University of British Columbia

Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Supporting Climate-Ready Food Gardens:

Climate Resilient Campus Community Foodscapes

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Prepared for: UBC Campus & Community Planning and UBC Botanical Gardens

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LAND ACKNOWLEDGEMENT

The University of British Columbia is located on the traditional, ancestral and unceded territories of the xʷməθkʷəy̓əm (Musqueam) First Nation. The Musqueam people have been tending to and cultivating this land since time immemorial.

The work, research, interviews, and focus groups presented in this project were conducted on these lands and include suggestions and practices that were introduced to this land through the ongoing process of colonialism. It is important to acknowledge the historical and ongoing impacts of agriculture on Indigenous communities and foodways and its use as a tool of colonization.

The land that UBC occupies was and continues to be significant to the Musqueam people and remains an integral part of their food system. We hope that our project can support UBC SEEDS, Campus and Community Planning and the Faculty of Land and Food System's ongoing reconciliation efforts.

PRACTITIONER SUMMARY

UBC Climate Ready Food Gardens

Climate Resilient Campus Community Foodscapes

RESEARCH BACKGROUND

- Our food systems are vulnerable to the impacts of climate change such as extreme heat, drought, flooding, and shifting seasonality.
- Regional, national, and international policies have highlighted the need to strategize pathways toward climate resiliency while maintaining food production.

PROJECT PURPOSE

- Support UBC institutional leadership on fostering climate-ready food systems.

PROJECT GOALS

1. Develop a knowledge base of food plants suitable for growth in projected climate conditions for 2030 to 2050.
2. Develop informational tools for developing and maintaining climate-ready campus food gardens.

PROJECT OBJECTIVES

- Determine climate-resilient food plants suitable for growth on the UBC Vancouver campus.
- Identify promising garden management practices.
- Elicit community feedback to inform future climate-ready campus food gardens.

METHODS

LITERATURE REVIEW
of climate projection data and promising gardening practices

2 FOCUS GROUPS
with campus food growers

3 INTERVIEWS
with community planning, climate emergency, and food security experts

DELIVERABLES

Climate-Ready Food Plant List

- Contains vegetables, fruit trees, berries, herbs, and medicinal plants that will be suitable for growth under future climate conditions on the UBC Vancouver campus.

Climate-Ready Food Garden Management Plan

- A visual and informative document for food growers.
- Contains climate-ready garden management strategies, climate-ready plants, planting suggestion diagrams, and more.

KEY FINDINGS: THE 4 PILLARS OF CLIMATE-READY FOOD GARDENS

- Community Resilience
- Indigenous Knowledge and Values
- Ecological Resilience
- Reciprocity

EXECUTIVE SUMMARY

The Intergovernmental Panel on Climate Change (IPCC) has forecasted an increase in mean annual temperatures and in the frequency and severity of weather events including droughts, heat waves and heavy precipitation (Seneviratne et al., 2012). Future shifts in weather events will expose vulnerabilities in our food system, necessitating action to mitigate their harmful effects (AAFC, 2022). In response to the climate emergency, UBC has developed the Climate Action Plan 2030 that aims to reduce GHG emissions and expand research on climate-friendly food systems (CFFS) at UBC (UBC, 2021; UBC 2023). UBC SEEDS and Campus Planning have also identified the need for more information on CFFS to support UBC's fifteen campus food gardens. Previous SEEDS research has recognized the roles that these gardens play in increasing food security and shaping the campus community (Ng et al. 2018; Zeng et al. 2019; Bharmal et al. 2007), highlighting the importance of safeguarding these spaces against future climatic changes.

Under the guiding principles of Community-Based Action Research (CBAR), our team carried out primary and secondary research through a literature review, focus groups and interviews to understand how campus food gardens could become more climate resilient. In focus groups and interviews, key stakeholders including campus food growers, the UBC Climate Emergency Task Force, UBC Campus and Community Planning, and the UBC Food Hub, were consulted to identify community needs and develop collaborative and informed recommendations for future campus food gardens.

Results from our literature review indicated general trends of increased temperatures and drier conditions throughout the summer months (Bush, E. and Lemmen, D.S., 2019) as well as increased frequency of extreme weather events (Metro Vancouver, 2016). This data informed the development of a food plant list suitable for future climate conditions. Focus groups conducted with campus food growers identified six main campus garden challenges, ten garden management practices, and twenty-two discrete criteria that campus food growers use when selecting plants for their campus food gardens. Interviews conducted with campus groups identified six potential roles of future campus food gardens, and nine challenges associated with establishing and maintaining them. From these findings, we identified four central themes that climate-ready campus gardens embody: Community Resilience, Ecological Resilience, Indigenous Knowledge and Values, and Reciprocity. Across these themes, our research participants identified a need for greater communication among campus food growers, including more opportunities for knowledge-sharing. These findings, along with our secondary research, helped to inform the development of two project deliverables: a 'Climate-Ready Food Plant List' and a 'Climate-Ready Food Garden Management Plan'.

Based on our findings, we recommend that UBC Campus and Community Planning implement our Climate-Ready Plant List and distribute our Garden Management Plan to campus food growers. We also propose the development of a campus food garden network and improved communication pathways between campus food growers to increase community *and* climate resilience. Recommendations for future SEEDS research include expanding our climate-ready plant list to include more planting information, updating food garden recommendations as climate projections change, and extending research on campus food gardens to foodscapes.

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LIST OF ABBREVIATIONS

1. **CAP 2030:** Climate Action Plan 2030
2. **C+CP:** Campus and Community Planning
3. **CCCR:** Canada's Changing Climate Report
4. **CFFS:** Climate Friendly Food Systems
5. **CIMP5:** Coupled Model Intercomparison Project Phase 5
6. **CIRS:** Centre for Interactive Research on Sustainability
7. **DPA:** Development Permit Application
8. **GHG:** Greenhouse Gas
9. **GMP:** Garden Management Plan
10. **IAF:** Investment Agriculture Foundation
11. **IPCC:** Intergovernmental Panel on Climate Change
12. **RCP:** Representative Concentration Pathways
13. **SEEDS:** Social Ecological Economic Development Studies
14. **UBC:** University of British Columbia
15. **UBCFSP:** UBC Food System Project
16. **UNA:** University Neighbourhood Association

1. INTRODUCTION

1.1 RESEARCH TOPIC

The impacts of climate change in the Vancouver region are being felt throughout society and will continue to increase into the future. Agriculture and food production is one of the areas that has and will continue to feel these impacts directly. As a world-leading academic research institution, UBC is well-positioned to enhance climate research and lead the demonstration of just and resilient campus-wide food systems. The UBC Climate Emergency Engagement Report and Recommendations has highlighted a community desire to see campus landscapes used to further food security at UBC (UBC, 2021). Additionally, UBC Campus Planning has identified the need for an integration of climate-ready campus food systems. (UBC, 2021) Many plants cultivated for food may not be able to survive in conditions of future climate scenarios as campus gardens are vulnerable to impacts of high heat, drought, and limited water (Tomatis et al., 2023). Extreme temperatures can scorch the leaves of food plants and reduce productivity, while changes in weather patterns can bring new challenges of pests and diseases (Tomatis et al., 2023). Our research is focused on increasing the climate resiliency of campus gardens into the future by identifying food plants that will be suitable for growth into the future based on climate predictions, and suggesting promising management practices for current and future campus gardens based on a synthesis of gardening knowledge that exists on campus. It is suggested that drawing upon local community knowledge can help overcome the combined challenges of climate change and biodiversity conservation, to enhance resilience in food cultivation and ensure food security (Tomatis et al., 2023). This research will explore the roles of future food gardens, as well as their function in promoting resilience within campus communities, particularly in the face of a changing climate. Overall, this study aims to identify the potential of campus food gardens to demonstrate and support the development of sustainable, adaptable, and resilient food systems that can withstand the impacts of climate change.

1.2 RESEARCH RELEVANCE

Anthropogenic induced climate change is evident through changing weather patterns observed across the globe (IPCC, 2021). An IPCC report from 2021 states that in order to prevent the worst-case climate change scenarios, a prompt and heavy reduction in greenhouse gas emissions is necessary to limit global warming beyond 1.5°C (IPCC, 2021). Across British Columbia, extreme weather events including scorching temperatures under heat domes, flooding induced by atmospheric rivers, droughts, and wildfires have had severe consequences to the health of communities and ecosystems alike; the 2021 heat dome alone resulted in the deaths of 600 people, an estimated billion intertidal marine organisms, and more than 650,00 farm animals (Government of Canada, 2021). Notably, local and global food supply chains have faced disruptions due to compounding effects of climate change and other recent global events such as the COVID-19 pandemic (Mu et al., 2022). Therefore, there is an urgent need to understand the risks, barriers, and opportunities for climate-resilient food production and to commit to actionable, local measures to increase resiliency.

In recognition of Canada's commitment to The Paris Agreement, leading institutions have taken on the responsibility of strategizing pathways towards climate resiliency, adaptation, and lowering emissions while maintaining food production (United Nations, 2015). The Climate Change Adaptation Program, funded by the Investment Agricultural Foundation (IAF) of BC, seeks to gain a better understanding of the impacts of climate change on agriculture in a regional setting, and to identify strategies for climate adaptation (IAF, 2022.). Similarly, the Metro Vancouver Climate 2050 Strategic Framework names agriculture as a regional priority and acknowledges the need for resilience in future food systems, as food plants that exist now but "will be impacted or could be displaced entirely" under future conditions (Metro Vancouver, 2018).

UBC has enacted several policies, plans, and strategies in response to the growing climate emergency including the UBC Climate Action Plan 2030 (CAP 2030) (UBC, 2021; UBC Wellbeing, 2022). Our research directly contributes to addressing CAP 2030 policies, within the focus area of food systems, by advancing research on

climate-friendly food systems at the UBC Vancouver campus. Our project made a significant impact on addressing CAP 2030 food system action items by conducting secondary research on future climatic conditions until 2050 and creating a list of food plants suitable for growth under these conditions. The Climate-Ready Food Plant List that our team developed will help guide a strategic climate-friendly planting strategy for UBC Campus and Community Planning, as well as the greater UBC community. Through community-based research and dialogue with key stakeholders, the needs of the campus community were identified for future food garden landscapes and a Climate-Ready Campus Food Garden Management plan developed, driven by the needs and expertise of the UBC Community.

Our project contributes to the informational tools and resources UBC has for demonstrating and sharing food-system climate research. Our research further informs campus policies and supports the broader Vancouver community on how to navigate food production challenges presented by climate change, while promoting community resilience. As such, we anticipate the long-term outcomes of our research will be foundational for developing and demonstrating a future climate-adapted local food system that can continue to produce food, reduce food insecurity, and promote sustainable communities.

1.3 PROJECT CONTEXT

In response to the threats that climate change poses to our food systems, many governments and organizations have begun developing climate change adaptation strategies and policies to increase their climate resilience (CRFS Alliance, 2022). It is imperative that community planners consider climate-resilient foodscapes as a key component of climate adaptation within these strategies. Foodscapes are particularly vulnerable to climatic changes as their productivity and health depend directly on the success of plants (Owino et al. 2022). Conventionally managed foodscapes are at an even higher risk of failure in the case of extreme weather events due to low plant diversity and monoculture cropping (Mirás-Avalos & Baveye, 2018). Protecting, conserving, and future-proofing our foodscapes will be necessary to maintain food security in the face of climate change.

On UBC campus, there are around 15 established food gardens operated by various student groups and campus organizations (UBC SEEDS, 2021). These gardens help to support on-campus food security and food sovereignty, increase access to local produce, contribute to community health and wellbeing, and act as a space for community engagement and connection (Ng et al. 2018; Zeng et al. 2019; Bharmal et al. 2007). While previous SEEDS Research has suggested that many of these gardens utilize sustainable garden management practices (Campomanes et al., 2021), few are equipped with the strategies required to withstand the impacts of future climatic changes (Tomatis et al., 2023).

To address the climate-preparedness of campus food systems and gardens, UBC has launched an ambitious strategy in the UBC Climate Action Plan 2030 or CAP 2030 (UBC, 2023). CAP 2030 has outlined six short-term action items for increasing food system sustainability on campus. These actions include developing a Food System Resilience and Climate Action Strategy that "advances climate-friendly foods" and a second action item of expanding interdisciplinary "research to advance climate-friendly food systems" spanning mitigation and adaptation at UBC by 2024 (UBC, 2021). Previous SEEDS research has also identified a need to advance community education on food system sustainability and enhance food garden diversity through a strategic planting strategy (Buchheister et al., 2020; Campomanes et al., 2021).

The initiatives of previous SEEDS research and the short-term action items outlined in CAP 2030 informed the need to develop this research project. This project has directly contributed to the outlined actions through the development of a holistic Climate-Ready Food Garden Management Plan and Climate-Ready Food Plant List that consider biodiversity, pollinators, and ecological sustainability in their design.

1.4 PROJECT PURPOSE, GOALS AND OBJECTIVES

The purpose of our research project was to support institutional leadership on fostering climate-ready local food systems in the UBC campus and broader Vancouver region. Our goal was to cultivate a knowledge base of food plants suitable for growth in future climate conditions in 2030 to 2050 in the UBC Vancouver region and develop informational tools for UBC food growers, landscape architects, and garden designers to use in developing and maintaining climate-ready campus food gardens. To address our research goal, we had the following three objectives: (1) Conduct a literature review of projected future climate conditions in 2030 and 2050 at the UBC Vancouver Campus and determine suitable food plants for growth in predicted climate conditions, (2) Identify promising garden management practices for climate-ready food gardens through engaging in dialogue with stakeholders involved with campus food gardens and through secondary research, and (3) Conduct interviews and focus groups with key stakeholders affiliated with growing food, landscape and garden design, food security, and climate planning to elicit community feedback to inform plans and practices for current and future climate-ready campus food-gardens.

2. METHODOLOGY AND METHODS

2.1 RESEARCH METHODOLOGY

Throughout the project, the research team adhered to the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (Panel on Research Ethics, 2023), and obtained informed consent (Appendix B.1) from participants prior to proceeding with research. We were guided by the methodology of 'Community-Based Action Research' (CBAR), an approach to research that is driven by stakeholders, collaborative at every stage, and offers a democratic model for who can produce, own, and use the knowledge gained from research (Pain et al., 2019). The team applied CBAR principles by engaging in meaningful dialogue with campus stakeholders to identify key issues, challenges, and opportunities for developing and maintaining climate-ready campus food gardens. This process enabled the team to establish a knowledge base of available community resources while mobilizing and strengthening existing relationships between stakeholders on campus. Guided discussions facilitated the

exchange of information and ideas to inform the design of the 'Climate-Ready Garden Management Plan' and the 'Climate-Ready Food Plant List' deliverables, these interactions led to recommendations for action and research driven directly by the needs and priorities of the UBC community. UBC's Safe Research Plan (Appendix B.2) was followed at all stages to ensure safety of clients. Additionally, all data and documents created in the research process were stored securely on Microsoft One Drive and shared through secure One Drive links.

2.2 RESEARCH METHODS

Research was conducted through a combination of primary and secondary research. Primary research methods included two focus groups and three semi-structured interviews. Secondary research methods included a literature review on projected climate conditions for the UBC campus and broader Vancouver region to determine the future environmental conditions for growing food plants. Literature on sustainable agricultural practices and urban gardening was also reviewed to identify promising gardening practices in the context of climate change. The objective of the focus groups was to assess the current state of food gardens and gather feedback from the food grower community on plants, practices, and strategies for enhancing climate-readiness of campus food gardens for projected climate conditions between 2030 and 2050. Interviews were conducted to gain insight into the development of campus gardens and gather feedback on community needs for the role of future climate-ready food gardens. Our primary data collection methods established meaningful dialogue with stakeholders who possess invaluable knowledge derived from their lived experiences in relation to growing food, campus landscape design, the climate emergency, and food security challenges. Together, focus groups and interviews were instrumental in mobilizing existing community knowledge for planning climate-ready food gardens on the UBC campus.

2.2.1 SECONDARY DATA COLLECTION RESEARCH METHODS

Climate data research began with a review of government climate change mitigation strategies such as the BC Climate Preparedness and Adaptation Strategy and the Metro Vancouver Climate 2050 Strategic Framework, to gain an understanding of the sources of climate data that were being used to create these plans. From these, we identified key sources of data on global, national, regional, and local scales to evaluate the consistency and accuracy of the downscaling of CMIP5 models that these climate science publications rely on. This included considering major publications such as the IPCC AR5 Synthesis Report, Canada's Changing Climate Report and the Metro Vancouver Climate Projections as well as models and reports from the Pacific Climate Impacts Consortium and the Climate Atlas of Canada. The consideration of climate data on multiple scales allowed us to synthesize an integrated picture of the future climate conditions on the UBC campus.

Research into climate resilience plants that would be suitable for growth under future climate conditions was done through a review of both plant science literature and local planting guides and seed banks to ensure that both academic and local community knowledge was being represented. The first step of this research involved developing a primary list of plants that are both available and in demand for growth locally through a review of local planting recommendations such as Metro Vancouver Seasonal Growing Charts, and past a UBC SEEDS Research Report, the Diversity of Food Plants in UBC Community Gardens. Next, we looked to our findings from climate data research to develop criteria for the Climate Ready Plant List that reflected increased resilience to identified future climate conditions. This was supplemented with additional research to understand criteria for the list that would support the overall resilience of food gardens. Plants were then evaluated against these criteria to determine their suitability. This was done through the consideration of numerical plant science data, such as single crop coefficients, crop root depth and availability coefficients made available for farmers by the BC government, as well as consulting local food growing resources such as West Coast Seeds, BC Eco Seed Co-op, the BC Vegetable Production Guide, the Grow Green Guide, and Salt Spring Seeds to understand the differing characteristics of specific plants and varieties. Plants were selected for the final plant list based on the

identification of qualities that allow them to be resilient to the major trends that are predicted under future climate change predictions.

Research throughout the project was also done to identifying promising gardening practices. To identify practices, search terms of 'sustainable growing practices', 'urban gardening', 'climate', 'adaptation', and 'sustainable agriculture' were used on UBC's web of science. These practices were identified early in the research process and then further built upon to support our discussion.

2.2.2 PRIMARY DATA COLLECTION RESEARCH METHODS

Focus Groups

Our sample included campus community stakeholders affiliated with student run, academic, and community food gardens. The research team selected our participant sample to ensure that our research on supporting climate-ready campus gardens, as well as deliverables and recommendations were driven directly by the perspectives and priorities of the UBC food grower community. Focus group participants represented six campus groups, including the UBC Farm, University Neighbourhood Association (UNA), The Climate Hub, Roots on the Roof, Agronomy Garden, and Residence Life. In total, we recruited 10 participants across the two focus groups. Of the eight campus groups invited, 6 responded. From those interested, we recruited 5 groups resulting in an attendance response rate of 63%. One additional campus group (Residence Life) also attended. Our focus group data collection tools included open-ended research questions (Appendix B.7, B.8) prepared in scripts (Appendix B.9, B.10) that encouraged participants to discuss openly with questions or comments they had for others in the group. Additional tools we used were audio recording devices, visual notetaking to capture important themes (Appendix B.11), and manual transcribing.

Interviews

The attributes of our interview sample groups included campus groups affiliated with campus landscape and garden design, climate justice initiatives, and food security. Interview participants represented UBC Campus

and Community Planning, the UBC Climate Emergency Task Force, and the UBC Food Hub. The research team selected these research areas to learn how campus food gardens relate to the diverse set of needs and agendas of different campus organizations. We wanted to get a full picture of the impact that campus food garden spaces have on the wider UBC community and ensure that our deliverables and recommendations considered a wide range of perspectives. Of the three campus organizations we sent emails to, we received a 100% response rate. Tools used included an interview script with preprepared research questions (Appendix B.12, B.13). We also used audio recording devices and took notes during the interviews to capture big ideas and recurring themes.

For both the focus groups and interviews, Otter AI was used to produce a raw transcript by uploading the audio files which were then edited for accuracy by the research team. To code the textual data, we used a combination of the following software tools: NVivo, Excel, and Word. See Figure C.1, Table C.2, and C.3 in Appendix C for an overview of the codes used across the focus groups and interviews. Once coding was complete, excerpts were transferred into Excel for the thematic analysis stage.

2.3 METHODS OF ADMINISTRATION

Focus Groups

Once the sample attributes for focus groups were established, a participant recruitment plan was developed which included contact information of the communication representative of on-campus food growing groups. To recruit campus food growers for focus groups, a combination of purposive sampling and snowball sampling was used. Purposive sampling, a non-probability sampling method, was utilized in order to reach campus student, staff, and residents who has the shared characteristic of being food growers. Contact was initiated by email on Friday, March 3rd inviting food growers to an in-person first focus group on Tuesday, March 14th from 2:30-4:00pm. The email provided a brief description of our project, the objective of the focus group, consent forms, and a Qualtrics registration form (Appendix B.4) to confirm their interest in participating. All invitees received the same email to ensure consistency in the information communicated (Appendix B.3). In order to reach relevant individuals that may have not been identified in our participant recruitment plan, invitees were

asked to forward the email invitation to relevant food growers in their campus group network. While the original intention was to have one larger focus group, due to participant availability, a second focus group was scheduled virtually for Friday, March 24th from 12:30-2:00 pm. The recruitment method for the second focus included following up with food growers who expressed interest in the first focus group but could not attend. The day before both focus groups, a research team member sent out a reminder email with the time and location of the event along with the research questions so that participants could prepare as desired.

The first focus group was hosted in Policy Lab A and B at the Centre for Interactive Research on Sustainability (CIRS) and the second focus group was hosted online using the Zoom platform. Overall, focus groups were selected as our data collection method with food growers due to their ability to facilitate conversations between multiple key stakeholders simultaneously and allow participants to interact with one another; a characteristic essential to CBAR that would be limited by surveys.

Interviews

After selecting organizations based on our priority research areas, a participant recruitment plan was developed that included the names and contact information of campus group representatives. To recruit participants for our interviews, we sent emails to identified groups engaged in climate action, campus planning and policy, Indigenous sovereignty, and food security. Individual and group interviews were selected as a method due to their flexibility in scheduling, the ability to ask follow-up questions, and to gain specific feedback.

Our first interview was arranged via email by one of our community partners. The following two interviews were arranged by the research team via email. Two emails were sent on Wednesday, March 15th, initiating contact and offering potential meeting times for a 45-minute Zoom interview. The emails contained more information about our project, how we felt the organization could offer knowledge on our topic, and guiding questions to direct the interview. The questions asked in the interviews were unique to each organization

to ensure that their responses would help us guide our research and the creation of our deliverables (See Appendix B.12, B.13).

Semi-structured interviews were conducted on March 17th in-person from 9:00-9:45 AM, March 20th on Zoom from 4:15-5:00 PM, and March 29th on Zoom from 1:00-1:45 PM. In the interviews, one researcher acted as a facilitator and a second as a notetaker. The in-person interview was audio-recorded using an iPhone and the interviews on Zoom were cloud recorded using Zoom's built-in software to ensure that the interview was documented and saved.

3. RESULTS

3.1 SECONDARY RESEARCH

3.1.1 CLIMATE DATA RESULTS

Projections of future climate conditions show similar trends across data sources and models on global, national, regional, and local scales. The IPCC uses four different RCPs to explain future scenarios based on differing levels of GHG emissions into the future (IPCC, 2014). Canada specific projections have been created based on 29 different CIMP5 models and represented with three of the RCPs (RCP2.6, RCP4.5 and RCP8.5) (Bush, E. and Lemmen, D.S., 2019) and Vancouver-specific projections based on 12 different CIMP5 models (Metro Vancouver, 2016).

On average, temperature increases will be seen throughout the year in British Columbia for all RCPs, ranging from a 1.3 to 1.9 degrees Celsius increase by 2050 (Bush, E. and Lemmen, D.S., 2019). Warming will continue to accelerate in the second half of the century under high emissions RCPs with a future projected increase of a maximum of 5.2 degrees Celsius in British Columbia by 2100 (Bush, E. and Lemmen, D.S., 2019).This will contribute to an increase in the number of heat days (Figure 1), or days above 30 degrees Celsius to an average of 14 days a year by 2050 (Metro Vancouver, 2019). This will lead to an increase in frost free days throughout the course of the year, with an average decrease in frost days (Figure 1) at low elevations in

Vancouver by 28 days by 2050 (Metro Vancouver, 2019). These days will occur most frequently earlier in the spring and later into the fall.

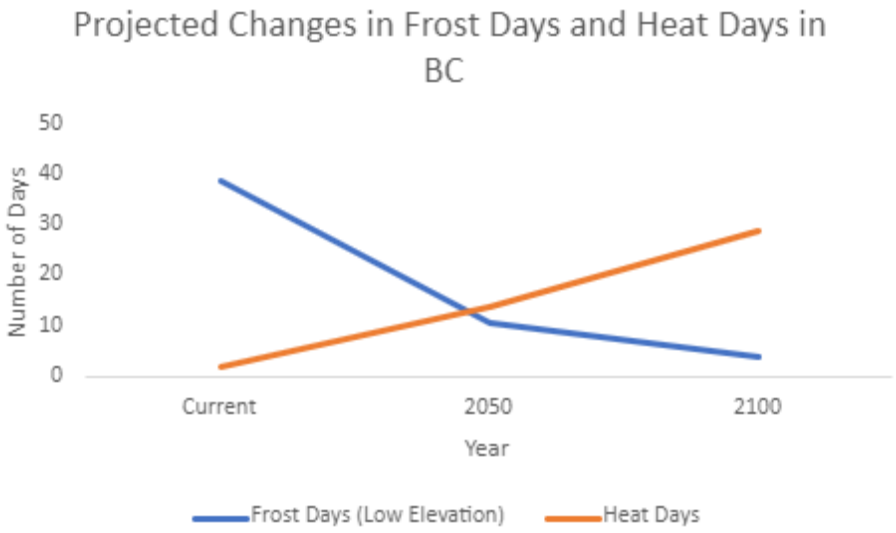

Figure 1: Projected Frost Days vs Heat Days in Vancouver

Precipitation changes will occur throughout British Columbia, and Vancouver is expected to see an increase in annual precipitation of 5% by 2050, with an increasing unevenness to the seasonal distribution of rainfall (Metro Vancouver, 2016). Fall, winter, and spring are all expected to see increases in total rainfall but precipitation in the summer months will decrease (Figure 2) by about 19% by 2050 (Metro Vancouver, 2016). Due to warmer annual temperatures, a higher percentage of precipitation will fall as rain rather than snow at all elevations. A reduction in annual snow accumulation by anywhere from 5 to 10% is predicted in southern Canada (Bush, E. and Lemmen, D.S., 2019) with a maximum of a 56% decrease by 2050 in Vancouver (Metro Vancouver, 2016). A decrease in winter and spring snowpacks has impacts on the availability of freshwater and the ability of local watersheds to be replenished. Overall, this will contribute to more frequent and severe water shortages in the summer months.

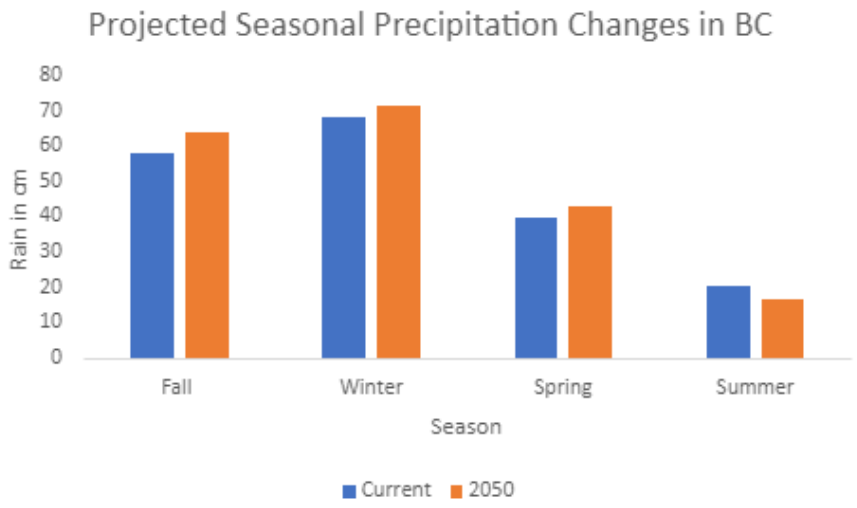

Figure 2: Projected Precipitation Changes in BC for all Seasons Under RCP8.5.

Lastly the frequency and intensity of extreme weather events such as droughts, flooding and wildfire is expected to increase (IPCC, 2014). Canada's Changing Climate Report identifies changes in climate extremes as the most serious impact of climate change (Bush, E. and Lemmen, D.S., 2019). In the summer of 2022 over 1700 wildfires were recorded, which is about 300 higher than the current ten-year average (PCIC, 2022). This is a number that will increase into the future with temperature increases and decreases in summer precipitation. Additionally, the probability of events that produce the level of precipitation that was seen in the atmospheric river in the Fraser Valley in 2021 is expected to increase by 45% (Gillett N.P., 2022). The frequency and duration of dry spells, or number of consecutive days where precipitation is less than 1mm, in the Vancouver region is expected to increase by 22% by 2050. These extreme events can be forecast in the short term, but their unpredictability is increasing, and so the reliability of forecasts will decrease with time (IPCC, 2014).

3.1.2 CLIMATE READY PLANTS

The climate-ready plant list was developed through the evaluation of 82 plants that were identified as available and relevant in the Vancouver region. The final list includes 37 different species of food plants that will be suitable for growth under future climate conditions, separated into four different categories: vegetables, fruit trees, berries, and herbs/medicinal plants. Among the plant species recommended, 50 varieties were included in

the list as well. Specific plant variety recommendations were made if there was a difference in characteristics of resilience based on our criteria for evaluation between varieties of a specific plant.

The criteria for selection against which each plant was evaluated (Table 1) is included in the plant list, either as an assigned value on a scale or a binary. For example, drought tolerance fell within a range from low to high, with a total of five possible designations, while pest resistance of a plant was assigned a Yes or No value. For each of the criteria, there was at least one plant identified for each possible option, with a greater emphasis on plant qualities that are relevant to general trends in future climate conditions, specifically drought and heat tolerance. 33 out of 50 varieties of plant were identified to have at least mid-drought tolerance and 31 of 50 varieties were identified to be heat tolerant, with another seven being identified as tolerant of temperature fluctuations. 26 of 50 prefer dry or average to dry soil moisture levels while three of 50 prefer wet or wet to average soil moisture. 44 of 50 require full or part sun while six of 50 can tolerate shade. Eight varieties were identified to be pest resistant, while 45 were pollinator friendly. Lastly, 22 of 50 were identified as perennial and five were native to BC.

Table 1. Criteria of Climate Resilience Used in the Development of the Climate Ready Plant List

Plant Selection Criteria and Designations	
Criteria	**Designations**
Drought Tolerance	Low, Low to Mid, Mid, Mid to High
Heat Tolerance	Cold Tolerant, Cold and Heat Tolerant, Heat Tolerant, Tolerant of Temperature Fluctuations
Soil Moisture Preference	Wet, Wet to Average, Average, Average to Dry, Dry, Wet to Dry
Sun Preference	Full Sun, Full Sun/Part Sun, Full Sun/Part Sun/Shade, Part Sun/Shade
Pest Resistant	Y or N
Pollinator Plant	Y or N
Perennial (P) or Annual (A)	P or A
Native to BC	Y or N

3.1.3 PROMISING GARDEN MANAGMENT PRACTICES

Results from secondary research on sustainable growing practices were centered around crop diversification, soil and water management and microclimate regulation. Crop diversification involves switching from a single crop scheme to cultivation of multiple crops, such as, intercropping, companion planting, crop rotation or integrating perennials (Dubey et al., 2020). Diversification improves productivity by increasing the efficiency of a growing space through the cultivation of multiple crop varieties. Through our literature review, we found that many sustainable growing practices are rooted in Indigenous Traditional Agroecological Knowledge (TAeK) (Guerrero Lara et al., 2019). Intercropping, for example, is a historical agricultural practice used by Indigenous peoples of America (Kapayou et al., 2023). Intercropping alters the crop microclimate by lowering soil temperatures through reducing sun exposure to the soil and increasing moisture levels (Dubey et al., 2020). This practice can improve water use efficiency by preventing evaporative water loss. Diversification also improves resilience by suppressing pest and pathogen transmission (Lin, 2011). The insurance hypothesis suggests that diverse cropping schemes provide an extra measure of resilience if one crop species is better adapted to changing environmental conditions (Yachi & Loreau, 1999) which allows growers an economic buffer to climate risk. To respond to the effects of climate change, gardens can be adaptive by selecting a diversity of plants and drought resilient plants (Tomatis et al., 2023). Sustainable soil management practices can improve the water holding capacity of the soil (Tomatis et al., 2023) and build soil structure to mitigate impacts from drought. Notable practices include mulching, utilizing compost, cover cropping. Sustainable water management practices significantly reflected soil health, as well as drip irrigation, and drought resilient plants (Tomatis et al., 2023). In the design of the garden space, planting perennials, such as trees or shrubs, can protect crops from high temperature and alter the crop microclimate, while the garden space overall can play a significant role in lowering urban heat island effects (Tomatis et al., 2023).

3.2 PRIMARY RESEARCH

3.2.1 Focus Group Results

Challenges

In our analysis of focus group data, we identified over 120 data points that alluded to challenges being experienced by campus growers on the UBC campus. The majority of this data fell into the following seven categories: (1) Barriers to resource access, (2) Institutional Barriers, (3) Management Discontinuity, (4) Community Disconnect, (5) Climate Events, (6) Site Concerns, and (7) Other (Figure 3). Access to adequate watering infrastructure, such as irrigation, was mentioned in 46% of the responses within Site Concerns category. Frequently discussed challenges with the Climate Events category included shifting seasonality, extreme heat, and more frequent drought. Extreme heat was discussed most frequently, cited in 54% of responses related to Climate Events, and was associated with concerns for soil moisture retention, scorching plants with sun exposure, and human safety. The main challenged cited within the Resource Access category were logistical barriers to were accessing to soil and compost.

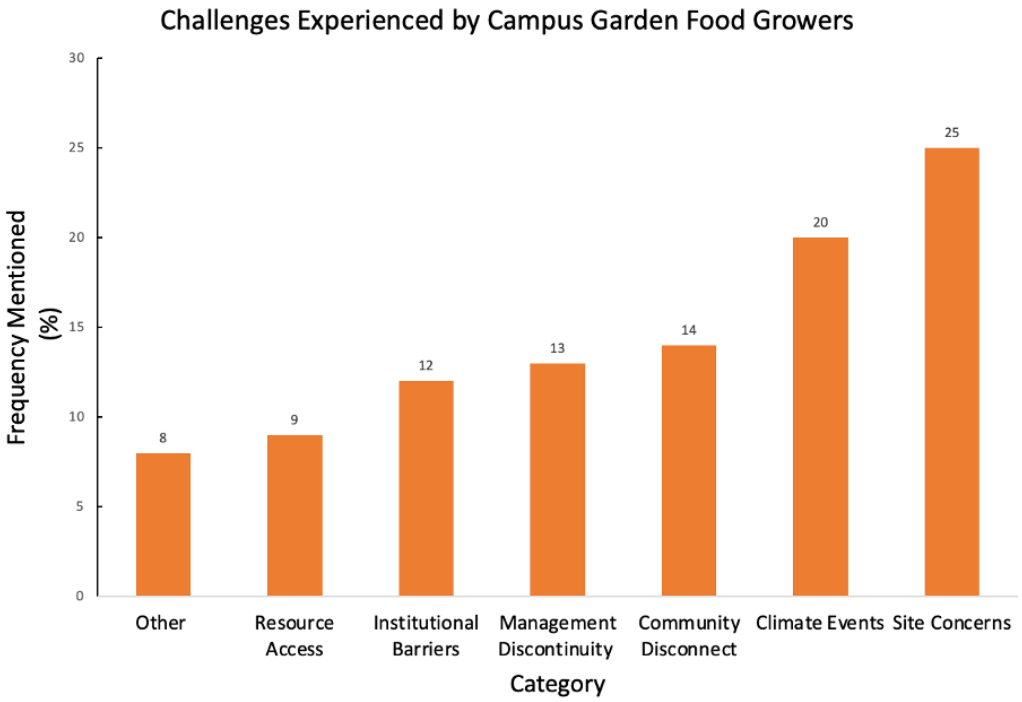

Figure 3: Challenges Experienced by Food Growers in Campus Food Gardens (n=120 data points)

Current Garden Management Practices

Through our focus group sessions, we identified 10 garden management practices currently being utilized across campus, which we have grouped into four distinct categories (Figure 4) based on our data analysis. The four categories which arose were as follows: (1) Building Soil health, (2) Sustainable Watering, (3) Microclimate Regulation, and (4) Crop Diversification. Microclimate regulation refers to the manipulation of small-scale environmental conditions within a garden, such as temperature, humidity, and light, in order to create an optimal growing environment for plants. Some growers described using techniques such as shade clothing, mulching, and planting perennials to embrace, and enhance, the shade in specific areas of their garden.

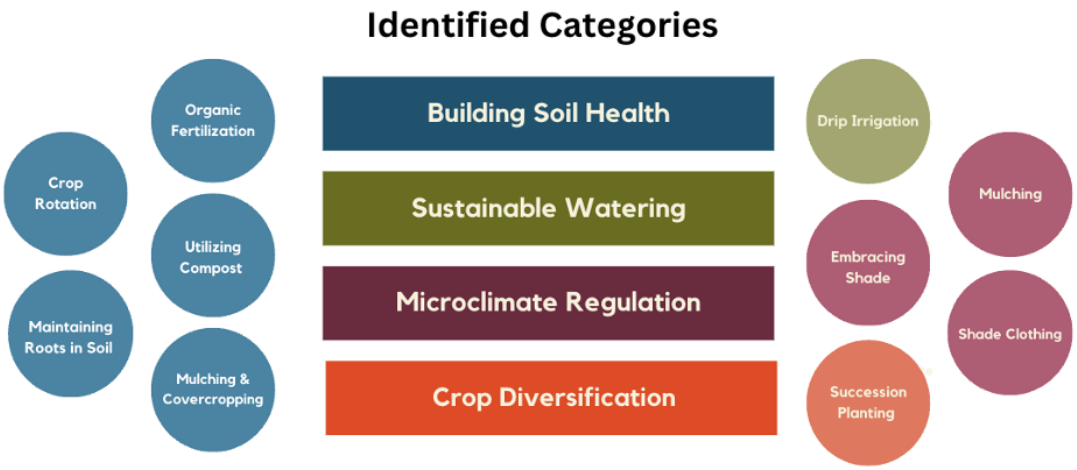

Figure 4: Garden Management Practices Identified in Focus Groups to be Used by Food Growers

Plant Selection Criteria

We determined 22 distinct criteria food growers consider when selecting plants for their campus food gardens. As shown in Figure 5, these criteria fell into the following five categories: (1) Economic Factors, (2) Logistical Consideration, (3) Climate Resilience, (4) Environmental Factors, and (5) Social Interests. Social Interests, Environmental Factors, and Climate Resilience were mentioned more frequently than logistical

Considerations and Economic Factors. Social interests were the largest category cited for plant selection in campus food gardens. As seen in Figure 5, Social Interest was mentioned in 21 of 53 responses related to plant selection and contained criteria such as community demand, cultural significance, research value, and productivity. The Environmental Factors category included criteria such as biodiversity value, pollinator-friendliness, whether it is a native plant, and soil-nutrient supporting capabilities. Considerations for selecting plants under the category of Climate Resilience were shade tolerance, heat tolerance, and micro-climate stabilization. See Table A.1 and Figure A.2 in Appendix A for a detailed analysis of all criteria food growers consider for plant selection.

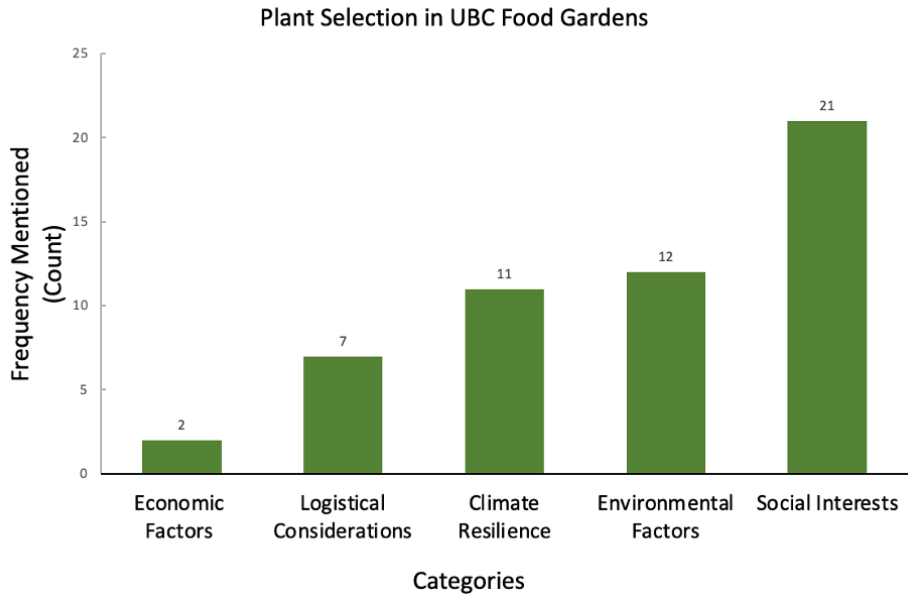

Figure 5: Main Categories for Food Grower Plant Selection (n=53 data points)

Food Grower Community Needs

The top three themes we identified as needs within the community of food growers were as follows: (1) a desire for community connection (40%), (2) pathways for knowledge sharing (40%), and (3) resource sharing (19%) (n=53 data points). Through focus group discussions, four strategies we determined for addressing these community needs and challenges discussed above (Table 2).

Table 2. Identified Strategies for Addressing Food grower Community Needs (n=34 data points)

Proportion	*Identified Strategy*
9%	Procedural documents to start and run a garden
15%	Information and recommendations for garden resiliency
18%	Food garden contact list and/or resource directory
59%	Communication pathways

3.2.2 INTERVIEW RESULTS

Role of Future Campus Gardens

Six roles of future campus gardens were identified from 28 datapoints collected from interviews (Figure 6). Building Stewardship Mentality was mentioned the most frequently at nine times, followed by Knowledge Sharing and the Growing of Native Plant Species at eight and seven mentions, respectively. Building Stewardship Mentality was defined by interview participants as "the abstract relationship built between a person and the land they are taking care of." Knowledge Sharing was identified as the communication and knowledge transfer that can occur between campus groups including planning and policy, and food growers. Diversifying Ecological Function was identified as the need for the inclusion of biodiversity, pollinator-friendly spaces, and wild spaces on campus.

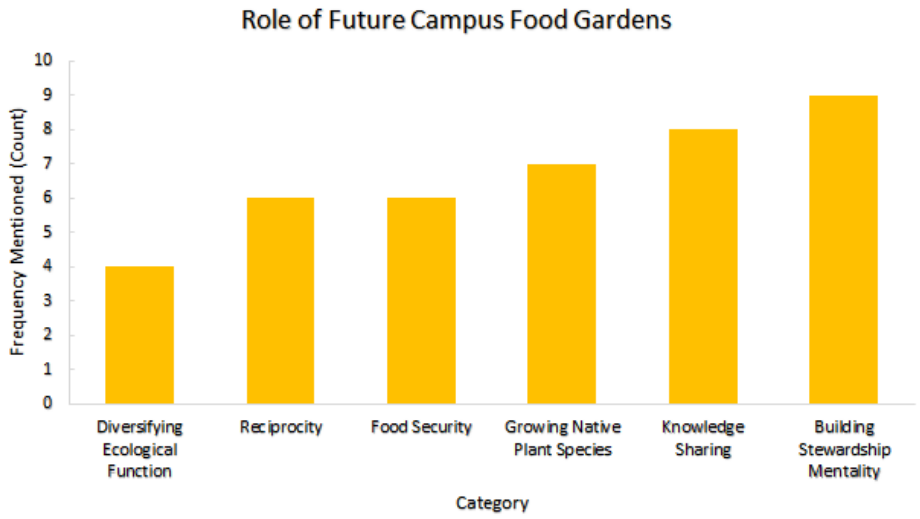

Figure 6: Suggested Roles of Future Campus Gardens (n=28 data points)

Challenges

Across our three semi-structured interviews there were nine challenges identified from 30 data points regarding the establishment and maintenance of campus food gardens. These challenges fell into the following two categories: Institutional Barriers and Climate Change Events. The Institutional Barriers category included mentions of challenges surrounding the (1) Development Permit Application (DPA), (2) siting challenges and concerns, (3) water access, (4) management continuity, and (5) garden aesthetic requirements. Concerns surrounding the DPA were the most frequent, being mentioned seven times, followed by concerns with management continuity at six mentions. Interview results demonstrated that we are currently seeing and likely to see an increased frequency of climate change events. In the Climate Change Events category, the top results included challenges with (1) Extreme Cold, (2) Extreme Heat, (2) Unexpected Weather Events, and (4) Drought. Unexpected Weather Events was mentioned most frequently at five times.

4. DISCUSSION

Results from our analysis provided meaningful insights for food growers current and future needs, as well as the future role of campus food gardens at the UBC campus. In the analysis of our results, we have determined that climate-ready campus gardens embody the following four themes: (1) Community Resilience, (2) Ecological Resilience, (3) Indigenous Knowledge and Values, and (4) Reciprocity.

4.1 COMMUNITY RESILIENCE

Community resilience is broadly defined as "the existence, development, and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise" (Magis, 2008). Through discussion in our focus groups with campus growers, we were able to gain insight into the "current state" of campus food gardens at the UBC Vancouver campus. This stage in our analysis enabled us to identify key issues, challenges, and opportunities in developing and maintaining climate-ready campus food gardens.

The results from our focus groups demonstrated that climate-induced uncertainty and unpredictability is already being experienced by their respective campus groups. Importantly, climate change impacts are not occurring in isolation, but rather in combination with other significant challenges such as logistical barriers to sourcing material resources (e.g., compost, soil, seeds, etc.), institutional barriers, discontinuity in food garden management, site concerns (e.g., inadequate water access, lack of shade, etc.), and community disconnect. When we conducted analysis of what opportunities were generated by these challenges, the following were consistent across our focus groups: (1) a desire for community connection, and pathways for (2) knowledge sharing, and (3) resource sharing. In a practical sense, there was a strong desire among community members for informational documents containing contact information for other food growers and recommendations for increasing resiliency in their garden spaces to climate events.

It became clear that the climate-readiness of campus food gardens would be substantially strengthened by the development of a campus food garden network through which food growers could seek recommendations, gain support, and ensure the transfer of knowledge that transcends management changes. Increase in communication and collaboration would not only allow for the sharing of soil, compost, and seeds but also for more community members to engage in tangible actions that inspire hope and joy in the face of more frequent climate shocks and extreme weather events.

Overall, given our objective on understanding current climate impacts and garden management approaches in campus food gardens in the focus group research questions, the emergent focus of community resilience as a form of climate resilience was an unexpected finding. This shaped the direction of our analysis and deliverables where the theme of community resilience being a key facet of climate readiness inspired us to include tools for building 'Community Connection' as a Climate-Ready Garden strategy in our Garden Management Plan.

4.2 ECOLOGICAL RESILIENCE

The promising growing practices we identified in our results from focus groups, and in our secondary research, are vital to both improving resource efficiency and mitigating the risk of climate events in campus food gardens. Through our analysis we determined that promising practices for increasing climate-readiness in campus food gardens are centered on building and managing soil health, crop diversification, sustainable watering, and microclimate regulation. As mentioned in our results, there is a wealth of knowledge of sustainable growing practices within the food grower community. Practices such as mulching and cover cropping are important for growers to build soil health, while also regulating the microclimate to increase resilience from climate impacts (Tomatis et al., 2023). Other practices, such as shade clothing, and row covers were mentioned less frequently. While drip irrigation was mentioned frequently, it seems to be a significant challenge for new and existing gardening spaces. However, this practice is important for growers to improve efficiency and sustainably water their plants, while reducing the risk of overdried soil from extreme heat. Diversifying crops is essential for ecological resilience, as it offers a safety net to growers (Yachi & Loreau, 1999) against the impacts of extreme weather events (Tomatis et al., 2023). We anticipate that practices such as shade clothing, and succession planting, will become increasingly important strategies to utilize in the future for food gardens on campus.

Plant diversity plays a large role in maintaining ecological resilience in a food garden. This is reflected in the diversity of plant variety options suggested in the Climate Ready Plant List, as well as the inclusion of plants

across four different categories, such as vegetables and fruit trees. Diversity is also reflected in the selected traits of the plants identified as climate ready. Across our selection criteria we were able to include plants with a range of tolerances and preferences. This is because despite the general trends of temperature increases and drought into the future, there remains the key concern of the unpredictability of weather events and seasonal averages. Growers will need to deal with changing annual weather patterns and unseasonal events that are very hard to predict in the long term, such as late spring frosts or warm, dry falls (IPCC, 2014). Providing a plant list inclusive of plants with a wide range of soil moisture and sun preferences, as well as varying levels of drought and heat tolerance allows growers to select plants that suit their specific needs at a site level on a year-to-year basis. This enhances the ecological resilience and climate readiness of the plant list by making diversity a key consideration in plant selection.

Ecological resilience is defined as "the ability of a system to return to an equilibrium state after a temporary disturbance" (Holling, 1973). On the note of resilience, an interesting quote from our focus groups was "what can we plant now that's going to help the garden be as good as it is today, tomorrow." This quote leads us into considering how the design of the landscape surrounding campus gardens will play a big role in how ecologically resilient the garden is to climate events, due to the ability for surrounding trees to significantly alter the microclimate of the garden (Edmondson et al., 2016).

While some growers are already utilizing the identified promising practices, we believe wide adoption of these management strategies, and selection of resilient plants, is necessary to increase the climate-readiness of campus food gardens for climate events we are already currently seeing, as well as into 2050. To increase resiliency to climate events, campus food gardens can be supported by assisting growers with setting up proper infrastructure for drip irrigation, as well as designing future campus gardens with various microclimate site aspects in mind. We hope our 'Climate-Ready Plant List' and 'Climate Ready Garden Management Plan'

deliverables (Appendix D) will provide useful information for food growers on campus, and particularly for the grower who is just starting out.

4.3 INDIGENOUS KNOWLEDGE AND VALUES

A key theme that emerged from our primary and secondary research is the importance of grounding climate resilient gardening strategies in Indigenous Knowledge and Values and recognizing their origins. Throughout our research, it became clear that Indigenous Knowledge and climate resilience cannot, and should not, be separated. Indigenous communities have been caring for and cultivating their lands since time immemorial and have developed an innate relationship with their natural environments (Gliessman & Montenegro, 2021). Their traditional knowledge has been refined over thousands of years, adapting with the earth's changing climate, and growing as they experience natural and human-caused disasters (Hasan, 2016). Indigenous communities' traditional ecological knowledge (TEK) is often grounded in the concepts of reciprocity and balance (Zidny et al., 2020). These themes were strongly represented in the climate-friendly management practices suggested by campus food growers. Participants highlighted the need for (1) more native plants, (2) diversified ecosystems, (3) natural garden design, (4) resource conservation strategies, and (5) habitat provisioning to improve the climate resilience of campus food gardens. Evidence highlighted in our primary and secondary research results suggest that all these recommendations are grounded in Indigenous Knowledge. Many native plant species, for example, have enormous potential for climate resilience as they have become well-adapted to our region's unique weather patterns (Lloyd & Shepherd, 2020). These species also offer the opportunity to decolonize campus garden spaces, restoring pieces of them to reflect their natural state before colonization.

Interview results offered a unique perspective on the broader role of future campus gardens, extending far beyond how they should be managed. Interview participants put a strong emphasis on the need for knowledge-sharing and the building of stewardship mentalities. Implementing these strategies would contribute

to both ecological and community resilience, helping to further the climate resilience of our campus food gardens. Many of these strategies were widely employed before the onset of colonization, when Indigenous communities throughout what we now call Canada were dispossessed of their land and had many of their food systems fragmented or destroyed (Robin, 2021). Beyond climate resilience, participants stressed that campus food gardens can present a valuable opportunity to decolonize campus spaces and forward UBC's reconciliation efforts in highlighting Indigenous Knowledge and foodways. Food gardens can offer a tangible way to support reconciliation efforts through the inclusion and distribution of native plants, creating knowledge-sharing opportunities, and building diversified and connected ecosystems (Alderhill Planning Inc, 2022). We found, however, that these strategies cannot be separated from education. Information on the application of Indigenous knowledge in food garden management and its impact on climate resilience should be made publicly available to encourage community awareness and engagement. Participants strongly recommended the implementation of informational signage in campus food gardens to explain certain management practices and how they connected to climate resilience and Indigenous Knowledge. Food growers and campus planners should strongly consider incorporating these ecological and community-based Indigenous practices into campus food garden spaces to support the climate resilience of campus food systems.

4.4 RECIPROCITY

The combined results from our primary research conducted with interview participants and food growers suggest that there is capacity for reciprocity to be implemented into the design and protocol of campus community food gardens in two ways, through Community Reciprocity and Ecological Reciprocity.

Throughout the focus groups, growers mentioned their openness to sharing their harvests with the community, and some growers suggested ideas of implementing U-Pick sections in their gardens where members of the community could experience harvesting fresh food first-hand. This idea is furthered when considering the results generated from the Focus Group Plant Selection Criteria which demonstrated that social interests of the

community are one of the largest driving factors in the selection of plants on campus gardens. Interview participants belonging to campus groups engaged in climate action and Indigenous sovereignty emphasized that food gardens could play a vital role in the reintroduction of native plant species that were forcibly removed from the land – a gesture described as a form of reciprocity and gifting to the Musqueam, Squamish, and Tsleil-Waututh Nations. Secondly, both growers and campus experts mentioned the importance of Knowledge Sharing being incorporated into campus gardens. Knowledge Sharing was the second most frequently referenced role in the interview results, with experts citing it as a potential method of advancing community resilience by engaging youth in educational programs that can forward understanding of small-scale mitigation, personal footprints, and the importance of ecology and native plant species in the larger scale of climate adaptation. Additionally, it would involve re-engaging members of Indigenous communities and involving Elders who can provide valuable knowledge that may not be available in scientific literature. In terms of Ecological Reciprocity, campus food gardens can contribute by establishing habitats that can support burrowing mammals, nesting birds and pollinators, and other insects. Interview participants proposed for campus gardens to Diversify Ecological Function, and Environmental Factors was the second most frequently mentioned category for driving Plant Selection Criteria which included incorporating biodiversity, and pollinator-friendly native plants.

The incorporation of these proposed roles into future campus gardens would support our objectives in both furthering the climate readiness of campus gardens and supporting institutional leadership in fostering climate-ready local food systems on the UBC campus. Especially the role of Knowledge Sharing, which would facilitate ongoing development and cultivation of a knowledge base of management practices suitable for an ever-changing climate.

4.5 DATA LIMITATIONS

Limitations of our research include the scope of UBC campus food gardens and food growers available to attend the focus groups, which may have resulted in a different collection of data. While we engaged with Indigenous knowledge keepers during our research, we were not able to consult directly with the Musqueam community to incorporate their values, perspectives, and ideas. We have referred to secondary research and through conversations with campus Indigenous engagement stakeholders on how Musqueam values can be incorporated into food gardens. Additionally, our project did not have the capacity for further research into food security initiatives and how food gardens can play a role in shaping food security outcomes on UBC campus, which will be an important area of research in the coming years.

5. RECOMMENDATIONS

5.1 RECOMMENDATIONS FOR ACTION

Short Term Recommendations (To be Implemented Within 6 Months)

1) Creation of a Live Campus Food Garden Contact Document

Our research strongly supports the idea that community resilience and connection are key pillars of climate resilience. Through our results and interpretation, a clear need for greater community interaction and communication among campus food growers has been identified. To support this finding, we recommend the creation of a live UBC Food Grower contact document. We envision this document housing the up-to-date contact information of the leaders and managers of on-campus food gardens. Having a live, or up to date, contact list will help to prevent the disconnect that can manifest as food garden leaders graduate or move on from their positions.

2) **Initiation of an Online Communication Platform**

Alongside the creation of the food growers contact document, we recommend the initiation of an online communication platform, such as a Slack or WhatsApp channel, to create a collective space for growers to connect. We recommend that this action be carried out by Campus Community Planning or by a Campus Food

Grower willing to lead its development. This medium will provide an easy, accessible method of communication that allows growers to communicate and access real-time updates from their mobile devices. We hope that this channel can facilitate knowledge-sharing, initiate resource-sharing and procurement strategies, inspire in-person community events and so much more. Most of all, we hope that these short-term actions can lead to a longer-term outcome of building a connected network of campus food growers.

3) Distribution of the Climate-Ready Food Garden Management Plan

We recommend that UBC Campus and Community Planning include the Climate-Ready Food Garden Management Plan in their website's *Planting Food Gardens* resource page. Here, the management plan could provide current and prospective food growers some insight into climate-ready gardening and act as an informational resource for those looking to start a campus food garden. We hope the distribution of the management plan can help break down the knowledge barriers that exist when first starting a campus food garden and support the climate readiness and resilience of campus food gardens.

Long Term Recommendations (To Be Implemented Now - 2030)

1) Implementation of the Climate-Ready Food Plant List Deliverable

To support the climate resilience of on-campus food gardens, we recommend that campus planners and food growers increase the planting of climate-ready plants in food gardens on campus. To encourage this, we have developed a Climate-Ready Food Plant List that can be referenced when making planting decisions. As time goes on, we hope to see the adoption of the listed plants in campus food gardens and in the larger campus landscape between now and the year 2030.

5.2 RECOMMENDATIONS FOR FUTURE RESEARCH

1) Expansion of Criteria in the Climate Ready Food Plant List *(Within 1-2 Years)*

The focus on of our research was on the climate resilient qualities of plant that will be suitable for growth under future climate conditions that were identified for the local region. Additional information that we found to

be beyond the scope of our project by would be helpful to have included within the Plant List would be technical growing information for each plant. This would be helpful for growers on campus to understand the considerations and growing requirements for each plant and would increase the usefulness and accessibility of the list. Some specific metrics that we would like to see included are spacing and size requirements when planting, harvest considerations such as time requirements and time to maturity, and companion planting suggestions for each plant. These would ensure growers have all the information about growing climate resilient plans without needing to consult secondary sources and allow our garden management plan and plant list to inform each other more seamlessly.

2) Ongoing Research on Climate Data to Ensure Continued Accuracy of Information *(Ongoing)*

Climate projections and models are always changing and being updated to account for new data that is continuously being captured. The secondary climate data research for this project may be the most recent and relevant today but predictions for future conditions will change as time progresses and emissions pathways into the future are narrowed (IPCC, 2014). IPCC released its sixth assessment report in March of 2023, and updates to predicted changes to future climate changes will likely be reflected in subsequent regional scale climate reports, that are relevant to Canada and British Columbia specifically. Ongoing research should be performed to ensure that the predicted future climate conditions used to create the deliverables for this project remain relevant. For example, we know with a high degree of certainty that average temperatures will increase over the next century, but if they were to increase at a rate much higher than currently predicted some of the plants on the Plant List may become unsuitable for growth. Climate data research should remain current to maintain climate resiliency on a campus scale.

3) Expand from a focus on food gardens to wider campus foodscapes *(Within 3 Years)*

This project was focused on research and the creation of resources that cater to food gardens. Most campus food growers are currently growing food in raised beds and our deliverables reflect that. We would like to

see a transition in future research to foodscapes through a greater emphasis on permanent spaces for food production and the planting of perennial plants on campus. This supports our research findings on the role that diversity plays in food gardens in increasing resilience. More research needs to be done into maximizing the ecological functionality of campus foodscapes and the role of wild, or un-curated, spaces in food production. Such research would be an opportunity to inform decolonial design approaches to campus foodscapes. This secondary area for research would involve understanding how to integrate indigenous ways of knowing in the campus landscape that has been traditionally designed with colonial values and principles.

6. CONCLUSION

Future climatic changes pose a serious threat to our food systems and to our communities. Through conversations with campus food growers, experts in climate action, Indigenous sovereignty, food security, and campus planning, we have come to understand how these changes may affect campus food gardens and what can be done to support them in the face of climate change. In their current states, campus food gardens may not be prepared to withstand climate impacts; however, we found significant potential and opportunity to enhance their climate readiness. While each garden is unique, our research demonstrates that climate-ready campus gardens embody four central themes: Community Resilience, Ecological Resilience, Indigenous Knowledge and Values, and Reciprocity.

We found that there is significant interaction between each of the four themes and that upholding them in campus food gardens is necessary to build community resilience, which can be supported through the development of a campus food garden network. Ecological resilience is a campus garden's ability to withstand and recover from climate events. Strategies to support ecological resilience include selecting diverse, climate-resilient plants and employing promising management practices, as identified in our research. Implementing practices grounded in Indigenous knowledge and recognizing their origins can help to restore ecosystem balance, increase climate resilience, and support reconciliation efforts. Centering reciprocity in garden design and

management can help build positive connections between communities and ecosystems and aid in fostering stewardship mentalities.

To address these findings, we recommend that UBC Campus and Community Planning develop an integrated campus food garden network to connect campus food growers and organizations, distribute the climate resilient garden management plan, and implement the climate-ready food plant list. To help support campus food growers in enhancing the climate resilience of their gardens, the research team has provided informational resources including the Climate-Ready Plant List and Climate-Ready Garden Management Plan. We hope our results and findings will be foundational for future research and for the demonstration of climate-resilient food systems on campus and the broader Vancouver community. The outcomes of this project serve as a promising basis for the design of climate-resilient food systems and highlight the importance of collaboration and community connection in achieving just, and climate-resilient food systems that continue to produce food and sustain our communities in the face of rapid change.

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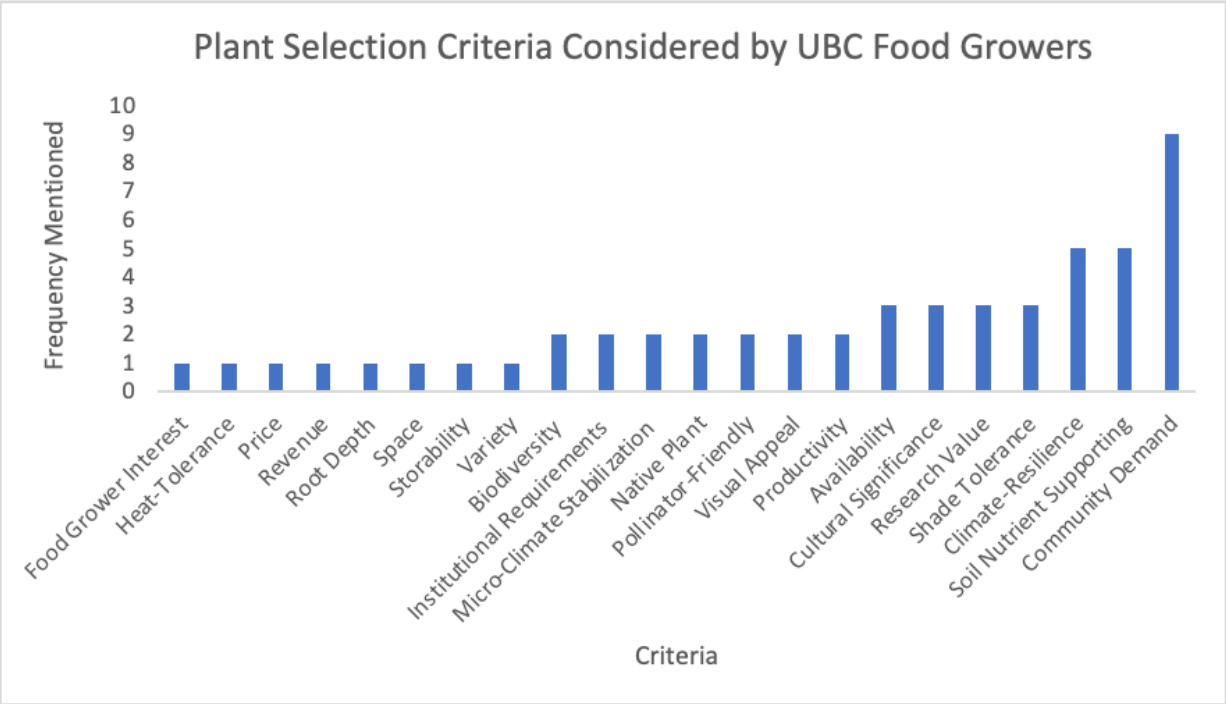
APPENDICES

APPENDIX A: ADDITIONAL FIGURES

Table A.1 Food Grower Plant Selection Criteria and Categories

Row Labels	Climate Resilience	Economic Factors	Environmental Factors	Logistical Considerations	Social Interests
Availability				3	
Biodiversity			2		
Climate-Resilience	5				
Community Demand					9
Cultural Significance					3
Food Grower Interest					1
Heat-Tolerance	1				
Institutional Requirements				2	
Micro-Climate Stabilization	2				
Native Plant			2		
Pollinator-Friendly			2		
Price		1			
Productivity					2
Research Value					3
Revenue		1			
Root Depth			1		
Shade Tolerance	3				
Soil Nutrient Supporting			5		
Space				1	
Storability				1	
Variety					1
Visual Appeal					2
Total	11	2	12	7	21

Figure A.2 Food Grower Plant Selection Criteria



APPENDIX B: DATA COLLECTION TOOLS

B.1 Focus Group and Interview Consent Form

THE UNIVERSITY OF BRITISH COLUMBIA
THE UNIVERSITY OF BRITISH COLUMBIA

Liska Richer
Faculty of Land and Food Systems
221-2357 Main Mall
Vancouver, BC, Canada V6T 1Z4

Tel: 604-822-3270
Email: liska.richer@ubc.ca

Campus Food System Sustainability Project: INFORMED CONSENT

STUDY TEAM: *Who is conducting the study?*

Principal Investigator:
Liska Richer, Instructor, Land and Food Systems 450 class, Faculty of Land and Food Systems
E-mail: liska.richer@ubc.ca
Tel: 604.822.3270

INVITATION AND STUDY PURPOSE
You are being invited to take part in this research study because you are affiliated with the UBC food system. We want to learn more about the sustainability of the campus of the food system. This study will help us advance our knowledge and learn more about ways to enhance the sustainability of the campus food system.

STUDY PROCEDURES: *How is the study done?*
This study is being carried out by students within their course on "Land, Food and Community III" (LFS 450) in the Faculty of Land and Food Systems. If you agree to participate, you are being asked to participate in either an interview or focus group (online, phone or in-person), or questionnaire (electronic or in-person). It is estimated that your time commitment will range from 5 minutes to 1 hour, depending on what you are participating in. You will be given either an electronic form to answer or be asked verbally a set a questions in-person. For online interviews or focus groups, you will be sent a link to a Zoom meeting. Please log in using a nickname or a substitute name or research code which will be given ahead of time by the research team. You can participate with your camera on or off, and can mute your microphone (if cases where it is not needed).

STUDY RESULTS
The results of this study will be reported in course based undergraduate reports and will be published in the SEEDS Sustainability Library and UBC cIRcle Digital repository.

SAFETY PROTOCOLS FOR IN-PERSON RESEARCH DURING COVID-19

THE UNIVERSITY OF BRITISH COLUMBIA

COVID-19 Vaccination and Proof of Vaccination:
Researchers in this study are required to be fully vaccinated for COVID-19 in order to conduct in-person research. Vaccine requirements for in-person research are in place across the university to ensure researcher, research participants and general public safety.

COVID-19 Health Check:
On the day of an in-person research activity, the student researcher will conduct a COVID Health Check with you, by asking these health questions verbally. Your responses will not be recorded. If you answer in a matter that appears to demonstrate that you have symptoms of COVID, the research event will be postponed and rescheduled at a later date.

In addition, all researchers engaged in in-person research will be required to complete a COVID-19 Health Check on the day of any in-person research event. If they answer in a matter that appears to demonstrate symptoms of COVID the research event will be postponed and rescheduled at a later date.

Masks and Physical Distancing
The researcher(s) will be required to where a mask and maintain physical distancing and will ask you and any other research participants to do the same.

Notice of COVID-Related Risks during Research:
The student researcher(s) have provided you with Notice of COVID-Related Risks during Research. It is important that you read this prior to providing consent.

POTENTIAL RISKS OF THE STUDY
We do not think there is anything in this study that could harm you or be bad for you. Some of the questions we ask might upset you or seem sensitive or personal. Please let one of the study staff know if you have any concerns. You do not have to answer any question if you do not want to.

POTENTIAL BENEFITS OF THE STUDY
You may be helped in this study by findings contributing to the advancement of a more ecological, economic and social sustainable food system. In the future, others may benefit from what we learn in this study.

CONFIDENTIALITY
You answers will remain anonymous unless you provide written permission (below) to the UBC student conducting the interview or survey, to disclose your name, working position or any other information revealing your identity in any possible future use of the information you provide. If you are participating in a focus group, please note that only limited confidentiality can be offered and we encourage participants not to discuss the content of the focus group to people outside the group; however, we can't control what participants do with the information discussed. All documents will be identified only by code number and kept in a locked filing cabinet. Subjects will not be identified by name in any reports of the completed study.

THE UNIVERSITY OF BRITISH COLUMBIA

PAYMENT
We will not pay you for the time you take to be in this study.

CONTACT FOR INFORMATION ABOUT THE STUDY
If you have any questions or concerns about what we are asking of you, please contact the Principal Investigator.

Principal Investigator:
Liska Richer, Instructor, Land and Food Systems 450 class, Faculty of Land and Food Systems
E-mail: liska.richer@ubc.ca Tel: 604.822.3270

Liska Richer
Principal Investigator, January 2023

CONTACT FOR COMPLAINTS: *Who can you contact if you have complaints or concerns about the study?*
If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598

PARTICIPANT CONSENT AND SIGNATURE PAGE
Taking part in this study is entirely up to you. You have the right to refuse to participate in this study. If you decide to take part, you may choose to pull out of the study at any time without giving a reason and without any negative impact on your employment, or class standing.

Your signature below indicates that you have received a copy of this consent form for your own records. Your signature indicates that you consent to participate in this study.

Participant Signature Date

Printed Name of the Participant signing above

B.2 In-Person Behavioural Research Safe Research Plan

Safe Research Plan

In-Person Behavioural Research
Safe Research Plan for new and resuming research

Please Note

1. The purpose of the Safe Research Plan is to demonstrate to the Behavioural Research Ethics Board that the necessary precautions and protocols are in place to protect research participants as well as the research team from unintentional transmission of COVID during research. See Safe Research Guidelines.
2. The Safe Research Plan is not intended to replace any safety protocols required by UBC or its faculties, departments, etc. for non-research academic activities.
3. If a section is not applicable, indicate n/a.
4. Include the version date in the footers before uploading to Box 9.7 of your Ethics Application.

A. Introduction	
PI name (and student name, if applicable)	Liska Richer
Dept/Faculty	Faculty of Land and Food Systems
Start Date	Winter Term - January 11th 2023
Ethics ID#	H17-03338

B. Vaccination Status

i. Is your ethics application for student course-based projects? (For general guidance).

☐ Yes ☐ No

ii. If you answered No to B.i, are all members of the research team fully vaccinated? This refers to those who will have face-to-face interaction with other researchers and/or participants.

☐ Yes ☐ No ☐ Prefer not to answer

iii. If you answered Yes to B.i, please ensure you have reviewed the requirements on the COVID webpage (**You are submitting or amending an ethics application for course-based research projects)** and confirm whether the course syllabus or other course documentation attached to the ethics application, includes:

- Notice that students conducting in person research for course-based projects are required to be vaccinated
- Options for students to conduct their research projects remotely or in person

☐ Yes ☐ No If No, please explain enter text.

C. Population Risk Profile

Describe the risk profile of the research participant group/s in relation to the COVID pandemic.

Other risks and their mitigation should be described in Box 6.2 of the ethics application and do not need to be repeated here.

1. Is age a significant risk factor? ☐ Yes ☐ No
2. Are there any underlying medical conditions in the population that may increase the risk of COVID-19? ☐ Yes ☐ No

   If Yes, please explain. enter text.

3. Are there any other factors that might elevate the risk of exposure to COVID-19 during research activity, e.g., medical setting, high case load or outbreak area, etc.?
4. ☐ Yes ☐ No

If Yes, please explain. enter text.

5. Will rapid antigen testing be used by the research team to test for asymptomatic or symptomatic status? ☐ Yes ☐ No

If Yes, describe who will test and the strategy for testing. enter text.

D. Research Location/s

If your research will be conducted in multiple sites or geographic locations, you may be required to submit a separate form for **each distinct location**.

E. Location: (provide a brief description of the location): All rooms and spaces (e.g. open area in a building) where research will be carried out will be in buildings on the UBC Vancouver Campus, Vancouver, British Columbia

F. Health jurisdiction: (include the region/province/state/country that sets the public health guidelines for your research location): UBC Vancouver Campus, Vancouver, British Columbia

G. Describe the ventilation and physical distancing options available during interactions with participants (select all that apply):

- ☐ Rooms are well-ventilated (windows and doors can be opened to allow fresh air to circulate; the air exchange rate is greater than 4 ACH though mechanical ventilation).
- ☐ Ventilation is unknown or poor
- ☐ Minimal distance of 2 metres can be maintained between all researchers and participants
- ☐ Minimal distance of 2 metres between all researchers and participants CANNOT be maintained or is unknown
- ☐ Meetings will occur outdoors only
- ☐ Other All rooms/spaces where research will be carried out will be on campus, and as such rooms and other spaces (e.g. open area in a building) will be subject to UBC cleaning standards, protocols and procedures and UBC Building Ventilation & Safety Measures

H. Types of interaction

For each type of participant interaction, indicate which of the listed safety precautions will be in place (select all that apply):

☐ **One-on-one**

- ☐ N95 or KN 95 masks will be worn by researcher
- ☐ N95 or KN 95 mask will be provided to participant
- ☐ Other safety measures (provide explanation): *Proper fitting non-medial masks will be worn by student researchers and provided to participants. Hand sanitizer will be provided to participants if needed (note that the course instructor will have these items available to students at no cost).*

☐ **Gatherings** (3 or more attendees)

- ☐ N95 or KN 95 masks will be worn by researcher

- ☐ N95 or KN 95 mask will be worn by – and provided to – participants
- ☐ Number of participants at one time limited to unknown. Likely between 3-60 participants based on research methods chosen by the students.
- ☐ Duration of event limited to 2 hours
- ☐ Other safety measures (provide explanation): *Proper fitting non-medial masks will be worn by student researchers and provided to participants. In addition to above, students as researchers must ensure when interacting with participants that they will comply with provincial and regional restrictions and health standards, and ensure:*
  -Appropriate physical distancing requirements be maintained
  -ensure they have hand sanitizer and that they can use and be provided to participants if needed (note that the course instructor will have these items available to students at no cost).

☐ **Naturalistic Observation** indoors only (no interaction with people being observed)
- ☐ N95 or KN 95 masks will be worn by researcher
- ☐ Other safety measures (provide explanation): enter text.

I. Off-campus, Community Based Research

1. Does this research involve in-community engagement? ☐ Yes ☐ No.
   (If no, leave the rest of this section blank.)
2. How many community groups will be involved in the research? enter text.
3. Who has been involved in developing the Safe Research Plan? enter text.
4. How many community members will the research team be in contact with? enter #
5. Will the research team be required to self-isolate before beginning research?
   ☐ Yes ☐ No.
   If Yes, provide details (location, duration, testing protocols): enter text.
6. What safety protocols will be in place during research events? (select all that apply):
   - ☐ N95 or KN 95 masks will be worn by researchers
   - ☐ N95 or KN 95 mask will be worn by participant/s
   - ☐ N95 or KN 95 mask will be provided to participant
   - ☐ Number of participants gathering at one time limited to enter #
   - ☐ Duration of event/s limited to enter maximum time
   - ☐ Other safety measures (provide explanation): enter text.

J. Research Involving Indigenous Communities

Please complete Section F above and answer the following question. If you are unable to affirm any of the statements below, we will only be able to provide conditional approval until arrangements have been confirmed.

- ☐ Current letter/s of agreement have been attached to the ethics application (required before ethics approval can be granted).
- ☐ The community has confirmed its capacity to accept research activity at this time
- ☐ The community has confirmed its guidance/policy related to COVID-19.

K. Travel and Accommodation

1. Will the research team need to travel to any research sites? ☐ Yes ☐ No.
2. Are any travel or health advisories in effect in the location you are travelling to?
   ☐ Yes ☐ No.

3. Will the research team be required to self-isolate before beginning research?
   ☐ Yes ☐ No.
4. If Yes, provide details (location, testing protocols, etc.): enter text.

L. Unanticipated events

Have contingency plans been developed to address if a study team member or participant becomes sick or develops COVID-19 symptoms? ☐ Yes ☐ No.

If No, please explain why no contingency is needed: enter text.

If Yes, please check all that apply:

- ☐ Self-isolation
- ☐ Rapid antigen testing
- ☐ Other: Students will be encouraged to use rapid antigen testing

M. Communications and Reporting

☐ I confirm that Safety issues will be reported via a Request for Acknowledgement to the BREB.

☐ I confirm that the Notice of COVID-Related Risks during research will be provided to invitees/participants before they are asked to consent.

☐ I confirm that research participants will be required to complete a COVID-19 Health Check before each interaction.

☐ I confirm that I will be responsible for maintaining the safety protocols; that changes to the Safe Research Plan will be submitted to the REB for approval and will be shared with the research team.

Principal Investigator Signature: 

Date: September 30, 2022

B.3 Focus Group #1 Invitation Email

Subject line: [Action Required] You are invited to a Climate-Resilient Food Garden Focus Group on Tuesday, March 14th at 2:30-4:00 PM!

Hello!

We have identified your campus group to be a leader in the UBC food system and would like to invite you to our focus group on **Tuesday, March 14th at 2:30-4:00 PM** in **Policy Lab A and B at the Centre for Interactive Research on Sustainability (CIRS)**. The objective of the focus group is to increase our understanding of current campus food garden management practices to better support plans for climate-resilient campus food gardens.

We are senior students from LFS 450 (Land, Food, and Community III) conducting course-based research on the sustainability of the UBC food system entitled 'The Campus Food System Sustainability Project". The purpose of the course-based research project is to engage in applied research to assess our campus food systems sustainability and develop solutions collectively with campus stakeholders. Our contribution to this larger study is a project called 'Supporting Climate-Ready Food Gardens: Climate Resilient Campus Community Foodscapes'.

The focus group session will be 90 minutes and we will be serving light refreshments of tea, coffee, and snacks! All participants will also receive a $5 gift card as a token of appreciation for your time.

Registration Steps:

1. Please first review the **'Notice of COVID-Related Risks during Research'** and **'Consent Form'** documents attached to this email.
2. Please email us a signed copy of the **'Consent Form'** or sign a physical copy day of.
3. Lastly, please fill out this Qualtrics survey link by **Thursday, March 9th at 11:59 pm** to confirm your participation.

Please invite relevant members of your organization (I.e., involved in food gardens) to the focus group by forwarding them this email with attached forms and CC Kassi Peters at [Omitted]

For more information or if you have any questions about the focus group or our project, feel free to contact our focus group contact, Kassi Peters [Omitted]

Thank you for your time and we hope to see you at the focus group on Tuesday, March 14th at 2:30 PM!

Best,

Kassi Peters, Annie McLeod, Eden Perry, Addie Truman and Sergo Oganesyan

B.4 Qualtrics Registration Survey for Focus Group #1

Block 1

Hello!

Thank you for taking interest in our research on supporting climate-resilient food gardens at the University of British Columbia. Your input is invaluable in increasing our understanding of current campus food garden management practices and can support plans for climate-resilient campus food gardens.

The focus group will take place on **Tuesday, March 14th from 2:30-4:00 pm** in **Policy Lab A and B** in the **Centre for Interactive Research on Sustainability (CIRS)** (2260 West Mall, UBC Vancouver Campus).

To register, please fill out this short survey by **Thursday, March 9th at 11:59 PM**.

In appreciation of your valuable time, light refreshments of tea, coffee, and snacks will be provided to enjoy during the focus group. Participants will also receive a $5 gift card as a thank you. As a reminder, please review both the 'Notice of COVID-Related Risks during Research' and 'Consent Form' documents attached to the focus group invitation email.

Deadline to fill out survey: **Thursday, March 9th at 11:59 PM**

Please indicate your availability to participate in the focus group:

- ○ Yes, I am able to attend
- ○ No, I am not able to attend

Which organization are you a part of?

- ○ UBC University Neighbourhood Association
- ○ UBC Climate Hub
- ○ UBC Roots on the Roof
- ○ UBC Farm
- ○ Agronomy Garden
- ○ Orchard Garden
- ○ UBC Botanical Garden
- ○ GeoGarden
- ○ [ ] None of the Above (Please Specify)

Please provide your full name:

Please provide your email address:

Light refreshments of tea, coffee, and snacks will be provided. Please let us know of any dietary restrictions that we can accommodate:

If you have any accessibility considerations, please reach out to kkpete@student.ubc.ca and we can make accommodations.

Powered by Qualtrics

B.5 Interview #2 Invitation Email (Climate Emergency Task Force (CETF))

Subject line:

[Action Required] You are invited to a Climate-Resilient Food Garden interview!

Hello Climate Emergency Task Force!

My name is Annie, and I am a part of a group of senior students from LFS 450 (Land, Food and Community: Leadership in Campus Food System Sustainability), with Professor Liska Richer. Our research project is titled *Supporting Climate-Ready Food Gardens: Climate Resilient Campus Community Foodscapes*. As a part of our project, we will be designing a climate-ready garden and plant list based on climate scenarios forecasted for 2030 and 2050. **The intent of this work is to inform both campus planners and community members that engage in food growing on campus in an effort to better support their activities in our changing climate.**

The research team has identified the UBC Climate Emergency Task Force as a leader in climate action at UBC and **would like to invite you to an interview. The interview would take place over Zoom and will take approximately 45 minutes.**

We believe the Task Force can offer unique insight into this project's implementation - after reading the First Progress Report on the Climate Emergency at UBC, we became curious about UBC's progress and commitments to climate action, and how their actions align with UBC's Indigenous Strategic Plan.

The objective of the interview would be to gain insight and strengthen relationships that can support our research for future climate-resilient campus food gardens.
In our interview, we hope to address the following guiding interview questions:

1. What are your biggest concerns in terms of changing climate conditions at the UBC Vancouver campus? What environmental changes can we expect to see on campus by 2030? By 2050?
2. What role do you see future campus gardens having in terms of climate action and advancing Indigenous sovereignty on campus and beyond?

If you would like to send a representative or a group to participate in this 45-minute interview at one of the proposed times, please let us know! **We are available Wednesday, March 15th between 12 - 2 PM or Monday, March 20th between 1 - 5 PM.** If these times do not align with your availability, we can make adjustments to accommodate your schedules!

Prior to the interview, we would request that you **review, sign, and send a copy of the Consent Form attached to this email.**

Thank you for your consideration!

Best,

Annie McLeod

B.6 Interview #3 Invitation Email (UBC Food Hub)

Subject line:

[Action Required] You are invited to a Climate-Resilient Food Garden interview!

Hello X!

My name is Sergo, and I am a part of a group of senior students from LFS 450 (Land, Food and Community: Leadership in Campus Food System Sustainability), with Professor Liska Richer. Our research project is titled *Supporting Climate-Ready Food Gardens: Climate Resilient Campus Community Foodscapes*. As a part of our project, we will be designing a climate-ready garden and plant list based on climate scenarios forecasted for 2030 and 2050. **The intent of this work is to inform both campus planners and community members that engage in food growing on campus in an effort to better support their activities in our changing climate.**

The research team has identified the UBC Food Hub as a leader in the UBC Food System and **would like to invite you to an interview. The interview would take place over Zoom and will take approximately 45 minutes.**

We believe the Food Hub can offer unique insight into this project's implementation - after reading the Food Hub's vision for food security at UBC, we became curious about current progress and commitments to food security, and how the Hub's actions can align with UBC's 2030 Climate Action Plan.

The objective of the interview would be to gain insight and strengthen relationships that can support our research for future climate-resilient campus food gardens.

In our interview, we hope to address the following guiding interview questions:

1. Has your organization considered the future impacts of climate change on food security on UBC? If so, how?
2. What role do you see future campus gardens having in terms of addressing food security issues on campus and beyond?

If you would like to send a representative or a group to participate in this 45-minute interview at one of the proposed times, please let us know! **We are available Wednesday, March 15th between 12 - 2 PM or Monday, March 20th between 1 - 5 PM.** If these times do not align with your availability, we can make adjustments to accommodate your schedules!

Prior to the interview, we would request that you **review, sign, and send a copy of the Consent Form attached to this email.**

B.7 Focus Group #1 Research Questions

Q1: Please share your name, your pronouns if you would like, and the capacity in which you are involved with campus food gardens (e.g., what food garden, for how many years, your position(s) in the group, etc.).

Q2: Where on campus are you growing food, and what are the key characteristics of your site in terms of amenities and environmental factors?

- **Examples of amenities include:** irrigation/access to water, compost facilities, raised beds etc.
- **Examples of environmental factors include:** exposure to the elements (sun/rain/wind), trees/structures providing shade, soil quality, drainage/slope.

Q3: Are there examples of ways in which any of these characteristics have presented challenges for growing food at your site?

Q4: When you are designing your garden, what are your considerations for selecting plants?

Q5: In recent years we have seen an increase in the frequency of heatwaves and droughts. How have these, or any other recent climate event, impacted your garden? How have these changes influenced your management practices or presented new challenges?

Q6: What soil management practices does your organization use and how is soil health considered throughout the different seasons?

Q7: What do you perceive to be the strengths in your approach to food garden planning and management? To frame this, if you would like to share a story of success with the group, you are welcome to!

Q8: *As part of our project, we are developing a climate-resilient garden plan to help support and guide on-campus growers and community planners in our changing climate. The garden plan will include designs, management suggestions, planting recommendations, etc.*

- What recommendations/information would you suggest including in the climate-resilient garden plan to support current and future campus growers?

Q9: What does your current collaboration look like with other food gardens on campus and are there any ideas you have which could further help increase collaboration and community building between groups?

B.8 Focus Group #2 Research Questions

Q1: Please share your name, your pronouns if you would like, and the capacity in which you are involved with campus food gardens (I.e. what food garden, for how many years, positions in the group, etc.).

Q2: Where on campus are you growing food, and what are the key characteristics of your site in terms of amenities and environmental factors?

- **Examples of amenities include:** irrigation/access to water, compost facilities, raised beds etc.
- **Examples of environmental factors include:** exposure to the elements (sun/rain/wind), trees/structures providing shade, soil quality, drainage/slope.

Q3- Are there examples of ways in which any of these characteristics have presented challenges for growing food at your site?

Transition: So now that we know more about each other's garden spaces, we are going to explore more about the garden planning or design stage of growing food.

Q4- When you are designing your garden, what are your considerations for selecting plants?

- **Examples of considerations:** flavor, biodiversity value, cultural significance, pest/drought/flood tolerance

Q5- In recent years we have seen an increase in the frequency of heatwaves and droughts. How have these climate events impacted your garden? How have these changes influenced your management practices or presented new challenges?

Q6 - What soil management practices does your organization use and how is soil health considered throughout the different seasons?

- ***Examples of management practices***: Mulching, applying compost, cover cropping, ground covers etc.

Q7: What do you perceive to be the strengths in your approach to food garden planning and management? To frame this, if you would like to share a story of success with the group, you are welcome to!

- **Examples of strengths:** Diversity, Circularity, community + cooperation, small-scale/local, low environmental impact, agroecological practices

Q8: What recommendations/information would you suggest including in the climate-ready garden plan to support current and future campus growers?

Q9: What does your current collaboration look like with other food gardens on campus and are there any ideas you have which could further help increase collaboration and community building between groups?

B.9 Focus Group #1 Script

1. **Welcome (Start at 2:40pm)**
    a. Thank you, everyone, for joining us for today's focus group; we really appreciate that you are willing to share your valuable time, experiences, and expertise with us.
    b. As we mentioned in the invitation email you received, the purpose of today's focus group is to learn more about your experiences growing food on campus as part of our course-based research project on Climate-Resilient Campus Foodscapes.
2. **Research Team Introductions**
    a. My name is Eden, I use she/her/hers pronouns and I will be facilitating the discussion today. Across from me is Annie, who will be assisting the facilitation by visualizing our discussion, and providing an oral summary at the end. She may also jump in with any clarifying questions or ideas throughout!
    b. Addie is our amazing notetaker today, Sergo is responsible for tech today, and Kassi will be our time keeper today who you've all heard from in your invitations.
3. **Land Acknowledgement**
    a. Before I introduce more about the project, I would like to acknowledge that the University of British Columbia is located on the traditional, ancestral and unceded territories of the xʷməθkʷəy̓əm (Musqueam) people. The Musqueam people have been tending to and cultivating this land since time immemorial.
    b. Within our research topic, it is particularly important to acknowledge the historical and ongoing impacts of agriculture on Indigenous foodways and its use as a tool of colonization.
    c. At UBC, the land on which we study and grow food, continues to be significant to the Musqueam people and remains an integral part of their food system. We hope that our project can support UBC and the Faculty of Land and Food Systems' reconciliation efforts through our final deliverables and recommendations
4. **Purpose and Context of the Focus Group**
    a. With that in mind I wanted to provide a high-level overview of our project and how today's discussion will inform its outcome.
    b. Our research is working to inform the development of two main project deliverables: a 'Climate-Ready Food Plant List' and a 'Climate-Ready Food Garden Plan'. The Food Plant List will document plants suitable for growth under changing climatic conditions on campus and the Garden Plan will include planting suggestions for future climatic changes.
    c. Ultimately, these deliverables will help to support UBC Campus and Community Planning's in their work designing campus landscapes and help inform future campus food garden initiatives.

d. With there being so many incredible food growing spaces on campus already, we wanted to hear directly from all of you about current successes, challenges, and key considerations to inform plans and practices for future climate resilient campus gardens.
e. Are there any questions about the project?

5. **Confidentiality/Anonymity**
    a. Before we share some ground rules and get to know each other, we would like to share some information about how we are protecting your confidentiality.
    b. Today's session is being recorded to ensure all your contributions are captured; however, the data will not be accessible to anyone at UBC besides our individual student team. Second, when we summarize results from today's focus group any identifying information will be removed to ensure the anonymity of your comments. Quotes from today may be used in our final report, however we will not include any information for who provided the quote or which organization they belong to.
    c. Also audio files and transcription files will be stored in a secure folder, and accessible only to our team members, and deleted at the end of this research project. So please feel free to share as much as you are comfortable with.
    d. Are there any objections or any questions about confidentiality?
6. **Ground rules**
    a. We will now go over a few ground rules for today.
    b. First I wanted to highlight that there are no right or wrong answers, we are seeking information based on your lived experiences. You are all the experts in your own food gardens and your knowledge and wisdom are extremely valuable.
    c. As we are recording the session, it is best if one person speaks at a time to ensure clarity when we are transcribing the audio.
    d. My goal is to ensure that everyone has an opportunity to share their thoughts, so there may be times when I limit some comments or transition to the next question. With that being said, we have time set aside at the end for sharing concluding comments or expanding on something you have shared previously.
    e. Lastly, as a facilitator, I am here to guide the discussion, however, it is intended to be more of a conversation than an interview, so you are all welcome and encouraged to respond to each other's comments and talk to each other. Some questions we will do as a round robin but otherwise we will be going popcorn style, and you can raise your hand whenever you have something to share. If you ever seek clarifications on my questions or would like me to repeat, please let me know.
    f. Does anyone have any questions?
7. **Icebreaker – introductions**
    a. Let’s go around the room for introductions so we can get to know each other.
    b. **Q1:** Please share your name, your pronouns if you would like, and the capacity in which you are involved with campus food gardens (I.e. what food garden, for how many years, positions in the group, etc.).
    c. Thank you so much everyone for sharing. Before we dive into our research questions I wanted to highlight that we acknowledge that each of your food growing spaces and roles varies in purpose, goals, and audience so a given question may be more or less relevant to your work. If a question

does not directly apply to you are still more than welcome to provide ideas or input on each others answers!

8. **Core Questions**
    - **Q2:** Where on campus are you growing food, and what are the key characteristics of your site in terms of amenities and environmental factors?
        - **If you are looking for some ideas**, examples of amenities include:
            - irrigation/access to water, compost facilities, raised beds etc.
        - **Examples of environmental factors include:**
            - exposure to the elements (sun/rain/wind), trees/structures providing shade, soil quality, drainage/slope.
    - **Q3-** Are there examples of ways in which any of these characteristics have presented challenges for growing food at your site?
        - **Transition:** So now that we know more about each other's garden spaces, we are going to explore more about the garden planning or design stage of growing food.
    - **Q4-** When you are designing your garden, what are your considerations for selecting plants?
        - *Examples of considerations:* flavor, biodiversity value, cultural significance, pest/drought/flood tolerance
    - **Q5-** In recent years we have seen an increase in the frequency of heatwaves and droughts. How have these climate events impacted your garden? How have these changes influenced your management practices or presented new challenges?
    - **Q6 -** What soil management practices does your organization use and how is soil health considered throughout the different seasons?
        - *Examples*: Mulching, applying compost, cover cropping, ground covers etc.
    - **Q7:** What do you perceive to be the strengths in your approach to food garden planning and management? To frame this, if you would like to share a story of success with the group, you are welcome to!
        - Examples of strengths: Diversity, Circularity, community + cooperation, small-scale/local, low environmental impact, agroecological practices
    - *As part of our project, we are developing a climate-resilient garden plan to help support and guide on-campus growers and community planners in our changing climate. The garden plan will include designs, management suggestions, planting recommendations, etc.*
        a. **Q8:** Based on this conversation and your prior knowledge, what information would be useful in a climate resilient garden plan which could help your organization to navigate future climate conditions? *For example, warmer temperatures and increased weather events.*
9. **Summary and Additional Comments**
    a. That marks the end of our questions, and now I will pass it over to Annie who will provide a brief summary of what we perceived to be the preliminary key takeaways from our discussion. After the summary, there will be time to comment about whether it captures what you wanted to share.
    b. *Annie provides summary on perceived trends and key takeaways*
    c. Thank you so much Annie!
        i. **Q9**: Does everyone feel that this is an adequate summary and is there anything you would like to add?

10. **Closing/wrap up**
    a. Thank you all for such an engaging discussion and sharing your experiences.
    b. Again, I want to reassure you that your comments will remain anonymous, and we will be securely storing the recording and transcript of today's session.
    c. We want to highlight that if anything comes to mind about the topics we discussed today, that you forgot to share or wanted to expand upon, please do not hesitate to reach out! You can contact Kassi at the email address from which you received all your communications to date. Additionally, please feel free to take some snacks and coffee/tea with you on your way out.
    d. As a small thank you for participating in this focus group, you all will receive 5$ gift card to an AMS Food Services Location. If you didn't do so when you walked in please make sure to fill in the sign-on form so we can contact you with pick-up instructions.

B.10 Focus Group #2 Script

1. **Welcome (Start at 11:30 am)**
    a. Thank you, everyone, for joining us for today's focus group; we really appreciate that you are willing to share your valuable time, experiences, and expertise with us.
    b. As we mentioned in the invitation email you received, the purpose of today's focus group is to learn more about your experiences growing food on campus as part of our course-based research project on Climate-Resilient Campus Foodscapes.
2. **Research Team Introductions**
    a. My name is Eden, I use she/her/hers pronouns and I will be facilitating the discussion today. Kassi will be taking notes, keeping time, and will also be providing a summary of key takeaways at the end of our discussion.
3. **Land Acknowledgement**
    a. Before I introduce more about the project, I would like to acknowledge that the University of British Columbia is located on the traditional, ancestral and unceded territories of the xʷməθkʷəy̓əm (Musqueam) people. The Musqueam people have been tending to and cultivating this land since time immemorial.
    b. Within our research topic, it is particularly important to acknowledge the historical and ongoing impacts of agriculture on Indigenous foodways and its use as a tool of colonization.
    c. At UBC, the land on which we study and grow food, continues to be significant to the Musqueam people and remains an integral part of their food system. We hope that our project can support UBC and the Faculty of Land and Food Systems' reconciliation efforts through our final deliverables and recommendations.
4. **Purpose and Context of the Focus Group**
    a. With that in mind I wanted to provide a high-level overview of our project and how today's discussion will inform its outcome.
    b. Our research is working to inform the development of two main project deliverables: a 'Climate-Ready Food Plant List' and a 'Climate-Ready Food Garden Plan'. The Food Plant List will document plants suitable for growth under changing climatic conditions on campus and the Garden Plan will include planting suggestions for future climatic changes.
    c. Ultimately, these deliverables will help to support UBC Campus and Community Planning's in their work designing campus landscapes and help inform future campus food garden initiatives.

   d. With there being so many incredible food growing spaces on campus already, we wanted to hear directly from all of you about current successes, challenges, and key considerations to inform plans and practices for future climate resilient campus gardens.
   e. Are there any questions about the project?

5. **Confidentiality/Anonymity**
   a. Before we share some ground rules and get to know each other, we would like to share some information about how we are protecting your confidentiality.
   b. Today's session is being recorded to ensure all your contributions are captured; however, the data will not be accessible to anyone at UBC besides our individual student team. Second, when we summarize results from today's focus group any identifying information will be removed to ensure the anonymity of your comments.
   c. Keeping this in mind, please feel free to share only as much as you are comfortable with.
   d. Are there any objections or any questions about confidentiality?
6. **Ground Rules**
   a. We will now go over a few ground rules for today.
   b. First I wanted to highlight that there are no right or wrong answers, we are seeking information based on your lived experiences. You are all the experts in your own food gardens and your knowledge and wisdom are extremely valuable.
   c. As we are recording the session, it is best if one person speaks at a time to ensure clarity when we are transcribing the audio.
   d. My goal is to ensure that everyone has an opportunity to share their thoughts, so there may be times when I limit some comments or transition to the next question. With that being said, we have time set aside at the end for sharing concluding comments or expanding on something you have shared previously.
   e. Lastly, as a facilitator, I am here to guide the discussion, however, it is intended to be more of a conversation than an interview, so you are all welcome and encouraged to respond to each other's comments either in the chat or verbally. Some questions we will do as a round robin but otherwise we will be going popcorn style, and you can raise your Zoom or physical hand whenever you have something to share and I will call on you. If you ever seek clarifications on my questions or would like me to repeat, please let me know. Kassi will also be dropping the questions into the chat and you are welcome to follow along with the question document we sent out on Wednesday!
   f. Does anyone have any questions?
7. **Icebreaker – Introductions**
   a. Let’s do a round of introductions so we can get to know each other.
   b. Q1: Please share your name, your pronouns if you would like, and the capacity in which you are involved with campus food gardens (I.e. what food garden, for how many years, positions in the group, etc.).
   c. Thank you so much everyone for sharing. Before we dive into our research questions I wanted to highlight that we acknowledge that each of your food growing spaces and roles varies in purpose, goals, and audience so a given question may be more or less relevant to your work. If a question does not directly apply to you are still more than welcome to provide ideas or input on each others answers!
8. **Annotation Overview**

a. Everyone was provided with the questions for today, but we will also be sharing them on your screen. Please feel free to annotate the slides or send in comments in the chat as you're reflecting on the question. Kassi will now share her screen and we will make sure everyone can access the annotation feature.

9. **Core questions:**
   - **Q2:** Where on campus are you growing food, and what are the key characteristics of your site in terms of amenities and environmental factors?
     - **If you are looking for some ideas**, examples of amenities include:
       - irrigation/access to water, compost facilities, raised beds etc.
     - **Examples of environmental factors include:**
       - exposure to the elements (sun/rain/wind), trees/structures providing shade, soil quality, drainage/slope.
   - **Q3-** Are there examples of ways in which any of these characteristics have presented challenges for growing food at your site?
     - **Transition:** So now that we know more about each other's garden spaces, we are going to explore more about the garden planning or design stage of growing food.
   - **Q4-** When you are designing your garden, what are your considerations for selecting plants?
     - *Examples of considerations:* flavor, biodiversity value, cultural significance, pest/drought/flood tolerance
   - **Q5-** In recent years we have seen an increase in the frequency of heatwaves and droughts. How have these climate events impacted your garden? How have these changes influenced your management practices or presented new challenges?
   - **Q6 -** What soil management practices does your organization use and how is soil health considered throughout the different seasons?
     - *Examples*: Mulching, applying compost, cover cropping, ground covers etc.
   - **Q7:** What do you perceive to be the strengths in your approach to food garden planning and management? To frame this, if you would like to share a story of success with the group, you are welcome to!
     - Examples of strengths: Diversity, Circularity, community + cooperation, small-scale/local, low environmental impact, agroecological practices
   - *As part of our project, we are developing a climate-resilient garden plan to help support and guide on-campus growers and community planners in our changing climate. The garden plan will include: designs, management suggestions, planting recommendations, etc.*
     - **Q8:** What recommendations/information would you suggest including in the climate-resilient garden plan to support current and future campus growers?
   - **Q9:** What does your current collaboration look like with other food gardens on campus and are there any ideas you have which could further help increase collaboration and community building between groups? (12:15-12:20)
10. **Summary and Closing** (12:20 – 12:25)
    a. That marks the end of our questions, and now I will pass it over to Kassi who will provide a brief summary of what we perceived to be the preliminary key takeaways from our discussion.
    b. *Kassi provides summary on perceived trends and key takeaways*
    c. Thank you so much Kassi

i. **Q10**: Does everyone feel that this is an adequate summary and is there anything you would like to add?

d. Thank you all for such an engaging discussion and sharing your experiences.

e. We want to highlight that if anything comes to mind about the topics we discussed today, that you forgot to share or wanted to expand upon, please do not hesitate to reach out! You can contact Kassi at the email address from which you received all your communications to date.

B.11 Visual Notetaking Tool

B.12 Semi-Structured Interview #1 Script (Campus and Community Planning)

1. What is your role in Campus and Community Planning. Can you describe how you might be involved in the design, siting and permitting process of establishing a food garden on campus?
2. Where in the process do you notice challenges for groups who wish to establish food gardens on campus?
3. How might the proposal/permitting process change in the face of climate change? Will there need to be a commitment to climate adaptation and resilience in the garden applications?
4. Irrigation and adequate water access came up as a challenge in some of our discussions with campus food growers. This challenge will only become more pressing as our climate changes and more water is needed – does campus and community planning provide any support in this? Can you offer any advice?
5. We'd love to get your input on design! Are there any promising practices in climate-resilient or sustainable garden design that you would like to implement on campus.

B.13 Semi-Structured Interview #2 Script (Climate-Emergency Task Force)

1. Introductions:
    a. Before starting the interview, we'd like to introduce ourselves and our project before handing it over to you!
    b. My name is Annie, I am studying Sustainable Agriculture here at UBC and I'll be leading the facilitation of the interview today
    c. My name is Sergo, I am also studying Sustainable Agriculture, I will be taking notes and supporting Annie.
2. Project Overview
3. Guiding Questions:
    a. What are your biggest concerns in terms of changing climate conditions at the UBC Vancouver campus? What environmental changes can we expect to see on campus by 2030? By 2050
        i. Follow-up – has your organization considered how this may impact food production and food security on campus?
    b. What role do you see future campus gardens having in terms of climate action and advancing Indigenous sovereignty on campus and beyond?
    c. Finally, are there any last thoughts or follow-ups to anything we discussed in the interview today? We've been taking notes and recording, but if there is anything you would like to highlight, now be a great time!

APPENDIX C: DATA ANALYSIS TOOLS

Figure C.1. Proportions of Codes used in Analysis of Focus Group Data

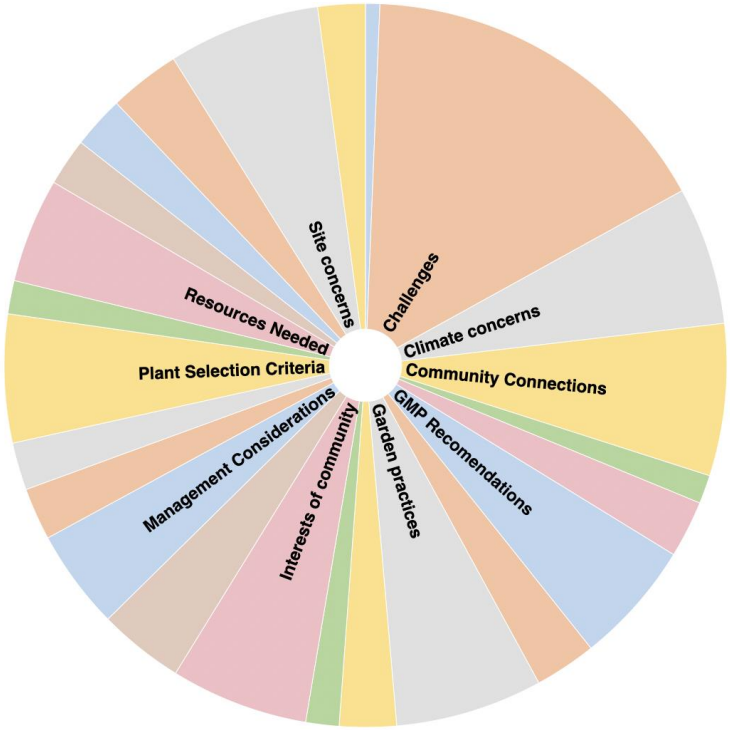


Table C.2 Focus Group Codes and Descriptions

Code	Description
Aesthetic considerations	Gardens aesthetic appeal vs ecological function
Challenges	Overall challenges with campus gardens
Climate concerns	Drought, soil moisture, soil, temperature, water, sun exposure, health of people working in the heat
Community Connections	Ways the community is connecting or wants to connect
Excitement	Noted excitement about a topic
Existing Amenities	Existing amenities on campus gardens (compost, irrigation, etc.)
Frequent word	Word used frequently
Garden practices	Ways the community is connecting or wants to connect
Garden Scope	Logistics, notable locations and quantity of beds, number of gardens
Giving	Ways gardens are giving back to community, or could or want to
GMP Recommendations	Recommendations for garden plans or information/feedback or conversation about garden plans
Good Quotes	Something significant said here
Interests of community	Things people are presently working towards. (Personal aspirations or goals, things people are trying to do)
Knowledge sharing	Ways knowledge is being shared, or desires for knowledge transfer
Management Considerations	How it is being run, who is providing information, who it is being run by, how the garden is connected to paid faculty. Labor availability
Money	Funding, costs, making revenue
Operational requirements	Anything required by C+CP or UBC

Plant Selection Criteria	How growers select the plants for their garden, plant selection criteria
Red Tape	Challenges due to policies, institutional barriers
Resources available	Resources that are available to the campus garden, on campus, and broader community
Resources Needed	Resource the community wants or needs
Seed	Conversation about sharing, donating, seeds, where they get seeds from, saving seeds, etc.
Site Characteristics	Characteristics of the site that are not a concern/are good qualities
Site concerns	Concerns or problems with existing sites
Strengths	Anything mentioned that highlights a positive impact of their garden or a project/approach they are proud of

Table C.3 Interview Codes and Descriptions

Code	Description
Challenges	Overall challenges with establishing and maintaining campus gardens
Development Permit Application	Development Permit Application challenges and concerns
Drought	Drought challenges and concerns for campus gardens
Garden Aesthetic	Gardens aesthetic appeal vs ecological function
Management Continuity	Long-term management and turnover challenges and concerns for campus gardens and campus planning and policy
Siting	Siting challenges and concerns for campus gardens and campus planning and policy
Water Access	Water access challenges and concerns for campus gardens
Role of Campus Gardens	Mentions of potential role of future campus gardens
Community Connection	Mentions of campus garden for facilitating community connections

Diversifying Ecological Function	Mentions of campus gardens for diversifying and restoring ecological function
Food Security	Mentions of campus gardens in facilitating food security
Knowledge Sharing	Mentions of campus garden in facilitating knowledge sharing
Planting Native Plant Species	Mentions of campus gardens in re-introducing native plant species
Reciprocity	Mentions of campus gardens facilitating reciprocity
Building Stewardship	Mentions of campus gardens building stewardship

APPENDIX D: DELIVERABLES

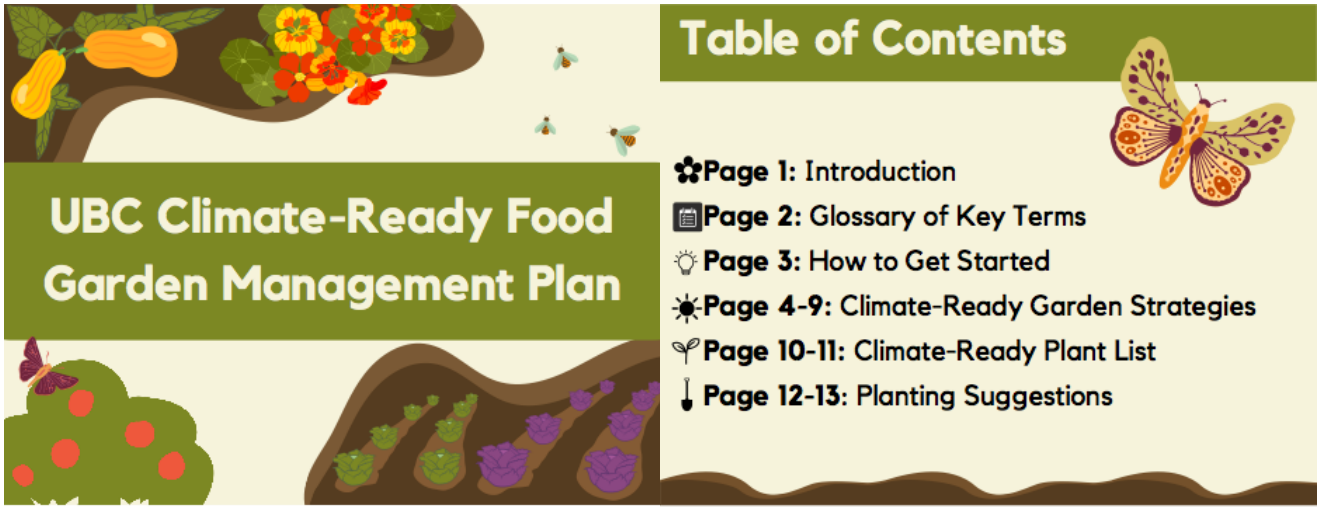
D.1 Climate Ready Food Plant List (Google Drive version linked here for higher resolution)

Plant Name	Scientific Name	Drought Tolerance	Temperature Tolerance	Soil Moisture Preference	Sun Preference	Pest Resistant (Y/N)	Pollinator Plant (Y/N)	Perrenial(P)/Annual (A)	Native Plant (Y/N)	Additional Notes
Vegetables										
Beans										
Scarlet Runners	*Phaseolus coccineus*	Mid to High	Cold and Heat Tolerant	Average to Dry	Full Sun	N	Y	A	N	This plant can grow to be over 2m tall and is a pole bean that will need trellising
Anasazi Tepary	*Phaseolus vulgaris*	High	Heat Tolerant	Dry	Full Sun	N	Y	A	N	This is a bush bean that grows up to 30cm tall.
Carrot										
Ingot	*Daucus carota*	Low	Cold and Heat Tolerant	Average	Full Sun/Part Sun	N	Y	A	N	Tolerates a wide variety of soils
Ya Ya	*Daucus carota*	Low	Cold and Heat Tolerant	Average	Full Sun/Part Sun	N	Y	A	N	Relatively frost tolereant, identified for growth in a Pacific Northwest coastal climate
Eggplant										
Long Purple	*Solanum melogena*	Mid	Cold and Heat Tolerant	Average	Full Sun	N	Y	A	N	Suited for a cooler climate than many eggplant varieties
Diamond	*Solanum melogena*	Mid	Cold and Heat Tolerant	Average	Full Sun	N	Y	A	N	Suited for a cooler climate than many eggplant varieties
Garlic										
Hardneck Varieties	*Allium sativum*	Mid	Cold and Heat Tolerant	Average to Dry	Full Sun	N	Y	P	N	Hardneck varieties are more cold tolerant than softneck and better suited to areas with cold winters
Softneck Varieties	*Allium sativum*	Mid	Heat Tolerant	Average to Dry	Full Sun	N	Y	P	N	Softneck varieties perfer mild climates and can be easier to grow than hardneck varieities under these conditions
Kale										
Nash's Green	*Brassica oleraceae*	Mid	Cold Tolerant	Average	Full Sun	N	N	A	N	Kale can tolerate heat and drought stress better than many leafy greens but it prefers cool growing temperatures
Onion (Bulbing)										
Egyptian Walking	*Allium x proliferum*	High	Cold and Heat Tolerant	Dry	Full Sun/Part Sun	N	Y	A	N	Exceptionally hardy variety that will grow in nearly all conditions. Is known to spread easily thoughout a garden.
Walla Walla	*Allium cepa*	Low to Mid	Cold Tolerant	Average to Dry	Full Sun	N	Y	A	N	Overwintering variety that is extremely cold hardy
White Wing	*Allium cepa*	Low to Mid	Cold and Heat Tolerant	Average to Dry	Full Sun	N	Y	A	N	Thrives in a wide range of climates and temperatures
Cabernet	*Allium cepa*	Low to Mid	Cold and Heat Tolerant	Average	Full Sun	Y	Y	A	N	Select this variety for good disease resistance
Onions (Bunching)										
Evergreen White	*Allium fistulosum*	Low	Heat Tolerant	Average to Dry	Full Sun	N	N	A	N	This variety can withstand summer heat better than most bunching onions
Onion (Nodding)										
All	*Allium cernuum*	High	Cold Tolerant	Dry	Full Sun/Part Sun	N	Y	P	Y	Flowering native plant with edible stalks and bulbs
Pepper (Bell)										
Milena	*Capsicum annuum*	Mid to High	Heat Tolerant	Average to Dry	Full Sun	Y	Y	A	N	While many varieties of sweet pepper are suitable for growth in our area, choose Milena for disease resistance
Pepper (Jalapeno)										
Early Jalapeno	*Capsicum annuum*	Mid to High	Heat Tolerant	Average to Dry	Full Sun	N	Y	A	N	Jalapenos love hot conditions but the Early Jalapeno can tolerate the cooler springs in our area
Radish										
Cheriette	*Raphanus sativus*	Low	Cold and Heat Tolerant	Average	Full Sun/Part Sun/Shade	N	Y	A	N	Radishes thrive in cooler temperatures but the selected variety can tolerate warmer summer temperatures
Rhubarb										
All	*Rheum rhabarbarum*	Mid to High	Cold Tolerant	Average	Full Sun/Part Sun	N	N	P	N	Can be grown nearly anywhere in your garden due to flexible light and soil requirements. The leaves of this plant are poisonous while the stem is edible
Soya Beans										
All	*Glycine max*	Mid	Tolerant of Temperature Fluctuations	Average to Dry	Full Sun	Y	Y	A	N	This plant can remain productive under stress from pests and adverse weather conditions
Squash										
Summer Varieites	*Cucurbita sp.*	High	Heat Tolerant	Average	Full Sun	N	Y	A	N	Popular types include zucchini, pattypan, luffa and cousa.
Winter Varieties	*Cucurbita sp.*	High	Heat Tolerant	Average	Full Sun	N	Y	A	N	Popular types include butternut, spaghetti, acorn, hubbard and kabocha. Winter types tend to be vining and will have larger space requirements
Swiss Chard										
Fordhook Giant	*Beta vulgaris*	Low to Mid	Cold and Heat Tolerant	Average	Full Sun/Part Sun	N	N	A	N	This plant can get very large if not pruned properly. Does well in summer heat
Silverado	*Beta vulgaris*	Low to Mid	Cold and Heat Tolerant	Average	Full Sun/Part Sun	N	N	A	N	A good variety for warmer conditions as it is resistant to bolting
Tomatoes										
Sakura	*Solanum lycopersicum*	Mid	Tolerant of Temperature Fluctuations	Average	Full Sun	Y	Y	A	N	Cherry type
Sweetie	*Solanum lycopersicum*	Mid	Tolerant of Temperature Fluctuations	Average	Full Sun	N	Y	A	N	Cherry type, can tolerate a very wide range of conditions, particularly cool, wet weather that may be encountered in the spring. Resistant to Alternaria Stem Canker (AS
Manitoba	*Solanum lycopersicum*	Low	Cold Tolerant	Average	Full Sun	Y	Y	A	N	Will do well in a majority of coastal conditions but is best suited to cool growing seasons
Potatoes										
Russian Blue	*Solanum tuberosum*	Mid	Tolerant of Temperature Fluctuations	Average to Dry	Full Sun		Y	A	N	Generally more tolerant of dry conditions than many other potato varieties
Russet Norkotah	*Solanum tuberosum*	Low to Mid	Tolerant of Temperature Fluctuations	Average	Full Sun	Y	Y	A	N	Wide range of disease resistance.
Fruit Trees										
Apple										
Pacific Crabapple	*Malus fusca*	High	Cold and Heat Tolerant	Wet to Dry	Full Sun/Part Sun	N	Y	P	Y	This tree can grow up to 12m tall in the right conditons. Consider size requirements and long life span when planting
Plum										
Pipestone	*Prunus domestica*	Mid	Cold and Heat Tolerant	Average	Full Sun	Y	Y	P	N	This tree can grow up to 15 feet tall. It requires cross pollination with other varieties, such as the wild plum tree P. nigra
Berries										
Blueberries										
Bluecrop	*Vaccinium uliginosum*	Low	Cold Tolerant	Average to Wet	Full Sun/Part Sun/Shade	N	Y	P	N	All varieties will have similar growing requirements, choose bluecrop for higher frost tolerance
Goji Berry										
All	*Lycium barbarum*	Mid to High	Heat Tolerant	Average to Dry	Full Sun	N	Y	P	N	Can grow up to 3m tall
Gooseberry										
Captivator	*Ribes hirtellum*	Low to Mid	Heat Tolerant	Average	Full Sun/Part Sun	Y	Y	P	N	Medium size bush that will grow to be 3x5ft. This variety is resistant to powdery mildew.
Oregon Grape										
Dull Orgeon Grape	*Berberis nervosa*	High	Cold Tolerant	Dry	Part Sun/Shade	N	Y	P	Y	Native berry producing shrub that can grow up to 7x5ft
Saskatoon Berry										
All	*Amelanchier alnifolia*	High	Tolerant of Temperature Fluctuations	Average to Dry	Full Sun/Part Sun	N	Y	P	Y	Native berry that will thrive in a wide range of conditions. Large shrub that will need plenty of space (15x15x20ft)
Herbs and Medicinals										
Basil										
Holy Basil	*Ocimum basilicum*	Low to Mid	Cold and Heat Tolerant	Average	Full Sun	N	Y	A	N	More hardy than many varieities
Dolly Basil	*Ocimum basilicum*	Low to Mid	Tolerant of Temperature Fluctuations	Average	Full Sun	N	Y	A	N	Can tolerate cold night temperatures
Chamomile										
All	*Matricaria recutita*	Mid	Cold and Heat Tolerant	Average to Dry	Full Sun/Part Sun	N	Y	P	N	Grows well in controlled garden environment. Naturalizes. Traditionally used in medicines and teas.
Chives										
All	*Allium schoenoprasum*	Mid	Cold Tolerant	Average to Dry	Full Sun/Part Sun	N	Y	P	N	Winter hardy perennial
Cilantro										
Santo	*Coriandrum sativum*	Mid	Cold and Heat Tolerant	Average to Dry	Full Sun/Part Sun/Shade	N	Y	P	N	Can tolerate cold better than most varieities. Resistant to bolting.
Lavender										
French	*Lavandula stoechas*	High	Cold Tolerant	Dry	Full Sun	N	Y	P	N	Winter hardy perennial
Lemon Balm										
All	*Melissa officinalis*	High	Cold Tolerant	Dry	Full Sun/Part Sun	N	Y	P	N	
Tarragon										
Mexican Tarragon	*Tagetes lucida*	Mid	Heat Tolerant	Average to Dry	Full Sun/Part Sun/Shade	N	Y	P	N	Acts as a perennial down to hardiness zone 8. May suffer in exceptionally cold winters on the coast
Mint										
All	*Mentha sp.*	Low to Mid	Cold Tolerant	Wet to Average	Full Sun/Part Sun/Shade	N	Y	P	N	Best grown in containers or raised beds to avoid uncontrollable spread of this plant
Oregano										
Greek Oregano	*Origanum vulgare*	Mid	Cold and Heat Tolerant	Average to Dry	Full Sun	N	Y	P	N	May not survive cold winters. Greek oregano is hardier than most varieties
Parsley										
All	*Petroselinum crispum*	Low to Mid	Cold and Heat Tolerant	Average	Full Sun/Part Sun	N	Y	A	N	
Rosemary										
All	*Salvia rosmarinus*	High	Heat Tolerant	Average to Dry	Full Sun	N	Y	P	N	Evergreen herb. Needs to be watered occassionally as they can be damaged from overwatering.
Sage										
Culinary	*Salvia officinalis*	High	Cold Tolerant	Dry	Full Sun	N	Y	P	N	Culinary sage is the most popular and widely available variety
Yarrow										
All	*Achillea millefolia*	High	Heat Tolerant	Dry	Full Sun/Part Sun	N	Y	P	Y	Grows well in controlled garden environment. Naturalizes. Traditionally used in medicines and teas.

D.2 Glossary of Key Terms in Climate-Ready Food Plant List

Term	Definition
Drought Tolerance	***Low*** = Cannot tolerate drought under current conditions
	Low to Mid = Will not be able to tolerate worsening drought conditions
	Mid = May be able to tolerate future drought conditions
	Mid to High = Will likely be able to tolerate future drought conditions
	High = Will tolerate future drought conditions
Temperature Tolerance	***Cold Tolerant*** = Tolerant of expected temperature minimums down to our current hardiness zone (8b) or colder
	Heat Tolerant = Tolerant of temperature highs expected under future conditions
	Cold and Heat Tolerant = Contains both qualities as listed above
	Tolerant of Temp Fluctuations = Tolerant of large daily temperature changes that occur now, in spring and fall
Soil Moisture Preference	***Dry*** = generally prefers infrequent watering and well drained soil
	Average =prefers regular watering and a range of soil types depending on other management factors
	Wet = generally prefers frequent watering and high moisture-retaining soil
Sun Preference	**Full Sun**= 6 or more hours of sunlight/day
	Part Sun= 4 to 6 hours of sunlight /day
	Shade= less then 3 hours of sunlight/day
Pest Resistant	***Y*** = Resistant to one or more identified pest for that plant species. See Additonal Notes column for more details
	N = Not pest resistant
Pollinator Plant	***Y*** = Attracts and benefits one or more local pollinators
	N = Has no impact on pollinators
Perennial or Annual	***P*** = Plants that will live and produce more than one year
	A = Plants that will live and produce only one year
Native Plant	***Y*** = This plant is native to British Columbia
	N = This plant is not native to British Columbia

D.3 Climate-Ready Food Garden Management Plan



Introduction

The earth's climate is changing - droughts, floods, extreme temperatures, and shifting seasonality continue to impact crop health and yield. Climate-ready gardening is a great way to practice climate action, increase local food production, and connect with your campus community!

Think of your garden as an ecosystem - it's made up of plants, soil, insects, humans, water, nutrients, and more! Try to keep each of these components in mind as you're planning and tending to your garden.

How to Use This Plan!

- A visual and accessible guide to support you in getting your campus food garden started or to share with beginner gardeners joining your team.
- No two food gardens are the same! To set yourself up for success, apply the guidance in this plan with the capacity and interests of your garden's caretakers in mind.

1

Glossary of Key Terms

Term	Definition
Climate-Ready Garden	Planned with evolving average temperatures and increased frequency of extreme weather events in mind.
Drought Tolerant	Ability of a plant to withstand a period of minimal soil moisture through various roots and leaf adaptations.
Heat Tolerant	Ability of a plant to withstand high temperatures while maintaining growth and production capacity.
Cold Tolerant	Ability of a plant to withstand cold temperatures and tolerating light to moderate frost without damage.
Pollinator-Friendly	A plant that offers resources to pollinators such as bees, butterflies, moths, hummingbirds, and more.
Native Plant	A native plant is a plant that grows in and is adapted to a specific geographic area.
Annual or Perennial	Annual plants complete their lifecycle within one year. Perennial plants can live for multiple years.
Light Requirements	Plants require different levels of sunlight to grow and thrive. Levels include full sun, part shade and shade.

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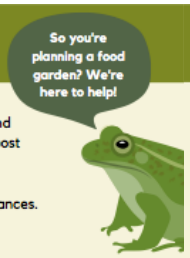
How to Get Started



1. **Get to Know Your Site**
   - Monitor light, temperature, shade, and exposure to rain and wind throughout the day. Identify water sources and space for compost and garden waste.
2. **Build up Your Soil**
   - Do a soil test to identify nutrient composition and possible imbalances.
   - Amend your soil with compost before planting and with organic fertilizers if necessary.
3. **Make a Crop Management Plan**
   - Ensure that the plan is suitable and realistic for your garden's microclimate and capacity. See planting suggestions on P.12 and P.13 for inspiration!
   - Make sure to check the availability and price of seeds before you include them in your plan.
4. **Source Locally Adapted Seeds/Seedlings**
   - Check out UBC Farm's Seed Donations, the BC Eco-Seed Co-op, Woodward Seed Library, Southlands Nursery, Phoenix Perennials, the Coast Salish Plant Nursery, Plan Bee Nursery, or seeds from seed swapping/trading!
5. **Get Going and Get Growing!**
   - Connect with other growers on campus for support and resource sharing!

3

Climate-Ready Garden Strategies

With added pressures of extreme heat, droughts, wildfires, and shifting seasonality, having strategies and plans in place can help you be more adaptable to rapid change.

Below are some techniques that can help build contingencies for various weather events and support the health of your ecosystem. Once you've reviewed these, check out the Climate-Ready Plant List and the Planting Suggestions diagrams for more inspiration!

1. **Soil Health**
2. **Plant Selection**
3. **Crop Planning**
4. **Water Management**
5. **Community Connections**

4

1. Soil Health

Healthy topsoil forms the basis of our food systems! It acts as a global carbon sink and regulates our climate. Factors that inform its ability to sustainably support food plants include pH levels, water retention capacity, drainage abilities, biological activity, and nutrient availability. One of the most important actions you can take to facilitate these characteristics in your garden is by incorporating organic matter using the strategies below.

Strategies:

1. **Applying Compost**
   a. High-quality compost is key to supplementing plants with nutrients before and during the growing season. Creating compost on-site is an amazing step to closing the carbon loop and reducing waste in your garden! There are plenty of DIY options such as vermicomposting, compost tumblers, or a 3-bay system where you can organize your composting materials and stages.
2. **Cover Cropping**
   a. Cover cropping is when a fast-growing crop such as clover, alfalfa, or buckwheat is planted approximately a month before your region's first frost date and left to grow until the spring. Having roots in the soil all winter is a low-maintenance way to improve soil structure, encourage nitrogen fixation, and encourages healthy microbial activity! The presence of the cover crop also reduces erosion and nutrient loss that can occur with the heightened precipitation in the fall and winter months.
3. **Minimizing Disruption**
   a. You can support carbon retention in your soil by leaving roots in the ground year-round! This can be accomplished through cover cropping, planting overwintering crops (e.g. cauliflower, garlic, cabbage, etc.), and incorporating perennial plants. Avoiding tilling (I.e. excessive digging or stirring) can reduce the disruption of soil organism communities and the release of carbon.

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2. Plant Selection

Increasing crop diversity can help food growers to withstand the effects of climate change. Having a range of plants that thrive under different conditions can give you greater security as weather patterns fluctuate, as some plants will better tolerate and survive certain conditions such as heat, drought, and cold temperatures.

Strategies:

1. **Embrace the Sun and Shade**
   a. If your site allows it, plant heat-sensitive crops in shady areas or under larger, more heat tolerant plants (ex. Plant lettuce between rows of potatoes). During the summer months, choose drought resilient crops to lessen water usage and preserve yields (see our plant list for more information!).
2. **Plant Native Varieties**
   a. Native plant varieties are especially well-adapted to the unique climatic conditions of your specific region. Native plants can also help to support ecological interactions with other native species like insects, birds, and small mammals.
3. **Attract Beneficial Insects**
   a. Plant flowering crops and herbs to attract pollinators and insect predators that feed on pests. Some favourites include berries, squash oregano, rosemary, and chives! Plants that support beneficial insects are great companion plants for crops that require pollination or face high pest pressures. For example, plant chives with tomatoes to attract bumblebee pollinators or plant marigolds to deter pests.
4. **Incorporate Perennial Plants**
   a. Perennial plants, shrubs and trees can have deep roots that help them to access water deeper in the soil during dry periods. Having larger and more established root systems can also help to support essential soil microbes and improve your soil's water and nutrient retention capacity.

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3. Crop Planning

Alongside selecting plants that are appropriate for your microclimate, crop management plays a big role in the resilience of your garden! By incorporating some of the strategies below, you can increase your harvest, extend your growing season, and support the long-term health of your soil.

Strategies:

1. **Succession Planting**
   a. Succession planting is a strategy used to generate more consistent production by planting seeds or seedlings every 2-3 weeks in alternating rows. This is particularly useful with crops such as carrots and lettuce which you may want to harvest more regularly. By having crops at different stages of growth, when you harvest from one planting cycle, the next one will be well on its way to maturation!
2. **Annual Crop Rotation**
   a. Crop rotation entails being intentional with minimizing the repetitive growth of a given crop in the same area of your garden. By taking note of planting locations each year, you can avoid depleting your soil of a given nutrient while interrupting the disease cycle that may be characteristic of certain plant families.
3. **Shoulder Season Growing**
   a. Shoulder seasons vary in length and timing per region, but are generally the periods between the off-seasons (e.g. winter) and peak seasons (I.e. summer) of growing (I.e. the spring and fall). With extreme heat and drought characterizing BC summers, taking advantage of milder weather can give cool-weather crops a higher chance of success, provide overwintering plants a head start, and overall extend your harvest window.

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4. Water Management

Heat waves and droughts can be devastating for the health of food plants. When temperatures exceed the optimal range for a given variety there can be a disruption to pollination, root development, and overall growth. Water scarcity can exacerbate these issues, making strategies to conserve and effectively manage water resources especially important!

Strategies:

1. **Drip Irrigation**
   a. While hand watering is an excellent option, it can be time-consuming, resource-intensive, and increases your plant's vulnerability to waterborne diseases. Drip irrigation involves installing pipes with small holes that allow water to drip onto the soil at a desired rate. These systems promote more even watering across your garden, conserve water by minimizing evaporation, and save time!
2. **Mulching**
   a. Mulching is a practice of applying organic materials such as wood chips, straw, or leaves to the soil around your plants year-round. In warmer months this cools the soil and reduces the evaporation of moisture, allowing for less water to be used! In cooler months, the mulch protects the soil from erosion, insulates plants, and protects them from cold snaps or unexpected frost.
3. **Shade Cloth**
   a. Shade cloth is a strategy in which a thin, light-permeable material such as row cover, cheesecloth, or burlap to reduce the amount of sunlight that reaches your plant. You can even customize the permeability of your material according to the needs of your crops! Applying shade cloth during warm periods of the growing season can conserve soil moisture and protect your plants from scorching.

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5. Community Connections

As climate events and extreme weather increase in frequency and severity, community connections and support networks will become more important for the resiliency of the people and plants that are part of your growing space. Connect with your community to help support food security, source drought-resilient plants and seeds, and engage in knowledge sharing to combat the effects of climate change.

Strategies:

1. **Connect with Other Campus Food Growers**
   a. Connect with other food gardens on campus to share knowledge and resources. To reduce costs and meet quantity requirements try to place group orders for seeds, soil, compost, mulch, and tools!
2. **Engage in Reciprocity**
   a. This strategy will look different for each garden! Here are some examples:
      i. Seek out community fridges to encourage the community to interact with your garden.
      ii. Consider establishing U-pick sections in the garden where community members can harvest food and connect with their local food system in a low-barrier way.
      iii. Create space for native medicinal plants and connect with Indigenous communities to share the harvest.
      iv. Dedicate some plants in your garden for wildlife by leaving varieties that have gone to seed or have started to flower for native birds and pollinators.
3. **Reach Out to Local Farms and Businesses for Support**
   a. Local farms and garden centers can offer great resources for soil, regionally-adapted seeds, perennial plants, and garden tools. The UBC Farm is a great resource for additional information about food growing in BC and they sometimes offer seed donations.

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Climate-Ready Plant List

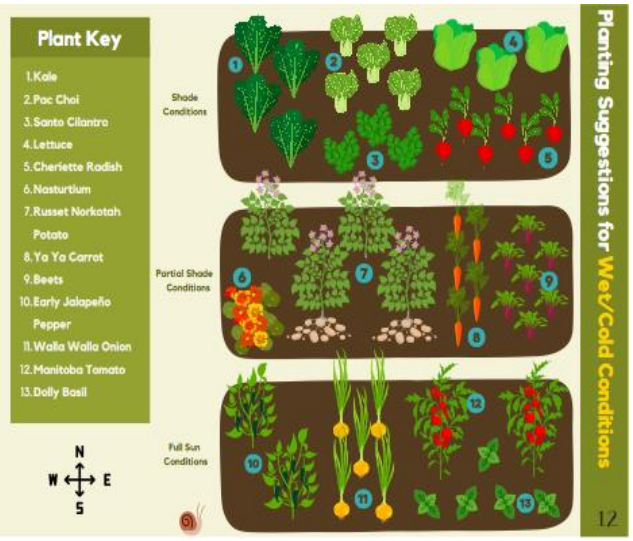
For a more extensive list of climate-ready plants and their growing considerations click here

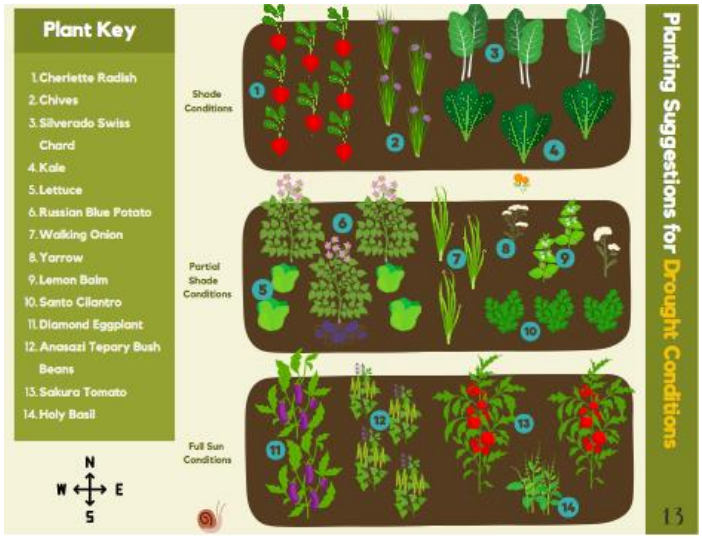
	Plant Name	Heat Tolerant	Cold Tolerant	Drought Tolerant	Pollinator Friendly	Native Plant	Annual (A) or Perennial (P)	Light Requirements
Vegetables	Egyptian Walking Onion (*Allium × proliferum*)	✓	✓	✓	✓		A	Full Sun/Part Sun
	Walla Walla Onion (*Allium cepa*)		✓		✓		A	Full Sun
	Nodding Onion (*Allium cernuum*)		✓	✓	✓	✓	P	Full Sun/Part Sun
	Hardneck Garlic (*Allium sativum*)	✓	✓		✓		P	Full Sun
	Anasazi Tepary Beans (*Phaseolus vulgaris*)	✓		✓	✓		A	Full Sun
	Ya Ya Carrot (*Daucus carota*)	✓	✓		✓		A	Full Sun/Part Sun
	Diamond Eggplant (*Solanum melogena*)	✓	✓		✓		A	Full Sun
	Early Jalapeño Pepper (*Capsicum annuum*)	✓		✓	✓		A	Full Sun

Heat Tolerant Cold Tolerant Drought Tolerant Pollinator Friendly

10


Climate-Ready Plant List
For a more extensive list of climate-ready plants and their growing considerations click here
Plant Name
Native Plant
Annual (A) or Perennial (P)
Light Requirements
Vegetables
Silverado Swiss Chard (Beta vulgaris) A Tolerates All
Cheriette Radish (Raphanus sativus) A Tolerates All
Manitoba Tomato (Solanum lycopersicum) A Full Sun
Russian Blue Potato (Solanum tuberosum) A Full Sun
Fruits
Bluecrop Blueberry (Vaccinium uliginosum) P Tolerates All
Saskatoon Berry (Amelanchier alnifolia) P Full Sun/Part Sun
Herbs
Santo Cilantro (Coriandrum sativum) P Tolerates All
Western Yarrow (Achillea millefolia) P Full Sun/Part Sun
Heat Tolerant
Cold Tolerant
Drought Tolerant
Pollinator Friendly
11


Plant Key
1. Kale
2. Pac Choi
3. Santo Cilantro
4. Lettuce
5. Cheriette Radish
6. Nasturtium
7. Russet Norkotah Potato
8. Ya Ya Carrot
9. Beets
10. Early Jalapeño Pepper
11. Walla Walla Onion
12. Manitoba Tomato
13. Dolly Basil
N
W
E
S
Shade Conditions
Partial Shade Conditions
Full Sun Conditions
Planting Suggestions for Wet/Cold Conditions
12


Plant Key
1. Cheriette Radish
2. Chives
3. Silverado Swiss Chard
4. Kale
5. Lettuce
6. Russian Blue Potato
7. Walking Onion
8. Yarrow
9. Lemon Balm
10. Santo Cilantro
11. Diamond Eggplant
12. Anasazi Tepary Bush Beans
13. Sakura Tomato
14. Holy Basil
N
W
E
S
Shade Conditions
Partial Shade Conditions
Full Sun Conditions
Planting Suggestions for Drought Conditions
13