A *Pondful* of Possibilities…

Reimagining Winnipeg's Residential Stormwater Retention Ponds as Urban Agricultural Assets

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Executive Summary

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1. Introduction

Research has demonstrated that North American cities have great potential for integrating urban agriculture into under-utilized open spaces, for example, along transport and infrastructural components, under utility corridors, and in vacant lots (Baker et al., 2009). This study argues that suburban Winnipeg's residential stormwater retention ponds are also capable of accommodating urban agricultural activities. Many potential uses of these retention ponds can be identified, for example, for active transportation, recreation, winter activities, and being biodiversity assets. However, growing and harvesting plants for biofuel, fodder, and food, while following low impact, chemical-free, and environmentally safe techniques, can improve the water quality of retained stormwater.

Other benefits of urban agricultural activities (i.e., reduction in greenhouse gas emissions due to fossil fuel displacement and shortening of supply chains) may be leveraged to support Canada's commitment to end all greenhouse gas emissions by 2050 (Government of Canada, 2021). Additionally, growing food locally may increase food security, equity, and support multiculturalism (Hough, 2004). This is especially relevant to Winnipeg where 11.5 % of the population faced food insecurity in 2018 (Canadian Centre for Policy Alternatives, 2018). To investigate this suggested urban agricultural potential, two key questions were formulated. These were:

> ***Q1 In what ways could suburban Winnipeg's residential stormwater retention ponds become urban agricultural assets?***
>
> ***Q2 Do Winnipeg's policy documents, guidelines, and instructions inhibit or make urban agriculture in stormwater retention ponds possible? Are there any amendments needed?***

The first question demanded to know the *whys* and *hows* associated with urban agriculture and urban agriculture's intersection with stormwater green infrastructure. The second question directed an inquiry regarding the City's approach towards stormwater and urban agriculture, facilitating the identification of gaps and required revisions to the City's policies. This study leveraged a **Literature Review**, a **Policy Scan** of the City's Policy Documents and guidelines, and a **Stormwater Retention Pond Audit** containing on-site observations from selected retention ponds in suburban Winnipeg, to identify key concerns and suggest ways to mitigate them.

2. Literature Review

A review of overarching principles of urban ecology, scholarly articles on the intersection of urban agriculture and stormwater green infrastructure, and research precedents helpful to nominate aquatic crops for agriculture in retained stormwater was conducted to build an understanding of the challenges and opportunities associated with integrating urban agriculture into suburban residential stormwater retention ponds. The learnings from this review are summarized below:

- Cities should accommodate edible and productive landscapes while employing agricultural techniques based on *traditional mixed farming practices* as urban agriculture can have various environmental, economic, and social benefits (Hough, 2004).
- The water quality issues, to which urban stormwaters are subjected, can be mitigated by integrating *Detention ponds* and *biofilters* with stormwater green infrastructure, where plants and microbes improve water quality by *bioremediation* (Forman, 2014). These plants can be harvested for a variety of uses such as biofuel, animal fodder, and food. Thus, urban stormwater should be treated as a nutrient-rich resource rather than a waste.
- The integration of urban agriculture with stormwater green infrastructure may have additional benefits including an increase in local food production; an increase in quality of urban stormwater and reduction in flood risks; an increase in ecological services of urban stormwater infrastructure; and an increase in opportunities for green energy production by biofuels, further reducing dependence on greenhouse emissions (Deksissa et. al., 2021; D'Odorico et. al., 2018).
- City administrations can promote urban agriculture by investing in demonstrative projects; providing incentives to developers like density bonuses; revising codes and guidelines to remove regulatory barriers; and leveraging partnerships with community and educational institutions, and advocacy groups to build capacity for urban agriculture in the community (Beatley, 2010).
- Growing and harvesting plants like cattail (Grosshans, 2014; Berry 2016), duckweed (Xu et. al., 2012; Hochman et. al. 2018), algae (Supraja et.al., 2020), wild rice (Agro-Man, 1984), tomatoes (Supraja et.al., 2020), lettuce, kale (Tikasz et al., 2019), and basil (Kim &

Yang, 2020) for various objectives including biofuel, fodder, and food can be economically profitable and beneficial for the ecological health of urban waters.

3. Stormwater Retention Pond Audit

Stormwater retention ponds in suburban Winnipeg's five selected neighbourhoods **Southdale**, **Island Lakes**, **Linden woods**, **Royalwood II** & **Bridgewater Forest** were visited in October and November 2021, and on-site observations were recorded to inform a Stormwater Retention Pond Audit. The City of Winnipeg's Open Data Portal and additional websites maintained by land developers and neighbourhood associations were also examined to inform this Audit.

Figure 1: The retention ponds at Royalwood II are replete with grassland and riparian vegetation.

With this Audit, it was assessed that suburban Winnipeg's stormwater retention ponds have become better integrated with the layout of the subdivision, over time. Design elements such as bridges, decks, and look-out points with benches provide opportunities to utilize the visual aesthetic value of these ponds. The linear arrangement of retention ponds has allowed developers to maximize the number of pond-facing lots. However, the ponds in four out of five selected neighbourhoods do not meet the recommended minimum area allocation. Recently, the naturalization of retention ponds through the addition of native prairie plant communities and riparian vegetation has led them to be used as biodiversity and ecological assets (see figure1). Warning signs note a variety of restrictions on the use of these retention ponds. These restrictions appear to be due to many reasons including water quality issues.

The design of suburban Winnipeg's stormwater retention ponds is dynamic and has been adapted to suit different sensibilities over time. This adaptability can be further exploited to integrate additional functions into these ponds. Riparian vegetation including cattails, which may be harvested for various uses, is already becoming a key component of the planting scheme for these retention ponds.

4. Policy Scan

City of Winnipeg's policy documents, including its development plan ***OurWinnipeg 2045*** (City of Winnipeg, 2021) and direction strategy plans ***CompleteCommunities 2.0*** (City of Winnipeg, 2021), ***Sustainable Water and Waste*** (City of Winnipeg, 2011), and ***A Sustainable Winnipeg*** (City of Winnipeg, 2011) were reviewed briefly to understand if urban agriculture in suburban stormwater retention ponds is prohibited, permitted, or encouraged by these policy documents. Technical instructions in ***Stormwater Management Criteria*** (City of Winnipeg, 2001) and guidelines on the City's website under the *Water and Waste Department*'s section *Retention Ponds*, were also assessed as a part of this Policy Scan. This scan included an assessment of the frequency and position of references to urban agriculture and identification of opportunities for integration of the term in the language of these documents and instructions.

With this Policy Scan, the Development Plan's reference to urban agriculture appeared tokenistic as the goals and policies in the plan were not found to elaborate on how or where urban agriculture may be integrated into the city. Urban agricultural possibilities were not found to be identified or incorporated into the vision, goals, and policies in the City's Direction Strategies. The City's Technical Instructions were not found to recommend agriculture as a permitted or encouraged activity in and around these ponds.

The Scan recommended using stronger language to support urban agriculture while incorporating it into the visions, goals, and policies stated in these four policy documents, to help the City to leverage urban agriculture for ecological, social, and economic benefits. Design considerations, permitted uses, and the language of the City's Technical Instructions could be revised to better integrate urban agriculture in stormwater retention ponds.

5. Analysis & Findings

The learnings from the Literature Review, Stormwater Retention Pond Audit & Policy Scan were analyzed to distill a list of five kinds of challenges to the integration of urban agriculture into residential stormwater retention ponds. These learnings also inform possible solutions to mitigate these challenges. These are tabulated on the following pages:

Biological Feasibility

Key Concerns	Possible solutions
Are there any useful aquatic plants that can be grown in retention ponds? *Will these plants survive in potentially toxic retained waters? If not, how can we make these waters suitable for their growth?* *If grown for food or animal fodder, will these plants be suitable for consumption?*	• Growing Cattail, duckweed, algae, wild rice, tomato, lettuce, kale, and basil in retention ponds is feasible. • Increasing water quality by revisiting regulations on management (including the design, operation, irrigation) of residential landscapes, defining permitted fertilization, and pest control methods. • Increasing water quality by mandating the use of stormwater quality checks, limiting lawn percentage and mandating the inclusion of *biofilters* and separate *detention basins*. • Building a system of collecting and analyzing water quality data from selected sites.

Economic Viability

Key Concerns	Possible solutions
Can profit be made from such ventures? *Can we prove other monetized benefits?*	• Collecting data from executed projects and commissioning new projects to monitor profitability. • Creating demand by branding and strategically positioning locally grown food, fodder, and biofuel. • Incentivizing and subsiding to make agricultural activities in the city more attractive. • Seeking ways for industry involvement including Corporate Social Responsibility (CSR).

Technical Feasibility

Key Concerns	Possible solutions
What technical considerations and operational challenges, must one be mindful of? *How can these challenges be resolved?*	• Cultivating plants on Floating Treatment Wetlands (FTWs), independent of water level fluctuations. • Using water level control mechanisms. • Employing Innovative yet tested cultivation techniques such as hydroponics and aquaponics. • Employing Innovative harvesting & land management techniques. • Investing in the formation of a Task Force for identification and barrier removal for urban agriculture.

Safety & Liability Concerns

Key Concerns	Possible solutions
Will agriculture in retention ponds be safe? *How can the perceived safety risks and liability concerns be minimized?*	• Revisiting design considerations and guidelines for suburban stormwater retention ponds. • Investing in additional research on risk mitigation and liability management. • Revisiting language on warning signs and phrasing of instructions on the City's website.

NIMBYism & Public Opinion

Key Concerns	Possible solutions
How can NIMBYistic attitudes be addressed? *How can favourable public opinion be generated?*	• Investing in public engagement and awareness initiatives. • Involving school kids and youth in awareness drives. • Involving public and community institutions to collaborate with neighbourhood associations for capacity building. • Advertising benefits of demonstrative projects via social media.

6. Conclusion

Winnipeg's residential stormwater retention ponds can be potentially used to grow and harvest crops for biofuel, fodder, and food. Concerns regarding biological and technical feasibility, economic viability, safety and liability concerns, and NIMBYism challenge this potential. The City of Winnipeg may explore the following recommendations to support the integration of urban agriculture into suburban retention ponds. City of Winnipeg may:

- **Revise the City's Policy Documents** to include supporting language for urban agriculture in the vision statements, objectives, actions, and policies. The City may work towards generating a bespoke *Urban Agriculture Direction Strategy* informed by a review of similar precedents from other Canadian cities and municipalities and align the additional strategies and initiatives with these revised policy documents.
- **Revise the City's Technical Instructions** to make stormwater retention ponds better suited to accommodate urban agriculture. Additionally, the City may mandate water quality standards; recommend chemical-free, low impact, landscape management

techniques; recommend planting guidelines to limit non-usable lawns and encourage the use of native and pollinator-friendly plants; and permit limited usage of retained stormwater for irrigation.

- **Commence additional initiatives**, including those to establish a Task Force to identify and remove regulatory barriers; consider additional measures to increase the economic viability of urban agricultural activities in Winnipeg; develop a robust data collection and analysis system; explore partnerships with community and education Institutions for capacity building; re-evaluate the language of warning signs around retention ponds.
- **Invest in additional research** projects including Winnipeg's Aquatic Agriculture Pilot Research Project while continuing to leverage partnerships with community and education Institutions, neighbourhood associations, expert agencies, and advocacy organizations for the operation and management of these projects.
- **Seek funding opportunities** including those from Federal and Provincial Governments and investment partnerships with industry leaders and business associations.
- **Partner with Indigenous organizations** to identify opportunities for reconciliation, increase indigenous food sovereignty, and leverage indigenous knowledge to reduce operational costs and environmental impacts.

Additional research could explore the impact of winter on urban agricultural opportunities; optimize safety and perceived risks; reduce liability concerns and generate favourable public opinion regarding urban agriculture. These directions could be pursued to further assist the integration of urban agriculture in Winnipeg's urban open spaces. The possible outcomes of exploring the directions suggested in this research include environmental benefits such as an improvement in the ecological health of the entire region, economic benefits by a reduction in waste management and flood mitigation costs, and social benefits by increasing equity and opportunities for reconciliation.

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