hunting location				Low
Develop new routes				Low
Choose different traveling equipment				Low
Utilize workshops and training programs				Low

Index	Description	Assessment score
High effectiveness	High evidence/potential to reduce risk.	High
Medium effectiveness	Moderate evidence/potential to reduce risk.	Medium
Low effectiveness	Low/no evidence/potential to reduce risk.	Low

The findings of this research further show high feasibility and high effectiveness for 7 adaptation practices employed by participants. These adaptation practices s therefore have high implementation and risk reduction potential to future change in climatic conditions. Evidence from this research also shows that not all adaptation practices that were reported to have high feasibility were identified to have high effectiveness. For example, adjusting hunting and fishing times was reported to have high feasibility but medium effectiveness. Similarly, relying on government and organizational support had high effectiveness but low feasibility. Also, changing hunting locations, choosing different traveling equipment, and taking up full or part-time work had medium feasibility but low effectiveness. A feasible adaptation practice may therefore not necessarily be effective. This shows the complexities of adaptation practices to climate change impact (Williams et al., 2021; Ford et al., 2013).

Results further illustrates the assertion of Singh et al. (2022), that the feasibility of an adaptation practice may not necessarily lead to an effective outcome and vice versa as it may be influenced by existing social, economic and institutional conditions. The feasibility and effectiveness assessment of this research provides information on what adaptation practice works and does not work for individuals in Pond Inlet, their vulnerabilities, and capacity to adapt to future change in climate.

Table 4 synthesizes and compares the feasibility and effectiveness of adaptation practices in the research community. The table (4) shows interrelationship and differences between feasible and effective adaptation practices adopted among participants. An adaptation practice that is

in more than one category indicate an equal percentage of participant evidence for that practice. These practices are distinguished with asterisks (**). For example, purchasing new equipment has an equal percentage of participant evidence for both medium and low feasibility and can therefore be found in both categories.

Table 4: Feasibility and effectiveness assessment of adaptation practices to climate change impact on local mobility in Pond Inlet.

Assessment score	Feasibility		
Effectiveness	High	Medium	Low
High	Rely on local and traditional knowledge. Share Inuit knowledge and experience. Bring extra gas. Rely on weather information. Wait for favourable weather conditions. Take extra supplies or preparations during travel. Don't go hunting alone.	Rely on institutional/organisational support for money, gas vouchers and safety equipment. **	Rely on institutional/organisational support for money, gas vouchers and safety equipment. **
Medium	Adjust hunting and fishing times.	Develop new hunting trails. Purchase new equipment. ** Avoid traveling or hunting at certain times. ** Rely on family and friends for food and information.	Purchase new equipment. ** Avoid traveling or hunting at certain times. **
Low	Choose different routes.	Take up full/part-time work. Change hunting location. Choose different traveling equipment.	Develop new routes. Utilize workshops and training programs.

2.4 Conclusion

This research provides considerable insight into current climate change impacts and risks for local mobility options in Pond Inlet. Findings show that climate change is negatively impacting local mobility patterns making local travel routes unsafe for residents, compromising subsistence activities and access to hunting areas. The inability to engage in traditional activities due to the disruption caused by climate change in accessing travel routes has resulted in further sociocultural, economic and health implications for the community. For Inuit in Pond Inlet future climate change will increase the risk for safe travel conditions on ice and exacerbate existing challenges associated with subsistence activities. Importantly, there is the increasing concern that current traditional knowledge about ice and weather conditions may not be enough for future travel on ice.

Currently, there are several adaptation practices being employed at the individual scale to enable hazard avoidance and risk reduction for safe travel. Although, residents have high adaptive capacity, adaptation options available are limited significantly due to existing economic factors such as inadequate monetary resources limiting adaptation for Inuit in Pond Inlet. Further research will need to focus and explore in-depth the sociocultural, economic and institutional processes that interact to influence the adaptive capacity of Inuit. This is significant given the limited research concerning human vulnerabilities to future climate change in the Arctic and how non-climatic factors will interact to affect exposure sensitivity (Pearce et al., 2011). Efforts to address adaptation to climate change should therefore take a holistic approach to enhance adaptive capacity (Pearce et al., 2011). By encompassing a holistic approach, adaptation should involve integrating traditional knowledge and cultural perspectives with Western science through collaboration between local people and institutions to foster effective adaptation to both current impact and future risks associated with climate change.

Although findings shows that the low adoption of government and organizational support as an adaptation practice may be due to the mindset of participants (as noted above). Despite this finding, previous research and best practice in climate change adaptation suggested that it is also imperative to strengthen local government and regional institutional support for local adaptation efforts in the research community by translating adaptation plans into actions that meet and address specific local needs. Evidence also shows high feasibility and effectiveness for 7 adaptation practices which encouragingly may be significant to cushion individuals against future change in climate. However, adaptation limits exist and may affect the adoption or risk reduction potential of several adaptation practices in a rising and intense climatic hazard. Enhancing individual adaptive capacity will also be significant in reducing if not avoid the challenges with the changing climate.

2.4.1 Contributions of study

This research contributes to the growing literature on climate change impact and adaptation to local mobility in Arctic Canada. Empirical findings of this research expand the understanding on community specific perspective and responses to the increasing impact of climate change on local mobility which could be relevant for specific policy planning to address the current and long-term future local transportation-related adaptation needs of the community. Findings also re-affirms the adaptability of Inuit to changing environmental conditions and their thoughts on the possible risks as climate change impacts heightens.

In a broader context knowledge gained is important and can be used locally, regionally, or nationally for communities with similar climatic zones experiencing climate-related transportation challenges. Insight gained can be relevant to transportation policy and planning in the area. The findings also provide a new perspective and approach to adaptation and the need to focus on not just adaptation but also a successful outcome to which is relevant to reduce climate change impact. For the Academic community, this research provides first-hand knowledge and opportunities to expand on this research and address any limit of this study to

provide a more holistic understanding of adaptation, risks and vulnerabilities related to local mobility in Pond Inlet which can be relevant to other coastal communities in the Arctic.

2.4.2 Limitations of study

There are knowledge gaps about how each adaptation practice has been able to reduce risk (effectiveness) and about the extent to which each practice would be possible to implement (feasibility) across various dimensions. The effectiveness of an adaptation practice should encompass the outcome but specific outcomes were not adequately explored in this study. Assessing how specific adaptation practices are able to address vulnerability or reduce the risk of climate change or the possibility of its implementation against future climate changes will provide valuable information and may facilitate support for adaptation needs. Nevertheless, this research has given an insight into the implementation and risk reduction potential of current adaptation practices in Pond Inlet. This insight can provide basis for further feasibility and effectiveness assessment of adaptation in the Arctic. Future research will need to broaden the study on feasibility and effectiveness of adaptation practices across various dimensions (technological, sociocultural, economic, institutional, etc.) and comprehensively examine specific opportunities for effective adaption for future risks to climate change.

The limited number of participant responses used in the final analysis could have affected the overall findings of the research. Also, it is possible that participants may have been confused with the term feasibility and effectiveness. However, these terms were explained in the questionnaire and with the majority of participants having high school education, they might have also clearly understood the terms. In addition, although information from other literature was consulted for feasibility and effectiveness assessment, the approach lacked a robust process and may have influenced the outcome. However, there is currently no single approach in assessing the feasibility and effectiveness of adaption as the approach is still developing (Williams et al., 2021; Singh et al., 2020; Owen, 2020). Nevertheless, the process of interpretation was objective and provides insight into possible adaptation practices that may be

effective in reducing risk to the changing climate. The results also reflect the conceptual basis of this research on climate change impact and risk for local mobility.

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Chapter 3

3.0 Discussion of results

Chapter 2 is presented in the form of a publishable article that will soon be submitted for publication. In chapter 3, additional thesis findings are presented, with some inevitable overlap with chapter 2. This chapter presents information that was not relevant for the prepared manuscript (chapter 2) but which is highly relevant to the thesis research. Thus, this chapter covers the broad themes of general characteristics of participants, patterns of local mobility, climate change impact and risks, local adaptation practices and feasibility and effectiveness of adaptation practices.

3.1 Patterns of local mobility

Local mobility in Pond Inlet reflected the seasonal mode and purpose of travel outside the community. Results show that participants travelled for various purposes outside the community and this varied across participants. Common purpose of travel identified by a majority of participants (55%) are traveling to cabins or camp for fun, hunting on sea ice and hunting in the ocean. Participant would also travel outside the community to fish in the lake, hunt on land (inland), gather food such as eggs, plants/berries, collect drinking water and fish in the ocean. One important finding of this research is that a majority of participants comprising 67.7% rarely travelled for mental health related purposes. Past studies have indicated that warmer temperatures have resulted in unstable ice conditions which limits travel outside communities, increasing the risk of mental and emotional health impacts (Ford et al., 2014; Cunsolo Willox et al., 2012). This research thus assumes that travel for mental health related purposes may not be the primary driver or intent for Inuit in Pond Inlet but rather, engage in activities which subsequently influence their mental and emotional health. As a result, the inability to engage in such activities due to the disruption caused by climate change affects their mental or emotional health.

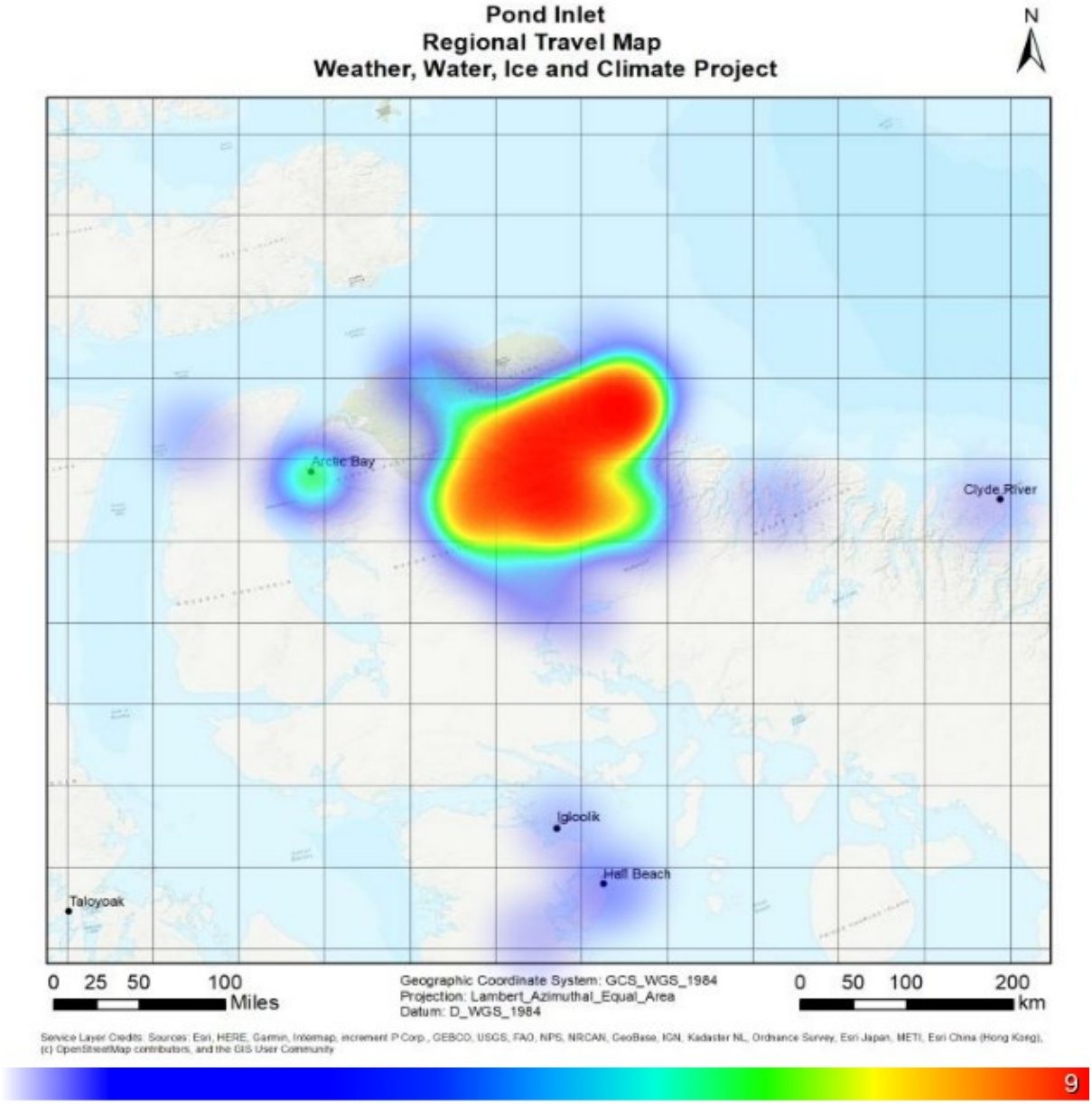
Travel outside the community is done using snowmachine with or without qamutik on frozen lands, frozen lakes, frozen rivers, and sea ice; ATV on lands, boat with or without motor on open waters such as lakes, rivers and open sea; vehicles (truck, car, SUV) on frozen and unfrozen grounds; by foot and dog team. However, like other coastal communities in Nunavut, travel outside the community is mostly accessible using for example snowmachine on ice during winter and boats during the summer and these are susceptible to disruptions caused by extreme weather events.

The maps below show the travel pattern of participants outside the community by either boat, snowmachine, ATV or dog team over the last three years. On the map, dark red shading represents area of high travel activity while purple shading indicates area of lower travel activity. All maps show that travel outside Pond Inlet is largely concentrated around the community and then reduces further outside.

In comparing the maps, travel outside Pond Inlet is mostly done using snowmachine (map 1) as the red shading extends to a larger area compared to the other maps (2-4). This is followed by travel by boats which shows the second largest area in red shading (map 2), then ATV (map 3) and lastly dog team (map 4). The reduced travel by dog team as a mode of transportation over ice outside the community shows the increasing adoption of technology such as snowmobile among participants. Thus, all communities surrounding Pond Inlet (except Taloyoak) were highlighted (purple shading) for map 4 showing that the use of snowmachine helped participants travel faster and further outside the community, although such travel activity may not be frequent in the surrounding communities. This could be said also for participants who use ATV, (map 3), as all communities (except Taloyoak) surrounding Pond Inlet were highlighted (purple shading) showing a certain level of travel activity in those areas indicating that ATV, assisted participants to travel further and faster outside the community.

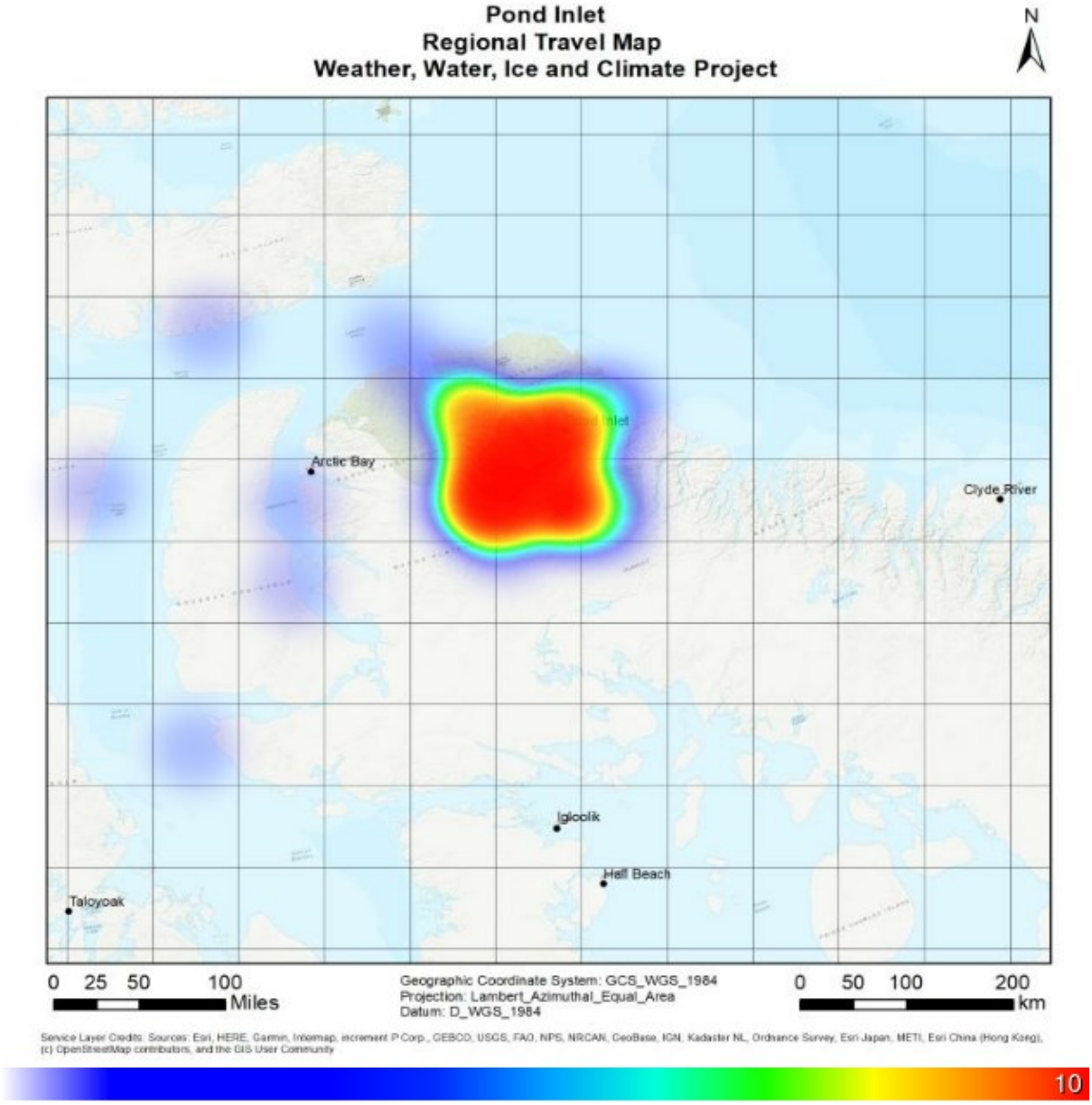
The use of snowmachine (during winter) and boats (during summer) are the two most common means of travel outside the community. This also reflects the seasonality in the mode of travel for participants. Participants are adopting new technologies such as snowmachine and ATV to travel faster and further outside the community on frozen grounds. Dog teams are used for travel mostly around the community as it might no longer be safe for far travel due to unstable travel routes under current extreme weather events. Climate change impact is resulting in changes in local mobility patterns and mode of transport. There is therefore the need to assess and support adaptation practices that ensure safe travel, reduce risk and sustains of local mobility patterns.

MAP 1



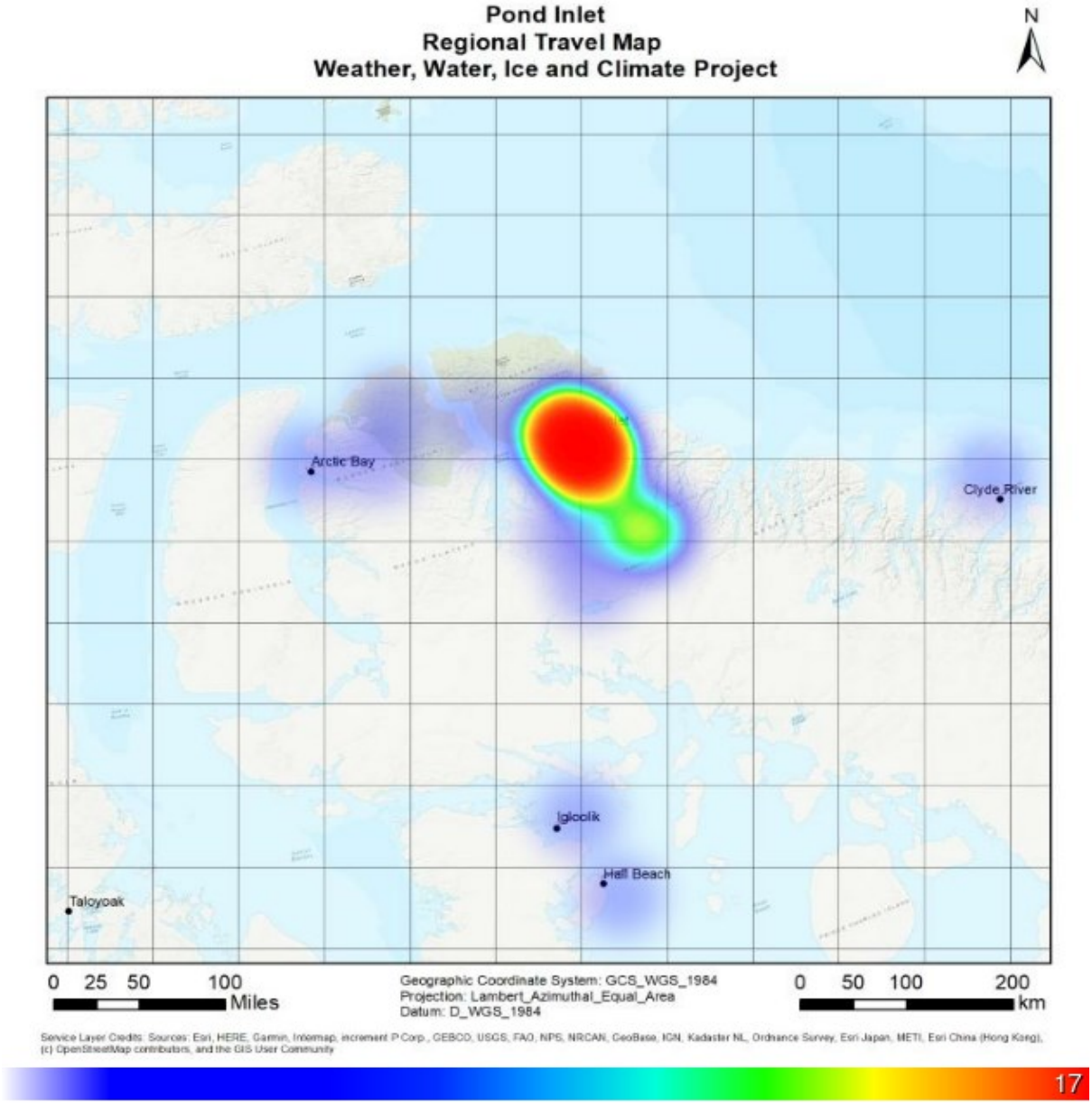
Travel pattern of participants in Pond Inlet by Snowmachine.
Source: Arctic Mobilities-Climate Change and Transportation - Pond Inlet Survey, 2023.

Map 2



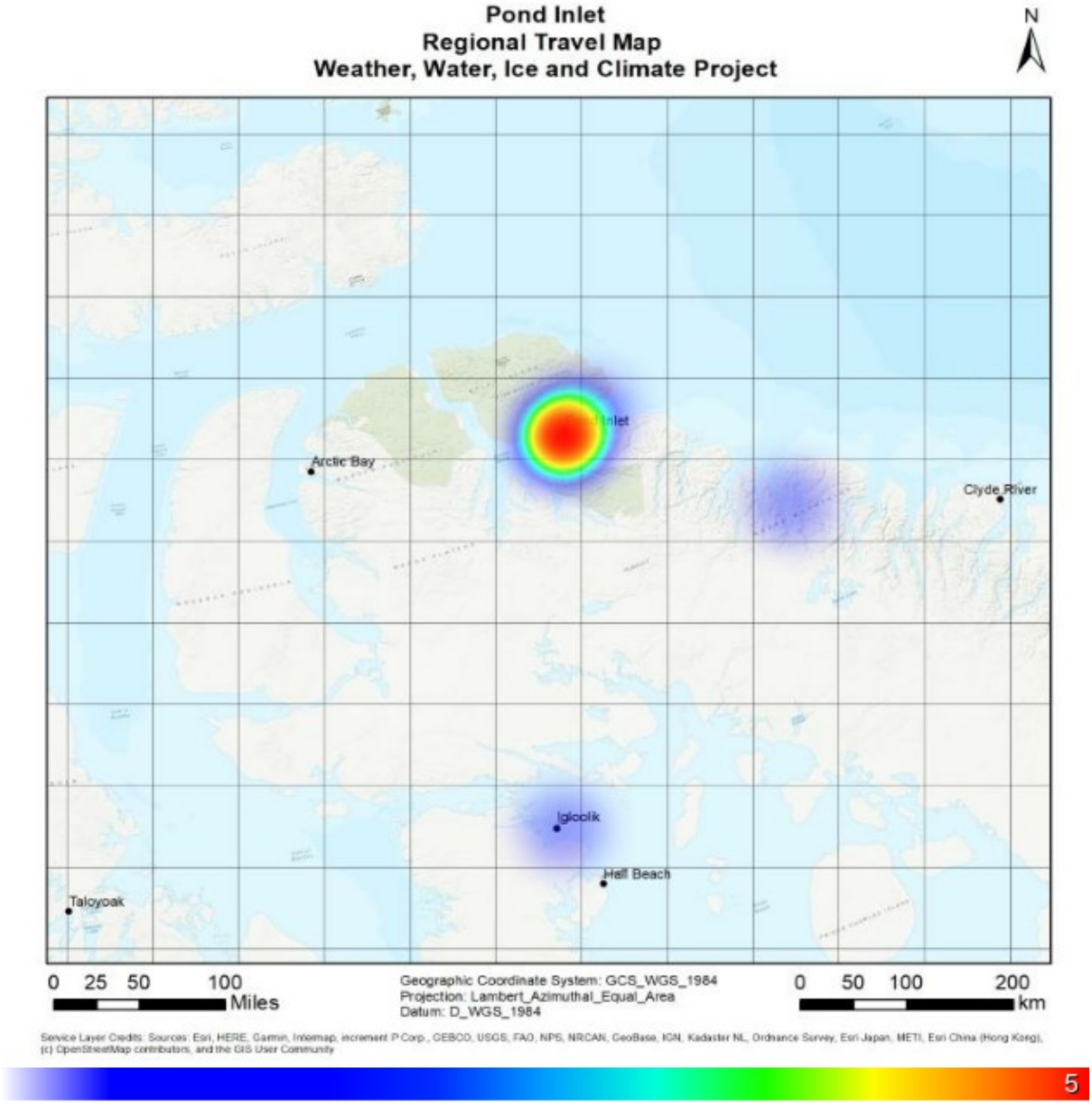
Travel pattern of participants in Pond Inlet by boat.
Source: Arctic Mobilities-Climate Change and Transportation - Pond Inlet Survey, 2023.

Map 3



Travel pattern of participants in Pond Inlet by ATV.
Source: Arctic Mobilities-Climate Change and Transportation - Pond Inlet Survey, 2023.

Map 4



Travel pattern of participants in Pond Inlet by dog team.
Source: Arctic Mobilities-Climate Change and Transportation - Pond Inlet Survey, 2023.

3.2 Climate change impacts and risks

3.2.1 Climatic and environmental hazards: All participants had knowledge about current changes in climatic conditions in the area. Such knowledge was derived from individual experience or observation of changes in local climate and environmental conditions over the years. However, perception and knowledge about hazards that influence local mobility varied

across participants. The most common environmental hazards identified by the majority of participants (55% and above) are decreased land or sea ice, extreme heat, permafrost thaw and increased average temperature. Other hazards observed by participants which are also worth mentioning include severe storm, extreme wind and ice storm. The changes in local climatic and environmental conditions have resulted in alterations in ice conditions necessary for safe travel. The most common changes as identified by participants include late and longer freeze up of sea ice (69.7%), thinner ice (66.6%), fewer days to access hunting locations (54.5%), more slush over ice (51.5%), other changes in ice conditions (54.5%) and less snow on land trails (50.7%). Other changes reported include warmer winters, and early break up of ice than expected. The changes in ice conditions were described by participants to increase risk for safe travel on ice. Thus, although Inuit have dealt with the changes related to local travel, the high variability in weather and ice conditions are currently increasing the hazards and vulnerability associated with travel on land, water and ice access (Wilson et al., 2021; Pearce et al. 2011; Pearce et al., 2010 and Laidler et al., 2009).

3.2.2 Impact of climate change: For all participants, change in climatic and environmental conditions in the area as observed have profound impacts on safe travel conditions on ice and open waters. Participants indicated that, in recent times there has been sea ice uncertainty which is making it difficult for community members to reach other locally known hunting grounds. For participants, although the change in sea ice is an annual occurrence, the main concern lies in the fact that the current change in ice is never the same as the previous year. This has created uncertainty and anxiety for travel over ice due to the unpredictability of ice conditions. Other impacts identified by participants include muddy or slushy trails due to heavy the rains which makes it difficult to walk on foot or with dogs during trips and also makes it easy for vehicles to get stuck. Floe edge was reported to be much closer than normal over the past few years creating difficulties in using boat.

The impact of climate change on travel conditions was found to have further consequences on the economic, sociocultural, and mental wellbeing of participants. Many participants reported that rapid changes in ice conditions have affected access to hunting grounds, travel to other communities and access to cabins and camping sites. For participants, changes in local mobility due to climate change affects their traditional lifestyle, subsistence activities and mental health. For majority of participants, less connectivity to other communities, less time available to spend out on land and being "stuck" in town affects their mental and emotional health. Being stuck in town also means being "stuck" with store bought food which was identified by participants as not good for the mental health as people get tired of consuming store-bought foods. For participants, consumption of country foods was considered an important part of the traditional livelihoods, community identity and taste preference. These findings are consistent with other studies in the Arctic (Wilson et al., 2021, Cunsolo Willox et al., 2012; Laidler et al., 2009).

Fewer days available to access hunting grounds was also linked to mental health as hunting was considered a way of life for the people and the activity provides a means of taking care of both the physical and mental health. As explained by a male participant: "*fewer days out there means less chance of harvesting, also less time of being mentally relaxed in the state I grew up with. Hunting is always my go to for my mental health".* Another impact described by participants is that the changing ice conditions which is affecting hunting activities today is increasing the cost of travel. For hunters, unpredictability of ice conditions means, extra preparations for unknown conditions out there. This means making extra preparations for everything such as gas, or getting better machines, clothes, or shoes and this is increasing expenditures for trips. Participants however indicated that hunters are still able to hunt safely as long as they are knowledgeable to avoid any hazardous areas. According to majority of participants, fewer days available to access hunting grounds affects access to food as there is less chance of harvesting or gathering country food. This has reduced hunting activities and

increased reliance on store-bought food. As indicated by participants, sometimes country foods such as caribou are ordered from other communities to supplement store-bought food. This emphasises the importance and preference of country foods for Inuit. The inability to access country foods increases food insecurity and change in dietary preference from traditional foods to store-bought food which is extremely expensive in the north (Kenny et al., 2018; Cunsolo Willox et al., 2009).

Participants experience what was described as "cabin fever" from being stuck in town when normally they would be out on land in their cabins relaxing or camping with family. Alterations in ice affects the amount of time spent out on land and with nature or less time to camp. For participants, signs of early break up of sea ice means, travellers would have to make an early return home to avoid any hazards. Participant indicated that such a situation affects their mental health as after a cold and dark winter, people would like to be out on land in cabins with family away from work and technology. These findings are also reported in other studies in Arctic Canada (Wilson et al., 2021; Pearce et al., 2011; Laidler et al., 2009; Ford et al., 2008).

3.2.3 Future exposure and risk: With respect to climate projections on ice thickness, majority of respondents comprising 69.7% agreed with previous research suggestions on present-day ice thickness of an average, between 0 and 20 cm in the fall (~October-December), 35 to 50 cm in the winter (~January-March) and 40 and 15cm in the spring (~April-June). For future climate change projections, 54.5% of participants agreed that sea ice thickness will in the future be ~10cm thinner in the fall, ~35cm thinner in the winter, and ~10cm thinner in the spring compared to current conditions. Based on these projections, many of the participants perceived a general negative impact of future change in climate on ice travel. There was the concern that the risk for safe travel will further have potential implications for subsistence livelihood and hunting activities in the future.

Many participants explained that presently there has been a lot of difference in traditional hunting activities compared with the past and there is the fear that changes associated with hunting will be worse in the future as temperatures continuous to get warmer. Risks identified by participants with future changes in ice thickness include shorter time available for spring camping due to thinner ice; reduce safe travel on ice; restricts outing and hunting for food especially in late spring and fall; increase challenges associated with hunting whether by boat or snow mobile; late hunting; utilizing longer travel routes which will demand a better and expensive travel equipment and increase the use of gas which is expensive; increase incidents of accidents such as hunters falling through thin ice or water; increase loss of traveling equipment as they fall through thin ice and loss of culture and traditional skills due to the inability to engage in subsistence activities. As explained by participants, dangerous and unsafe ice conditions will restrict opportunities for hunters to go far out of the community to places to hunt for narwhals and caribou. According to participants, Inuit need traditional food and less travel time or hunting activity will increase the chances of getting sick from not being able to consume country food.

Participants also expressed that reduced ice conditions will result in reduced travel by snowmobile on ice to increased travel on open waters by boat. However, a young male participant perceived challenges in changing patterns of transportation. He expressed, "*it would take more time to switch from boating season to snowmobile season and that would mean more time being stuck in the community and not being able to go out"*. This finding clearly illustrates that future warming will shift local mobility pattern and modes of transport from ice to open waters (Ford et al., 2023; Larsen et al., 2014). Other participants expressed concerns that traditional knowledge about ice and weather conditions may not be enough and this will affect how and when travel is done.

Table 1: Common perceived risks expressed by participants in Pond Inlet to change in future sea ice conditions and their implications for local mobility, hunting activities and sociocultural, economic and health impact.

Risks	Specific risk
Increased travel risk	• Reduce safe travel on ice especially in the spring and fall. • Shift in local mobility pattern and mode from ice to open water. • Longer transition from one season to the other. • Increased incident of accident.
Increased risk for subsistence hunting	• Late hunting. • Navigation of longer travel routes. • Increased cost of travel equipment/gas • Increased challenges associated with hunting. • Reduce opportunities for hunting country food.
Sociocultural risk	• Loss of cultural identity and traditional skills. • Increased food insecurity. • Restricts and limits time available to engage in camping and other outdoor activities.
Economic risk	• Increased the purchase of expensive store food. • Increased the use of gas. • Increased the need to purchase new traveling machines.
Health risk	• Mental and emotional stress and anxiety from being "stuck" in town. • Increased chance of physical sickness of not being able to consume country food.

3.3 Adaptation practices to climate change induced impact

3.3.1 Adaptation practices: Participants have adopted multiple adaptation practices to reduce the impact of climate change on local mobility. Common adaptation practices adopted are relying on local and traditional knowledge (72.7%), relying on weather information

(78.8%), sharing Inuit knowledge and experience (81.8%), taking extra supplies (66.7%), waiting for favourable weather conditions (69.7%), bringing extra gas (81%) and not hunting alone (57.6%). Findings of this research also show that changing hunting locations (84.8%), developing new access routes (66.6%), choosing different routes (63.7%) choosing different travel equipment (66.6%), purchasing new equipment (54.4%), adjusting hunting and fishing times (72.7%) and avoiding traveling or hunting at certain time (54.5%) were not often adopted by participants in Pond Inlet. Research have indicated that changing hunting locations or routes require knowledge and experience, which experienced hunters or travellers currently find challenging due to the unpredictable weather and ice conditions (Ford et al., 2023). Similarly, change in hunting location or route also requires a change or purchase of new traveling equipment which is often expensive for most Inuit (Ford et al., 2008). These reasons may account for the low adoption of these practices and may heighten food insecurity among community members. Research have indicated that, avoiding traveling or hunting at certain times result in scarcity of some country foods and increased reliance of store-bought foods (Ford et al., 2008).

Interesting to the findings of this research, 78.8% of participants did not consider reliance on family and friends as part of their main adaptation practices. Studies have indicated that social networks such as family and friends facilitate the sharing of knowledge, equipment and food and is important in helping Inuit adapt with the changing climatic conditions (Ford et al., 2008). This may account for reasons why changing travel equipment is also less adopted by participants as the reliance on family and friends includes borrowing equipment which subsequently enables them to change hunting locations or route to make safe travel and access hunting areas. It is thus reasonable to assume that this category of participants is more at risk to unpredictable exposure which will affect how and when they travel in certain climatic condition, influencing the ability to engage in traditional activities. Further discussion with Ikaarvik also revealed that, the use of the term “reliance” may have accounted for this response

as Inuit do not consider themselves as being reliant on each other but prefer "sharing" among each other. However, other studies have indicated that, social networks such as sharing among family is increasingly under stress, changing intra-family relationship (Ford et al., 2008). Furthermore, the on-going effect of colonialism (Wilson et al., 2021); and the shift towards a more Western lifestyles (McLean, 2010) which is changing Inuit behaviour may also account for the reduced reliance on family and friends as an adaptation practice. This finding thus reflects the opinions and adaptation decisions of participants. Similarly institutional and organizational support (63.6%) and utilizing workshops and training programs (75.8.%) are not primarily adopted among participants. Further discussions indicate that residents in Pond Inlet consider governmental support as the duty of the government for using their lands and this may have attributed to the responses of participants. Other practices identified by participants used to reduce risk when traveling include, taking along communication devices such as satellite phones, avoiding traveling long distance and taking more than one traveling equipment or machine such as snowmobile when hunting in groups.

3.3.2 Non-Climatic factors that influence adaptation.

Various socio-economic and institutional factors were identified to influence adaptation and the ability to stay safe while engaging in local travel over either land, water, or sea ice during extreme weather conditions. These are Inuit knowledge (90.9%) land-based skills (77.6%), availability of equipment (87.9%), following knowledgeable people (81.3%), access to information and education (75.1%), access to technology (84.4%), individual experience (71.9%), social network (sharing among family and friends) (71.9%), monetary resources (69.7%), availability of time (62.5%) and ability to take risk (59.4%). These factors were considered by majority of participants as significantly influencing adaptation decisions for safe travel during extreme weather events. As explained by a community council member *"distance traveling to some areas are so required but money and cost are a barrier".* This shows that factors that influence adaptation practices can either be barriers or enablers. In addition,

government support did not mainly influence adaptation among 67% of participants. This finding also reflects why the dependence on government and organizational support was less adopted as an adaptation practice by majority of participants.

3.3.3 Sources of information

Participants relied on multiple sources of information to make safe travel decisions. Notably among these are information from friends and family (87.9%), Elders (75%), recent travellers (66.7.%), active land users (65.6%), personal observation (54.5%) and local community organizations (51.5.8%). These sources of information serve as important guidance for safe travel on ice. Assess to good reliable information is therefore vital for participants to prepare for safe travel and adapt to climate change.

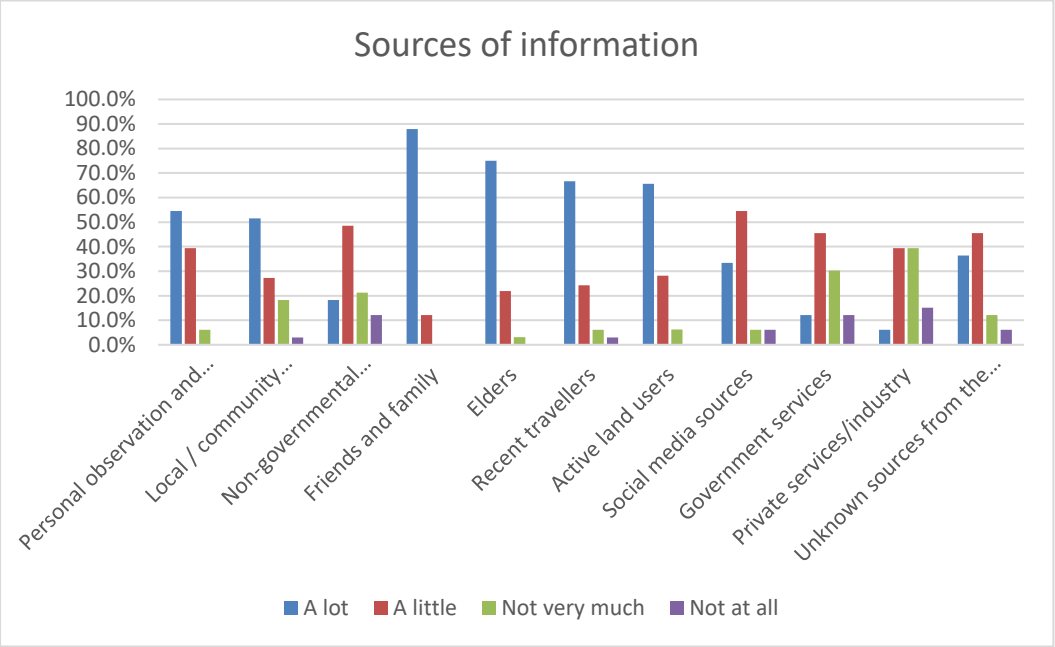


Figure 3: Sources of participant information in Pond Inlet.

Apart from the above sources of information, various environmental conditions were deemed important to consider before any travel decisions are taken. Ice conditions identified by majority of participants are position of floe edge, river and lake thickness, location and size of leads and polynyas, position of grounded ice bergs, snow depth, ice ridges, ice roughness, sea ice thickness, ice brittleness, position of grounded icebergs, position of multi-year ice and ice colour. Water conditions identified by majority of participants are wave direction, tide timing,

wave height, tide height, storm surge, strong current areas, flooding, water levels of rivers and lakes, ice jams and flow rate of rivers. Weather and other general environmental conditions include window of clear weather, wind direction, blowing snow, white out, wind strength, temperature, fog, freezing rain intensity, snow amount, rainfall amount, ice fog, flight light, thunderstorms, atmospheric pressure, snow texture, angle of sun/reflection, moon phase, snow drift and trail condition. These environmental conditions were regarded necessary or good information to know by majority of participants (about 57% and above) before travel or making any travel decisions.

3.4 Feasibility and effectiveness of adaptation practices

3.4.1 Feasibility of adaptation practices: Participants identified the feasibility of the various adaptation practices adopted based on the extent to which the option would be possible to implement or not. Among the nineteen (19) adaptation practices identified, sharing Inuit knowledge, and relying on local and traditional knowledge were observed as highly feasible by 71.5% of participants, followed by bringing extra gas (64.5%), relying on weather information (61.6%), taking extra supplies or preparations (57.1%), waiting for favourable weather conditions (53.9%), adjusting hunting and fishing times (46.2%), not hunting alone (42.8%) and choosing different route (38.5%). Adaptation practices which were observed by participants to have medium feasibility are developing new hunting trails (61.5%), changing hunting location (50%), choosing different traveling equipment (50%), taking up full or part time work (42.9%) and relying on family and friends (42.9%). Utilizing workshop and training programs had the highest evidence of low feasibility (50%), followed by developing new routes (38.8%). Other adaptation practices fell within both medium and low feasibility as they were supported by similar number of participants' evidence. These are avoiding traveling and hunting at certain times (38.8%), relying on institutional and organisational support (35.7%) and purchasing new equipment (35.7%).

Below is the feasibility assessment of observed adaptation practices in the study community. The size of the circle in a category indicates the amount of evidence for that category. Shading is used to distinguish one category from the other for easy visibility. Assessment score is the final evidence for the adaptation practice. Further information about the assessment is found under methods in appendixes.

Table 2: Feasibility assessment of adaptation practices to climate change impact on local mobility in Pond Inlet.

Adaptation practices	**Feasibility**			
	High	Medium	Low	Assessment score
Share Inuit knowledge and experience				High
Rely on local and traditional knowledge				High
Bring extra gas				High
Rely on weather information.				High
Take extra supplies or preparations during travel				High
Wait for favourable weather conditions				High
Adjusting hunting and fishing times				High
Don’t go hunting alone				High
Choose different routes				High
Develop new hunting trails				Medium
Change hunting location				Medium
Choose different traveling equipment.				Medium
Take up full/part-time work.				Medium
Rely on family and friends for food and information				Medium
Avoid traveling or hunting at certain times.				Medium/low
Rely on institutional/organisational support for money, gas vouchers and safety equipment				Medium/low
Purchase new equipment				Medium/low
Develop new routes				Low
Utilize workshops and training programs				Low

3.4.2 Effectiveness of adaptation practices

Participants identified the effectiveness of 19 adaptation practices adopted based on if the practice will work or not or the potential of reducing risk to local mobility. Among these, relying on local and traditional knowledge and bringing extra gas were ranked as being highly effective by 72% of participants. This was followed by waiting for favourable weather conditions (65.4%), taking extra supplies (64.5%), rely on weather information (56%), sharing Inuit knowledge, (56%), not going hunting alone (56%) and relying on government and institutional support (36%). Adaptation practices that were observed to have medium effectiveness are adjusting hunting and fishing times (46%), developing new hunting trails (46.2%), purchase new equipment (45.8%), avoiding traveling, or hunting at certain times (42%) and relying on friends and family (40%). Adaptation practices that were observed to have low effectiveness are utilizing workshops and training programs (52%), choosing different traveling equipment (52%), developing new routes (46.1%), changing hunting locations (44%), choosing different routes (42.3%) and taking full or part time work (40%).

Below is the effectiveness assessment of observed adaptation practices in the study community. The size of the circle in a category indicates the amount of evidence for that category. The shading is used to distinguish one category from the other. Assessment score is the final evidence for the adaptation practice. Further information about the assessment is found under methods in the appendixes.

Table 3: Effectiveness assessment of adaptation practices to climate change impact on local mobility in Pond Inlet.

Adaptation practices	**Effectiveness**			
	High	Medium	Low	Assessment score
Rely on local and traditional knowledge.				High
Bring extra gas				High
Wait for favourable weather conditions				High
Take extra supplies or preparations during travel.				High
Rely on weather information				High
Share Inuit knowledge and experience				High
Don’t go hunting alone				High
Rely on institutional/organisational support for money, gas vouchers and safety equipment				High
Adjust hunting and fishing times				Medium
Develop new hunting trails				Medium
Purchase new equipment				Medium
Avoid traveling or hunting at certain times				Medium
Rely on family and friends for food and information.				Medium
Take up full/part-time work.				Low
Choose different routes				Low
Change hunting location				Low
Develop new routes				Low
Choose different traveling equipment				Low
Utilize workshops and training programs				Low

Evidence shows 7 adaptation practices (rely on local and traditional knowledge, share Inuit knowledge and experience, bring extra gas, rely on weather information, wait for favourable weather conditions, take extra supplies or preparations during travel and don't go hunting alone) had both high implementation and risk reduction potential. Two (2) adaptation practices (rely on family and friends for food and information and develop new hunting trails) had both medium implementation and risk reduction potential. Two (2) adaptation practices (develop new routes and utilize workshops and training programs) showed both low potential for implementation and risk reduction.

Only 1 adaptation practice (adjusting hunting and fishing times) showed evidence of high potential for implementation but medium potential to reduce risk. Similarly, choosing different travel routes showed high implementation potential but low risk reduction potential. Three (3) adaptation practices (take up full/part-time work, change hunting location and choose different traveling equipment) showed medium implementation potential but low potential to reduce risk. Two (2) adaptation practices (purchase new equipment and avoid traveling or hunting at certain times,) had both medium to low implementation potential but medium potential to reduce risk. Only relying on institutional and organizational support was found to have both medium to low potential for implementation and but high potential for risk reduction. This result indicates that the feasibility of an adaptation practices may not necessarily lead to an effective outcome and vice versa as it may be influenced by existing social, economic and institutional conditions (Singh et al., 2022).

Table 4 synthesizes and compares the feasibility and effectiveness of adaptation practices in the research community. Adaptation practices that can be found in more than one category are distinguished with asterisks (**).

Table 4: Feasibility and effectiveness assessment of adaptation practices to climate change impact on local mobility in Pond Inlet.

Assessment score	Feasibility		
Effectiveness	High	Medium	Low
High	Rely on local and traditional knowledge. Share Inuit knowledge and experience. Bring extra gas. Rely on weather information. Wait for favourable weather conditions. Take extra supplies or preparations during travel. Don't go hunting alone.	Rely on institutional/organisational support for money, gas vouchers and safety equipment. **	Rely on institutional/organisational support for money, gas vouchers and safety equipment. **
Medium	Adjust hunting and fishing times.	Develop new hunting trails. Purchase new equipment. ** Avoid traveling or hunting at certain times. ** Rely on family and friends for food and information.	Purchase new equipment. ** Avoid traveling or hunting at certain times. **
Low	Choose different routes.	Take up full/part-time work. Change hunting location. Choose different traveling equipment.	Develop new routes. Utilize workshops and training programs.

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Chapter 4

4.0 Conclusion

This chapter outlines several high-level conclusions revealed in the study in relation to the research objectives. Concluding discussion is mainly divided into climate change impact and risk for local mobility, adaptation practices to reduce impact and the feasibility and effectiveness of the adaptation practices.

4.1 Climate change impact and risk for local mobility

Climate change in the Arctic is affecting local mobility in Pond Inlet as reported in other studies in the Arctic (Wilson et al., 2021; Pearce et al., 2015; Ford et al., 2013; Pearce et al., 2010). Inuit in Pond Inlet travel for various reasons throughout the year. Common purposes of travel outside the community are to engage in activities such as hunting on sea ice, traveling to cabins or camp for fun, fishing in the lakes and rivers, hunting on land (inland), gathering food such as eggs, plants/berries, hunting in the ocean, collecting drinking water and fishing in the ocean and visit to neighbouring communities. Findings of this research show that Inuit in Pond Inlet do not travel directly for mental or emotional health purposes but rather, engage in activities such as hunting or camping which subsequently influence their mental and emotional health. As a result, the inability to engage in such activities due to the disruption caused by climate change on travel routes affects the mental and emotional health of people (Ford et al., 2014; Cunsolo Willox et al., 2012). Mode of travel outside the community is usually by snowmobiles, ATVs, boats, vehicles (truck, car, SUV), by foot and dog teams.

Local travels are influenced by multiple climatic and environmental hazards such as extreme heat, permafrost thaw, increased average temperature, decreased land or sea ice, ice storms, severe storms, and extreme winds which have implications for local travel compromising subsistence activities and access to hunting areas (Pearce et al., 2015; Pearce et al., 2011; Ford et al., 2008). Local observations indicate that these hazards have resulted in alterations of ice

and trail conditions such as less snow on land trails, thinner ice, more slush over ice, late and longer freeze-up of sea ice, and early break up of ice as reported by other studies (Ford et al., 2019; Pearce et al., 2010). It is evident from this research that, changes in ice and trail conditions are disrupting local mobility on ice and open waters which is having a negative sociocultural and economic impact on the physical, emotional mental well-being of individuals. This is also consistent with other reports in the Arctic (Wilson et al., 2021, Kenny et al., 2018; Cunsolo Willox et al., 2012; Laidler et al., 2009; Ford et al., 2008). Sociocultural and economic impacts include fewer days available to access hunting grounds, neighbouring communities, cabins, and camping sites; less chance of harvesting or gathering country food; increase in the purchase of store-bought food due to shortage of country food which increases the financial burden and shift traditional taste and preference for country foods and loss of traditional culture and skills due to reduction in hunting activities. Physical, mental, and emotional health impacts observed include sickness and tiredness from not consuming country foods; nervousness, anxiety, and worry due to less connectivity with other communities, less time "spent out on land" and with nature and being "stuck" in town for longer periods than expected (Ford et al., 2014; Cunsolo Willox et al., 2012; Ford et al., 2012).

Despite the current impact of climate change on local mobility, the findings of this research show that future climate changes will continue to affect ice thickness and dynamics and this is expected to extend current challenges for local travel conditions (Ford et al., 2023; Pearce et al., 2015). The risk associated with safe travel will further have potential sociocultural, economic, physical, emotional, and mental implications for individuals. Risks identified with future changes in ice are shorter time available for spring camping due to thinner ice, reduced safe travel on ice, restricted outings and hunting for food, especially in late spring and fall, increased challenges associated with hunting, late hunting, utilizing longer travel routes which will demand better and expensive travel equipment and increased use of gas, increased incidents of accidents such as hunters falling through thin ice, increase loss of traveling

equipment as they fall through thin ice, loss of culture and traditional skills due to the increasing inability to engage subsistence activities and high possibilities of getting sick from not being able to consume country food. In addition, to the findings of this research, there is the recognition among participants that future climate change may lead to a shift in patterns of local mobility from frozen grounds to open waters and mode of travel from snowmachine to increased use of boats. This finding is consistent with other discussions on future climate change and local mobility in the Arctic (Ford et al., 2023; Larsen et al., 2014). Inuit in Pond Inlet are getting increasingly concerned that current traditional knowledge about ice and weather conditions may not be enough for future travel on ice and how this will affect the ability to engage in subsistence activities.

4.2 Adaptation practices to reduce impact

Despite the challenges posed by current climate change for local mobility, several adaptation practices are being adopted within the community to reduce risk for safe travel. Common adaptation practices already being employed in Pond Inlet are relying on local and traditional knowledge, relying on weather information, sharing Inuit knowledge and experience, taking extra supplies, waiting for favourable weather conditions, bringing extra gas, hunting in groups, and using communication devices such as satellite phones. This finding supports the results of other studies in the Arctic (Wilson et al., 2021; Pearce et al., 2011, Ford et al., 2008). The adaptation practices adopted are acknowledged to be significant in reducing vulnerability and were thus adopted by the majority of participants.

Inuit are known to have strong on social networks such as haring among family and friends for food, equipment, and other necessities in adapting with the changing environment to reduce vulnerabilities (Ford et al, 2012; Ford et al., 2008). Interestingly, the findings of this research show that relying on family and friends was not a primary adaptation pratices for a majority participants. In this situation, adaptation may occur independently of the individual (Pearce et

al., 2011). This category of participants is more at risk to unpredictable exposure which will affect how and when they travel in certain climatic conditions, influencing their ability to engage in subsistence activities and sustain daily needs (Ford et al., 2008). Similarly, the adoption of institutional or organizational support and the use of workshop and training programs was not a prominent adaptation practice among a majority of participants. Literature indicates that the cost of numerous adaptation practices tends to exceed the financial capabilities of many communities, regional governments, and regional institutions and this may be a barrier to maintaining or implementing climate adaptation projects (Pearce et al., 2011). This finding thus stresses the need for further research to examine the role of institutions and organizations in strengthening adaptive capacity and fostering adaptation to reduce vulnerabilities to future climatic exposure. This research establishes that there are linkages between numerous climate adaptation practices. For example, changing hunting locations or routes which were less adopted by participants may require a change in or purchase of new traveling equipment such as snowmachine which can be obtained from family and friends. Thus, the inability to share among family and friends means less chance of obtaining the needed equipment to make changes to travel routes or hunting locations. This indicates the need to understand the linkages between adaptation practices and how each may influence the other to enable flexible adaptation options.

Non-climatic sociocultural, economic, and institutional factors interact with climatic conditions to influence adaptation practices. Locally observed non-climatic factors affecting adaptation among participants are Inuit knowledge, land-based skills, availability of equipment, following knowledgeable people, access to information and education, access to technology, individual experience, social networks (sharing among family and friends), monetary resources, availability of time, and ability to take risk (Ford et al., 2012; Pearce et al., 2011; Pearce et al., 2010). These factors can facilitate or limit the adoption of an adaptation practice. For example, participants expressed the importance of monetary resources as the

rising cost of the economy makes it difficult to purchase traveling equipment to ensure safe travel or the increasingly rising cost of fuel which limits the ability to travel to far locations to hunt. This finding is consistent with other studies in Arctic (Pearce et al., 2011, 2010; Laidler et al., 2009). Thus, adaptive capacity should not be taken lightly and will vary among individuals and households (Ford et al., 2012).

Information related to current climatic and environmental conditions is necessary to ensure safe travel outside the community. Important sources of information to make safe travel decisions include friends and family, Elders, recent travellers, active land users, personal observation, local community organizations, social media, NGOs, and government services. Apart from the above sources of information, environmental conditions on ice, weather, and water conditions were considered important to know to inform valuable travel decisions.

4.3 Feasibility and effectiveness of adaptation practices.

This research assessed the feasibility and effectiveness of 19 adaptation practices to climate change's impact on local mobility in Pond Inlet. For feasibility, there were 8 adaptation practices identified to have high implementation possibility. Five (5) adaptation practices were identified to have medium potential of implementation and 2 low implementation possibilities. However, four adaptation practices fell within both medium and low implementation potentials. Interestingly, institutional and organizational support, and utilizing workshop and training programs were identified to have low feasibility as an adaptation practice. As discussed above this may be due to a lack of information about existing institutional or organizational support that may exist within the community, and the high cost of implementing or maintaining existing climate projects (Pearce et al., 2011). It is therefore important to identify what major barriers exist for the adoption and implementation of institutional and other organizational programs as an adaptation practice in the research community.

For effectiveness, 7 adaptation practices were identified to have high-risk reduction potential, 5 adaptation practices were identified to have medium risk reduction potential and 6 adaptation practices were identified to have low risk reduction. Institutional and organizational support was the only adaptation practice that had both medium and low-risk potential. Findings show that not all adaptation practices that were reported to have high feasibility were also identified to have high effectiveness. For example, adjusting hunting and fishing times was reported to have high feasibility but medium effectiveness. Similarly, changing hunting locations, choosing different traveling equipment, and taking up full or part-time work had medium feasibility but low effectiveness. A feasible adaptation practice may thus not necessarily be effective. This shows the complexities of adaptation practices to climate change impact (Williams et al., 2021; Ford et al., 2013). The feasibility and effectiveness assessment of this research provides information on what adaptation practice works and does not work for individuals in Pond Inlet, their vulnerabilities, and capacity to adapt to future changes in climate.

4.4 Concluding statement.

This research provides considerable insight into current climate change impact and risk for local mobility options in Pond Inlet. Findings show that climate change is significantly impacting local mobility patterns making local travel routes unsafe in the community with further socio-cultural, economic, and health implications. Although local adaptations exist, efforts to address adaptation to climate change should also take a holistic approach in enhancing adaptive capacity (Pearce et al., 2011). By encompassing a holistic approach, adaptation should involve integrating traditional knowledge and cultural perspective with Western science through collaboration between local people and institutions to foster effective adaptation to both current impact and future risks associated with climate change. There is also the need to strengthen local government and regional institutional support for local adaptation efforts in the research community.

Evidence shows high feasibility and effectiveness for 7 adaptation practices which encouragingly are significant to cushion individuals against future changes in climate. However, adaptation limits exist and may affect the adoption or risk reduction potential of several adaptation practices in an intense climatic event. Future research will need to broaden the study on feasibility and effectiveness of adaptation practices across various dimensions (technological, sociocultural, economic, institutional etc) and comprehensively examine specific opportunities for effective adaption for future risk to climate change. Notwithstanding, the result supports the conceptual basis of this research on climate change impact and risk for local mobility.

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Appendices

Appendix 1.

Research methodology.

Study Area

Pond Inlet (77^0 58.8[1] W 72^0 40[1].8 N) is located in the Qikiqtaaluk Region of the Canadian Nunavut Territory[6] as shown in Figure 2. The community has a total population of 1,555 who are predominantly 95% Inuit; with a population density of 9.1 per km^2 and covers a total land mass of 170.83 km^2 (StatsCan, accessed 01, 2023)[7]. The hamlet has a variety of wildlife which serves a source of tourist attraction. The area is a destination for tourists all over the world due to the beautiful of mountains, glaciers and icebergs (Nunavut Climate Change Secretariat, accessed 14 March 2023)[8]. Pond Inlet has a mixed economy of traditional subsistence activities including hunting, fishing, trapping and gathering which support the cultural identity of the Inuit and formal wage-based activities including administration, business finance, government services, tourism and businesses relating to arts, crafts and wildlife harvesting (Aarluk Consulting Inc. 2011).

Like other parts of the world, Nunavut has experienced recent climate change with regional increase of 1- 3˚C. The changes include increase in temperature, unpredictable winds, storms, change in rainfall amount and pattern. These events affect traditional Inuit seasons, which are closely linked to traditional activities. Recent climate projections shows that the warming is expected to continue into the next century and is expected to affect existing cultural, social and environmental factors within the Nunavut area. (Nunavut Climate Change Secretariat, accessed

[6] https://www.nunavut.ca/pond-inlet
[7] Census Profile, 2021 Census Population, Pond Inlet Hamlet, Nunavut. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm? Accessed 30 January 2023.
[8] Nunavut Climate Change Secretariat. Pond Inlet. https://www.climatechangenunavut.ca/en/community/pond-inlet Accessed 14 March 2023.

14 March, 2023)[9]. For these reasons, the community of Pond Inlet has identified climate change as a major cause of concern (Aarluk Consulting Inc. 2011).

The Nunavut territory was selected for the research due to the reported current and projected severity of climate change in the territory (Ford et al., 2008). Pond Inlet is particularly relevant to this research as it provides a better perspective of current observed impact of climate change on local mobility and process of adaptation. This is because, Pond Inlet falls within the category of high-risk area being both a coastal community and its location in Northern Canada (CCA, 2019). Likewise, the community experiences high ship traffic in the area (Dawson et al., 2018) and is dependent on sea ice, lakes, rivers, ocean and frozen grounds as a means of transportation of which climate change is posing significant risk (Ford et al., 2019; 2023). Below is a community base map of Pond Inlet [10].

[9] Nunavut Climate Change Secretariat. Climate Change in Nunavut. An overview of major scientific findings and local observations about climate change in Nunavut. https://www.climatechangenunavut.ca/en/understanding-climate-change/climate-change-nunavut Accessed 14 March 2023.
[10] https://cgs-pals.ca/downloads/pond-inlet/

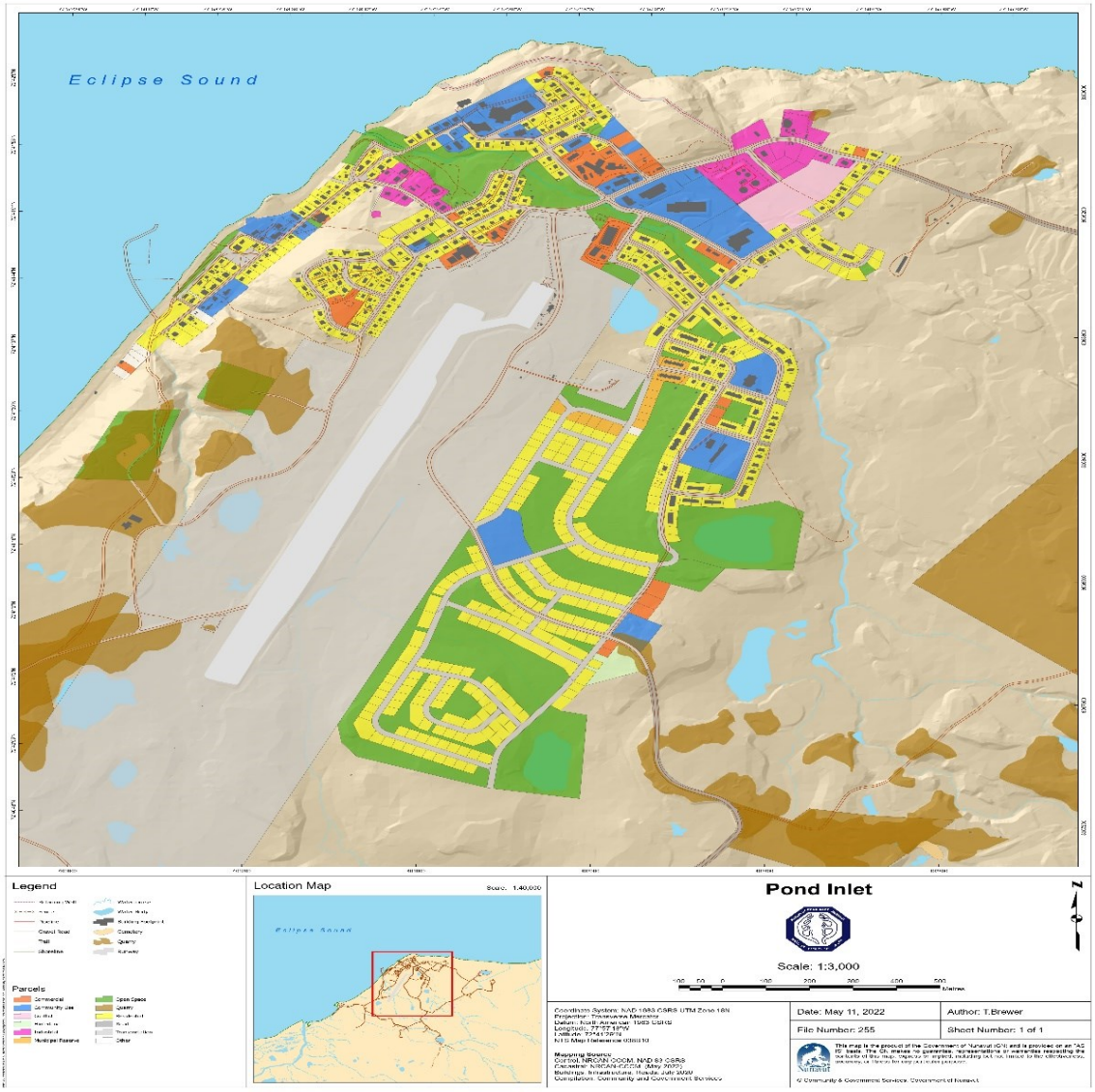

Figure 2. Community base map of Pond inlet.

Source: Government of Nunavut, Community and Government Services Planning and Lands Division. Accessed on 16 June, 2023.

Research approach and design.

This research uses a research survey design, which is a systematic method of gathering information from a specific aspect of a population that reflects the characteristics, attitude and opinion of the population that cannot be directly observed of which findings can be used to quantitatively describe the population (Avedian, 2014; Glasow, 2005). The research builds on a community-based participatory approach which is a collective and self-reflective inquiry where researchers and community stakeholders are actively engaged in every step of the research process with the aim of benefiting participants either by improving practices, bringing

about direct intervention or change in action (Israel et al., 1998; Baum et al., 2006). Accordingly, this research partnered with and built on the principles of Ikaarvik and the research priorities of the community, Pond Inlet. Ikaarvik is an indigenous non-profit organization, headquartered in Pond Inlet who help to identify and address the research priorities of their local communities in Nunavut by integrating indigenous knowledge and western science[11]. Ikaarvik therefore has research experience with the community and are acquainted with the culture, research priorities and experiences of the community.

This research was thus in full collaboration with Ikaarvik who co-designed the process of this project to ensure relevancy of the research for both the research teams and the community of Pond Inlet. It involved regular communication and exchange of innovative ideas for the benefit of a more relevant and robust outcome. Thus, the research partner participated in developing the methodology, questions, data collection as well as explanation of findings and sharing of results to Pond Inlet.

Data collection

Data collection involved a cross-sectional field survey which allows information to be collected at a point in time from a selected sample to represent a larger population (Avedian 2014; Glasow, 2005). This survey type was appropriate for this research as it allows for complex analysis by exploring the relationship between variables, allows time-ordered questions (such as past, present and future) which helps to understand change of events, and saves time and resources (Guyette, 1983). Ikaarvik directly engaged the community to collect primary data. Primary data was collected using the questionnaire. The questionnaire is a fixed lists of questions that reflects the research aim and aid in quantitative analysis which can be self-administered, administered by a professional, individually or in a group (Ponto, 2015). The questionnaire was structured in sections with each section addressing a particular theme based

[11] https://ikaarvik.org/ Accessed on 2 June, 2023.

on the research objective. The survey questions explored interrelated topic of local observations, experience and opinions on climate change impacts and risks on local travel conditions, the subsequent sociocultural and economic impact, local adaptation practices, and the feasibility and effectiveness of the adaptation practices. Participants were also asked to identify the effect of increased ship traffic on local mobility in and around the community. Questions were both in closed and open-ended format. Closed-ended questions were avoided to ensure that participants would be able to provide information in their own words which better reflected their perspectives and opinions.

Climate models were additionally employed to explore participants opinion regarding the implications of projected changes in climate and sea ice conditions on local mobility for the community. Climate models usually forecast future variations in climate across specific time periods which are valuable for understanding the potential future variations in temperature and precipitation and their resulting affects such as sea ice extent and thickness (Pearce et al., 2010). Using climate projection in the data collection method, helped to assess participants perception on their exposure sensitivity and adaptive capacity to future anticipated changes in climate and ice thickness and their implications for safe travel. The series of data collection methods allowed for rigorousness in the process which aided in analysing extremely diverse findings. Secondary sources of data involved review of documents such as government reports, journal articles and books and websites relevant to the research objective.

The research employed a mixed sampling procedure, purposive and snowball sampling (Teddlie & Yu, 2007). Purposive sampling is where certain types of participants are chosen intentionally due to their ability to provide information relevant for the research questions (Guetterman, 2020). The rationale is to ensure that the perspective of certain group of individuals who are regarded important to the research are captured in the final sample of the project (Robinson, 2014). For purposive sampling method, to ensure holistic response and

significant representation of different groups of people in the community, community elders, board members, community members (such as hunters) and the youth were recruited. Individuals 18 years and above, with different education background, from various gender and work employment in the local economy were represented in the sample. Snowball sampling involves assessing information through referral of contacts by participants who might be relevant for participating in the research (Robinson, 2014). This sample technique provides a unique way of reaching the desired group of people and provides dynamic quality of social knowledge to be generated on the research questions (Noy, 2008). Following this, the community research partners recruited people who were interested in taking part in the survey. The recruited participants then referred other individuals who were willing to participate in the survey.

Survey was administered online and conducted in English as majority of participants spoke English. However, participants who were not comfortable to take the survey in English were given an option to be assisted by the research partners or a family member using Inuktitut. In this case, the assistant identifies as a witness to the survey. Questionnaire took approximately 30 to 45 minutes to complete. Majority of the survey was done in the residential homes of the participants to allow flexibility and comfortability. Data collection lasted for 6 weeks after which data analysis begun. Final data obtained was cut down to 33 completely answered questionnaire.

Table 5. Demographic characteristics of participants

Background	Percentage N=100	Count N=33
Gender		
Male	62.2	23
Female	35.1	9
Other	2.7	1
Years of residency		
Less than one year	0	0
1 – 4 years	6.1	2
5 – 9 years	0	0
10 – 19 years	27.3	9
20 – 39 years	42.4	14
40 or more	18.2	6
Prefer not to answer	6.0	2
Indigenous group(s)		
Inuit	93.9	31
Métis		
First Nation		
No/Prefer not to answer	6.0	2
Highest level of education		
No formal schooling	3.0	1
Some Elementary school	3.0	1
Completed Elementary school	3.0	1
Secondary (High) school	39.4	13
College, CEGEP or non-University	30.3	10
University (bachelor's)	6.1	2

Graduate/Professional	3.0	1
Other/prefer not to answer	12.1	4
Employment status		
Employed	78.8	26
Unemployed	12.1	4
Voluntary work	6.0	2
Prefer not to answer	6.0	2
Role within the community		
Community member/resident	69.7	23
Elder	6.1	2
Community council or board member	9.1	3
Head of a local organisation	3.0	1
Other/prefer not to answer	22.2	8

Data Analysis

Quantitative data was analysed using descriptive statistics with the assistance of the software program Qualtrics. For each question, percentages were created for each variable (for example major impact, moderate impact less impact etc) and overall trends assessed. Data was then exported to excel to allow for enhanced visual representation of overall findings and participant responses using bar graphs. Quantitative data are also represented in tables (using percentages). Inclusion and exclusion analysis was used to distinguish major and minor responses and final findings discussed. Demographic information describing sampled participants were represented with tables. Qualitative data was transcribed and coded based on emerging themes. Qualitative data was also presented by quoting participants to allow a better understanding of participants opinions. For the purpose anonymity, the age, gender or status of quoted participants were used.

Appendix 2.

Supplementary information on methods.

Feasibility assessment

Index	Description	Assessment score
High feasibility	Highest level of being implemented/low or no implantation barrier.	High
Feasible	High level of being implemented/ low or no implantation barrier.	
Moderate feasibility	Moderate level of being implemented/presence of some barriers	Medium
Less feasibility	Lowest level of being implemented/multiple implementation barrier.	Low
Not feasible	No evidence of being implemented/multiple implementation barrier.	
Amount of evidence	Percentage of evidence/participants supporting the assessment for that adaptation practice for the unit.	N=33

Amount of evidence

Effectiveness assessment

Index	Description	Assessment score
Highly effective	Highest potential for risk reduction.	High
Effective	High potential for risk reduction.	
Moderately effective	Moderate potential for risk reduction.	Medium
Less effective	Lowest potential for risk reduction.	Low
Not effective	No potential/evidence for risk reduction	
Amount of evidence	Amount of evidence supporting the assessment for the adaptation practice for the unit.	N=33

Amount of evidence

Appendix 3

Glossary

This glossary defines specific terms by IPCC and reflects how it is intended to be interpreted in the context of this research.

Adaptation practices: The array of strategies and measures that are available and appropriate for addressing adaptation (IPCC, 2019).

Adaptation: The process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities (IPCC, 2019).

Adaptive capacity: The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities or to respond to consequences (IPCC, 2014).

Effectiveness: Evaluates how successful an adaptation response is at reducing risk based on specified outcomes (Williams et al., 2021).

Exposure: The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected (IPCC, 2019).

Feasibility: The degree to which climate goals or response option are considered possible and/or desirable (IPCC, 2019).

Hazard: The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources (IPCC, 2019).

Impacts: The consequences of realised risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather/climate events), exposure, and vulnerability. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial (IPCC, 2019).

Risk: In the context of climate change risks can arise from potential impacts of climate change as well as human responses to climate change (IPCC, 2019).

Sensitivity: The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change.

Vulnerability: The propensity or predisposition to be adversely affected (IPCC, 2019).

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Welcome to the survey!

Thank you for your interest in participating in this research project.

Climate Change and Local Transportation – Adaptation Practices for Local Mobilities

Community Survey

Introduction

Do you travel near-by your community across the land, sea ice, lakes? Would you like to help improve options for making local travel safer? If so, we want to hear from you! Our research team includes Inuit, northern, and southern researchers who have worked in Nunavut communities together over many years. We have heard about how the environment is changing and is creating many challenges and risks, as well as some opportunities for safe travel around your community.

We invite you to complete this survey if you have been travelling on the land, the sea, or across frozen lakes and sea ice in the past three years. We want to hear from men and women of different ages and experiences, whether you are an active harvester, a seasonal traveller, or you just like to get out on the land and sea. We ask these questions about your travel habits to learn about how and why you travel in different seasons. When we ask about travel habits, we use this in a general way to mean any travel you do outside of the community that takes you over land, water, and ice (not by plane and not travel inside your community). The results of this research will be provided to the collaborators (Ikaarvik) and community.

This survey is voluntary, it will take approximately between 30 to 45 minutes, and you can stop at any time. ***You will receive a gift card for your time.*** **Are you interested in participating in the survey?**

□ Yes □ No

Are you 18 years of age or older?

□ Yes □ No

Consent (Inuktitut follows)

Title of Study: Climate Change and Adaptation Practices for Local Mobilities and Marine Shipping in Arctic Canada.

Principal Investigator: Selina Agyemang Duah; University of Ottawa; Department of Geography; Environment, Society, & Policy Group.
Supervisor: Dr. Jackie Dawson; University of Ottawa; Department of Geography; Environment, Society, & Policy Group.

Invitation to Participate: You have been selected / invited to participate in a research project by Selina Agyemang Duah from the Environment, Society, and Policy Group at the University of Ottawa, in partnership with Ikaarvik. Thank you for your engagement with us in this questionnaire on Arctic mobilities. This research is funded by the Canada-Inuit Nunangat-United Kingdom Arctic Research Programme. This research project is part of a Master's Thesis at the University of Ottawa by Selina Agyemang Duah (MA in Geography), supervised under Dr. Jackie Dawson.

Purpose of Study: The purpose of our project will be to survey community members such as yourself through a questionnaire, providing a variety of questions that the respondent will answer. The questions will be on the topic of climate change in the Arctic and Arctic mobilities (transportation systems) with a focus on your community (Pond Inlet). Our goals for this research project are to gain insights into how climate change can affect local mobilities and the adaptation response. Our research aims to integrate community perspectives when considering issues in climate change impacts and adaptation. These insights are important for us to consider as climate change continues to pose transport related challenges for local communities.

Participation: Your participation will consist of reading a list of questions on the questionnaire and choosing answers that reflect your opinion, knowledge, and experience. Your participation will include reading multiple choice questions on Arctic mobilities that are presented to you on the questionnaire, then answering the questions to the best of your knowledge. There will also be some questions that require a written response. If requested, assistance can be provided for answering the questionnaire. The estimated time to complete the questionnaire is around 30 to 45 minutes depending on your level of comfort.

Anticipated Risks: This questionnaire may cause discomfort, stress, and/or anxiousness due to the considerations of climate change impacts around your community. These questions contain future projection on sea ice conditions in the Arctic and this will be considered in the context of your community and region (Pond Inlet and the Northwest Passage).

Benefits: By engaging with us and participating in the questionnaire, you will be providing valuable knowledge to the research community focused around modern Arctic issues and a voice for your community on the topic.

Confidentiality & Privacy: You have the choice of allowing or not allowing the Principal Investigator to refer to you by a pseudonym, your role, title, or occupation within the community within the final products (research papers and/or reports). If you have chosen to not allow this information to be presented, the Principal Investigator will take steps to ensure these personal details are not referred to in the final publication or report and will ensure your identity and personal information is protected. If you have chosen to allow for details such as personal identifiers to be used, the Principal Investigator will ensure that the appropriate / preferred identifiers (e.g. pseudonym, role, title, or occupation within the community) are used. Names are not necessary for the final products of this study. Please note that we will also be collecting personal / demographic information from you within the questionnaire to be used within the study.
The web application, Qualtrics, will primarily be used to administer the questionnaire. The Principal Investigator will be the only one with access (control) to the Qualtrics application for the purpose of monitoring and exporting responses for the final dataset. Paper copies can be made available upon request.

Ikaarvik is the research group within the community who will primarily be involved in the data collection and will have access to your participation and responses. Ikaarvik will have access to the full dataset but will not have access to your personal identifiers within the dataset. As such, while Ikaarvik will know who participated (through assistance and/or for the purpose of distributing the gift card), they will not know who said what. While the questionnaire may contain identifiers (names of participants, email addresses, and demographic info), these will be removed (anonymized) before being shared with Ikaarvik.

The only exception to the above is if the Ikaarvik team directly assisted you in completing the questionnaire. In this case, the Ikaarvik team member who assisted you would know the answers you provided at the time of the questionnaire (as both of you completed it together).
The Principal Investigator will own the data while Ikaarvik will have access to the data with personal identifiers removed.

Conservation of Data: Your data will be stored on password protected laptops, while back-up data will be stored on an external hard-drive stored / hidden within a home-office desk. Paper

questionnaires administered would be stored in locked cabinets, with digital versions stored on the password protected laptops. The data and research documents will be retained for a maximum of 5 years after which it would be destroyed.

Compensation: Your participation in answering the questionnaire will be compensated with a $50 gift card to The Northern which will be given to you in-person via Ikaarvik. The researchers will provide your name to Ikaarvik for the purpose of distributing the gift cards. This list of names will be separate from the data. Should you choose to withdraw your participation for any reason when answering the questionnaire, you will still receive the compensation.

Voluntary Participation: Your participation in this questionnaire will be entirely voluntary and your choice. You can withdraw from answering the questionnaire at any point, and you can withdraw your answers to the questionnaire without penalty. You also have the choice to allow or not allow the researchers to refer to you by a pseudonym, your role, title, or occupation within the final publication or report.
Participants should print a copy of the consent form to keep for their personal records.

Questions: If there are any questions, concerns, or comments, regarding this research, you can contact the research team at any time. You can contact Selina Agyemang Duah or Dr. Jackie Dawson.
If you have any questions regarding the ethical conduct of this study, you may contact the Protocol Officer for Ethics in Research, University of Ottawa by phone or by email.

By Signing this form, you agree to the following:
I have been fully informed of the objectives of the project being conducted. I understand these objectives and consent to having my answers to the questionnaire recorded for the project. I understand that steps will be undertaken to ensure that the response to this questionnaire will remain confidential unless I consent to being identified. I also understand that, if I wish to withdraw from the study, I may do so without any repercussions.

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ᖃᐅᔨᓴᖅᑎᒡᒪᓚᐅᐳᑦ ᐊᐃᐸᓪᓐᓄ: ᓯᓕᓇ ᐊᓱᔨᒫᓐ ᑐᐊ, ᓯᓚᑦᑐᓴᕐᐲᔨᐊᖅ ᐊᑐᓵᓱ; ᐱᓕᓚᐃᓐᓄ ᓄᓇᓂ ᖃᐅᔨᓴᓂᒪᑦ; ᐊᐸᑎᓐᓄ, ᐃᓅᖅᑎᑎᓯᓂᒪᑦ, ᐊᓱᒪ ᐊᑐᐊᔪᐃᑦ ᑲᑎᓪᓐᓄᔨᓄᑦ.

ᑲᒪᔨ: ᓘᑦᑖᖅ ᔩᑭ ᑖᓵᓐ; ᓯᓚᑦᑐᓴᕐᕕᒃᓴᐊᖅ ᐋᑐᕚ; ᐱᓕᕆᕕᖓ ᓄᓇᓂ ᖃᐅᔨᓴᓂᕐᒧᑦ; ᐊᕙᑎᖓ, ᐃᓅᖃᑎᒌᓐᓂᕐᒧᑦ, ᐊᒻᒪ ᐊᑐᐊᓚᐃᑦ ᑲᑎᙵᕙᓄᑦ.

ᖃᐃᖅᑯᔨᓂᖅ ᐃᒪᕆᔭᐅᓗᓂ: ᓂᕈᐊᖅᑕᐅᓯᒪᔪᑎᑦ/ᒪᖃᐃᖅᑯᔭᐅᓯᒪᔪᑎᑦ ᐃᓚᒋᔭᐅᓗᑎᑦ ᖃᐅᔨᓴᓂᕐᒧᑦ ᐱᓕᕆᐊᒥᑦ ᐆᒧᖓ ᔨᐊᐳᓇ ᔭᓇᐊᓪᑯ ᐊᒻᒪ ᓯᓖᓇ ᐊᒃᔩᒫᖕ ᑐᐊ ᐊᕙᑎᓕᕆᔩᒃᑯᓐᓂᑦ, ᐃᓅᖃᑎᒌᓐᓂᕐᒧᑦ, ᐊᒻᒪ ᐊᑐᐊᓚᐃᑦ ᑲᑎᙵᕙᓄᑦ ᓯᓚᑦᑐᓴᕐᕕᒃᓴᐊᒥᑦ ᐋᑐᕚ, ᐱᓕᕆᖃᑎᖃᖅᑐᑎᑦ ᐃᑳᕐᕕᒃ. ᕐᑯᔭᓐᓇᒦᒃ ᐃᓚᒋᔭᐅᔪᓐᓇᕋᕕᑦ ᐅᕙᑦᑎᓐᓄᑦ ᑕᕝᕙᓂ ᖃᐅᔨᓴᕐᓂᐅᔪᒥᑦ ᐅᑭᐅᑕᖅᑐᒥ ᐃᖏᕋᖃᑦᑕᕐᓂᐅᔪᑦ. ᑖᓐᓇ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᑮᓇᐅᔭᖃᖅᑎᑕᐅᔪᖅ ᑲᓇᑕ–ᐃᓄᐃᑦ ᓄᓇᖓᑦ–ᑕᕿᐅᑉ ᐊᑭᐊᓂ ᐅᑭᐅᑕᖅᑐᒥ ᖃᐅᔨᓴᓂᕐᒧᑦ ᐱᓕᕆᐊᖅ.

ᑖᓐᓇ ᖃᐅᔨᓴᓂᕐᒧᑦ ᐱᓕᕆᐊᖅ ᐃᓚᒋᔭᖓ ᒪᕿᓐᓂᒃ ᓇᓗᓇᐃᒃᑯᑕᓂᕐᒧᑦ ᓯᓚᑦᑐᓴᕐᕕᒃᓴᐊᒥ ᖃᐅᔨᓴᓂᕐᒧᑦ ᓯᓚᑦᑐᓴᕐᕕᒃᓴᐊᒥ ᐋᑐᕚ ᓯᓖᓇ ᐊᒃᔩᒫᖕ ᑐᐊ (MA ᓄᓇᓂᑦ ᖃᐅᔨᓴᓂᕐᒧᑦ), ᑲᒪᔨᕆᓪᓗᓂᐅᒃ ᓘᑦᑖᖅ ᔩᑭ ᑖᓵᓐ.

ᐱᔾᔪᑎᖓ ᖃᐅᔨᓴᓂᕐᒧᑦ: ᐱᓕᕆᐊᑦᓴᖅᑭᑎᒋᔭᕗᑦ ᖃᐅᔨᓴᕈᒪᓪᓗᑕ ᓄᓇᓕᖕᒥᐅᑕᓂᑦ ᓈᖅᑐ ᐃᓕᑦᓯᓐᓂᒃ ᐊᐱᖅᑯᑎᒃᑯᑦ, ᐊᔾᔨᒌᙱᑦᑐᓂᑦ ᑕᑯᓐᓇᖕᖑᐊᑎᑦᓯᕙᑦᑐᓂᑦ ᖃᓄᐃᓐᓇᖅ ᐊᒻᒪ ᐊᐱᖅᑯᑎᒃᑯᑦ ᑭᐅᔾᔪᑎᒋᕙᓐᓂᐊᖅᑕᖏᓐᓂᑦ ᐊᐱᕐᓱᖅᑕᐅᑉ. ᐊᐱᖅᑯᑎᐅᔪᑦ ᐅᖃᐅᓯᐅᔪᓂᑦ ᓯᓚᖓ ᐊᓯᔾᔨᕐᓂᖓᓄᑦ ᐅᑭᐅᑕᖅᑐᒥ, ᐅᑭᐅᑕᖅᑐᒥ ᐅᒥᐊᕐᔪᐊᓕᕆᓂᖅ, ᐊᒻᒪ ᐅᑭᐅᑕᖅᑐᒥ ᐃᖏᕋᔪᓯᑎᑕᐅᔪᑦ (ᐃᖏᕋᔪᓕᕆᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᔪᑦ) ᐱᓕᕆᐊᖃᓗᐊᖅᓗᑎ ᐃᕝᕕᑦ ᓄᓇᓕᖓᓂᑦ (ᒥᑦᑎᒪᑕᓕᒃ). ᖃᓄᐃᓕᖓᓂᐅᔪᓐᓇᖅᑐᑦ ᐱᔾᔪᑎᖃᓂᐊᖅᑐᑦ ᐅᑭᐅᑕᖅᑐᒥ ᐅᒥᐊᕐᔪᐊᓕᕆᓂᕐᒧᑦ ᑐᐊᕕᕐᓇᖅᑐᓂᑦ ᐊᒻᒪ ᐅᑭᐅᑕᖅᑐᒥ ᐃᖏᕋᖃᑦᑕᕐᓂᐅᔪᑦ. ᑐᕌᓚᑎᒋᔭᕗᑦ ᑖᔅᓱᒧᖓ ᖃᐅᔨᓴᓂᕐᒧᑦ ᐱᓕᕆᐊᖅ ᖃᐅᔨᓗᒋᑦ ᖃᓄᖅ ᓯᒪᖓ ᐊᓯᔾᔨᕐᓂᖓ ᐊᑦᑐᐊᓂᖃᕈᓐᓇᖅᓯᓐᓂᕐᒧᑦ ᓄᓇᓕᒻᒥ ᐃᖏᕋᖃᑦᑕᕐᓂᐅᔪᓂᑦ, ᐃᒪᒃᑯᑦ ᐅᒥᐊᕐᔪᐊᓕᕆᓂᖅ ᐊᒻᒪ ᐊᑦᑕᓇᕈᑎᐅᔪᓐᓇᖅᑐᑦ ᐃᒪᒃᑯᑦ ᐅᒥᐊᕐᔪᐊᓕᕆᓂᕐᒥᑦ ᓄᓇᓕᒻᒧᑦ. ᖃᐅᔨᓴᕐᓂᖃᖅᑐᒍᑦ ᑐᕌᖅᑐᖅ ᐃᓚᓕᐅᔾᔭᐅᑎᓪᓗᒋᑦ ᓄᓇᓕᒻᒧᑦ ᐃᓱᒪᒋᔭᐅᔪᓂᑦ ᐃᓱᒪᒋᔭᖅᑎᓪᓗᒋᑦ ᐃᓱᒫᓗᑕᐅᔪᑦ ᐅᑭᐅᑕᖅᑐᒥ ᐅᒥᐊᕐᔪᐊᓕᕆᓂᕐᒥᑦ, ᓯᓚᖓ ᐊᓯᔾᔨᕐᓂᖓᓄᑦ ᐊᑦᑐᖅᑕᐅᔪᑦ ᐊᒻᒪ ᐊᑐᓕᖅᑭᓇᓂᕐᒧᑦ, ᐊᒻᒪ ᑐᐊᕕᕐᓇᖅᑐᓂ ᐊᐅᓚᑦᑎᓂᓕᕐᒧᑦ. ᑖᒃᑯᐊ ᖃᐅᔨᔭᐅᔪᑦ ᐱᒪᓗᐊᖅᑐᑦ ᐅᕙᑦᑎᓐᓂᒃ ᐃᓱᒪᒋᔪᒍ ᓯᓚᖓ ᐊᓯᔾᔨᕐᓂᖓ ᑲᔪᓯᕙᓪᓕᐊᑎᓪᓗᒍ ᐃᖏᕋᔪᓕᕆᓂᕐᒧᑦ ᐊᑦᑐᐊᓂᓕᓐᓄᑦ ᐊᔅᓯᕈᕈᑕᐅᔪᓐᓇᖅᑐᓂᑦ ᓄᓇᓕᓐᓂᑦ ᐱᖃᓯᐅᑎᓪᓗᑎ ᐊᒥᓱᕈᖅᐸᓪᓕᐊᓐᖑᐊᖅᑐᑦ ᐃᒪᒃᑯᑦ ᐅᒥᐊᕐᔪᐊᓕᕆᓂᖅ ᐅᑭᐅᑕᖅᑐᒥ ᐃᒪᕐᒥᐅᑕᓂᑦ ᐆᒪᔪᓂᑦ ᐱᔾᔪᑎᓕᒃᑯᑦ ᓯᑯᖃᖏᓐᓂᕐᓴᐅᓕᕐᓂᖓᓄᑦ.

ᐃᓚᒋᔭᐅᖃᑕᐅᓂᖅ: ᐃᓚᒋᔭᐅᖃᑕᐅᓂᕆᔭᐃᑦ ᐅᖃᓕᒫᓂᐊᖅᑐᑦ ᑎᑎᕋᖅᓯᒪᔪᓂᑦ ᐊᐱᖅᑯᑎᓂᑦ ᐊᐱᖅᑯᑎᐅᔪᓂᑦ ᐊᒻᒪ ᓂᕈᐊᕐᓗᑎ ᑭᐅᔾᔪᑎᓂᑦ ᑕᑯᔅᓴᐅᑎᑦᑎᔪᑦ ᐃᕝᕕᑦ ᐃᓱᒪᒋᔭᖓᓂ, ᖃᐅᔨᒪᔭᖓᓂ, ᐊᒻᒪ ᐊᑐᖃᑦᑕᖅᓯᒪᔭᖓᓂ. ᐃᓚᒋᔭᐅᖃᑕᐅᓂᕆᔭᐃᑦ ᐱᖃᓯᐅᔾᔨᓂᐊᖅᑐᖅ ᐅᖃᓕᒫᓂᕐᒥᑦ (ᐅᕝᕙᓘᓐᓃᑦ ᓈᓚᓐᓂᕐᒥᑦ) ᖃᓄᐃᓕᖓᓂᐅᔪᓇᖅᑐᓂᑦ ᐅᑭᐅᑕᖅᑐᒥ ᐅᒥᐊᕐᔪᐊᓕᕆᓂᕐᒧᑦ ᐱᓂᕐᓗᑦᑐᓂᑦ ᐊᒻᒪ ᖃᓄᐃᓕᓂᐅᔪᓂᑦ ᐊᒻᒪᓗᑦᑕᐅᖅ ᐊᒥᓱᓚᓐᓂᑦ ᓂᕈᐊᓂᕐᒧᑦ ᐊᐱᖅᑯᑎᓂᑦ ᑐᓂᔭᐅᔪᑦ ᐃᓕᓐᓄᑦ ᐊᐱᖅᑯᑎᓂᑦ, ᑭᐅᓕᖅᓗᒋᑦ ᐊᐱᖅᑯᑎᐅᔪᑦ ᐃᕝᕕᑦ ᐱᐅᓛᓂ ᖃᐅᔨᒪᔭᖓᓂᑦ. ᖃᓄᐃᖓᓂᐅᔪᓇᖅᑐᓄᑦ ᑐᓐᖓᓂᖃᖅᑐᑦ ᐊᐱᖅᑯᐃᑦ ᖁᕙᓯᓐᓂᖏᓐᓅᖅᑕᐅᓂᐊᖅᑐᑦ ᓈᓴᐅᑎᖏᓐᓄᑦ, ᐱᒋᐊᖅᑐᓂ ᐊᑦᑎᓛᖓᓂ (1) ᑎᑭᑦᑐᒍ ᖁᑦᑎᓛᖓᓄᑦ (10), ᐊᐱᖅᑯᑎᐅᔪᑦ ᐅᑭᐅᑕᖅᑐᒥ ᐃᖏᕋᖃᑦᑕᕐᓂᐅᔪᑦ ᐊᒥᓱᓚᐅᓂᐊᖅᑐᑦ ᓂᕈᐊᕋᔅᓴᐃᑦ ᐊᐱᖅᑯᑎᓂᑦ. ᐊᐱᖅᑯᑎᑕᖃᓂᐊᖅᒥᔪᑦ ᑎᑎᕋᖅᓯᒪᔪᓂᑦ ᑭᐅᔭᐅᔭᕆᐊᖃᖅᑐᓂᑦ. ᐃᑲᔪᖅᑕᐅᔪᒪᒍᑎᒃ, ᐃᑲᔪᖅᑕᐅᒍᓐᓇᐸᓐᓂᐊᖅᑐᑦ ᐊᐱᖅᑯᑎᓕᕆᓕᕈᑎᒃ. ᓇᓚᐅᑦᑖᖅᑕᐅᓯᒪᔪᖅ ᖃᓄᑎᒋ ᐊᐱᖅᑯᑎᓕᕆᓂᐊᕐᒪᖔᑕ ᐃᒻᒪᖄ 30 ᒪᓇᑦᓯᐸᓗᓐᓂᒃ ᐃᑲᕐᕋᑲᓴᒥᑦ ᐃᑲᕐᕋᒧᑦ ᒪᓕᓪᓗᒍ ᖃᓄᖅ ᐃᓱᒪᑦᓴᕐᓯᐅᕆᑎᒋᙵᓂᐊᖅᑕᑎᑦ.

ᓂᕿᐅᒋᔭᐅᔪᑦ ᐊᑦᑕᓇᕈᑎᐅᔪᓐᓇᖅᑐᑦ: ᐊᐱᖅᑯᑎᒃᑯᑦ ᐊᑲᐅᔫᓐᑐᐃᓐᓇᓇᐊᖃᕐᓂᐊᖅᑐᓯ, ᐊᑦᓱᕉᓴᐅᑎᒋᓗᒋᑦ ᐃᓚᖏᑦ, ᐊᒻᒪ/ᐅᕝᕙᓘᓐᓃᑦ ᐃᓱᒫᓅᑎᒋᓕᖅᐸᓪᓗᒋᑦ ᐱᔾᔪᑎᒋᓪᓗᒋᑦ ᑕᑯᓐᓇᙳᐊᓚᐅᕐᑯᔭᐅᔪᑦ ᐊᒻᒪ ᐃᓱᒪᑦᓴᕐᓯᐅᕆᑎᐅᔪᑦ ᐱᓪᓗᒍ ᓯᓚᐅᑉ ᐊᓯᔾᔨᐸᓪᓕᐊᓂᖓ ᐊᕙᑎᐊᒍᑦ ᓄᓇᓕᑦᓯ. ᑕᒪᒃᑯᐊ ᑕᑯᓐᓇᙳᐊᓚᐅᔪᑦ ᐃᓗᓕᖅᑲᐅᕐᒪᑕ ᐊᑐᖅᑕᐅᓯᒪᔪᒥᓂᕐᓂᒃ ᐅᒥᐊᕐᔪᐊᒃᑯᑦ ᖃᓄᐃᓕᔾᔪᑎᒥᓂᕐᓂᒃ ᐊᒻᒪ ᖃᓄᐃᓕᐅᕆᑎᒥᓂᕐᓂᒃ ᐊᑐᖅᑕᐅᓯᒪᔪᓂᑦ ᐊᓯᖏᓐᓂ ᓯᔾᔭᖏᓐᓂ ᑲᓇᑕᒥ ᐊᒻᒪ ᐃᓱᒪᑦᓴᕐᓯᐅᕆᑎᐅᕙᓐᓂᐊᕐᓗᑎᒃ ᐃᓗᓕᖏᒍᑦ ᓄᓇᓕᑦᓯᓐᓂ ᐊᒻᒪ ᓄᓇᓕᕋᕐᕕᓐᓂᑦ (ᒥᑦᑎᒪᑕᓕᒃ ᐊᒻᒪ ᐅᐊᓕᓂᕐᒥᑦ ᑲᓇᑕᐅᑉ ᑲᓇᓐᓇᖓᓄᑦ ᐃᑳᕐᕕᖓ).

ᐃᑲᔫᓯᐊᑦ: ᐱᓕᕆᖃᑎᖃᕐᓗᓯ ᐅᕙᑦᑎᓐᓂᑦ ᐊᒻᒪ ᐱᖃᑕᐅᓗᓯ ᐊᐱᖅᑯᑎᒃᑯᑦ, ᐊᑑᑎᓕᒻᒪᕆᓐᓂᑦ ᑐᑭᓯᒋᐊᕈᑎᑦᓴᓂᑦ ᐅᖃᐅᓯᖃᕐᓂᐊᖅᑐᓯ ᐊᑑᑎᖃᕐᓂᐊᑐᒻᒪᕆᓐᓂᑦ ᖃᐅᔨᓴᖅᑎᓄᑦ ᑐᕌᖓᖅᐸᑦᑐᓂᑦ ᒫᓇᐅᓕᖅᑐᖅ ᐅᑭᐅᖅᑕᖅᑐᒥ ᐱᔾᔪᑎᐅᕙᓕᖅᑐᓂᑦ ᐊᒻᒪ ᓂᐱᐅᓗᓯ ᑕᒪᓐᓇ ᐱᓪᓗᒍ ᓄᓇᓕᑦᓯᓐᓄᑦ.

ᑲᖑᓇᖅᑎᑕᐅᓂᖏᑦ ᐊᒻᒪ ᑲᖑᓇᖅᑐᓕᕆᓂᕐᒧᑦ: ᐃᓱᒪᕐᓯᖅᑎᑕᐅᓂᐊᖅᑐᓯ ᖃᓄᖅ ᑕᐃᒍᖅᑕᐅᔪᒪᓂᐊᕐᒪᖔᖅᐱᑦ ᖃᐅᔨᓴᖅᑎᒻᒪᕆᓐᓄᑦ ᖃᓄᖅ ᑐᖅᑐᖃᐅᓯᒃᑯᑦ, ᖃᓄᖅ ᐊᑑᑎᖃᕐᓂᒃᑯᑦ, ᑕᐃᒎᓯᖓᒍᑦ ᐃᕝᕕᑦ ᐅᕝᕙᓘᓐᓃᑦ ᐃᖅᑲᓇᐃᔮᒃᑯᑦ ᐃᓗᐊᓂ ᓄᓇᓕᑦᓯ ᐃᓗᐊᓂ ᑭᖑᓪᓕᖅᐹᖑᓂᐊᖅᑐᓂ ᓴᖅᑭᑕᐅᔪᓂ (ᖃᐅᔨᓴᖅᑎᒻᒪᕆᓐᓄᑦ ᑎᑎᖅᑲᖁᑎᓂ ᐊᒻᒪ/ᐅᕝᕙᓘᓐᓃᑦ ᐅᓂᒃᑳᓕᐊᓂ). ᑕᒪᓐᓇ ᑐᑭᓯᒋᐊᕈᑎᐅᔪᖅ ᓴᖅᑭᑕᐅᖅᑯᓂᐊᖅᒋᒃᑯᕕᐅᒃ, ᖃᐅᔨᓴᖅᑎᒻᒪᕆᐅᔪᑦ ᐱᓕᕆᓂᐊᖅᑐᑦ ᓇᓗᓇᐃᕐᓯᒪᓂᒃᑯᑦ ᑕᒪᒃᑯᐊ ᐃᒻᒥ ᒨᖓᔪᑦ ᓇᓗᓇᐃᔭᐃᑎᐅᔪᑦ ᐅᖃᐅᓯᐅᕐᑯᖏᓪᓗᒋᑦ ᑭᖑᓪᓕᖅᐹᒥ ᐅᖃᓕᒫᒐᓕᐊᒥ ᐅᕝᕙᓘᓐᓃᑦ ᐅᓂᒃᑳᓕᐊᒥ ᐊᒻᒪ ᓇᓗᓇᐃᖅᓯᒪᓇᓱᐊᕐᓗᑎᒃ ᓇᓗᓇᐃᔭᐃᑎᒋᔭᐃᑦ ᐊᒻᒪ ᐃᓕᓐᓅᖓᔪᑦ ᑐᑭᓯᒋᐊᕈᑎᐅᔪᑦ ᓴᐳᒻᒥᔭᐅᖅᑯᓪᓗᒋᑦ. ᓴᖅᑭᖅᑕᐅᖅᑯᓐᓂᕈᕕᒋᑦ ᓇᓗᓇᐃᔭᐃᑎᐅᔪᑦ ᓰᕐᓗ ᐃᓕᓐᓂᒃ ᓇᓗᓇᐃᔭᐃᑎᐅᔪᑦ ᐊᑐᖅᑕᐅᔪᓇᖅᑐᑦ,

ᖃᐅᔨᓴᖅᑎᒪᓇᐅᔪᑦ ᓇᓗᓇᐃᕐᓯᒪᓂᐊᖅᑐᑦ ᓈᒻᒪᒋᔭᐅᔪᖅ/ᐊᑐᖅᑕᐅᕐᑯᔭᐅᔪᑦ ᓇᓗᓇᐃᔭᐃᑎᐅᔪᑦ (ᓲᕐᓗ ᑕᐃᒫᓯᐅᕐᑯᔭᐃᑦ, ᐋᑑᑎᒋᔭᐃᑦ, ᑕᐃᒫᓰᑦ, ᐅᕝᕙᓘᓐᓃᑦ ᐃᖅᑲᓇᐃᔮᓇᔾᑯᑦ ᐃᓗᐊᓂ ᓄᓇᓕᐅᑉ) ᐊᑐᖅᑕᐅᕐᑯᔭᐅᓗᑎᒃ. ᐊᑎᖏᑦ ᐱᑕᖃᓇᐊᑐᖏᑦᑐᑦ ᑭᖑᓪᓕᖅᐸᒥ ᓴᖅᑭᖅᑎᑕᐅᔪᓂᑦ ᑖᔅᓱᒧᖓ ᖃᐅᔨᓴᓂᕐᒧᑦ. ᖃᐅᔨᒪᓂᐊᖅᑯᓯ ᓄᐊᑦᓯᕈᕐᒥᕗᑦᑕ ᐃᒻᒥ ᒨᖓᔪᓂᑦ/ᐃᓕᓐᓅᖓᔪᓂᑦ ᑐᑭᓯᒋᐊᕈᑎᓂᑦ ᐃᓕᓐᓂᒃ ᐃᓗᐊᓂ ᐊᐱᖅᑯᑎᐅᑉ ᐊᑐᖅᑕᐅᓂᐊᖅᑑᑉ ᖃᐅᔨᓴᕐᓂᒃᑯᑦ.

ᐃᑭᐊᖅᑭᕕᒃᑯᑦ ᐊᑐᖅᑕᐅᔪᓐᓇᖅᑐᖅ ᐊᐱᖅᑯᑎᓕᕆᔪᖅ, Qualtrics, ᐊᑐᖅᑕᐅᒋᐊᖓᕋᔭᖅᑐᖅ ᐱᓕᕆᔾᔪᑎᐅᓗᓂ ᐊᐱᖅᑯᑎᒥᑦ. ᖃᐅᔨᓴᖅᑎᒪᓇᐅᔪᑦ ᑕᐃᒃᑯᐋᕙᔭᖅᑐᑦ ᐅᐸᒍᓐᓇᕐᓗᑎᒃ (ᐊᐅᓚᑦᓯᔨᐅᓗᑎᒃ) ᐊᐱᖅᑯᑎᒥᑦ (Qualtrics) ᐊᑐᖅᑕᐅᕙᔭᖅᑐᒥᑦ ᖃᐅᔨᓴᐅᑎᒋᓂᐊᕐᓗᒍ ᐊᒻᒪ ᓅᑎᕆᔾᔪᑎᒋᓗᒍ ᑭᐅᔾᔪᑎᐅᓯᒪᔪᓂᑦ ᑭᖑᓪᓕᖅᐹᒧᑦ ᐱᓕᕆᐊᓂᑦ ᓄᐊᑦᓯᔾᔪᑎᒧᑦ. ᐸᐃᑉᐹᒨᕐᓯᒪᔪᑦ ᑎᑎᖅᑲᐃᑦ ᐊᑐᐃᓐᓇᐅᑎᑕᐅᔪᓐᓇᖅᑐᑦ ᑐᑦᓯᕌᖑᒍᑎᒃ.

ᐃᑳᕐᕕᒃ ᖃᐅᔨᓴᖅᑎᐅᔪᑦ ᐃᓗᐊᓃᑦᑐᑎᒃ ᓄᓇᓕᐅᔪᒥ ᐃᓚᒋᔭᐅᕙᔭᖅᑐᒥ ᐱᓕᕆᐊᓂᑦ ᓄᐊᑦᓯᕕᐅᔪᓂᑦ ᐊᒻᒪ ᑕᑯᔫᓇᕐᓂᐊᖅᑐᑎᒃ ᐱᖃᑕᐅᔾᔪᑎᓐᓂᑦ ᐊᒻᒪ ᑭᐅᔾᔪᑎᓐᓂᑦ. ᐃᑳᕐᕕᒃ ᑕᑯᔫᓇᓂᐊᖅᑐᑦ ᐃᓘᓐᓇᖏᓐᓂᑦ ᐱᓕᕆᐊᒥᓂᕐᓂᒃ ᓄᐊᑕᐅᓯᒪᔪᓂᑦ ᑭᓯᐊᓂ ᑕᑯᔫᓇᖅᑎᑕᐅᔾᔮᖏᑦᑐᑦ ᐃᓕᓐᓅᖓᔪᓂᑦ ᑭᓇᐅᓂᕐᓂᒃ ᓇᓗᓇᐃᔭᐃᑎᓂᑦ ᐃᓗᐊᓃᑎᑕᐅᔪᓂᑦ ᐱᓕᕆᔾᔪᑎᐅᑉ. ᓲᕐᓗ, ᐃᑳᕐᕕᒃ ᖃᐅᔨᒪᓂᐊᕋᓗᐊᕐᓗᑎᒃ ᑭᒃᑯᑦ ᐱᖃᑕᐅᓯᒪᓂᖏᓐᓂᑦ (ᐃᑲᔪᖅᑕᐅᓗᑎᒃ ᐊᒻᒪ/ᐅᕝᕙᓘᓐᓃᑦ ᑭᒃᑯᑦ ᐱᑎᑕᐅᓯᒪᓂᖏᓐᓂᑦ ᐊᐅᑦᑕᕉᓂᑦ ᓂᐅᕕᐅᑎᑦᓴᓂᑦ), ᖃᐅᔨᒪᒐᔭᖏᑦᑐᑦ ᑭᓇ ᖃᓄᖅ ᐅᖃᐅᓯᖃᕐᓂᕐᒪᖔᖅ. ᐊᐱᖅᑯᒥ ᑭᓯᐊᓂ ᐃᑕᖃᑐᐃᓐᓇᕆᐊᖃᖅᑐᓂ ᓇᓗᓇᐃᔭᐃᑎᓂᑦ (ᐊᑎᖏᓐᓂᑦ ᐱᖃᑕᐅᔪᑦ, ᐃᖕᖐᓇᖅᑕᐅᑎᓄᑦ ᑐᕌᕈᑎᒍᑦ, ᐊᒻᒪ ᓇᒥᒥᐅᑕᐅᓂᖏᓐᓄᑦ ᑐᑭᓯᐊᕈᑎᒃᑯᑦ), ᑕᒪᒃᑯᐊᓕ ᐋᔭᖅᑕᐅᕙᔭᖅᑐᑦ (ᓇᓗᓇᓕᖅᑎᑕᐅᓗᑎᒃ) ᐅᖃᐅᓯᐅᖏᓐᓂᖏᓐᓂ ᐃᑳᕐᕕᒍᓐᓄᒃ.

ᕐᑯᓪᓕᖅ ᐊᑐᖅᑕᐅᕙᔭᖏᑦᑐᖅ ᐃᑳᕐᕕᒃ ᐃᓕᓐᓂᒃ ᐃᑲᔪᕐᓂᕈᑎᒃ ᐊᐃᑉᐸᕆᔭᐅᓗᑎᑦ ᐱᔭᕇᕐᓂᒃᑯᑦ ᐊᐱᖅᑯᑎᒥᑦ. ᑕᒪᐅᓇᓕ, ᐃᑳᕐᕕᒃ ᐱᓕᕆᔫᖓ ᐃᓕᓐᓂᒃ ᐃᑲᔪᖅᑐᖅ ᖃᐅᔨᒪᓕᕋᔭᖅᑐᖅ ᐃᕝᕕᑦ ᑭᐅᔾᔪᑎᒥᓂᖏᓐᓂᑦ ᐊᐱᖅᑯᑎᓕᕆᑎᓪᓗᑎᑦ (ᑕᒪᒃᑭᕐᓗᓯᒃ ᑭᐅᖃᑦᑕᕋᔭᕋᑦᓯᐅᒃ ᖃᐅᔨᒪᓚᕿᕙᔭᖅᑐᖅ ᑭᓇᐅᓂᕐᓂᒃ).

ᖃᐅᔨᓴᖅᑎᒪᓇᐅᔪᑦ ᓇᖏᓂᖃᓕᕋᔭᖅᑐᑦ ᐱᓕᕆᔾᔪᑎᒥᓂᕐᓂᒃ ᐃᑳᕐᕕᒃ ᑕᑯᔫᓇᑎᓪᓗᒋᑦ ᐱᓕᕆᔾᔪᑎᒥᓂᕐᓂᒃ ᐃᒻᒥ ᒨᖓᔪᑦ ᑐᑭᓯᒋᐊᕈᑎᐅᔪᑦ ᐋᔭᕐᓯᒪᓕᖅᑎᓪᓗᒋᑦ.

ᓴᐳᒻᒥᔭᐅᓂᖏᑦ ᑐᑭᓯᒋᐊᕈᑏᑦ: ᑐᑭᓯᒋᐊᕈᑎᑎᑦ ᑐᖅᑯᖅᑕᐅᓯᒪᓂᐊᖅᑐᑦ ᐃᓯᕈᓐᓇᑎᖃᕿᐊᖃᖅᑐᒧᑦ ᖃᕋᓴᐅᔭᕐᒥᑦ, ᐊᔾᔨᖏᑦ ᑐᖅᑯᖅᑕᐅᓯᒪᓂᐊᖅᑐᑦ ᓯᓚᑖᓂ ᖃᕋᓴᐅᔭᒥᑦ/ᐃᔨᖅᑕᐅᓯᒪᔪᑦ ᐊᖏᕋᒥ ᐊᓪᓚᕕᒻᒥ ᓵᖓᓂ. ᐸᐃᑉᐹᑦ ᐊᐱᖅᑯᑏᑦ ᐊᐅᓚᑕᐅᔪᑦ ᑐᖅᑯᖅᑕᐅᓯᒪᓂᐊᖅᑐᑦ ᓴᓐᓂᕈᐊᖅᓯᒪᔪᒥ ᐸᐃᑉᐹᒃᑯᕕᒻᒥ, ᖃᕋᓴᐅᔭᒃᑰᕈᓐᓇᖅᑐᑦ ᑐᖅᑯᖅᑕᐅᓯᒪᓗᑎ ᐃᓯᕈᓐᓇᐅᑎᖃᖅᑐᓄᑦ ᓴᐳᒻᒥᔭᐅᔪᑦ ᖃᕋᓴᐅᔭᓂᑦ. ᐱᓕᕆᐊᖑᔪᑦ

ᓄᐊᑕᐅᒐᔭᖅᑐᑦ ᐊᒻᒪ ᖃᐅᔨᓴᖅᑎᓄᑦ ᑎᑎᖅᑲᖁᑎᐅᔪᑦ ᐱᓯᒪᔭᐅᒐᔭᖅᑐᑦ ᐊᕐᕿᒍᓄᑦ ᑕᓪᓕᒪᓄᑦ (5) ᐊᒻᒪ ᓱᕋᑦᑕᐅᕉᕐᓂᐊᖅᑐᑎᒃ.

ᐊᑭᓕᖅᑕᐅᓂᐅᔪᑦ: ᐱᖃᑕᐅᓂᕋᔭᐃᑦ ᑭᐅᕙᓂᒃᑯᑦ ᐊᐱᖅᑯᑎᒥᑦ ᐊᑭᓕᖅᑕᐅᔾᔪᑎᕆᒐᔭᖅᑕᐃᑦ ᐊᐅᑦᑕᕗᒥᑦ ᓂᐅᕕᐅᑎᑦᓴᒥᑦ $50-ᒥᑦ ᓂᐅᕕᕐᕕᒻᒧᑦ ᓄᐊᓘᓐ (The Northern) ᐃᓕᓐᓅᖅᑕᐅᒐᔭᖅᑐᒧᑦ ᐊᖅᑯᑎᐅᓗᓂ ᐃᑳᕐᕕᒃ. ᖃᐅᔨᓴᖅᑎᐅᔪᑦ ᐃᕝᕕᑦ ᐊᑎᖓᓂᑦ ᐃᑳᕐᕕᒃᑯᓐᓅᓇᒐᔭᖅᑐᑦ ᐱᑎᑦᓯᕉᕐᓂᖏᓐᓂᑦ ᐊᐅᑦᑕᕗᓂᑦ ᓂᐅᕕᐅᑎᑦᓴᓂᑦ. ᐅᑯᐊ ᑎᑎᖅᑕᐅᓯᒪᔪᑦ ᐊᑎᐅᔪᑦ ᐃᕉᒃᑰᖓᑎᑕᐅᓯᒪᓂᐊᖅᑐᑦ ᐱᓕᕆᔾᔪᑎᓂᑦ. ᐱᖃᑕᐅᔪᒪᔪᓐᓃᕐᓂᕈᕕᑦ ᖃᓄᐃᓐᓇᑦᓯᐊᖅ ᐱᔾᔪᑎᖃᕐᓗᑎᑦ ᑭᐅᖃᑦᑕᖅᑐᒍ ᐊᐱᖅᑯᑎ, ᓱᓕ ᐊᑭᓕᖅᑕᐅᓂᐊᖅᑐᑎᑦ.

ᐃᑲᒧᑐᐃᓐᓇᓂᕐᒧᑦ ᐃᓚᒋᔭᐅᖃᑕᐅᓂᕐᒧᑦ: ᐱᖃᑕᐅᓂᕋᔭᐃᑦ ᐆᕗᖓ ᐊᐱᖅᑯᑎᒧᑦ ᐃᓕᓐᓃᖕᒑᕐᓂᐊᖅᑐᖅ ᑎᓕᔭᐅᖏᓪᓗᑎᑦ ᐊᒻᒪ ᐃᓱᒪᕐᓲᑎᒋᓗᒍ. ᖃᖓᑐᐃᓐᓇᓯᐊᒃᑯᑦ ᐊᐱᖅᑯᑎᒥᑦ ᑭᐅᒪᔪᓐᓃᕈᓐᓇᖅᑐᑎᑦ ᑕᐃᒪᐃᒍᒪᒍᕕᑦ, ᐊᒻᒪ ᑭᐅᔾᔪᑎᑎᑦ ᐋᔭᕈᓐᓇᖅᑕᑎᑦ ᐊᐱᖅᑯᑎᒧᑦ ᖃᓄᐃᓕᔭᐅᖏᓪᓗᑎᑦ. ᐃᓱᒪᕐᓱᕐᒥᔪᑎᑦ ᖃᐅᔨᓴᖅᑏᑦ ᐃᓕᓐᓂᒃ ᓇᓗᓇᐃᕐᓯᒪᕐᑯᒧᕕᒋᑦ ᐊᑐᕈᒪᔭᕐᒥᓂᒃ ᑕᐃᒎᓯᕐᒥᒃ, ᐃᖅᑲᓇᐃᔮᖕᒐᒍᑦ ᐃᕝᕕᑦ, ᖃᓄᖅ ᐃᖅᑲᓇᐃᔮᒃᑯᑦ ᑕᐃᒎᓯᒃᑯᑦ, ᐅᕝᕙᓘᓐᓃᑦ ᐃᖅᑲᓇᐃᔮᒃᑯᑦ ᐃᓗᐊᓂ ᑭᖑᓪᓕᖅᐹᑉ ᐅᖃᓕᒫᒐᓕᐊᑦᓴᐅᑉ ᐅᕝᕙᓘᓐᓃᑦ ᐅᓂᒃᑳᓕᐊᑦᓴᐅᑉ.

ᐱᖃᑕᐅᔪᑦ ᐊᒥᓱᓕᐅᕐᑯᔪᑦ ᐊᔾᔨᖓᓂᑦ ᐊᖏᕈᑎᐅᑉ ᐱᓯᒪᕐᑯᓪᓗᒋᑦ ᐃᖕᒥᒎᖓᔪᓂᑦ ᑎᑎᖅᑲᑎᖏᓐᓂ.
ᐊᐱᖅᑯᑏᑦ: ᐊᐱᖅᑯᑎᑕᖃᕐᓂᖅᐸᑦ, ᐃᓱᒫᓗᑎᓂᓪᓗᓐᓃᑦ, ᐅᕝᕙᓘᓐᓃᑦ ᐅᖃᐅᑎᑦᓴᓂᑦ, ᐱᔾᔪᑎᒋᓪᓗᒍ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ, ᖃᐅᔨᒋᐊᕆᐊᖃᖅᑕᑎᑦ ᖃᐅᔨᓴᖅᑎᐅᔪᑦ ᖃᖓᑐᐃᓐᓇᓯᐊᒃᑯᑦ. ᖃᐅᔨᒋᐊᕐᕕᒋᔭᐅᓐᓇᖅᑕᐃᑦ ᓯᓃᓇ ᐊᒡᔨᒫᖕ ᑐᐊ ᐅᕙᓂ, ᐅᕝᕙᓘᓐᓃᑦ ᓘᑦᑖᖅ ᔫᑭ ᑖᓴᓐ ᐅᕙᓂ.
ᐊᐱᖅᑯᑎᖃᕐᓂᕈᕕᑦ ᐱᔾᔪᑎᒋᓪᓗᒍ ᐱᓕᕆᔾᔪᑎᒧᑦ ᐊᐅᓚᑕᐅᓂᖓ ᐆᒪ ᖃᐅᔨᓴᐅᑎᐅᔫᑉ, ᖃᐅᔨᒋᐊᕆᐊᖃᖅᑕᐃᑦ ᐱᓕᕆᔾᔪᑎᓂᑦ ᑲᒪᔨᐅᔪᖅ ᐅᑯᓄᖓ ᐱᓕᕆᔾᔪᑏᑦ ᖃᐅᔨᓴᕐᓂᕐᒥᑦ, ᓯᓚᑦᑐᓴᕐᕕᔾᔪᐊᕐᕕᒃ ᐋᑐᐋ ᐅᖄᓚᐅᑎᒃᑯᑦ ᐅᕙᓂ ᐅᕝᕙᓘᓐᓃᑦ ᐃᖕᒌᓇᖅᑕᐅᑎᒃᑯᑦ ᐅᕙᓂ.
ᐅᓇ ᐊᑎᓕᐅᖅᑐᒍ ᑎᑎᕋᕐᕕᑦᓴᖅ, ᐅᑯᓂᖓ ᐊᖏᖃᑎᖃᖅᑐᑎᑦ:
ᑐᓴᐅᒪᑎᑕᐅᑦᓯᐊᖅᑐᖓ ᐱᓕᕆᐊᖑᔪᒪᔪᓂᑦ ᐱᓕᕆᐊᑦᓴᒃᑯᑦ ᐊᐅᓚᑕᐅᔪᒃᑯᑦ. ᑐᑭᓯᔭᒃᑲ ᑕᒪᒃᑯᐊ ᐱᓕᕆᐊᖑᔪᒪᔪᑦ ᐊᒻᒪ ᐊᖏᖅᑐᖓ ᑭᐅᔾᔪᑎᕆᓂᐊᖅᑕᒃ ᐊᐱᖅᑯᑎᒧᑦ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᒍᓐᓇᕐᑯᓂᑦ ᐱᓕᕆᐊᑦᓴᒧᑦ. ᑐᑭᓯᕗᖓ ᐱᓕᕆᐊᖃᕐᓯᒪᓂᐊᕐᓂᖏᓐᓂᑦ ᓇᓗᓇᐃᕐᓯᒪᓂᕐᒥᑦ ᑭᐅᔾᔪᑎᐅᔪᑦ ᐆᕙᓂ ᐊᐱᖅᑯᑎᒥ ᑲᖕᖑᓇᖅᑐᓕᔾᔪᑎᐅᓂᐊᕐᒪᑕ ᐊᓯᐊᒍᑦ ᓇᓗᓇᐃᓚᐅᕐᓂᕐᓂ ᓇᓗᓇᐃᖅᑕᐅᔪᓐᓇᓂᕐᓂᒃ. ᑐᑭᓯᒻᒥᔪᖓ ᐃᒪᐃᒍᓐᓇᕋᒪ, ᖃᐅᔨᓴᕐᓂᕐᒥᑦ ᐊᓂᒍᒪᒍᒪ, ᐊᓂᒍᓐᓇᕋᒪ ᐃᓱᒪᕐᓯᓯᐊᕐᓗᖓ.
Do you consent?
□ *Yes* □ *No*

Check one of the following:

ᑎᑎᖅᓯᓗᑎ ᐊᒥᐅᓯᖏᑦ ᐅᑯᓇᓂ:

□ **I ALLOW** for details such as a pseudonym, my role, title, or occupation to be referred to within the final products (research papers and/or reports).

□ ᐱᔨᓴᓇᖅᑎᑦᑎᔨᖓ ᓇᓗᓇᐃᔭᖅᓯᒪᓂᖓᓐᓄᑦ ᓯᖏᓗ ᐊᑎᓴᖓᐊᕐᕋᖏᓐ, ᐱᓕᕆᔨᐸᑦ, ᐃᖅᑲᓇᐃᒋᔭᕐᖏᓐ ᐅᑭᐅᖅᑕᐅᓂᕐᖏᓐ ᖃᐅᔨᒪᔨᐅᓂᕐᖏᓐ ᐃᓗᐊᓂ ᐅᖓᔪᓕᖅᑭᒥ ᓴᖅᑭᖅᑎᑕᐅᔨᓂᑦ (ᖃᐅᔨᓴᓂᖏᓐᓇᑦ ᐸᐃᑦᑐᑦ ᐊᒻᒪ/ᐅᕙᓚᓐᓂᑦ ᐅᓂᒃᑲᑦ).

□ **I DO NOT ALLOW** for my details such as a pseudonym, my role, title, or occupation to be referred to within the final products (research papers and/or reports)**.**

□ ᐱᔨᓴᓇᖅᑎᑦᑎᐟᑦᑐᑦᑐᖓᓐ ᓇᓗᓇᐃᔭᖅᓯᒪᓂᖓᓐᓄᑦ ᓯᖏᓗ ᐊᑎᓴᖓᐊᕐᕋᖏᓐ, ᐱᓕᕆᔨᐸᑦ, ᐃᖅᑲᓇᐃᒋᔭᕐᖏᓐ ᐅᕙᓚᓐᓂᑦ ᖃᐅᔨᒪᔨᐅᓂᕐᖏᓐ ᐅᑭᐅᖅᑕᐅᓂᕐᖏᓐ ᐃᓗᐊᓂ ᐅᖓᔪᓕᖅᑭᒥ ᓴᖅᑭᖅᑎᑕᐅᔨᓂᑦ (ᖃᐅᔨᓴᓂᖏᓐᓇᑦ ᐸᐃᑦᑐᑦ ᐊᒻᒪ/ᐅᕙᓚᓐᓂᑦ ᐅᓂᒃᑲᑦ).

Participant signature (Print name)- Sign your name here to begin the survey.

ᐃᓕᓴᕆᐅᖃᑕᐅᓕᖅ ᐊᑎᓕᐅᑕᓯᓐᓄ (ᑎᑎᕋᑎᑐᐊᖅᓗᒍ ᐊᑎᓐᓄ)

Note: Please leave this blank if you do NOT consent to doing the survey and having your answers recorded.

ᐊᑎ ᑕᓐᓇ ᑎᑎᖅᓯᐃᒋᑕᑐᓕᔪᓐ ᐊᓐᓴᓐᓱᓐᓄᐃᐃᓕᑦ ᑭᐅᐳᔨᑎᑭᑎᑦ ᑎᑎᖅᑕᐅᔭᒪᓂᖓᓐᓄᑦ.

Verbal Consent (Skip to Date of Consent if you are NOT doing this survey with assistance)

ᐅᖃᐅᓯᓄᑦ ᐊᓐᓴᖅᓂᖅ

Date of consent (Day, month and year)

ᐅᓪᓗᓐᓄ(ᓐᓴᑦ) ᐊᓐᓴᓂᖅᓗᑦ

The following information below is necessary for the purpose of distributing the Northern gift cards.

Address / Residence

_____

_____

Please provide your email (or skip to phone number)

_____

Please provide your phone number

_____

ABOUT YOU

1. **How long have you lived in this community?**
   □ Less than one year □ 1 – 4 years □ 5 – 9 years □ 10 – 19 years □ 20 – 39 years □ 40 or more years □ Prefer not to answer □ If you have lived in the community on and off over the years, and would like to provide more context, please explain:
   _____

2. **Do you identify as an Indigenous person (Inuit, Métis, First Nation, or other)?** (check one)
   □ Yes □ No □ Prefer not to answer.

If yes, please select which Indigenous group(s) you identify with. (check all that apply, and use the text box to specify further if you like) □ Inuit _____ □ Métis _____ □ First Nations _____ □ Other _____

3. **Which languages do you speak?** (check all that apply) □ Inuktitut □ Inuinnaqtun □ Inuvialuktun □ English □ French □ Other language(s) (list): □ Prefer not to answer.
4. Please indicate your gender
   □ Male □ Female □ You don't have an option that applies to me. I identify as (please specify) _____ □ Prefer not to answer.
5. What year were you born? _____
6. Are you a resident of this community? □ Yes □ No
   If yes, how long have you lived here? Please indicate in years _____
   □ Prefer not to answer
7. What is your highest level of education completed? Please check one box.
   □ No formal schooling □ Some Elementary school □ Completed Elementary school □ Secondary (High) school □ College, CEGEP or non-University □ University (bachelor's)
   □ Graduate/Professional □ Other □ Prefer not to answer
8. Employment status: Please check one box.
   □ Employed □ Unemployed □ Voluntary work □ Prefer not to answer

8b. If employed, which industry do you work in? *Please check all that apply.*

□ Defense (including Canadian Rangers) □ Search and Rescue (including emergency response activities) □ Energy □ Mining □ Fishery □ Government

□ Non-Governmental Organization □ Other, please specify _____

9. Please indicate your role within the community. *Please check all that apply.*

□ Community member/resident □ Elder □ Community council or board member

□ Head of a local organisation □ Other, please specify_____ □ Prefer not to answer

ABOUT YOUR LOCAL TRAVEL HABITS

1. When considering your local travel, to what extent do you travel for the following purposes? 1= never, 2= rarely (0-1 time per year), 3= occasionally (2-5 times per year), 4=regularly (5-10 times per year), 5= very often (more than 10 times per year)

Hunting – in ocean	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Hunting – on sea ice	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Hunting – on land (inland)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Fishing – in ocean	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Fishing – in lakes/rivers	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Fishing – commercially	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Gathering food (eggs, plants/berries)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Gathering stone (soap stone, other materials)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Gathering plants (fuel, wick materials, etc.)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Collecting drinking water (ice/water/snow)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
For fun (to get out of town, go to cabin or camp)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Travel to other communities (please list:_____)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Guiding or outfitting	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
For other types of paid work (please list:_____)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Research or environmental monitoring	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
With the Canadian Rangers	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Search and Rescue	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
School or work sponsored land trips	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Mental health ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Other (please list): _____ ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Other (please list): _____ ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

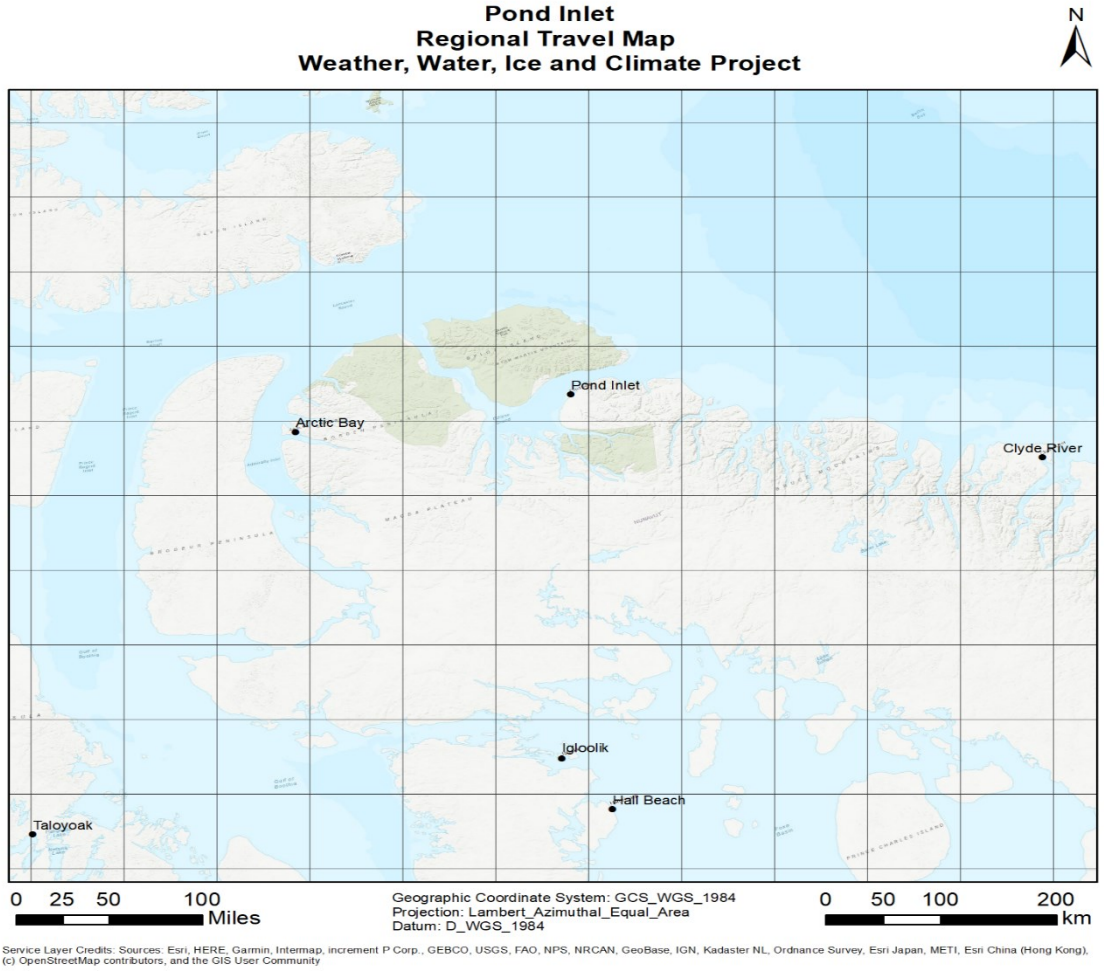
2. When considering your modes of travel, how often would you estimate you travel on the following types of terrain? 1= never, 2= rarely (0-1 time per year), 3= occasionally (2-5 times per year), 4=regularly (5-10 times per year), 5= very often (more than 10 times per year)

Mode of transport	**Land**		**Lakes**		**Rivers**		**Sea**	
	unfrozen ground	***frozen ground***	***open water***	***frozen water***	***open water***	***frozen water***	***open water***	***frozen sea ice***
Snow Machine (no qamutik)					x		x	
Snow machine with qamutik					x		x	
ATV					x		x	
Boat with motor (please indicate approximate length) _____	x	x		X		x		x
Boat with no motor (please indicate type) _____	x	x		X		x		x
Vehicle (truck, car, SUV)					x		x	
On Foot					x		x	
Dog Team					x		x	

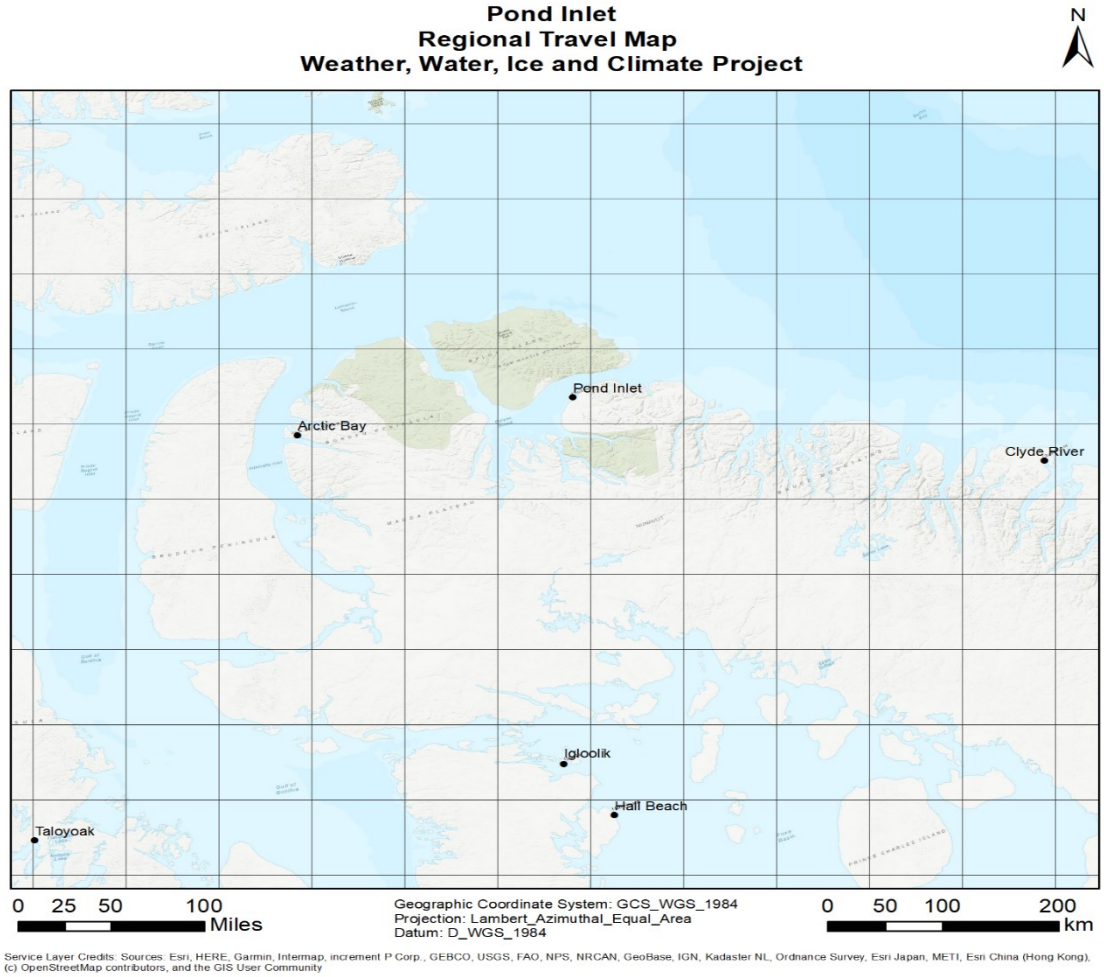
Other (please list): _____								
Other, (please list): _____								

3. When thinking about your travel over the past few years, where did you normally go?

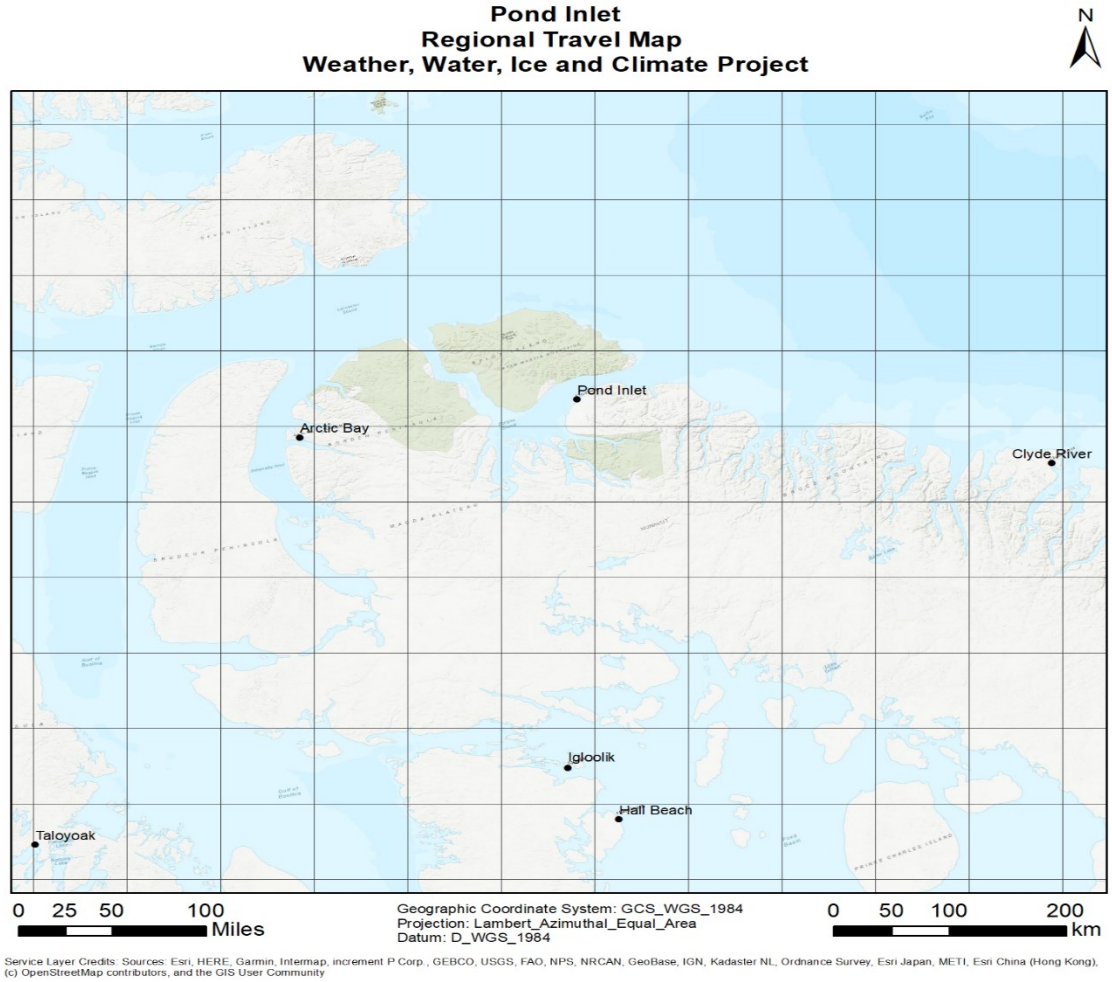
   By snow machine?



By ATV?


Pond Inlet
Regional Travel Map
Weather, Water, Ice and Climate Project
N
Pond Inlet
Arctic Bay
Clyde River
Igloolik
Hall Beach
Taloyoak
0 25 50 100
Miles
Geographic Coordinate System: GCS_WGS_1984
Projection: Lambert_Azimuthal_Equal_Area
Datum: D_WGS_1984
0 50 100 200
km
Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

By boat?


Pond Inlet
Regional Travel Map
Weather, Water, Ice and Climate Project
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Pond Inlet
Arctic Bay
Clyde River
Igloolik
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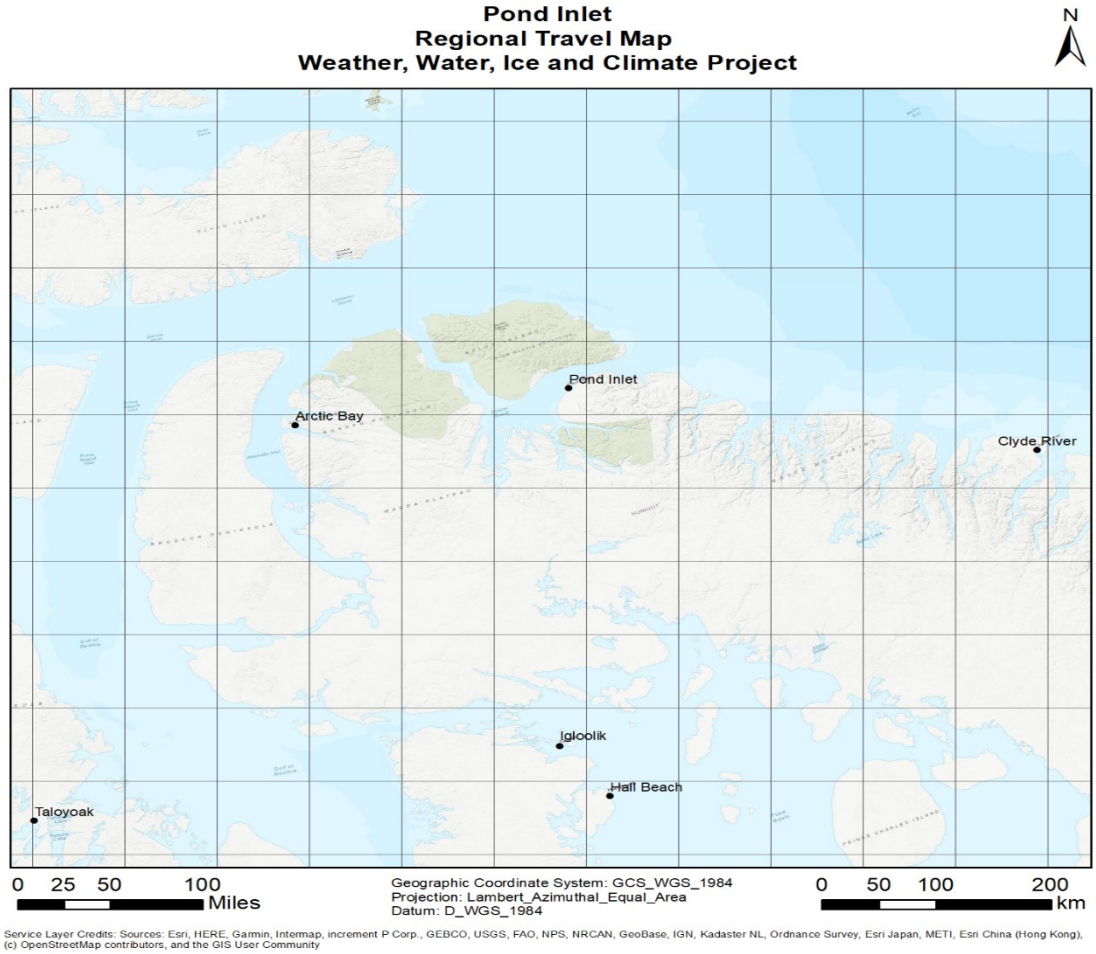
0 25 50 100
Miles
Geographic Coordinate System: GCS_WGS_1984
Projection: Lambert_Azimuthal_Equal_Area
Datum: D_WGS_1984
0 50 100 200
km
Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

By dog team?



4. Based on your experience, how thick does the ice need to be around your community in order for different types of local travel modes to be safe? Kindly indicate your answer in cm.

   Snow machine (no qamutik) _____

   Snow machine (with qamutik)_____

   ATV _____

   Boat with motor _____

   Vehicle (truck, car, SUV) _____

   On Foot _____

   Dog Team _____

   Other, (please list): _____. _____

   Other, (please list): _____. _____

   Other, (please list): _____. _____

5. Do you want to make other comments about your local travel? (Optional). If you prefer not to respond, please type N/A in the text box.

_____

_____

_____

_____

HAZARDS, IMPACTS, AND RISKS

6. In your opinion, which of the following changes in the environment have an impact on your ability to safely access travel routes that you use. Kindly use the following ratings for each hazard and type of route: 1=unsure/don't know, 2=no impact, 3=little impact, 4=moderate impact, 5=major impact

Environmental Hazards

Increased average temperature	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Decreased average temperature	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Extreme heat events	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Cold spell	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Frost	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Increased precipitation	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Decreased precipitation	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
River Flood	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Drought	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Aridity (dryness)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Increased average wind speeds	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Decreased average wind speeds	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Extreme wind	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Severe storm	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Decreased land/sea ice	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Heavy snow	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Heavy slush	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Ice storm	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Permafrost thaw	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Hail	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Snow avalanche	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Increased average sea level	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Decreased average sea level	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Coastal flood	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Coastal erosion	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Ocean circulation patterns	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Ocean salinity (changes to salt content in the ocean)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Increased average ocean temperature	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Marine heat waves	☐ 1	☐ 2	☐ 3	☐ 4	☐

Current Impacts

7. When thinking about changing environmental conditions, such as those listed above, what impacts are you experiencing with respect to your ability to travel safely nearby your community? Kindly use the following ratings for each observed impact: 1=unsure/don't know, 2=no impact, 3=little impact, 4=moderate impact, 5=major impact

Late and longer freeze-up of (sea) ice	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Early break of sea ice	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Late break of ice	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Changing ice conditions	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Thinner ice	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
More snow on ice	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Less snow on land trails	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Deep snow on inland trails during winter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
New areas of open water	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Muddy trails	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Rough ice on land and sea	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
More slush over ice	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Fewer safe travel days over ice	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Increase incident of accident	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Fewer days to access hunting locations ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

7b. Other observed impact, please list below. If you prefer not to respond, please type N/A in the text box.

_____

_____

_____

8. What does the impacts listed above have on your socio-cultural and economic wellbeing? (i.e. reliance on store food, less connectivity with other communities, mental health impact on being stuck in town vs being out on land etc). If you prefer not to respond, please type N/A in the text box.

_____

_____

_____

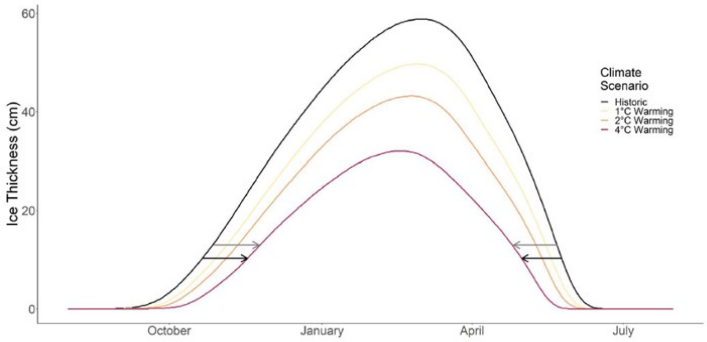
Future Risks

9. Previous research (see figure) has suggested that present-day ice thickness is on average, between 0 and 20 cm in the fall (~October-December), between 35 to 50 cm in the winter (~January-March) and between 40 and 15cm in the spring (~April-June). Based on your experience, do you feel these estimates are mostly accurate?

☐ Yes, these ice thickness estimates seem reasonable for Pond Inlet in recent years.

☐ No, these ice thickness estimates do not seem reasonable for Pond Inlet in recent years.

If no, what do you estimate to be the average ice thickness (in cm) around Pond Inlet in the fall _____, winter _____, and spring_____?



10. Climate change projections suggest that sea ice thickness will in the future be ~10cm thinner in the fall, ~35cm thinner in the winter, and ~10cm thinner in the spring compared to current conditions. If this were to happen, what would be the impact be for you with respect to your ability to travel safely around your community? (positive and/or negative)? Kindly explain. If you prefer not to respond, please type N/A in the text box.

_____

_____

_____

11. What are your main concerns about how these projections above may affect your future safe travel (on ice) nearby your community? If you prefer not to respond, please type N/A in the text box.

_____

_____

_____

ADAPTATION OPTIONS

12. From the list of environmental conditions below, kindly indicate which of the conditions you check before you travel? Where **N/A =** Not applicable in my community, **Don't consider** = I don't consider this condition to make travel decisions, **Good to know =** It is helpful to know about this condition, it informs travel decisions, **Necessary information =** I would not travel without knowing about this condition

Ice conditions	**Not applicable.**	**Don't consider**	**Good to know**	**Necessary information**
Position of the floe edge (edge of sea ice).				
Position of multi-year ice.				
Position of grounded icebergs.				
Location and size of leads and polynyas (cracks and open water areas in ice).				
Sea ice thickness.				
River and lake ice thickness.				
Overflow (water flowing over river ice that is not melt water).				
Snow depth on ice.				
Sea water/slush				
Ice colour.				
Ice roughness (rough to travel on, rubble ice, tidal zones.)				
Ice ridges (hard to travel on).				
Ice brittleness.				
Other, (please describe):				
Other, (please describe):				
General weather conditions	**N/A**	**Do not consider**	**Good to know**	**Necessary information**
Temperature.				
Wind direction.				
Wind strength.				
Rainfall amount (how much it will rain, a measurement).				
Rainfall intensity (how hard it will rain, light drizzle or heavy downpour.				

Freezing rain intensity (light drizzle, heavy freezing rain, ice pellets.				
Fog.				
Ice fog.				
Thunderstorms.				
Snow fall amount (how much it will snow, a measurement).				
Snow fall intensity (how hard it will snow, light flurries, heavy snow, blizzard).				
Blowing snow.				
Whiteout				
flat light				
Low visibility (any reason).				
Window of clear weather (a few days).				
Atmospheric pressure.				
Other, (please describe):				
Other, (please describe):				
Water conditions	**N/A**	**Do not consider**	**Good to know**	**Necessary information**
Wave height.				
Wave direction (erosion).				
Tide height.				
Tide timing.				
Strong current areas.				
Water level of rivers and lakes.				
Flow rate of rivers.				
Flooding.				
Ice jams.				
Storm surge.				
Other, (please describe):				
Other, (please describe):				

Other environmental conditions	N/A	Do not consider	Good to know	Necessary information
Trail conditions				
Snow drift				
Snow texture and sound				
Moon phase				
Angle of the sun/reflection				
Other, (please describe):				
Other, (please describe):				

13. By ticking one box on each row, kindly indicate how much you will rely on information from the following sources about making safe travel decisions**.**

Sources of information	A lot	A little	Not very much	Not at all
Personal observation and experience.				
Local / community organizations.				
Non-governmental Organizations, (NGOs).				
Friends and family.				
Elders				
Recent travellers				
Active land users				
Social media sources.				
Government services.				
Private services/industry.				
Unknown sources from the internet (i.e., windy.com or other).				
Other, (please specify): _____				

Other, (please specify): _____				

14. Please check one box in each row to let us know how significantly the following factors influence your ability to stay safe while engaging in local travel over either land, water, or sea ice during extreme weather conditions.

Factors	**Very Significant**	**Significant**	**Moderately significant**	**Somewhat significant**	**Not significant**
Inuit knowledge.					
Land-based skills.					
Monetary resources / income.					
Availability of equipment.					
Ability to take risk.					
Access to technology (GPS, satellite phone).					
Availability of time.					
Social network (sharing among family and friends).					
Individual experience.					

Following knowledgeable people (Learning through observation)					
Access to information and education.					
Government support.					
Other, (please specify): _____					
Other, (please specify): _____					
Other, (please specify): _____					

15. From the list of adaptation options below, kindly indicate by checking one box on each row how often you have used them to reduce any negative impact of climate change on your ability to safely access trails over land, water and sea ice, where 1= never, 2= less often, 3=somewhat often, 4=often, and 5=very often.

Adaptation practices	**1=never**	**2=less often**	**3=somewhat often**	**4=often**	**5=very often**
Develop new routes.					
Choose different routes.					
Choose different traveling equipment.					
Don’t go hunting alone.					

Take up full/part-time work.					
Avoid traveling or hunting at certain times.					
Take extra supplies or make extra preparations during travel to access hunting grounds.					
Bring extra gas					
Purchase new equipment.					
Wait for favourable weather conditions.					
Change hunting locations					
Rely on family and friends (for food, money, equipment, information.					
Wait for favourable weather conditions.					
Adjust hunting and fishing times.					
Rely on institutional/organisational support for money, gas vouchers or safety equipment.					
Rely on local and traditional knowledge.					
Rely on weather information.					
Share Inuit knowledge and experience.					
Utilize workshops and training programs.					

Other, (please specify): _____					
Other, (please specify): _____					
Other, (please specify): _____					

16. Are there any other practices that you use to reduce your safety risk when traveling? If you prefer not to answer, please type N/A in the text box.

_____

_____

_____

17. For the list of adaptation options (activities) below, kindly rate based on effectiveness (***i.e., if the option would work or not in your opinion***) and feasibility (***i.e., the extent to which the option would be possible to implement or not*)** while engaging in local travel over either land, water, open waters or sea ice during extreme weather conditions. *Use the drop-down menu* 1=not effective/feasible, 2=less effective/feasible, 3=moderately effective/feasible, 4=effective/feasible, 5= highly effective/feasible.

Adaptation options	**Effectiveness**	**Feasibility**
Develop new routes.		
Choose different routes.		
Choose different traveling equipment.		
Take up full/part-time work.		
Don't go hunting alone.		
Avoid traveling or hunting at certain times.		
Take extra supplies or preparations		

during travel.		
Bring extra gas		
Purchase new equipment.		
Wait for favourable weather conditions.		
Adjust hunting and fishing times.		
Develop new hunting trails.		
Rely on family and friends for food and information.		
Change hunting locations		
Rely on institutional/organisational support for money, gas vouchers and safety equipment.		
Share Inuit knowledge and experience		
Rely on local and traditional knowledge.		
Rely on weather information.		
Utilize workshops and training programs		
Other, (please specify):		
Other, (please specify):		
Other, (please specify):		