UNIVERSITY OF MANITOBA | CAPSTONE REPORT

INTEGRATING URBAN AGRICULTURE INTO WINNIPEG'S CLIMATE ADAPTATION STRATEGIES THROUGH ONLINE PUBLIC ENGAGEMENT: A PILOT PROJECT

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ABSTRACT

The purpose of this research project was two-fold: (1) to identify lessons learned from the utilization of a GIS web mapping application for online public engagement, and (2) to demonstrate the value of data gathered from mapping urban agriculture in the City of Winnipeg, and how the data may or may not encourage the integration of urban agriculture into the Winnipeg Climate Action Plan. The research contributes to the evolving tools of online public engagement for planners, and should also raise awareness about the benefits of urban agriculture in the context of climate change, our understanding of climate adaptation planning, and the value of mapping urban agriculture via an online public database in advancing climate adaptation policy in the City of Winnipeg. The methods were the development and deployment of a GIS web mapping application (app) to create an inventory of existing urban agriculture sites and potential locations for urban agriculture in the City of Winnipeg with the help of the public. The web app asked participants to locate said sites and answer three survey questions about the urban agriculture site. Three key findings include the following: a) time is a factor, and online public engagement should be given enough time to achieve sufficient participants, b) the integration of urban agriculture into Winnipeg's Climate Action Plan will require a multi-level governance model, ensuring all relevant stakeholders have a mutual understanding. And c) online public engagement tools should be used in harmony with traditional methods to achieve the greatest outcome; online public engagement tools should not be a replacement for these traditional strategies. The literature supports both the use of online public engagement strategies, such as the GIS web mapping application created for this research, and the use of mapping urban agriculture to raise awareness of the benefits of UA and encourage the City of Winnipeg to integrate UA into the Winnipeg Climate Action Plan.

[Keywords: online public engagement, digital engagement, urban agriculture, climate change, climate adaptation, adaptation planning, planning, GIS, mapping]

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1. INTRODUCTION

Climate change and public engagement are the major themes of this pilot project, with urban agriculture and climate adaptation as the underlying topics. Addressing climate change is no small feat, however, finding ways to include the public in a meaningful way can help planners build adaptive capacity for cities experiencing the negative impacts of climate change. One way adaptive capacity can be achieved is by planners using online public engagement methods, particularly as many cities, regions, and countries become more dependent on technology. Online public engagement methods can include social media outreach, web-based apps, online forums (Levenda et al., 2020), and much more. Online public engagement methods can help planners to reach a greater number of participants and a more diverse public (Levenda et al., 2020). When planners are working directly with climate change and climate adaptation, online public engagement can create awareness about issues between planners and the public, and between planners and fellow planners near or far (Syvixay, 2019).

Finding alternative and innovative ways for cities to adapt to climate change is imperative (UN, n.d.). Urban agriculture has been relatively limited in the Global North except for during World War I and II (Tornaghi, 2014) and is more recently experiencing a resurgence. This resurgence of UA may be able to contribute in a positive way to climate adaptation strategies. Recent studies have advocated for the value of mapping urban agriculture in a digital format, as a way to advance both online public engagement practices and climate adaptation.

As planning is an interdisciplinary field, planners may be exposed to all, or at least some of these key topics (online public engagement, urban agriculture, climate adaptation planning, and mapping). This creates space and a need in the planning field to identify tools that can apply to a variety of practices.

The purpose of this pilot project was to identify lessons learned and recommendations from the development and deployment of an ArcGIS (geographic information system) Online web mapping application (app) to collect public data on both existing urban agriculture sites and opportunities for urban agriculture in the City of Winnipeg. The intention was to explore the utility of a web-based mapping app as an online public engagement tool for planners. In addition, to observe how establishing an urban agriculture inventory (for both existing sites and potential sites) could contribute to the recognition of urban agriculture as a climate adaptation opportunity in Winnipeg's Climate Action Plan.

1.1 CONTEXT

Public engagement for the purpose of building and maintaining meaningful relationships between the public and decision-makers is a critical component of planning (Arnstein,

1969). Planners must continue to improve upon and expand tools and strategies utilized to maintain effective public engagement practices (Syvixay, 2019). There is a need to examine the opportunities for online public engagement tools and strategies within the planning field, in addition to potential limitations or drawbacks of such. Online public engagement tools such as GIS web mapping applications have been identified as an online medium with great potential for all fields of planning, such as environenmental planning or adaptation planning (Levenda et al., 2010; Mandarano et al., 2010; Syvixay, 2019). However, greater research is needed to support their effective integration into public engagement practices, particularly those involved with climate adaptation planning.

Urban agriculture has been identified through the literature as an effective strategy for climate adaptation across the globe (Dubbeling, n.d.; Deelstra & Giradet, 2017). Urban agriculture (UA) can be defined as "the growing, processing, and distribution of food and other products through intensive plant cultivation and animal husbandry in and around cities" (Tornaghi, 2014, p. 551). UA can include "small-intensive urban farms, food production on housing estates, land sharing, rooftop gardens and beehives, schoolyard greenhouses, public space food production, guerilla gardening, allotments, balcony, and windowsill vegetable growing and other initiatives" (Tornaghi, 2014, p. 551). For this pilot project, urban agriculture will specifically relate to those practices that exist outdoors only (i.e., rooftop gardens, community gardens, living walls, etc.). As urban agriculture becomes more recognized for its benefits, particularly for climate adaptation, the City of Winnipeg could better include urban agriculture in its Climate Action Plan as an effective strategy for climate adaptation. There currently is no extensive list of urban agriculture practices or locations for Winnipeg. This gap has been identified through a brief review of the City of Winnipeg's Climate Action Plan, in addition to other relevant documents.

Planners can be faced with significant challenges and are often tasked with addressing big picture issues of climate change, affordable housing, or homelessness. As there are many aspects of the planning field, professionals are required to be equipped with a wide range of tools and knowledge. Continuing to add tools to the planning toolbox will only enhance planners' ability to cause an effective change in the cities, communities, and neighbourhoods in which they work.

1.2 RESEARCH QUESTIONS

As a result of a review of the literature, identifying precedents and a brief analysis of current policy in Winnipeg, two research questions emerged. I attempt to answer the following research questions through this pilot project:

Q1: How can GIS web mapping applications help contribute to effective public engagement strategies for those planners (and other professionals) working on issues of climate adaptation?

Q2: How can data gathered through web mapping applications encourage recognition of urban agriculture as a climate adaptation strategy in Winnipeg, particularly in its Climate Action Plan?

1.3 LIMITATIONS AND CONSIDERATIONS

This pilot project had to consider several factors and limitations. First, is the context in which the pilot project was being executed, Winnipeg. Lessons learned and recommendations from the pilot project will be derived from the local context of Winnipeg. Recognizing the context will be crucial in applying lessons learned and recommendations to the broader field of planning and other municipalities. A potential next step for this pilot project would be to deploy similar pilot projects in cities across Canada to gather more well-rounded data to apply at a larger scale. Secondly, the success of the pilot project relied heavily on garnering enough participants which was a variable not in the researcher's control.

1.4 OVERVIEW

Section 1 introduces the pilot project, including context, the research questions, and limitations. Section 2 provides a review of the literature as it relates to public engagement, online public engagement, climate adaptation, urban agriculture, mapping, a brief context of urban agriculture and climate adaptation policy in Winnipeg, and informative precedents. Section 3 explains the methodology of the pilot project, outlining a rationale, an overview of the research methods, and the research process. In section 4, the findings are discussed, along with an analysis of the findings. In section 5, a brief discussion of the findings, lessons learned are identified, the research questions are answered, recommendations are provided, followed by further research questions that have arisen throughout the pilot project, and concludes with final thoughts.

2. LITERATURE REVIEW

In this section, existing literature on the identified key themes: public engagement, online public engagement, climate adaptation, and urban agriculture are discussed. These seemingly unrelated topics converge in this pilot project, and often in professional planning practices. Public engagement, in the traditional sense, is explored as the conceptual framework against which the pilot project is explored. Sherry Arnstein's seminal work is dated back to 1969 and still feels relevant to all public engagement practices in planning today. Arnstein's ladder of citizen participation has become the standard by which all public engagement processes are measured. Applying her ladder, and the later work of Davidson to the newer digital age of online public engagement still provides value. Emerging technologies and techniques in the realm of online public engagement are identified as they relate to the field of planning, reinforcing the appropriateness of this pilot project. Comparing traditional methods of public engagement on Arnstein's ladder with newer, digital public engagement technologies in the literature, sheds a light on how far public engagement has come and how far public engagement still needs to go.

Climate adaptation and urban agriculture are both defined from the existing literature, and the key benefits of each are highlighted. More specifically, this literature review seeks to explore how urban agriculture can be utilized to aid cities in their efforts to adapt to the negative impacts of climate change. The goal of this pilot project is to further the City of Winnipeg's efforts to integrate climate adaptation more effectively in their climate change plans and policies. In addition, the value of mapping agriculture is explained through the literature, particularly how mapping can contribute to the planning practice, and how it can be incorporated successfully into online public engagement practices. Finally, three key informative precedents are identified to provide insight into current practices similar to this pilot project. In addition, these informative precedents inspire potential next stages of this pilot project or other potential projects.

2.1 PUBLIC ENGAGEMENT

Public engagement has been a crucial element of planning for decades and will continue to be for decades to come. In a democracy, seeking out public feedback is crucial to maintaining the support of our citizens and continuing to make effective change. There should always be a partnership between planners and the communities being planned (Davidson, 1998). What does real citizen participation look like? Arnstein critiqued citizen participation in her 1969 article, comparing notions of citizen participation with citizen power. No single person can have absolute power, citizen participation is a type of citizen power (Arnstein, 1969). Citizen participation should allow the opportunity for the 'have-nots'—a term Arnstein used to describe the marginalized, to gain influence in

planning decisions, such as policies, taxes, community programs, etc. (Arnstein, 1969). Many planners have been known for simply going through the motions of what citizen participation should look like without effectively redistributing power to the citizens, more specifically to the have-nots (Arnstein, 1969). Planners often use the term 'public' to prove they have consulted everyone but, this is not always the case. The planner's role should be "facilitating greater discussion, democracy, and engagement" (Syvixay, 2019). Levenda et al. ask the question of 'what is the public?', introducing the idea public engagement may not include everyone it should (2020). This commonality in citizen participation, or public engagement "allows the powerholders to claim that all sides were considered but makes it possible for only some of those sides to benefit" (Arnstein, 1969, p. 216). To better address and articulate her critiques, Arnstein created the ladder of citizen participation, which is still referenced to this day, some 50 years later. Arnstein placed federal programs of the time on certain rungs of the ladder, though the concept can be applied to virtually all situations (1969). "The underlying issues are essentially the same— 'nobodies' in several arenas are trying to become 'somebodies' with enough power to make the target institutions responsive to their views, aspirations, and needs" (Arnstein, 1969, p. 217). To understand completely Arnstein's argument and to better understand where certain public engagement tools may fall, the eight rungs of the ladder of citizen participation are:

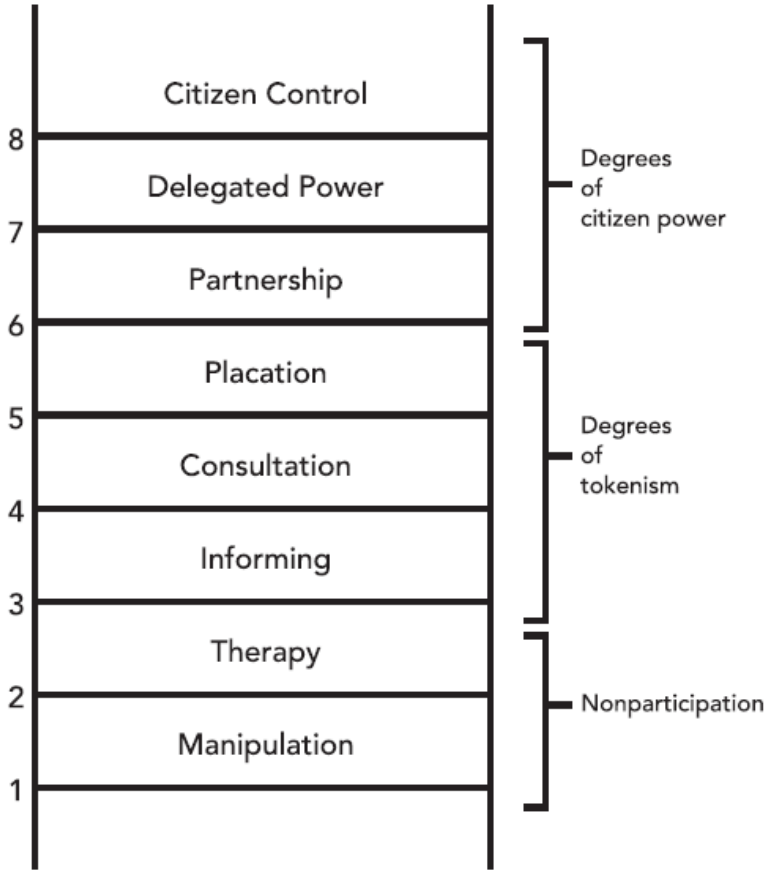

Figure 1: Ladder of citizen participation (source: Arnstein, 1969)

Table 1: Detailed description of the ladder of citizen participation (source: Arnstein, 1969)

	Description	**Example**
Rung 1: Manipulation	On rung one, citizens are placed in what they consider influential roles (advisory boards, etc.), but they are only there to be educated on the topic at hand (Arnstein, 1969).	An example of this would be the urban renewal programs; with these programs' city housing officials invited participants to serve on citizen advisory committees, which also included subcommittees for minority groups. These committees and similar ones gave the citizen no tangible power. The powerholders simply needed their signatures to move forward with their programs and check 'citizen participation' off their to-do list. In doing so, powerholders were able to say that they considered everyone's thoughts and opinions when in fact they did not.
Rung 2: Therapy	The second rung assumes "that powerlessness is synonymous with mental illness" (Arnstein, 1969, p. 218). Citizens feel they are being involved in the planning process, but rather the experts or powerholders are attempting to cure them of any conflicting views they may hold.	Experts make citizens participate in 'clinical group therapy'.
Rung 3: Informing	The third rung is often a one-way street, with officials informing citizens, with no opportunity to provide feedback. This information is often provided towards the end of the planning process leaving little time for citizens to actively engage. Though this rung is low on the ladder of citizen participation, "informing citizens of their rights, responsibilities, and options can be the most important first step toward legitimate citizen participation" (Arnstein, 1969, p. 219).	Examples of informing could be news media, posters, or pamphlets.
Rung 4: Consultation	Much like the lower rung 3, consultation is another step towards meaningful participation. Citizens are just participating, and powerholders can now prove they involved the public, though in a meaningless way. Arnstein referred to this run as a "window-dressing ritual" (1969, p. 220). Arnstein stresses that consulting must be combined with other avenues of participation to ensure concerns will be taken seriously and applied.	Examples of consultation could be surveys, meetings, and public hearings.
Rung 5: Placation	The fifth rung, placation, still holds some degree of tokenism but does allow citizens to have minor influences.	An example of placation could be placing a few have-nots on a board, here they have a vote but are most often going to be outvoted by the actual powerholders.

Rung 6: Partnership	The sixth rung sees a redistribution of power and allows for productive negotiation between citizens and powerholders. This participation often results from "angry citizen demands, rather than city initiative" (Arnstein, 1969, p. 222).	An example of partnership would be a joint policy board.
Rung 7: Delegated power	Nearing the top of the ladder, rung 7 allows citizens to have dominant decision-making authority on a particular program or plan.	For example, on a board, the citizens would have the majority of the seats.
Rung 8: Citizen control	At the top of the ladder is citizen control, though Arnstein noted previously that there is no such thing as complete power.	An example of this would be a neighbourhood corporation that does not have to deal with any middlemen and has its source of funds.

The ladder of citizen participation can act as a baseline against which all public engagement practices including this pilot project, can be analyzed. Arnstein notes the top of the ladder is the goal but may be unattainable. After summarizing Arnstein's ladder above, this pilot project lands between rungs 3 and 4: informing and consultation. The GIS web mapping application for this pilot project was designed to allow citizens to participate in data-gathering which is intended to encourage the City of Winnipeg to make changes to existing policy. In addition, the web app educated citizens on urban agriculture and the benefits of UA for climate adaptation efforts in Winnipeg. The goal of asking the public to identify both existing urban agriculture and opportunities for UA was to create awareness with residents, stakeholders and decision-makers about UA in Winnipeg. The survey questions were designed to engage the public with UA in their communities; to allow them to see what UA currently exists, and the potential for more UA. Unfortunately, this method of public engagement does not allow for the public to obtain more power than being informed and contributing to the data.

Arnstein's ladder of citizen participation points out the problem but does not necessarily address any potential barriers planners may face or solutions to moving up the ladder. Community involvement in planning projects can often be viewed as a delay, and an obligatory notion, often pulling attention away from the value it may bring (Davidson, 1998). In 1998, Davidson reworked Arnstein's ladder to become his 'spinning wheel of participation' to better address the complexity of citizen participation. Davidson's "wheel promotes the appropriate level of community involvement to achieve clear objectives, without suggesting the aim is always to climb to the top of the ladder" (1998, p. 14). He argues for new citizen participation techniques for all planning processes, and the wheel of participation could provide a clearer path towards achieving successful engagement rather than Arnstein's ladder. This pilot project practiced good quality information and genuine consultation from the information and consultation quarters of Davidson's wheel. Participation and empowerment were not exercised to the best of my ability for this pilot project. The GIS web mapping application for this pilot project allowed citizens to participate in the data-gathering phase of the anticipated change in climate adaptation policy. Citizens were unable to make their own decisions

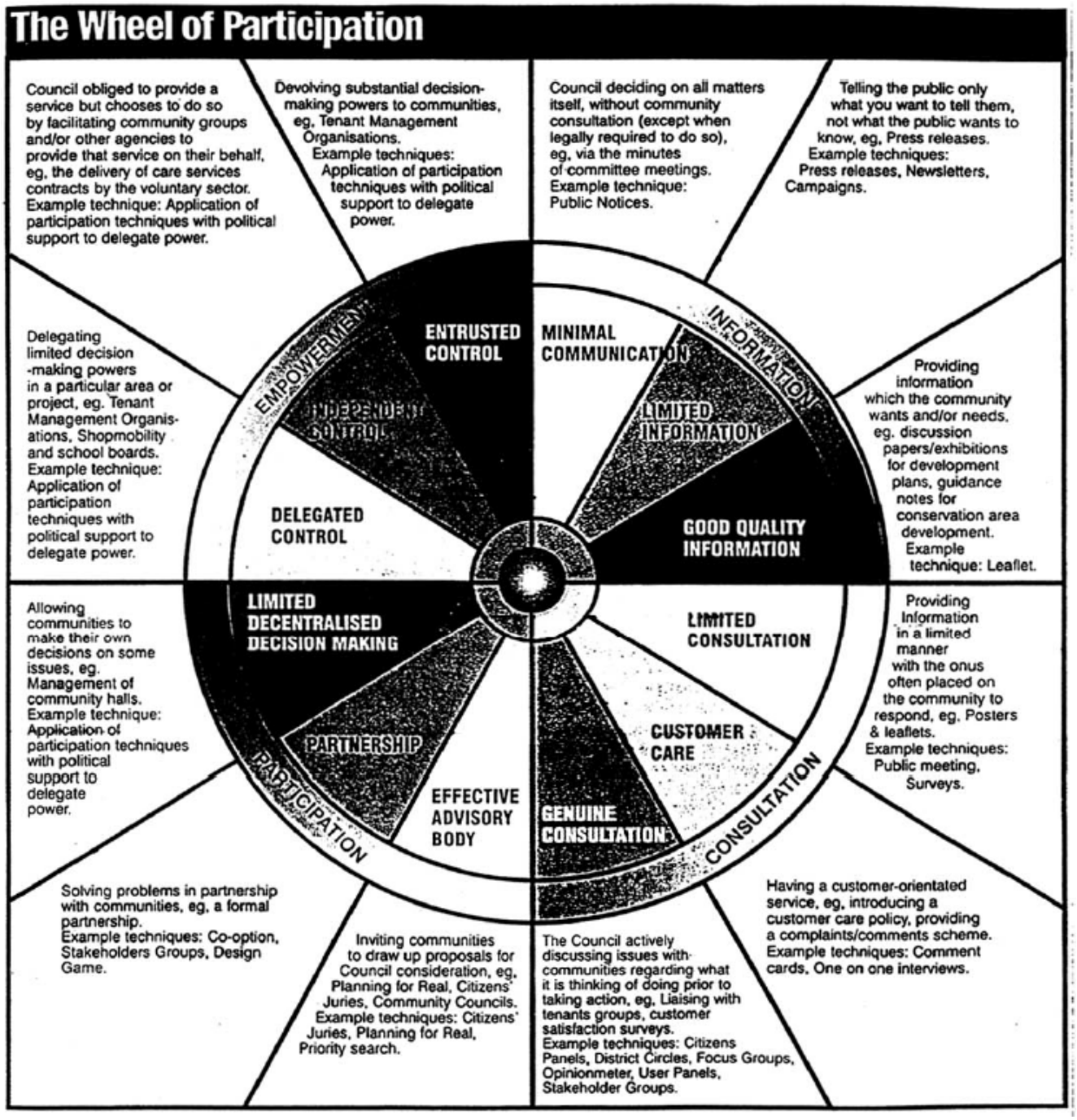

Figure 2: Spinning wheel of participation (source: Davidson, 1998)

about the pilot project and how the data would be utilized to make effective change.

Both Arnstein and Davidson established concrete foundations of how they believed public engagement should be in the field of planning. Their work has provided a guideline for best practices and has also created a space to better assess the effectiveness of public engagement tools or strategies. This pilot project had successes and failures, and both the ladder of citizen participation and the wheel of participation provided an avenue to better understand those successes and failures. Placing the pilot project within Arnstein's and Davidson's work will help in identifying lessons learned and how the pilot project could have been improved to achieve more effective public engagement.

2.2 ONLINE PUBLIC ENGAGEMENT

Levenda et al. state “citizen participation has been revered as a central process for democratic decision making and at the same time criticized as tokenism that merely placates the public” (2010, p. 345-346). As the world continues to become more dependent on and integrated with technology, the field of planning must implement more digital technologies into their projects and policies. Technology-enhanced and Internet-based participation in urban planning should increase participation and allow for more meaningful engagement with the public (Levenda et al., 2020). Mandarano et al. introduce the term e-democracy, “the use of Internet tools to enhance traditional public participation processes and to build a new form of a social capital—digital social capital” (2010, p. 123). Planners often play the role of facilitators, between the public and the issue at hand, in which the top rung of Arnstein’s ladder of citizen participation is the goal but it is important to recognize that lower levels on the ladder can contribute to the formation of social capital (Mandarano et al., 2010).
Social capital consists of three elements:

1. Relationships
2. Trust
3. Norms

“Social capital can facilitate information sharing to arrive at mutual understandings leading to conflict resolution, more effective decision making, more efficient coordination, and increase capacity to respond to future challenges” (Mandarano et al., 2010, p. 125). Levenda et al. list some examples of technology-enhanced public engagement: participatory geospatial information systems, smartphones, computer games, 3-D models, comment forums, social media. The literature has identified successful examples of online public engagement practices from a variety of cities. Portland, Oregon has been successfully using participatory geospatial information systems in many civic activities. An example of this is their interactive maps accessible from their website that inform the public of the locations of recycling centres or allow the user to plan a bike route (Mandarano et al., 2010). Portland’s utilization of participatory mapping software on their municipal website suggests the willingness of residents to use similar software like the one for this pilot project. A Winnipeg Free Press article authored by Jason Syvixay interviewed planners on their opinions, attitudes, and exposure to digital public engagement. Some of the opinions expressed by his interviewees were: digital public engagement can create more opportunities to engage in the moment, rather than waiting to attend in-person events. This pilot project presents an opportunity for citizens to engage over a longer period rather than attending a one-day public hearing for example. Citizens can contribute as much or as little as they wish and can do this from the comfort of their own homes. Interviewees also expressed the ability of digital technology in planning practice to allow planners to reach further beyond their immediate geographic areas, potentially receiving feedback or new ideas.

Developing an online public engagement process such as the GIS web mapping app in this pilot project presents the opportunity for planners from other jurisdictions to contribute to the process as well. Another opinion expressed was the potential for digital public engagement to foster the idea of planning cities for everyone, not just those in power. Bringing in the public to contribute to the data-gathering stage of a project, can create a more trusting, meaningful relationship with all relevant stakeholders including the citizens. One interviewee stated, "almost every planning department needs to significantly change business-as-usual in how the public is engaged" (Syvixay, 2019), suggesting the need for projects such as pilot project. Addressing the opinions and attitudes of planners on online public engagement can aid in a better understanding of potential benefits and barriers to integrating such public engagement practices permanently in the City of Winnipeg.

Levenda et al. analyzed the City of Calgary's 'Engage Policy' from 2013 in which a new direction for engagement processes was established to be citizen-centric, consistent, and clear and to enhance the City's reputation of being open to ideas and actively listening (Levenda et al., 2020). Two case studies were assessed, the first centred on a participatory budgeting process, the other on integrating secondary suites into plans and policies. The participatory budgeting process involved an online portal and the development and deployment of an app. Levenda et al. interviewed City employees that were involved with the project, gaining insight into the successes and pitfalls. The online participation, in this case, increased the number of participants; approximately 50,000 pieces of information were gathered, compared to the roughly 200 people that may be consulted or attend a traditional event such as an open house (Levenda et al. 2020). An interviewee stated that the online participation component led to a wider range of opinions, passionate people participating and the ability to reach people that are not typically motivated to attend in-person events (Levenda et al., 2020). Levenda et al.'s analysis noted the participatory budgeting process lacked dialogues between decision-makers and the public and seemed to cater to certain publics, landing itself on the bottom rung of Arnstein's ladder (2020).

The current state of the literature on digital public engagement for planning practices recognizes the high potential of these tools to create greater reach, attract a vast majority of participants that are passionate about the issues, activate communities into being, and provide accessible information that is available online 24/7. Though potential has been recognized, there are a few cautionary tales that have emerged from the literature. Further evaluation needs to be executed to "consider how digital engagement platforms shape and constrain who defines matters of concerns, who is involved, who can contribute to decision making, and how certain groups can meaningfully contribute to city planning processes" (Levenda et al., 2020, p. 356). In addition, more extensive research is needed to determine to what degree how much digital platforms are improving the accountability, transparency, and responsiveness of governments (Mandarano et al., 2010). Digital public engagement tools can be

beneficial to planners but should not replace traditional tools such as public hearings, open houses, and continued dialogue. It should not be viewed as the easy way out, as traditional tools often require more time and cost to carry out. A combination of both digital and traditional public engagement tools will allow planners to reach a higher rung on the ladder of citizen participation, than if used separately from each other.

2.3 DEFINING CLIMATE ADAPTATION

Climate change is a phenomenon we can no longer ignore. Average temperatures are shifting, sea levels continue to rise, extreme weather events are occurring more frequently and the impact of them continues to devastate cities across the globe, the threat to humanity is significant. Unfortunately, the world is at the point where "a specific level of climate change impact is irreversible and the rate of change very slow, CO2 concentrations are not expected to decrease significantly, even if the world were to suddenly shift to a net-zero carbon economy" (Krellenberg & Hansjürgens, 2014, p. 4). There are two major paths to addressing climate change: (1) climate mitigation and (2) climate adaptation. As climate adaptation is the primary focus of this pilot project, a further definition is needed. Climate adaptation refers to "the process of adjustment to actual or expected climate and its effects" (IPCC, 2014, p. 5), seeking to either avoid potential harm or exploit beneficial opportunities (IPCC, 2014). This can present itself in several ways that are not limited to: adjusting laws, programs, plans, and measures, flood defences, early warning systems, switching to drought-resistant crops (Krellenberg & Hansjürgens, 2014; UN, 2021).

Climate adaptation can be further defined as anticipatory, referring to adaptation measures that are implemented before observing any climate change impacts, and reactive, referring to adaptation measures that are implemented following observing climate change impacts (Krellenberg & Hansjürgens, 2014). When discussing climate adaptation, it is important to also define resilience, which means "the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance,

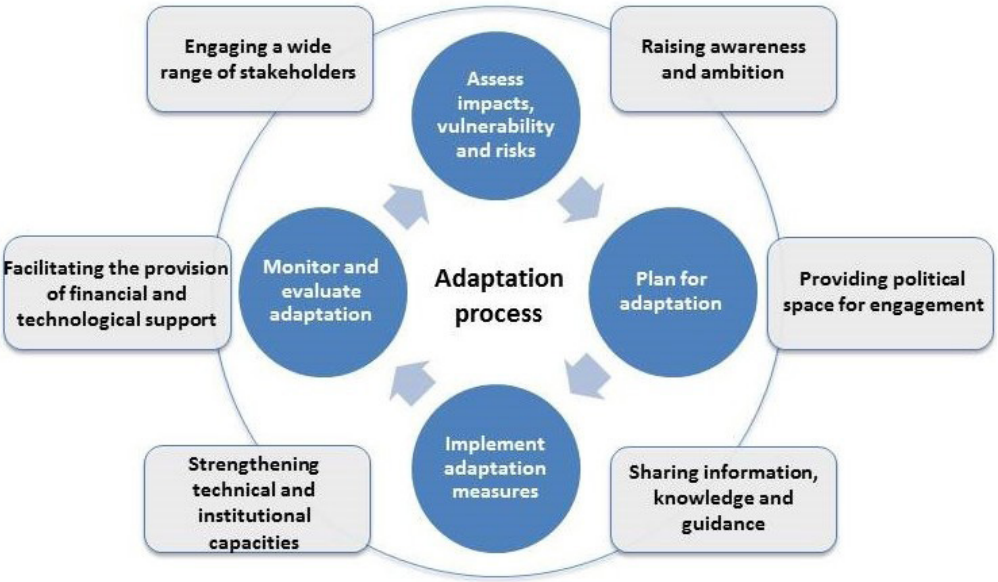

Figure 3: The adaptation cycle developed by the United Nations (source: UN, 2021)

responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintain the capacity for adaptation, learning, and transformation" (IPCC, 2014, p. 5).

Climate adaptation is the key to a global response to climate change (UN, 2021) and is slowly becoming more integrated into policy and planning processes for both the public and private sectors. We can start to see climate adaptation incorporated into significant policy documents such as development plans (IPCC, 2014) and environmental policies (UN, 2021). The adaptation process can be complex, as seen in figure 3, which may be a significant barrier for municipalities that are struggling to implement climate adaptation measures successfully. The components of this pilot project sit primarily on the outer circle of figure 3, raising awareness and ambition, engaging a wide range of stakeholders, strengthening technical and institutional capacities, and sharing information, knowledge, and guidance. "Successful adaptation not only depends on governments but also on the active and sustained engagement of stakeholders including national, regional, multilateral and international organizations, the public and private sectors, civil society and other relevant stakeholders" (UN, 2021). In addition, adaptation is not a one size fits all approach, effective adaptation requires actions unique to the local context (IPCC, 2014) and will continue to require forward-thinking.

2.4 DEFINING URBAN AGRICULTURE

As urbanization continues to accelerate across the globe, achieving sustainable development is only becoming more crucial. By the year 2030, 59% of the world's population will be living in cities (IISD, 2018). The International Institute of Sustainable Development (IISD) urges the promotion of urban agriculture (UA) as UA can play a supporting role in helping cities to achieve their sustainable goals (2018). Urban agriculture has been defined in several ways. Tornaghi defines UA "as the growing, processing, and distribution of food and other products through intensive plant cultivation and animal husbandry in and around cities (2014, p. 55). UA includes:

Table 2: Types of urban agriculture (Tornaghi, 2014, p. 51)

Small-intensive urban farms	Food production on housing estates	Land sharing	Rooftop gardens and beehives
Schoolyard greenhouses	Restaurant-style salad gardens	Public space food production	Guerilla gardening
Allotments	Balcony and windowsill vegetable growing	Other initiatives	

Mougeot defines UA as "an industry located within (intraurban) or on the fringe (periurban) of a town, a city, or a metropolis, which grows or raises, processes and distributes a diversity of food and non-food products, (re-)using largely human and material resources, products and services found in and around that urban area, and in turn, supplying human and material resources, products and services largely to the

urban area" (n.d., p.1 0). Though many definitions exist for UA, the common theme is UA involves food production in cities. The practice of growing food in urban spaces has existed since the beginning of cities; Forman states this food production primarily occurs on large fields in peri-urban, exurban, and suburban areas, and in underutilized spaces and vacant lots in urban areas (2014). Forman organizes UA practices into three location types:

1. Large sites: livestock on pastureland, fields with national-market crops, market gardening, community service agriculture (CSAs), aquaculture, and fish farms
2. Small sites in peri-urban/exurban and suburban areas: house-plot gardens, greenhouse production
3. Small sites in city and suburb: institutional gardens, community gardens, tiny gardens in little-used spaces, buildings growing food (Forman, 2014, p. 345-346)

Urban agriculture has been a common practice in the Global South and is slowly gaining traction in the Global North (Tornaghi, 2014), as "more urban governments are now seeking to exchange policy and technical expertise to better deal with a spreading phenomenon in their city" (Mougeot, n.d., p. 1). Examples of UA initiatives include a rooftop garden on an IGA in Montreal, Canada, a rooftop beehive on Chicago City Hall (Tornaghi, 2014), or Sole Food Street Farms using container gardens in Vancouver, Canada. Many benefits of UA have been identified in the literature:

- Increased social capital and civic engagement in low-income communities
- An increase in the sharing of knowledge and cultural values
- Those involved in UA practices learn many new skills
- Aids in addressing food insecurity
- Increased nutrition due to the greater access to fresh produce
- Overall mental and physical health
- A source of income
- Climate mitigation
- Climate adaptation (IISD, 2018)

As the potential of urban agriculture becomes more recognized globally, the proper mechanisms and policies must be in place to ensure it can be integrated seamlessly. Successful urban agriculture policies will require collaboration between all levels of government, in addition to the private sector – a multi-stakeholder approach. Relevant powerholders can:

- incorporate UA practices into larger policy documents such as Master Plans
- update regulations such as zoning bylaws to allow for more UA
- create more institutional mechanisms such as the Cuban Ministry of Agriculture

created the Urban Agriculture Office for Havana, Cuba

- allocate city-owned public spaces for either temporary or permanent UA practices
- officially promote UA initiatives and programs
- strive for international agency supports
- establish education programs so more people can practice UA safely (Mougeot, n.d.)

Urban agriculture practices can utilize open spaces more productively, both treat and recover urban wastes, generate income and employment opportunities, and manage stormwater more efficiently (Mougeot, n.d) and has been proven to be “a promising solution for sustainable development” (IISD, 2018).

2.5 HOW URBAN AGRICULTURE CAN HELP COMMUNITIES ADAPT TO CLIMATE CHANGE

Climate change is no longer deniable and at this point is irreversible (IPCC, 2014). As stated previously, we must find new and innovative ways to address and adapt to the impacts of climate change. Key concerns of climate change are rising temperatures, increasing precipitation, flood events, food insecurity, droughts, negative effects on public health, the urban heat island effect, and others (Dubbeling, n.d.). The urban heat island effect refers to the increase of temperature within urban areas due to closely packed buildings and impermeable surfaces (Urban heat island effect, n.d.). Urban areas trap heat more than natural areas, thus raising the temperature, in addition, humans generate more heat in these urban areas from the use of cars, and heating and cooling systems (Urban heat island effect, n.d.). Urban agriculture has the potential to help build adaptive capacity within cities in several ways. Adaptive capacity refers to “the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences” (IPCC, 2014).

Urban gardens, agricultural lands, street trees, and green roofs can “contribute to decreasing direct solar radiation by providing shade and can help lower temperatures through evaporative cooling” (Dubbeling, n.d., p. 2). Specifically, rooftop gardens can “increase thermal comfort in apartments located under the rooftop” (Dubbeling, n.d., p. 2), lowering energy use overall. UA in the city can also increase humidity, capture gases, and dust, help break heavy winds and create protected places from direct solar radiation (Deelstra & Giradet, 2017).

As urbanization trends continue, the number of built-up surfaces will only increase resulting in less permeable surfaces in cities thus creating ideal situations for heavy flooding events or flash floods. UA can aid in increasing water infiltration by reintroducing more permeable surfaces, ideally reducing the impact of such flooding events (Dubbeling, n.d.). In addition, cities with low-lying areas could direct construction away from these areas and instead convert them into UA zones, again increasing water infiltration capabilities (Dubbeling, n.d.). Further so, UA practices can incorporate the

use of rainwater collection systems for irrigation purposes, resulting in less precipitation hitting the ground and decreasing demand on urban water supply (Deelstra & Giradet, 2017).

UA can also increase the capacity of individuals to develop a personal food supply, allowing them to adapt to food insecurity caused by climate change. As individuals become more self-reliant on food sources, there is less strain on food transportation systems resulting in fewer greenhouse gas emissions from such processes. Not all UA practices work in every city, and cities need to identify which work best with their geography, "local socio-economic, climatic, agronomic and spatial conditions" (Dubbeling, n.d., p. 5).

The literature has identified the observed benefits and potential UA can have on cities, particularly in efforts to mitigate climate change and adapt to the impacts of climate change. This begs the question, why is UA not more pronounced in urban plans and policy? Currently, UA is not reaching its full potential in cities due to political restraints that include restrictive urban policy, laws and regulations, uncertainty about property rights of the land, lack of supportive services, unfeasible implementation of environmental technologies, lack of organization and representation of urban farmers (Deelstra & Giradet, 2017). "It is crucial that planners start recognizing the importance of urban farming in the rich mix of activities that characterize modern cities" (Deelstra & Giradet, 2017, p. 60) and the role it can have in "contributing to the future sustainability of cities" (Deelstra & Giradet, 2017, p. 45). As stated previously, the successful integration of UA into urban policy requires a multi-stakeholder approach, including all levels of government; these actors can be proactive and aid in this integration by:

- Integrating urban agriculture and food security into climate adaptation strategies
- Maintaining and managing UA as part of the urban and peri-urban green infrastructure
- Identifying open urban spaces prone to floods and landslides, and protecting or developing these as permanent agricultural and multi-functional areas
- Integrating UA and forestry into comprehensive city water management plans, development plans, building codes, and housing programs
- Recognizing UA as an accepted, permitted, and encouraged land use
- Developing a municipal urban agriculture and food security policy and programs
- Establishing education programs for urban farmers, or residents who wish to produce their food (Deelstra & Giradet, 2017)

Urban agriculture has immense potential to provide cities with new and innovative ways to adapt to the never-ending and ever-changing impacts of climate change; this potential will only be fully achieved if planners and policymakers recognize this and begin making changes. As this pilot project is focused on encouraging the City of Winnipeg to integrate UA more effectively into their plans and policies, the next section will provide

an overview of current relevant documents.

2.6 CURRENT STATE OF URBAN AGRICULTURE AND CLIMATE ADAPTATION POLICY IN WINNIPEG

To briefly understand the current context of urban agriculture and climate adaptation policy in Winnipeg, three documents were analyzed:

1. *OurWinnipeg 2045*
2. *Winnipeg's Climate Action Plan*
3. *Green Infrastructure for Food Production*

1. *OurWinnipeg 2045* was selected as it is one of the most recent plans for the City of Winnipeg to guide development goals and policies in the city. The document is reflective of the most up-to-date planning objectives, including environmental and sustainable land uses and development goals. *OurWinnipeg 2045* is also a document in which urban agriculture could be addressed, perhaps UA, such as rooftop gardens could be a requirement for new developments. *Winnipeg's Climate Action Plan* was selected because it is the sole plan specific to how the City of Winnipeg plans to mitigate and adapt to the negative impacts of climate change. *Winnipeg's Climate Action Plan* provides a strong opportunity for urban agriculture to be included as a strategy for adapting to and mitigating climate change. *Green Infrastructure for Food Production* published by the Winnipeg Food Council was selected due to its successful integration of urban agriculture and climate adaptation in the City of Winnipeg.

OurWinnipeg 2045 Development Plan is a visionary document set out to "guide the physical, social, environmental, and economic objectives and sustainable land uses and development" of Winnipeg. The development plan is organized into six goals which were adopted from the 17 United Nations Sustainable Development Goals (SDGs). Goal number two: Environmental Resilience encapsulates SDGs 6 (clean water and sanitation), 7 (affordable clean energy), 12 (responsible consumption and production), 13 (climate action), 14 (life below water), and 15 (life on land). Each City of Winnipeg identified goal has its own set of objectives and policies to further reinforce the intention of the development plan. Goal two references climate adaptation only three times, specifically in policies 2.4 (climate resilient growth), 2.20, and 2.21 (leverage green infrastructure). Urban agriculture is only referenced once in policy 2.22 (local food security).

Table 3: OurWinnipeg 2045 relevant policies (Source: City of Winnipeg, 2021)

Policy 2.4	**Policy 2.20**	**Policy 2.21**	**Policy 2.22**
Facilitate compact, dense, complete, and physically and virtually connected communities through integrated land use, transportation, and infrastructure planning, to achieve climate change mitigation and **adaptation** goals and objectives, and greenhouse gas emissions reduction targets.	Create a master green space and natural corridor plan by-law that enables conservation, management, restoration, and enhancement of the inherent value and ecological functioning of parks, waterways, natural areas, and systems year-round, to support the environment, advance **climate change adaptation**, and mitigation, and increase the quantity of such lands by 1,000 acres that can be accessed for recreation, social interaction, active living, and connection of people and nature with nature, as population growth occurs.	Conserve, restore, and enhance the urban forest as a key contributor to air quality, erosion control, carbon sequestration, stormwater management, efficient energy resource consumption, shade, improved health and wellbeing, and mitigation of and **adaptation** to the urban heat island effect.	Enable sustainable **urban agriculture** and local food systems that include access to land, Indigenous landbased practices where possible, culturally relevant food practices, scalable production, processing, storage, distribution, preparation, consumption, and disposal, to achieve food security.

Table 2 summarizes the policies in which climate adaptation and urban agriculture are mentioned in *OurWinnipeg 2045*. Policies 2.4, 2.20, 2.21 and, 2.22 provide clear direction towards goal two (environmental resilience), however, these policies are high-level and do not provide actionable items. This gap could be addressed by identifying specific suggestions on how to follow the policy; for example, in policy 2.22, creating a more UA-supportive zoning by-law could be a way to enable sustainable urban agriculture. In addition, there could be better integration of urban agriculture and climate adaptation in the policies outlined for goal two. Policies 2.20 and 2.21 recognize the role green space and the urban forest in Winnipeg can play in advancing climate adaptation. One step further could include the direct mention of the benefits urban agriculture can have for Winnipeg's climate adaptation efforts. *OurWinnipeg 2045* is an influential document that will guide the development of Winnipeg for the next 23 years. Better integration of urban agriculture as a potential climate adaptation tool in the plan could allow for UA to be a part of the development processes, not an afterthought.

2. The intention of terms stated in *Winnipeg's Climate Action Plan* is to "provide a framework to proactively, meaningfully, and effectively mitigate climate change by reducing greenhouse gas emissions" (City of Winnipeg, 2018, p. iii). The plan is structured into seven strategic opportunities for Winnipeg to pursue, only one of which addresses climate adaptation.

Table 4: Winnipeg's Climate Action Plan strategic opportunities 1-6 (source: City of Winnipeg, 2018)

Strategic opportunity 1
Corporate leadership
Climate action that sets Winnipeg on a path towards reaching its greenhouse gas mitigation target requires integrated and concerted actions by the entire community. City leadership in climate action is essential to creating momentum for broad uptake and action in the community.
Strategic opportunity 2
Empower Community Leaders and Collaborate with Stakeholders
Winnipeg cannot achieve its community climate change emissions targets with action taken solely through actions implemented by the City. Successful climate action strategies amplify and align the knowledge and efforts of local business, community organizations, and citizens to generate additional momentum for climate action. A key opportunity is to further enhance levels of collaboration between the City and community leaders, industry, academia and other stakeholders.
Strategic opportunity 3
Advancing Sustainable Transportation – Increasing Mobility Options and Shift to Zero Emission Vehicles
Increasing access to mobility options and fuel switching are key directions for reducing emissions from transportation. Key directions aim to directly shift residents out of single occupancy vehicles through sustainable transportation options with lower or no emissions (walking, cycling, public transit, carshare, and carpooling) or indirectly enable diverse mobility choices through the development of higher density, and more complete communities. A key opportunity to advance fuel switching in Winnipeg is through electric vehicles for both private vehicles and public transit.
Strategic opportunity 4
Facilitate Compact, Complete Development and Increase Density
Winnipeg's built environment and public realm are a key part of how citizens and visitors choose to get around the City. Research shows that energy used for transportation increases as a city becomes more spread out and as housing, jobs, daily needs and recreation or community destinations become more dispersed. Complete communities and increased density throughout the City allow new growth and development to create the conditions for sustainable transportation choices leading to reduced greenhouse gas emissions. These actions have co-benefits related to public health including increased outdoor physical activity and access to healthy foods. As well, amenities within close proximity to where people live and work equalize opportunities, especially amongst people disadvantaged by income or other barriers.
Strategic opportunity 5
Low Carbon and Energy Efficient Buildings
In order to lower energy and greenhouse gases used in Winnipeg's new and existing buildings, the City and community need to find better ways to understand the energy use and emissions from buildings and provide builders with the tools and resources (where needed and feasible) to support these retrofits and designs.
Strategic opportunity 6
Waste Reduction and Diversion
Advancing waste reduction and diversion initiatives is a critical part of reducing the City of Winnipeg's overall greenhouse gas emissions, and can help to address other environmental challenges. Strategies that maximize the diversion of organic wastes from the landfills are critical, along with reusing resources, which not only reduces the raw materials used in their production, but also reduces emissions from the transportation of new and waste products.

Table 5: Winnipeg's Climate Action Plan strategic opportunity #7 in detail with key directions (source: City of Winnipeg, 2018)

Strategic Opportunity #7	**Community Climate Resiliency**
Description	Climate resilience is the integration of climate mitigation and climate adaptation. Communities are facing serious threats related to public health, infrastructure costs, economic viability, and social equity associated with climate change. During the public consultation for this Plan, numerous participants identified the important connection between climate adaptation and mitigation. They expressed a clear desire for the City to take a holistic approach to climate action that considers multiple co-benefits between adaptation and mitigation. Opportunities for additional climate resilience actions need to be considered in a formal Climate Adaptation Strategy.
Key Directions	**7.1** Implement Opportunities to Improve Winnipeg's Resilience and Adaptability to the Effects of a Changing Climate (Primary Responsibility: Office of Sustainability) **7.2** Increase and Preserve Tree Canopy (Primary Responsibility: Public Works Department) **7.3** Preserve and Manage Parks and Natural Areas to Support Climate Change Mitigation (Primary Responsibility: Public Works Department)

Climate adaptation appearing as the last of the seven strategic opportunities for climate actions alludes to adaptation being the lowest priority, in my opinion. As a certain amount of climate change impact has been deemed irreversible (Krellenberg & Hansjürgens, 2014), cities must develop adaptive capacities in addition to continuing to mitigate climate change. *Winnipeg's Climate Action Plan* could take climate adaptation into more account and develop a robust adaptation strategy, potentially as an entirely separate plan. A climate adaptation plan could include urban agriculture as a specific strategic opportunity, similar to the language utilized in the *Climate Action Plan*. In addition, a supplementary document within *Winnipeg's Climate Action Plan* addresses urban agriculture in conjunction with urban forestry as important emission reduction opportunities. However, the potential for urban agriculture to provide adaptive capacity is not mentioned here. Urban forestry as an emission reduction strategy is supported by a handful of case studies pursuing similar strategies. Further information could include case studies identifying urban agriculture as a strategy as well, raising more awareness of the positive impact urban agriculture can have on Winnipeg.

3. The *Green Infrastructure for Food Production* Report published by the Winnipeg Food Council in October of 2020 examines the "ability of green infrastructure in the City of Winnipeg to address issues of combined sewer overflows and sustainable food systems for social equity, wellbeing, and climate change resilience" (Winnipeg Food Council, 2020, p. 3) and proposes UA be incorporated within green infrastructure projects. Green infrastructure can include "natural vegetation, soils, water and bioengineered solutions that collectively provide society with a broad array of products

and services for healthy living" (Winnipeg Food Council, 2020, p. 3). The Winnipeg Food Council is advocating for UA to be central to green infrastructure projects, and the utilization of rainwater harvesting systems (Winnipeg Food Council, 2020). The report analyzes case studies and existing green infrastructure projects in Winnipeg and suggests in looking forward, the City of Winnipeg should consider the benefits of incorporating UA into any further green infrastructure projects.

While all three documents included climate adaptation and urban agriculture as opportunities, or policies, the *Green Infrastructure for Food Production* Report is the only one that recognized the mutually beneficial relationship between the urban agriculture and climate adaptation. *OurWinnipeg 2045* addresses green infrastructure and climate adaptation simultaneously, but UA is addressed as it relates to food insecurity rather than climate adaptation. *Winnipeg's Climate Action Plan* lists climate adaptation as its final 'strategic opportunity' and recognizes only briefly in a supplementary document the opportunity for UA and urban forestry to contribute to climate adaptation strategies. The brief analysis provided here of the two policy documents (*OurWinnipeg 2045* and *Winnipeg's Climate Action Plan*) suggests the need for not only further understanding of the benefits of UA for climate adaptation strategies but also the need to better integrate the two in such documents. The *Green Infrastructure for Food Production* Report accomplishes a successful partnering of urban agriculture and climate adaptation, but is merely a suggestion for the City of Winnipeg. The report could serve as an excellent starting point for the City of Winnipeg to begin incorporating these suggestions into their policy documents.

2.7 THE VALUE OF MAPPING URBAN AGRICULTURE

The mapping of urban agriculture is not a novel idea, there is ample literature on the topic and several initiatives ongoing across the globe which as discussed in this section. Though each case of mapping UA is slightly different in terms of methods, scope, tools, and purpose, the benefits of mapping urban agriculture remain common throughout. These benefits will be explained further in this section (2.7). Mapping initiatives identified in the literature have utilized the analysis of high-resolution Google Earth images, geospatial databases, lists, and public forums to map urban agriculture in their cities.

As the literature has highlighted the benefits of urban agriculture, and more specifically the potential of UA to contribute to climate adaptation, the importance of effectively incorporating UA into policy and plans is clear. Planners are promoting urban agriculture and fostering urban food production across the globe, and the mapping of UA can aid this forward momentum. To successfully develop policies and programs which integrate UA effectively, we must first accurately map both public and private forms of UA. Pulighe & Lupia (2016, p.55) state "the availability of an updated spatially explicit UA database is an essential step to understand the citizen's demand and to develop programs for vacant lands, community gardens, farmers' markets" and other UA

practices. Locating UA "can help planners, government officials, and advocates identify gaps in the spatial distribution of existing sites—where urban agriculture is not occurring but possibly should be because of poverty, lack of food access, or public health problems such as obesity, diabetes and heart disease" (Taylor & Lovell, 2012, p. 58). Mapping UA can also locate resources for the development of new UA sites or provide opportunities to improve existing sites (Taylor & Lovell, 2012). Mapping UA can tell planners and other decision-makers several things: where UA is located, what types of UA are being produced, the condition of existing sites, and how UA is being distributed. Locating existing sites, along with the physical and socio-demographic characteristics of the immediate surrounding areas can better inform planners, advocates, and educators to provide more specific outreach programs (Taylor & Lovell, 2012). In addition, the mapping of open green spaces, vacant lots, and underutilized places can provide information for potential UA sites. "Maps that accurately document the extent and diversity of food production sites can demonstrate to city officials and others that urban agriculture is a valid and productive use of urban land" (Taylor & Lovell, 2012, p. 58). Mapping initiatives, integrated with other methods such as surveys or interviews with local farmers will improve understanding of urban food systems and how they are developed. Effective UA mapping practices will ultimately allow planners and policymakers to both create new UA policies and update current policies to better cultivate urban agriculture in cities.

2.8 INFORMATIVE EXAMPLES

The scope of this pilot project did not include a precedent study, however secondary research revealed a three examples which stood out as best practices of urban agriculture mapping initiatives, and effective urban agriculture policy frameworks and initiatives. The use of best practices, or precedents in urban planning is a common technique when embarking on a new project or plan. Knowledge or perspective gained from precedents can guide or drive projects, and also validate them (Arab & Mullon, 2022). In addition, the use of precedents or examples can aid in defining priorities, and allow planners to apply lessons learned to their projects (Arab & Mullon, 2022). These informative examples were identified to be similar to the overall goal of this pilot project. Precedents 2.8.1 and 2.8.2. are examples of urban agriculture mapping initiatives that are similar to the GIS web mapping application deployed during this pilot project. Precedent 2.8.3. identifies Toronto, Canada as a city in which urban agriculture is thriving in part due to successful initiatives and supportive UA policies. These three examples can provide inspiration and guidance to any future pilot projects of a similar nature.

2.8.1 The Chicago Urban Agriculture Mapping Project (CUAMP)

CUAMP established in 2010 is a unique collaboration of businesses, institutions, organizations, and individuals with the sole purpose of both mapping and building an

inventory of urban agriculture in Chicago, Illinois (Chicago Urban Agriculture Mapping Project, n.d.). CUAMP is an online interactive map and directory of urban agriculture for anyone that needs and would benefit from the information. This resource is available to the public and no one person or organization owns the information (Chicago Urban Agriculture Mapping Project, n.d.). Everyone is encouraged to utilize the information, from individuals to government agencies, and CUAMP recognizes that the information can contribute to educational, research, policy, or informational purposes (Chicago Urban Agriculture Mapping Project, n.d.). NeighborSpace, Advocates for Urban Agriculture, and DePaul University's Irwin W. Steans Centre are those currently responsible for all administrative duties of CUAMP (Chicago Urban Agriculture Mapping Project, n.d.). The map and inventory are added to voluntarily; participants who wish to add or edit an urban agriculture site will complete a Google form accessed via the website. All submissions are then reviewed by the City of Chicago and NeighborSpace, and if approved, added to the database (Chicago Urban Agriculture Mapping Project, n.d.). Each point on the map will provide the user with additional information such as ownership, garden features, location information (ward, community area, district #), and any other information. There are currently 890 urban agriculture sites identified on the map. The overall purpose of the Chicago Urban Agriculture Mapping Project is to promote urban agriculture in the city and provide a publicly available resource to whoever may need to access this information (Chicago Urban Agriculture Mapping Project, n.d.)

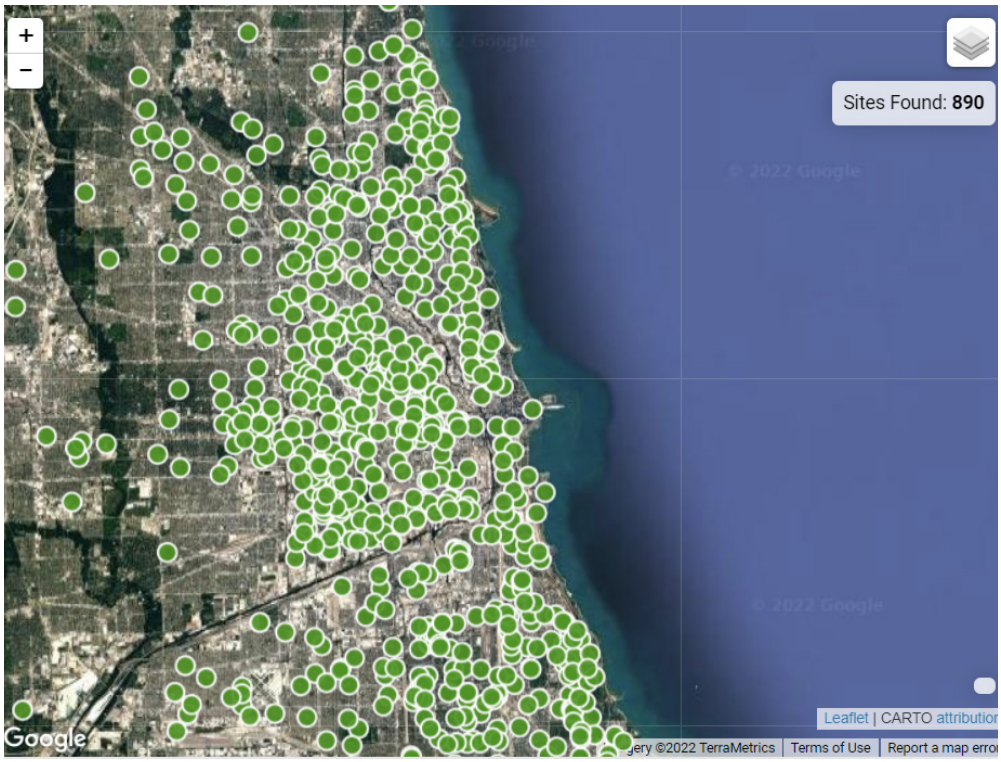

Figure 4: Chicago Urban Agriculture Mapping Project (CUAMP) map, showing all 890 urban agriculture sites identified (Chicago Urban Agriculture Mapping Project, n.d.)

2.8.2 Mapping urban agriculture potential in Rotterdam

Vlad Dumitrescu while an Intern at Rotterdam's Engineering and Environmental Bureau conducted research which aimed to map the potential for urban agriculture in Rotterdam. The purpose of his research was to promote UA in Rotterdam to increase the number of UA initiatives in the city through these digital maps. Dumitrescu chose to map the potential for urban agriculture based on three key criteria: physical, economical, and social.

The physical criteria observed included:

- Unsealed areas: meaning the land is uncovered and the soil would likely be accessible.
- Soil quality: as the soil in urban areas is typically contaminated and unsuitable, it is important to determine the level of contamination for suitable UA use.
- Height of flat roofs: rooftop UA can be a solution for urban areas that do not have enough unsealed land, in which the heights of buildings can indicate whether UA would be suitable.
- Roof strength: UA can only exist on rooftops that are strong enough to bear the extra load.
- Access to water: water access is highly important for UA practices and can become quite costly if one must invest in irrigation systems rather than having access to the municipal water supply. (Dumitrescu, 2013)

The economical criteria observed included:

- Ownership: who owns the land or building which is suitable for UA is often a deciding factor (i.e., municipality-owned for private).
- Farm size: the size of an urban farm will directly affect production therefore profits.
- Wholesale: many urban farms are created with the main goal being profitability, when this is the case, proximity to retailers such as restaurants, farmer's markets, and food retailers can be a helpful tool.
- Energy: only applicable to indoor urban agriculture. (Dumitrescu, 2013)

The social criteria observed included:

- Income: as the benefits of urban agriculture have been proven, income provides an insight into which neighbourhoods may benefit the most from UA practices, such as low-income neighbourhoods.
- Age: can be an important factor in assessing the potential participation of

a certain area with urban agriculture; young people are often drivers of UA and benefit greatly from the educational aspects, in addition, seniors can also benefit significantly from UA to fulfill their lives and provide opportunities for recreation, social gatherings, and exercise.

- Education: as one of the greatest social benefactors of UA, analyzing the location of educational institutions and their likelihood to start and receive funding for such programs can be an important tool.
- Placemaking & lifestyle: UA can bring vibrancy and added value to neighbourhoods through community building which can directly correlate to economic value. Behaviour has also been determined to be a significant factor in consumer targeting, and policy and urban planning issues. Therefore, there is value in mapping lifestyle choices to determine the suitability of UA in these neighbourhoods. (Dumitrescu, 2013)

Figure 5: Physical criteria map classifying Rotterdam's potential for urban agriculture based on soil quality (Dumitrescu, 2013)

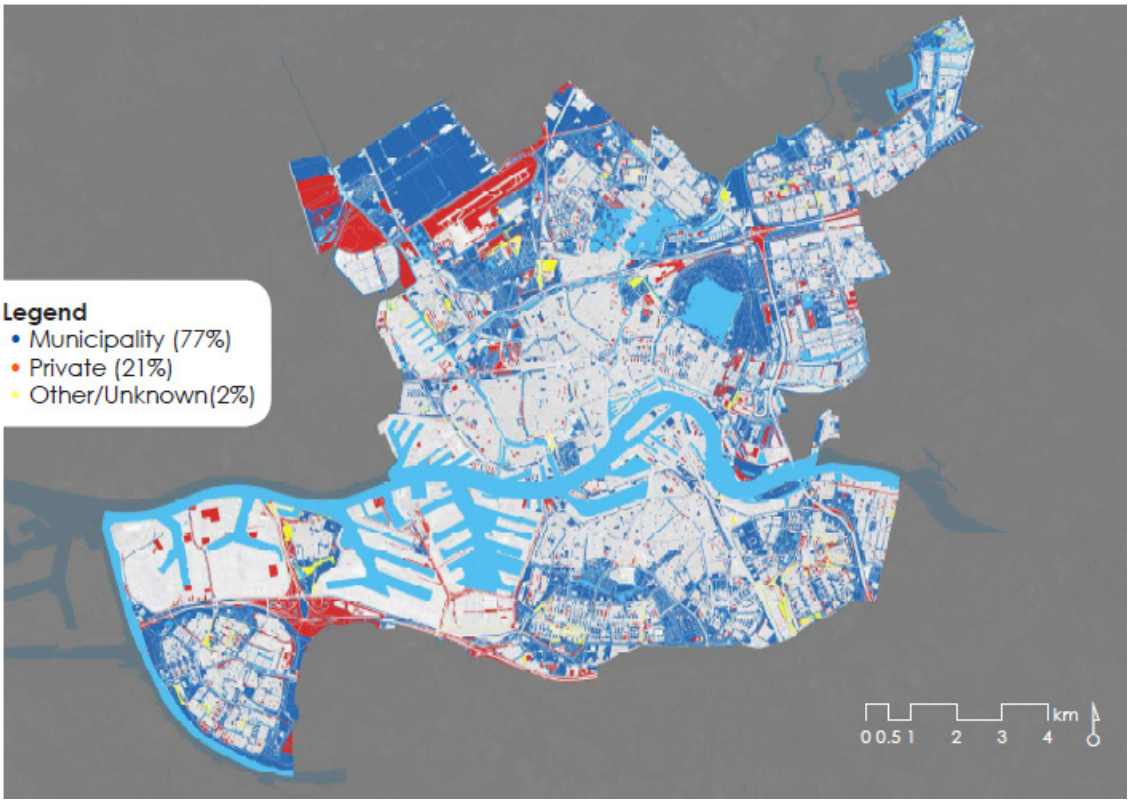

Figure 6: Economical criteria map classifying Rotterdam's potential for urban agriculture based on land ownership (Dumitrescu, 2013)

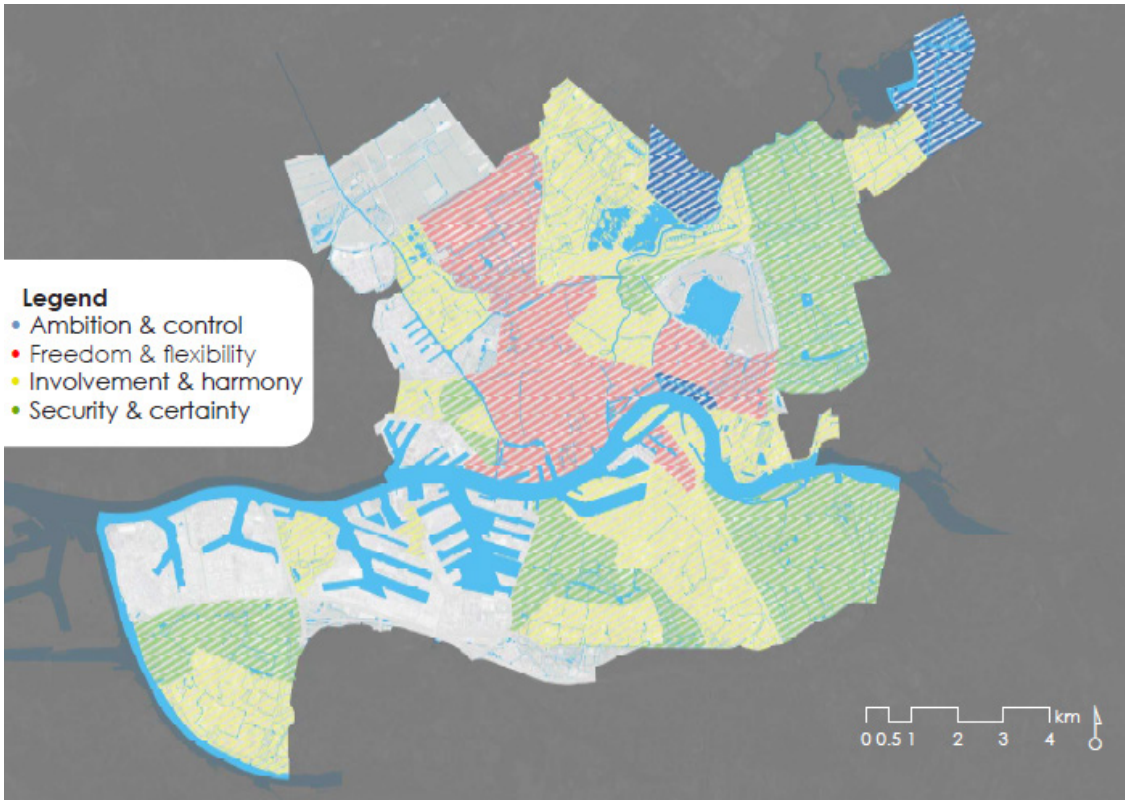

Figure 7: Social criteria map classifying Rotterdam's potential for urban agriculture based on land ownership (Dumitrescu, 2013)

The researcher then combined these criteria maps into one interactive PDF, intending to provide a resource to locate and establish UA sites in Rotterdam. The researcher did note the scope and timeframe in which the project was conducted limited the result to just the interactive PDF, and with more time he would have created a more usable resource through ArcGIS Online or a similar platform.

This precedent reveals that similar mapping projects are being conducted elsewhere and UA is continuing to grow and gain momentum. This precedent also provides an example of how my pilot project can be utilized once an urban agriculture inventory is established for Winnipeg. My pilot project has already applied Dumitrescu's idea to an online platform (ArcGIS Online), however, the scope did not allow for such a detailed analysis to be conducted in Winnipeg. The next steps of this pilot project could include a similar study, with the criteria Dumitrescu has developed to map the urban agriculture potential in Winnipeg.

2.8.3 Toronto (Urban Growers, Food Policy Council & GrowTO)

Toronto, Canada is a leading city worldwide in urban agriculture practices (Laddha, 2021), there are several organizations, projects, and policies in place which contribute to the cities' successes. Outlined below are two key organizations and one policy document that have contributed to the successful integration of urban agriculture into the city. There are several initiatives identified below, those specific to mapping urban agriculture are highlighted in green as they are most relevant to this pilot project.

The Toronto Urban Growers (TUG) organization "is a member based network of urban farmers, gardeners, businesses, organizations, institutions and networks that aims to increase availability of healthy, organic and sustainable food grown, processed and sold in Toronto" (Toronto Urban Growers, 2016). TUG aims to generate and share information, work in partnership with governments to develop supportive policies, develop effective strategies for expanding urban food production, promote the benefits of urban agriculture, establish connections between urban farmers and available land, and cultivate positive relationships in the urban farming community (Toronto Urban Growers, 2016). TUG has several projects that support its goals:

- **TUG's map: The map allows urban farmers to join the membership and add their projects to the map, with any information they see fit. The map and information are available to the public, but one must be a member to add or edit an UA project.**
- Garden Sharing: This program connects landowners who have underutilized space with urban farmers who are searching for garden space.
- Urban Agriculture Week: This is an event held annually that promotes urban agriculture in Toronto with several daily activities throughout the city, including competitions, markets, and a veggie derby.

- Grower2Grower: This project highlights Toronto growers and their knowledge on the website to provide those searching with access to informational videos, photo essays, and articles.
- Indicators for Urban Agriculture: This is a report published in 2016 by TUG "to develop indicators that a wide range of stakeholders could use to make the case for making land, resources and enabling policies available for urban agriculture" (Teitel-Payne et al., 2016).

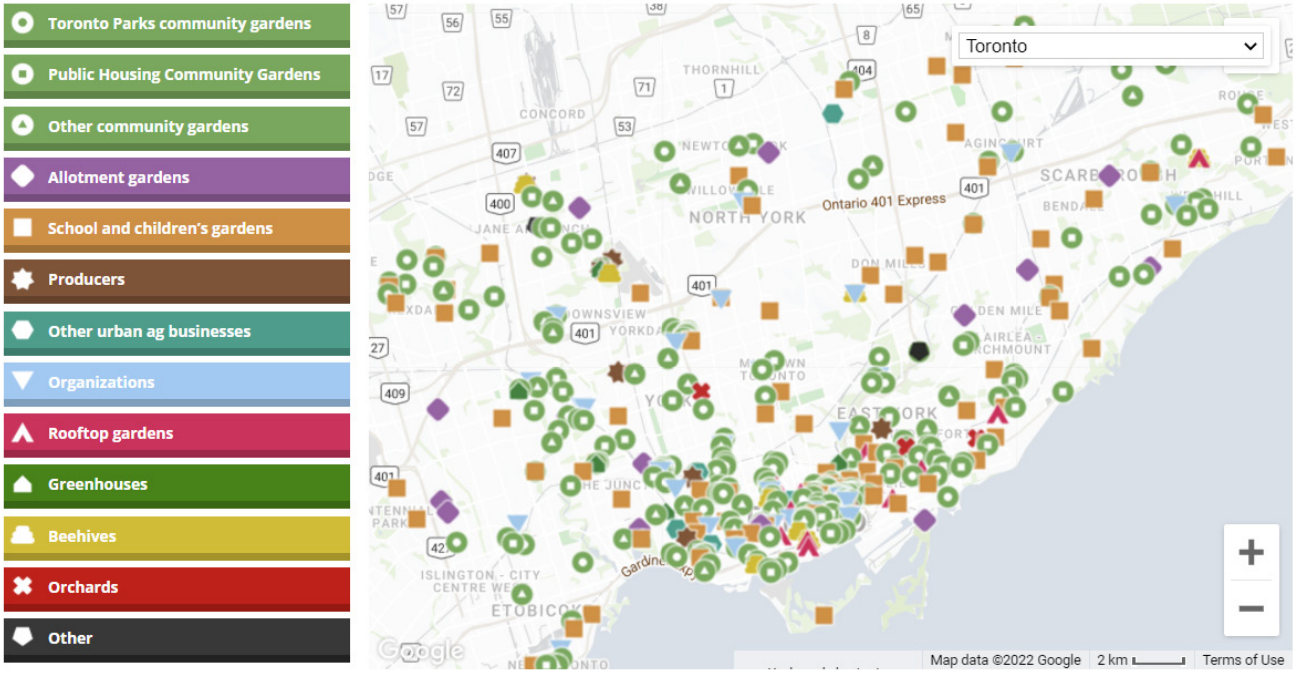

Figure 8: Toronto Urban Growers Map identifying varying types of urban agriculture in the area (Toronto Urban Growers, n.d.)

The Toronto Urban Growers organization is making an impact on UA in the City of Toronto with its programs and projects. Particularly, the map which has been created to host and share information about UA projects within the city. TUG is a member-only organization; however, the map is available to the public. Everyone is encouraged to sign up to become a member and participate in contributing to the map. TUG's map provides an example of how an urban agriculture mapping project can promote UA, contribute to knowledge, and resource sharing, help strengthen the urban farming community and promote the benefits of UA.

The Toronto Food Policy Council (TFPC) was established in 1991 as a subcommittee of the Board of Health to advise the City of Toronto on food policy issues (Toronto Food Policy Council, n.d.) and has since grown into its own entity. "The TFPC connects diverse people from food, farming and community sector to develop innovative policies and projects that support a health-focused food system and provides a forum for action across the food system" (Toronto Food Policy Council, n.d.). The TFPC has several initiatives:

- Resource Library: The resource library initiative is an online collection of all

documents, papers, and reports about food in Toronto.

- Public Markets: The Toronto Public Markets project was established in 2015 and is a group of public market groups who develop solutions for any challenges public markets may face in Toronto. The TFPC recognizes the value of public markets in the foodscapes of its city, and this project aims to increase opportunities for public markets and encourage their integration of them into the municipal infrastructure and relevant policies.
- **Food by Ward: The Food by Ward initiative is centred around a map which reveals "the unequal distribution of food assets across the city and addresses the barriers communities face when trying to find or start food programs. It tells the story of the incredible food-minded grassroots organizing that is happening across the city and makes the case that food should be considered just as important as other urban infrastructure" (Toronto Food Policy Council, n.d.). The goals of the Food by Ward initiative are:**
  - » **Highlight the geographical complexity of food resources, networks, and systems in Toronto**
  - » **Help City Councillors see food assets in their communities and integrate the food assets and activities in each ward into broad planning and decision-making**
  - » **Build tools, skills, capacity, and channels so food leaders can move food priorities forward;**
  - » **Strengthen and connect local and city-wide food networks to facilitate conversations on food with City Councillors and city leaders**
  - » **Advocate for the equitable distribution of food assets in all wards across the city (Toronto Food Policy Council, n.d.)**

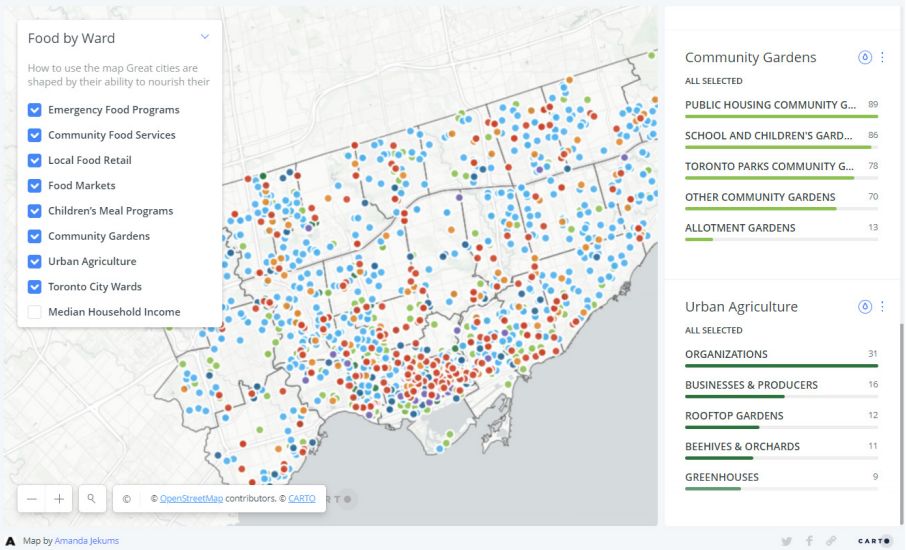

Figure 9: Food by Ward initiative map, highlighting food assets across the City of Toronto (Toronto Food Policy Council, n.d.)

- Toronto Food Charter: This charter was adopted by City Council in 2001 and outlines a commitment to food security through several strategies.
- Community Gardens: The TFPC has led the way for a community gardening strategy in Toronto for decades by collaborating on important programs and policies such as the Community Gardens Program, GROW T.O.GETHER Community Gardeners, the Toronto Community Gardening Network, a Community Garden Action Plan, Our Common Grounds report, and From The Ground Up: Assessing the Risks and Maximizing the Benefits of Gardening on Urban Soils guide.
- Toronto Green Roof Bylaw: Toronto is the first city in North America to adopt a bylaw requiring some new buildings (residential, commercial, institutional, or industrial) to be fitted with green roofs. This bylaw was adopted by City Council in May of 2009. The Bylaw states "every building or building addition constructed after January 30, 2010, with a gross floor area of 2,000 square metres or greater shall include a green roof with a coverage of available roof space" dependent on the gross floor area (City of Toronto, 2017). There are some exceptions to this rule which have been outlined in the Bylaw.
- Urban Agriculture: "UA has been vibrant within the City of Toronto long before there have been formalized structures to support and expand production" (Toronto Food Policy Council, 2015). The Toronto Community Garden Network has been a critical component of the successful expansion of UA in Toronto. More so, the City of Toronto has recognized "the need to acknowledge the growing urban agriculture movement" (Toronto Food Policy Council, 2015) and continues to support the growth of UA. TFPC organized the first North American Conference on Urban Agriculture in 2000 and has also produced the GrowTO Urban Agriculture Action Plan and the Toronto Agricultural Program.
- LiveGreen Toronto: LiveGreen Toronto is an initiative providing funding for projects that either "build capacity within local communities and neighbourhoods to identify, develop and initiate actions that will reduce greenhouse gas emissions and smog causing emissions" (Toronto Food Policy Council 2015) or "result in significant reductions in emissions within the local community has identified and is engaged in supporting" (Toronto Food Policy Council, 2015). This funding has had an influential impact on the successes of the food community in Toronto by contributing to several food-based organizations. Examples of organizations who have received funding are The Compost Council of Canada, Greenest City Environmental Organization, North York Harvest Food Bank, Green Thumbs Growing Kids, and many more similar organizations (Toronto Food Policy Council, 2015).

The Toronto Food Policy Council has been instrumental in advocation for urban agriculture in the City of Toronto. The TFPC was established as a direct result of the *Toronto Food Strategy, titled; Cultivating Food Connections: Toward a Healthy and*

Sustainable Food System for Toronto adopted in 2010 by the Board of Health. The TFPC has influenced the successful integration and appreciation of UA in the city, most notably by collaborating on initiatives such as the "*Toronto Environment Plan, Toronto Food Charter, The City of Toronto Official Plan,* and *the Toronto Food and Hunger Action Plan*" (City of Toronto, 2020). The Winnipeg Food Council should recognize the success of the TFPC on urban agriculture practices in Toronto, and integrate similar plans, policies, and initiatives into the Winnipeg context.
GrowTO: An Urban Agriculture Action Plan for Toronto (2012) was created to:

- Bring together the stakeholders who play a vital role in Toronto;
- Propose solutions to different Divisions across the City of Toronto to increase support for urban agriculture;
- Highlight the economic and social development opportunities that urban agriculture can bring to communities and neighbourhoods;
- Focus attention on the untapped potential of urban agriculture in Toronto;
- Involve, inform and propose both policy solutions and on-the-ground actions that build and support urban agriculture (Toronto Food Policy Council, 2012)

The Urban Agriculture Action Plan outlines the current state of UA in Toronto, the benefits, and identifies six priorities for moving UA forward in Toronto. These six priorities are:

1. Link growers to land and space
2. Strengthen education and training
3. Increase visibility and promotion
4. Add value to urban gardens
5. Cultivate relationships
6. Develop supportive policies (Toronto Food Policy Council, 2012)

In sum, *GrowTO* is a policy document the City of Winnipeg can learn from for guidance and inspiration on best practices for integrating urban agriculture more efficiently into the city.

2.9 SUMMARY

The literature argues for better public engagement practices in the field of planning, Arnstein (1969) advocated for more inclusive and citizen-centric participation. Public engagement practices have often been viewed as tokenism, in which planners simply complete public engagment as it is on a checklist without creating a meaningful upward dialogue between the public and those in power. (Arnstein, 1969), As public engagement practices become more interwined with the technology of the 21st century, the literature supports the ability of online public engagement to reach a more diverse population,

obtain more responses, foster more transparent and open relationships between the public and those in power, among other benefits (Levenda et al., 2020; Mandarano et al., 2010). However, this only remains true if participants have access to the technology required. The literature has cautioned online public engagement should not replace traditional practices, but instead be complementary, to create public engagement that lies higher on Arnstein's ladder of citizen participation.

Climate adaptation as a strategy to help communities defend themselves against the negative impacts of climate change has become a hot topic over the last decade. The literature (UN, 2021) is supporting new and innovative ways for cities to adapt, one of them being urban agriculture (Dubbeling, n.d.). The benefits of UA as a climate adaptation strategy are being increasingly recognized. UA can increase water infiltration, decrease overall temperatures, decrease demand on water supply in drought-prone cities, capture gases, divert winds, and more. The literature strongly supports the better integration of UA into policy and plans worldwide, suggesting a successful integration would require a multi-level governance approach. Furthermore, the mapping of UA has become an increasingly researched topic, as the benefits of doing such mapping can help create awareness for UA in cities, generate momentum for cities to integrate UA into plans and policy, and help cities understand UA and how it is being successfully deployed.

The creative nexus of online public engagement and mapping urban agriculture offers the potential for encouraging better integration of urban agriculture into climate adaptation planning and poicies for the City of Winnipeg, and indeed, across the country.

3. METHODS

In this section, I describe the rationale of the pilot project, in addition to the development and deployment of the GIS web mapping app. In addition, I outline the research process, ethics process, participation requirements and recruitment.

3.1 RATIONALE

The world is urbanizing at a rapid rate and becoming more dependent on digital technologies. Planners should embrace the digital world and incorporate online public engagement strategies into their practices, as the literature has argued. The rapid urbanization of our world has contributed negatively to climate change, resulting in more frequent and severe impacts of climate change being observed. The purpose of the development and deployment of the GIS web mapping application (web app) was two-fold: (i) to advocate for the use of online public engagement tools in the planning field, and (ii) to demonstrate the value of mapping urban agriculture in the City of Winnipeg to further integrate UA into Winnipeg's Climate Action Plan, specifically into climate adaptation strategies.

3.2 OVERVIEW OF THE GIS WEB MAPPING APPLICATION

3.2.1 Creation

The GIS web app was created and designed using ArcGIS Online software. ArcGIS Online is the web-based version of ArcGIS desktop, and provides several benefits over its counterpart. ArcGIS online allows users to:

- Easily share data, maps, apps, and other items with teams, departments, and/or the public.
- Visualize the data spatially through web maps and apps that can be accessed from anywhere at any time.
- The data can be accessed in a web browser, ArcGIS Pro, smartphones, tablets, and even be embedded into websites.
- There is no need to access a file share for the data – one can simply publish to ArcGIS Online, then share with the intended audience. It also makes sharing data with clients outside the organization easy.
- There is no need to invest in additional hardware, staff, or training because ArcGIS Online is a standalone solution for mapping and analysis, or one can extend to ArcGIS Desktop if needed. (Doré, 2021)

To create the app, a web map, and two feature layers were developed. The web map served as the interface participants engaged with, and is where all layers were located. These layers included the two feature layers, the City of Winnipeg boundary, parks, and open space, vacant assessment parcels, and buildings. The creation of the web map is where most of the design comes in, this is where one can change colours, symbols, base maps, which layers to show and which to hide, the extent of the map, among many other elements. The two feature layers were for collecting the public data, (1) was for existing urban agriculture sites, and (2) was for opportunities for urban agriculture. These two feature layers were set up as blank layers and set as 'public data collection' to allow for the participants to add to them in the web app. The survey questions were incorporated into these two feature layers as a pop-up when a participant would add a pin to the map. Once the web map was finalized, it was brought into the web app, which became the final product. During the development of the web app, many customizations were made to improve the participant's experience. Customizations involved the pop-up consent page (called the splash page), style and theme, location of widget buttons, title, the addition of the University of Manitoba logo, and scale. The widget buttons are those located on the outer boundaries of the app (positions of widgets can change based on the device), the developer can choose which widgets to include from a list of fifty-one options. For this web app, widgets: information, save as PDF, measurement, legend, layer list, edit, bookmark, and distance and direction were selected. The information widget provided the background information from the splash page, allowing participants to have access to this information while in the app. The save as PDF widget provided an option for participants to save and/or print the map for any reason. The measurement widget allowed participants to measure area and distance on the map. The legend widget broke down each layer with its corresponding symbol and/or colour to ensure clarity. Incorporating the layer list widget allowed participants to turn on and off layers at their discretion. The edit widget was the most important one, as it allowed participants to add their pins to the map and answer the associated survey questions. The bookmark widget could be used to bookmark a certain map view extent in the app, so if they chose to leave and return to the app, their place would still be saved. And lastly, the distance and direction widget allowed participants to navigate to and from locations as if they were using Google Maps. All the custom modifications, design choices, and widget selections were carefully chosen to ensure a clear, appealing, and accessible web mapping application for participants to engage with.

3.2.2 Survey Questions

For each of the two feature layers (existing urban agriculture sites and opportunities for urban agriculture), there were corresponding survey questions participants were prompted to answer. When locating existing UA sites, participants were asked to answer:

1. Does the site have a specific name, or is it on/near a specific building?
2. What type of urban agriculture is it? (i.e., community garden, rooftop garden, private yard, etc.)
3. What type of food is grown here, if any? (i.e., fruits, vegetables, herbs, etc.)

These questions were intended to encourage participants to engage with any local UA in their neighbourhoods or throughout Winnipeg, with the hopes of fostering more support for UA. In addition, this information could help make the map more detailed, providing more than just the UA site location.
When locating opportunities for urban agriculture sites, participants were asked to answer the following questions:

1. What type of urban agriculture do you think would be most suitable for this site?
2. What are your reasons for thinking this would be a suitable site?
3. What are some of the opportunities or benefits that you think urban agriculture could bring to a community?

These questions were intended to encourage a deeper understanding of UA and how it could impact communities, neighbourhoods, or Winnipeg as a whole.

3.2.3 Participation

Participation in the web app required participants to follow a URL code posted to a variety of online forums (Instagram, LinkedIn) and was also sent out through email to relevant groups and organizations. Once participants reached the URL page, a pop-up page appeared with consent information, as well as background information on the pilot project and urban agriculture. After accepting the terms, participants were brought into the app, where they were able to navigate through the map to identify locations for existing urban agriculture and opportunities for urban agriculture. Using the edit widget, participants could place a pin for either feature layer, and following the pin placement, participants would be prompted to answer the survey questions. Participants could place as little or as many pins as they wished and could continue to access the app throughout the public engagement period. The goal for the participation portion of the GIS web mapping application pilot project was to achieve fifty participants or higher. This goal was set to ensure there were at least fifty pins on the map, likely one hundred if participants provided one location for each of the options (existing UA sites and opportunities for UA).

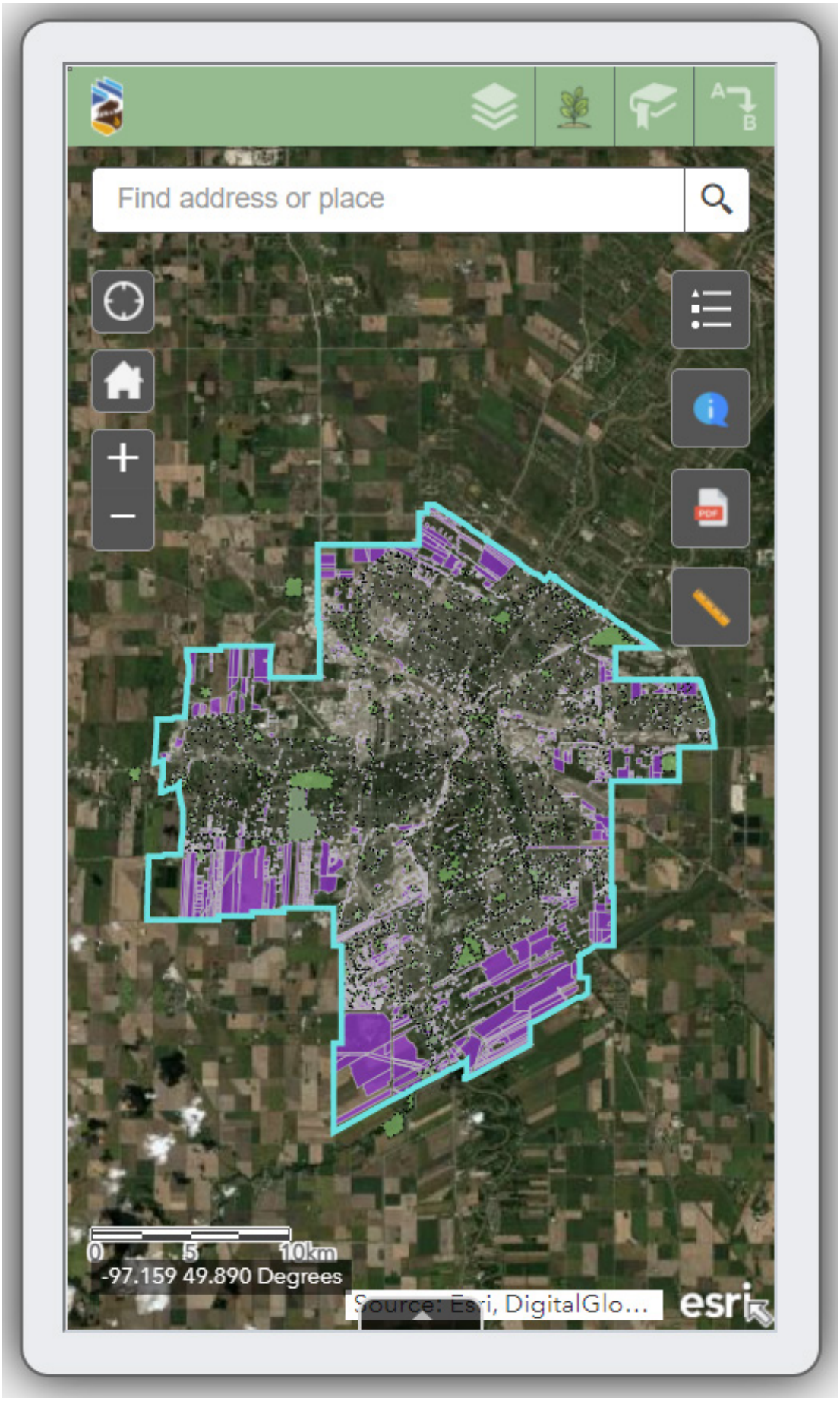

Figure 10: GIS web mapping app appears as it would be on a smartphone

3.3 THE PROCESS

3.3.1 Ethics

This pilot project focused on public data collection, therefore requiring ethics approval from the University of Manitoba. This process was lengthy and time-consuming and was, unfortunately, largely postponed due to the University of Manitoba Faculty Association's (UMFA) strike from November 2, 2021 until December 6, 2021. During the strike, all workings, processes, and communications were completely halted by the Ethics Review Board, ultimately delaying the approval required to move forward with the deployment of the GIS web mapping application. In addition, during the strike, UMFA professors were unable to communicate with students, limiting the amount of feedback received, preventing any further editing of materials. When the strike was lifted in December 2021, both the Ethics Review Board and professors were quick and efficient, allowing the proposal to be approved promptly.

3.3.2 Recruitment

The recruitment process was conducted in three stages, with three different online platforms.

Stage one: December 28, 2021

This first stage involved the distribution of a 'group/organization email contact form' (see appendix E) to relevant community groups or organizations. The purpose of this email was to ask these groups or organizations to distribute the pilot project internally or further to other interested parties.

The organizations contacted were:

- Manitoba Professional Planners Institute (MPPI)
- Winnipeg Food Council
- Food Matters Manitoba
- Green Action Centre
- Sustainable Building Manitoba
- Aurora Farm

This stage also involved a feed post to LinkedIn through my profile (see appendix F) detailing the pilot project, the goals of the pilot project and how participants could engage. The goal of this post was to engage directly with potential participants, they could access the URL code right from the post. A post was made to Instagram via the story function (see appendix G) to engage directly with any potential participants and allowed access directly from the post (story).

Stage two: January 11, 2022

The second stage involved follow-up social media posts on both LinkedIn and Instagram.

On LinkedIn, the original post from December 28, 2021, was reposted with additional information (see appendix F). For Instagram, another post was made via the story function, with the same information as the first post on December 28, 2021 (see appendix G).

Stage three: January 25, 2022
The third stage involved a social media post on both LinkedIn and Instagram. On LinkedIn, the original post was reposted with additional information stating this would be the final week of the public engagement period. For Instagram, another post was made via the story function, with the same information as the first post on December 28, 2021. The public engagement period ended on January 31, 2022.

3.4 SUMMARY

The GIS web mapping application was the sole research method for this pilot project, which included a short survey. The methodology intended to obtain lessons learned about the development and deployment of the app. In addition to identifying further research that may be required, specifically concerning online public engagement practices within climate adaptation planning. The methodology was subject to approval from the Ethics Review Board, this process was delayed by roughly five weeks due to the UMFA's strike between November 2021 and December 2021, ultimately shortening the public engagement period. Participants were recruited via several social media posts (Instagram and LinkedIn) and email circulation from relevant organizations. The pilot project asked participants to engage online with the app, by placing pins throughout Winnipeg locating existing urban agriculture sites and opportunities for urban agriculture. In addition, participants were prompted to answer a short survey about the site they were identifying. The public engagement period lasted from December 28, 2021, until January 31, 2022. The following section will discuss the findings, and the analysis of these findings.

4. FINDINGS AND ANALYSIS

This section reports on the findings of the pilot project: recruitment findings, participation findings and the survey answers. In addition, the final map with all identified pins is included in this section (4.4).

4.1 RECRUITMENT

The recruitment process consisted of email and social media posts on both LinkedIn and Instagram over the five-week public engagement period from December 28, 2021, and January 31, 2021.

Summary of email recruitment results:

Emails were sent out to the previously mentioned relevant groups and/or organizations requesting they circulate a request for participation in the pilot project internally or to other potentially interested parties (see appendix E). The Manitoba Professional Planners Institute circulated the request for participation in the pilot project to all members via an email newsletter. As a result of MPPI's newsletter requesting participation in my pilot project, three planners responded directly via email. They provided very informative input, feedback, and comments. Unfortunately, these insights could not be included in the study, as that method of public engagement would have required submission to and approval by the Review Ethics Board at the University of Manitoba. The input included suggestions for the web app itself, cautionary tales about urban agriculture and online public engagement, ideas for further research, suitability of Winnipeg for UA improvements, positive comments on the flow and design of the web app, enthusiasm for the project, and additional resources. Food Matters Manitoba responded to the recruitment email with a suggestion to post a request for participation in the pilot project to the Food Action Hub. Due to their late response (in the final week of the public engagement period), there was not enough time to gain approval to access the Food Action Hub and post the pilot project.

Summary of social media results:

LinkedIn was the primary social media platform for this pilot project, because of the platforms ability to engage planning professionals, other related professionals, and the public. Of the three posts made to my LinkedIn account, these were the recruitment results:

Table 6: Recruitment results from LinkedIn posts over the public engagement period

	Post 1: December 28, 2021	**Post 2: January 11, 2022**	**Post 3: January 25, 2022**
Views	580	103	76
Likes	9	3	0

As seen in Table 5, post one received the most views (580) and the subsequent posts (two and three) declined significantly (103 and 76 respectively). The same declining trend occurred with the number of likes per post, as seen in Table 5. This trend reveals there was more interest in the pilot project following the first post, and interest declined over the following two posts. This may be because those who had already viewed the first post, chose to scroll past and not engage with the second and third posts resulting in the decline in views and likes.

The Instagram story posts yielded an average of 200 views which is just under 25% of my total followers. This is a typical ratio for all posts made to my Instagram story. The Instagram story posts did not see a decline in views like the LinkedIn posts; I attribute this to how the Instagram story function works. Instagram story posts are displayed in such a fashion where followers are unable to see the contents of the post before clicking on them to view, therefore not allowing the option to not view or engage like they can on LinkedIn.

4.2 PARTICIPATION

After the public engagement period, a total of six pins had been placed on the map in the GIS web mapping application. Six pins are drastically lower than the goal of fifty or more identified in section 3.2.3. Following the first LinkedIn post, the number of views (see Table 5) was encouraging, and I expected to see a similar number of pins placed on the map. Unfortunately, this was not the case, only four pins were placed between the first and second social media posts. A potential reason for this may have been the timing of the first posts, as they were posted on December 28, 2021, over the holiday break for most. This prompted the second follow-up post on January 11, 2022, in which the LinkedIn post saw a substantially lower view count than the first post (see Table 5). Two more pins were placed following this second social media post. Following the second post is also when MPPI circulated the pilot project to its members, prompting the three planners to reach out to me directly via email. At this point, the pilot project still appeared promising and on the right track due to the engagement of the three planners and MPPI. Some of the planners identified other potential organizations/groups who may be interested in the pilot project, and I followed up with an email to those identified. After the initial enthusiasm following the second social media posts, there was a lull where no more pins were placed on the map, and no one was reaching out to me via email. This prompted the final post on January 25, 2022, in hopes of reaching the desired goal of fifty pins before the public engagement period was to end on January 31, 2022.

Unfortunately, this final social media post to LinkedIn saw little engagement leading me to believe I would not reach my goal.

4.3 SURVEY RESPONSES

Table 7: Existing urban agriculture survey responses

	Pin 1	Pin 2
Question 1	Did not answer	Unsure
Question 2	Did not answer	Community garden, may require sign up to use
Question 3	Did not answer	Looks like vegetables

Two locations of urban agriculture were identified by the participants: one location was identified near Harris Park in the Norberry neighbourhood of Winnipeg. The survey questions were not answered for this location as seen in Table 6. The second location identified was a community garden in Grant Avenue Greenspace 3 near Grant Park. This location was described as a community garden growing primarily vegetables as described in Table 6. These locations will be shown in the next section (figure 11 and 12).

Table 8: Opportunities for urban agriculture survey response

	Pin 1	Pin 2	Pin 3	Pin 4
Question 1	Community garden	Rooftop garden or community garden	Did not answer	Rooftop
Question 2	Already exists nearby, very high density	The high school could be involved in maintenance/ education	Did not answer	Solar orientation
Question 3	Cheaper healthier foods for low-in-come people	Knowledge of urban agriculture practice to young minds	Did not answer	Did not answer

Four opportunities for urban agriculture were identified by the participants: one location was identified near pin 1 from the existing urban agriculture locations, in Grant Avenue Greenspace 5. The participant suggested this location could be a community garden because it is already near an existing community garden. The participant also noted that the area is very high in density and another community garden in the area could provide more affordable healthy food options for low-income people. The second opportunity for urban agriculture was identified at Grant Park High School, the participant suggested this could become a rooftop garden or a community garden. This opportunity could involve the high school students with the maintenance of the garden, creating an educational opportunity for young minds. The third opportunity for UA was identified in the Truro Creek Greenway-Winchester in the St. James neighbourhood of Winnipeg. The participant who placed this pin did not provide any responses to the survey question. The fourth and final opportunity for UA location identified was a vacant

rooftop in the St. James neighbourhood, at the corner of Portage Avenue and Sharp Boulevard. The participant suggested a rooftop garden for this location, because of the ideal solar orientation of the building. These locations will be shown in the next section on the map.

4.4 GIS WEB MAPPING APPLICATION

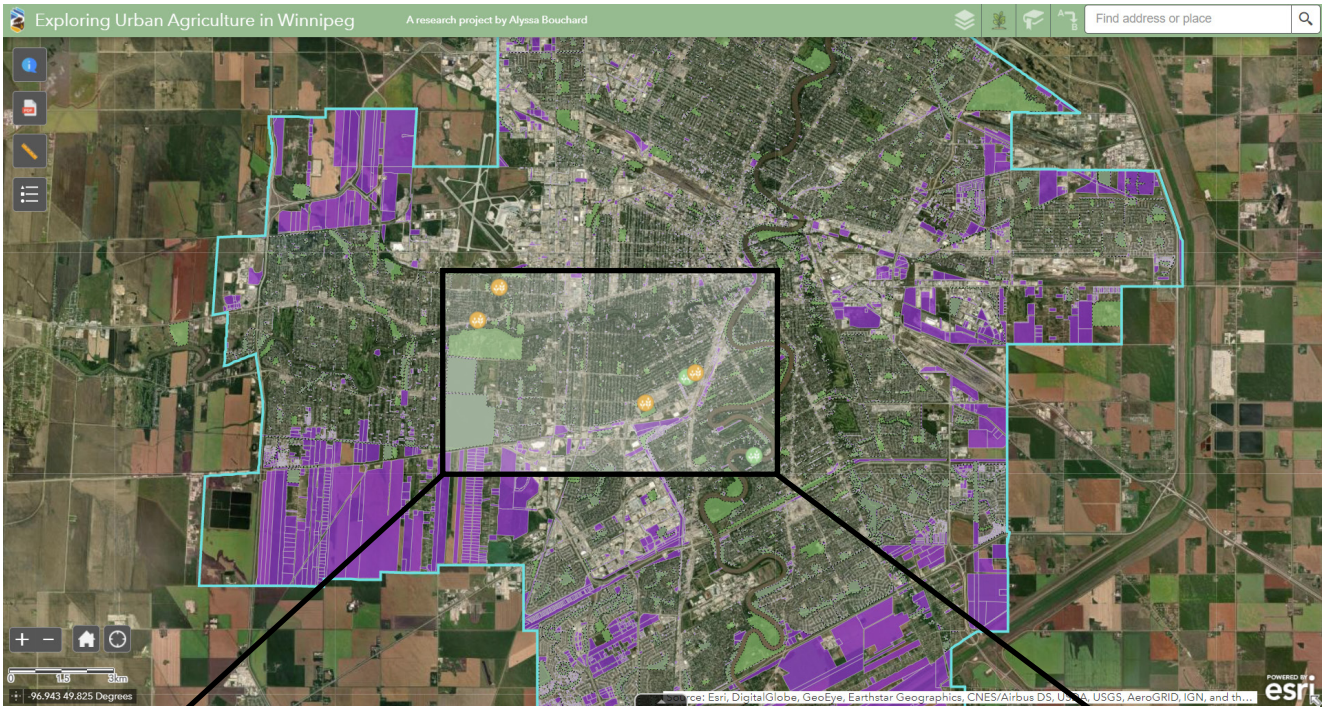

Figure 11: GIS web mapping app with participant pin locations, zoomed out

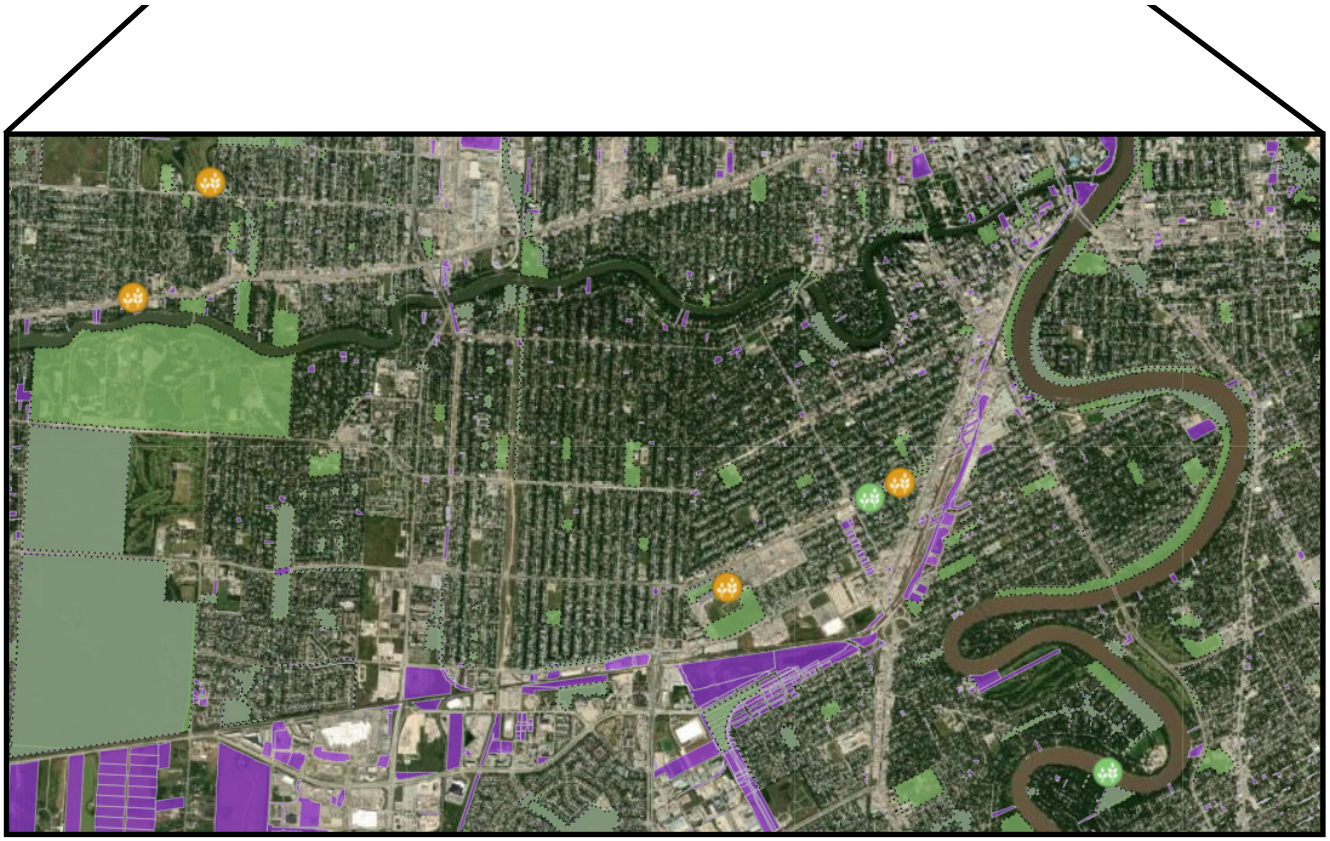

Figure 12: GIS web mapping app with participant pin locations, zoomed in

Section 4.4 showcases the GIS web mapping app, as it would be viewed on a computer screen (figure 11) and also a zoomed in photo of the six pins that were placed by the pilot project participants (figure 12). The green pins represent identified existing urban agriculture sites, and the orange pins represent identified opportunities for urban agriculture in Winnipeg.

Potential drawbacks of the web app, or areas of potential improvement have arisen from feedback, comments, and internal reflection. (i) If the map would have been pre-populated with popular urban agriculture spots in Winnipeg, participants may have been more encouraged or may have found it easier to add to the map. (ii) Creating a layer of neighbourhood boundaries may have allowed for easier navigation around the map and Winnipeg. Users may have found the entire city of Winnipeg view to be daunting, or unapproachable. Implementing a pre-testing phase prior to the public launch of the web app would have allowed the finer details of design, and usability to be refined, to create the most polished version for the public.

4.5 SUMMARY

This section outlines the findings and analysis of the pilot project. Participation in the pilot project (web app) was significantly lower than anticipated with only six pins being placed on the map during the public engagement period. The recruitment processes (email, Instagram, and LinkedIn) were successful in reaching potential participants but they did not result in actionable participation. The emails sent out to relevant groups and organizations resulted in MPPI circulating a request for participation in the pilot project through an email newsletter. The MPPI email newsletter resulted in three professionals engaging in an informal conversation with me via email providing valuable insights. LinkedIn posts yielded over 500 views for the first post, this declined throughout the five-week period of public engagement. The Instagram story posts yielded on average 200 views per post, just under 25% of my total followers.

In summary, the online recruitment process was fruitful and was able to reach over 700 potential participants. In choosing to utilize both LinkedIn and Instagram for online recruitment purposes, I was able to reach more citizens than if I just utilized one or the other, reinforcing arguments made in the literature by Levenda et al. There was a significant disconnect between the relatively high number (~700) of potential participants exposed to the pilot project and the only six pins placed on the GIS web mapping application. These findings led me to conclude social media recruitment lands low on Arnstein's ladder of citizen participation, likely in rung 3 (informing). The following section will discuss the findings, and identify lessons learned, recommendations, among other concluding thoughts.

5. CONCLUSION

In this section, a brief discussion of the findings and analysis outlined in the previous section is provided. Lessons learned from the pilot project and recommendations are also identified in this section. The research questions identified in section 1.2 will be answered, and further research questions are identified and explained. This section concludes with final thoughts.

5.1 DISCUSSION OF FINDINGS

The rate of engagement with the GIS web mapping application did not meet my expectations, nor did it accord with the existing literature on the subject. This pilot project did not use conventional public engagement methods to allow for a comparison between the online public engagement practices (social media and email recruitment and the GIS web mapping application) utilized and conventional methods. This comparison could have provided a better understanding of how the online public engagement methods performed against more conventional methods, such as open houses, or public hearings. Without this comparison, assumptions have been made to provide conclusions about the findings. To reach the goal of fifty individual participants in the pilot project, less than 10% of those that viewed the first LinkedIn post would have had to participate with the app, instead only 1.05% of the viewers participated. This low percentage does not support the existing literature arguments for 'greater reach' and a 'wider audience' (Levenda et al., 2020). The lack of engagement in the GIS web mapping app results in more questions than answers at this point in the research. Some of the questions for further research are outlined in section 5.4. Section 4 shows more people engaged via direct email than with the web app itself. Some people responded to my email contacting them to distribute this pilot project, and others contacted me following the email distributed by the Manitoba Professional Planners Institute asking for participation in the research and/or after viewing the social media posts. Conversations via email provided insights by planners on varying views and suggestions about online public engagement and urban agriculture in the City of Winnipeg context. The email responses proved this pilot project, the method, purpose, and scope was exciting and would be relevant to the current context of Winnipeg. More importantly that the project was fostering new ideas and awareness about online public engagement practices, urban agriculture, and climate adaptation, as the literature suggested it could. Comparing the social media post results to the participation results, more people preferred to read and engage "like" with the LinkedIn post rather than engaging further to participate in the GIS web mapping app. These findings led me to consider which rung on Arnstein's (1969) ladder was relevant for this pilot project and begs to ask how can a more meaningful engagement process be achieved? The relative success of the social

media recruitment process supports the literature in that online public engagement platforms can be easier for citizens to engage in (Mandarano et al., 2010) and potentially reach a greater audience.

Quantifying the value of mapping urban agriculture based on the findings of this pilot project was difficult, even more so due to the small number of sites identified by participants during the public engagement period on the map in the app. However, the value in establishing an inventory of urban agriculture has been identified in the literature review and the informative precedents in section 2.8. If the GIS web mapping app were to meet my expectations, this pilot project would have provided a resource of significant value to planners, policymakers, citizens, decision-makers, and many other stakeholders. In addition, this pilot project could shed light on the missing components of Winnipeg's Climate Action Plan – climate adaptation, and urban agriculture as an opportunity for this.

5.2 LESSONS LEARNED

This pilot project intended to identify lessons learned from the development and deployment of a GIS web mapping application as they relate to online public engagement, climate adaptation planning, and the value of mapping urban agriculture. Identified lessons learned are detailed below:

1. **Duration of the public engagement period is a factor**: As the overall participant turnout was quite a bit lower than hoped for, a longer public engagement period would have likely yielded more individual participants in the GIS web mapping application. The public engagement period was only five weeks due to the University of Manitoba Faculty Association's (UMFA) strike. Ideally, the public engagement period would have been doubled to at least 10 weeks, allowing for greater reach and participation.

2. **A strategic launch is required:** The mapping app asked participants to locate existing urban agriculture sites, and sites for potential urban agriculture, how could a researcher expect citizens to be able to do this when Winnipeg is covered in a blanket of snow? January 2022, the month in which the majority of the public engagement period was online, saw twenty centimetres of new snowfall (Environment and Climate Change Canada, 2022). In comparison, the previous January (2021) saw only five centimetres of snowfall (Environment and Climate Change Canada, 2022). Winnipeggers also experienced a much colder January in 2022, with a mean temperature of -19.4°C, compared to the mean temperature in January 2021 of -10.4°C (Environment and Climate Change Canada, 2022). Colder than typical temperatures in combination with substantial snowfall would not be ideal circumstances for the public to explore their neighbourhoods in search of urban agriculture sites. This app, and others like it, would be improved by a spring or summer launch, allowing citizens the ability to confirm on the ground the sites they are highlighting, rather than attempting to do this from memory.

3. **Utilize conventional public engagements methods in conjunction with online public engagement:** This pilot project relied solely on online public engagement strategies both for the app, as well as for recruitment. Utilization of these likely inhibited the full potential of the project. The literature supports a mixed-use approach, relying on both traditional forms of public engagement – flyers, town halls, open houses, door-to-door, along with newer online strategies – social media, and email. In addition, I feel the pilot project would have benefited substantially from interviews with planners involved in adaptation strategies and urban agriculture initiatives, as well as other professionals operating in related fields (i.e., landscape architects, engineers). The feedback received via email responses to MPPI's request for participation email newsletter was very relevant and would have been of great use to this project. Interviews would have created opportunities to identify any barriers planners may experience when planning for climate adaptation. In addition, barriers to the growth of urban agriculture in Winnipeg could have been highlighted with interviews with planners, residents, or urban farmers. Furthermore, interviews could have identified relevant opinions planners and decision-makers may have on online public engagement practices.

4. **Finding the benefits even when things do not go as expected:** The turnout was not what I had hoped for in this pilot project, however, it is important for decision-makers to recognize still the potential benefits of GIS web mapping applications and similar tools, to allow for a second attempt. This was the first pilot project, and with the opportunity, the next pilot project should continue to improve and evolve. The literature supports the benefits of all the key components of this pilot project (online public engagement, adaptation planning, and mapping urban agriculture), providing a reason to try again, adjusting based on lessons learned. These adjustments could include ensuring the public engagement period is over warmer months in spring, summer, or fall. As well as employing a longer public engagement period, potentially upwards of two or three months, compared to the five-week period for this pilot project. Adjustments could also be made to the design of the GIS web mapping app, based on suggestions from those planners who emailed feedback to me.

5. **Comparison is key:** Concluding this pilot project was difficult without the ability to compare the findings of the online public engagement methods to a conventional public engagement method. Establishing a baseline study involving conventional public engagement would potentially allow for more grounded insights. Such a study would establish a larger context for the data generated through online engagement.

5.3 REVISITING THE RESEARCH QUESTIONS

In this section, the research questions identified in section 1.2 are answered,

Question 1: How can GIS web mapping applications contribute to effective public

engagement strategies for those planners (and other professionals) working on issues of climate adaptation?

Mapping UA using GIS web mapping apps can be an effective strategy to raise awareness for all stakeholders involved and to get the community excited (Mandarano et al., 2010; Pulighe & Lupia, 2016) about more effective UA policy in Winnipeg, particularly concerning climate adaptation. This platform can inform participants about the benefits of UA on climate change, while simultaneously creating an inventory of both existing UA and potential sites for UA in Winnipeg. The inventory created via the app can be expected to help foster stronger communities, bringing people together through UA practices, allowing those participating in urban agriculture practices to learn from each other and grow together, whether they have a small herb garden in their backyard or use an allotment garden to obtain additional income. Utilizing the GIS web mapping app platform from ArcGIS Online potentially allows a greater number and wider variety of people to become engaged if people have ready access to the Internet and a computer, tablet, or smartphone. In addition, online engagement practices such as this GIS web mapping app, and social media can allow environmental or climate adaptation planners to share ideas, knowledge, precedents, and research findings to better improve overall adaptation plans everywhere.

Question 2: How can data gathered through web mapping applications encourage recognition of urban agriculture as a climate adaptation strategy in Winnipeg, particularly in its Climate Action Plan?

Data gathered through web mapping applications such as the one in this pilot project can build awareness of UA and encourage residents to participate in such practices, putting more pressure on Winnipeg to create more robust adaptation plans, and integrate UA into them. In addition, mapping UA can serve as a baseline for planners and professionals alike to better understand the current conditions of UA in Winnipeg. Conditions could include the number of sites, where they are located within the city, types of UA that are happening around the city, and how UA is being dispersed throughout Winnipeg (i.e., are urban farmers producing food for themselves, or selling it?). This baseline can serve as the starting point for a more in-depth analysis of UA in Winnipeg, environmental assessments, and site analyses of both existing UA sites and potential sites for UA. In developing a better understanding of these conditions, the City of Winnipeg could be encouraged to recognize the impact utilizing urban agriculture as a climate adaptation opportunity can have.

5.4 RECOMMENDATIONS

In identifying lessons learned from this pilot project and conducting an extensive literature review on key topics, the following recommendations are made to encourage online engagement practices within adaptation planning and to support the integration of urban agriculture as a climate adaptation strategy in Winnipeg's Climate Action Plan.

1. Envoke a multi-level governance approach

The review of the literature and the brief analysis of current climate adaptation and urban agriculture policy in Winnipeg (see section 2.6) suggests the need for a multi-level governance model and cooperation to successfully integrate UA into Winnipeg's Climate Action Plan as a climate adaptation strategy. UA and climate adaptation are important topics in many fields and levels of government, from the community level up to the provincial level, this calls for all levels to be on the same page to ensure effective policy to allow for the benefits of UA to reach their full potential in Winnipeg.

2. Embrace engagement

Arnstein (1969) criticized planners and their failed attempts at public engagement practices over 50 years ago, things may have improved, but public engagement practices are still not where Arnstein indicated they should be. Planners, policymakers, and decision-makers should aim to shift perspectives on public engagement and make changes to facilitate more meaningful practices. Public engagement should not be viewed as a box on a checklist, but rather for the positive impact, it can bring to any plan or project in any city. Continuing to improve public engagement practices and learning new tools such as those in the digital world should aid in shifting this perspective and allowing for more meaningful public engagement.

3. Utilize crowd-source mapping as a supplementary tool

Utilizing online engagement practices to enlist the public to map UA in Winnipeg can be a significant strategy to identify existing sites throughout the city, in addition to identifying potential sites for future UA. This crowd-sourced inventory can help planners and decision-makers better understand the current state of UA in Winnipeg, including the number of UA sites, who uses these sites, how they are maintained, and their physical condition. This better understanding will aid the City of Winnipeg in establishing an effective policy to foster UA as a climate adaptation strategy. Crowd-sourced mapping should be combined with other tools (e.g. aerial imagery through resources such as Google Earth), site analyses, and site visits to further understand the current condition of these sites and any potential sites.

5.5 RESEARCH QUESTIONS ARISING

In conducting this pilot project, the literature review and methodologies have brought to light areas where further research is warranted to better understand the key topics and how they can be integrated to form effective climate adaptation plans. Additional research questions:

1. **What prevents citizens from actively engaging in pilot projects such as this one, when being recruited via social media posts or email solicitation?**

In the online recruitment process, the first LinkedIn post received 580 views, however,

only six pins were placed on the map. This finding suggests a disconnect between the recruitment process and the engagement process for potential participants. Further research could seek to identify what inhibited viewers from clicking on the link and participating in the GIS web mapping app. Interviews could be a possible research method to determine the causes for potential participants not engaging or an online survey. This further research could be conducted by those employing similar pilot projects as a preliminary public engagement method to address any identified barriers. In addition, the City of Winnipeg could conduct a similar study to address this concern, the results would be valuable to a wide variety of public engagement projects. It is important to determine the barriers to achieving expected engagement targets before conducting a similar pilot project in the future.

2. What other data should be gathered for vacant sites to determine suitability for urban agriculture practices?

Identifying potential locations for urban agriculture is the first step, further analysis should be conducted on identified sites to determine if they would be suitable for UA. A study similar to Vlad Dumitrescu's Mapping Urban Agriculture Potential in Rotterdam (2013) would be instrumental in answering this research question. Soil quality in urban areas is an important factor to consider, as this would determine if produce could be grown. When considering a rooftop garden, it would be important to determine if that roof is capable of withstanding the added weight of urban agriculture. Ensuring identified sites have access to water could also be a key indicator, without existing water access, it may be too costly to install additional irrigation systems. Classifying identified sites by size could also provide further insights into suitability, depending on the type and scale of urban agriculture that may go there. In addition, analyzing the solar orientation of identified sites would provide valuable data on how much sun urban agriculture would receive. This could affect what type of agriculture should be grown in a particular location. This research could be conducted by individual researchers potentially from the University of Manitoba or the University of Winnipeg, or the City of Winnipeg.

3. What type of urban agriculture would be most suitable within the Winnipeg context?

The literature argues for better climate adaptation strategies and notes adaptation is not one-size-fits-all and different contexts will require different adaptation strategies. This context-specific approach should be the same for urban agriculture practices – not all UA will be suitable for Winnipeg. Further research identifying what types of UA would be best suited to Winnipeg, will aid in the most effective utilization of UA as a climate adaptation strategy. For this further research question, type of urban agriculture is referring both to those identified in Table 2, as well as specific produce which could be grown on urban agriculture sites. Undoubtedly, not all types of urban agriculture would

be best suited to the Winnipeg context. Downtown Winnipeg for example, has several older buildings whose roofs may not be strong enough to bare the added weight from a rooftop garden. In addition, certain produce types are more suited to the Winnipeg climate, and it would be important to ensure these are priortized in urban agriculture practices. As to not waste resources, attempting to grow and cultivate produce that will likely not be grown successfully. This research could be conducted by several researchers: individual researchers, the Winnipeg Food Council, the City of Winnipeg, or urban agriculture organizations in Winnipeg.

4. **What is considered a significant number of respondents in comparison to the total population to be considered effective public engagement?**

Further research could investigate the number of respondents required for such a pilot project to represent public opinion appropriately. Addressing only the number of potential participants exposed to the pilot project may not be enough information to form any conclusions about the success or failure of online public engagement methods. This further research could investigate other forms of public engagement such as online surveys, email polls or social media initiatives and the results they recieved. Identifying what the literature and other precedents considered an adequate participation rate would further inform the goals and scope of such a pilot project.

5.6 LIMITATIONS

The process for obtaining ethics approval was delayed significantly due to the University of Manitoba's Faculty Association (UMFA) strike in November and December of 2021. As the strike caused a delay in approval, the public engagement piece of the project was delayed as well, resulting in a shorter public engagement period.

The GIS web mapping application came with its own set of limitations. The web mapping app function does not provide the ability to view the number of total participants, only the number of pins placed on the map. For example, a single participant could place six pins, or six participants could each place one pin; there is no way to distinguish the difference. Time of year may have also been a limitation, as the research project called for participants to identify and locate urban agriculture, this would have been considerably more difficult during the winter months than the summer unless the participant was already aware of sites, or there was adequate signage. This pilot project was focused on online public engagement, therefore assuming all potential participants had access to a computer or a mobile device, which may not always be the case.

5.7 FINAL THOUGHTS

This pilot project explored the utility of a GIS web-based mapping app as an online public engagement tool for planners. In addition, to observe how establishing an urban agriculture inventory could contribute to the recognition of urban agriculture

as a climate adaptation opportunity in *Winnipeg's Climate Action Plan*. The literature argues planners should adopt online public engagement tools such as GIS web mapping applications. Online engagement tools can reach a greater number of citizens and activate communities to bring awareness to planners on topics of importance to them. When designed and conducting effectively, mapping UA utilizing GIS web mapping applications can contribute to the understanding of the current conditions of UA in Winnipeg, for example, how much UA exists in the city, who is using these sites, or how they are maintained. Potential sites for UA can also be identified through mapping initiatives such as this pilot project, in addition, a stronger urban farming community in the city could be a result. The Winnipeg Food Council, as evident by their Green Infrastructure for Food Report, is advocating for the integration of UA into Winnipeg's plans and policies and recognizes the potential UA can have for efforts against climate change. Combining online engagement, and the mapping of urban agriculture can encourage the City of Winnipeg to recognize the ability of UA to contribute to adaptation strategies, integrate supportive policy, and build local productive capacity. The hope is for the City of Winnipeg to explicitly outline UA as a priority in *Winnipeg's Climate Action Plan*. Decision-makers could draw from the *Green Infrastructure for Food Report* and the informative examples outlined in section 2.8. Decision-makers could explore conducting their online public engagement projects through mapping UA, thus advancing research and establishing more precedents for other cities to learn from. This pilot project did not go as expected, however, the findings, in combination with the literature review support this statement.

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APPENDICES

Appendix A: Informed consent form pilot project/survey

Informed Consent
You can screen print this to keep a copy of the consent form.

Title of Project: Exploring a GIS web mapping app as a public engagement tool for planners through an urban agriculture lens

Principal Investigator: Alyssa Bouchard, Masters student, boucha54@myumanitoba.ca
Course Instructor: Dr. Rae Bridgman, Faculty of Architecture, Department of City Planning, University of Manitoba; rae.bridgman@umanitoba.ca
This consent is only part of the process of informed consent. It should give you a basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Summary of Research Project:
This study explores the utilization of a GIS (geographic information system) web mapping application in public engagement practices within the planning profession through an urban agriculture lens. The goal of the project is to identify lessons learned, ideas for future pilot projects, and potential next steps. The web mapping application will allow users to input data about existing urban agriculture and potential sites for urban agriculture in the City of Winnipeg. This data will include the location of the site; and for existing sites, the name of the site or building, what type of urban agriculture it is, and what is grown at the site. And for potential sites, data will include what type of urban agriculture the participant thinks could be located there and why the participant believes the location to be suitable.

Research Procedure:
This pilot project and survey use a GIS web mapping app. You will be utilizing the application and locating points on a map, and answering a few short questions.

Time Requirement:
This pilot project/survey is expected to take about 10 minutes for each participant to complete.

Confidentiality:
The data collected through this research is confidential. This means that participants' names or any other personal or identifiable information will not be included in presentations or reports arising from the study.

Survey participation: Should a participant wish to withdraw from the GIS web mapping app and survey, they may do so at any point before they 'Save' their responses. There will be no negative consequences to withdrawing. If participants wish to withdraw before clicking the Save button, they may simply close the browser window and their responses will not be included in the final results. Once pins and surveys are submitted, it will be impossible to remove a participant's submissions due to the anonymous nature of the data collection (i.e., participants are not asked for their names or contact information). All data that remains after the participation period will be held in confidence and remain private.
Survey responses/answers: Please note that the survey responses/answers are not anonymous if you provide information that could be used to identify you. Any identifying information is discouraged.

Use of Data, Secure Storage and Destruction of Research Data:
Information collected from participants will be used as part of the Exploring a GIS web mapping app as a public engagement tool for planners through the lens of urban agriculture Capstone research project. It may be used for conference presentations and/or publication in journals and other academic and professional resources. In addition, a final report/summary/post may be posted on the Department of City Planning's website (https://umanitoba.ca/architecture/department-city-planning/student-work). This data will be stored on the ArcGIS online platform through the University of Manitoba's license. ArcGIS Online utilizes the cloud infrastructure of Microsoft Azure and Amazon Web Services (AWS); therefore, customer data may flow through these systems or be stored within them. This data is stored in the United States. Responses are thus subject to American laws. Risks associated with participation are minimal and are similar to those associated with many email and social media websites such as Hotmail and Facebook. Any data that is pulled from the ArcGIS Online platform will be encrypted and securely stored on the University of Manitoba-provided Individual File Storage system OneDrive under my personal University account. All information will be treated as confidential and stored in a private and secure place, and subsequently destroyed at the end of the project, on or before May 2022. The researcher, Alyssa Bouchard, is responsible for destroying the data.

Copies of consent will be securely kept on file by the researcher for information purposes only for two years and then destroyed, in accordance with University ethics policies. Participant Consent: By clicking “I agree” below, you indicate that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as to your initial consent, so you should feel free to ask for clarification or new information throughout your participation. The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.

This research has been approved by the Research Ethics Board at the University of Manitoba, Fort Garry campus. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Officer at 204-474-7122 or HumanEthics@umanitoba.ca.

Thank you for your interest in this project. Your cooperation and insights are valuable and are greatly appreciated! Please click the following to be directed to the survey:

I have understood the details of this consent form, I confirm that I am 18 years of age or older, and I agree to participate in this study. Yes ☐ No ☐

Appendix B: Information sheet

INFORMATION SHEET

Title of Project: Exploring a GIS web mapping app as a public engagement tool for planners through an urban agriculture lens

Principal Investigator: Alyssa Bouchard, Masters student, boucha54@myumanitoba.ca
Course Instructor: Dr. Rae Bridgman, Faculty of Architecture, Department of City Planning, University of Manitoba; rae.bridgman@umanitoba.ca

INFORMATION TO BE DISPLAYED BEFORE ENTRY INTO THE APP ALONG WITH AN INFORMED CONSENT DISCLAIMER.

BACKGROUND INFORMATION:
"Humans have been growing crops and raising animals in and around cities since we began organizing ourselves into long-term settlements over five thousand years ago (The Urban Farmer, n.d.). In recent decades in the post-World War II era, primarily in North America, there has been a divide between the urban and rural, and urban planning and regulatory practices have only solidified this division (The Urban Farmer, n.d.). But since the 1990's this trend has begun to shift again, bringing urban agriculture back into the forefront of food production (The Urban Farmer, n.d.).

Types of urban agriculture:
1) Private yards and gardens
2) Community projects (community gardens, etc.)
3) Institutional initiatives (local food production by schools, churches, hospitals, municipalities, etc.)
4) Small commercial enterprises (small plot intensive farming & small-scale production of high-value crops)
5) Peri-urban agriculture (farming on the urban fringe)
6) Roof-top growing and other innovations (vertical farms, etc.)
7) Urban chickens, rabbits, bees, and others

Cities across the globe are fighting against the detrimental effects that climate change can bring. Some cities are experiences more frequent or extreme flooding events

annually, while other cities are experiencing drought and urban heat island effects. Urban agriculture has been recognized to help some cities adapt to such negative effects.

Climate change benefits of urban agriculture:

1) Decrease temperature in urban centres
2) Provide insulation for buildings effectively reducing energy required for heating and cool
3) Direct source of food, reducing food miles
4) Reduce impacts of flash flooding by increasing the amount of permeable surface area
5) Reduce pesticide use and fossil fuel use typically required from traditional large scale rural farming practices
6) Contribute to the absorption of CO2, thus reducing the amount released into the atmosphere
   (RUAF Foundation, n.d. & The Urban Farmer, n.d.)

This app contains four informational layers, a boundary of the city of Winnipeg for reference, a layer of all buildings in the city to help identify rooftops and landmarks, a map of all parks and open space, and all vacant lots. The parks and open spaces are labelled with their respective names, and the vacant lots are labelled with their zoning type to better understand why that lot is vacant and what could potentially go there. You can turn these layers off and on (through the Layers List widget) to help guide you through what we are asking of you. In addition, there are two public data collection layers: one for existing urban agriculture and one for potential locations.

What is being asked of you:

1) Identify existing urban agriculture locations.
Do you know of a community garden in your neighbourhood?
Is there a rooftop garden that you have been admiring on your commute to work?
Help create a map outlining what urban agriculture sites Winnipeg already has.
2) Identify potential locations for urban agriculture.
Based on the information provided, is there a park near your home that is being underutilized? Or do you live near the river where it floods frequently? Is there a vacant lot that you think could benefit from a community garden?

You can place points on both public data collection layers by navigating to the Edit widget (plant icon).

Sources:

RUAF Urban Agriculture and Food Systems. https://ruaf.org/document/policy-brief-urban-agriculture-as-a-climate-change-strategy/.

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Appendix C: Pilot project/survey questions

University of Manitoba

Title of Project: Exploring a GIS web mapping app as a public engagement tool for planners through an urban agriculture lens

Name of Researchers:
Alyssa Bouchard, Masters student, Department of City Planning, University of Manitoba; boucha54@myumanitoba.ca
Rae Bridgman, course instructor, Department of City Planning, University of Manitoba; rae.bridgman@umanitoba.ca

Survey Questions:

Existing urban agriculture (when participant places a pin for existing urban agriculture):

1. Does the site have a specific name, or is it on/near a specific building?
2. What type of urban agriculture is it? (i.e., community garden, rooftop garden, private yard, etc.)
3. What type of food is grown here, if any? (i.e., fruits, vegetables, herbs, etc.)

Opportunities for urban agriculture (when participant places a pin for potential urban agriculture locations):

1. What type of urban agriculture do you think would be most suitable for this site?
2. What are your reasons for thinking this would be a suitable site?
3. What are some of the opportunities or benefits that you think urban agriculture could bring to a community?

Please click “save” to finalize the submission. If you do not click “save” your data will not be recorded.

Appendix D: Recruitment email scripts

Email Script

Re: Research pilot project/survey participation request

Hello,

My name is Alyssa Bouchard, and I am a Masters student registered in the graduate City Planning Capstone Course in the Department of City Planning at the University of Manitoba, taught by Dr. Rae Bridgman. I am exploring a GIS web mapping app as a public engagement tool for planners through an urban agriculture lens.

I am recruiting participants to participate in a pilot project using a GIS web mapping application to obtain public data to further inform public engagement practices for planners, in addition to the City of Winnipeg's Climate Action Plan. Your participation in this pilot project is completely voluntary and involves your accessing the GIS web mapping application via a computer, laptop, or smartphone and locating locations of existing urban agriculture or potential sites for urban agriculture in Winnipeg. The GIS web mapping application will provide you with any relevant background information required to understand the content.

Research confidentiality will be maintained, and I would like to assure you the study has been reviewed and received ethics clearance through the University of Manitoba Research Ethics Board (REB 2). If you have questions for the Ethics Board, you can contact them through humanethics@umanitoba.ca or telephone 204-474-7122.

If you have any questions about the study, please let me know. Or if you would like additional information to assist you in reaching a decision about participation, please also feel free to contact Dr. Rae Bridgman (email: rae.bridgman@umanitoba.ca; telephone: 204-474-7179).

Thank you in advance for your time,

Alyssa Bouchard

Follow-up recruitment materials:

E-mail script
Re: Research pilot project/survey participation request follow-up

Hello,

I am following up on my previous e-mail sent one month ago.

My name is Alyssa Bouchard, and I am a Masters student registered in the graduate Capstone course in the Department of City Planning at the University of Manitoba, taught by Dr. Rae Bridgman. I am exploring a GIS web mapping app as a public engagement tool for planners through an urban agriculture lens.

I am recruiting participants to participate in a pilot project using a GIS web mapping application to obtain public data to further inform public engagement practices for planners, in addition to the City of Winnipeg's Climate Action Plan. Your participation in this pilot project is completely voluntary. Your role involves accessing the GIS web mapping application via a computer, laptop, or smartphone and locating locations of existing urban agriculture or potential sites for urban agriculture in Winnipeg. The GIS web mapping application will provide you with any relevant background information required to understand the content.

Your participation should take no more than ten minutes of your time.

Research confidentiality will be maintained, and I would like to assure you the study has been reviewed and received ethics clearance through the University of Manitoba Research Ethics Board (REB 2). If you have questions for the Ethics Board, you can contact them through humanethics@umanitoba.ca or telephone 204-474-7122.

If you have any questions about the study, please let me know. Or if you would like additional information to assist you in reaching a decision about participation, please also feel free to contact Dr. Rae Bridgman (email: rae.bridgman@umanitoba.ca; telephone: 204-474-7179).

For those that have already participated, thank you very much.
For those that have not had a chance yet, the participation period will end on January 5th, 2022.

Thank you for your time,

Alyssa Bouchard

Appendix E: Group/organization email contact form

This is a template for contacting groups and/or organizations.

Re: Research pilot project/survey participation

Hello,

My name is Alyssa Bouchard, and I am a Masters student registered in the graduate Capstone course in the Department of City Planning at the University of Manitoba, taught by Dr. Rae Bridgman. I am exploring a GIS web mapping app as a public engagement tool for planners through an urban agriculture lens.

I am reaching out to relevant community groups and organizations to circulate my research project within your organization or to any other parties you feel would be interested. This study explores the utilization of a GIS web mapping application for public engagement practices within the planning profession through an urban agriculture pilot project in Winnipeg. The goal of the project is to identify lessons learned, ideas for future pilot projects, and potential next steps for other researchers to further explore the technology. The web mapping application will allow users to input data about existing urban agriculture and potential sites for urban agriculture in the City of Winnipeg. This data will include the location of the site; and for existing sites, the name of the site or building, what type of urban agriculture it is, and what is grown at the site. And for potential sites, participants will include what type of urban agriculture could be located there and why the participant believes the location to be suitable.

Research confidentiality will be maintained, and I would like to assure you the study has been reviewed and received ethics clearance through the University of Manitoba Research Ethics Board (REB 2). If you have questions for the Ethics Board, you can contact them through humanethics@umanitoba.ca or telephone 204-474-7122.

If you have any questions about the study, please let me know. Or if you would like additional information to assist you in reaching a decision about participation, please also feel free to contact Dr. Rae Bridgman (email: rae.bridgman@umanitoba.ca; telephone: 204-474-7179).

Thank you in advance for your time,

Alyssa Bouchard

Appendix F: Recruitment LinkedIn scripts

LinkedIn Script

Hi everyone, as part of my Master of City Planning Capstone project I am conducting a pilot project titled: Exploring a GIS web mapping app as a public engagement tool for planners through an urban agriculture lens. I am asking anyone over the age of 18 years old to participate in an online web mapping application to gather information on existing urban agriculture and potential sites for urban agriculture in Winnipeg. This should not take up more than 10 minutes of your time. All background information required is in the app and the link is: INSERT LINK HERE.

If you have any questions about my research or the survey questions, I would be happy to answer them.

This research has been approved by the Research Ethics Board at the University of Manitoba, Fort Garry campus. If you have any concerns or complaints about this project, you may contact any of the above-named persons or the Human Ethics Officer at 204-474-7122 or HumanEthics@umanitoba.ca.

Thank you for your time.

Follow-up recruitment materials:
LinkedIn

Hi everyone, I am following up on my previous post asking for your help on my Master of City Planning Capstone project. For those of you who have already participated, thank you so much for your time. For those of you that have not had a chance yet, you have two weeks left! I have re-shared the original post here for your information.
Research confidentiality will be maintained, and I would like to assure you the study has been reviewed and received ethics clearance through the University of Manitoba Research Ethics Board (REB 2). If you have questions for the Ethics Board, you can contact them through humanethics@umanitoba.ca or telephone 204-474-7122.
Thank you in advance for your time and participation,

Alyssa Bouchard

Appendix G: Recruitment Instagram scripts

Instagram script:

Fellow followers: I am asking for your help in my Graduate Capstone Project! If you feel inclined, please go to the link, and help me locate urban agriculture and potential sites for urban agriculture in Winnipeg. Thank you so much!

Research confidentiality will be maintained, and I would like to assure you the study has been reviewed and received ethics clearance through the University of Manitoba Research Ethics Board (REB 2). If you have questions for the Ethics Board, you can contact them through humanethics@umanitoba.ca or telephone 204-474-7122.

INSERT LINK HERE.
Follow-up recruitment materials

Instagram: (I WILL MAKE THE SAME POST AS THE ORIGINAL ONE)
Fellow followers: I am asking for your help in my Graduate Capstone Project! If you feel inclined, please go to the link, and help me locate urban agriculture and potential sites for urban agriculture in Winnipeg! Thank you so much!
Research confidentiality will be maintained, and I would like to assure you the study has been reviewed and received ethics clearance through the University of Manitoba Research Ethics Board (REB 2). If you have questions for the Ethics Board, you can contact them through humanethics@umanitoba.ca or telephone 204-474-7122.

INSERT LINK HERE.