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CELLULAR AGRICULTURE FUTURES:

A survey of public perceptions in the Lower Mainland, British Columbia

University of the Fraser Valley
Food and Agriculture Institute

Royal Roads University

The University of British Columbia

AUTHORS

Alesandros Glaros
Postdoctoral Fellow
Food and Agriculture Institute
University of the Fraser Valley

Robert Newell
Canada Research Chair in Climate Change, Biodiversity and Sustainability
School of Environment and Sustainability
Royal Roads University

Sarah-Louise Ruder
PhD Candidate, Institute for Resources, Environment and Sustainability
University of British Columbia
Researcher, Food and Agriculture Institute
University of the Fraser Valley

Jessica Mukiri
PhD Candidate, Institute for Resources, Environment and Sustainability
University of British Columbia

Stefania Pizzirani
Associate Director
Food and Agriculture Institute
University of the Fraser Valley

COLLABORATING INSTITUTIONS

Food and Agriculture Institute,
University of the Fraser Valley

Royal Roads University

University of British Columbia

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Executive Summary

Cellular agriculture refers to a suite of technologies to grow proteins indoors, with minimal (or no) use of live animals. This technology has much promise to contribute to food system sustainability, animal welfare, and resilience. A rich array of studies have examined consumer perceptions of cellular agriculture products across several communities, cultures, and nations. These studies have found that perceptions of and willingness to try cellular agriculture vary according to numerous demographic factors (e.g., age, gender, income), between cultures and religions, as well as occupation. Yet, to date, few studies have explored public perceptions of futures for cellular agriculture (i.e., their hopes and concerns for the impacts of this novel food production technology).

This report presents findings of a survey (n=504) delivered to residents in the Metro Vancouver region of British Columbia. The survey study examined demographic, dietary, and values-based factors that affect willingness to try cellular agriculture products, as well as public perceptions, hopes, and concerns around futures for the cellular agriculture industry in their home region. We build on previous research undertaken by the authors which developed a framework across which to assess futures for novel food technologies (see Glaros, 2023). Accordingly, the survey included question sets related to different futures or scenarios for the cellular agriculture industry (i.e. how accessible, integrated, or centralized the industry will be in the future). Responses to these questions, along with demographic characteristics, were compared to preferences for the industry and interest in the products (i.e., if respondents would like to see products widely available and industry integrated in their local region).

Our key findings were as follows:

Demographics

- There was moderate statistical evidence that those who identified as male were more willing to try and likely to buy cellular agriculture products regularly, compared to those who identified as female. Similarly, there was statistical evidence that those with a university education were more willing to try or buy cellular agriculture products compared to those with a college or non-university education.

- There was medium statistical evidence that those of South or South East Asian descent were more likely to buy cellular agriculture than those of European descent, as were those with a higher combined household income ($50,000-$100,000) than those with a lower combined income ($20,000-$50,000).

- There was some statistical evidence that those with special dietary considerations (e.g., vegetarian, vegan) were more likely to buy cellular agriculture products.

Futures for Cellular Agriculture

- We identified and tested two conceptual variables that we term “Reformist” and “Status Quo” scenarios for the future of cellular agriculture. Through further exploratory factor analysis techniques, we found that the Reformist scenario group factored into “Decentralized” scenarios for cellular agriculture (small-business-led and accessible for public or home use) and “Widely Available” scenarios (high positive contribution to food security and accessibility at stores). In contrast, the Status-Quo scenario group factored into “Centralized” scenarios (cellular agriculture run by few companies in urban areas) as well as “Closed” scenarios (minimal public or farmer participation in transition).

- Respondents had a statistically significant higher average for Concerns over Hopes, suggesting some trepidation about the emerging industry.

- There was high statistical evidence that Reformist scenarios were strongly associated with higher preferences for the cellular agriculture industry (that products would be available in grocery stores as well as developed and globally). This suggests that if the cellular agriculture industry is to develop, it ought to consider how to integrate public and farmer concerns (Widely Available Scenarios), and be implemented at more localized scales (Decentralized Scenarios). There was strong statistical evidence that Reformist scenarios were moderately correlated with environmental concerns, suggesting public stakeholders are optimistic for the potential of cellular agriculture to achieve its environmental promises.

From these results, we would suggest that frameworks to assess novel food technology scenarios ought to strongly consider futures ‘for whom’ – in this case, distinguishing between futures for the public and for farmers. While the scenario variables we explored here mapped fairly well onto the framework previously developed by the authorship team, this was not the case for all the framework’s dimensions, specifically the ‘integration’ dimension (i.e., the extent to which novel food technologies interface with conventional food systems). Despite the potential benefits of a ‘higher replacement’ for conventional agriculture through cellular agriculture, there is strong and evident public concern for the incorporation of farmer livelihoods in this transition.

1. Background

Cellular agriculture holds much promise to contribute to local food systems. Using an array of genomics technologies, tissue culturing techniques, and precision fermentation approaches, cellular agriculture can produce animal-based proteins with minimal (or no) use of actual living livestock or fish (Newman et al. 2023). The potential benefits of this emerging approach to food production are many, including reducing emissions related to livestock production, sparing land for possible biodiversity conservation, and minimizing pressure on wild fish stocks (Mattick, 2018; Rubio et al., 2020). Harnessing biological processes ex-situ to produce proteins fit for human consumption also has ethical benefits, bypassing major animal welfare concerns for industrial animal agriculture systems (Heliwell & Burton, 2021). As of January 2023, several national governments around the world have either developed regulations to govern cellular agriculture (United States), incentivized major research into its feasibility and implementation (Netherlands), or have permitted the production and sale of cellular agriculture products in stores (Singapore) (Smith, 2022). It is clear that cellular agriculture is not a speculative exercise in science fiction, but a technologically possible and probable contributor to food systems of the future (Post et al., 2020).

Despite its potential contributions to food systems and increasing regulatory acceptance around the world, the benefits of cellular agriculture are not guaranteed. Many scholars and experts caution against unfettered optimism for this new and exciting suite of technologies (see Guthman & Biltekoff, 2022; Heliwell & Burton, 2021). For example, the potential emissions and land sparing implications of cellular agriculture may not occur without supporting policies put in place. Appropriate policies and integrations are required that might include incentives and infrastructure for green energy adoption, developing localized cellular agriculture value chains, or safeguarding agricultural land taken out of production for biodiversity conservation (Lynch & Pierrehumbert, 2019; Newman et al., 2021).

In addition to environmental concerns, there are numerous social and economic questions prompted by cellular agriculture. For example, there is concern regarding the potential livelihood implications of these technologies for livestock farmers and agriculture workers, and increasing calls for a just transition that provides incentives and training for livelihoods outside conventional agriculture (e.g., Ruder et al., 2022). There are also socio-cultural barriers related to the acceptance of cellular agriculture products.

It is crucial to anticipate and understand the different ways that transitions to this novel food production method may play out in practice. Additionally, it is important to understand how the public, being stakeholders of the food system, may embrace or reject these different ways or future scenarios for cellular agriculture. Multiple studies have explored consumer acceptance barriers related to cellular agriculture, concluding that further engagement and education is necessary to assure marketplace demand for these emerging products (e.g., Bryant et al., 2019; Weinrich et al., 2020). However, what

is missing from the literature to date is an examination of the public's envisioning of futures for the industry and its potential role in their local food systems. Envisioning public futures for technologies such as cellular agriculture is crucial to develop alternative and potentially more democratic mechanisms for its governance (e.g., Chiles et al., 2021).

In this study, we present the results of a survey to assess the publics' social perceptions of cellular agriculture and its future scenarios in the Metro Vancouver region of British Columbia, which consists of 21 municipalities and one treaty First Nation. The study explores how the Metro Vancouver residents view possible transitions to cellular agriculture with respect to likely, ideal, and concerning food futures. The study examines the demographic factors associated with willingness to try and likelihood of buying cellular agriculture products. Then, the study engages survey respondents in the possible and/or desirable future scenarios for cellular agriculture's emergence in public food systems.

2. Methods

2.1 Recruitment

The survey was available to residents of Metro Vancouver, and it was delivered with the assistance of a Vancouver-based market research company, Kai Analytics. Ultimately, responses were received from residents of only a few municipalities in the region, specifically Burnaby, Surrey, Vancouver, North Vancouver, and New Westminster. Participants were excluded if their postal code was outside the boundaries of our study area or if they were younger than 18 years of age. The data were cleaned by excluding incomplete survey responses, surveys that were finished too quickly (in about 2 minutes or less) to allow for sufficient time to read/review questions, and/or responses that did not reflect likely attitudes and options (e.g., when participants selected the first option for every question). A total of 599 survey responses were initially collected, and 95 responses were excluded through the data cleaning procedures, resulting in a final dataset of 504 responses.

2.2 Survey Design

The survey was designed and tested by the research team and collaborators of the Food and Agriculture Institute, and then, it was sent to Kai Analytics for online programming and dissemination. The survey was designed to examine the public's perceptions of cellular agriculture, including their willingness to try these products, their expectations for the future of the industry (i.e., how the transition might happen), and what futures they would like to see for cellular agriculture in Metro Vancouver. Additionally, the survey examined whether these opinions and attitudes differed by product, specifically cellular salmon, dairy, and chicken. As shown in Table 1, the survey asked participants a variety of questions related to their demographics, what priorities they have for food systems planning, and then a suite of questions specific to cellular agriculture.

Table 1. Survey Constructs

Theme	Variables
General demographic traits	Age, income, ethnicity, gender, level of education
Animal sourced food purchasing and consumption (habits)	Where consumers shop the most, what product qualities they value (e.g., cost, organic certification, cleanliness, etc.)
Participation	How frequently surveys respondents participate in local food initiatives and environmental initiatives
Food System Sustainability Priorities (18 action statements)	Environmental dimensions (e.g., reducing greenhouse gas emissions in agriculture), economic dimensions (e.g., supporting local farmers), social dimensions (e.g., increasing availability of culturally diverse food options)
Scenarios for Cellular Agriculture (18 statements)	How accessible and available products will be; how integrated cellular agriculture will be within conventional protein systems; if the industry will be highly consolidated or more decentralized
Preferences for Cellular Agriculture Futures	How widely available cellular agriculture products will be; preferences between proteins (chicken nuggets, salmon, dairy)

The questions relating to cellular agriculture scenarios, specifically, drew from a framework used to understand and identify different possible futures for the cellular agriculture industry developed by Glaros et al (2023). The framework identifies three dimensions (access, centralization, integration) across which futures for cellular agriculture are discussed and debated by industry and government stakeholders.

- **Access**: the degree to which products and intellectual property in the industry are available and usable by the public.
- **Centralization:** the extent to which cellular agriculture is run by large, urban-based companies.
- **Integration:** the extent that cellular agriculture and conventional protein systems interface.

As illustrated in Table 2, the survey questions reflect the various scenarios across the three dimensions, and the aim of this design was to elucidate the ways in which the public conceptualizes cellular agriculture futures. To try to achieve relative equal representation across all dimensions in the survey questions, we presented six

questions per dimension, with each question set split in half to reflect different and opposing future trajectories. It is worth noting that the purpose of presenting questions derived from the future scenarios framework was not to observe the degree to which survey responses coalesced into these themes, but to test the framework and ascertain how accurate and appropriate our scenario statements are for future survey work.

Table 2. Scenario statement conceptualization

Access	
Open	Cellular agriculture will contribute to greater food security at the local or regional level (i.e., BC's Lower Mainland).
	Cellular agriculture products will be widely available in most grocery stores.
	Anyone will be able to access information and training to learn how to grow cellular agriculture foods.
Closed	Only wealthier people will be able to afford cellular agriculture products.
	Production methods for cellular agriculture will be kept out of public view and understanding (e.g., intellectual property, patents, "trade secrets").
	Becoming a cellular agriculture professional will require specialized, advanced education that most people will not be able to access.

Centralization	
Centralized	Cellular agriculture will mainly be run by large food processing and production companies.
	Cellular agriculture products will mainly be available in larger cities and urban centres.
	Cellular agriculture jobs will mostly be in larger cities and urban centres.
Decentralized	Food banks and community centres will benefit from local cellular agriculture production to provide fresh meats and animal products.
	Cellular agriculture production will happen with small community-owned businesses in BC's Lower Mainland, much like the microbrewery business model.
	In the future, I could see people producing cellular agriculture food in their kitchen, like a sourdough starter.

Integration	
Replacement	Cellular agriculture will replace most or all fresh meat products (e.g., steak, chicken breast) in grocery stores.
	Conventional farmers will lose businesses and livelihoods as the cellular agriculture industry grows.
	Farmers are likely to transition to producing animal products with cellular agriculture (e.g., swapping a poultry operation to cellular chicken production).
Complement	Cellular agriculture products will be an added ingredient in most or all frozen/prepared meat products (e.g., chicken nuggets, fish sticks).
	Cellular agriculture products will be something you can buy online or in most superstores.
	Conventional farmers will benefit from cellular agriculture industries as it gives them new business opportunities, such as producing inputs/feedstock for fermentation-based dairy.

All questions were posed on a 7-point Likert scale, with 7 being the highest level of agreement or frequency and 1 being the lowest level of agreement or frequency for any of the variables.

2.3 Analysis

The analysis examined the public's perceptions of cellular agriculture transitions and demographic factors that affect their willingness to try these products. The variables involved in, and approaches to, the analysis procedures are summarized in Table 3.

Table 3. Description of Variables and Analyses

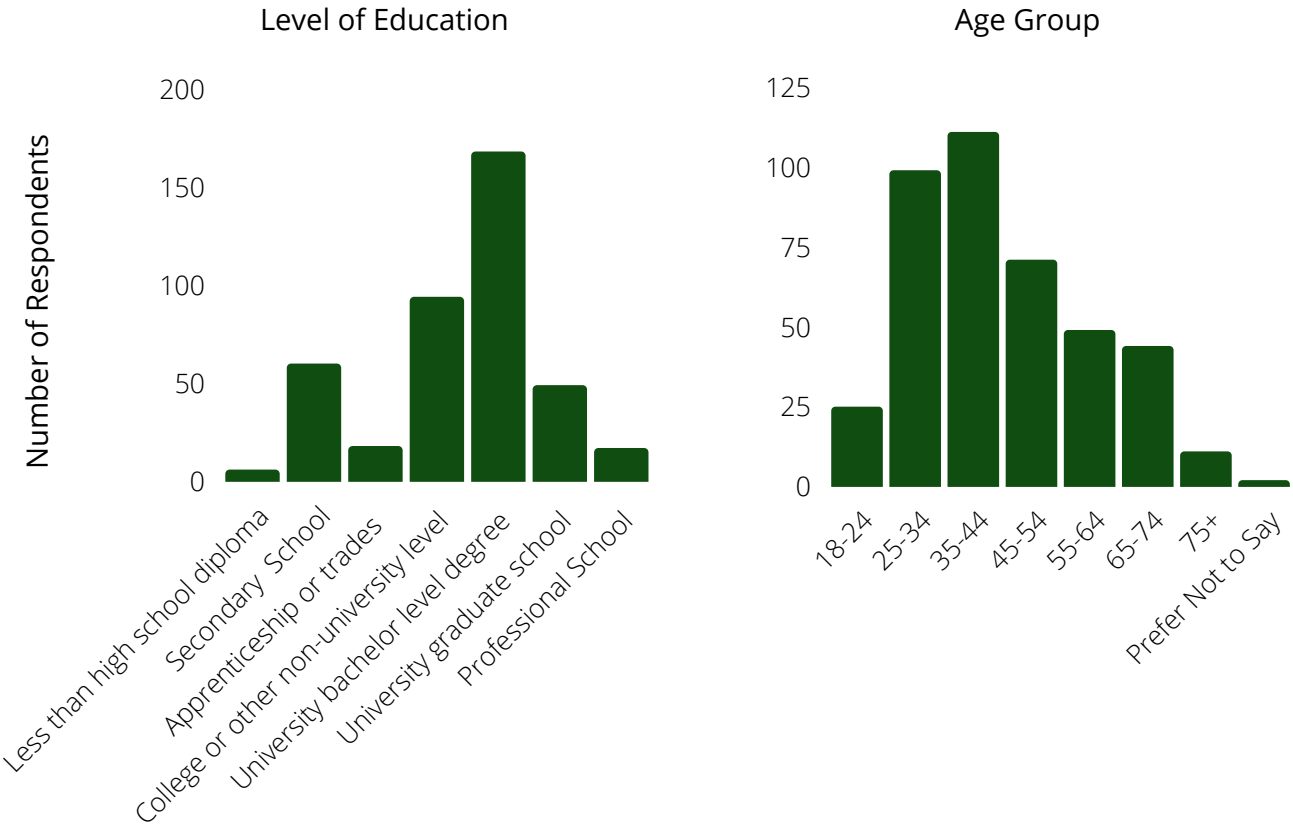
Variables	Analysis
Demographic and Dietary Habits	Relationship between demographic factors (e.g., age, education, gender, combined income, dietary considerations) and willingness to try and likelihood of buying cellular agriculture products regularly.
Sustainability Values and Food System Development Priorities	Relationship between food system development priorities and frequency of participating in environmental as well as local food initiatives and willingness to try and buy cellular agriculture products.
Scenarios and Preferences	Relationship between scenarios for cellular agriculture futures and demographic variables as well as preferences for cellular agriculture futures.

The analysis involved a combination of descriptive and inferential statistical techniques to explore trends and relationships within the data. In terms of the latter, exploratory factor analysis (EFA) was done to examine sustainability values and food system development priorities, as well as scenarios and preferences data. EFA is an approach to data analysis that uses statistical techniques to inductively determine latent groupings that emerge from survey results, finding common themes among survey responses (Fabrigar et al., 2011). EFA can identify commonalities and patterns in survey responses to allow for grouping of survey items to identify "dimensions" in a complex dataset. For such reasons, this statistical technique is highly relevant to this research's objective of identifying items and variables related to future scenarios for cellular agriculture.

3. Results

3.1 Descriptive Statistics

The majority of survey respondents had post-secondary education (e.g, college or other non-university level degree, university) (>60%). Most survey respondents (>50%) were under the age of 45 years, and most survey respondents (>50%) also identified as male. The most common combined household income value for survey respondents was between $50,000 to $100,000. One hundred and sixteen respondents (n=116) indicated that they had special dietary considerations (e.g., vegan, vegetarian, etc.).



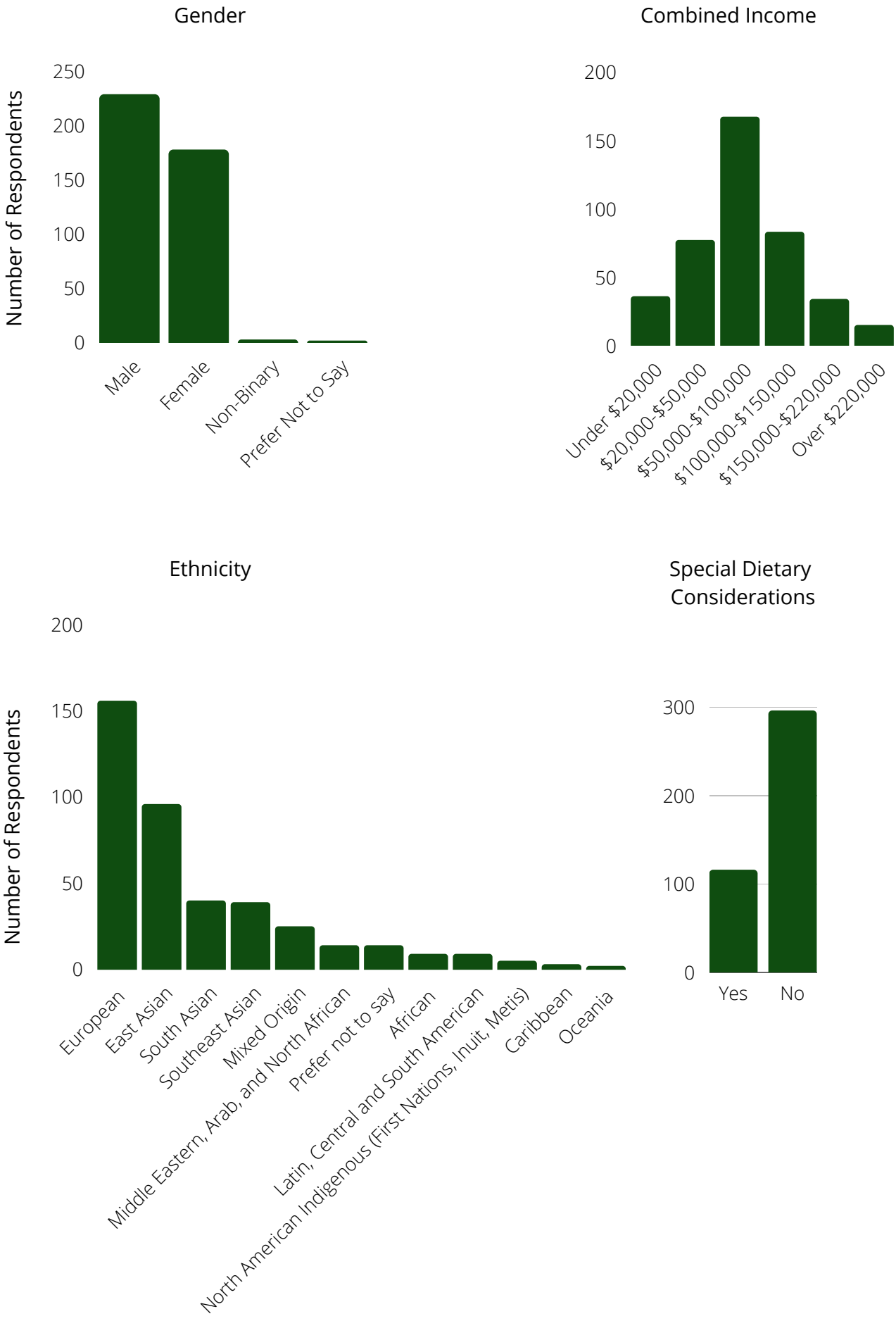


Figure 1. Overview of survey respondent demographic factors

3.2 Willingness to Try Once and Likelihood of Buying Regularly

Demographic Factors

We asked participants to answer questions related to their willingness to try and buy cellular agriculture across multiple possible products (cellular dairy, cellular chicken nuggets, cellular salmon) on a 7-point Likert scale, with 7 as the most willing to try or buy products. The responses had strong Pearson correlations ($r > 0.5$) across all products, indicating the respondents had similar values and attitudes for all the product types. Accordingly, we treated each preference statement as a singular value by averaging survey responses across each of the products.

We ran a series of one-way Analysis of Variance (ANOVA) tests for each demographic factor to determine if/which demographic factors influence respondent's "willingness to try" and "willingness to buy regularly" cellular agriculture products. We found that gender ($df=3$, $F=2.94$, $p<0.05$) and education ($df=6$, $F=3.87$, $p<0.01$) have strong correlations with willingness to try a cellular agriculture product at least once. Those who identified as male were more willing to try cellular agriculture products (*Mean*=4.48) than those who identified as female (*Mean*=3.92). Further, we found that those with a university undergraduate or graduate degree reported a significantly higher average willingness to try cellular agriculture products (*Mean*=4.53 and *Mean*=4.90, respectively) than those with a college or non-university-level degree (*Mean*=3.64).

All demographic variables, with the exception of age, exhibited statistically significant relationships with the statement: "I would like to buy this product regularly (i.e., at least once a week)." For gender ($df=3$, $F=3.08$, $p<0.05$), those who identified as male reported significantly higher average values for this statement (*Mean*=3.87) than those who identified as females (*Mean*=3.35). For level of education ($df=6$, $F=3.98$, $p<0.01$), those who reported a university level bachelor degree and graduate degree reported significantly higher average values (*Mean*=3.94 and *Mean*=4.18, respectively) than those who reported a college/non-university level education (*Mean*=3.16).

For ethnicity and interest in regularly purchasing cellular agriculture products ($df=11$, $F=3.29$, $p<0.01$), those of South Asian descent reported significantly higher average value for likelihood of buying cellular agriculture products regularly (*Mean*=4.3) than those of European descent (*Mean*=3.10). Similarly, those of South East Asian descent reported a statistically higher average value for the statement (*Mean*=4.48) than those of European descent (*Mean*=3.10). Finally, for combined household income ($df=5$, $F-2.26$, $p<0.05$), those who reported a combined income of $50,000 to $100,000 reported a significantly higher average for likelihood of buying cellular agriculture products regularly (*Mean*=3.78) than those with an income of $20,000 to $50,000 (*Mean*=2.95).

Moderate statistical evidence ($df=1$, $F=3.00$, $p <0.1$) suggests that those with special dietary considerations are more likely to want to buy cellular agriculture products

regularly (*Mean*=3.84) than those who do not have a special dietary consideration (*Mean*= 3.48). No statistical evidence was found for claiming that special dietary considerations are associated with willingness to try cellular agriculture products.

We then tested all other preference statements against demographic variables of interest, using ANOVA tests (and t-tests where there were only two means to compare for special dietary considerations). Gender was statistically associated with the following statements: wanting to see cellular agriculture products available in grocery stores ($df=3$, $F=5.41$, $p<0.01$) and cellular agriculture industry to develop in BC's Lower Mainland ($df=3$, $F=5.25$, $p<0.01$). Those who identified as male had a statistically significant higher average for each statement (*Mean*=4.40 and *Mean*=4.35, respectively) than those who identified as female (*Mean*=3.68 and *Mean*=3.70, respectively). Level of education was statistically associated with the same statements: wanting to see cellular agriculture products available in grocery stores ($df=6$, $F=3.96$, $p<0.01$) and cellular agriculture industry to develop in BC's Lower Mainland ($df=6$, $F=3.84$, $p<0.01$). Those who reported having a university bachelor's degree or graduate school degree reported statistically higher agreement with wanting to see cellular agricultural products available in grocery stores (*Mean*=4.31 and *Mean*=4.69, respectively) than those with a college or non-university level education (*Mean*=3.51). Further, those who reported having a university bachelor's degree or graduate school degree reported statistically higher agreement with wanting to see cellular agricultural industry in the Lower Mainland (*Mean*=4.27 and *Mean* = 4.65, respectively) than those with a college or non-university level education (*Mean*=3.55).

All demographics variables with the exception of age were associated with the statement "I want to see this industry develop in places across the world". For gender ($df=3$, $F=4.30$, $p<0.01$), those who identified as male reported higher average values for this statement (*Mean*=4.53) than those who identified as female (*Mean*=3.90). For level of education ($df=6$, $F=5.01$, $p<0.01$), those who reported having a university level bachelor degree and graduate degree reported higher average values for "I want to see this industry develop in places across the world" (*Mean*=4.58 and *Mean*=4.86 respectively) than those who reported a college/non-university level education or high school diploma (Mean=3.62 and *Mean*=3.62, respectively). For ethnicity ($df=11$, $F=2.20$, $p<0.05$), those of South Asian descent reported statistically significant higher average values for the statement "I want to see this industry develop in places across the world" (*Mean*=4.69) than those of European descent (*Mean*=3.85). For combined income ($df=5$, $F=2.27$, $p<0.05$), those indicating an income of $100,000 to $150,000 (*Mean*=4.51) reported statistically higher average values those this statement than those of a lower income bracket of $20,000 to $50,000 (*Mean*=3.57).

We undertook a series of t-tests to determine if respondents who have special dietary considerations (i.e., indicated they are flexitarian, vegetarian, vegan, ketogenic, pescatarian, or want to decrease red meat consumption) had different perspectives on cellular agriculture preferences than those who do not have special dietary

considerations (Figure F). We found that there was moderate statistical evidence (df=226, t=-1.95, p <0.1) that those with special dietary considerations were more likely to want to see cellular agriculture products in their local grocery store (*Mean*=4.27) than those who do not have a special dietary consideration (*Mean*= 3.89, respectively).

Table 4. Summary of statistically significant demographic factors

Survey question	Variable	Higher response	Lower response
"I would be willing to try this product once"	Gender	Male (*Mean*=4.48)	Female (*Mean*=3.92)
	Education	Undergraduate (*Mean*=4.53); Graduate degree (*Mean*=4.90)	College or non-university degree (*Mean*=3.64)
"I would like to buy this product regularly"	Gender	Male (*Mean*=3.87)	Female (*Mean*=3.35)
	Education	Undergraduate (*Mean*=3.94); Graduate degree (*Mean*=4.18)	College or non-university degree (*Mean*=3.16)
	Ethnicity	South Asian descent (*Mean*=4.3); South East Asian descent (*Mean*=4.48)	European descent (*Mean*=3.10)
	Income	$50,000 to $100,000 (*Mean*=3.78)	$20,000 to $50,000 (*Mean*=2.95)
	Special dietary considerations	Yes (*Mean*=3.84)	No (*Mean*=3.48)
"I want to see cellular agriculture products available in grocery stores in the Lower Mainland"	Gender	Male (*Mean*=4.40)	Female (*Mean*=3.68)
	Education	Undergraduate (*Mean*=4.31); Graduate degree (*Mean*=4.69)	College or non-university degree (*Mean*=3.51)
	Special Dietary Considerations	Yes (*Mean*=4.27)	No (*Mean*=3.89)
"I want to see this industry develop in places across the world"	Gender	Male (*Mean*=4.53)	Female (*Mean*=3.90)
	Education	Undergraduate (*Mean*=4.86); Graduate degree (*Mean*=4.58)	College or non-university degree (*Mean*=3.62) Secondary (*Mean*=3.62)

	Ethnicity	South Asian descent (*Mean*=4.69)	European descent (*Mean*=3.85)
	Income	$100,000-$150,000 (*Mean*=4.51)	$20,000-$50,000 (*Mean*=3.57)
"I would like to see cellular agriculture industry develop in BC's Lower Mainland"	Gender	Male (*Mean*=4.35)	Female (*Mean*=3.70)
	Education	Undergraduate (*Mean*=4.27); Graduate degree (*Mean*=4.67)	College or non-university degree (*Mean*=3.55)

Food System Development Priorities and Food Habits

Survey respondents were asked to indicate how strongly they agreed with what we term 'food system development priority statements' (see Glaros et al., 2023 for a similar approach). These eighteen total statements reflect a variety of strategies and actions to make food systems more sustainable. In undertaking a factor analysis, we found that statements factored into four distinct groupings (Figure 2):

- **Land Use and Local Economies** statements reflect finding ways to bolster local food production through, for example, bolstering home gardening, attracting younger agricultural workers, and producing more food locally.

- **Environmental Concern** statements prioritize resource use efficiencies and sustainable education.

- **Social and Cultural Considerations** statements emphasize relationships (e.g., between farmers and consumers, animals) as well as local food access

- **Food Security** statements centre on nutrition and decreasing vulnerabilities to food supply.

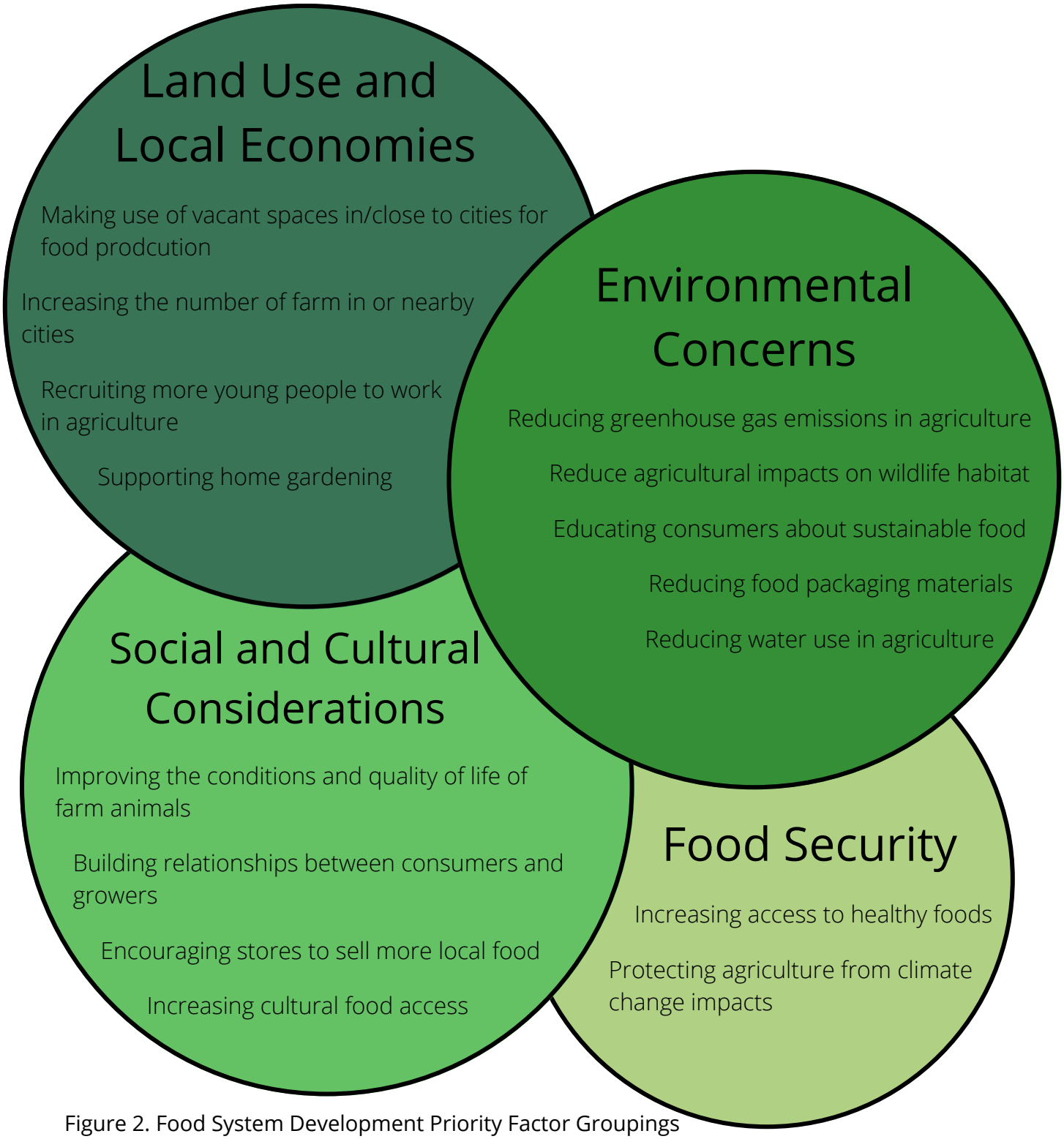


Figure 2. Food System Development Priority Factor Groupings

Pearson correlation tests were conducted between the food system development priority factors (using averages of statements within a factor) and willingness to try or interest in buying cellular agriculture products, and no strong correlations were found (i.e., $r < 0.3$). When disaggregating the statements from their factors, "reducing water use in agriculture" significantly correlated with "I would like to try this product at least once" ($r=0.32$); however, no other significant correlations were found.

Pearson correlation tests between frequency of participation in local food and environmental initiatives and willingness to try and interest in buying cellular agriculture products regularly resulted in no strong, statistically-significant correlations (i.e., $r < 0.3$). Similarly, Pearson correlation tests on frequency of consuming animal-sourced proteins (i.e., how often survey respondents reported consuming fish, beef, pork, poultry, eggs) exhibited no strong correlations (i.e., $r < 0.3$) with willingness to try and interest in buying cellular agriculture products regularly.

We tested Pearson correlations between the food system development priority factor statements (i.e., average of statements within each Environmental, Land Use, Socio-Cultural, and Food Security factor groupings) and cellular agriculture scenarios as well as cellular agriculture preferences. We found no moderate or strong correlations (i.e., $r > 0.3$). Only one individual food system development priority statement (water use) was significantly correlated with 'I would like to see this product be part of the BC's Lower Mainland food industry' ($r=0.30$), and 'I would like to see this product in my local grocery store' ($r=0.30$). Similarly, we tested Pearson correlations between frequency of participation in local food and environmental initiatives and cellular agriculture scenarios as well as preferences and found no moderate or strong correlations (i.e., $r > 0.3$). We also tested Pearson correlations between frequency of animal-sourced proteins (i.e., fish, beef, pork, poultry, eggs) and found no moderate or strong correlations (i.e., $r > 0.3$).

3.3 Cellular Agriculture Scenarios and Preferences

3.3.1 Scenarios Factor Analysis

The EFA conducted on the scenario statements revealed two underlying factors in the responses (Table 3). Based our interpretation of what the associated statements have in common and what makes the groups distinct, we view the first group as describing more significant change to the food system, which we label "REFORMIST" and the second group as not changing the power relations or patterns of the food system, which we label "STATUS-QUO." In adopting this language of Reformist versus Status-Quo we draw from Holt-Giménez and Wang (2011), acknowledging that our survey questions do not explicitly engage with questions of power relations in the food system or transformative movements toward food sovereignty and broader systemic food system change.

Table 5. Each column is a distinct factor grouping. Dark, medium, and light green coloured boxes denote statements derived from "access", "centralization", and "integration" axes (Glaros et al., under review).

	Reformist	Status-Quo
Centralization	Food banks and community centres will benefit from local cellular agriculture production Cellular agriculture production will happen with small community-owned businesses In the future, I could see people producing cellular agriculture food in their kitchen, like a sourdough starter	Cellular agriculture jobs will mostly be in larger cities and urban centres Cellular agriculture products will mainly be available in larger cities and urban centres Cellular agriculture will mainly be run by large food processing and production companies
Access	Anyone will be able to access information and training to learn how to grow cellular agriculture foods Cellular agriculture will contribute to greater food security at the local or regional level Cellular agriculture products will be widely available in most grocery stores	Becoming a cellular agriculture professional will require specialized, advanced education that most people will not be able to access Production methods for cellular agriculture will be kept out of public view and understanding Only wealthier people will be able to afford cellular agriculture products
Integration	Conventional farmers will benefit from cellular agriculture industries as it gives them new business Cellular agriculture will replace most or all fresh meat products Farmers are likely to transition to producing animal products with cellular agriculture Cellular agriculture products will be something you can buy online or in most superstores	Conventional farmers will lose businesses and livelihoods as the cellular agriculture industry grows

Within each of the Reformist and Status-Quo factors, we wanted to determine if the statements further factored into the three dimensions identified through the cellular agriculture scenarios framework (i.e., centralization, access, integration). As such, we undertook a second order factor analysis of future scenario statements, as individual categories.

As shown in Figure 3, we found that "Reformist" statements grouped into what we term Decentralized and Widely Available factors (Figure 3). Statements in the Decentralized factor emphasize small business and community/public participation in cellular agriculture futures. Statements in the Widely Available factor emphasize the prevalence and availability of cellular agriculture products. We found that Status-Quo loaded into what we term Centralized and Closed factors (Figure 4). Statements in the Centralized factor emphasize futures wherein large companies run the cellular agriculture industry and agricultural jobs and cellular agriculture products are mainly located in urban areas. Statements in the Closed factor reflect lack of ability for the public, farmers, and low-income groups to participate in the cellular agriculture industry and food system.

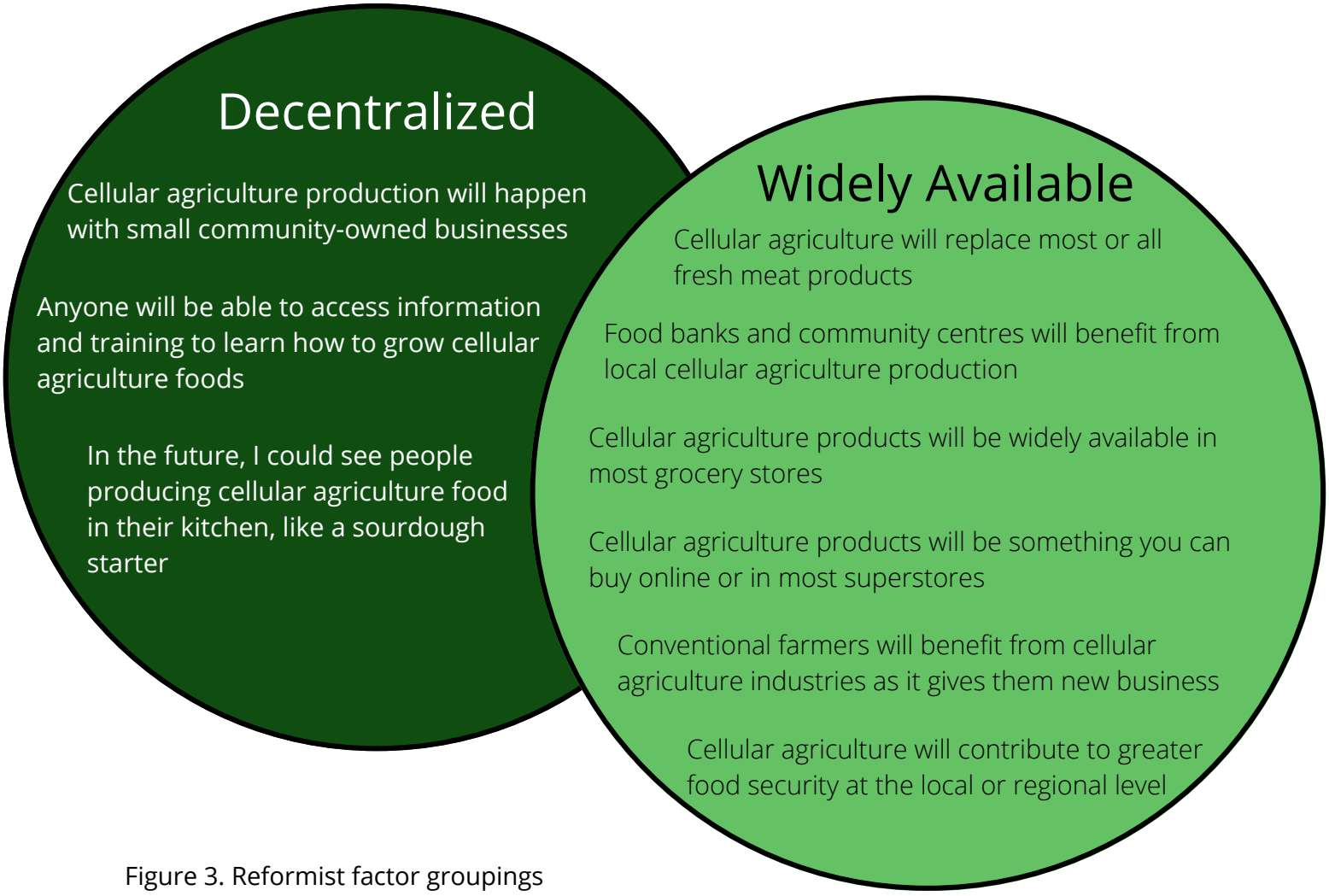


Figure 3. Reformist factor groupings

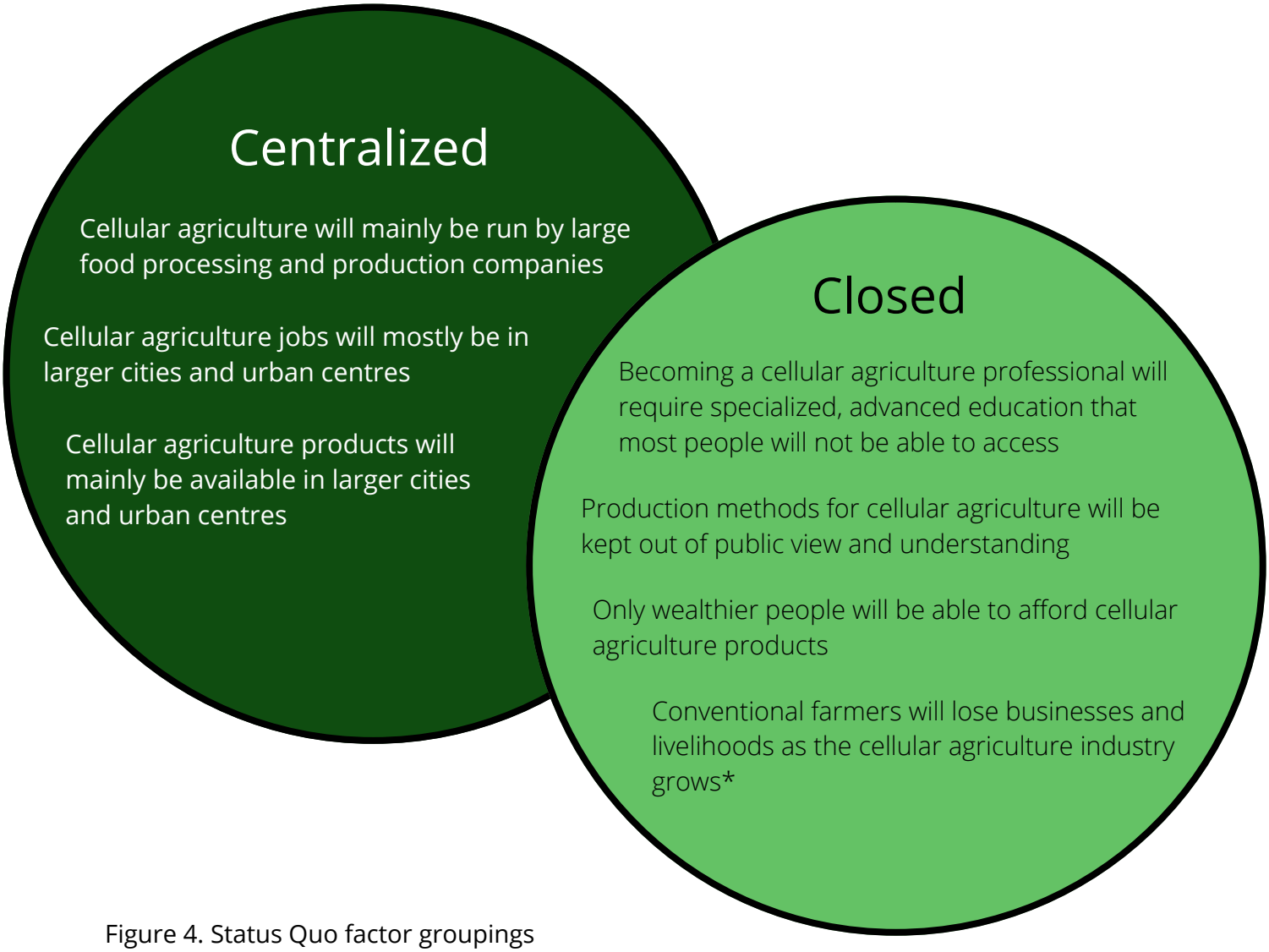


Figure 4. Status Quo factor groupings

Using pairwise t-tests, the first and second order factors were compared (using averages of responses to all statements within a given factor). We found that responses were higher ($df=411$, $t=-4.60$, $p<0.01$) for Status-Quo scenarios (*Mean*=4.51) than for Reformist scenarios (*Mean*=4.24), indicating that respondents felt the Status-Quo future to be more likely to transpire. We also found that responses were higher ($df = 411$, $t = -5.03$, $p < 0.01$) for the Widely Available / Reformist scenario (*Mean*=4.32) than for Decentralized / Reformist scenario (*Mean*=4.08). Finally, we found that respondents had a higher average value ($df=411$, $t=-5.13$, $p<0.01$) for the Centralized / Status-Quo scenario (*Mean*=4.67) than for Closed / Status-Quo scenario (*Mean*=4.39).

3.3.2 Cellular Agriculture Preferences and Scenarios

Scenario and Preference Correlations

We asked participants to answer questions related to their preferences and interests in the cellular agriculture industry across multiple possible products (cellular dairy, cellular chicken nuggets, cellular salmon), with respect to whether they would like: the industry to exist in (a) Metro Vancouver and/or (b) globally, (c) the products to be in local grocery

stores, (d) to try and/or (e) to regularly buy the products, and (f) the technology to not be adopted. With each question, all products had strong Pearson correlations ($r > 0.5$) with each other (i.e., shared similar values across products). Accordingly, we treated each preference/interest statement as a singular value by averaging survey responses across each of the products.

We tested for variable associations between the factor grouping (i.e., Scenarios and Food System Development Priorities) and Cellular Agriculture Preferences. We found that, among the Reformist and Status-Quo variables, only the Reformist variable had any moderate ($0.3 < r < 0.5$) or strong correlations ($r > 0.5$) with any of the other variables of interest. All correlations between the Reformist scenarios variable and the Cellular Agriculture Preferences or Development Priorities were significant ($p < 0.01$). All Cellular Agriculture Preferences had strong positive associations with the Reformist scenario ($r > 0.5$), with the exception of the statement 'cellular agriculture should not be adopted' (Figure 5). However, the cellular agriculture preferences exhibited only weak correlations with the food systems development priorities, with the only exception being Environmental Concerns which exhibited a moderate relationship ($r > 0.3$) with the Reformist scenario.

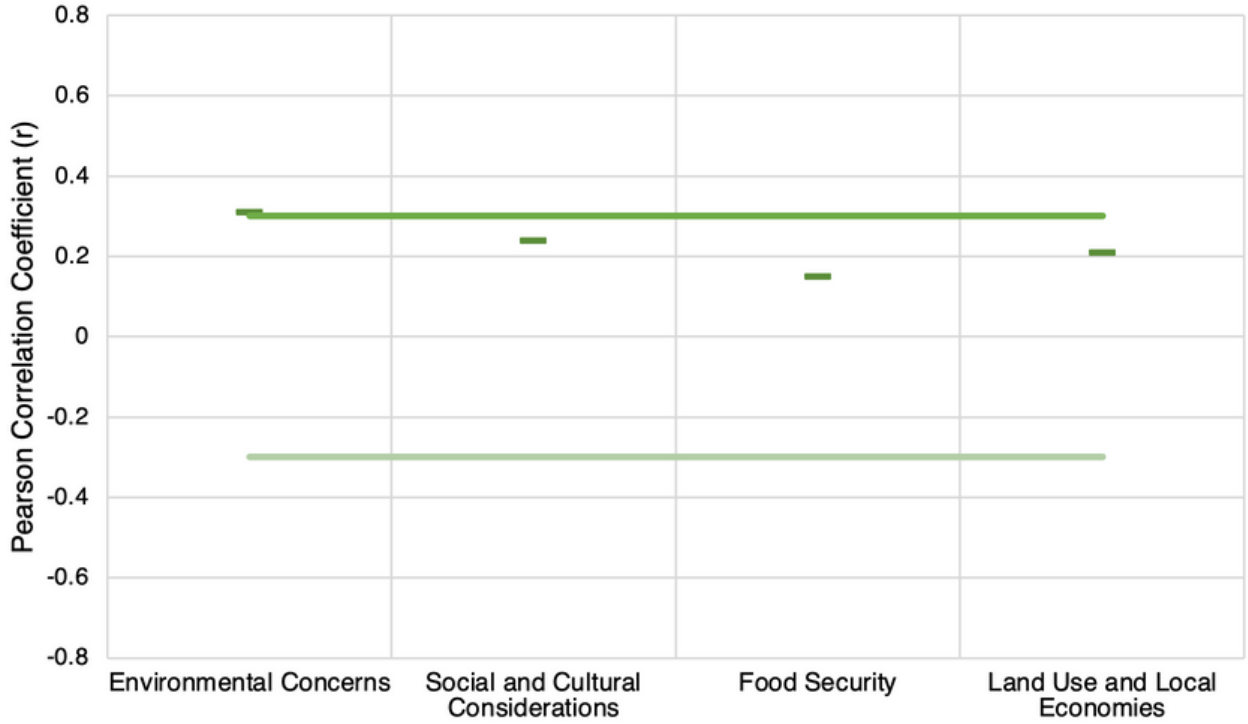


Figure 5: Correlations between Reformist Scenario and all Cellular Agriculture Preference and Food System Development Priorities variables. Strong correlations are above Pearson correlation coefficients of 0.5, and moderate are between 0.3 and 0.5. Horizontal green lines denote thresholds for moderate correlations at -0.3 and 0.3, respectively.

Familiarity with Cellular Agriculture

We undertook a series of separate t-tests to determine if familiarity with cellular agriculture has a relationship with cellular agriculture preferences and scenarios (Figure A). We found a weak statistical evidence to support a relationship (df=389, t=-1.84, p=0.066) between familiarity with cellular agriculture and the widely available scenario for cellular agriculture futures, where those who had heard of cellular agriculture had a higher average value (*Mean*=4.43) than those who had not heard of it before (*Mean*=4.20). We found a strong significant correlation (df=389, t=-3.57, p<0.01) between familiarity with cellular agriculture and the centralization concern scenario where those who had heard of cellular agriculture had a higher average value (*Mean*=4.90) than those who had not (*Mean*=4.48). We found no significant correlation for the Closed concern scenario.

There was a weak and moderate relationship between having heard of cellular agriculture and the statements "I would like to see this product be part of BC's Lower Mainland food industry" (df =374, t=-1.86, p=0.064) and "I do not think that this product should exist or be adopted at all" (df=370, t=2.09, p=0.037). Those who had heard of cellular agriculture on average responded higher (*Mean*=4.14) than those who had not (*Mean*=3.81) to the former statement, while those who had heard of cellular agriculture had a lower average (*Mean*=3.61) than those who had not (*Mean*=4.01) for the latter statement.

Table 5. Summary of Familiarity with Cellular Agriculture Findings

	Yes, Heard of Cell Ag (Mean average)	No, Have not Heard of Cell Ag (Mean average)	Results of t-test
Decentralized	4.02	4.09	df=378, t=0.51, p=0.61
Widely Available	4.43	4.20	df=389, t=-1.84, p=0.066*
Centralized	4.90	4.48	df=389, t=-3.57, p<0.01***
Closed	4.41	4.35	df=389, t=-0.47, p=0.64
I would like to try this product at least once	4.32	4.00	df=383, t=-1.52, p=0.13
I would like to buy this product regularly (i.e., at least once a week)	3.48	3.63	df=376, t=-0.82, p=0.41
I would like to see this product in my local grocery store, in the BC's Lower Mainland	4.13	3.84	df =379, t=-1.55, p=0.12
I would like to see this product be part of the BC's Lower Mainland food industry	4.14	3.81	df =374, t=-1.86, p=0.064*
I want to see this industry develop in places across the world	4.32	4.00	df=380, t=-1.61, p=0.11
I do not think that this product should exist or be adopted at all	3.61	4.01	df=370, t=2.09, p=0.037**

4. Discussion

In this study, we developed a survey instrument to better understand the public's interest and concerns regarding cellular agriculture in the Metro Vancouver region of British Columbia, Canada. Following similar studies in other countries (e.g., Bryant et al., 2019), we wanted to know if and what kind of demographic factors (i.e., ethnicity, gender, education, and age) affect willingness to try or buy cellular agriculture products in the Metro-Vancouver context. Additionally, we wanted to know how individual values and priorities for food system development (i.e., concern for the environment, land use change, etc.), as well as how often individuals participate in local and environmental initiatives, affect willingness to try or buy cellular agriculture products.

We found that gender and level of education are statistically associated with willingness to try or buy cellular agriculture products. Specifically, those who identified as male and reported a higher level of education had a higher average willingness to try or buy than those who identified as females or non-binary and those who had lower levels of education. This confirms the findings of multiple studies of consumer acceptance for cellular agriculture that those who identify as female are more likely to want to reduce meat consumption but not through the adoption of cellular agriculture technologies, and those who have higher levels of education as being more willing to try cellular agriculture (see Pakseresht et al., 2022). Some possible reasons behind these findings related to gender may be due to the way in which these products are marketed (i.e., as feminine or masculine), but requires further research to explore specific causes (Slade, 2018).

For education, some scholars have discussed how higher education levels may result in increased exposure to information regarding the negative health and environmental impacts of conventional livestock production, and thus willingness to try cellular agriculture (Grasso et al., 2019). We found statistical correlations between previous knowledge/exposure to cellular agriculture as well as the statements "I would like to see this product in my local grocery store, in the BC's Lower Mainland" and "I do not think this product should exist or be adopted at all", where those without previous knowledge of cellular agriculture had a more negative perception of the technology. This suggests that widespread education and outreach that exposes the public to cellular agriculture technologies may increase the public's positive perceptions of this technology.

In contrast to much of the literature (e.g., Grasso et al., 2019), we did not find that age had a significant association with willingness to try or buy cellular agriculture products, though this may be due to our study only selecting respondents above the age of 18, where youth have reported higher interest in cellular agriculture products (Ruzgys & Pickering, 2020). We found that those from Asian and South Asian descent were more willing to buy cellular agriculture products, which echoes consumer perceptions studies that have compared Asian and North American perceptions of cellular agriculture (Bryant et al., 2019). Finally, we found that respondents who indicated they had a special dietary consideration had a higher average for likely to buy cellular agriculture products,

confirming literature that highlights health and environmental concerns as key motivations for accepting cellular agriculture technologies (Onwezen et al., 2019). However, our evidence for this relationship was moderate ($p < 0.1$).

Our study is among the first to move beyond broad demographic and consumer acceptance factors, specifically, to better understanding and describing potential futures for how this technology will unfold and affect food systems, and if these attitudes vary between cellular agriculture products. All cellular agriculture preferences were strongly correlated among the different products ($r > 0.5$), suggesting that attitudes regarding cellular agriculture technologies do not vary between products (i.e., between cellular salmon, cellular dairy, cellular chicken). Survey responses factored into two distinct groupings for future scenarios, which we called Reformist and Status-Quo, where Reformist futures include statements that describe significant changes to the food system and reversal of patterns and Status-Quo is a continuation of existing food system trends.

The average for all Status-Quo statements was significantly higher than for Reformist statements. Reformist statements factored into two distinct subgroups that we call Decentralized and Widely Available scenarios. Decentralized scenarios include more open futures for the industry, while Widely Available scenarios are those where products have high supply and are accessible. In contrast, Status-Quo statements factored into two distinct subgroups that we call Centralized and Closed scenarios. Centralized scenarios are those geographically focused on urban production and distribution of cellular agriculture products, while Closed scenarios are those with limited public engagement or opportunity for farmer participation.

There was moderate to strong correlation between Reformist scenario statements and the majority of the cellular agriculture preference statements (e.g., willing to try, developing in the Lower Mainland, etc.), suggesting that for cellular agriculture to lead to a 'beneficial' future it ought to be widely available and accessible as a local and global industry. Further, concern for the environment was the only food system development priority with moderate correlation with the "Reformist" scenario. This suggests that, for public survey respondents, they see the most potential for cellular agriculture to fulfill its environmental benefits over other contributions (e.g., to food security, local economic development, and social and cultural considerations).

These findings suggest that the public have many of the same concerns and hopes for the cellular agriculture industry as seen with food and agriculture industry stakeholders and government, with respect to centralization and access (see Glaros, 2023). Most of these centralization and access statements neatly grouped into discrete Reformist and Status-Quo factors, with the (respectively speaking) decentralized and open access items being part of the Reformist factor and the centralized and closed access being part of the Status-Quo factor. In other words, the public shares concerns regarding the potential for cellular agriculture to lead to consolidation in the food system as well as less accessible

and transparent futures, similar to perceptions of other stakeholders from industry, government, and third sector (e.g., Chiles et al., 2021; iPES-FOOD 2022).

In contrast, the survey questions related to integration (the possibility for cellular agriculture to replace or complement traditional agriculture) did not factor as neatly into the Reformist and Status-Quo factors. Statements factored more between those that described 'better' versus 'worse' outcomes of cellular agriculture for farmers, than between statements that implied more or less integration with conventional food production. This suggests that integration has more normative complexity than do categories related to access or centralization. Thus, future survey work should consider parsing apart statements related to integration into questions about farms and farmers (e.g., farmer livelihood impacts), as well as questions about food supply and food system systems (e.g.,availability of cellular agriculture products).

5. Conclusions

In this study we explored how the public in Metro-Vancouver, Canada, perceives the cellular agriculture industry. Using an array of inferential statistical techniques we tested associations between demographic variables and willingness to try and buy various cellular agriculture products, in addition to assessing the public perceptions of ideal and/or plausible futures for the cellular agriculture industry in this geographic context. We found that perceptions of cellular agriculture do not vary between products (i.e., respondents ranked statements similarly for fish versus chicken versus beef). Further, we found that associations between demographic factors and willingness to try a product once and likelihood of buying a product regularly varied. Gender and education were both associated with both variables, where those who identified as male and had higher educational attainment expressed higher averages for both statements. No other variables were associated with willingness to try cellular agriculture products. Those of Southeast Asian and South Asian descent reported a statistically significant higher average for likelihood of buying a product regularly than those of European descent, as did individuals reporting a higher income bracket ($50,000-$100,000) than lower income bracket ($20,000-$50,000). There was some statistical evidence that those with special dietary considerations (e.g., vegetarian, vegan) were more likely to buy cellular agriculture products regularly, but this requires further testing.

Using exploratory factor analysis techniques we examined future scenarios for cellular agriculture industry development in the Lower Mainland, British Columbia. We found two distinct factor groupings that we term "Reformist" and "Status-Quo". Through further exploratory factor analysis techniques, we found that the Reformist scenario group factored into "Decentralized" scenarios for cellular agriculture (small-business-led and accessible for public or home use) and "Widely Available" scenarios (high positive contribution to food security and accessibility at stores). In contrast, the Status-Quo scenario group factored into "Centralized" scenarios (cellular agriculture run by few companies in urban areas) as well as "Closed" scenarios (minimal public or farmer

participation in transition). Crucially, Reformist scenarios were strongly associated with higher preferences for the cellular agriculture industry, suggesting that if cellular agriculture is to scale in the region, it ought to consider how to integrate public and farmer concerns (Widely Available Scenarios), and be implemented at more localized scales (Decentralized Scenarios). There was strong statistical evidence that Reformist scenarios were moderately correlated with environmental concerns, suggesting public stakeholders are optimistic for the potential of cellular agriculture to achieve its environmental promises.

Future work is required to replicate this study in additional geographic contexts. Further, the conceptual variables tested and identified through this work would benefit from being tested in a survey distributed at a larger scale and analyzed using confirmatory factor analysis techniques. Additional scenario statements could be included in future survey work that tease apart perceptions of futures for the public and for farmers as distinct variables.

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Appendices

Appendix 1. Statistical Output

ANOVA Tests for Willingness to Try and Likelihood of Buying Cellular Agriculture Products

Willingness to Try		Df	Sum of Squares	Mean Square	F Value	Pr(>F)
Gender Identity	Gender Identity Categories	3	36.4	12.12	2.94	0.033**
	Residuals	408	1681.9	4.12		
Income	Combined Income Categories	5	31.1	6.22	1.50	0.19
	Residuals	406	1687.2	4.16		
Education	Education Categories	6	93.2	15.54	3.87	p<0.001***
	Residuals	405	1625.0	4.012		
Ethnicity	Ethnicity Categories	11	84.2	7.65	1.87	0.041**
	Residuals	400	1634.1	4.09		
Likelihood to Buy		Df	Sum of Squares	Mean Square	F Value	Pr(>F)
Gender Identity	Gender Identity Categories	3	32.8	10.95	3.08	0.028**
	Residuals	408	1451.0	3.56		
Income	Combined Income Categories	5	40.2	8.03	2.26	0.048**
	Residuals	406	1443.7	3.56		
Education	Education Categories	6	82.6	13.8	3.98	p<0.001***
	Residuals	405	1401.2	3.46		
Ethnicity	Ethnicity Categories	11	123.2	11.20	3.29	p<0.01***
	Residuals	400	1360.6	3.40		

Tukey's Post-Hoc Test for Willingness to Try and Likelihood of Buying Cellular Agriculture Products

	Willing to Try				Likelihood of Buying			
Ethnicity	Diff	Lwr	Upr	p	Diff	Lwr	Upr	p
Caribbean-African (e.g., Central and West African, North African, Southern and East African)	0.00	-4.43	4.43	1.00	-0.11	-4.15	3.93	1.00
East Asian-African (e.g., Central and West African, North African, Southern and East African)	0.47	-1.85	2.79	1.00	0.55	-1.56	2.67	1.00
European (e.g., British Isles, French, Western European)-African (e.g., Central and West African, North African, Southern and East African)	-0.21	-2.49	2.07	1.00	-0.23	-2.31	1.85	1.00
Latin, Central and South American-African (e.g., Central and West African, North African, Southern and East African)	0.15	-2.98	3.28	1.00	0.30	-2.56	3.15	1.00
Middle Eastern, Arab, and North African-African (e.g., Central and West African, North African, Southern and East African)	0.76	-2.08	3.60	1.00	0.83	-1.76	3.42	1.00
North American Indigenous (First Nations, Inuit, Metis)-African (e.g., Central and West African, North African, Southern and East African)	-0.33	-4.04	3.37	1.00	-0.53	-3.92	2.85	1.00
Oceania (Australian, New Zealander, Pacific Islander)-African (e.g., Central and West African, North African, Southern and East African)	2.00	-3.19	7.19	0.98	1.17	-3.57	5.91	1.00

Mixed Origin-African (e.g., Central and West African, North African, Southern and East African)	-0.53	-3.12	2.05	1.00	-0.55	-2.90	1.81	1.00
Prefer not to say-African (e.g., Central and West African, North African, Southern and East African)	0.10	-2.74	2.93	1.00	0.12	-2.47	2.71	1.00
South Asian-African (e.g., Central and West African, North African, Southern and East African)	0.59	-1.86	3.04	1.00	0.97	-1.27	3.20	0.96
Southeast Asian-African (e.g., Central and West African, North African, Southern and East African)	0.89	-1.57	3.35	0.99	1.15	-1.10	3.39	0.88
East Asian-Caribbean	0.47	-3.43	4.36	1.00	0.66	-2.89	4.22	1.00
European (e.g., British Isles, French, Western European)-Caribbean	-0.21	-4.08	3.66	1.00	-0.12	-3.65	3.41	1.00
Latin, Central and South American-Caribbean	0.15	-4.28	4.58	1.00	0.41	-3.63	4.45	1.00
Middle Eastern, Arab, and North African-Caribbean	0.76	-3.47	4.99	1.00	0.94	-2.91	4.80	1.00
North American Indigenous (First Nations, Inuit, Metis)-Caribbean	-0.33	-5.19	4.52	1.00	-0.42	-4.85	4.01	1.00
Oceania (Australian, New Zealander, Pacific Islander)-Caribbean	2.00	-4.07	8.07	1.00	1.28	-4.26	6.81	1.00
Mixed Origin-Caribbean	-0.53	-4.59	3.53	1.00	-0.44	-4.14	3.27	1.00
Prefer not to say-Caribbean	0.10	-4.13	4.32	1.00	0.23	-3.63	4.09	1.00
South Asian-Caribbean	0.59	-3.39	4.57	1.00	1.08	-2.55	4.71	1.00
Southeast Asian-Caribbean	0.89	-3.09	4.87	1.00	1.26	-2.38	4.89	0.99
European (e.g., British Isles, French, Western European)-East Asian	-0.68	-1.54	0.18	0.29	-0.78	-1.57	0.00	p<0.1*
Latin, Central and South American-East Asian	-0.32	-2.64	2.00	1.00	-0.26	-2.37	1.86	1.00

Middle Eastern, Arab, and North African-East Asian	0.29	-1.61	2.19	1.00	0.28	-1.45	2.02	1.00
North American Indigenous (First Nations, Inuit, Metis)-East Asian	-0.80	-3.85	2.25	1.00	-1.09	-3.87	1.70	0.98
Oceania (Australian, New Zealander, Pacific Islander)-East Asian	1.53	-3.22	6.28	1.00	0.61	-3.72	4.95	1.00
Mixed Origin-East Asian	-1.00	-2.49	0.49	0.54	-1.10	-2.46	0.26	0.25
Prefer not to say-East Asian	-0.37	-2.27	1.53	1.00	-0.43	-2.17	1.30	1.00
South Asian-East Asian	0.12	-1.13	1.37	1.00	0.41	-0.73	1.56	0.99
Southeast Asian-East Asian	0.42	-0.84	1.68	0.99	0.59	-0.56	1.74	0.87
Latin, Central and South American-European (e.g., British Isles, French, Western European)	0.36	-1.92	2.64	1.00	0.53	-1.55	2.61	1.00
Middle Eastern, Arab, and North African-European (e.g., British Isles, French, Western European)	0.97	-0.88	2.83	0.86	1.06	-0.63	2.76	0.65
North American Indigenous (First Nations, Inuit, Metis)-European (e.g., British Isles, French, Western European)	-0.12	-3.14	2.90	1.00	-0.30	-3.06	2.45	1.00
Oceania (Australian, New Zealander, Pacific Islander)-European (e.g., British Isles, French, Western European)	2.21	-2.52	6.94	0.93	1.40	-2.92	5.71	1.00
Mixed Origin-European (e.g., British Isles, French, Western European)	-0.32	-1.75	1.11	1.00	-0.32	-1.62	0.99	1.00
Prefer not to say-European (e.g., British Isles, French, Western European)	0.31	-1.55	2.16	1.00	0.35	-1.34	2.04	1.00
South Asian-European (e.g., British Isles, French, Western European)	0.80	-0.37	1.98	0.52	1.20	0.12	2.27	p<0.05 **
Southeast Asian-European (e.g., British Isles, French, Western European)	1.10	-0.09	2.29	0.10	1.38	0.29	2.46	p<0.01 ***

Middle Eastern, Arab, and North African-Latin, Central and South American	0.61	-2.23	3.45	1.00	0.54	-2.05	3.13	1.00
North American Indigenous (First Nations, Inuit, Metis)-Latin, Central and South American	-0.48	-4.19	3.22	1.00	-0.83	-4.21	2.55	1.00
Oceania (Australian, New Zealander, Pacific Islander)-Latin, Central and South American	1.85	-3.34	7.05	0.99	0.87	-3.87	5.61	1.00
Mixed Origin-Latin, Central and South American	-0.68	-3.26	1.90	1.00	-0.84	-3.20	1.51	0.99
Prefer not to say-Latin, Central and South American	-0.05	-2.89	2.79	1.00	-0.18	-2.77	2.41	1.00
South Asian-Latin, Central and South American	0.44	-2.01	2.90	1.00	0.67	-1.57	2.91	1.00
Southeast Asian-Latin, Central and South American	0.74	-1.72	3.20	1.00	0.85	-1.39	3.09	0.98
North American Indigenous (First Nations, Inuit, Metis)-Middle Eastern, Arab, and North African	-1.10	-4.56	2.37	1.00	-1.37	-4.53	1.79	0.96
Oceania (Australian, New Zealander, Pacific Islander)-Middle Eastern, Arab, and North African	1.24	-3.78	6.26	1.00	0.33	-4.25	4.92	1.00
Mixed Origin-Middle Eastern, Arab, and North African	-1.30	-3.51	0.92	0.75	-1.38	-3.40	0.64	0.52
Prefer not to say-Middle Eastern, Arab, and North African	-0.67	-3.18	1.84	1.00	-0.71	-3.01	1.58	1.00
South Asian-Middle Eastern, Arab, and North African	-0.17	-2.23	1.89	1.00	0.13	-1.75	2.02	1.00
Southeast Asian-Middle Eastern, Arab, and North African	0.13	-1.94	2.20	1.00	0.31	-1.58	2.20	1.00

Oceania (Australian, New Zealander, Pacific Islander)-North American Indigenous (First Nations, Inuit, Metis)	2.33	-3.23	7.89	0.97	1.70	-3.37	6.77	0.99
Mixed Origin-North American Indigenous (First Nations, Inuit, Metis)	-0.20	-3.46	3.06	1.00	-0.01	-2.98	2.96	1.00
Prefer not to say-North American Indigenous (First Nations, Inuit, Metis)	0.43	-3.03	3.89	1.00	0.65	-2.51	3.81	1.00
South Asian-North American Indigenous (First Nations, Inuit, Metis)	0.93	-2.23	4.08	1.00	1.50	-1.38	4.38	0.86
Southeast Asian-North American Indigenous (First Nations, Inuit, Metis)	1.22	-1.93	4.38	0.98	1.68	-1.20	4.56	0.75
Mixed Origin-Oceania (Australian, New Zealander, Pacific Islander)	-2.53	-7.42	2.35	0.86	-1.71	-6.17	2.74	0.98
Prefer not to say-Oceania (Australian, New Zealander, Pacific Islander)	-1.90	-6.93	3.12	0.98	-1.05	-5.63	3.54	1.00
South Asian-Oceania (Australian, New Zealander, Pacific Islander)	-1.41	-6.22	3.41	1.00	-0.20	-4.59	4.19	1.00
Southeast Asian-Oceania (Australian, New Zealander, Pacific Islander)	-1.11	-5.93	3.71	1.00	-0.02	-4.42	4.37	1.00
Prefer not to say-Mixed Origin	0.63	-1.59	2.85	1.00	0.67	-1.36	2.69	1.00
South Asian-Mixed Origin	1.13	-0.57	2.82	0.56	1.51	-0.03	3.06	0.06
Southeast Asian-Mixed Origin	1.42	-0.28	3.12	0.21	1.69	0.14	3.25	p<0.05 **
South Asian-Prefer not to say	0.50	-1.57	2.56	1.00	0.85	-1.04	2.73	0.95
Southeast Asian-Prefer not to say	0.79	-1.28	2.86	0.98	1.03	-0.86	2.92	0.82
Southeast Asian-South Asian	0.30	-1.20	1.79	1.00	0.18	-1.19	1.54	1.00

Combined Income	Diff	Lwr	Upr	p	Diff	Lwr	Upr	p
$150,000 to $220,000-$100,000 to $150,000	-0.05	-1.24	1.14	1.00	0.05	-1.05	1.15	1.00
$20,000 to $50,000-$100,000 to $150,000	-0.81	-1.73	0.11	0.12	-0.71	-1.56	0.14	0.17
$220,000 and over-$100,000 to $150,000	-0.29	-1.92	1.35	1.00	-0.28	-1.80	1.23	0.99
$50,000 to $100,000-$100,000 to $150,000	-0.21	-0.99	0.58	0.97	0.12	-0.60	0.85	1.00
Under $20,000-$100,000 to $150,000	-0.17	-1.34	0.99	1.00	0.09	-0.99	1.16	1.00
$20,000 to $50,000-$150,000 to $220,000	-0.76	-1.96	0.44	0.46	-0.76	-1.88	0.35	0.36
$220,000 and over-$150,000 to $220,000	-0.24	-2.05	1.57	1.00	-0.34	-2.01	1.34	0.99
$50,000 to $100,000-$150,000 to $220,000	-0.16	-1.26	0.94	1.00	0.07	-0.95	1.08	1.00
Under $20,000-$150,000 to $220,000	-0.12	-1.52	1.27	1.00	0.03	-1.26	1.33	1.00
$220,000 and over-$20,000 to $50,000	0.52	-1.12	2.17	0.94	0.43	-1.10	1.95	0.97
$50,000 to $100,000-$20,000 to $50,000	0.60	-0.20	1.41	0.27	0.83	0.09	1.58	p<0.05 **
Under $20,000-$20,000 to $50,000	0.64	-0.54	1.82	0.63	0.80	-0.29	1.89	0.29
$50,000 to $100,000-$220,000 and over	0.08	-1.50	1.65	1.00	0.41	-1.05	1.86	0.97
Under $20,000-$220,000 and over	0.11	-1.68	1.91	1.00	0.37	-1.29	2.03	0.99
Under $20,000-$50,000 to $100,000	0.03	-1.04	1.11	1.00	-0.03	-1.03	0.96	1.00

Gender	Diff	Lwr	Upr	p	Diff	Lwr	Upr	p
Male-Female	0.55	0.03	1.08	p<0.05 **	0.51	0.03	1.00	p<0.05 **
Non-binary person (gender diverse)-Female	1.08	-1.97	4.12	0.80	1.42	-1.40	4.25	0.56
Prefer not to say-Female	1.58	-2.14	5.30	0.69	-0.85	-4.31	2.60	0.92
Non-binary person (gender diverse)-Male	0.52	-2.52	3.57	0.97	0.91	-1.92	3.74	0.84
Prefer not to say-Male	1.02	-2.70	4.75	0.89	-1.37	-4.82	2.09	0.74
Prefer not to say-Non-binary person (gender diverse)	0.50	-4.28	5.28	0.99	-2.28	-6.72	2.16	0.55
Level of Education	Diff	Lwr	Upr	p	Diff	Lwr	Upr	p
College or other non-university level-Apprenticeship or trades	-0.01	-1.54	1.52	1.00	0.36	-1.06	1.78	0.99
No formal education (less than high school diploma)-Apprenticeship or trades	0.07	-2.72	2.87	1.00	0.37	-2.23	2.97	1.00
Professional School-Apprenticeship or trades	0.00	-2.01	2.01	1.00	0.46	-1.41	2.32	0.99
Secondary (high school diploma or equivalent)-Apprenticeship or trades	0.15	-1.44	1.75	1.00	0.33	-1.16	1.81	0.99
University bachelor level degree-Apprenticeship or trades	0.88	-0.59	2.35	0.57	1.14	-0.22	2.51	0.17
University graduate school-Apprenticeship or trades	1.26	-0.38	2.89	0.26	1.38	-0.14	2.90	0.10
No formal education (less than high school diploma)-College or other non-university level	0.08	-2.42	2.58	1.00	0.01	-2.31	2.33	1.00
Professional School-College or other non-university level	0.01	-1.56	1.57	1.00	0.10	-1.35	1.55	1.00

Secondary (high school diploma or equivalent)-College or other non-university level	0.16	-0.82	1.14	1.00	-0.03	-0.94	0.88	1.00
University bachelor level degree-College or other non-university level	0.89	0.12	1.65	p<0.05 **	0.78	0.07	1.49	p<0.05 **
University graduate school-College or other non-university level	1.27	0.22	2.31	p<0.01 ***	1.02	0.05	1.99	p<0.05 **
Professional School-No formal education (less than high school diploma)	-0.08	-2.89	2.74	1.00	0.09	-2.53	2.71	1.00
Secondary (high school diploma or equivalent)-No formal education (less than high school diploma)	0.08	-2.46	2.62	1.00	-0.04	-2.40	2.32	1.00
University bachelor level degree-No formal education (less than high school diploma)	0.80	-1.66	3.27	0.96	0.77	-1.52	3.06	0.95
University graduate school-No formal education (less than high school diploma)	1.18	-1.38	3.75	0.82	1.01	-1.37	3.39	0.87
Secondary (high school diploma or equivalent)-Professional School	0.15	-1.48	1.78	1.00	-0.13	-1.65	1.38	1.00
University bachelor level degree-Professional School	0.88	-0.63	2.39	0.60	0.69	-0.72	2.09	0.78
University graduate school-Professional School	1.26	-0.41	2.93	0.28	0.92	-0.63	2.47	0.58
University bachelor level degree-Secondary (high school diploma or equivalent)	0.73	-0.17	1.62	0.20	0.82	-0.01	1.65	0.06
University graduate school-Secondary (high school diploma or equivalent)	1.10	-0.04	2.25	p<0.1*	1.05	-0.01	2.12	p<0.1*
University graduate school-University bachelor level degree	0.38	-0.58	1.34	0.91	0.24	-0.66	1.13	0.99

Factor Loadings

Statement	Factor 1: Environmental Concerns	Factor 2: Social and Cultural Considerations	Factor 3: Land Use and Local Economies	Food 4: Food Security
Building relationships between consumers and growers	0.16	**0.68**	0.33	0.12
Encouraging stores to sell more local food	0.27	**0.60**	0.30	0.34
Improving the conditions and quality of life of farm animals	0.30	**0.51**	0.15	0.46
Increasing access to culturally appropriate foods	0.34	**0.50**	0.21	0.18
Providing resources for people to grow their own food	0.28	**0.47**	0.45	0.14
Reducing greenhouse gas emissions in agriculture	**0.72**	0.14	0.11	0.31
Reducing water use in agriculture	**0.60**	0.15	0.29	0.14
Reducing food packaging materials	**0.58**	0.21	0.14	0.11
Reducing agriculture impacts on wildlife habitat	**0.57**	0.29	0.16	0.34
Educating consumers about sustainable food	**0.51**	0.45	0.27	0.20
Making use of vacant spaces in/close to cities	0.35	0.22	**0.70**	0.13
Increasing the number of farms in or nearby cities	0.08	0.28	**0.67**	0.19
Recruiting more young people to work in agriculture	0.19	0.34	**0.41**	0.19
Increasing access to healthy foods	0.32	0.20	0.17	**0.66**
Protecting food production against natural disasters	0.27	0.19	0.32	**0.46**

Food System Development Priorities Factor Loadings.

Statement	Factor 1: Reformist	Factor 2: Status Quo
Cellular agriculture production will happen with small community-owned businesses	**0.76**	**0.20**
Anyone will be able to access information and training to learn how to grow cellular agriculture foods	**0.73**	**0.09**
In the future, I could see people producing cellular agriculture food in their kitchen, like a sourdough starter	**0.69**	**0.13**
Farmers are likely to transition to producing animal products with cellular agriculture	**0.69**	**0.13**
Conventional farmers will benefit from cellular agriculture industries as it gives them new business	**0.65**	**0.03**
Cellular agriculture will contribute to greater food security at the local or regional level	**0.62**	0.11
Cellular agriculture will replace most or all fresh meat products	**0.62**	0.18
Food banks and community centres will benefit from local cellular agriculture production	**0.52**	0.11
Cellular agriculture products will be widely available in most grocery stores*	**0.54**	0.16
Cellular agriculture products will be an added ingredient in most or all frozen/prepared meat products*	**0.43**	0.23
Cellular agriculture products will be something you can buy online or in most superstores*	**0.48**	0.19
Only wealthier people will be able to afford cellular agriculture products	0.10	**0.61**
Becoming a cellular agriculture professional will require specialized, advanced education that most people will not be able to access	0.09	**0.57**
Cellular agriculture jobs will mostly be in larger cities and urban centres	0.13	**0.55**
Production methods for cellular agriculture will be kept out of public view and understanding	0.08	**0.55**

Cellular agriculture products will mainly be available in larger cities and urban centres	0.20	**0.53**
Cellular agriculture will mainly be run by large food processing and production companies	0.02	**0.51**
Conventional farmers will lose businesses and livelihoods as the cellular agriculture industry grows	0.09	**0.47**

Scenarios Factor Loadings. Note: the '*' denotes factor statements that originally loaded onto a third variable but, due to similar factor loadings and conceptual similarities, were combined with Factor 1 scenario statements.

Statement	Factor 1: Widely Available	Factor 2: Decentralized
11. Cellular agriculture production will happen with small community-owned businesses	0.25	**0.68**
3. Anyone will be able to access information and training to learn how to grow cellular agriculture foods	0.29	**0.68**
12. In the future, I could see people producing cellular agriculture food in their kitchen, like a sourdough starter	0.37	**0.61**
18. Conventional farmers will benefit from cellular agriculture industries as it gives them new business	0.44	0.43
2. Cellular agriculture products will be widely available in most grocery stores	**0.77**	0.27
17. Cellular agriculture products will be something you can buy online or in most superstores	**0.67**	0.28
1. Cellular agriculture will contribute to greater food security at the local or regional level	**0.70**	0.34
10. Food banks and community centres will benefit from local cellular agriculture production	**0.54**	0.32
13. Cellular agriculture will replace most or all fresh meat products	**0.38**	0.43
15. Farmers are likely to transition to producing animal products with cellular agriculture	0.30	0.33

Reformist Scenarios Factor Loadings.

Statement	Factor 1: Centralized	Factor 2: Closed
B7 Cellular agriculture will mainly be run by large food processing and production companies	**0.48**	0.40
B9 Cellular agriculture jobs will mostly be in larger cities and urban centres	**0.74**	0.27
B8 Cellular agriculture products will mainly be available in larger cities and urban centres	**0.73**	0.27
B5 Production methods for cellular agriculture will be kept out of public view and understanding	0.26	**0.52**
B14 Conventional farmers will lose businesses and livelihoods as the cellular agriculture industry grows	0.14	**0.50**
B4 Only wealthier people will be able to afford cellular agriculture products	0.30	**0.42**
B6 Becoming a cellular agriculture professional will require specialized, advanced education that most people will not be able to access	0.26	**0.63**

Status-Quo Scenarios Factor Loadings.