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Understanding the Northern Perishable-Food Supply Chain: A Scoping Review of Challenges and Drivers of Change

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ABSTRACT. In northern (including Arctic) Canada, remote communities face significant challenges in accessing perishable foods that meet national food-security standards. Geographic isolation and harsh climatic conditions exacerbate issues related to the affordability, adequacy, and availability of fresh produce in these communities. This scoping review evaluates the challenges within the northern perishable food supply chain (NPFSC), examining demand and supply factors and major drivers of change. A comprehensive literature search across four major databases, with no time restrictions, yielded 105 relevant records from academic and grey literature. On the demand side, challenges include food insecurity, dietary shifts from traditional foods to lower-quality store-bought items, a scarce food environment, and northern consumers' preferences. On the supply side, key challenges involve transportation, last-mile delivery, product perishability, cold-chain management, and limitations in retail outlets. Together, these issues contribute to the unaffordability, low adequacy, and limited availability of fresh produce. This research highlights key drivers of change, including climate change, societal shifts, geopolitical interests, and policy developments, and examines their impacts on transportation, retail, consumption patterns, and the overall supply chain. Recommendations emphasize developing adaptive supply-chain strategies that incorporate local knowledge and technological innovations to enhance food security. Policy improvements should refine subsidy programs and explore local food production options, among other considerations. A comprehensive framework has been developed to guide stakeholders in addressing these challenges and improving food security in northern communities. This analysis lays the foundation for future studies and policies aimed at boosting the resilience and sustainability of northern food systems.

Keywords: northern perishable-food supply chain; perishable produce; remote northern communities; drivers of change

RÉSUMÉ. Dans les régions éloignées du Nord canadien (y compris l'Arctique), les communautés font face à d'importants défis en matière d'accès aux denrées périssables répondant aux normes nationales de sécurité alimentaire. L'isolement géographique et les conditions climatiques difficiles exacerbent les problèmes d'abordabilité, d'adéquation et de disponibilité de produits périssables frais dans ces communautés. Cette étude de la portée évalue les défis liés à la chaîne d'approvisionnement alimentaire périssable du Nord, en mettant l'accent sur les facteurs de l'offre et de la demande ainsi que sur les principaux moteurs de changement. Une recherche approfondie dans quatre grandes bases de données, sans limite de temps, a permis de repérer 105 résultats pertinents issus de la littérature académique et de la littérature grise. En ce qui concerne la demande, les défis se rapportent à l'insécurité alimentaire, à l'évolution du régime alimentaire (passant des aliments traditionnels à des produits de qualité inférieure achetés en magasin), à un environnement alimentaire restreint et aux préférences des consommateurs du Nord. En ce qui concerne l'offre, les principaux défis ont trait au transport, à la distribution finale, à la périssabilité des produits, à la gestion de la chaîne du froid et aux contraintes des points de vente. Tous ces facteurs contribuent à l'inabordabilité des produits périssables frais, au faible degré de satisfaction à leur égard et à leur offre limitée. Cette étude met en lumière les principaux moteurs de changement, dont le changement climatique, les changements sociétaux, les intérêts géopolitiques et l'évolution des politiques, et analyse leurs incidences sur le transport, le commerce de détail, les tendances de consommation et la chaîne d'approvisionnement dans son ensemble. Les recommandations mettent l'accent sur l'élaboration de stratégies d'adaptation de la chaîne d'approvisionnement qui intègrent les connaissances locales et les innovations technologiques pour renforcer la sécurité alimentaire. Les améliorations aux politiques devraient notamment inclure l'affinement des programmes de subvention et l'exploration de possibilités de production alimentaire locale. Un cadre intégrateur a été élaboré pour aider les parties prenantes à relever ces défis et à améliorer la sécurité alimentaire des communautés nordiques. Cette analyse servira de fondement aux études et aux politiques futures visant à améliorer la résilience et la durabilité des systèmes alimentaires dans le Nord.

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Mots-clés : chaîne d'approvisionnement des denrées périssables dans les régions du Nord; produits périssables; communautés nordiques éloignées; moteurs de changement

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INTRODUCTION

While Canada is globally recognized for its strong food production capacity, food insecurity remains a significant public health issue, particularly in remote northern regions (Chen and Natcher, 2019; Ingram et al., 2021; Pagaduan et al., 2024). In Nunavut, for example, food insecurity rates have reached 57% compared to a national average of 12.7% in 2017–18 (Leblanc-Laurendeau, 2020), placing its population among the most food-insecure in the developed world (Gilbert et al., 2021). In these regions, challenges such as logistical complexities, communication barriers, inefficient subsidies, dietary shifts, limited employment opportunities, and disruptions such as COVID-19 hinder the availability, affordability, and adequacy of perishable produce—critical for maintaining nutritional health (Hobbs, 2020; Akande et al., 2021; Gharakhani Dehsorkhi et al., 2026; Afif et al., 2026). These issues are further intensified by climate change, economic shifts, social transformations, and evolving governance structures (Crépin et al., 2017; Galloway, 2017).

Despite efforts by researchers, governments, non-profit organizations, and private entities to address food insecurity in Northern Canadian communities (e.g., Prentice et al., 2021), significant research gaps on the perishable-food supply chain remain. Addressing these gaps is crucial, given the persistent issues related to the availability, affordability, and adequacy of perishable produce (e.g., Akande et al., 2021; Little et al., 2021; Levesque, 2023). This highlights the need for a deeper, more nuanced understanding of the demand- and supply-side factors that contribute to these issues (Kenny et al., 2020).

Previous studies have predominately focused on challenges at specific levels of the northern perishable-food supply chain (NPFSC), such as transportation (e.g., Bråthen and Halpern, 2012; Prentice et al., 2021), retail (e.g., Enrg Research Group, 2016; Ferguson et al., 2016; Piltch et al., 2020), and consumption (e.g., Brown et al., 2019; Akande et al., 2021). While these studies provide valuable insights within their respective areas, they do not capture the broader NPFSC dynamics (Ford et al., 2019; Kenny et al., 2020; Gharakhani Dehsorkhi et al., 2026). Hence, there is a notable gap in research that integrates both supply- and demand-side challenges, along with the main drivers of change. The combined impact of these factors on the supply of adequate, affordable, and accessible food in remote northern communities has not been sufficiently examined.

This paper addresses these research gaps by synthesizing current knowledge on the challenges of supplying perishable foods to remote northern communities. By integrating both demand- and supply-side perspectives, it aims to systematically evaluate the challenges limiting the affordability, adequacy, and availability of fresh produce in these areas. The paper also identifies the key drivers of change in the NPFSC. Ultimately, it aims to establish a structured framework to guide future research in this field.

To achieve this, we conducted a scoping review and developed a comprehensive framework based on prior studies. This framework integrates demand and supply perspectives within the broader socio-economic and environmental context of the Canadian Arctic, offering a holistic approach to understanding the unique complexities of the NPFSC.

This paper builds upon the work of Kenny et al. (2020) by exploring the full range of factors influencing the supply of perishable food in the Canadian Arctic. Taking a broad view of the challenges on both the demand and supply sides, we also examine the main regional drivers of change. This approach initiates a critical discussion on what is known about the key factors that impact food availability, adequacy, and affordability, and the challenges faced by those responsible for perishable-food supply. Through this comprehensive analysis, the paper contributes to advancing academic discussions and provides a structured pathway for future research in this field. Additionally, it supports the development of targeted strategies and policies tailored to the unique needs and challenges of the NPFSC.

RESEARCH METHODS

We conducted a scoping review of peer-reviewed and grey literature to explore the demand and supply challenges of perishable food and the key drivers of change in Northern Canada. This method is well-suited for synthesizing existing knowledge and identifying gaps in the field (Grant and Booth, 2009). This review employed an open time horizon to capture foundational research, track shifts in knowledge, and identify emerging trends, thereby mapping the full scope of evidence in this field. The detailed search process is outlined in Figure 1.

A two-stage search approach was employed to identify relevant literature. In the first phase, comprehensive keyword searches were performed across four key databases: Arctic Science and Technology Information System, Google Scholar, Scopus, and Web of Science. These databases were selected for their extensive coverage of the main topics related to research in the North, food security, and supply-chain management. Various keyword combinations were used to ensure comprehensive coverage

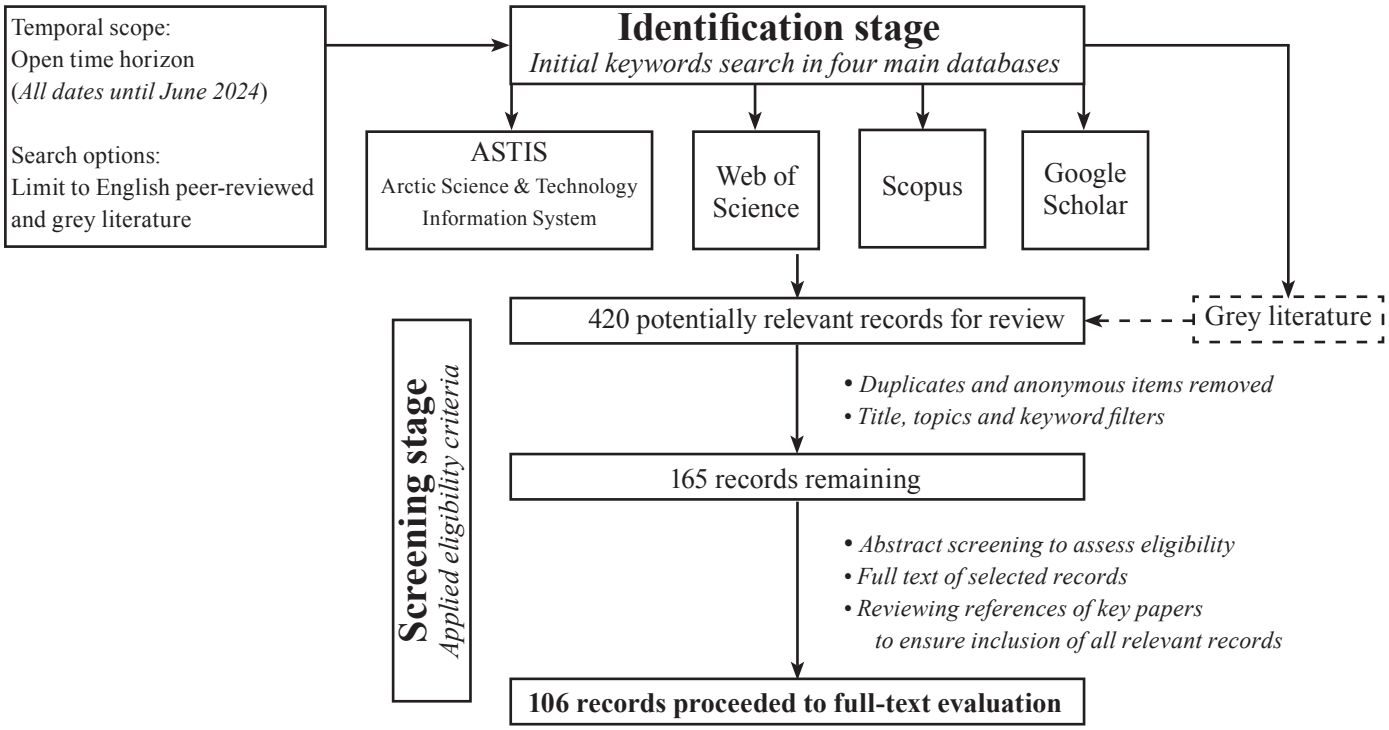

FIG. 1. Overview of the scoping review search process.

(see Table S1). To refine the search, cross-referencing was employed, with two reviewers examining keywords in relevant records to identify additional terms and locate more records. The search was limited to publications in English to ensure accessibility and comparability. To further broaden the scope, the database search was complemented by a manual search of grey literature, through the GreySource Index, Web of Conferences, and government publications—including reports from relevant Canadian federal, provincial, and territorial government bodies and authoritative organizations (e.g., the Council of Canadian Academies and the Arctic Council). Page titles, descriptions, and initial screens were assessed for relevance. In the second phase, the reference lists of the initially identified sources were screened to identify further relevant research. This step was crucial for uncovering literature that may have been missed due to variations in terminology or indexing.

Through this iterative process (in which references were independently screened for inclusion by two reviewers), 106 relevant records were selected and advanced to full-text evaluation. Data extraction was organized in an Excel table. A sequential dual-reviewer approach was employed, with one reviewer initially extracting citation details (e.g., authors, year of publication, peer-reviewed or grey literature), study-specific information (e.g., objectives, methods, supply-chain level), key findings, and recommendations for future research that aligned with the review objectives. The extracted data was then cross-checked and validated by a second reviewer. Any discrepancies or inconsistencies in the extracted data were addressed through consensus discussions.

The extracted data was grouped and analyzed based on the three primary topics of the review: (i) demand-side challenges, (ii) supply-side challenges, and (iii) drivers of change. A thematic synthesis approach was employed to organize and compare key findings across studies—highlighting commonalities, differences, insights, and emerging trends. A narrative synthesis was then used to summarize and interpret findings—identifying themes and gaps in the literature. To ensure rigour, the results were discussed and refined with the reviewers, resolving discrepancies through consensus, with the final findings aligned with the review objectives.

FINDINGS

Demand Challenges

Food Insecurity: remains a persistent issue among Indigenous communities in Arctic Canada (e.g., Ingram et al., 2021, Little et al., 2021). These communities are experiencing a nutrition transition, with a preference for nutrient-poor foods over traditional options and limited consumption of fruits and vegetables (F&V). Further challenges related to the food environment, along with consumer perceptions and preferences, also influence food availability, adequacy, and affordability.

Food Insecurity: Food insecurity is defined by Health Canada (2020) as “the inability to acquire or consume an adequate diet quality or sufficient quantity of food in socially acceptable ways, or the uncertainty that one will be able to do so. Household food insecurity is often linked

with the household's financial ability to access adequate food." However, broader definitions of food insecurity, beyond financial access alone, also consider factors such as the availability, accessibility, and affordability of food, as well as dietary quality and utilization (FAO, 2006; Egeland et al., 2011). Recognizing these differing viewpoints underscores the multidimensional nature of food insecurity (e.g., Pagaduan et al., 2024). This underlines the complexity of addressing food insecurity in remote northern communities (Skinner et al., 2013), where a range of demand-side challenges intertwine to shape the issue. Factors such as poverty, reduced access to traditional foods, high living costs, and income disparities all contribute to the barriers preventing access to nutritious food (Natcher and Ingram, 2021). Across Northern Canada, the severity of the situation varies based on age, gender, and location (Natcher et al., 2016). Alarming statistics show that households with children experience disproportionately higher food insecurity (CCA, 2014). A 2007–08 survey in Nunavut revealed that only one-third of Inuit children had healthy body weights, while 28% were obese and 39.3% were overweight due to malnutrition and the consumption of energy-dense processed foods (Egeland, 2010). Food insecurity among children—56.1% of whom lived in food-insecure households—is closely linked to rising rates of overweight and obesity. These findings are consistent with studies showing that food insecurity often contributes to poor dietary quality and reliance on unhealthy, calorie-dense foods, leading to overnutrition (e.g., Juric et al., 2017; Ingram et al., 2021). Overall, food insecurity negatively impacts the physical, nutritional, and emotional health of Northerners, reflecting a broader public health issue where both undernutrition and overnutrition coexist, creating a double burden of malnutrition in vulnerable populations.

Moving Away from Rich Traditional Foods to Low-Quality Store-Bought Foods: Indigenous Peoples living in Northern Canada face challenges in accessing culturally preferred, locally harvested traditional foods due to acculturation pressures and changing lifestyles (Mahmud, 2020; Bowers et al., 2022). The terms "traditional food" and "country food" are generally used interchangeably. In this paper, we use "traditional food" throughout. Traditional foods, derived from hunting and fishing, are essential to the diets and cultural identity of northern communities (Schiff and Møller, 2021). These foods hold significant cultural value, and there are strong community efforts to preserve them. In some areas, communal freezers are maintained, prioritizing seniors and individuals with diabetes. Much of the traditional food exists outside formal retail systems, with hunters sharing surplus food with family and friends or through informal markets (Kuhnlein et al., 2006; Kuhnlein, 2018). Employment and income support enhance access to traditional foods, as stable jobs enable individuals to purchase from local hunters or community networks (Chan et al., 2006; Hopping et al., 2010).

A shift from traditional food gathering (hunting) to store-bought food is driven by rising harvesting costs, time constraints, and economic pressures (Sharma et al., 2010; Skinner et al., 2013; Schiff and Møller, 2021). Expenses like equipment, fuel, and travel have increased the cost of traditional harvesting, leading to greater reliance on store-bought foods. Declining traditional harvesting practices and broader economic challenges further pressure Indigenous communities to secure adequate, nutritious food, intensifying reliance on expensive store-bought options and exacerbating food insecurity (Little et al., 2021).

Altering access to traditional food resources significantly impacts dietary quality. The decline in traditional food consumption is concerning, especially as growing evidence suggests that returning to traditional diets offers not only spiritual and cultural value but also health benefits. Traditional foods are rich in protein, fat-soluble vitamins, and essential fatty acids (Erber et al., 2010). Reduced reliance on these foods may lead to deficiencies in iron, zinc, protein, and omega-3 fatty acids (Mead et al., 2010).

The vulnerability of each community to food-security shifts is shaped by factors such as current harvesting practices, dependence on specific species, access to alternative traditional food sources, and exposure to climate change risks (Kuhnlein, 2018). Understanding the link between climate change and traditional food security is crucial for strengthening adaptive capacity and developing effective strategies to address future challenges (Little et al., 2021).

Similarly, the consumption of junk food has become increasingly widespread, driven by factors such as affordability, convenience, and pervasive community promotion. Although younger individuals express a preference for healthier food choices, they often find these options unavailable or less appealing, resulting in a higher reliance on convenience and processed foods. As traditional food consumption declines in favour of market-based foods, nutrient-rich traditional foods are becoming less prevalent in diets (Kuhnlein et al., 2006; Hopping et al., 2010; Wesche and Chan, 2010). This shift, combined with nutritional deficiencies, underscores the urgent need for interventions to combat the rising prevalence of diet-related chronic diseases (e.g., Mead et al., 2010; Sheikh et al., 2011).

Scarce Food Environment: Residents of Northern Canada face numerous challenges, including limited access to clean water, reliance on non-renewable energy, and the highest rates of food insecurity among industrialized nations. The region performs poorly on indicators such as undernourishment, protein supply, and dietary energy adequacy. The harsh climate makes local agricultural production unfeasible in many areas (Brown et al., 2019; Chen and Natcher, 2019). These challenges reveal a dual issue: limited access to affordable, healthy food contributes to undernourishment, while the prevalence of low-quality, affordable food in grocery stores contributes to high obesity rates and associated health problems (Ingram et al., 2021). The scarcity and high cost of healthy foods, such as F&V, are major contributing factors, with retail prices in Nunavut being 140% higher than in southern Canada (Campbell et

al., 2014). In Old Crow, Yukon, residents pay $496 per week for a healthy food basket, compared to $206 in Whitehorse (Natcher et al., 2016). These price disparities stem from various factors, with logistical challenges, particularly elevated transportation costs, being a key contributor (ENRG, 2016; Afif and Doyon, 2023). Communities reliant exclusively on air transportation for food supplies face higher prices than those that benefit from a combination of supply methods (Prentice and Adaman, 2017).

Consumer Perceptions, Preferences, and Behaviour: Food-consumption patterns indicate that retail foods are consumed more frequently than traditional foods in northern communities (e.g., Skinner et al., 2013; Kenny et al., 2018a). However, ongoing challenges in many remote northern communities include poor quality of fresh produce and the sale of expired food by retailers (Akande et al., 2021). A survey by Burnett et al. (2015) examined food retail-purchasing experiences in these areas and found that 82% of respondents reported seeing frequent or occasional sales of expired food, and 57% noted perishable items were often in poor condition. Packaging and quantity preferences also influence shopping behaviour. While some stores offer loose-format F&V, allowing customers to select desired amounts, others use prepackaged bags. Residents prefer the flexibility of choosing quantities to manage costs and have raised concerns about overripe items in prepackaged bags (Brown et al., 2019; Akande et al., 2021). Unfamiliarity with certain produce and its high cost make residents cautious when purchasing fresh items. To address this, store managers host in-store demonstrations and taste tests (ENRG, 2016). The high retail prices and limited availability of nutritious foods also drive outshopping, when consumers buy goods from outside their communities (Joseph et al., 2012; Schiff and Møller, 2021). Gilbert et al. (2021) underscore that store managers also influence dietary choices of residents in remote northern communities, since food availability is shaped by inventory practices, store capacity, delivery schedules, and consumer demand.

Existing literature offers limited insights into northern consumers' preferences for store-bought fresh produce and their consumption patterns, complicating efforts to align supply with demand, ensure freshness and quality, and account for cultural and dietary factors. This gap hinders progress on food security, affordability, environmental impacts, and community health. Bridging these gaps is essential for developing strategies to improve food availability, affordability, and cultural relevance that will ultimately enhance the well-being of Northerners.

Supply Challenges

The NPFSC involves multiple handling steps, transportation modes, and aircraft transfers (ENRG, 2016). The remoteness and isolation of many northern communities, often located far from major agricultural hubs (Singh-Peterson et al., 2015; Wendimu et al., 2018), coupled with a short growing season, result in a heavy reliance on imported produce from the South (Lee et al., 2002; Kenny et al., 2020). This dependency leads to longer transportation routes, further complicating the NPFSC (e.g., Mead et al., 2010; Ford and Beaumier, 2011).

Transportation Challenges: Food insecurity in the Canadian Arctic is largely driven by high food prices, primarily due to transportation costs (Lasserre and Pelletier, 2022). The need for specialized logistics to transport goods to remote areas adds expenses, making food less affordable for residents (Kenny et al., 2020). The region's remoteness and harsh climate further complicate the transportation and storage of perishables (Duhaime et al., 2004; Prentice and Adaman, 2017). With 70% of Canada's landmass lacking year-round road infrastructure, Arctic communities rely on costly, often unreliable transportation systems that are vulnerable to seasonal and weather fluctuations (Bråthen and Halpern, 2012; Prentice and Adaman, 2017). This lack of affordable, reliable, year-round freight transport results in food prices that are two-and-a-half to three times higher than those in southern Canadian cities, particularly in remote communities without all-weather road access (Campbell et al., 1997; Prentice and Adaman, 2017). The primary modes of transportation in the Arctic are by air and sea (e.g., Lasserre and Pelletier, 2022). However, transportation needs vary across regions, with airfreight being essential for remote and isolated communities (Mercier et al., 2018). Maritime shipping remains an option when waters are ice-free, but this is limited to a short period each year. Ice roads, though occasionally used, are unreliable for transporting highly perishable goods such as F&V because of their inadequate infrastructure and long shipping times (Rogers et al., 2018; Lasserre and Pelletier, 2022).

Lack of Competition in Air Transportation: In Northern Canada, a limited number of transportation companies serve a small, hard-to-access market (Bråthen and Halpern, 2012; Levesque, 2023). As a result, northern retailers face significant challenges because of inconsistent or insufficient air transportation, particularly during periods when aircraft are grounded because of weather (Bråthen and Halpern, 2012; Kenny et al., 2020). Delays are further compounded by the risk of spoilage during layovers. Sometimes substantial portions of cargo must be discarded upon air resupply. Unlike in southern regions, where alternative delivery options are readily available, northern stores can experience extended periods without new products (Kenny et al., 2020). Additionally, unlike southern retailers whose suppliers typically manage transportation, northern retailers must cover the full cost of product delivery. These dependencies, combined with limited delivery options, make the system highly vulnerable (Bråthen and Halpern, 2012; Kenny et al., 2020; Prentice et al., 2021).

Last-Mile Delivery Challenges: Last-mile delivery, crucial for resupplying remote communities, is challenging in many areas due to the lack of roads and inadequate infrastructure, necessitating the use of small planes or snowmobiles for final delivery (Prentice and Adaman,

2017; Mercier et al., 2018; Levesque, 2023). In contrast, southern supply chains are more straightforward—there are fewer handling steps, no need for multiple transit points or intermediate warehousing—making them more cost-effective and efficient (ENRG, 2016). Additionally, community resupply is the second most critical aspect of commercial shipping in the Canadian Arctic; it involves the delivery of fuel, consumer goods, fresh food, and high-value items to 18 communities. These extra delivery costs contribute to the elevated retail prices in Arctic regions (Lasserre and Pelletier, 2022). The seasonal nature of transportation in the North also creates challenges in accessing groceries outside communities when winter roads or summer ferries are unavailable (Bråthen and Halpern, 2012).

Product Perishability and Cold-Chain Management: Quality fluctuations are common in the NPFSC, particularly for perishable items such as F&V, which deteriorate quickly. Extended transportation times reduce the window of time for selling these items, lowering their economic value, nutritional content, and consumer appeal (Mercier et al., 2018). Effective cold-chain management—maintaining optimal conditions from production to delivery—is particularly crucial in remote northern communities, where geographic isolation and limited infrastructure pose significant challenges (Mercier et al., 2018; Prentice et al., 2021). Temperature fluctuations, along with improper handling and storage during transport, further compromise quality, accelerating spoilage and shortening produce shelf life (e.g., Jedermann et al., 2014; Gwanpua et al., 2015). For instance, Emond et al. (2003) observed that transport temperature fluctuations from Montréal to Nain resulted in poor-quality produce because of chilling injuries, water loss, bruising, and browning. To preserve freshness and nutritional value, cold-chain management in the Arctic requires precise control over transport, storage, in-store display, and packaging (Mercier et al., 2018). Although technological advancements could enhance quality management, their implementation requires significant investment and adaptation to Arctic conditions, which may progress slowly and unevenly (Dawson et al., 2018; Prentice et al., 2021; Lasserre and Pelletier, 2022).

Local Retail Outlets Challenges: Retail outlets in remote northern communities face high operational, logistical, and infrastructure costs (ENRG, 2016), making a physical retail presence significantly more expensive than in southern communities (Ferguson et al., 2016). A major challenge is high staff turnover and difficulty recruiting qualified workers. Northern retailers compete with employers such as provincial and territorial governments for skilled labour but often lack the resources to offer competitive salaries, resulting in inconsistent staffing and increased recruitment and training costs (Socha et al., 2011; Gladun et al., 2021). Additionally, electricity costs are higher, backhaul opportunities are limited, and the scarcity of local mechanical repair services all add to operational costs. Freight shipping to the North is about 30 % more expensive than to communities in southern Canada (Kenny et al., 2020). Costs are exacerbated by spoilage from extended travel times, weather delays, and harsh conditions. Fuel costs are also higher, with planes often needing to refuel in the North for the return trip, and maintaining airline infrastructure is costly. These factors, along with the significant carrying costs of annual resupplies, contribute to high grocery prices.

In northern communities, spoilage rates for perishable foods range from 5% to 20% due to community isolation and logistical challenges (Mercier et al., 2018). Unlike the situation in southern regions, returning unsold or damaged food for credit is not feasible in the North because of the complex logistics (ENRG, 2016). Notably, low spoilage rates can be misleading, as consumers often buy deteriorated produce because they have limited alternatives (Burnett et al., 2015).

Warehousing practices in northern communities differ from the southern just-in-time model. Northern stores often maintain large inventories, requiring significant warehouse space—over 60% of which is heated to prevent freezing—thus increasing operational costs (Nagurney et al., 2013; ENRG, 2016). Limited cold-storage facilities lead to frequent replenishment, while fluctuating demand in smaller markets can result in stock shortages or expired goods (ENRG, 2016). These challenges contribute to high retail prices, such as $13 for cauliflower, $9 per kg for tomatoes, and $7 per kg for carrots in 2020 (Natcher and Ingram, 2021). Consumer dissatisfaction with high prices and limited variety is common, particularly in single-store communities, where the lack of competition can lead some residents to feel exploited by a lack of competition. Many believe prices could be lower if retailers were less profit-driven, a view shared by residents and some government officials (ENRG, 2016; Kenny et al., 2020).

Lack of Retail Competition: Northern communities without year-round road access often face limited retail competition, resulting in monopolies or oligopolies (Burnett et al., 2017; Kenny et al., 2020). One study found that over 90% of remote Indigenous communities in Northern Canada rely on a single corporate food retailer (Burnett et al., 2017). These communities, with only one food retailer, typically experience higher food costs. Although the presence of a second retailer may not drastically reduce prices, increased competition has been shown to improve both pricing and product quality (Kenny et al., 2020). However, the combination of a sparsely populated region, complex market entry barriers, and vast distances makes it difficult for new competitors to enter the market, which perpetuates high prices and limited food options (Burnett et al., 2017; Akande et al., 2021). These factors significantly restrict access to affordable food in remote northern areas (Duhaime et al., 2004). A summary of the key demand- and supply-side challenges discussed above is presented in the Supplemental Material (Table S2).

Main Drivers of Change in the Arctic Region

Key drivers expected to reshape the future of the Arctic—with implications for the NPFSC—include the extensive effects of climate change, shifts in cultural and societal practices, the emergence of new economic opportunities, advancements in technology, and other innovations, as well as regional and geopolitical agendas (e.g., Ford et al., 2019; Meredith et al., 2019). While these drivers of change have not been extensively studied in the context of the availability of fresh produce in northern communities, future research should develop an overview of the forthcoming changes expected to redefine the Arctic landscape and, consequently, have a significant impact on the NPFSC.

Climate Change: One of the main drivers of change causing rippling effects across the Arctic is climate change. The Arctic is undergoing significant climate change and is expected to warm more than any other global region this century, with impact varying across the region (Box et al., 2019; Meredith et al., 2019). Climate warming impacts the region's residents by disrupting food systems, increasing losses from disasters, damaging infrastructure, and creating new shipping routes (Ford et al., 2021). Research in the Arctic remains largely focused on the physical aspects of the environment. However, several recent projects and papers have focused on the impacts of climate change on communities in the region. Ford et al. (2021) provided a review of this work, looking at the societal effects of climate change in the Arctic and how changes in the physical environment affect local communities.

The Arctic is warming more than twice as fast as the global average (Box et al., 2019), and it is expected to maintain this trajectory (Meredith et al., 2019). Warming is bringing significant seasonal variations in temperature increases and increased precipitation and storm intensity (e.g., Rapaic et al., 2015). While long-term and broad-scale effects of these changes are better known, their effects at smaller, local scales remain less known (Crépin et al., 2017; Box et al., 2019)—but this is the scale that is particularly relevant for planning and decision-making (Ford et al., 2021).

Decreases in the area, thickness, and volume of Arctic sea ice over the last three decades (with an accelerated rate of decline noted in the early 21st century) (Stroeve et al., 2012; Crépin et al., 2017) have had a direct impact on species that are harvested for food and that have significant cultural value for Arctic Indigenous Peoples. Sea ice changes extend the shipping season, which has tripled in length in the last 10 years in the Canadian Arctic Ocean (Dawson et al., 2018) and opens possibilities for new shipping routes. Climate change has made previously unnavigable sea routes accessible, particularly in the Arctic Ocean. This change allows for more direct shipping routes across Arctic Canada, which could be economically advantageous (Andrew, 2014). However, the economic viability of increased maritime shipping in the Arctic depends on ice conditions—currently variable from year to year, which constrains further expansions (Milakovic et al., 2018).

The opening of Arctic Sea routes could improve the efficiency and cost-effectiveness of transporting goods, including food. This change has the potential to improve both food availability and affordability in Arctic regions. However, increased shipping and resource extraction activities could increase the risk of environmental incidents, such as oil spills. Such events can significantly harm marine ecosystems and local food sources (Prentice et al., 2021).

With less Arctic snow, the permafrost thawing rate has increased, in turn affecting critical infrastructure such as airports, roads, and buildings (Hjort et al., 2018). Community infrastructure, ice cellars used for storing harvested food (Nyland et al., 2017), heritage sites, buildings, and entire settlements (Bronen and Chapin, 2013) are increasingly susceptible to damages caused by sea level rises and increased temperatures (Ford et al., 2021).

Climate change is also shortening the operational season and compromising the safety of such critical Arctic transportation infrastructure as winter roads, which are vital for connecting remote communities and transporting heavy goods. Changes in weather patterns and permafrost thaw are degrading road quality and accessibility, driving up costs, and reducing reliability (Ksenofontov et al., 2017; Hori et al., 2018; Kiani et al., 2018). While some climate effects may improve aviation visibility, the overall impact on Arctic transportation remains negative (Debortoli et al., 2019).

Snook et al. (2022) delved into the impacts of climate change on food security in northern communities. They looked at the critical influence of climate change on the availability, affordability, and quality of traditional foods, which are vital for nutrition and cultural identity. Their findings highlight the importance of integrating Indigenous knowledge with scientific research to develop comprehensive environmental monitoring programs that aim to enhance community resilience to climate-change effects on food security.

Warming temperatures caused by climate change are creating new opportunities for expanding agricultural activities in northern regions, however, with longer growing seasons and extended shoulder seasons fostering increased cultivation of local food. These developments have the potential to improve food security and stimulate economic growth. For example, Natcher et al. (2021) examined the adoption of containerized agriculture in Northern Canada, highlighting its potential to address food insecurity in cold climates. However, significant barriers to widespread adoption persist, including financial considerations (upfront costs and expected profits), environmental impacts, and technological complexity (Natcher and Ingram, 2021). To make containerized agriculture a viable solution for food insecurity in the North, Natcher and Ingram (2021) emphasize the need for targeted strategies to mitigate financial risks, simplify the technology, and maximize environmental benefits.

In addition, climate change is expected to drive out-migration, or climigration, which refers to the relocation of communities threatened by climate-change impacts such as rising sea levels and extreme weather events. Initially framed as a government responsibility, practical responses to the challenges have been limited. In regions outside Alaska, climigration is often viewed as a personal decision that is shaped by various factors beyond climate risks, which reflects the multifaceted drivers of migration.

Hamilton et al. (2016) studied migration patterns in Arctic Alaska, where climate change impacts such as thawing permafrost, increased river flows, and reduced sea ice threaten communities. Their findings revealed no clear evidence of increased migration from high-risk areas. Net migration rates were similar to those in other regions, suggesting that, in this specific case, climate change alone does not drive large-scale migration. The study emphasized that migration decisions are shaped by a complex interplay of factors beyond environmental risks, including perceptions of long-term vulnerability, economic opportunities, and community ties. This suggests that while environmental stressors like climate change certainly play a role, they do not operate in isolation and are often mediated by social, economic, and political factors (Bronen and Chapin, 2013; Ford et al., 2021). Hamilton et al. (2016) proposed comparing communities with varying levels of climate impacts to better understand how these different factors interact and influence migration decisions. The need for a nuanced approach to migration studies is evident, going beyond direct causality between climate change and migration. Climate-induced migration is driven not only by environmental push factors but also by local adaptive capacities, policy responses, and alternative livelihood options (Natcher and Ingram, 2021). As climate change disrupts infrastructure, food security, and safety, migration may become inevitable, particularly for communities with limited adaptive resources (Ksenofontov et al., 2017, Snook et al., 2022).

Social Changes: Communities in Northern Canada, with their small populations and a high proportion of Indigenous People, are experiencing demographic shifts that can impact the demand for fresh produce. Recent changes are mainly driven by migration: out-migration to southern regions and immigration from abroad, particularly for resource-extraction opportunities. The out-migration trend, especially among youth, presents a developmental challenge for the North, and is reflected in the decline of individuals under 20. Canada's Arctic population, including that of Yukon, Northwest Territories, and Nunavut, is projected to grow by 12% from 2012 to 2030, though growth rates will vary by region. Fertility rates in these areas exceed the Canadian average, with Nunavut having the highest rate in the country. However, regions such as Nunavik and Nunatsiavut lack specific population projections (Andrew, 2014).

Geopolitical Interests in the Region: Canada is focused on developing infrastructure and strengthening its presence in the Northwest Passage to assert its sovereignty (Weir, 2024). Canada claims sovereignty over much of the passage, considering it to be internal waters, while the United States and European Union regard it as an international strait. This distinction is significant, as it determines whether Canada can control access to these waters (Carnaghan and Goody, 2006). The geopolitical dynamics surrounding the Northwest Passage have both direct and indirect implications for food supply and food security. Infrastructure development, control over waterways, environmental preservation, and international relations will all play a crucial role in shaping the future of food security in this sensitive and rapidly evolving region.

Governmental Northern Food Subsidy Programs: Food-related governance in Canada's northern communities is often fragmented, with a lack of comprehensive oversight across municipal, regional, and provincial or territorial levels. To address these gaps, more adaptable governance structures are needed to meet the evolving needs of diverse and rapidly changing northern communities (Schiff and Brunger, 2013). Government efforts to improve access to healthy food in these areas have faced numerous challenges and have not fully achieved their objectives. For instance, the Food Mail Program, which aimed to lower the cost of fresh and frozen foods in fly-in communities through subsidized postage, saw limited use. Reducing postage costs alone proved inadequate in making food affordable for residents with limited incomes. This underscores the need for more targeted interventions, such as directly subsidizing specific items such as F&V to ensure their availability in northern regions (Socha et al., 2011).

The effectiveness of the Nutrition North Canada (NNC) program has been widely debated (e.g., Pagaduan et al., 2024). Introduced in 2011, NNC aims to improve access to nutritious foods in remote northern communities by subsidizing retailers to lower prices at the point of sale. While some argue that the program supports food security in the North (Burton et al., 2015; Naylor et al., 2020), it has also been criticized for inefficiencies, limited eligible food lists, and lack of transparency (Pagaduan et al., 2024). Moreover, evidence suggests that NNC implementation in Nunavut may be linked to increased food insecurity (St-Germain et al., 2019; Watson et al., 2022). The extent to which NNC creates incentives to supply affordable, high-quality perishable produce to remote communities remains unclear (Watson et al., 2022; Galloway and Li, 2023). Pagaduan et al. (2024) suggested key improvements, including increased support for community food initiatives, enhanced communication and transparency, and a stronger focus on food price regulation.

Before the launch of NNC, annual food insecurity rates ranged from 33% to 40%. After initial implementation, these rates increased to between 39% and 46%, and following full implementation, they rose further to between 46% and 56% (St-Germain et al., 2019). Galloway and Li (2023) examined the impact of NNC subsidies on retail prices and found that the pass-through rate, or the extent

to which subsidies lower consumer prices, was below a rate of one. This indicated that not all subsidy benefits were reaching consumers. In communities with a single dominant retailer, about 33% of the subsidy benefited the retailer rather than marginalized populations. These observations raise concerns about the effectiveness of subsidies in monopolistic contexts, where even with accountability measures, price reductions are limited. Additionally, the NNC lack of detailed fiscal reporting and insufficient tools for evaluating community subsidy rates and retailer pass-through raise transparency and accountability concerns, while inconsistent application and confusion with other regional programs further hinders effectiveness (Galloway, 2017; Naylor et al., 2020).

Recent community-recommended improvements to programs, including increasing funding for local food initiatives, could enhance competition and empower consumers (Galloway and Li, 2023). However, focusing solely on the NNC program overlooks the broader scope of food insecurity across northern Canada, which is rooted in deeper historical and systemic challenges tied to Canada's colonial past. While current food subsidy programs offer temporary relief, they fail to address the underlying causes of food insecurity. A comprehensive re-evaluation, recognizing these foundational issues, is essential for developing long-term solutions to food insecurity in these regions (Ford et al., 2019; St-Germain et al., 2019; Galloway and Li, 20223; Pagaduan et al., 2024).

Recent Initiatives: To respond to food-security challenges in the Canadian Arctic, recent initiatives have included a $62.6 million investment from the Arctic and Northern Policy Framework to enhance the Nutrition North Canada program and support Indigenous-led food-security projects, such as the Harvesters Support Grant (Crown-Indigenous Relations and Northern Affairs Canada [CIRNAC], 2022). Additionally, $1.5 million has been allocated to five Indigenous-led research projects under NNC to address food inequality (CIRNAC, 2023). Innovative agricultural practices, such as using greenhouses, offer promising solutions for local food production to alleviate fresh food shortages (Canadian Northern Economic Development Agency, 2022). Strategies from the Arctic Foods Innovation Cluster emphasize a collaborative, research-based approach to improving food security that blends traditional knowledge with modern techniques to build sustainable food systems (Sustainable Development Working Group, 2020).

TOWARD A COMPREHENSIVE FRAMEWORK

The comprehensive framework (Fig. 2) is structured to provide a detailed understanding and approach to addressing the challenges facing the supply of affordable, adequate, and available perishable foods to remote Arctic communities. It is designed for a wide range of interested parties, including Arctic retailers, researchers, and policymakers. By highlighting critical areas for intervention in operations, logistics, policy, and research, the framework exposes key challenges and identifies significant research gaps. This holistic perspective is essential for developing adaptive strategies to ensure the continued affordability, adequacy, and availability of perishable foods amid evolving economic, environmental, social, and political conditions.

Transportation Level

Our scoping review highlights that high transportation costs coupled with unpredictable schedules, and frequent delays in the Canadian Arctic contribute to higher food prices compared to southern cities (e.g., Piltch et al., 2020). A significant part of Northern Canada lacks year-round road infrastructure, leading to dependence on costly and seasonal air and sea transport (Campbell et al., 1997; Bråthen and Halpern, 2012; Prentice and Adaman, 2017a). Limited competition and high airfreight costs further complicate perishable deliveries, while maritime shipping, viable only during ice-free periods, involves complex logistical coordination (Kenny et al., 2020; Prentice et al., 2021; Mahoney et al., 2022). Moreover, last-mile delivery in the Arctic is hindered by inadequate infrastructure, requiring the use of small planes or snowmobiles, which adds to both the cost and complexity of food distribution (Prentice and Adaman, 2017; Mercier et al., 2018; Levesque, 2023).

Addressing transportation challenges in supplying affordable F&V to the Arctic thus requires a multifaceted approach. High transportation costs and unreliable logistics are significant contributors to food insecurity in remote Arctic communities. Key drivers of change—climate change, societal shifts, economic opportunities, technological advancements, and geopolitical interests—are expected to worsen these challenges. For instance, climate change is causing permafrost thaw and shortening the operational season of ice roads, which are crucial for transporting heavy goods (Ford et al., 2021). While new shipping routes may emerge as ice melts, the overall impact on transportation infrastructure is largely negative, increasing costs and vulnerabilities (Milakovic et al., 2018; Prentice et al., 2021). Despite these anticipated changes, there is limited research on how these factors will specifically affect the availability, affordability, and reliability of perishable-food transport to remote Arctic communities.

To address these gaps, targeted studies are needed. From a retailer's operations and logistics perspective, research should focus on developing adaptive supply-chain strategies capable of navigating the unpredictable northern environment. This includes exploring alternative transportation methods, assessing the efficiency of current transportation modes, and evaluating the feasibility of local food production to reduce dependence on long-distance transport (Bråthen and Halpern, 2012; Kenny et al., 2020).

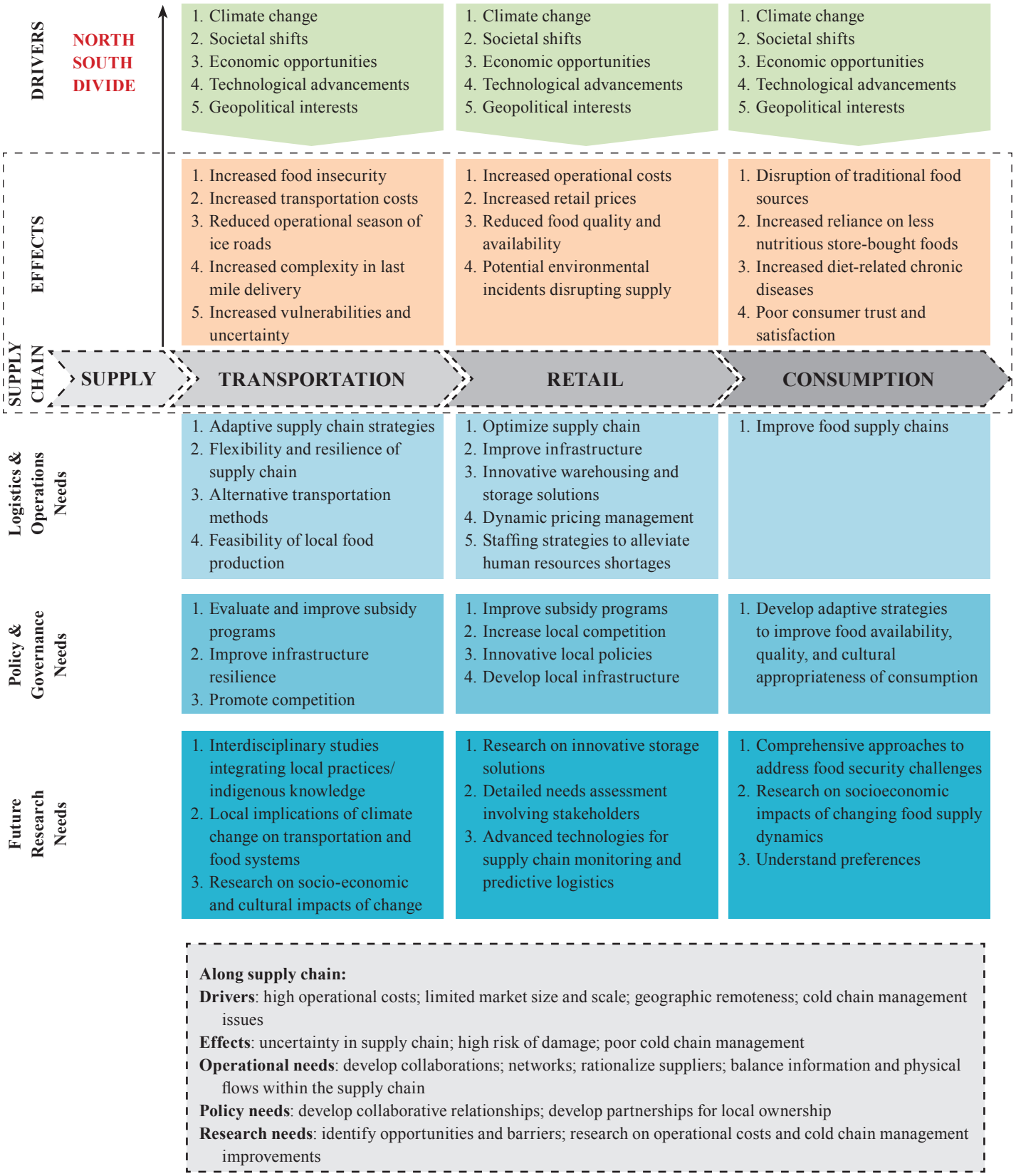

FIG. 2. Comprehensive framework.

From a policy and governance perspective, research should not only focus on improving existing subsidy programs such as NNC but also evaluate alternative policies that could be more effective. For example, cash transfers could address food insecurity and nutrition while avoiding retention of consumer data (Galloway and Li,

2023). Policy interventions to foster competition, such as boosting subsidy uptake by independent stores, subsidizing shipments from non-local retailers, or implementing in-kind transfers or government-run retail models, such as the Public Distribution System in India or Greenland state-run stores, could also reduce food prices in remote northern regions (Galloway, 2017). Additionally, research should address knowledge gaps about the local impacts of climate change on transportation and food systems in the Arctic. Interdisciplinary studies integrating local expertise, Indigenous knowledge, and scientific research are essential for developing effective strategies. Finally, research should consider the socio-economic and cultural implications of shifting transportation patterns and food supply dynamics to ensure solutions are sustainable and culturally appropriate (Ford et al., 2021; Snook et al., 2022).

Retail Level

Our findings highlight significant challenges faced by Arctic retailers, including high operational costs, expensive logistics, and infrastructure limitations. Staffing, fuel, electricity, and freight shipping costs are substantially higher in the Arctic compared to southern regions, driving up consumer prices (Ferguson et al., 2016; Kenny et al., 2020). Perishable goods are prone to spoilage due to long travel times, harsh weather, and limited backhaul options, requiring larger inventories and extensive warehouse space (Nagurney et al., 2013). These factors contribute to elevated retail prices and decreased food quality and availability (Kristin et al., 2017; Natcher and Ingram, 2021).

Future changes in the Arctic, particularly climate-related shifts, are expected to exacerbate these challenges. While projections are based on assumptions (because of limited direct research), climate change is anticipated to increase extreme weather events, thus damaging transportation infrastructure and raising shipping costs and risks (Ford et al., 2021). Thawing permafrost will further compromise critical infrastructure and escalate operational costs (Hjort et al., 2018). These changes will probably increase the cost of maintaining and operating retail outlets, reduce profit margins, and potentially raise retail prices. Social changes, such as population growth and urbanization, will shift demand patterns, possibly leading to increased waste in smaller markets or items being out of stock (Andrew, 2014).

There is a significant gap in research on how these changes will specifically affect the availability of affordable, adequate fresh produce in the Arctic. Research focusing on optimizing supply chains, improving transportation infrastructure, and exploring innovative storage solutions to minimize spoilage and costs would be valuable. Additionally, understanding how climate change will impact transportation routes and local infrastructure is essential for developing resilient logistics strategies.

To effectively address the challenges faced by Arctic retailers, a comprehensive research approach should begin with a detailed needs assessment involving all interested parties. This assessment should identify specific logistical, operational, and economic challenges. Engaging directly with local communities will provide valuable insights into the practical difficulties and unmet needs. Research should then explore innovative solutions, such as remote sensing for real-time supply-chain monitoring and AI for predictive logistics, co-developed and co-implemented with local interested parties.

Consumption Level

Northern consumers face significant challenges, including high food costs, a shift from nutrient-rich traditional diets to less healthy store-bought foods and poor-quality produce. Limited variety, expired items, and high retail prices further exacerbate these issues (Burnett et al., 2015; Kristin et al., 2017), undermining consumer trust and satisfaction. As a result, diet-related chronic diseases are widespread and contribute to health disparities (e.g., Kenny et al., 2018b).

Climate change is expected to disrupt traditional food sources by altering hunting and harvesting conditions (Ford et al., 2021) and thus increasing reliance on costly, less nutritious store-bought foods. Climigration may force communities to relocate, exacerbating food insecurity (Hamilton et al., 2016), while social shifts, such as population growth, could increase demand for store-bought foods (Andrew, 2014). Economic opportunities in resource extraction may disrupt traditional lifestyles and food practices (Schiff and Møller, 2021). While technological advancements could improve food supply, they require significant investment and adaptation to Arctic conditions, which may not be immediately feasible.

These challenges highlight the need for adaptive strategies, such as enhancing local hunting programs, integrating both traditional and modern food-security approaches, building community engagement, and improving access to affordable, high-quality market foods (Chan et al., 2006; Hopping et al., 2010; Skinner et al., 2013). Educational programs are particularly essential for building nutritional knowledge and skills in food preparation and sustainable practices. These programs could promote the nutritional value of traditional foods, revive intergenerational knowledge-sharing, and teach preservation techniques such as freezing and canning to reduce spoilage (Kuhnlein, 2018). Financial literacy and food-planning programs can empower individuals to maximize resources and minimize waste (Hopping et al., 2010), while engaging youth in food-security education fosters long-term, sustainable change (Wesche and Chan, 2010). Community-wide initiatives can raise awareness and promote collective responsibility for addressing food insecurity (Skinner et al., 2013; Schiff and Møller, 2021). These combined efforts could enhance food security and cultural relevance in Arctic regions (e.g., Sharma et al., 2010; Juric et al., 2017; Kenny et al., 2018b).

Alongside the Supply Chain

This review highlights the complex operations of the NPFSC in remote Arctic regions, which differ significantly from conventional supply chains. Multiple supply-and-demand challenges create unique barriers for northern retailers. The fragility and perishability of fresh produce introduce uncertainty and reduce reliability in the NPFSC. Operational costs in the North are substantially higher than in the South due to elevated transportation and labour costs, along with a limited market size. Cold-chain management is particularly critical in these regions with limited specialized transportation systems (Prentice et al., 2021), which often results in improper food handling, reduced shelf life, and spoilage (Kenny et al., 2020).

Collaboration within NPFSC is crucial, as interconnections directly impact its effectiveness (Mahoney et al., 2022). Supply-chain rationalization—working closely with suppliers, integrating systems, and optimizing resources—has proven beneficial in enhancing cold-chain management and achieving efficiencies (Ogden and Carter, 2008; Fernie and Sparks, 2009). Rationalizing the supplier base also facilitates long-term partnerships between retailers and suppliers (Calderwood and Freathy, 2011), and these partnerships help to control costs, increase buying power, and create a more competitive and sustainable offering in the North. However, our review did not identify specific barriers or opportunities for adopting these practices in the NPFSC.

A valuable research direction is to conduct a comprehensive needs assessment involving all interested parties—retailers, consumers, and local communities—to identify practical, sustainable solutions to these challenges. Improving communication and governance within the NPFSC is also essential to ensure more efficient, timely, and interconnected operations, ultimately supporting strategies and policies aimed at improving perishable-food availability in Arctic communities.

CONCLUSION

This scoping review aimed to identify the challenges on both the demand and supply sides that hinder northern retailers from providing affordable, adequate, and accessible perishable food in remote Arctic communities. It also sought to uncover the underlying causes of these challenges, their impact on supply-chain performance, and the key drivers of change. Through a comprehensive analysis, important future research directions are underscored, laying the foundation for further investigation into critical issues in remote Arctic regions.

Theoretical Contributions

This research makes a significant contribution to the existing literature on food supply in remote Arctic communities. Supplying affordable, adequate, and accessible perishable food in these regions presents a unique set of challenges. The comprehensive framework developed provides an integrated view of critical supply- and demand-side issues within the broader socio-economic and environmental context of the Canadian Arctic. It helps to understand the interdependencies and complexities specific to the NPFSC. The research highlights critical supply-side challenges, such as high transportation costs, lack of competition in air transportation, last-mile delivery difficulties, and cold-chain-management issues. It emphasizes key demand-side challenges such as food insecurity, the shift from traditional to store-bought foods, and the consequences of a scarce food environment. The research also identifies key drivers of change in the North, including climate change, social shifts, economic opportunities, technological advancements, and geopolitical interests, all of which have significant implications for the NPFSC. These factors influence both current and future perishable-food supply in the region. Furthermore, the study uncovers gaps in the literature and points to important areas for future research, which can contribute to more effective food supply strategies and help to ensure food security in remote northern communities.

Managerial Implications

Retailers can leverage the insights from this research to develop adaptive supply-chain strategies that address the high costs and unreliability of transportation in the North. Exploring alternative transportation methods and promoting local food production could help alleviate some of these challenges. The findings underscore the importance of improving infrastructure and logistics to reduce spoilage and ensure timely delivery of fresh produce. Investments in advanced storage solutions and resilient logistics strategies are essential for maintaining the quality and availability of perishable foods. A key area for future research is exploring how supply-chain actors can enhance communication and governance to improve the flow of goods. This includes examining ways to strengthen real-time data sharing and interconnectivity among interested parties, ensuring more timely and effective communication (Ford et al., 2021).

Policy Implications

The study highlights the need to re-evaluate and improve subsidy programs such as NNC, as their effectiveness in addressing food insecurity in northern communities remains mixed. Research gaps include a lack of long-term data, insufficient focus on Indigenous perspectives, and limited understanding of how NNC affects access to culturally important foods. Future research should prioritize long-term studies, engage directly with communities to understand their needs, and examine the social and cultural impacts of NNC (e.g., Pagaduan et al., 2024). Moreover, a broader transformation of food systems is needed,

including decolonizing and strengthening Indigenous food sovereignty, which would address structural inequities and support community-led food systems (Wendimu et al., 2018). Alternative policies should be explored, such as fostering competition in air transport, subsidizing shipments from non-local retailers, and supporting local food production and infrastructure. These approaches could lower food prices, improve access, and reduce monopolies and systemic inequities.

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REFERENCES

Afif, K., and Doyon, M. 2023. Perishable food supply chain in remote Arctic communities: An empirical investigation of the main challenges. Annual scientific meeting 2022 conference book of abstracts. Arctic Science 9(1):3–145. https://cdnsciencepub.com/doi/10.1139/as-2023-0007

Afif, K., Azima, S., and Doyon, M. 2026. Investigating perishable food supply chain management challenges in remote Arctic communities: Insights from an embedded case study. British Food Journal 128(2):853–873. https://doi.org/10.1108/BFJ-05-2025-0624

Akande, V.O., Fawehinmi, T.O., Ruiter, R.A., and Kremers, S.P. 2021. Healthy dietary choices and physical activity participation in the Canadian Arctic: Understanding Nunavut Inuit perspectives on the barriers and enablers. International Journal of Environmental Research and Public Health 18(3): 940. https://doi.org/10.3390/ijerph18030940

Andrew, R. 2014. Socio-economic drivers of change in the Arctic. AMAP Technical Report No. 9. Oslo: Arctic Monitoring and Assessment Programme (AMAP). https://www.amap.no/documents/download/3011/inline

Bowers, R., Turner, G., Graham, I.D., Furgal, C., and Dubois, L. 2022. Coming full circle: A critical review of the historical changes in governance, nutrition, and food security of Labrador Inuit between 1500 and 2005. Food, Culture and Society 26(3):545–570. https://doi.org/10.1080/15528014.2021.2025311

Box, J.E., Colgan, W.T., Christensen, T.R., Schmidt, N.M., Lund, M., Parmentier, F.J.W., Olsen, M.S, et al. 2019. Key indicators of Arctic climate change: 1971–2017. Environmental Research Letters 14(4): 045010. https://iopscience.iop.org/article/10.1088/1748-9326/aafc1b

Bråthen, S., and Halpern, N. 2012. Air transport service provision and management strategies to improve the economic benefits for remote regions. Research in Transportation Business and Management 4:3–12. https://doi.org/10.1016/j.rtbm.2012.06.003

Bronen, R., and Chapin, F.S. 2013. Adaptive governance and institutional strategies for climate-induced community relocations in Alaska. Proceedings of the National Academy of Sciences 110(23):9320–9325. https://doi.org/10.1073/pnas.1210508110

Brown, M.C., Shrestha, U., Huber, C., Best, L.G., O'Leary, M., Howard, B., Fretts, A.M. 2019. Characterizing the local food environment and grocery-store decision making among a large American Indian community in the north-central USA: Qualitative results from the Healthy Foods Healthy Families Feasibility Study. Public health nutrition 22(14):2653–2661. https://doi.org/10.1017/S1368980019001095

Burnett, K., Skinner, K., and LeBlanc, J. 2015. From food mail to nutrition north Canada: Reconsidering federal food subsidy programs for northern Ontario. Canadian Food Studies 2(1):141–156. https://doi.org/10.15353/cfs-rcea.v2i1.62

Burnett, K., Skinner, K., Hay, T., Leblanc, J., Chambers, L. 2017. Retail food environments, shopping experiences, First Nations and the provincial Norths. Health Promotion and Chronic Disease Prevention in Canada 37:333–341. https://doi.org/10.24095/hpcdp.37.10.03

Burton, P., Daley, A., and Phipps, S. 2015. The well-being of adolescents in northern Canada. Child Indicators Research 8(3):717–745. https://doi.org/10.1007/s12187-014-9252-8

Calderwood, E., and Freathy, P. 2011. Challenges in the supply of perishable products to island communities. The International Review of Retail, Distribution and Consumer Research 21(2):145–160. https://doi.org/10.1080/09593969.2011.562679

Campbell, M.L., Diamant, R.M., Macpherson, B.D., and Halladay, J.L. 1997. The contemporary food supply of three northern Manitoba Cree communities. Canadian Journal of Public Health 88(2):105–108. https://doi.org/10.1007/BF03403871

Campbell, M., Honrado, L., Kingston, B., Lafontaine, A., Lewis, L., and Muller, K. 2014. Hunger in Nunavut: Local food for healthier communities.
https://actioncanada.ca/wp-content/uploads/2021/06/TF-3-Hunger-in-Nunavut-EN.pdf

Canadian Northern Economic Development Agency. 2022. Northern food innovation challenge projects announced. Ottawa: Government of Canada.
https://www.canada.ca/en/northern-economic-development/news/2022/01/northern-food-innovation-challenge-projects-announced.html

Carnaghan, I., and Goody, A. 2006. Aboriginal food security in northern Canada: An overview. Parliamentary Information and Research Service, Library of Parliament. PRB 05-61E.
https://publications.gc.ca/collections/Collection-R/LoPBdP/PRB-e/PRB0561-e.pdf

Chan, H.M., Fediuk, K., Hamilton, S., Rostas, L., Caughey, A., Kuhnlein, H., Egeland, G., and Loring, E. 2006. Food security in Nunavut, Canada: Barriers and recommendations. International Journal of Circumpolar Health 65(5):416–431.
https://doi.org/10.3402/ijch.v65i5.18132

Chen, A., and Natcher, D. 2019. Greening Canada's Arctic food system: Local food procurement strategies for combating food insecurity. Canadian Food Studies 6(1):140–154.
https://doi.org/10.15353/cfs-rcea.v6i1.301

CCA (Council of Canadian Academies). 2014. Aboriginal food security in northern Canada: An assessment of the state of knowledge.
https://cca-reports.ca/wp-content/uploads/2018/10/foodsecurity_execsummen.pdf

CIRNAC (Crown-Indigenous Relations and Northern Affairs Canada). 2022. Arctic and northern policy framework. Ottawa: Government of Canada.
https://www.rcaanc-cirnac.gc.ca/eng/1560523306861/1560523330587

———. 2023. Minister Vandal announces five new Indigenous-led projects that study food security in northerncommunities. Ottawa: Government of Canada.
https://www.canada.ca/en/crown-indigenous-relations-northern-affairs/news/2023/06/minister-vandal-announces-five-new-indigenous-led-projects-that-study-food-security-in-northern-communities.html

Crépin, A.S., Karcher, M., and Gascard, J.C. 2017. Arctic climate change, economy and society (ACCESS): Integrated perspectives. Ambio: A Journal of the Human Environment 46(3):341–354.
https://doi.org/10.1007/s13280-017-0953-3

Dawson, J., Pizzolato, L., Howell, S.E., Copland, L., and Johnston, M.E. 2018. Temporal and spatial patterns of ship traffic in the Canadian Arctic from 1990 to 2015. Arctic 71(1):15–26.
https://doi.org/10.14430/arctic4698

Debortoli, N.S., Clark, D.G., Ford, J.D., Sayles, J.S., and Diaconescu, E.P. 2019. An integrative climate change vulnerability index for Arctic aviation and marine transportation. Nature Communications 10(1):1–15.
https://doi.org/10.1038/s41467-019-10347-1

Duhaime, G., Searles, E., Usher, P.J., Myers, H., Frechette, P. 2004. Social cohesion and living conditions in the Canadian Arctic: From theory to measurement. Social Indicators Research 66(3):295–318.
https://doi.org/10.1023/B:SOCI.0000003726.35478.fc

Egeland, G.M., Pacey, A., Cao, Z., and Sobol, I. 2010. Food insecurity among Inuit preschoolers: Nunavut Inuit child health survey, 2007–2008. Canadian Medical Association Journal 182(3):243–248.
https://doi.org/10.1503/cmaj.091297

Egeland, G.M., Williamson-Bathory, L., Johnson-Down, L., and Sobol, I. 2011. Traditional food and monetary access to market-food: Correlates of food insecurity among Inuit preschoolers. International Journal of Circumpolar Health 70(4):373–383.
https://doi.org/10.3402/ijch.v70i4.17836

Emond, J.-P., Mercier, F., Laurin, É., Nunes, M.C.N. 2003. Cold chain management of perishable distribution in northern communities of Canada. International Congress of Refrigeration, Washington, D.C., ICR0334.

Enrg Research Group. 2016. Northern food retail data collection and analysis. Ottawa: Nutrition North Canada.
https://nutritionnorthcanada.gc.ca/eng/1424364469057/1424364505951

Erber, E., Hopping, B.N., Beck, L., Sheehy, T., De Roose, E., and Sharma, S. 2010. Assessment of dietary adequacy in a remote Inuvialuit population. Journal of Human Nutrition and Dietetics 23:35–42.
https://doi.org/10.1111/j.1365-277X.2010.01098.x

Ferguson, M., King, A., and Brimblecombe, J. 2016. Time for a shift in focus to improve food affordability for remote customers. Medical Journal of Australia 204(11): 409.
https://doi.org/10.5694/mja15.00868

Fernie, J., and Sparks, L. 2009. Retail logistics: Changes and challenges. In: Fernie, J., and.Sparks, L., eds. Logistics and retail management: Emerging issues and new challenges in the retail supply chain, 3rd ed. Kogan Page.
https://doi.org/10.1108/9780080435930–024

Ford, J.D., and Beaumier, M. 2011. Feeding the family during times of stress: Experience and determinants of food insecurity in an Inuit community. The Geographical Journal 177(1):44–61.
https://doi.org/10.1111/j.1475-4959.2010.00374.x

Ford, J.D., Clark, D., and Naylor, A. 2019. Food insecurity in Nunavut: Are we going from bad to worse? Canadian Medical Association Journal 191(20):E550–E551.
https://doi.org/10.1503/cmaj.190497

Ford, J.D., Pearce, T., Canosa, I.V., and Harper, S. 2021. The rapidly changing Arctic and its societal implications. Wiley Interdisciplinary Reviews: Climate Change 12(6): e735.
https://doi.org/10.1002/wcc.735

Galloway, T. 2017. Canada's northern food subsidy Nutrition North Canada: A comprehensive program evaluation. International Journal of Circumpolar Health 76(1): 1279451.
https://doi.org/10.1080/22423982.2017.1279451

Galloway, T., and Li, N. 2023. Pass-through of subsidies to prices under limited competition: Evidence from Canada's Nutrition North program. Journal of Public Economics 225: 104971.
https://doi.org/10.1016/j.jpubeco.2023.104971

Gharakhani Dehsorkhi B, Afif K, and Doyon M. 2026. Challenges and practices in perishable food supply chain management in remote Indigenous communities: A scoping review and conceptual framework for enhancing food access. International Journal of Environmental Research and Public Health 23(1): 118.
https://doi.org/10.3390/ijerph23010118

Gilbert, S.Z., Walsh, D.E., Levy, S.N., Maksagak, B., Milton, M.I., Ford, J.D., Hawley, N.L., and Dubrow, R. 2020. Determinants, effects, and coping strategies for low-yield periods of harvest: A qualitative study in two communities in Nunavut, Canada. Food Security: The Science, Sociology and Economics of Food Production and Access to Food 13(1):157–179.
https://doi.org/10.1007/s12571-020-01112-0

Gladun, E., Nysten-Haarala, S., and Tulaeva, S. 2021. Indigenous economies in the Arctic: To thrive or to survive? Elementa: Science of the Anthropocene 9(1): 00088.
https://doi.org/10.1525/elementa.2019.00088

Grant, M.J., and Booth, A. 2009. A typology of reviews: An analysis of 14 review types and associated methodologies. Health Information and Libraries Journal 26(2):91–108.
https://doi.org/10.1111/j.1471-1842.2009.00848.x

Gwanpua, S.G., Verboven, P., and Defraeye, T. 2015. 2023 to 2027 Departmental sustainable development strategy (Cat. No. R101–8E-PDF). Polar Knowledge Canada.
https://www.canada.ca/en/polar-knowledge/proactivedisclosure/2023-to-2027-departmental-sustainable-development-strategy.html

Hamilton, L.C., Saito, K., Loring, P.A., Lammers, R.B., and Huntington, H.P. 2016. Climigration? Population and climate change in Arctic Alaska. Population and Environment: A Journal of Interdisciplinary Studies 38(2):115–133.
https://doi.org/10.1007/s11111-016-0259-6

Health Canada. 2020. Canada's food guide. Ottawa: Government of Canada.
https://food-guide.canada.ca/en/

Hjort, J., Karjalainen, O., Aalto, J., Westermann, S., Romanovsky, V.E., Nelson, F.E., Etzelmüller, B., and Luoto, M. 2018. Degrading permafrost puts Arctic infrastructure at risk by mid-century. Nature Communications 9(1): 5147.
https://doi.org/10.1038/s41467-018-07557-4

Hobbs, J.E. 2020. Food supply chains during the COVID-19 pandemic. Canadian Journal of Agricultural Economics 68(2):171–176.
https://doi.org/10.1111/cjag.12237

Hopping, B.N., Erber, E., Mead, E., Sheehy, T., Roache, C., and Sharma, S. 2010. Socioeconomic indicators and frequency of traditional food, junk food, and fruit and vegetable consumption amongst Inuit adults in the Canadian Arctic. Journal of Human Nutrition and Dietetics 23:51–58.
https://doi.org/10.1111/j.1365-277X.2010.01100.x

Hori, Y., Cheng, V.Y., Gough, W.A., Jien, J.Y., and Tsuji, L.J. 2018. Implications of projected climate change on winter road systems in Ontario's far north, Canada. Climatic Change 148(1–2):109–122.
https://doi.org/10.1007/s10584-018-2178-2

Ingram, S., Bogdan, A.M., Shah, T., Lu, X., Li, M., Sidloski, M., and Natcher, D. 2021. Unpacking the WEF nexus index: A regional and sub-regional analysis of northern Canada. Sustainability 13(23): 13338.
https://doi.org/10.3390/su132313338

Jedermann, R., Nicometo, M., Uysal, I., and Lang, W. 2014. Reducing food losses by intelligent food logistics. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 372(2017): 20130302.
https://doi.org/10.1098/rsta.2013.0302

Joseph, P., Davis, A.D., Miller, R., Hill, K., McCarthy, H., Banerjee, A., Chow, C.K., Mente, A., and Anand, S.S. 2012. Contextual determinants of health behaviours in an aboriginal community in Canada: Pilot project. BMC Public Health 12(1): 952.
https://doi.org/10.1186/1471-2458-12-952

Juric, A.K., Batal, M., David, W., Sharp, D., Schwartz, H., Ing, A., et al. 2017. A total diet study and probabilistic assessment risk assessment of dietary mercury exposure among First Nations living on reserve in Ontario, Canada. Environmental Research 158:409–420. https://doi.org/10.1016/j.envres.2017.06.025

Kenny, T.-A., Fillion, M., MacLean, J., Wesche, S.D., and Chan, H.M. 2018a. Calories are cheap, nutrients are expensive–The challenge of healthy living in Arctic communities. Food Policy 80:39–54. https://doi.org/10.1016/j.foodpol.2018.08.006

Kenny, T.-A., Wesche, S.D., Fillion, M., MacLean, J., and Chan, H.M. 2018b. Supporting Inuit food security: A synthesis of initiatives in the Inuvialuit Settlement Region, Northwest Territories. Canadian Food Studies 5(2):73–110. https://doi.org/10.15353/cfs-rcea.v5i2.213

Kenny, T.-A., Little, M., Lemieux, T., Griffin, P.J., Wesche, S.D., Ota, Y., and Lemire, M. 2020. The retail food sector and Indigenous peoples in high-income countries: A systematic scoping review. International Journal of Environmental Research and Public Health 17(23):1–48. https://doi.org/10.3390/ijerph17238818

Kiani, S., Irannezhad, M., and Ronkanen, A.-K. 2018. Review of quantitative methods to assess impacts of changing climate and socioeconomic conditions on Arctic transportation systems. Cold Regions Science and Technology 151:96–108. https://doi.org/10.1016/j.coldregions.2018.02.010

Kristin, B., Kelly, S., Travis, H., Joseph, L., and Lori, C. 2017. Retail food environments, shopping experiences, First Nations and the provincial norths. Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice 37(10): 333. https://doi.org/10.24095/hpcdp.37.10.03

Ksenofontov, M.Y., Feldman, L.I., and Vorob'ev, A.S. 2017. Climate change and its impact on the Northern Sea Route: The role of satellite monitoring in ensuring navigational safety. Izvestiya, Atmospheric and Oceanic Physics 53(2):154–165.

Kuhnlein, H.V. 2018. Vitamin D intake by Indigenous Peoples in the Canadian Arctic. Public Health Nutrition 21(11):1986–1987/ https://doi.org/10.1017/S1368980018000411

Kuhnlein, H.V., Barthet, V., Farren, A., Falahi, E., Leggee, D., Receveur, O., and Berti, P. 2006. Vitamins A, D, and E in Canadian Arctic traditional food and adult diets. Journal of Food Composition and Analysis 19(6–7):495–506. https://doi.org/10.1016/j.jfca.2005.02.007

Lasserre, F., and Pelletier, S. 2022. Canadian Arctic marine transportation issues, opportunities, and challenges. The School of Public Policy Publications 15(1). https://doi.org/10.11575/sppp.v15i1.72626

Leblanc-Laurendeau, O., Canada Library of Parliament, Canada Parliamentary Information and Research Service, and Canada Library of Parliament Legal and Social Affairs Division. 2020. Food insecurity in northern Canada: An overview. Ottawa: Library of Parliament. https://epe.lac-bac.gc.ca/100/201/301/weekly_acquisitions_list-ef/2020/20-35/publications.gc.ca/collections/collection_2020/bdp-lop/bp/YM32-2-2020-47-eng.pdf

Lee, A., Darcy, A.M., Leonard, D., Groos, A.D., Stubbs, C.O., Lowson, S.K., Dunn, S.M., Coyne, T., Riley, M.D. 2002. Food availability, cost disparity and improvement in relation to accessibility and remoteness in Queensland. Australian and New Zealand Journal of Public Health 26(2):266–272. https://doi.org/10.1111/j.1467-842X.2002.tb00685.x

Levesque, A. 2023. A systematic literature review on remote logistics: Exploring new ways to reduce food insecurity in northern Canada. Master's thesis, Montreal, University of Quebec, UQAM Repository. https://archipel.uqam.ca/16967/1/M18099.pdf

Little, M., Hagar, H., Zivot, C., Dodd, W., Skinner, K., Kenny, T.-A., Caughey, A., Gaupholm, J., and Lemire, M. 2021. Drivers and health implications of the dietary transition among Inuit in the Canadian Arctic: a scoping review. Public Health Nutrition 24(9):2650–2668. https://doi.org/10.1017/S1368980020002402

Mahmud, A. 2020. A systematic review of literature on dietary transition-causes and consequences in the Indigenous populations of the Arctic. Master's thesis, Norwegian University of Science and Technology. NTNU Repository. https://ntnuopen.ntnu.no/ntnu-xmlui/bitstream/handle/11250/2782770/no.ntnu:inspera:60189664:34518614.pdf?sequence=1

Mahoney, E., Golan, M., Kurth, M., Trump, B.D., and Linkov, I. 2022. Resilience-by-design and resilience-by-intervention in supply chains for remote and indigenous communities. Nature Communications 13(1). https://doi.org/10.1038/s41467-022-28734-6

Mead, E., Gittelsohn, J., Kratzmann, M., Roache, C., and Sharma, S. 2010. Impact of the changing food environment on dietary practices of an Inuit population in Arctic Canada. Journal of Human Nutrition and Dietetics 23:18–26. https://doi.org/10.1111/j.1365-277X.2010.01102.x

Mercier, S., Mondor, M., Villeneuve, S., and Marcos, B. 2018. The Canadian food cold chain: A legislative, scientific, and prospective overview. International Journal of Refrigeration 88:637–645. https://doi.org/10.1016/j.ijrefrig.2018.01.006

Meredith, M., Sommerkorn, M., Cassotta, S., Derksen, C., Ekaykin, A., Hollowed, A., Kofinas, G., et al. 2019: Polar regions. In: Pörtner, H.-O., Roberts, D.C., Masson-Delmotte, V., Zhai, P., Tignor, M., Poloczanska, K., Mintenbeck, A., et al., eds. IPCC. Special report on the ocean and cryosphere in a changing climate Cambridge: Cambridge University Press. https://doi.org/10.1017/9781009157964

Milaković, A.-S., Gunnarsson, B., Balmasov, S., Hong, S., Kim, K., Schütz, P., and Ehlers, S. 2018. Current status and future operational models for transit shipping along the Northern Sea Route. Marine Policy 94:53–60, https://doi.org/10.1016/j.marpol.2018.04.027

Nagurney, A., Yu, M., Masoumi, A.H., and Nagurney, L.S. 2013. Networks against time: Supply chain analytics for perishable products. New York: Springer Science and Business Media. https://doi.org/10.1007/978-1-4614-6277-4

Natcher, D., and Ingram, S. 2021. A nexus approach to water, energy, and food security in northern Canada. Arctic 74(1):1–11. https://doi.org/10.14430/arctic72045

Natcher, D., Shirley, S., Rodon, T., and Southcott, C. 2016. Constraints to wildlife harvesting among aboriginal communities in Alaska and Canada. Food Security: The Science, Sociology and Economics of Food Production and Access to Food 8(6):1153–1167. https://doi.org/10.1007/s12571-016-0619-1

Natcher, D., Ingram, S., Solotki, R., Burgess, C., Kulshreshtha, S., and Vold, L. 2021. Assessing the constraints to the adoption of containerized agriculture in northern Canada. Frontiers in Sustainable Food Systems 5: 643366. https://doi.org/10.3389/fsufs.2021.643366

Naylor, J., Deaton, B.J., and Ker, A. 2020. Assessing the effect of food retail subsidies on the price of food in remote Indigenous communities in Canada. Food Policy 93: 101889. https://doi.org/10.1016/j.foodpol.2020.101889

Nyland, K.E., Klene, A.E., Brown, J., Shiklomanov, N.I., Nelson, F.E., Streletskiy, D.A., and Yoshikawa, K. 2017. Traditional Iñupiat ice cellars (SIĠḶUAQ) in Barrow, Alaska: Characteristics, temperature monitoring, and distribution. Geographical Review 107(1):143–158. https://doi.org/10.1111/j.1931–0846.2016.12204.x

Ogden, J.A., and Carter, P.L. 2008. The supply base reduction process: An empirical investigation. The International Journal of Logistics Management 19(1):5–28. https://doi.org/10.1108/09574090810872578

Pagaduan, J.E., Lazarescu, C., Vallieres, E., Skinner, K., Zuckermann, A.M.E., and Idzerda, L. 2024. The impacts of the Nutrition North Canada program on the accessibility and affordability of perishable, nutritious foods among eligible communities: A scoping review. International Journal of Circumpolar Health 83(1). https://doi.org/10.1080/22423982.2024.2313255

Piltch, E.M., Shin, S.S., Houser, R.F., and Griffin, T. 2020. The complexities of selling fruits and vegetables in remote Navajo Nation retail outlets: Perspectives from owners and managers of small stores. Public Health Nutrition 23(9):1638–1646. https://doi.org/10.1017/S1368980019003720

Prentice, B.E., and Adaman, M. 2017. Economics of cargo airships for food transport to remote northern communities. Research in Transportation Business and Management 25:87–98. https://doi.org/10.1016/j.rtbm.2017.06.001

Prentice, B.E., Lau, Y.-Y., and Ng, A.K. 2021. Transport airships for scheduled supply and emergency response in the Arctic. Sustainability 13(9): 5301. https://doi.org/10.3390/su13095301

Rapaić, M., Brown, R., Markovic, M., and Chaumont, D. 2015. An evaluation of temperature and precipitation surface-based and reanalysis datasets for the Canadian Arctic, 1950–2010. Atmosphere-Ocean 53(3):283–303. https://doi.org/10.1080/07055900.2015.1045825

Rogers, A., Ferguson, M.M., Ritchie, J., Boogaard, C.V.D., and Brimblecombe, J.K. 2018. Strengthening food systems with remote Indigenous Australians: Stakeholders' perspectives. Health Promotion International 33(1):38–48. https://doi.org/10.1093/heapro/daw047

Schiff, R., and Brunger, F. 2013. Northern food networks: Building collaborative efforts for food security in remote Canadian Aboriginal communities. Journal of Agriculture, Food Systems, and Community Development 3(3):121–138. https://doi.org/10.5304/jafscd.2013.033.012

Schiff, R., and Møller, H. 2021. Health and health care in Northern Canada. Toronto: University of Toronto Press. https://doi.org/10.3138/9781487514600

Sharma, S., Cao, X., Roache, C., Buchan, A., Reid, R., and Gittelsohn, J. 2010. Assessing dietary intake in a population undergoing a rapid transition in diet and lifestyle: The Arctic Inuit in Nunavut, Canada. British Journal of Nutrition 103(5):749–759. https://doi.org/10.1017/S0007114509992224

Sheikh, N., Egeland, G.M., Johnson-Down, L., and Kuhnlein, H.V. 2011. Changing dietary patterns and body mass index over time in Canadian Inuit communities. International Journal of Circumpolar Health 70(5):511–519. https://doi.org/10.3402/ijch.v70i5.17863

Singh-Peterson, L., Lieske, S., Underhill, S.J.R., and Keys, N. 2015. Food security, remoteness and consolidation of supermarket distribution centres: Factors contributing to food pricing inequalities across Queensland, Australia. Australian Geographer 47(1):89–102. https://doi.org/10.1080/00049182.2015.1093700

Skinner, K., Hanning, R.M., Desjardins, E., Tsuji, L.J.S. 2013. Giving voice to food insecurity in a remote Indigenous community in subarctic Ontario, Canada: Traditional ways, ways to cope, ways forward. BMC Public Health 13: 427. https://doi.org/10.1186/1471-2458-13-427

Snook, J., Harper, S., Perrin, A., Balasubramaniam, A., Alisauskas, R., Basterfield, M., Gruben, et al. 2022. Understanding the effects of climate change on food security in northern Indigenous communities. Polar Knowledge: Aqhaliat Report, Volume 4, Polar Knowledge Canada. 106–126. https://www.canada.ca/en/polar-knowledge/publications/aqhaliat/volume-4/climate-change.html

Socha, T., Chambers, L., Zahaf, M., Abraham, R., Fiddler, T. 2011. Food availability, food store management, and food pricing in a northern community First Nation community. International Journal of Humanities and Social Science 1(11):49–61. https://ijhss.thebrpi.org/journals/Vol_1_No_11_Special_Issue_August_2011/6.pdf

St-Germain, A.-A.F., Galloway, T., and Tarasuk, V. 2019. Food insecurity in Nunavut following the introduction of Nutrition North Canada. Canadian Medical Association Journal 191(20):552–558. https://doi.org/10.1503/cmaj.181617

Stroeve, J.C., Serreze, M.C., Holland, M.M., Kay, J.E., Malanik, J., and Barrett, A.P. 2012. The Arctic's rapidly shrinking sea ice cover: A research synthesis. Climatic Change 110(3-4):1005–1027. https://link.springer.com/article/10.1007/s10584-011-0101-1

Sustainable Development Working Group. 2020. Arctic Food Innovation Cluster. Arctic Council. https://sdwg.org/what-we-do/projects/arctic-food-innovation-cluster-afic/.

Watson, B., Daley, A., Pandey, S., and Phipps, S. 2022. From the food mail program to nutrition north Canada: The impact on food insecurity among Indigenous and non-Indigenous families with children. Paper presented at the 37th International Association for Research in Income and Wealth General Conference, Luxembroug, 22–26 August. Accessed 15 November 2023. https://iariw.org/wp-content/uploads/2022/07/Watson-et-al-IARIW-2022.pdf

Weir, S. 2024. Oh Canada: Why Canada should recognize the Northwest Passage as an international strait. Notre Dame Journal of International and Comparative Law 14(2): 6. https://scholarship.law.nd.edu/ndjicl/vol14/iss2/6

Wendimu, M.A., Desmarais, A.A., and Martens, T.R. 2018. Access and affordability of "healthy" foods in northern Manitoba? The need for Indigenous food sovereignty. Canadian Food Studies 5(2):44–72. https://doi.org/10.15353/cfs-rcea.v5i2.302

Wesche, S.D., and Chan, H.M. 2010. Adapting to the impacts of climate change on food security among Inuit in the Western Canadian Arctic. EcoHealth *7*(3):361–373. https://doi.org/10.1007/s10393-010-0344-8