

Case Report

Non-Conventional Agricultural Spaces and Climate Change: The Cases of Le Grenier boréal and Lufa Farms in Quebec, Canada

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Abstract: The objective of this text is to present a reflection on the link between local initiatives to combat food insecurity and actions adapting to climate change. To this end, two case studies of ongoing experiments in the Canadian province of Quebec will be presented and compared. While these two cases are very different in terms of location, production and people involved, they share the objective of bringing fresh and healthy food, produced locally, to the population of their territory and of rethinking the relationship of the community to nature through food production. Despite their significant differences, each of these two cases features actions for responding to problems that have a common cause: an agro-industrial food system that, by decoupling the locations of production and consumption, in order to maximize the economic profitability of the capital invested, has compromised both the health of citizens and the ecological balance.

Keywords: climate change; food insecurity; local initiatives; food miles; ecological transition

1. Introduction

Climate change resulting from the production of greenhouse gases (GHGs) is certainly the most evident aspect of the environmental crisis facing the planet, even if it is not the only factor. As Swyngedouw [1] pointed out, this crisis is global and concerns a model of society that sees nature only as an unlimited pool of resources to be exploited for economic growth and financial profitability. The options for dealing with this crisis must target the various facets of human life, such as health, transportation, agriculture, finance and water, and how these interlock with nature [2]. Thus, social innovations aimed at transforming society's relationship with the environment must be deployed across several dimensions, with food production targeted as a main, if not a flagship, priority [3] (p. 8).

Climate change and other aspects of the crisis such as the nutritional crisis are intimately linked. We have seen that events caused by climate change, which are becoming more frequent, destabilize the world food system, which consequently diminishes food security. An example of this is the case of Russia, which in 2010, fearing that it would be unable to meet its domestic demand following a major heat wave, decided to stop exporting wheat. This caused an increase of more than 40% in the price of wheat, making it more difficult for citizens in several regions of the world to obtain this grain [4].

This growing insecurity signals the need to rethink the food system with a view to experiments that promote an alternative to the globalized option of the food industry, or even of the economy as a whole. The territory can thus become a framework for restructuring based on the local, supported by visions that mobilize the interaction of the various dimensions of human life while also taking non-human life into account [1]. This calls for a return to a territorialized vision of development that brings consumption and production closer together and that draws on a new post-capitalist model of development built on the basis of local experiments [5]. In such a model, territories are seen as life

environments, which means they are used and valued primarily from a perspective of improving the quality of life of citizens [6].

For several years now, the global food system has been under pressure due to rising temperatures, changes in precipitation patterns and more frequent extreme events (heat waves, droughts, hail) [7]. These climate challenges are compounded by global population growth, non-food uses of food crops and a shift to an increasingly animal-based diet [8]. These major trends threaten the food security of populations. According to the FAO [9], considering the current food system, 50% more food will have to be produced to meet the growing needs of the world's population.

While tropical and subtropical regions are already feeling the negative impacts of climate change on their agricultural yields, more northern regions are benefiting from these changes and are experiencing increased productivity for certain crops such as corn, soybeans and wheat. However, the IPCC [7] warns that these positive impacts will be short-lived. Declining yields of the major cereals will increase their cost, and this increase will affect the price of food in general. Fruit and vegetable production is not left out and also remains vulnerable to climate change. Heat stress and extreme events affect plant growth and even destroy crops. In addition to these direct impacts on production, there are impacts on productive resources. Decreased water quantity and quality, soil degradation and the presence and proliferation of pests and diseases are also to be expected. Finally, it should be noted that extreme temperatures likewise have impacts on agricultural workers [7]. One third of the world's food production would no longer benefit from a "safe climate space" and would be threatened in the medium term [10].

The relationships between climate change and food systems are complex and have consequences on the four dimensions of food security identified by the FAO [11], namely, food availability, food access, utilization and stability of these three dimensions over time. Availability refers to food supply and is derived from production, productivity, provisioning and trade. Food access is both economic and physical. The economic dimension refers to income in relation to the price of food, while physical access refers to infrastructure and the organization of supply and distribution systems, as well as to non-market practices (home production, social and solidarity economy organizations) [12]. Food utilization concerns the attainment of nutritional well-being that satisfies all physiological needs. Finally, the fourth pillar relates to the stability of the three previous pillars and concerns the different temporalities (cyclical, seasonal, annual).

Several studies have focused on measures to adapt to and mitigate climate change in food systems. Some of these measures concern demand-side changes (e.g., changes in diets) [13]. Others address the supply side such as adapting food production systems [14] and maintaining traditional productive systems [15]. In this article, we would like to discuss the contribution of non-traditional agricultural production sites to food security in a context of climate change and the territorialization of production practices. Given the pressures of climate change on production areas and human and natural resources, we believe it is necessary to reflect on the alternative dimension of these experiments in terms of their potential effects on natural and social balances.

The objective of this text is to present a reflection on the link between actions to adapt to food insecurity. To this end, two case studies of ongoing experiments in the Canadian province of Quebec will be presented and compared. While these two cases are very different in terms of location, production and people involved, they share the objective of bringing fresh and healthy food, produced locally, to the population of their territory and of rethinking the relationship of the community to nature through food production.

2. Materials and Methods

This article is based on a meta-analysis of two case studies that were conducted separately: Le Grenier boréal initiative in the Côte-Nord region (the study of Le Grenier boréal initiative was carried out by Jessica Élie-Leonard as part of her master's degree under the direction of Mélanie Doyon [16]), and Lufa Farms in Montreal (the study of

Lufa Farms was carried out by Roufai Ouro-Koura as part of a master's thesis under the supervision of Juan-Luis Klein [17]). Both applied the case study method that is appropriate for comprehensive inductive studies of complex initiatives that need to be seized in their territorial context (for the case study method, see Yin [18] and Crowe et al. [19]). Our meta-analysis is based on the pattern matching of both case studies (Figure 1). It is inspired by grounded theory [20]. Therefore, the resulting theoretical and strategic considerations and proposals about the potential effect of food security-oriented initiatives on the ecologic transition and, consequently, on climate dynamics are presented in the last section of the article.

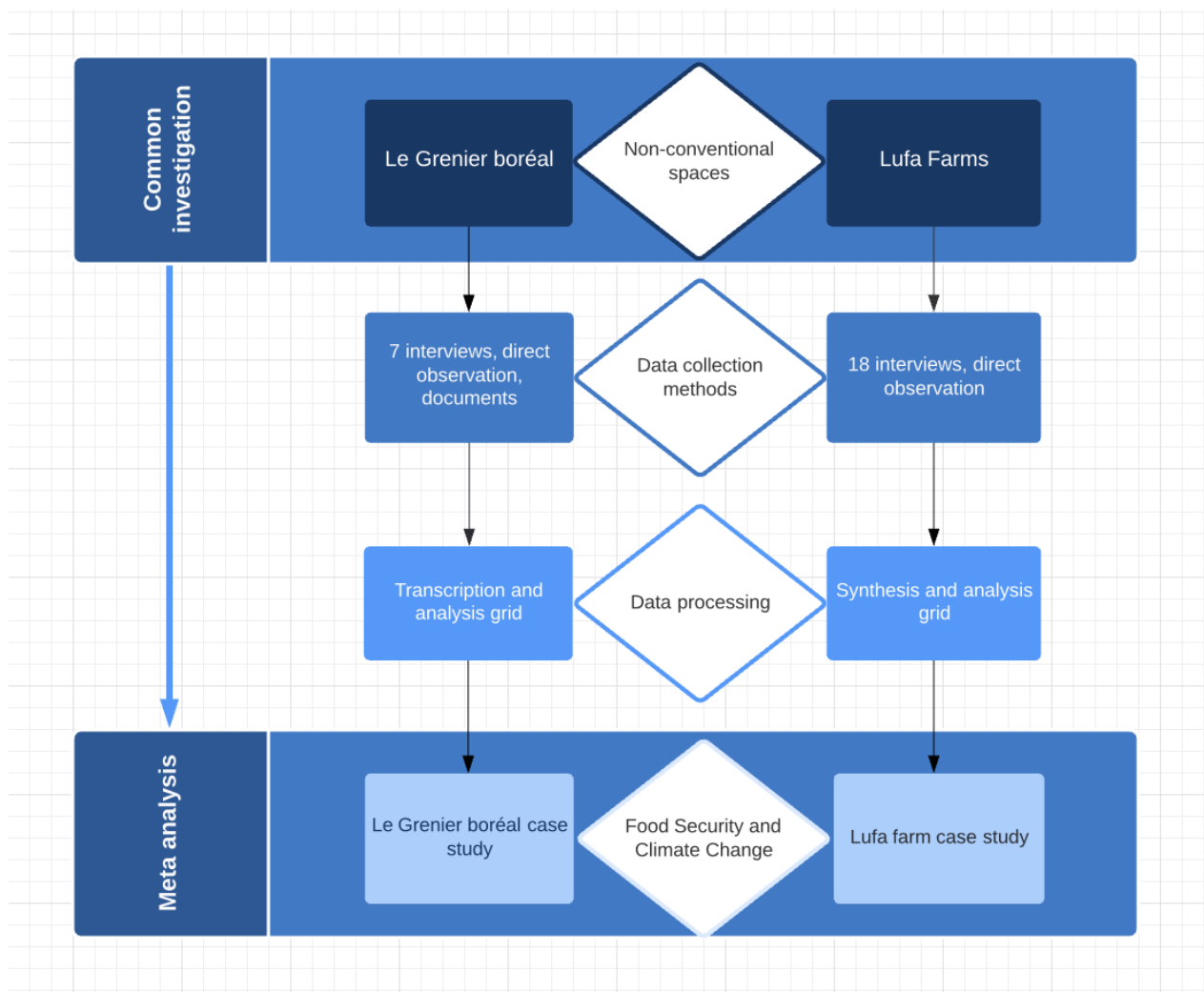


Figure 1. Meta-Analysis Chart.

The case study of Le Grenier boréal drew on a field survey which included direct observation as well as seven (7) semi-structured in-depth interviews with key project stakeholders (professionals, elected officials, project leaders, volunteers). These interviews, which lasted 90 min on average, were carried out in 2018. Information collected was recorded and transcribed and then analyzed using a reading grid. We also drew on government documents such as socio-territorial portraits of Minganie and Côte-Nord, a portrait and an action plan concerning poverty and social exclusion and the Minganie development plan, as well as maps, statistical information (Statistics Canada and Institut de la statistique du Québec) and graphs (Institut national de santé publique du Québec). Local newspapers and larger, more high-circulation newspapers, as well as radio and TV

reports, were also mobilized and allowed us to determine the highlights of the project since its creation.

The data about Lufa Farms were drawn from eighteen (18) in-depth semi-structured interviews, conducted in 2018, with a variety of respondents, including two (2) main managers of the company, five (5) employees and nine (9) partners (agricultural producers, food artisans and distributors). These respondents were interviewed about the company's organizational practices and production methods. In addition, two (2) representatives of neighborhood organizations involved in food security and the social economy were interviewed about the company's community.

3. The Territorial Context of the Case Studies

The first case is located in an area on the outskirts of major urban centers, in the far east of the province. It is the agricultural initiative Le Grenier boréal (<https://grenierboreal.coop/> accessed on 28 June 2021), an agroforestry solidarity cooperative located in the municipality of Longue-Pointe-de-Mingan in Quebec's Côte-Nord region. Founded as a result of citizen mobilization, this social economy enterprise, which has transformed an abandoned military site (tests have been conducted in order to ensure that there is no contamination) into agricultural land, relies on traditional resources and know-how as well as innovative methods in order to produce fruits, vegetables and herbs. The second study presents the case of a social enterprise (albeit private) of urban agriculture located in the metropolitan area of Montreal, thus in a central region and in a global city. This is the enterprise Les Fermes Lufa (<https://montreal.lufa.com/fr/> accessed on 28 June 2021), or Lufa Farms, in English. In this project, actors mobilize innovative technologies to produce fresh food on a large scale in greenhouses located, in some cases, on the roofs of repurposed abandoned buildings.

Despite their significant differences, each of these two cases features actions showing autonomy-oriented responses to problems that, being different, have a common cause: an extractivist food system that, by decoupling the locations of production and consumption, in order to maximize the economic profitability of the capital invested, has compromised both the health of citizens and the ecological balance.

3.1. Case 1: Le Grenier boréal in Quebec's Côte-Nord Region—A Challenge with Regard to Remoteness and Climatic Conditions

Le Grenier boréal cooperative was established in 2013 by citizens of Longue-Pointe-de-Mingan, following a study on non-timber forest products (NTFPs) in Minganie and the obtaining of funding [21]. Two observations gave rise to the creation of this cooperative: the need to renew the economic base of the region, and the lack of fresh fruits and vegetables in the territory [22]. As a solidarity cooperative (A solidarity cooperative "is characterized by the diversification of its membership and its openness to partnership. It brings together, within the same enterprise, individuals or companies that have a common cause or interest, but varied needs" [23]. *Entreprise Québec. La coopérative: un modèle d'affaires à découvrir*. Available online: <https://www2.gouv.qc.ca/portail/quebec/infosite?lang=fr&x=2371115552> accessed on 15 July 2021). Solidarity cooperatives are very present in home and health care services, professional services, business services and local services (grocery stores, gas stations, restaurants, etc.) as well as in arts and culture.), the mission of Le Grenier boréal is, on the one hand, to provide work for its members through the production, harvesting, processing and marketing of food and, on the other hand, to offer some agricultural and agroforestry products and services to the cooperative's members.

The enterprise has four components: (1) NTFP harvesting, which valorizes forest resources; (2) agrotourism and educational animation; (3) consulting services in agroforestry and the environment; and (4) market garden production [24]. The market garden component occupies approximately two hectares of leased public land. The site, which was a military wasteland, was cleaned up and reclaimed. Some development was required to address the challenges of the environment. Hedges were planted to protect the site from the strong winds that blow in Côte-Nord. Thanks in large part to local resources,

the cooperative was also able to meet the challenge of poor soil. From the beginning, the cooperative relied on the residues from the local crab processing plant to produce compost. Over time, it has diversified its sources of supply, and fertilization is now mainly conducted with algae from the river, harvested by hand along the banks. The cooperative wishes to enhance the valorization of scallop residues of local companies and has set up a project for this purpose. Finally, shredded branch residues from the territory also contribute to fertilizing the gardens [25].

Although not “certified organic”, the agriculture practiced by Le Grenier boréal respects organic farming principles [21]. The cooperative hopes that the agricultural and agroforestry expertise it develops will contribute to the social, economic and environmental progress of the communities located in the Minganie regional county municipality (RCM) [24].

3.1.1. The Territorial Framework: Minganie in Quebec’s Côte-Nord Region

The municipality of Longue-Pointe-de-Mingan is located in the RCM of Minganie in the administrative region of Côte-Nord. This region is characterized by its vastness as well as its nature marked by the boreal forest and the St. Lawrence River. Located between Tadoussac and Blanc-Sablon, Côte-Nord is the second largest administrative region in Quebec, with a land area spanning 236,664 km² [26]. While the western part of the region is served by Route 138, the eastern part is not connected to the provincial road network and can only be reached by plane or boat. In 2020, the region had a population of 90,529 [27], a decrease of 4.5% from 2011 [28]. The region is subdivided into six RCMs, including Minganie.

Minganie is composed of eight municipalities (ten villages) and two Aboriginal (Innu) communities. It covers 55,355 km² of land, including the island of Anticosti [29]. In 2020, its population was 6437, with a density of 0.1 inhabitants/km² [30]. The municipality of Havre-Saint-Pierre, which provides the majority of services, had 3371 inhabitants [26]. Longue-Pointe-de-Mingan, where Le Grenier boréal is located, had a population of 423 in 2021 [29], a decrease of about 10% from 2011 [28]. The municipality is located nearly two hours by car east of Sept-Îles, the main city in the region (population 25,400 in 2016 [28]). The total median household income in 2015 was CAD 78,080, well above the Quebec average of CAD 59,822 [31]. However, in 2017, the percentage of low-income families was 12.4%, which is higher than the Quebec rate of 9.5% [32].

The majority of jobs in the RCM are in the sales and services and transportation and machinery sectors [33]. Since the early 2000s, the region has been developing ecotourism activities, including marine mammal watching tours and excursions to the islands of Anticosti and the Mingan Archipelago [34]. Nevertheless, the local economy depends on primary sector activities (fishing, mining, forestry), which are threatened by the depletion of resources and the lack of new workers. In addition, regional economic activity is driven by major extractive projects (e.g., the Romaine hydroelectric power complex, the Rio Tinto mine) [35]. However, only part of the Mingan population benefits from these projects, since many jobs are taken up by workers from outside the region, whose arrival puts pressure on local resources, particularly housing [35].

Agricultural activities, for their part, are rare in Minganie. In fact, in 2020, the RCM had no agricultural zone (In Quebec, provincial agricultural zoning was established in 1976 through the *Act respecting the preservation of agricultural land and agricultural activities*. The purpose of this act is to exclude non-agricultural uses in the agricultural zone. Essentially located along the St. Lawrence River and its main tributaries, the agricultural zone spans a total area of 63,000 km². It is present in 954 municipalities (out of 1132) and in all administrative regions of the province.). This can be explained by climatic conditions that are not very conducive to agriculture, notably average temperatures in July of 14.6 °C and an annual snowfall of 252 cm (data for Rivière-au-Tonnerre, between 1981 and 2010), compared to 21.2 °C and 158 cm on the island of Montreal (data for Rivière-des-Prairies, between 1981 and 2010) [36]. This results in an average growing season that is two months

shorter than that of the Montreal region [37]. In 2011, the MAPAQ [38] counted only three agricultural enterprises in Minganie.

3.1.2. Food Insecurity in Minganie

Food insecurity in Minganie has various causes. First, the RCM, as with the entire region, relies on food deliveries from the large distribution centers located in the south of the province to meet most of its needs. Between two deliveries, fresh food can be scarce, indicating an instability in the food supply. In addition, transportation difficulties (e.g., accidents, weather) sometimes delay deliveries and disrupt supply, creating a sense of insecurity among the population [16].

Physical and economic access conditions are difficult for some segments of society. As it occurs elsewhere, poorer populations have less access to food [39], a problem that is exacerbated by high food prices. Indeed, in 2009, the cost per person per day of a nutritious food basket was CAD 7.84 in Minganie, while it was CAD 6.75 in Montreal [40].

The physical conditions of access are also an issue in Minganie. First, the food supply is limited by the scarcity of food stores. The only supermarket in the RCM is located in Havre-Saint-Pierre (30 min from Longue-Pointe-de-Mingan), and many villages have only small grocery stores, gas stations or convenience stores to obtain supplies. Furthermore, a car is almost always necessary for travel, due to the long distances involved; however, some people do not have one, and the region offers few alternatives to car transportation [35].

Finally, the quality of fruits and vegetables is regularly compromised in Minganie because of the thousands of food miles they have to travel. This is especially true in winter due to delivery difficulties, sometimes resulting in losses.

As with many rural communities in Quebec, Longue-Pointe-de-Mingan, and more generally the Minganie region, is characterized by a low demographic weight. Businesses are few and far between, and the cost of food is high, mainly due to transportation. While some foods are less affected by this circumstance, such as milk, for which a ceiling price was adopted (Although this price ceiling is still a little higher here than in the rest of Quebec, the price of milk is nonetheless much lower now than prior to the adoption of the price ceiling. Since 1 July 2016, the Régie des marchés agricoles et alimentaires has been regulating the price of milk across all of Quebec. In 2009, in Côte-Nord, the cost of four liters of 3.25% milk even reached CAD 15.96, while the maximum price in 2021 in Minganie was CAD 8.86 [40,41]. The price of other foods, however, is not regulated.), the price of other foods raises certain questions of equity.

3.1.3. The Marketing of Products

Since its inception, an increasing variety of fruits, vegetables and herbs have been produced by Le Grenier boréal, although the challenges remain significant. The cooperative has also had to adapt its production techniques. For example, it has installed plastic tunnels and greenhouses to extend the season, introduced winter covers to protect crops from the cold, chosen varieties adapted to the climate, made increasing use of local resources to fertilize the soil and planted willow hedges to protect the gardens from the wind [25]. Initially, its production was exclusively marketed through weekly baskets, the number of which grew from 10 baskets to 35 baskets between 2016 and 2017. In 2017, the cooperative successfully inaugurated a U-pick strawberry farm [42]. Since 2018, Le Grenier boréal has provided food to be sold at the Havre-Saint-Pierre grocery store [43] and, as of 2019, has supplied ingredients to the Puyjalon distillery in Havre-Saint-Pierre, to produce gin [44]. Although the 2020 season was complicated by pandemic-related delays in the construction of a greenhouse and the arrival of student interns, as well as redevelopment that took some acreage out of production, the harvest was very good. Le Grenier boréal also managed to set up a food stand in the villages of Minganie. Finally, market garden production is expected to increase over the next few years due to the cultivation of areas that had not been used prior to 2020 and the completion of the greenhouse [45].

3.2. Case 2: Lufa Farms in Montreal: Urban Agriculture and Socio-Technical Innovation

Lufa Farms is located in a territorial setting that is the polar opposite of the one that supports Le Grenier boréal. However, in relation to climate change and food autonomy, the two projects share certain objectives and techniques. Montreal is the largest city in the province of Quebec and the second largest in Canada in terms of population and economic importance. It is at the center of a metropolitan community of 4374 km² that includes more than four million inhabitants according to the 2016 census. As such, the agglomeration of Montreal had a population of 2,050,053, according to City of Montréal estimates in 2019 (The urban agglomeration of Montreal includes the City of Montréal and 15 autonomous cities located on the island of Montreal. The Communauté métropolitaine de Montréal includes the City of Montréal and 81 autonomous cities. For information on the City of Montréal, http://ville.montreal.qc.ca/portal/page?_pageid=6897,67633583&_dad=portal&_schema=PORTAL 30 September 2021. For information on the Communauté métropolitaine de Montréal, see <https://cmm.qc.ca/> accessed on 25 September 2021). Montreal is one of North America's major metropolises serving as an industrial and service hub and offering high-level services. However, as with most large centers in our hyper-globalized and hyper-industrialized world [46,47], this city is fraught with social divides that separate the wealthy from the poor. Neighborhoods that are more affected by poverty are challenged with various forms of precariousness and socioeconomic vulnerability [48], including food insecurity [49,50].

As a result, several types of initiatives to fight for food security are emerging. These initiatives are divided into four sectors: production, processing, distribution and consumption. In terms of production, the most important activity is urban agriculture. It goes without saying that urban agriculture alone will never be able to feed the entire population of a city such as Montreal. Nevertheless, it remains a field of experimentation for complementary solutions to food problems in an environmental and social perspective [51]. Urban agriculture is spread over several sectors and is practiced in various types of areas at multiple scales.

Urban agriculture is on the rise all over the world. It has been practiced for a long time in the so-called countries of the South, where urban populations are more likely to have some of their needs met through food self-provisioning, often driven by poverty. On the other hand, in the cities of so-called developed countries, agricultural production in urban areas for the purpose of mitigating food insecurity is more recent. Historically, it was practiced for recreational, social or therapeutic purposes or was reserved for specific uses (e.g., vines, for homemade wine, in Montreal). Thus, in general, the food system, including food distribution, was expected to satisfy the needs of urban residents. Yet, the food system can no longer meet these demands. This is due to several factors including the deterioration of food quality [52] and the new aspirations of residents regarding the link between ecology, social justice and food production. In that context, for a low-income population with difficulties in obtaining adequate food supplies, urban agriculture can facilitate access to certain foods [53,54]. In addition, urban agriculture can contribute to residents' overall level of health [55] and education [54]. Finally, urban agriculture contributes to strengthening social ties [55,56]. Today, as environmental problems intensify, urban agriculture is increasingly called into play as a means to promote sustainable development [53,54,57]. It is part of the repertoire of collective actions oriented toward the co-construction of a "sustainable city" [58]. It is this aspect that we will address with the help of the Lufa Farms case.

3.2.1. Lufa Farms in Montreal

Lufa is one of Canada's leading urban agriculture production experiments. It is innovative at several levels. On the one hand, it was a pioneer in the implementation of commercial greenhouses on building roofs [59]. On the other hand, given that it involves the construction of rooftop greenhouses, it mobilizes high-level technologies for both production and management. In 2010, the company built its first greenhouse, with a surface area of 2973 m², on a disused building located in the borough of Ahuntsic-Cartierville.

Harvesting and delivery of products began in April 2011. In 2013, a second greenhouse of 3995 m² was built on a roof in Laval. In 2017, a third larger greenhouse (5853 m²) was put into operation in the borough of Anjou. In August 2020, finally, Lufa inaugurated a fourth greenhouse, spanning 15,217 m², on the roof of a building located in the borough of Saint-Laurent, doubling the productive capacity that the company had reached by then. Altogether, Lufa Farms provides fresh food year-round to nearly 30,000 people. More than fifty varieties of vegetables are produced annually in its four greenhouses (many varieties of tomatoes, cucumbers, peppers, lettuce, eggplants, microgreens, basil and Swiss chard, among others). The production is conducted in accordance with the requirements of organic agriculture, that is, without pesticides, using biocontrol (the use of beneficial insects to combat pests) alongside rational use of water and electricity.

Lufa relies on a very complex computerized system run by the Argus Titan software, designed for facilities management in protected environments such as agricultural greenhouses (The company that markets this system is located in British Columbia. See <http://arguscontrols.com/about-argus/system-applications/> accessed on 23 July 2021). This application manages parameters such as temperature, humidity, light, CO₂ level, air exchange and circulation, snow loads, rain and wind protection. In addition, the system takes into account the protection of buildings and crops.

3.2.2. The Creation and Putting into Operation of the Company

Lufa was founded in 2009 (“The name of the project is inspired by luffa, a climbing plant that grows in Lebanon, among other places, where it thrives in urban environments. It decorates the walls and fences it covers, provides shade under pergolas, and supplies squash that can be cooked or dried to make sponges” [60]). The project was the brainchild of Mohamed Hage, who was joined by Lauren Rathmell, a biochemist by training and researcher at McGill University’s Macdonald campus, who is now the director of the greenhouses; Yahya Badran, director of engineering and a graduate of the Technical University of Construction in Bucharest; and Kurt Lynn, a Toronto-based contractor who acts as an advisor to the company.

A number of resources were needed to launch the business. Among these, the main ones were human. While experts, architects and engineers were hired, the initiators also learned a lot as they went along. Financial investments were likewise necessary. The construction of the pilot greenhouse, for example, was realized with private funding coming from only one partner, the senior manager. As this was a high-risk investment, it had been difficult to attract external private investors. By contrast, the company was able to attract several investors for the construction of the second greenhouse, in Laval. Cycle Capital Management (Cycle Capital invests in several areas including responsible agriculture, renewable energy and clean technology. See <http://www.cyclecapital.com/> accessed on 23 July 2021 and <http://www.cyclecapital.com/lufa-farms-inc-a-new-company-in-the-cycle-c3e-portfolio/> accessed on 23 July 2021), a venture capital fund that promotes sustainable technologies, was a main participant in this project. The construction of the third greenhouse, in Anjou, completed in 2016, was funded primarily by Solidarity Fund QFL, a fund created by the Fédération des travailleurs du Québec (FTQ, Montréal, QC, Canada) in 1983 to support job retention and creation in Quebec. The construction of the fourth greenhouse was supported by Sollio Groupe Coopératif (formerly Co-op fédérée), a large agricultural cooperative network in Quebec that saw Lufa Farms as a major ally. This partnership has strengthened the ties between Lufa Farms and agricultural producers located near Montreal.

The main goals of Lufa’s creators are to increase the food autonomy of the city and to contribute to the improvement of the food distribution chain by bringing food production closer to the consumer. These goals are intended to address the dramatic growth (demographic and spatial) of cities and the attendant ever-increasing need for food products. The creators of the company also aim to offer an option in the face of the disappearance of farmland due to urbanization. In addition, by bringing food production closer to consumers,

the company reduces the number of food miles traveled, thereby reducing the amount of energy required to distribute food products. In the beginning, the company only supplied consumers with products from its agricultural greenhouses. Today, Lufa's list of partners includes approximately 200 agricultural and food processing businesses, the majority of which are located on the island of Montreal or within a 25 km radius.

At Lufa, marketing is conducted exclusively through baskets. The distribution of products is divided into six steps, from the customer's registration to the reception of their basket. Subscription, orders and payment are all carried out online. The baskets are delivered to their respective pick-up points as soon as the order preparation is completed. The company's customers are referred to as "Lufavores," which promotes loyalty and a sense of belonging.

4. Cross Analysis: Le Grenier boréal and Lufa Farms at the Crossroads of Food Security and Ecological Transition

4.1. Contribution to Food Security

Le Grenier boréal contributes to the reduction in certain dimensions of food insecurity in Minganie, although it contributes, in particular, to the quality of the food, which is why the cooperative was created (Table 1). On the one hand, the cooperative's local production guarantees freshness, since it does not require traveling long distances for delivery or storage. On the other hand, the cooperative improves the diversity of the food offered. In addition to a better food quality, mobile food stands likewise contribute to food security, as they facilitate people's physical access to the fruits and vegetables produced. Indeed, in some places, the merchandise from the food stands was sold out in less than an hour [45].

Table 1. Contribution of Le Grenier boréal and Lufa Farms to food autonomy.

Themes	Le Grenier Boréal	Lufa Farms	Summary
Productive spaces	2 ha on abandoned military site in boreal forest space	2.8 ha on urban roofs	Agricultural use of non-conventional spaces for agriculture
Production chain	Collaborates with crab and scallop processing plants for compost production Algae harvested locally	Creation of a short food supply chain with a network of agricultural producers	Productive ecology perspective
Ecological production practices	Intensive organic farming practices, without certification Fertilization with local resources, greenhouses, tunnels, winter cover, windbreaks	Hydroponic greenhouse Use of an almost entirely organic management system (Lufa Farms is not certified organic, as the vegetables produced are not grown in the ground. However, the company, as with its partners, follows the same practices as organic farms for pest and disease control. See https://montreal.lufa.com/en/lufa-faq accessed on 23 August 2021) Heating of the greenhouses from solar energy and building losses[i]	Ecological methods
Distribution methods	Pre-determined base baskets Permanent and mobile food stands Local businesses Local distillery	Customized baskets Links with merchants for pick-up points	Promotes community-supported agriculture
Bringing production and consumption closer together	Food produced for the local population distributed in baskets and at food stands	Horticultural and other products delivered to the local population through pick-up points or home delivery	Promotes food autonomy
Challenges as a non-conventional location	Adapts to the climate with northern techniques and varieties	Ensures year-round production despite winter temperatures	Technological adaptation to climatic conditions and promotion of food autonomy

Table 1. Cont.

Themes	Le Grenier Boréal	Lufa Farms	Summary
Dimensions of food security to which the initiative contributes	Supply of fresh, locally grown fruits and vegetables Physical access through mobile food stands (launched in 2020)	Economic access for people in need through the direct donation program (launched in 2020) and 50% discount on fruits and vegetables from Lufa Physical access through pick-up points in areas underserved by fresh fruits and vegetables	Physical access to quality food products Contribution to food self-sufficiency
Challenges	Economic access Seasonality Expands production and production period Climate-adapted crops Decreases food miles	Access mainly for the middle class, to be expanded to vulnerable populations	Increases access and disseminates the model
Effect on environmental and climate protection	Promotes the productive use of waste Raises awareness of the virtues of organic production	Use of solar energy and decrease in food miles	Reduction in GHGs caused by distribution Decreases pollution caused by insecticides, herbicides and chemical fertilizers Promotes a cultural change in the population

Lufa Farms facilitates access to healthy food for a portion of the population, mainly young people or members of the middle classes who wish to have access to food produced according to ethical guidelines for social justice (fair trade, among others) and standards that guarantee respect for the environment. Thus, in terms of urban agriculture, Lufa is a pioneering, innovative and ecological company. Lufa's experience opens up various perspectives in the fight against food insecurity. Reclaiming space for year-round food production, bringing food products closer to consumers, establishing partnerships with local producers and saving energy used in production, processing, preservation and distribution are some of the avenues to pursue. In addition, Lufa and its partners are implementing short food supply chains, which promote local food systems and reduce the food miles required to make food accessible to consumers. Finally, Lufa's customer relationship model has a significant educational dimension.

Due to its prototypical nature, Lufa is a true laboratory for reflection, self-training, experimentation with new knowledge and collective learning. The vision of urban agriculture that Lufa cultivates has implications for the entire community. The production of food through a system of short food supply chains that allow for a circular economy integrating Lufa Farms and local producers builds bridges between the urban and the rural. The promotion of local products is recognized as a means of supporting local agriculture and a contribution to environmental protection due to the reduction in energy used for transportation. Its distribution system brings consumers closer to the producers of the food they consume, which promotes consumer awareness of food production. In this way, it responds to the concerns expressed by various specialists regarding the effects of the industrial and globalized food system regarding the origin of food and the conditions in which it is produced. As practiced by Lufa Farms, urban agriculture contributes to sustainable cities and shows a way to increase food self-sufficiency in cities.

4.2. Production Using Ecological Techniques

Lufa Farms uses a number of technologies for the construction of its greenhouses, the management of the company and the production of food. Firstly, it opts for biological management techniques for its production, recreating a balanced ecosystem of harmful and beneficial insects. Secondly, some greenhouses recover rainwater, which is then used in a closed circuit. Further, it applies various energy optimization techniques, including the recovery of heat loss from buildings located under the greenhouses. Finally, Lufa makes sure to reduce its waste by limiting its losses and by composting its green waste. While

Le Grenier boréal, for its part, was pest-free for the first few years of operation, this is no longer the case. Additionally, the enterprise uses natural products, in keeping with the principles of organic agriculture.

4.3. Local Marketing

Both Le Grenier boréal and Lufa Farms demonstrate the social and ecological value of community-supported agriculture. Le Grenier boréal distributes a significant share of its production through baskets, the contents of which are determined based on the products in season. For Lufa Farms, the entire production is marketed through baskets that are distributed mainly through pick-up points located in local businesses throughout the city and delivered by electric vehicles. Thanks to the quantity and variety of food produced in its own greenhouses, or in other farms and processing companies in its network, Lufa Farms is able to offer “Lufavores” the option of customizing their baskets. Le Grenier boréal, for its part, does not limit its marketing to baskets, offering a self-service counter on the cooperative’s site and selling in selected local businesses. It also supplies a local company to produce a regional flavored gin. Finally, in 2020, it also began distributing its food via a mobile food stand [45].

4.4. Limitations of the Studied Cases

At present, however, both initiatives present some limitations. For instance, the production of Le Grenier boréal is not sufficient to meet demand, is seasonal and does not improve economic access to food by offering fruits and vegetables at a lower cost, although the cooperative strives to compete with supermarket prices. Still, the cases of La Clé des champs and Cultur’Innov, in the municipality of Saint-Camille, in the Eastern Townships (Quebec) [61], show that establishing gardens on land that is less suitable for growing vegetables is not an insurmountable obstacle. On the one hand, the improvement of a site (soil, redevelopment), the adoption of certain production techniques (greenhouses, varieties) and continuous learning on the part of the staff all increase productivity, at least in the first few years, as it can be observed at Le Grenier boréal. On the other hand, a community’s attachment and commitment to the enterprise can also help to compensate for certain weaknesses, for example, by facilitating the establishment of markets or food stands, as is the case for La Clé des champs in Saint-Camille [61,62], or by volunteering, in the case of Le Grenier boréal. Thus, if Le Grenier boréal maintains its present core strengths, it can be expected to overcome some of the challenges as it matures, at which point it may have more impact on other dimensions of food insecurity in Minganie.

Of course, because of the costs of production, but also because of the differences in food emergencies felt by different social strata, Lufa Farms does not contribute directly to the fight against food insecurity for the poorest. Indeed, its products are inaccessible to the poorest segments of society. That said, while food emergencies have not yet led the poorest to focus on a quest for organic food but rather to improving access to food at affordable costs, the fact remains that the needs of this part of the population in terms of health are not different from those of the better-off classes. A partnership with the public sector should be designed to make these types of products accessible to people with low incomes who are likewise seeking access to quality products.

5. Discussion

Even though Le Grenier boréal and Lufa Farms are very different experiences, particularly in terms of their scope, the quantity of food produced and, therefore, the number of consumers served, the two cases have certain points in common and show the importance of promoting agricultural production models that contribute to bringing the sites of production and consumption closer together. Proximity agriculture promotes an awareness of the issues involved in food production, issues that are invisible to the dominant model. These issues concern, in particular, the link between food production and the geographical characteristics of places. It implements a change of scale insofar as the large-scale industry

that dominates the global food system, driven by big capital, large companies and major distributors, is replaced by models implemented by small collective or socially oriented enterprises that make it possible for consumers to participate in production choices. This also serves to strengthen links with local communities. Our study of the two cases reveals the main analysis criteria, allowing for a better understanding of this model.

The two experiments operate on the periphery of the conventional agricultural system. On the one hand, the environments in which they are located (urban and northern environments) are not considered *a priori* as agricultural environments. While cities do have gardens and small developments producing some fruits and vegetables, Lufa Farms has launched a model that has no equal in Canada. This model could help reduce the dependence of large cities on the currently dominant extractivist food system. Le Grenier boréal, for its part, is located in a region that has had very little market garden production to date due to climatic and soil limitations. Its objective is also to reduce the double dependence of a remote region on extractivist production and on distribution centers located in large cities.

On the other hand, the areas they occupy—roofs in the case of Lufa, and, in the case of Le Grenier boréal, a boreal forest wasteland with soil that is very sandy and acidic and contains very little organic matter—are not known for their agronomic quality. However, the implementation of adapted and even innovative means of production has made it possible to overcome, at least partially, these limitations. Lufa Farms has opted for hydroponic greenhouse farming, which means that the company does not need land, and for a partnership approach with local agricultural producers while adopting an environmentally friendly distribution system (electric vehicles, for example).

Le Grenier boréal is also taking a partnership approach to productive ecology insofar as it fertilizes its gardens with residues from the fishing processing plant located in the municipality, thereby improving soil fertility. However, poor soil has remained a limiting factor for the cooperative, and in 2020, a portion of the fields was amended with green manure. While agricultural enterprises in the southern part of the province generally opt for manure spreading, this is not really an option for Le Grenier boréal, as there is no livestock in Côte-Nord. The manure would have to be trucked in over several hundred kilometers, which would be very expensive and would contribute to GHG emissions. To avoid this, other local resources such as branch residues and algae are also used [25]. In order to extend the season, Le Grenier Boréal has greenhouses and uses plastic tunnels. In addition, the cooperative makes a point of choosing its plant varieties so that they are well adapted to the northern climate [16]. The cooperative has also expressed an interest in collaborating with other crab and shellfish producers in the region and reusing their waste products, which would allow reducing the dependence on fertilizers from outside the region from an industrial ecology perspective.

In a context where the global food system is increasingly under pressure due to sudden crises and gradual but major transformations, such as those induced by climate change, there is a need to build more resilient food systems to ensure food security [63]. To do this, it is important to recognize and promote the diversity of production models [64]. Diversification improves the robustness of the system, in that it increases the chances that some links in the chain can take over if another link is weakened [65]. This diversification concerns production practices, the varieties used or the actors involved; yet, it also concerns, in our opinion, the sites and environments of production. Le Grenier boréal and Lufa are investing in sites and environments where agricultural production is little, if not very little, present, thus providing new possibilities for agricultural production.

Efforts must also be made to improve the food autonomy of territories [65]. This must, on the one hand, enable consumers to obtain supplies locally, as is the case for a part of the population of both the Les Grenier boréal and Lufa communities. On the other hand, the development of greater territorial autonomy must allow businesses to obtain the inputs they need locally (which is what Lufa is able to do to a large extent, and what Le Grenier boréal seeks to achieve by valorizing local resources).

Thus, in recent years, the development of agricultural initiatives of various sizes, both individual and collective, has led to the removal of local regulatory barriers that prohibited food production in some areas (in some Quebec municipalities, front yard gardens have recently been permitted; in others, greenhouses are now permitted in industrial zones). In addition, in 2021, the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ, Quebec, QC, Canada) launched a program to support the implementation of local food community development plans. These plans seek to promote "greater food autonomy and better resilience in the face of numerous challenges, including climate change" [66]. All this shows a progressive change in the understanding of the relationship between citizens and food production and testifies to the transformation of certain public policies.

Thus, while the cases studied have interesting impacts, although limited for the moment, in terms of both the food diversification and food autonomy of territories, they contribute to improving the resilience of the system, and, above all, they show possibilities. In this sense, they are beacons in their respective contexts and inspire other initiatives and projects implemented by local communities in their wake.

6. Conclusions

Climate change will gradually reduce the production capacity of many spaces. In order to maintain or even improve production levels, diversification of production environments is necessary, including the cultivation of traditionally non-productive areas. It is therefore important to diversify production systems and, above all, to integrate them in local processes where producers and consumers interact—which is essentially what Le Grenier boréal and Lufa Farms have been doing.

Climate change is accelerating. Let us recall that at the end of spring 2021, the media reported that early heat followed by late frosts had heavily impacted French viticulture and arboriculture [67]; that Australia was experiencing an invasion of mice that devoured crops, due to the years of drought that allowed them to proliferate [68]; that North Korea was in a "tense food situation" following typhoons and floods, occurring in 2020, that reduced domestic grain production [69]; and that the Western United States, including California, North America's vegetable garden, had entered a vicious cycle of drought, aridity and record high temperatures [70]. In Canada, in late June and early July 2021, the western provinces experienced the highest temperatures ever recorded in the country's history, breaking several records, especially in the Lytton area, where the temperature exceeded 49.6 degrees Celsius [71]. While some people such as the president of Brazil consider these extreme events to be deviations from the norm, which brings them to endorse the extractivist model, other people affirm that these events are part of a long-term trend and that the worst is yet to come, as stated in the IPCC report of 2021 [72]. These events are part of a context of globalized capitalism in which the food industry seeks to increase its profitability, which causes deterioration in product quality, leads to environmental degradation, especially due to transportation and the use of heavy machinery, and contributes to food insecurity.

The analysis of local initiatives aimed at food security points to ways of rethinking the relationship between food production, food consumption and a societal and ecological transition. Alternative models of action oriented toward social innovation are being implemented [3] and contribute to adaptation to climate change. We would do well to learn more about these models, especially in the context of a post-pandemic economic recovery, which many actors believe must be greener. For many, food is an area that calls on us to innovate in order to build a post-pandemic world that is more just and equitable and more respectful of nature [73,74]. In this perspective, the transformations to be made to food systems must have a strong territorial basis in relation to living environments [75] and must be conceived within a broad framework that implies a paradigm shift [76] in order to reduce dependence on inter-territorial imports. The cases of Le Grenier boréal and Lufa Farms point in this direction.

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