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Food System Scenarios in Uncertain Futures: A Case Study on Long-Term Local Food System Planning in Revelstoke, Canada

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Abstract: Scenario planning is a potentially effective method for supporting long-term planning for sustainable and resilient food systems; however, scenario exercises are often limited by too much focus on a single preferred future, not accounting for uncertainty in global trajectories and future conditions. This study engaged local food system actors in Revelstoke (Canada) in a workshop that explored a qualitative, scenario-based approach to long-term food systems planning in the face of uncertain futures. The study involved applying different global narratives to identify future local scenario alternatives that respond to the socioeconomic, environmental, and political pressures in these narratives. This study identifies two trajectories and sets of possible future conditions (i.e., Scenario 1 and Scenario 2) that differ from one another in the following areas: (1) health and wellbeing, (2) connectivity and scale, (3) human–environment interactions, and (4) economies and the nature of work. Additionally, the strengths and weaknesses of the qualitative scenario method developed and used in this study were identified, including considerations related to the application of the method, participant selection, the nature of the data, and the assessment (or lack thereof) of the likelihoods of future events. The insights from such a scenario-planning approach can be used to stimulate thinking about what actions and interventions are useful for making progress toward local wellbeing, sustainability, and resilience in the face of global challenges and exogenous shocks.

Keywords: local food systems; scenarios; integrated food system planning; climate change; food security

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1. Introduction

Food systems are complex, consisting of interconnected processes from food production to access to consumption that affect, and are affected by, social, cultural, political, economic, and environmental factors [1]. The concept draws from general systems theory, which involves understanding multiple interacting and interconnected factors as a "whole" [2]. Using this systemic lens, researchers and scholars recommend that communities and regions engage in integrated approaches to food systems planning and policy [3,4]. Researchers also argue that long-term planning (i.e., comprehensive multidimensional approaches that seek to navigate uncertainties and align present actions with future goals) is important for communities to define the directions and pathways for local development in ways that make progress toward sustainability and resilience [5,6]. However, long-term integrated food systems planning and governance are challenging tasks for communities because local food systems are impacted by global conditions that are outside of local control, such as climate change or conflict, which creates great uncertainty with respect

to the types of actions and interventions that are needed to build resilience. Additionally, important questions exist about the ability of local planning systems to govern the current and future configurations of inherently complex socio-ecological systems (e.g., [7]). It is critical for communities to engage in long-term planning that recognizes uncertainty [8,9] and how the plurality and unknowability of global futures affect local food systems and (broadly) sustainability in different ways.

Scenario planning has been identified as a potentially effective method for long-term planning, as it allows for communities to explore and examine the implications of different interventions and/or exogenous shocks [10]. Scenario exercises can be performed through multiple methods, such as focusing on issues, as demonstrated in Tian et al.'s [11] study on the potential effects of climate change scenarios on future irrigation water use in the agricultural sector of the Zhangye region in China. This type of work can produce insights into how to prepare for and adapt to impacts and change. Scenario planning can also involve exploring development options or strategies, such as in McDougall et al.'s [12] study on the effects of urban agriculture development on the local food supply in Sydney, Australia.

Along with approaches for defining scenarios, the analysis of scenarios can be performed using multiple techniques. These include quantitative analyses, where scenario outcomes are presented using metrics and indicators, as is demonstrated in Tong et al.'s. [13] study on different scenarios for increasing urban agriculture to address food desert issues in Tucson, Arizona, a community located in a semi-arid region. Scenario analysis also can involve a qualitative approach, such as in McGreevy et al.'s [14] exploration of different food strategies and policies in Kyoto, Japan. Additionally, research that employs mixed methods, both qualitative and quantitative, may have the potential to address the challenges and limitations of using these methods in isolation. As Vliet et al. [15] note, there remains a significant knowledge gap in frameworks that bridge the divide between narrative-driven scenarios and quantitative modeling.

Although scenario planning is useful for long-term planning, many scenario exercises are often limited by too much focus on identifying a single preferred future, whereas uncertainty demands explorations of multiple possibilities and futures [16]. Scenario planning (and scenario-based research conducted to support planning) thus needs to engage and account for uncertainty, and this can be performed in multiple ways. In quantitative analyses, uncertainty in scenarios can be captured using techniques such as estimating confidence intervals and identifying ranges within which analytical outputs may lie [17]. Such an approach is common, and it has been employed in a number of agri-food-related studies, such as Riahi et al.'s [18] study on global agricultural land-use changes under different climate change and socioeconomic conditions scenarios. Other analytical approaches involve qualitative methods, such as Wonsak et al.'s [19] research in the field of production planning, which articulates ways of identifying sources and implications of uncertainties and risks.

As noted above, approaches to addressing and accounting for uncertainty have long been used and are commonplace in quantitative analyses (e.g., confidence intervals); however, approaches for accounting for uncertainty are not as well developed in qualitative studies. As Reilly and Willenbockel [20] note, the complexities of food systems and the challenges of managing uncertainty using scenario analysis indicate that qualitative methods often remain underutilized in comprehensive food system analyses. This represents a gap in planning research and practice; as Amer et al. [10] note, qualitative approaches to scenario planning and analysis are useful in cases where the scenarios are large in scope and have long-term horizons. Long-term integrated food systems planning represents these types of cases, as such planning involves far-future time horizons and a recognition of the multitude of the connections food systems form with social, cultural, environmen-

tal, political, and economic factors. For example, long-term food systems planning must consider how the development of local food assets contributes to (or detracts from) a sense of community [21], plant–pollinator relationships [22], and green infrastructure for stormwater management [23], while also recognizing how the need for, and impact of, these contributions are affected by global trends and exogenous shocks.

This study explores approaches for long-term food systems planning in ways that account for and respond to uncertainty around global trends, external pressures, and exogenous shocks. This research engages community members and food system actors in the municipality Revelstoke (BC, Canada) to explore possible local food system futures. This research involves presenting these stakeholders with a previously developed scenario that represents a just, sustainable, and resilient local food system in Revelstoke. This study is part of a larger research project, entitled the Reimagining Food Systems for a Sustainable and Equitable Future project (www.triaslab.ca/equitable-food-systems (accessed on 1 February 2024)), and the scenario presented to the stakeholders was developed in a previous study (see [24]). The aim of this work is to develop and experiment with a qualitative scenario-based approach for effectively addressing the nuances and complexities of long-term integrated planning in the face of uncertain futures.

2. Materials and Methods

2.1. Case Study

The case study for this research is the community of Revelstoke, which has a population of approximately 8300 people [25], and it is located in the Columbia Mountain range in the southeast of British Columbia, Canada (Figure 1). Due to its location, Revelstoke offers a plentitude of outdoor recreational opportunities, and tourism is a major part of the local economy, along with forestry and the rail-based transportation of goods [26]. Agriculture is not a major economic sector in Revelstoke, as most of the local arable land was flooded by the damming of the Columbia River. Agricultural capability mapping indicates that numerous parcels in the community could support small-scale backyard growing operations; however, these spaces are unsuitable for larger-scale farming [27].



Figure 1. Location of Revelstoke in the province of British Columbia, Canada. Data sources: Google, Landsat/Copernicus, SIO, NOAA, U.S. Navy, NGA, GEBCO, LDEO-Columbia, NSF, NOAA, and INEGI. Figure source: [24].

As with many communities across the world, Revelstoke is experiencing multiple food system issues, including food security challenges related to higher living costs, stagnant wages, and many residents working in the service sector. The Revelstoke Food Bank identified that food purchasing costs have nearly doubled since 2019 [28], while salaries and (in the case of food-related businesses) revenues have not kept pace with these increases. These challenges are significant; however, the political will and community support for improving the sustainability, resilience, and equity of local food systems is strong in Revelstoke. A Revelstoke Food Security Strategy was developed in 2014 through a collaboration between the local government and a non-governmental organization, Community Connections Revelstoke Society, and it was updated in 2023. The strategy involves an integrated perspective, as it is based on a recognition of the relationships among food security, climate change, and local economic development [27]. Because of its food systems challenges and the community's desire to address these challenges, Revelstoke serves as a valuable case study for this community-engaged research on scenario methods for supporting long-term integrated food system planning.

2.2. Background

This project builds on previous research detailed in [24,29], which engaged community members and food system actors in Revelstoke (BC, Canada), June 2023, to develop a series of scenarios that represent possible food futures in the community. Three scenarios were developed using workshop methods, which centered on approaches to addressing issues in the areas of food supply, food affordability, and food governance. The approaches to addressing these issues consist of, respectively, increasing farmers' control over food production, reducing/eliminating barriers to accessing food, and enacting the rights of nature via an ecocentric governance system.

An interactive visualization tool was developed using the Unity3D (v.2021) game engine, which consisted of virtual environments that allow for users to "walk through" and experience the three different food futures from a first-person perspective. The visualization development process involved the use of ArcGIS Pro (version 3.1.0) for ensuring spatial accuracy in the virtual environment and GIMP (2.10.34) for creating the images and textures that contribute to the visualization's realism and representation of place. The visualized scenarios centered on an abandoned railway site in Revelstoke, and users are able to explore four scenarios: a current conditions scenario (i.e., the current conditions at the time of the study in 2023), the empowered farmers scenario (i.e., food supply), the barrier-free food scenario (i.e., food affordability), and the ecocentric governance scenario (i.e., food governance). Objects and sounds were added to the virtual environments to represent these scenarios, as well as narrative components in the form of pop-up text boxes that provide further context and information about the scenarios. Figure 2 shows screenshots of the scenarios, and the visualization tool can be accessed online here: www.triaslab.ca/equitable-food-systems#visualization (accessed on 1 February 2024).

A stakeholder workshop held in February 2024 was organized and facilitated for Revelstoke community members and food system actors to engage with the scenarios and discuss their respective advantages and disadvantages. The workshop participants found the empowered farmers scenario to be undesirable due to how it depicts high degrees of corporate control over the food system, with some noting that the scenario elicited feelings of "despair". The participants also found issues with the ecocentric governance scenario, namely that it lacked elements related to public infrastructure and housing, and, as a consequence, it was difficult to comprehend how the community would operate and how community members would live in this scenario. The participants noted that, albeit not perfect, the barrier-free food scenario is more desirable than the empowered farmers

scenario and is more comprehensible/relatable than the ecocentric governance scenario. Accordingly, this scenario was selected for this study, and it was used as the basis for further exploration of how future food scenarios may vary in the face of uncertainty.



Figure 2. (**A**–**D**) Screenshots of the visualization scenarios. Source: [24]. (**A**) Screenshot of the Revelstoke Railway site under the current conditions (Year 2023). (**B**) Screenshot of the Revelstoke Railway site under the empowered farmers scenario (Year 2100). (**C**) Screenshot of the Revelstoke Railway site under the barrier-free food scenario (Year 2100). (**D**) Screenshot of the Revelstoke Railway site under the ecocentric governance scenario (Year 2100).

2.3. Workshops

The project used a community-engaged research approach [30] and it employed workshop methods, such as those performed in other community-engaged research on community planning and local sustainability issues (e.g., [31,32]). A 2.5 h workshop was held in May 2024 involving 10 participants from local government, non-governmental organizations, Indigenous organizations, and academia (Table 1), which follows the small-sized focus group methods discussed by [33] that involve a small number of participants with specialized knowledge and experience related to a particular topic. The workshop was conducted online using Zoom (v. 5.14.5) and it involved a series of activities supported by Padlet-based online posting boards (see below). The number of participants and the length of time of the workshop proved to be adequate for this research, as participants felt they had reached saturation in that time. The study involved human participants (i.e., the Revelstoke community members and stakeholders); thus, it was reviewed and approved by the Royal Roads University's Research Ethics Board. Prior to the workshop, participants were provided with a letter of informed consent to read and sign.

Table 1. Sectoral affiliations of workshop participants.

Sectoral Affiliation	Participants (n)
Food-related non-governmental organization	2
Social and community development non-governmental organization	4
Regional government (health authority)	1
Indigenous organization	2
Academia	1

The aim of the workshop was to qualitatively explore, with local community members and food system actors, potential variations in the barrier-free food scenario (hereafter referred to as the "baseline scenario") based on uncertainty in future global conditions. The workshop was conducted using a systems lens, meaning that the workshop activities facilitated a comprehensive exploration of food systems in terms of being connected and related to a variety of social, cultural, political, economic, and environmental factors [1]. Therefore, although the baseline scenario was developed based on food affordability considerations, the qualitative scenario exercise captured a broader range of considerations beyond just the affordability and accessibility of food products.

The stakeholders explored variations in the baseline scenario by applying the Intergovernmental Panel on Climate Change's (IPCC) shared socioeconomic pathways (SSP) framework [34] to identify and explore local scenario alternatives that respond to socioeconomic, environmental, and political pressures and exogenous shocks. The SSP framework includes a series of five global narratives (i.e., SSP1, SSP2, SSP3, SSP4, and SSP5) that describe geopolitical, technological, economic, and social trajectories and future conditions across the planet. The narratives discuss how the different trajectories and conditions will result in varying degrees (i.e., high, medium, and low) of challenge with respect to implementing climate change adaptation and mitigation strategies and policies across the world. The workshop involved applying SSP1 ("sustainability: taking the green road") and SPP3 ("regional rivalry: rocky road") specifically, as these SSP scenarios represent the extremes of (respectively) low and high challenges to climate change adaptation and mitigation [18]. Their key features were summarized and presented to the workshop participants in a series of bullet points, and this information can be found in the Supplementary Materials (Table S1). Note that food is not specifically featured in the SSP narratives, aside from a mention of "food security" in the SSP3 narrative [18]; however, the SSP framework and narratives were deemed to be useful for this work, as they succinctly capture different

possibilities for global conditions with implications for local food systems, sustainability, and resilience.

The workshop began with a presentation on the background and purpose of the research and an overview of the workshop activities. The participants were then introduced to the baseline scenario using the visualization tool, which involved the workshop facilitators/researchers sharing their screen via Zoom and "walking through" the scenario visualization. Following the walkthrough, the participants were organized into two breakout groups, with one group exploring changes and variations in the baseline scenario under SSP1 conditions and the other group exploring the baseline scenario under SSP3 conditions. These activities led to the creation of two new scenarios, referred to here as Scenario 1 (i.e., SSP1 applied to the baseline scenario) and Scenario 2 (i.e., SSP3 applied to the baseline scenario).

Scenario 1 and Scenario 2 were explored and elaborated on by participants through three activities. The first activity involved participants considering and identifying the features of the scenarios and how these features may represent differences from the original baseline scenario. Participants were asked to first post their ideas about these features on a Padlet board and then discuss/elaborate on these ideas in a group discussion.

The second activity involved participants identifying potential outcomes for Scenario 1 or Scenario 2. To help focus their thoughts, a climate–biodiversity–health–justice framework was used in this activity. The framework was developed to support integrated planning and policy by stimulating thinking about how different strategies, actions, and policies may align or conflict with objectives and priorities in the critical sustainability areas of climate action, biodiversity conservation, community health, and social justice [35]. In this study, these four sustainability areas were written on the activity's respective Padlet board, and participants posted their ideas about the potential scenario outcomes based on the actions, progress, and/or challenges in these areas. They then elaborated on these ideas/posts via group discussions. As discussed in the Introduction section of this paper, food systems are highly complex and are connected to a variety of environmental, social, economic, political, and culture factors. Accordingly, the climate–biodiversity–health–justice framework served to scope the scenario exercise performed by the participants to prevent them from being overwhelmed by the extremely wide variety of topics and considerations that can be explored with respect to food systems and food futures.

The final activity involved participants identifying the events and interventions that may occur for Scenario 1 and Scenario 2 to come to fruition. The baseline scenario represents the potential conditions in Revelstoke in the year 2100 and, accordingly, the Padlet board for this activity was organized into three time periods: from 2025 to 2050, from 2050 to 2075, and from 2075 to 2100. Participants used the Padlet board to identify potential events and interventions that may occur in these different periods for the Scenario 1 or Scenario 2 future to occur, and, as performed in the other activities, they then discussed these ideas in further detail through group discussions.

For each of the activities, questions were presented to the participants to facilitate and guide their Padlet work and group discussions. The questions were listed above the Padlet boards by embedding both the questions and Padlet boards in a web page created for the workshop. The guiding questions are displayed in Table 2 alongside their respective activities.

2.4. Analysis

The data in this research consists of PDF exports from the Padlet boards and a Word document of the discussion transcripts from the breakout session, which was collected using Zoom's transcription feature. The analysis was performed using NVivo (v. 1.6.1),

and the data were organized into categories (via NVivo coding) as per their respective scenarios (Scenario 1, Scenario 2) and activities (scenario features, outcomes, and timeline). The analysis followed an open-coding, axial-coding, and selective-coding approach, as per Gibbs [36]. The open-coding work used an inductive approach to identify emergent themes in the data, and it was performed twice to ensure consistency in the coding. Following other studies. The code list was then refined to aggregate codes that have few references ($n < 5$) with other codes.

Table 2. Guiding questions for workshop activities and discussions.

Activity	Guiding Questions
Scenario features	• What features of the Food for All scenario in Revelstoke are changed/transformed by a world in the SSP1/SSP3 scenario? • What does SSP1/SSP3 say about demographics, urbanization, land uses, economic development, resources, institutions, welfare, and ecosystems?
Scenario outcomes	• What is the climate like in the Year 2100? Is it different across seasons? • How have people in Revelstoke adapted to climate change? How does the future address climate mitigation? • What do surrounding ecosystems look like? What about urban ones? • How has habitat been protected or regenerated? How are wildlife faring? • What are the states of health of different community members in 2100? • How is the physical and mental health of people? How does the food system contribute? • What parts of the scenario show inequities being addressed? • How is food insecurity addressed? How are unequal power relations addressed in food governance?
Scenario timelines	• What are the events, issues, and/or actions that are needed in each of the 25 year periods? How does the action build, grow, change over the 25 year periods to get to the Year 2100? • What should be avoided or prevented from happening? • Who has primary responsibility for implementation? Who are the partners/collaborators needed? • Who will benefit from the action? Who may be harmed by it? Who may resist it?

Axial coding was performed after the open-coding process. As explained by Gibbs [36], axial coding involves developing categories for and identifying relationships among themes/codes to identify a smaller set of (more comprehensive) themes that capture the main findings and insights that emerge from the data. These themes captured various aspects of the food systems futures that differed between Scenario 1 and Scenario 2 and deviated from the original baseline scenario. Finally, a selective coding process was conducted, which was based on the axial coding and was performed to identify coherent narratives for each of Scenario 1 and Scenario 2. Once these narratives were defined, a coding matrix was created that organized the data into scenarios (i.e., rows) and workshop activities (i.e., columns). The coded data that related to each cell in the matrix were examined in the context of the selective codes to identify how the Scenario 1 and Scenario 2 narratives differ with respect to the scenarios' features, outcomes, and timelines.

3. Results

The inductive coding process resulted in 25 codes, and the axial coding process identified four distinct themes. The themes produce using axial coding pertained to the following aspects of food futures: (1) the state of and relationships among healthcare, wellbeing, and food security, (2) the scale of governance systems and connectivity among people and

communities, (3) the interconnectedness among humans, ecosystems, and the physical environment, and (4) the nature of economies, labor, and work. These represent the areas of uncertainty and variation in the scenarios, and, as presented in Table 3, these areas can be concisely described as a series of factors, being, respectively, (1) health and wellbeing, (2) connectivity and scale, (3) human–environment interactions, and (4) economies and work.

Table 3. Summary of coding for each scenario.

Axial Codes	Scenario 1 Codes (n = References)	Scenario 2 Codes (n = References)
Healthcare and wellbeing	Culture (n = 10), Diets (n = 9), Food diversity (n = 6), Food security (n = 12), Health (n = 25), Inclusion and equity (n = 12)	Culture (n = 6), Diets (n = 5), Food diversity (n = 4), Food security (n = 6), Health (n = 6), Inclusion and equity (n = 2)
Connectivity and scale	Community connectivity (n = 12), Global connectivity (n = 16), Localization (n = 11), Policy and governance (n = 10), Population trends (n = 2), Technology and innovation (n = 2)	Community connectivity (n = 7), Global connectivity (n = 14), Localization (n = 22), Policy and governance (n = 13), Population trends (n = 5), Technology and innovation (n = 5)
Human-environment interactions	Ecosystems (n = 4), Education and knowledge (n = 7), Energy (n = 2), Environmental strategies (n = 2), Infrastructure (n = 4), Societal values (n = 7), Water resources (n = 7)	Ecosystems (n = 10), Education and knowledge (n = 8), Energy (n = 7), Environmental strategies (n = 8), Infrastructure (n = 11), Societal values (n = 6), Water resources (n = 5)
Economies and work	Changes in agriculture (n = 7), Basic needs (n = 2), Economic systems (n = 12), Extreme weather (n = 5), Human migration (n = 3), Labor (n = 6)	Changes in agriculture (n = 3), Basic needs (n = 13), Economic systems (n = 9), Extreme weather (n = 2), Human migration (n = 8), Labor (n = 9)

The selective coding process identified the key features and differences between Scenario 1 and Scenario 2. These differences and variations represent the uncertainty in the trajectory of the local food system in Revelstoke (and beyond) in that they demonstrate how food futures can vary dramatically in response to different global conditions (i.e., an SSP1 world or an SSP3 world). Scenario 1 can be described as depicting a community that is shaped by a societal shift toward cooperation, human and ecological wellbeing, and holistic approaches to sustainability challenges. Scenario 2 can be described as a community that is shaped by isolationism, the importance of meeting basic needs, and localization of systems. Table 4 provides a summary of each scenario, as per their features, outcomes, and timelines, and the sections below elaborate on these different aspects of the scenarios.

3.1. Scenario Features

3.1.1. Scenario 1 Features

Scenario 1 involves a change in societal values that supports a more efficient use of resources. Food systems and economies will not be as market-driven as observed in today's society, allowing for a reduction in food production that better matches demand with supply. Communities are still embedded in global markets; however, such markets would involve more cooperation and collaboration, which will change the nature of local food landscapes due to initiatives such as a global seed exchange. A potential loss of cultural foods may occur in the face of climate change and the sharing of seeds across borders, which may impact local food identity and perpetuate monocultural practices.

Table 4. Summary of scenario aspects and characteristics.

Aspect	Scenario 1	Scenario 2
Description	• The community is shaped by a societal shift toward cooperation, human and ecological wellbeing, and holistic approaches to sustainability challenges	• The community is shaped by isolationism, the importance of meeting basic needs, and localization of systems
Features	• The community has localized systems through the support of technological advancements in food and energy, while still being connected to global markets and cooperation • A global seed sharing system supports local food production, and the Revelstoke community members make deliberate efforts to preserve cultural foods and practices, recognizing their importance to health and wellbeing	• The community has localized their food systems and diets due to a lack of external investment and support, and the economic development and quality of education are low • An isolationist approach guides local development, and the community focuses on meeting the basic needs of its current citizens, while making efforts to prevent others from entering and settling in Revelstoke (e.g., establishing physical barriers)
Outcomes	• The community implements a system of preventative healthcare, involving producing nutrient-dense foods, improving recreation opportunities, and reducing social isolationism • Societal values shift from consumerism to wellbeing, improving the local volunteer pool and quality of leisure and travel • Community members adapt to climate change, including understanding how to live with wildfires and how to produce food in new climatic conditions	• The community has lower access to medical resources and professionals, which impacts health and reduces lifespans; however, health benefits from improved social connectivity • Urban and rural dwellers have moved to Revelstoke due to it being an appropriate size to provide access to resources, community, and infrastructure • Food production adapts to a changed climate, and the Revelstoke dam is demolished to open new growing spaces
Timelines	• The community progressively moves toward a holistic system of healthcare, which is supported by increases and expansions in the local food production system • Revelstoke exists and participates in a global system that coordinates sustainability action and initiatives • Water sharing infrastructure and systems are implemented and normalized by 2100	• The community shifts toward a localization of systems (e.g., food, energy, manufacturing) at neighborhood scales • The localization of production leads to cultural and ceremonial practices • Those with practical skills are highly valued, and desired leadership qualities and education shift from knowledge-based to skills-based

Technological innovation will allow for localized systems, such as decentralized energy generation and controlled environment agriculture (CEA). Such innovation will be driven/supported by global connectivity and sharing of ideas across borders. There will be an increase in local renewable energy infrastructure, which includes solar and wind installations to power farms, kitchens, and food storage facilities. Different types of foods (i.e., different from what is seen in the baseline scenario) will be grown due to climate change and technological capabilities, and these will be consumed locally and sold on international markets. Automated systems would change the nature and types of jobs (i.e., people are not needed in food labor positions). In addition, Scenario 1 involves high degrees of inter-community collaboration and coordination, and, accordingly, new infrastructure and systems will be built to share water among communities and across borders.

Revelstoke will engage in efforts to promote and encourage the use of CEA and microclimate management practices for diversifying local food production and preserving the production of cultural foods. Although technology allows for automated growing, manual growing practices remain to support local community health and wellbeing objectives, with inter- and intra-community collaboration enabling teaching and education about traditional food and farming practices. Such practices are part of a greater preventative healthcare approach, which includes promoting foods that reduce health issues and organizing food-related community events that improve mental and physical health.

Housing demand will decrease due to lower populations, and this opens more space and opportunities for growing food. Housing will now be affordable, and there will be lower socioeconomic inequality, which will improve people's access to nutritious food. Social support programs will be established around food and housing at the local level in Revelstoke.

3.1.2. Scenario 2 Features

Scenario 2 involves high place-based collaboration due to a lack of international engagement and connectivity. Food systems (along with housing, water, etc., systems) will be shaped and defined by a basic need for survival, and a lack of externally driven economic development will shift local development interests to those related to meeting basic needs rather than attracting investment. Such systems will be supported by local cooperative networks, which will form out of necessity.

Low international trade leads to a need for localizing food economies. Local food system development will occur in the absence of strong national and international direction, and this development will include policies that control food prices and corporate profits to ensure a reliable local supply. Diets will change to be much more localized (e.g., 100-mile diet), and Revelstoke community members will have a lower abundance/excess of food choices due to reduced imports.

Limited investment in the community will result in low economic and infrastructure development. Fewer people will be traveling and spending money through activities like tourism, which will change the nature of the local tourism industry and landscape in Revelstoke (i.e., outdoor recreation). In addition, climate change will significantly reduce (or eliminates) the ski season, and there will be a lower availability of transient labor to support seasonal industries. Such a lack of economic activity and infrastructure will have some benefits for ecosystems; however, these are offset by how the local food system will be developed with a general lack of environmental concern due to an anthropocentric focus on the survival of Revelstoke's community members. Additionally, a decline in community investment will result in a decline in education, thus reducing spaces and opportunities for discussing philosophical topics such as food access being a human right and social responsibility.

Climate refugees still exist in the Scenario 2 future, even though there is little in the way of international agreements and rules for migration. Such a situation will lead to conflict, including cross-border conflicts for water resources. Along with worsening natural disasters due to climate change, the conflicts will provide justification for further isolation, localization of the economy, and the development of barriers to prevent new people from moving into the community. As a result, Revelstoke will have a reduced (and lower-diversity) workforce and diminished quality of education.

3.2. Scenario Outcomes

3.2.1. Scenario 1 Outcomes

The Scenario 1 pathway results in a healthcare system centered on preventative measures, such as producing nutrient-dense foods and designing communities for outdoor recreation. The definition of healthcare in Revelstoke (and beyond) is holistic in nature, involving mental, physical, and inclusivity considerations, and there is equal access to healthcare for all community members. The community implements actions to address social isolation issues and improve the sense of community, such as farmers' markets, communal meals, and gardening programs for people of older generations. Technological advancements in medical sciences increase lifespans; thus, the elderly are a large demographic in the community, making programs that reduce their isolation (e.g., farmers' markets and communal meals) and support active living (e.g., gardening programs) particularly important.

A societal shift in values will change the local economic focus from material goods and consumption toward volunteering and leisure activities. The volunteerism sector (and volunteer pool) will increase, which will improve community connections and (as a result) the sense of community. The focus on leisure activities includes travel, which improves access to education, other cultures, and diversity of ideas. Travel supports global connectivity and empathy, and new technologies are developed to improve the environmental sustainability of travel (i.e., current travel methods are carbon-intensive).

In Scenario 1, humans have learned to live with their new climate reality. The community of Revelstoke has a strong understanding about how wildfires contribute to forest health, and people learn to live with wildfires and appreciate their regenerative effects. Longer growing seasons improve food production and economies, while producers find ways (including CEA) to contend with new challenges, such as novel pests, increased drought, and wildfires. Additionally, carbon sequestration strategies (technological and natural) will be implemented throughout the community, and societal values for ecosystems will reduce the need for boundary-defined parks and protected areas, with undisturbed (or low-disturbance) natural spaces found throughout and around Revelstoke.

3.2.2. Scenario 2 Outcomes

In Scenario 2, reduced access to medical resources and professionals will contribute to lower lifespans (i.e., the community would consist of younger demographics). Isolationism and reduced quality of education will result in a loss of educated workers, which will impact the health and technology sectors. Additionally, a decrease in investment in the community will result in a decrease in medical resources and infrastructure.

Community members will need to survive on the local resources available, which will improve local community connectivity and (albeit not intentional) was suggested by participants to possibly increase socioeconomic equity due to how the general lack of outside investment in the community "levels the playing field" with respect to large corporations and economic power. Additionally, participants identified how reductions in global connectivity and technological advancement may result in a widespread decrease in the use of online technologies such as social media. Participants noted that such a trend may improve mental health and wellbeing, as a reduction in the consumption of digital media may drive people to primarily interact in real life and (thus) decrease rates of anxiety and depression.

A reduction in international and inter-community connectivity will result in a decline in the urban centers that rely on rural resources. Self-sufficiency is challenging in an urban center; thus, urban populations will migrate toward resource-rich areas. At the same time, people will migrate out of isolated, primarily natural areas due to low governmental invest-

ment in rural, unincorporated areas and a need for access to a community to survive. These migratory patterns will position smaller communities such as Revelstoke as desirable places to settle due to the provision of access to natural resources, community, and infrastructure. The migration from rural areas will allow for rewilding in these spaces, providing benefits for biodiversity and ecosystems; however, resource extraction still occurs at high rates, particularly with an urban diaspora moved into Revelstoke. Additionally, biodiversity will have been lost due to rapid climate change, with new ecosystems and biodiversity being adapted to the change in climate in place by 2100.

A reduction in international trade will localize the food economy; however, this will involve a regional economy (such as Revelstoke trading with the neighboring Okanagan region). The change in climate may reduce the ability for Revelstoke to produce diverse food crops (particularly in the south of the community), which will result in the community producing warm-weather crops (e.g., wine grapes) and developing CEA facilities. In addition, low global connectivity reduces the need to produce electricity via the Revelstoke dam, which will allow for the demolition of the dam to increase space for food production (this is what the land was used for prior to the area being dammed and flooded).

3.3. Scenario Timelines

3.3.1. Scenario 1 Timelines

From the current year to 2100, the community of Revelstoke will move toward a holistic system of healthcare that involves community connections, food production, and cooperation among different organizations and a variety of different types of healthcare actors/practitioners. This progress is facilitated by a shift from focusing on health infrastructure development to developing new networks of diverse health actors and practitioners. The healthcare system will (eventually) be supported by a thriving local food system, with local food production increasing to 10% by 2050, 30% by 2075, and 60–75% by 2100. Such increases in production are made possible through strategies such as healthy food subsidies and education programs that inform people about healthy diets (with culturally appropriate materials and information in these programs). In addition, significant funding is invested into research on healthy gut microbiomes by 2050, and nutritional research is no longer funded by major food corporations.

A global coordinating governmental body has been formed to support and coordinate sustainability initiatives. The governing body begins as a two-generation council (in the 2050–2075 timeframe), and it will become a seven-generation council by 2100. Local governments and organizations (including in Revelstoke) are given provincial and federal funding to align/work with this global system, and a bottom-up approach to governance is supported. Under this new system, innovation and technology are developed for global benefits rather than primarily for profit, and these are shared widely. Additionally, the global climate crisis increases migration, which leads to local multiculturalism, and such multiculturalism is fostered/supported through diversity education programs and societal shifts away from discrimination, inequities, and colonialism. Leadership accordingly increases in diversity and representation.

Water scarcity prompts new systems and regulations for efficient and shared water usage. The regulations result in efficient water use in industrial, commercial, and residential buildings by 2050. Inter-community water-sharing infrastructure is built by 2075, and water sharing systems will be socio-culturally normalized by 2100. In addition, water supply to ecosystems will be prioritized by the mid-century to ensure that Revelstoke is situated in and supported by a healthy environment.

A shift will occur in economic systems over the next 75 years, moving from a consumption focus to a wellbeing focus. Along with this shift, agricultural practices will change

from mass production to pro-biodiversity approaches. Labor seasonality decreases due to longer growing seasons and the establishment of CEA facilities, and, as a result, transient labor decreases. Funding initiatives will be established by 2050 to enable food production capacity in (new) climate-appropriate areas, which will bolster local food production systems in Revelstoke and contribute to economic diversity.

3.3.2. Scenario 2 Timelines

A withdrawal of higher levels of government in terms of their engagement and responsibility to communities in the 2025–2050 timeframe will lead to a loss of the temporary workers program, which will result in a decline (or elimination) of service industries and decreases in local/regional agricultural production. In response, Revelstoke will establish seed preservation programs and build large-scale community gardens by 2050. Access to diverse varieties of foods will ultimately decrease; however, the increased reliance on local production will increase cultural and ceremonial processes around food production. Such increases in cultural/ceremonial practices will occur during the 2050–2075 timeframe or later, as the earlier timeframe(s) primarily focus on survival.

A local artisanal economy will emerge by the end of the century, and it will be based on self-sufficiency and needs (i.e., rather than commodity). Relatedly, knowledge-based skills and industries will decrease in value, and trades and practical skills will increase in value. Those with practical skills will be elevated in status above those in knowledge-based positions/roles, and a shift in leadership toward community-oriented governance will occur, with leaders being selected based on survival skills and knowledge. Knowledge keepers that can guide people in the creation of furniture and tools will be highly valued, and education systems will focus on practical skills and trades. The healthcare system will also rely on knowledge keepers, and it will shift toward a smaller-scale system with a variety of practitioners such as midwives.

Local governance and planning will focus on self-sufficiency, and systems (e.g., food, energy, etc.) will eventually be developed at neighborhood scales. Such development can happen in different ways; for instance, energy systems can be developed at the household level by 2050 and at the neighborhood scale by 2100. In addition, the localizations of different systems will be connected; for example, the dam will be dismantled in the 2075–2100 timeframe due to a widespread localization of energy systems, which will result in new land to be used/left for other purposes (e.g., agriculture and food systems). Regions will be self-sufficient by 2100, which includes the bespoke artisanal crafting system/community that develops furniture, tools, etc., and the localization of these systems will enable a circular economy.

3.4. Reflections

This study developed and experimented with a qualitative scenario method for generating insights that can be used to support long-term integrated planning in the face of uncertain futures. This section reflects on the outcomes of the experiment to identify the strengths and weaknesses (or areas for further development) of the method. The section discusses these strengths and weaknesses with respect to considerations related to the application of the method, participants, data, and likelihood of the scenario outcomes.

3.4.1. Application

The qualitative scenario exercise was conducted in the context of only one community; thus, this study generated insights that are primarily relevant to this particular case study's community. However, the method was found to be straightforward to apply and could be easily adapted to other communities and contexts. Sufficient data were collected in a relatively short (i.e., 2.5 h) workshop to effectively identify a wide range of aspects that may

vary in future scenarios under different global conditions, as well as the ways in which these aspects vary. The method was well-suited for convenient online engagement, while also having the potential for being replicated in an in-person setting by using (for example) flipcharts instead of Padlet boards and breakout tables instead of virtual breakout rooms. Overall, the flexibility and ease of application are deemed to be strengths of this method, and the qualitative scenario exercise can be performed in multiple formats (i.e., in-person or online) and without a burdensome time commitment from the participants.

3.4.2. Participants

The qualitative scenario exercise produced rich and nuanced insights about potential future scenarios in Revelstoke, and these insights covered a wide range of factors and considerations. This being said, many of the insights appeared to specifically relate to the interests and expertise of the participants, indicating that the outputs of the method are dependent on the composition and affiliations of the participant sample. For example, healthcare and wellbeing were topics that appeared frequently in the data due to the participation of individuals who work in these fields. To some degree, the climate–biodiversity–health–justice framework used to focus the participants' thoughts and comments also could have contributed to the prevalence of healthcare and wellbeing comments in the data, as health is a component of the framework; however, the other framework components (i.e., climate, biodiversity, and justice) were not as heavily featured in the data. The qualitative scenario method used in this study is best suited for small groups of participants, as it involves participatory workshop methods with breakout groups; therefore, it is important to consider who is represented in these small groups and/or whether there are opportunities to run multiple sessions to increase the participant sample size.

3.4.3. Data

The qualitative scenario exercise produced rich data that covered a wide range of considerations related to food systems and the future of Revelstoke. The data's richness was useful for gaining comprehensive insights about the future trajectories of Revelstoke under different global conditions and trends, and these are valuable insights for understanding and addressing the complexities involved in long-term sustainability planning. However, the wide range of topics and considerations in the data can also create challenges for planners and scenario analysts, as it can create difficulties for identifying the key actionable insights from the data that can be used for developing plans and policies. To some degree, the use of the climate–biodiversity–health–justice framework served to focus the data collection, and thematic coding methods were applied to the data to identify key insights and areas of uncertainty from the rich data. This being said, the data and thematic analysis outputs still covered a wide range of topics. This study comprehensively included all the data in the analysis as to not make decisions about excluding particular participant comments and ideas; however, future research could center the analysis on a particular selection of the data (such as just data related to food production), as this would focus the outputs and insights produced from the scenario exercise.

3.4.4. Likelihood

The qualitative scenario exercise conducted in this study produced outputs that comprehensively describe the potential futures of Revelstoke, which may occur in response to different global conditions and trajectories. The exercise was valuable for simulating thinking about the possibilities for how Revelstoke may develop and change in the context of exogenous shocks and trends that are outside of the community's control. However, although the exercise was effective for highlighting what is "possible", it did not necessarily identify what is "likely". Identifying the likelihood of particular events was beyond

the scope of this study, and it can be a challenging task in the case of complex analyses of far-future time frames. This being said, future research could add a likelihood component to this scenario method by (for example) asking workshop participants to qualitatively assess the likelihood of near-term events (e.g., from 2025 to 2050) and then identifying/highlighting the long-term outcomes of these events.

4. Discussion

This study developed and employed a qualitative approach to explore ways of accounting for uncertainty in long-term food systems planning. The approach involved examining a local food system scenario in the community of Revelstoke, Canada, and considering how it may change under varying global conditions, as defined by IPCC's [34] SSP framework. The analysis identified areas of uncertainty, and these include (1) health and wellbeing, (2) connectivity and scale, (3) human–environment interactions, and (4) economies and work. The research demonstrated how the future is uncertain, as varying global conditions (as per the SSP1 and SSP3 scenarios) can result in dramatically different local food system features and outcomes related to the aforementioned areas of uncertainty. The result of this work is the articulation of two food systems scenarios (i.e., Scenario 1 and Scenario 2) that represent significantly different, but both possible, futures for Revelstoke (and beyond).

The approach used in this research is similar to quantitative scenario modeling exercises that capture uncertainty through the use of numerical ranges, confidence intervals, and error terms (e.g., [11,18]) in that it examined uncertain futures in terms of a range from low to high extremes (i.e., low and high challenges to climate change mitigation and adaptation). However, unlike quantitative studies, the output of this research is not an interval for a continuous variable, and, instead, the qualitative approach resulted in the production of two new scenarios that capture variations and nuances in a number of factors, such as economic systems, governance, infrastructure, and others. As the types of outputs from quantitative and qualitative scenario exercises differ, the ways that these outputs can be used for decision-making and policy-making also differ. For instance, numerical ranges and intervals produced using quantitative exercises can provide insight into the likelihood that a particular strategy may be able to meet a particular target (e.g., achieving a certain level of local food production) or the range of potential impact that could occur due to disturbance (e.g., climate impacts on crop production). Accordingly, the results from a quantitative scenario analysis can be used to make decisions and policies that promote the implementation of a particular scenario (e.g., supporting the development of a certain type of food asset) or build resilience against a shock (e.g., reducing reliance on a local crop that could experience severe impacts). In contrast, the qualitative scenario approach results in a series of considerations for designing policies and actions, both in terms of key interventions and critical challenges. For example, this qualitative scenario exercise identified a role for CEA in multiple different food futures (i.e., Scenario 1 and Scenario 2), while also alluding to how potential challenges may exist for deploying CEA in scenarios that offer relatively few opportunities for technological development (i.e., Scenario 2).

Amer et al. [10] discuss how qualitative approaches to scenario planning can be useful when a planning time frame extends far into the future. As seen in this research, such qualitative approaches can result in rich information and a comprehensive picture of how communities may look and operate across different temporal scales from the near- to long-term. This being said, qualitative and quantitative approaches to scenario analyses each carry a distinct set of advantages and limitations, and no approach is inherently better than the other. For example, Tian et al.'s [11] research on projected changes in irrigation water use in China's Zhangye region due to climate change produced clear metrics on the potential scale of future water usage and demands, with error bars showing the low

and high values of these estimates. With such outputs, planners, policymakers, engineers, and industry players can work toward developing systems and innovations that meet the potential future irrigation demand. In contrast, the qualitative scenario exercise conducted in this study did not specify levels of future water usage and needs; instead, it identified possibilities on the types of systems that may develop in response to these needs, as well as the conditions under which such systems are possible. One of the features of Scenario 1 is inter-community water-sharing infrastructure, and the scenario exercise indicated that a water-sharing system using such infrastructure may be possible in an SSP1-based world where global cooperation and connectivity are high. Based on this information, government agencies, non-governmental organizations, and other stakeholders can begin discussions on how to develop such infrastructure, while also being mindful that the extensivity and effectiveness of the water-sharing system will be influenced by the degree to which the world leans toward an SSP1- or SSP3-based future.

Food systems are highly complex and are linked to a range of social, cultural, political, economic, and environmental issues and factors [1]. The findings from this study reflect this complexity, as the axial coding process revealed a series of themes that capture a variety of factors, including healthcare, governance, social-ecological systems, and economies. Such themes align with other studies that have drawn linkages between food systems and (for instance) political systems (e.g., [37]), ecological health (e.g., [23]), and economic development (e.g., [38]). The findings from this study demonstrate how long-term food systems planning necessitates integrated approaches to food systems planning and policy, as argued by other scholars (e.g., [3]), as well as how variations in future food systems have implications for a wide range of social, environmental, and economic issues and objectives. For example, the scenario planning exercise performed in this study identified how decreases in cross-border travel may impact the availability of transient labor, which consequently might reduce food production and (re)shape local food systems and economies.

The scenario exercise performed in this study identified how the global climate and socioeconomic conditions presented through the SSP scenarios may manifest locally, which, in many ways, resembles the quantitative process of downscaling (i.e., creating regional climate models from global climate models) [39]. In this case, the global narratives articulated in IPCC's SSP framework have local implications, and (like regional climate models) these "downscaled narratives" would differ from community to community, based on local geographical and place-based characteristics. The downscaled narratives are important for local governments and planners to understand what factors may affect the development of plans and policies for increasing resilience in the face of exogenous shocks and opportunities. For example, the degree of inter- and intra-community connectivity in the SSP scenarios influenced the features and outcomes of Scenario 1 and Scenario 2. In the former, global connectivity was high, which resulted in a world where travel and exchange of ideas and culture was possible and commonplace. As a result, Scenario 1 was envisioned as a scenario where technology, innovation, healthcare, and governance were thriving and supported through cooperation and collaboration. In contrast, Scenario 2 had low global connectivity, and this contributed to an insular community, with its governance, economy, and food systems centered on meeting basic needs and the survival of community members.

Although the features and outcomes of Scenario 1 and Scenario 2 differed in many ways, the exercise performed in this study also resulted in some commonalities among the scenarios. Such findings are particularly interesting in light of the fact that the scenarios were developed by two different breakout groups and in the context of dramatically different global conditions. An example of such commonalities includes how both Scenario 1 and Scenario 2 featured decentralized energy systems. The pathways and impetuses for developing these systems differed in that the Scenario 2 community developed these sys-

tems to meet energy security objectives whereas the Scenario 1 community developed these systems to achieve broader sustainability objectives. In many ways, this finding supports arguments by researchers and scholars that argue for identifying and articulating climate action co-benefits in planning processes to engage and meet the interests of diverse stakeholders in climate action efforts (e.g., [40]).

The exercise performed in this study is useful for identifying how a future scenario may look very different that initially envisioned due to conditions beyond a community's control. Such an exercise is useful in that it introduces nuance and complexity to scenario planning processes to support the long-term planning needs of communities. Often, scenario planning involves the development of a desirable scenario that communities wish to achieve [16], which aligns with visioning processes that involve a community articulating the key aspects of an "ideal future" they wish to see locally [41]. Visioning processes are useful for providing goals and direction for long-term planning [5]; however, they can also be problematic in that they do not adequately capture (and prepare) communities for a variety of external conditions and exogenous shocks that may affect and "derail" the pathways to these visions. For example, Scenario 2 presented a future where engagement from higher levels of government and global economies have greatly decreased in Revelstoke, resulting in low investment in the community and necessitating governance systems geared toward self-sufficiency. Insights such as these produced through this scenario exercise are important for planning for a plurality of futures, rather than rigidly adhering to a particular vision that may not be feasible under certain global conditions.

The insights produced using the scenario planning exercise can be applied by the local government and practitioners in Revelstoke in two ways. First, these insights can stimulate thinking about what the actions and strategies would be useful for making progress toward local wellbeing and sustainability. For example, Scenario 1 featured a healthcare system that took a holistic approach and focused on preventative health measures, such as encouraging exercise, reducing isolation of senior citizens, and promoting healthy diets. Accordingly, the community could begin investing in the infrastructure, education, and social programs to facilitate the development of such a system. Second, the scenario planning method can be used to identify interventions and adaptations for building resilience and mitigating the impacts of potential future challenges. For example, a participant in the Scenario 2 group noted that it would be worthwhile to invest in CEA in the near future, as Scenario 2 presents future challenges for conventional outdoor agriculture due to climate change, lack of trade, and labor availability.

This study has several limitations. First, the sample size was relatively small (n = 10), and although these participants represented a variety of roles and interests in Revelstoke's food system, the representation was not comprehensive. The outcomes of this scenario exercise may vary if it was run with a different set of stakeholders and expertise; for example, if the participants consisted of primarily private sector actors, the scenarios may have had a stronger focus on the roles of and changes to businesses in the different possible futures. Second, this scenario exercise did not assess whether certain features of the scenarios are more likely to occur than other features or aspects. Considerations around likelihood were avoided in this exercise, as it is difficult to assess what is likely to occur in a 75-year timeframe, and the aim of the exercise was to facilitate vision for a variety of possibilities for the future. However, planning exercises and/or future research that build on the outputs of this type of scenario exercise could involve assessing and making decisions on what is actionable, feasible, and likely to transpire in the near term. Finally, this research focused on a single case study, and although the methods can be applied to other communities, the results of this work specifically draw from the environmental, social, and economic contexts of the case study community.

5. Conclusions

This study develops and uses a qualitative approach to explore the future of local food systems in the face of uncertain global trajectories and conditions. The research experiments with a long-term scenario-planning approach which identifies how a particular food future may differ and vary under different socioeconomic pathways, as per IPCC's SSP framework. As demonstrated in this work, food systems are highly complex, and, accordingly, the nuances and variations in the scenarios capture a wide range of factors, including governance, community health and wellbeing, ecosystems, and local economies. For such reasons, this type of scenario exercise and research can be useful for integrated long-term food systems planning that recognizes the complexities of food systems and their relationships among a range of social, cultural, environmental, political, and economic factors [3]. Using such scenario planning approaches, communities can prepare themselves and be proactive in making progress toward sustainability and resilience in the face of unpredictable global dynamics and uncertain futures.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/agriculture15060611/s1, Table S1. Summaries of SSP1 and SSP3 scenarios presented to workshop participants.

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