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EDITED BY
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Muhammad Haseeb Raza,
Muhammad Nawaz Shareef University of Agriculture, Pakistan

*CORRESPONDENCE
Gumataw Kifle Abebe
✉ gumataw.abebe@dal.ca

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Sustainable production and distribution practices in Atlantic Canadian short food supply chains: Explorative study

Rebecca Balcom, Gumataw Kifle Abebe*, Emmanuel K. Yiridoe and Christopher M. Hartt

Department of Business and Social Sciences, Faculty of Agriculture, Dalhousie University, Truro, NS, Canada

Introduction: How food is produced, processed, distributed, and consumed significantly impacts the sustainability of food supply chains. Short food supply chains (SFSCs) have been promoted as an alternative approach to offer sustainable solutions. However, empirical studies provide mixed evidence, and the findings greatly vary based on context. This study explores the social, economic, and environmental sustainability practices in Atlantic Canada's SFSCs from the perspective of farm businesses (producers).

Methods: A semi-structured survey was conducted among 64 farmers/producers who participated in Atlantic Canadian SFSCs. Participants were asked what channel they used to sell their products and how far this location is in comparison to the production location if sold to an intermediary, how they believe they could better to improve the sustainability of their production methods, what barriers stood in their way of implementation, and how supply chain supporters could help achieve their sustainability goals.

Results: The findings show that most farm businesses linked to SFCSs have applied ecologically sound production methods such as organic farming, IPM, or other sustainable practices, including regenerative agriculture and no-till farming. Over two-thirds of farm businesses applied sustainable practices such as pasture rotations, green fertilizers, low-carbon couriers, locally sourced inputs, and compostable or recyclable packaging materials. Farm businesses in the Atlantic Provinces highly value the social sustainability of SFSCs, followed by economic and environmental sustainability. Most farm businesses linked to SFSCs were robust to supply- and demand-side shocks, registered a low number of layoffs and fast recovery of operations, and increased their profits during COVID-19 compared to pre-COVID-19 levels. Yet, several barriers remain, the most important ones being high capital costs and longer payback periods. Other barriers include inconsistent inter-provincial trading restrictions, lack of qualified workers and shrinking agricultural land base.

Discussion: SFSCs in Atlantic Canadian SFSCs have implemented several sustainable practices in their production and distribution systems. Most of the farm businesses linked to SFSCs are small, are focused on specific product groups, target small towns or rural areas, and rely on direct-on farm sales to individual customers, and thus can play a crucial role by complementing longer food supply chains. By taking SFSCs in Atlantic Provinces as a case, this study expands our understanding of recent efforts and challenges local producers face to adopt sustainable practices in their production and distribution systems.

KEYWORDS

sustainable production, sustainable distribution, short food supply chains, Atlantic Canada, COVID-19

1. Introduction

How food is produced, processed, distributed, and consumed significantly impacts the sustainability of food supply chains (Govindan, 2018; Wang et al., 2019; Wezel et al., 2020). Indeed, sustainability has gained increasing attention since the end of the Green Revolution as concerns over the sustainability of current food production and distribution systems have reached to new levels (Armanda et al., 2019). Today, the global food system is responsible for 26% of greenhouse gas emissions, of which crop production (human consumption and animal feed) and other stages of the food supply chain (such as food processing, distribution, transport, packaging, and retail) generating about 44% of total food emissions (Poore and Nemecek, 2018; Ritchie and Roser, 2022). Furthermore, the globalization of food production and consumption has significantly increased the carbon footprint of food miles, which is estimated to account for 20% of food emissions (Li et al., 2022).

Short food supply chains (SFCSs) have emerged as sustainable solutions to address the food system's recent and future sustainability concerns, including food sovereignty, which is the ability for citizens to access nutritious, local, and sustainably produced foods to include in their diets (Matacena and Corvo, 2020; Doernberg et al., 2022). Although the definition of SFSCs may vary, they generally describe the distance between where food is grown/produced and consumed or primary production and final consumption (Coelho et al., 2018; Majewski et al., 2020). SFCSs are being popularized as a sustainable alternative (Benos et al., 2022) or complement (Thomé et al., 2021) to conventional, long food supply chains. Indeed, SFSCs can offer solutions for several sustainability challenges in the food system, such as reducing food waste and food miles. Currently, one-third of all food produced is wasted and ends up in landfills, creating 6 to 8% of all carbon and methane emissions (Lipińska et al., 2019; World Wildlife Fund, n.d.); long-distance food distribution accounts for 39% of food waste (Lipińska et al., 2019).

SFSCs are faced with several challenges due to limited production scale, resources and skills. One challenge is for these actors to access funding to invest in new production, processing and distribution technologies that are more sustainable (Jarzebowski et al., 2020). Another barrier is the difficulty of achieving market access. Whether they choose to sell the products themselves, which has initial costs of the location, set up, and proper storage for the foods, or try and sell to grocers who have larger companies that can offer lower prices than a smaller business, they tend to lose money starting off or in the long term (Jarzebowski et al., 2020). Another recent issue SFSCs have faced is the COVID-19 pandemic. This not only affected the demand for food in the service industry but also workers at different stages of the supply chain as they were unable to work because of catching the virus (Weersink et al., 2021). This has prompted interest in understanding the lessons gained during COVID-19 and how future supply chains can use these experiences and adapt and overcome future pandemics. The push for more sustainable supply chains has also resulted in consumers looking to reduce adverse effects on the planet by shopping ecologically sound and socially acceptable food products (Gillespie and Rogers, 2016; Tandon et al., 2020) and increased consumers' desire to purchase local foods (Cappelli and Cini, 2020; Maas et al., 2022).

Against this background, the present study aims to explore social, economic, and environmental sustainability practices in SFSCs and barriers thereof. Although there has been a renewed interest in local foods and SFSCs have been promoted as an alternative approach to offer sustainable solutions, empirical studies provide mixed evidence, and the findings vary based on context. Therefore, this study seeks to provide insights into current sustainable practices and barriers from the perspective of SFSCs in four Atlantic Canada Provinces (i.e., Nova Scotia, New Brunswick, Newfoundland and Labrador, and Prince Edward Island). More specifically, the objectives of this study are to (1) describe short food supply chains in Atlantic Canada; (2) assess the level of sustainable production and distribution practices within SFCSs in Atlantic Canada; (3) assess the robustness of SFSCs to supply- and demand-side shocks due to COVID-19; and (4) explore opportunities and barriers to implementing sustainable practices in SFSCs. Considering recent changes in demography and dietary habits, local food movement, and sustainability concerns, the findings from this study could inform research gaps in local food systems within Atlantic Canada and beyond. In Canada, about 87% of consumers believe that shopping for food locally is more environmentally friendly and supports the local economy, with 45% trying to buy Canadian brands (Business Development Bank of Canada, n.d.). This has increased the desire of producers to adopt more sustainable practices in all three pillars of sustainability, social, economic, and environmental. Therefore, understanding current sustainable challenges is critical for creating economic incentives for SFSCs and investing in sustainable practices. Specifically in Atlantic Canada, the population is considered leaders in the shop local movement (Business Development Bank of Canada, n.d.). If this trend of supporting local continues, there is great potential for the SFSCs in the region to expand and the creation of more job opportunities for local communities (Business Development Bank of Canada, n.d.).

The remainder of the paper is structured as follows. The next section presents the literature review, followed by the methods section. Section 4 provides the results and discussion, followed by the conclusion section.

2. Literature review

2.1. Sustainable supply chains

The 2030 Agenda for Sustainable Development (United Nations, n.d.) adopted 17 Sustainable Development Goals (SDGs) to meet current needs without compromising future generations' ability to meet their needs. At the heart of these SDGs is sustainability. The first is to have decent work and economic growth such as creating sustainable jobs. Another is having responsible consumption and production by reducing waste and using renewable energy. The last sustainability goal relates to supply chains and their climate action by reducing their carbon footprint (United Nations, n.d.). Pagell and Wu (2009) argue that sustainable supply chains should at least be carbon neutral and not harm social systems but still create a profit that would allow businesses to run continuously. Also, Sisco et al. (2010) defined supply chain sustainability as "the management of environmental, social, and economic impacts, and the encouragement of good governance practices, throughout the lifecycles of goods and services" (p. 7). This definition resonates with the widely used concept called the "triple bottom line approach" that takes environmental, economic, and social dimensions as the minimum threshold for achieving sustainability (Elkington and Rowlands, 1999; Seuring and Müller, 2008).

Sustainable supply chain drivers can be both internal and external. Governmental policies and regulations play a significant role in promoting sustainable business practices (Raut et al., 2019). Also, pressures from society (expectations from consumers and civil society) and industry (competitors) can be important forces in driving sustainable practices in supply chains (Sajjad et al., 2015; Emamisaleh and Rahmani, 2017). For example, Oxfam's global campaign against the disproportionate power imbalance in the global coffee supply chain led to the launch of the Fair-Trade system and other sustainable programs in the coffee industry (Barrientos, 2006; Macdonald, 2007). Also, in 2004, Starbucks launched a sourcing approach called "Coffee and Farmer Equity (C.A.F.E.) to promote economically, socially, and environmentally coffee growing practices (Starbucks, 2020). Internally, management commitment, operational and economic benefits can drive various sustainable practices (Emamisaleh and Rahmani, 2017; Sajjad et al., 2020). Many global companies have applied Corporate Social Responsibility (C.S.R.) as their business model to apply social and ethical practices (Lindgreen and Swaen, 2010). The blockchain technology is another important initiative aimed at overcoming transparency and traceability issues and enhancing environmental sustainability in the global food supply chains (Friedman and Ormiston, 2022).

2.2. Short food supply chains: Conceptualization and current practices

Malak-Rawlikowska et al. (2019) provide three-proximity criteria to define SFSCs. First, SFSCs must have close geographical proximity from where food is produced to where it will be consumed, and this is measured using food miles (Coelho et al., 2018; Malak-Rawlikowska et al., 2019). The second proximity is organizational, meaning the number of actors within the chain should consist of one or no intermediaries between the initial producer and the end consumer (Chiffoleau et al., 2016). Lastly is social proximity, which is the knowledge and information that is shared by the producer to create a relationship with the end consumer (Marsden et al., 2002). Social proximity focuses on the relationships that are created during the chains and how the consumers feel about the producers, whereas geographical proximity only focuses on the distance the food has gone to reach the end consumer. The later description lacks specifics of the proximities, such as the distance of food miles for geographical proximity, as well as the level of the relationships created between producer and end consumer for social proximity (Marsden et al., 2002; Malak-Rawlikowska et al., 2019). Though other research has suggested that local food or SFSCs can achieve geographical proximity by traveling a few miles within the city or state or even traveling up to 400 miles (Martinez, 2010; Coelho et al., 2018).

SFSCs can take various definitions, including alternative food networks and local food systems. Indeed "Alternative food networks" is an umbrella term to refer to SFSCs, box schemes, which are usually subscription-based, farmers' markets, and community gardens (Kessari et al., 2020). Local food systems, like SFSCs, look at geographical proximity as a determining factor. Typically, their end consumers are farmers' markets, restaurants, and retailers. Local food systems also consider the population of the community for choosing distance; if it is densely populated, the distance to be considered a local food system is much smaller than that of a spread out, less dense area (Uchanski et al., 2018). In this study, we opted to use SFSCs vis-à-vis alternative food networks as we believe such chains need to be conceptualized as a complement rather than an alternative to longer food supply chains. SFSCs would include sales occurring at farmers' markets, retailers, and restaurants if the food sold comes right from the producer but follows the geographical proximity.

There have been studies attempting to provide empirical evidence about the sustainability of SFSCs. However, the findings are context-specific and diverse. For example, Malak-Rawlikowska et al. (2019) studied the social, economic, and environmental sustainability of SFSCs in Europe in relation to the long food supply chains (LFSCs) or conventional food supply chains. Within economic sustainability, their study found that SFSCs can receive higher prices for their products in comparison to LFSCs. Schmitt et al. (2017) found similar results in European SFSCs in terms of their ability to get higher prices. For environmental sustainability, Malak-Rawlikowska et al. (2019) looked at food miles from production to consumer and the CO_2 that is produced. The study concluded that though some SFSCs create lower levels of CO_2 or food miles, LFSCs, on average, create less of an environmental impact as they can transport and produce larger amounts of food at once. Lastly, for social sustainability, the study looked at labor to production, gender equality, bargaining power, prices, the quantity they can sell, labor hours, and contract ability (Malak-Rawlikowska et al., 2019). For labor to production, due to the smaller batches in SFSCs, more labor is required per product in comparison to LFSCs. As for gender equality in labor, SFSCs tend to have more diverse employment overall. LFSCs typically have better chances of getting contracts and creating more products (Malak-Rawlikowska et al., 2019).

One of the recent projects that documents desired sustainable practices in SFSCs is the Short supply chain Knowledge and Innovation Network (SKIN, n.d.); its Good Practice Repository provides empirical evidence from 24 European countries, the US, and Armenia. The sustainable practices encompass various food sectors such as fresh dairy, fresh meat, fruits, processed dairy, processed meat, processed other, and vegetables (SKIN, n.d.). The main indicators used to measure economic sustainability include profitability, local employment generation, economic uncertainty reduction, training and coaching initiatives, synergies with other sectors, markets/events/initiatives for multiple producers locally, and preservation and valorization of small farms (Vittersø et al., 2019; Jarzebowski et al., 2020; SKIN, n.d.). Environmental sustainability practices can be measured through greenhouse (GHG) emissions, energy use, carbon footprint, ecological soundness of production methods, food miles, and food waste (Malak-Rawlikowska et al., 2019; Vittersø et al., 2019). These studies cite several sustainable practices including Házikó, a catering business in Budapest that uses bicycle delivery to reduce its emissions and use environmentally friendly packaging, and Hello Fresh, a company that helps with reducing food miles and food waste by working closely with producers. With social sustainability, SFSCs are considered very important in creating strong connection between producers and consumers, building trust/sense of community, promoting community education, and recognizing of producers (SKIN, n.d.). Labor to production, gender equality, bargaining power, and other chain performance indicators are considered critical to evaluate the sustainability of SFSCs (Malak-Rawlikowska et al., 2019).

2.3. The COVID-19 effects on food supply chains

When COVID-19 occurred, it had differential effects on SFSCs and LFSCs. Initially, lockdowns caused by the pandemic forced hotels, restaurants, and schools to shut down affecting the distribution of food supplies. This increased sales occurring at grocery stores as at home meals became one of the very few options to get food and due to lockdown measures; this affected farmers' markets and on-farm stand sales (Thilmany et al., 2021; Weersink et al., 2021). The pandemic also required food producers and processors to change how they packaged foods as people wanted some foods in larger quantities. The pandemic also changed what foods people were buying, such as people deciding to bake with the extra time they had. People also started storing foods that can last longer, which resulted in empty shelves for products such as flour and frozen goods (Weersink et al., 2021). During this time, many producers saw a decrease in supply due to a shift in demand.

In Canada, chicken production in May and June of 2020 decreased 6 and 7% respectively, and dairy also decreased around the same time. Another issue that occurred due to COVID-19 was the increase in prices, with beef increasing by around 10%, whereas milk saw consistent pricing due to the supply management system used in Canada (Weersink et al., 2021). During the Pandemic, there were not only issues within the production but also in other parts of the chains. One issue was the difficulty of transporting food to and from the United States due to increased border restrictions (Hobbs, 2020). Also, labor shortages affected food distribution due to the regulations put on travel throughout the pandemic. It also affected processing due to workers being ill or even just having to isolate due to COVID exposures (Hobbs, 2020). Despite the disruptions in global food supply chains due to COVID-19, this may have benefitted SFSCs in some ways. For example, the shift to more online sales during lockdowns created another option for producers in SFSCs to increase sales and expand their reach beyond on-farm sales and customer base (Weersink et al., 2021).

3. Research methods

For this study, a semi-structured survey was conducted to explore the sustainability of current production and distribution systems in Atlantic Canadian SFSCs. The study included farmers/food producers who participated in short food supply chains (i.e., that sell their food products in proximity and/or use one or no intermediaries to sell their products, have a farm business within the four Atlantic Canadian provinces -i.e., Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador- and whose contact information was publicly available). Within public forums, Buy Local New Brunswick (https://buylocalnb.ca/), Newfoundland and Labrador Farm Guide (https://www.gov.nl.ca/farm-guide/farm-directory/all-farms/), Fresh Products Directory Prince Edward Island PEI (https://www.princeedwardisland.ca/en/publication/fresh-products-directory-2022), and Buy Local Nova Scotia (https://buylocal.novascotia.ca/business-search) provide the email or phone numbers of food producers in the respective provinces. We found 302 contacts on the provincial forums of local producers, and all of them were contacted (*via* email or by phone) to participate in the study. Although more than 200 initiated the online questionnaire, only 64 of them completed the semi-structured questionnaire, with a response rate of 21%.

The questionnaire was distributed to the local producers on the directory boards or personal contacts from each province through email and on Facebook forum. Although more than 200 initiated the online questionnaire, only 64 participants could complete it. Within the survey, most questions were semi-structured, with open-ended questions developed based on the empirical evidence documented in the SKIN's Good Practice Repository (SKIN, n.d.). This was necessary because Europe is considered the leader in sustainable production and consumption practices (Wang et al., 2019). Most questions about the three pillars of sustainability were measured on a 5-point Likert-scale. The questionnaire was hosted on "Opinio" survey tool after Dalhousie University's Research Ethics Board approval.

Participants were asked a variety of questions, such as their education level, what province they operate in, and other demographic information (farm size, main activity, etc.). For characterizing the chains, participants were asked what channel they used to sell their products and how far this location is in comparison to the production location if sold to an intermediary. This was quantitatively analyzed to show the typical length of these chains. Lastly, to understand how they could improve or what support is needed, participants were asked how they believe they could better to improve the sustainability of their production methods, what barriers stood in their way of implementation, and how supply chain supporters could help achieve their sustainability goals.

Data were analyzed both quantitatively (descriptive statistics, factor analysis, and multivariate analysis) and qualitatively. The semi-structured nature of the questions allowed us to gain deeper insights into the current sustainable practices and the potential to enhance the sustainability of current production and distribution systems in SFSCs.

4. Results and discussion

4.1. Description of short food supply chains in Atlantic Canada

Table 1 summarizes the sociodemographic characteristics of the participants in the semi-structured survey from the four Atlantic Provinces. Many participants were between the ages of 46–65 (43%) and 26-45 (33%), and 59% were males. Of the participants, about 78% were owners of the farm business. In addition, many participants (56%) held a "University Degree, Certificate or Diploma" or an "Advanced University Degree" (Graduate) and participants were from New Brunswick (56%). Most of the participants had 1 to 10 employees for their farm business (79%) and a farm income of $100,000 or more (52%).

Most farm businesses were involved in fruits or vegetables (58%) and sold their products in small towns or rural areas (68%). The farm businesses implemented different farming systems–conventional (31%), organic (23%), Integrated Pest management (IPM) (22%), and other (23%). "Direct on-farm sales" (to individual consumers) was the most commonly used distribution channel (84%), followed by "Direct off-farm" sales at farmers' markets (63%) and delivery to the consumer (58%). Likewise, 59% of the participants reported having sold *via* small retailers (Table 2). The fact that most farm business in Atlantic Canada choose direct on-farm delivery may be attributed its benefits for consumers in terms of the quality and quantity of food

10.3389/fsufs.2023.1121006

TABLE 1 Sociodemographic characteristics of study participants.

Demographics	Description	%
Age ($n = 63$)	18–25	4.8
	26–45	33.3
	46–65	42.9
	Above 65	19
Gender ($n = 62$)	Male	61.3
	Female	38.7
Position ($n = 64$)	Manager	15.6
	Owner	78.1
	Other	6.3
Education ($n = 64$)	High School Diploma or Equivalent	15.6
	Registered Apprenticeship or Other Trades Certificate or Diploma	4.7
	College, CEGEP or Other Non-University Certificate or Diploma	23.4
	University Degree, Certificate or Diploma	37.5
	Advanced University Degree (Graduate)	18.8
Location ($n = 63$)	Nova Scotia	25.4
	New Brunswick	55.6
	Newfoundland and Labrador	12.7
	Prince Edward Island	6.3
	1–10	78.7
# Employees ($n = 61$)	11–25	11.5
	26–50	8.2
	51–99	1.6
Farm income ($n = 62$)	<$35,000	16.1
	Between $35,000 and $49,999	8.1
	Between $50,000 and $74,999	12.9
	Between $75,000 and $99,999	11.3
	Between $100,000 and $149,999	8.1
	$150,000 +	43.5

purchased, as indicated by Loiseau et al. (2020), in the context of France. Studies elsewhere also documented direct-selling, specifically on-farm sales, as a preferred outlet choice for SFSCs (e.g., Chiffoleau and Dourian, 2020; Jarzebowski et al., 2020).

The participants were asked to share the farthest distance their primary product could travel before selling it to a buyer; the median and mean values food could travel were reported at 65 km and mean 83 km, respectively. Apparently, the food miles of SFSCs in Atlantic Provinces are relatively modest but higher than most SFSCs in Europe (Coley et al., 2009; Vaillant et al., 2017). However, the empirical literature is inconclusive regarding the environmental sustainability of such practices. Some studies indicated that direct-on-farm sales might contribute to increased carbon footprints because it forces buyers to drive to farms and buy smaller quantities (Coley et al., 2009); this means that LFSCs may have an overall lower food mile and carbon footprint per unit than SFSCs (Malak-Rawlikowska et al.,

TABLE 2 Summary of production and distribution systems in Atlantic Canada SFSCs.

Variable	Description	%
Main product category ($n = 64$)	Fruits/vegetables	57.8
	Dairy products	6.3
	Meat	14.1
	Prepared food	4.7
	Other	17.2
Primary production method used ($n = 64$)	Conventional farming system	31.3
	Organic farming system	23.4
	Integrated pest management	21.9
	Other	23.4
Packaging method used ($n = 64$)	No packaging	14.1
	Plastic (recyclable)	29.7
	Other recyclable (i.e., glass, cardboard)	43.8
	Non-recyclable material	12.5
Sales outlet/selling location ($n = 62$)	Urban core	25.8
	Suburban	6.5
	Small town or rural	67.7
Distance traveled to sell products	Kilometers	65[a]
Distribution channels used ($n = 64$)	Direct on-farm sales: Pick your own	39.1
	Direct on-farm sales: Sales to Individuals	84.4
	Direct off-farm sales: Internet Deliveries	31.3
	Direct off-farm sales: Delivery to the Consumer	57.8
	Direct off-farm sales: Farmers Markets (fairs	62.5
	Sales to Small Retail Outlets (one intermediary)	59.4
	Other	31.3
Use of transportation means that requires fuel consumption ($n = 64$)	Never	2
	Rarely	3
	Sometimes	17
	Often	31
	Always	47
Use of a cooling system that requires fuel consumption ($n = 64$)	Never	38
	Rarely	20
	Sometimes	14
	Often	20
	Always	8

[a]Median distance.

2019). Also, it should be noted that other factors such as the level of technology used in production and distribution systems may have greater environmental impact than food miles *per se* (Coley et al., 2009; Mundler and Rumpus, 2012).

Regarding packaging material, only 12.5% of the respondents reported using non-recyclable material. The remaining 87.5% either used no packaging (14%), recyclable plastic (30%), or other recyclables such as glasses and cardboard (44%). About 72% of the participants in SFSCs reported that they had never (38%), rarely (20%), or sometimes (14%) used a cooling system that required fuel consumption. About 78% reported having used transportation that required fuel consumption. Most of the farm businesses (69%) used organic farming, IPM, or other farming systems. The overwhelming majority of farm businesses use compostable or recyclable packaging material made of plastic, glass, and cardboard. The use of chemical pesticides, herbicides, and fertilizers is minimal; only 31% of the farm businesses use conventional farming. Some farms use predator insects and culture control to manage pests, pasture rotations, green fertilizers, low-carbon couriers, and locally sourced inputs.

Table 3 summarizes the main source of information and level of trust among participants in SFSCs. Most farm businesses in the study (88%) used social media as the primary method to build their relationships with customer/consumer. However, the overwhelming majority of producers did have no to some influence on the activities of intermediaries or buyers. Likewise, farm-to-farm collaborations are less prevalent. As a result, most farm businesses were either unable to judge or had little or some level of trust in other farm businesses participating in SFSCs. Also, the level of trust between farm businesses and their customers ranges from fair to complete in the Atlantic Provinces SFSCs.

4.2. Analysis of the economic, social, and environmental sustainability of SFSCs

SFSCs in Atlantic Provinces achieved higher social sustainability scores compared to studies elsewhere, such as in Europe (Jarzebowski et al., 2020). The strong social factor within SFSCs could serve as an effective marketing tool to receive recognition as a producer and create a trusted relationship between consumers and producers (Schmitt et al., 2017). In addition, farm businesses in the study agree that they supply trusted products that care for consumers' wellbeing and create strong social connections. This finding mirrors that of Maas et al. (2022), who looked at the value of SFSCs from the perspective of Atlantic Canadian consumers. Studies in Europe also provide support about the role of SFSCs in generating local employment (Malak-Rawlikowska et al., 2019; Jarzebowski et al., 2020).

Relatively, the economic sustainability dimension received lower scores compared to the social sustainability dimension. In fact, this was reflected in the qualitative responses, which cited economic incentives and longer payback periods as the main obstacles to implementing sustainable production and distribution practices. Yet, compared to the European context, SFSCs in Atlantic Canada provide reasonable economic benefits for the farm businesses. This is perhaps because consumers in the Atlantic region tend to have a higher value of SFSCs as helping the local economy, safe and fresh; as a result, consumers are willing to pay more to encourage farm business in SFSCs (Maas et al., 2022). According to the farm businesses, SFSCs contribute greatly to generate local employment and link their activities with other local businesses in different sectors. SFSCs in the study are considered as a source of regular and assured payments by establishing long-term relationships with their individual and industrial customers. Farm businesses in Atlantic Canada consider the price received and overall profitability generally "good"; however, the view that SFSCs achieve premium prices (Schmitt et al., 2017; Malak-Rawlikowska et al., 2019) is inconclusive, especially compared to the high capital cost required to implement sustainable practices.

Regarding the environmental dimension, most farm businesses agree that their current production and distribution systems create little to no food waste and are making efforts to reduce greenhouse gas emissions. In fact, over two-thirds of farm businesses applied farming practices that are more sustainable such as organic agriculture, IPM, and other sustainable practices such as regenerative agriculture, hydroponics systems, and Integrated Multi-Trophic Aquaculture (IMTA) (Table 4).

Factor analysis was carried out using the oblique rotation technique and principal components extraction to understand the underlying economic, social, and environmental sustainability factors in SFSCs. All the multi-scale items loaded above 0.5. The Kaiser-Meyer-Olkin (KMO), sampling adequacy, test for the social, economic, and environmental dimensions reported at 0.70, 0.66, and 0.56, respectively, which are all above the minimum acceptable value of 0.5; likewise, Bartlett's Test of sphericity was reported at $p < 0.001$. Both tests confirmed the suitability of the data for factor analysis. Thus, the multi-item scales, measured on a five-point Likert scale, were subjected to factor analysis and reliability tests using Cronbach's alpha. Except for the single construct measuring environmental sustainability ($\alpha = 0.64$), the other four measured a value of 0.69 or above.

As shown in Table 4, there were seven statements measuring the social sustainability dimension; five factors loaded in a single construct (Fac. 1), which relates to "community" related attributes, and the other component (Fac. 2) is attributed to "product authenticity." The highest loaded community-related item is the statement "We work to educate our consumers about the products they are consuming," with a factor loading of 0.772, followed by the statement "We have an equal gender distribution among employees." Both statements loaded high for the construct related to product authenticity (Table 4). Likewise, three statements related to economic sustainability are loaded in one factor (Fac. 1), "sustainable profit" related, and the remaining two statements are loaded to factor 2 (Fac. 2), "local economy" related. For the profit-related construct, the statement "We can sell our products for a premium price" has the highest factor loading (0.892) followed by "We produce a sustainable profit year-round." Both statements related to the "local economy" construct have high factor loadings. The environmental items loaded to a single factor (Fac. 1), and the statements "We work to reduce our overall greenhouse gas emissions" and "We are aware of how much energy and carbon we use during production and delivery" have factor loadings of 0.869 and 0.828.

Next, we carried out a multivariate analysis of variance (MANOVA) to test the effects of the constructs identified in the factor analysis (Table 4) on the choice of distribution channels (sales outlets) by the farm businesses. There was a statistically significant main effect in sales outlet choices based on the economic sustainability constructs "sustainable profit" (Pillai's Trace = 0.227, F = 2.490, p

10.3389/fsufs.2023.1121006

TABLE 3 Information sources and the level of trust in SFSCs.

Variable		%
Methods used to build customer/consumer relationships ($n = 64$)	Social media	87.5
	Farmers markets (for interaction purposes)	57.8
	Smartphones (calling)	14.1
	E-communication (emails)	40.6
	No method used	6.3
To what extent can you influence the activities of intermediates within this chain? ($n = 55$)	I do not influence the activities of other chain participants	51
	I have some influence on the activities of chain participants	42
	I have a significant influence on the activities of chain participants	7
How do you characterize the level of trust among other farmers/producers within this chain? ($n = 63$)	There is little trust among all farmers/producers	6
	I am unable to judge	32
	There is some trust among all farmers/producers	30
	There is a lot of trust among all farmers/producers	17
	Not applicable; no other farmers/producers in the chain	14
How do you characterize the level of trust between farmers/producers and the customers/ consumers? ($n = 64$)	I am unable to judge	9
	Customers do have a fair level of trust in the quality of our products/offerings	41
	Customers do have complete confidence in the quality of our products/offerings	50

= 0.034) and "local economy" (Pillai's Trace = 0.336; F = 4.299; p = 0.001) and the "community" related social sustainability construct (Pillai's Trace = 0.211, F = 2.278, $p = 0.050$). The results show that economic sustainability constructs related to "sustainable profit" (F = 9.818; p = 0.003) and "local economy" (F = 18.965; $p < 0.001$) have a statistically significant effect in choosing "direct on-farm sales to individual consumers" as a primary outlet to sell food products. The "local economy" construct also has a significant main effect (F = 5.869; $p = 0.019$) in choosing direct on-farm sales ("pick your own") as a primary sales outlet by farm businesses in Atlantic Canadian SFSCs. Only one of the social sustainability constructs ("community" related attribute) has a statistically significant main effect (F = 9.487; $p = 0.003$) in choosing "farmers markets" as the main off-farm sales outlet by farm businesses in the region. The other social sustainability construct related to "product authenticity" and the environmental construct did not have a statistically significant main effect in any of the on-farm or off-farm sales outlets or selling *via* an intermediary. Overall, the distribution channel decision (direct on-farm sales) appeared to be induced by economic motives. Environmentally, internet sales tends to be a preferred method to reduce food miles and carbon footprint (Majewski et al., 2020); however, direct sales *via* the internet was the lowest used channel in the study context compared to Europe (Malak-Rawlikowska et al., 2019).

Furthermore, study participants were asked to provide the overall attractiveness of SFSCs on a scale of 1 (poor) to 5 (excellent). Accordingly, SFSCs are perceived as "very good" as a source of regular and assured payments and in establishing long-term customer relationships. Likewise, price received and overall profitability of SFSCs are judged "good" by most of the farm businesses in the study context (Figure 1). The findings are generally consistent with the empirical evidence elsewhere (Malak-Rawlikowska et al., 2019; Vittersø et al., 2019; Abebe et al., 2022).

4.3. Robustness of SFSCs to supply- and demand-side shocks

SFSCs' robustness to supply- and demand-side shocks during COVID-19 was assessed from the perspective of farm businesses in the four Atlantic Provinces. Approximately 63% of the study participants mentioned that COVID-19 affected their operations. However, 79% of them reported that they did not lay off their employees, and only 33% saw a decline in revenue. As of January 2022, about 54% of the farm businesses reported an 80% to a full return of pre-pandemic profit levels. In fact, about 59% had overall profits increased since COVID-19 (Table 5). This is perhaps surprising as farm businesses were affected by labor shortages due to Canada's border restrictions and strict lockdown measures (Hobbs, 2020). This may be attributed to the closeness of SFSCs to consumers (Cappelli and Cini, 2020) and changes in consumer behaviors toward local foods due to COVID-19 (Benos et al., 2022).

4.4. Opportunities, barriers, and policy options to implement sustainable practices in SFSCs—qualitative analysis

This section explores the intensity and scope of current sustainable practices and the barriers in the context of Atlantic SFSCs using the qualitative information gathered through the semi-structured survey. Many of the farm businesses in the study have implemented multiple sustainable practices in their production and distribution systems, which are largely environmental or social.

10.3389/fsufs.2023.1121006

TABLE 4 Sustainability of SFSCs (farm businesses' perspectives).

Sustainability dimensions (1 = Strongly Disagree; 5 = Strongly Agree)	Mean	Std. dev.	Factor analysis	
Economic sustainability ($n = 64$)			Fac. 1 ($\alpha = 0.69$)	Fac. 2 ($\alpha = 0.76$)
We generate local employment.	4.42	0.905	−0.016	**−0.893**
We work with other local businesses in different sectors.	4.28	0.786	0.067	**−0.859**
We produce a sustainable profit year-round.	3.61	1.002	**0.715**	−0.227
We have various strategies to reduce economic uncertainties.	3.78	0.863	**0.698**	−0.249
We can sell our products for a premium price.	3.84	0.996	**0.892**	0.306
Social sustainability ($n = 62$)			Fac. 1 ($\alpha = 0.77$)	Fac. 2 ($\alpha = 0.72$)
We create a trusted product.	4.78	0.49	0.076	**−0.832**
We look out for the wellbeing of our consumers when producing our foods.	4.76	0.429	**0.661**	−0.056
We work to educate our consumers about the products they are consuming.	4.5	0.69	**0.772**	−0.240
We have strong connections with our consumers.	4.36	0.843	**0.662**	−0.501
Our local community knows what foods we produce.	4.11	0.893	−0.066	**−0.869**
We have attended local markets or events to sell or promote our products.	4.09	1.205	**0.660**	0.015
We have an equal gender distribution among employees.	4.03	1.098	**0.702**	0.286
Environmental Sustainability ($n = 64$)			Fac.1 ($\alpha = 0.64$)	
We create little to no food waste before the products reach consumers.	4.14	0.852	**0.571**	
We work to reduce our overall greenhouse gas emissions.	4.08	0.931	**0.869**	
We are aware of how much energy and carbon we use during production and delivery.	3.56	1.067	**0.828**	

Bold values indicate those statements loaded to the corresponding factor.

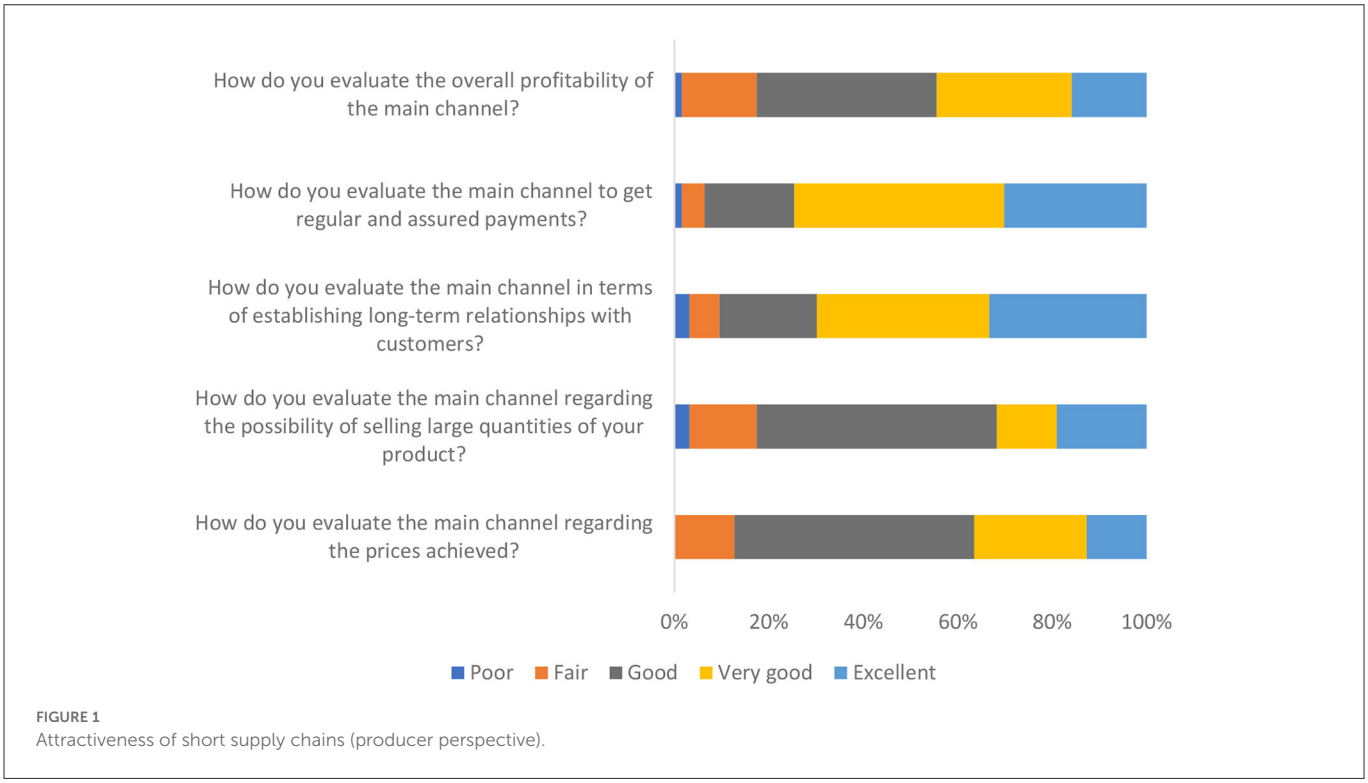

FIGURE 1
Attractiveness of short supply chains (producer perspective).

10.3389/fsufs.2023.1121006

TABLE 5 The effect of COVID-19 on SFSCs.

	Description	%
Have any of your business/farm operations encountered a negative impact during the COVID-19 pandemic that was temporary? ($n = 64$)	Yes	62.5
	No	37.5
Since the start of the pandemic, have you laid off any of your employees? ($n = 63$)	Yes	20.6
	No	79.4
Has your overall business/farm revenue declined over the past 20 months of the COVID-19 pandemic compared to 20 months before the pandemic? ($n = 64$)	Yes	32.8
	No	67.2
If yes to the above question, what percentage of your business/farm revenue returned to the pre COVID-19 level as of January 2022? ($n = 26$)	Fully returned	23.1
	80–99%	30.8
	50–79%	19.2
	26–49%	3.8
	25% or less	23.1
Has your overall business/farm revenue increased over the past 20 months of COVID-19 compared to 20 months before the pandemic? ($n = 63$)	Yes	58.7
	No	41.3

However, the findings reveal that achieving economic sustainability in SFSCs remains elusive.

Many farm businesses implemented sustainable production and distribution practices. A farm business manager that used IPM identified "*minimum tillage*," *reduction of "plant health products", and "capture carbon"* as the primary sustainable practices being implemented (Respondent #33, New Brunswick). Another farm business manager engaged in producing fruits and vegetables using hydroponic systems highlighted some of the current practices: "*Sustainability must be prioritized in all aspects of food products to try and reduce the impact of the impending climate disaster(s). Indoor production uses 95% less water, 90% less space (or more), and very little (if any) fossil fuel-burning machinery. We also do not use pesticides, herbicides, or preservatives*". (Respondent #11, Newfoundland and Labrador).

Several farm businesses also adopted better packaging methods, such as compostable materials and a return program for glass materials, reduced energy use and emissions, including a switch from gas-powered tools and vehicles to electric vehicles and power tools, and using energy-efficient appliances or switching to solar or wind energy. For example, the owner of a farm business engaged in organic farming (fruits and vegetables) explained his farm's practices as follows: "*We are willing and have invested in sustainable practices. We have almost eliminated the use of fossil fuels on the farm and would adopt more sustainable packaging if there was a viable/recyclable alternative.*" (Respondent #12, Nova Scotia). Likewise, the owner of a farm (fruits and vegetables), using the organic farming system expressed her business commitment to sustainable practices: "*I'm buying solar panels this year to offset some of my electricity use. Eventually, I plan to buy an electric vehicle for running errands and delivering produce. I'm also in the process of replacing gas powered small tools and equipment with electric. I am planting flowering plants to support biodiversity and plan to increase this every year. I am fine-tuning the management of irrigation to reduce water use as much as possible. I am creating a hay field so we can produce our own hay instead of buying off-farm (I also have some livestock). I am trying to minimize tillage as much as possible and experiment with no-till when feasible.*" (Respondent #8, New Brunswick).

Table 6 summarizes the qualitative responses regarding current sustainable practices in Atlantic Provinces' SFSCs. As shown in Table 6, many farm businesses have implemented sustainable practices in their production and distribution systems. This includes a switch from gas (fossil fuel) to electric and solar energy sources for delivery and power tools. Others are using minimum tillage and no-till farming. The overwhelming majority of farm businesses use compostable or recyclable packaging material made of plastic, glass, and cardboard. The use of chemical pesticides, herbicides, and fertilizers is minimal; only 31% of the farm businesses use conventional farming. Some farms use predator insects and culture control to manage pests, pasture rotations, green fertilizers, low-carbon couriers, and locally sourced inputs. Most farm businesses use on-farm sales.

Next, the farm businesses were asked about the barriers to implement sustainable practices in their production and distribution systems. The barriers ranged from high capital costs (most important constraint), access to new technology, regulatory frameworks, and supply chain governance to limited human capital and shrinking farmland bases (Table 7).

A farm business owner described his frustration with access to finance as follows: "*We applied for a grant to upgrade our refrigerators, stoves, and freezers to be more energy efficient! It is our aim to attempt to source local pork. We would like to be able to reuse our pickling jars, but we do not have the money for the dish washer required for cleaning the jars.*" (Respondent #3, Nova Scotia).

Farm businesses are also struggling due to varying regulations. The owner of a farm business stated her frustration: "*The compostable bags and containers that are currently in circulation for these items are not accepted by our waste management in Nova Scotia and therefore are not useful in our system.*" (Respondent #26, Nova Scotia). Access to sustainable input sources is another constraint described by the same manager (Respondent #26): "*Currently, there are no avenues for larger farms (that require bulk feed delivery) to obtain certified organic feed; this is a major barrier in our system as we would like to begin buying organic feed for our livestock but none of the feed companies will ship organic feed in their trucks. Also, there is nothing currently in place with our waste management to process compostable containers effectively, so they are not allowed in the green bin systems. This makes it useless for us to use these items unless the people buying them put them into their own composting systems or straight into the garbage.*"

Another farm business manager engaged in a 95% pesticide-free farming system had to say the following: "*We have been working toward more sustainability for 30 years and have been very successful in the running of the farm. However, we are still in a precarious position due to our socioeconomic climate. It is no exaggeration to say that the biggest threat to our existence is irresponsible bureaucracy and politics. We live in a disconnected society with ever-increasing levels of government regulation (interference) that is irresponsible in that they make rules and laws and let us try to find a way to survive. Socialism in Canada is very hypocritical in that it makes socialist rules and expects capitalism and the*

TABLE 6 Current sustainable practices in Atlantic Canada SFSCs.

Sustainable practices being implemented	Stage of supply chain applied	Implementation intensity (rank)
Switching from gas (fossil fuel) to electric machinery (electric delivery vehicles, power tools) and solar energy sources	Production, logistics and distribution	1st
Reduction of packaging waste and use of recyclables and compostable containers	Logistics and distribution	2nd
Application of natural pest controls, wildflower/native to encourage good predator insects, and culture control of pests.	Production	3rd
Reliance on locally sourced materials	Processing	3rd
Minimal use of farm machinery, no-till farming, minimum tillage	Production	3rd
Green, chelated fertilizers, carbon capture	Production	3rd
Application of cover crops to reduce soil erosion	Production	3rd
Use of draft horses, low-carbon courier, and mail services	Logistics and distribution	4th
Farmland and grazing land rotations	Production	4th
Waste reduction (make dried ingredients for human and pet consumption out of surplus and cull vegetable products)	Processing	5th
Reduction of water use through improved irrigation systems	Production	5th
		5th
Use of passive thermal heated systems	Production	5th
Plasticulture	Production	5th

TABLE 7 Barriers preventing the implementation of sustainable practices.

Barriers to implementing sustainable practices	Constraining factor	Severity (rank)
High cost of implementing sustainable practices	Input supply (financial capital)	1st
Limited access to technology, including charging stations packaging material, certified organic feed	Input supply (technology)	2nd
Difficulty in inter-provincial trading–rules, restrictions	Policies and regulatory frameworks	3rd
Time (long payback period)	Short-term economic motives	4th
Power imbalance and limited market information	Supply chain governance	4th
Lack of skilled workers	Input supply (human capital)	5th
Shrinking farmland base	Input supply (land availability)	5th

free market to figure out a way to keep going." (Respondent #20, Nova Scotia).

Perhaps a major challenge within the Atlantic SFSCs is the economic incentives, at least in the short term, in implementing sustainable practices. The owner of a farm business described the sustainability challenges his business faced: "*Right now, we are under constant pressure to push the land and employees (and ourselves) harder to generate enough revenue to stay in business. We are very productive, but it is never quite enough. As a result, we sometimes have to use practices that we believe are unsustainable and are caught in a trap where we cannot afford to invest in things like energy-reducing technologies or infrastructure because we are continually paying those costs and, therefore, must continue to externalize costs in the form of pollution* (Respondent #63, New Brunswick). He went on listing the main barriers as follows: " (1) *Revenue is limited by prices that are determined by external factors; (2) policies that support cheap food, food is now cheaper as a percentage of income than it has ever been in history; (3) invisible subsidies to transportation of non-local produce in the form of highways and CO2 emissions; (4) invisible externalized social and environmental costs of production, like topsoil loss; and 95) power differentials within the food to retail chain that allow big players to restrict farm revenues and maximize their own profits.*" This was also echoed by a farm business manager engaged in fruits and vegetables: "*I agree to have sustainable production if it does not negatively impact my income. Society is asking farmers to produce high-quality food and protect the environment without using plant health products at very low prices. I have little sympathy for consumers who are only interested in looking for the lowest price and demanding the highest quality. Farmers can only be suckers for so long. Pay me for quality, and I will apply sustainable production practices.*" Respondent #33, New Brunswick). Another farm engaged in the meat business (certified humane and antibiotic-free) briefly described how economic incentives influence the decision to implement sustainable practices: "*I love to use sustainable practices, but there needs to be greater recognition of the additional costs involved.*" (Respondent #35, Prince Edward Island). Evidence elsewhere also shows SFSCs struggle to be economically sustainable in the current competitive environment. Due to their economies of scale and scope, large corporations can be able to supply food products at lower prices (Jarzebowski et al., 2020). However, if these companies had to pay for the negative environmental effects, their food prices would increase consumers' costs by between 12 and 28% (Kalfagianni and Skordili, 2018) and would put SFSCs in a more competitive position, in terms of price.

10.3389/fsufs.2023.1121006

TABLE 8 Potential policy interventions to promote sustainable practices in Atlantic Canada SFSCs.

Required policy support	Priority index (rank)
Government incentives for sustainable practices (electric vehicles, carbon sequestration, hydroponic, etc.)	1st
Consistency in (inter-provincial) food inspection regulations	2nd
Incentives for on-farm innovations and improved systems	2nd
Easy access to finance	3rd
Support for local farms (Note Resp #51)	3rd
Government incentives to promote farming	3rd
Financial support for small producers	4th
Investment in research and development	4th
Payments for set-aside land	5th
Banning of unsustainable packaging material (non recyclables)	5th
Market assistance, including co-operative initiatives	5th

A shrinking farmland base is another concern described by a farm business owner engaged in processed foods by growing own vegetables: "*Our farm uses green fertilizers to reduce the use of man-made ones, but we would need another farmland to fully take advantage of green fertilizer and to plant more flowers and plants to encourage beneficial predators and pollinators to prevent spraying of chemicals. We would rely on row covers more often if we had more farm hands.*" (Respondent #3, Nova Scotia).

The last part of the qualitative study focused on policy supports and programs farm businesses would like to see introduced or enforced (Table 8). The responses varied from being unsure of the type of policy support to more robust approaches to promote sustainable practices. For example, a farm business owner engaged in processed foods by growing his own vegetables under the conventional farming system stated, "*I am unsure of how policies would help us. Some of the food inspection policies tie our hands. We would like to recycle our jam jars, but we are required to have a commercial dishwasher instead of washing the jars in our domestic dishwasher and then baking them in an oven. Financial institutions do not like to support small businesses, especially farms. We went to three institutions to change our banking style to help us with the business and no one wanted to take the risk. I don't know if policy could help that! In general, government officials move slowly and are not creative. Having said that, Perennia was a help to us when we first started. Small Farm Acceleration program is the only thing that has allowed us to grow*!" (Respondent #3, Nova Scotia).

Another farm business engaged in producing fruits and vegetables under indoor vertical hydroponic farming called for a policy refocus toward inter-provincial collaboration: "*I am not sure. With disrupted supply chains, this may help make local options more appealing. Maybe this is a time for policymakers to highlight and connect different businesses that can benefit from each other. Perhaps a policy that could help businesses and farms in Atlantic Canada if the four provinces could collaborate on standards. What I mean by this is that if a provincially inspected facility (butcher) can sell its product to all Atlantic provinces and not just the province it is located in. Or that farmers can sell their produce in Nova Scotia that is grown in New Brunswick, for example.*" (Respondent #21, New Brunswick).

Others called for policy incentives to encourage investment in sustainable practices such as electric vehicles (to be used in the production and distribution systems), carbon sequestration, and hydroponic systems; incentives for on-farm innovations and improved systems; easy access to finance; incentives to promote farming (young farmers); financial support for small producers; investment in research and development; payments for set-aside land; banning of unsustainable packaging material (non-recyclables); and market assistance, including co-operative initiatives.

Some of the direct quotes regarding policy interventions include the following:

> "*Pay farmers who set land aside, uncultivated, to improve biodiversity. Subsidize the cost of organic certification and the cost of transitioning to organic for existing conventional operations. Subsidize the cost of sustainably produced food for low-income folks*" (Respondent #8, New Brunswick).
>
> "*Every question or problem in agriculture comes down to economics and the unlevel playing field. We all talk about fair-trade coffee and chocolate, but we don't even have fair-trade food in our own province. We are required to meet ever higher standards for the benefit of our society (mostly food safety, environmental safety and human safety/ decency/ giving wage) but are expected to compete with imported products that meet little or none of these criteria.*" (Respondent #20, Nova Scotia).
>
> "*From a policy perspective, some of these sustainability practices are very expensive short term, and it needs to be decided if it is a public good to be supported in earnest. Long-term payback on most of the COP practices is there, but we need to engage enough cash flow to support short term.*" (Respondent #29, New Brunswick).
>
> "*Change food safety policies - too much waste and excessive burdens on small business owners*". (Respondent #44, Nova Scotia).
>
> "*Taxing grocery stores who do not allow small production facilities to be part of the distribution of local foods.*"

5. Conclusion

How food is produced, processed, distributed, and consumed significantly impacts the sustainability of food supply chains. SFSCs have been promoted as an alternative approach to offer sustainable solutions. However, empirical studies provide mixed evidence, and the findings greatly vary based on context. This study sought to describe SFSCs in Atlantic Canada, assess the level of sustainable production and distribution practices and the robustness of the COVID-19 pandemic, and explore opportunities and barriers to implement sustainable practices in SFSCs.

The findings show that most farm businesses linked to SFCSs in the Atlantic region have applied ecologically sound production methods such as organic farming, IPM, or other sustainable practices, including regenerative agriculture, IMTA, and no-till farming. Such ecologically sound approaches have been cited as essential pathways to transform agri-food systems sustainably (Wezel et al., 2020). In the study context, the median distance food transported was 65 km. Many farm businesses relied on direct-on-farm sales for

both industrial buyers and individual consumers primarily located in small towns or rural areas. Social Media helped farm businesses build trustful relationships with their customers and create strong connections with society. However, the low level of horizontal coordination among farm businesses may prevent them from co-learning and creating economies of scale and scope in their relationship with their customers.

Farm businesses in the Atlantic Provinces show a higher value for the social sustainability of SFSCs, followed by economic and environmental sustainability dimensions. Compared to the European context, SFSCs in Atlantic Canada appeared to offer superior local employment opportunities and economic benefits in the form of regular and assured payments. Environmentally, over two-thirds of farm businesses applied more sustainable practices such as using predator insects and culture control to manage pests, pasture rotations, green fertilizers, low-carbon couriers, and locally sourced inputs. Most farm businesses use compostable or recyclable packaging materials and minimal chemical pesticides, herbicides, and fertilizers.

Consistent with several studies (Hobbs, 2020; Ghosh-Jerath et al., 2022; Maas et al., 2022; Millard et al., 2022), the farm businesses linked to SFSCs in the Atlantic Provinces were robust to supply- and demand-side shocks associated with COVID-19; most of the farm businesses registered low number of layoffs, and fast recovery of operations and increased profits compared to pre-COVID-19 levels. Yet, several barriers remain, the most important ones being high capital costs and longer payback periods. Other barriers include a lack of qualified workers and options to source sustainable materials, such as recyclables and compostable packaging, and a shrinking agricultural land base. Furthermore, inconsistent (inter-) provincial policies remain a challenge for farm businesses in the region.

Finally, as shown in the study, SFSCs in Atlantic Canadian SFSCs have implemented several sustainable practices in their production and distribution systems. Yet, most of the farm businesses linked to SFSCs are small, with a farm income of less than $150,000 (56.5%), are focused on specific product groups such as fruits and vegetables (58%), target small towns or rural areas (68%), and rely on direct-on farm sales to individual customers (84%). This may suggest that SFSCs can be considered as a complement rather than a replacement for the more efficient (due to economies of scale and scope) longer food supply chains. According to a recent global estimate, SFSCs can serve within a 100-km radius or less and only fulfill the demands of 11–28% of the world population for specific crops (Kinnunen et al., 2020).

The main limitation of this study was the small number of participants. There were over 200 people who started the survey; however, only 64 were completed it. We believe the semi-qualitative nature of the study would help to overcome the relatively small sample size in the study.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Dalhousie University Ethical Board. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

RB gathered data and authored the first draft. GA guided research design, data collection, and authored the final draft. EY and CH assisted the study design and peer-reviewed the final draft. All authors approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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