

Wither the Garden? Farming for Self-Sufficiency in the Greater Toronto Area

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Abstract

Climate catastrophes are slow-moving threats to agricultural lands in North America. Corporatization and concomitant agglomeration of small farms likewise jeopardize continuous agricultural production. At some future point, food security will become paramount, especially for population centers such as the Greater Toronto Area. Diasporic rearrangements of farming as it exists today are inevitable. Collectively, are these phenomena opportunities for reforming land conservation and agricultural practices? Or, are they mandates? Based on Jim Dator's notion of possible 'alternative futures' — Continuation, Transformation, Limit and Discipline, and Decline and Collapse — this project develops a hypothetical demonstration farm of four archetypes for resilient farming, hoping to hedge inevitable change.

Keywords: Climate catastrophes, climate-induced migration, corporatization, demonstration farm

1. Introduction

1.1. Background

The Greater Toronto Area (GTA) in Southern Ontario, Canada, is currently classified as plant hardiness zones 5 and 6. Climate projections indicate a significant northward shift of the zones to 7 and 8 by the year 2100, spanning an average distance of 400 kilometers (Figure 1, 2) (Mckenney et al., 2014). The gradual onset of these changes complicates our understanding of their severity, prompting us to delve deeper into how the slow-moving catastrophe may constrain and transform agricultural practices even in regions known for their fertile soils. Climate catastrophes erode and reconfigure landforms, borders, and origins, affecting humans and non-humans alike; requiring us to reconceptualize how they will be seen and engaged in the future. Recognizing that any site will change over time or be subject to migration, how can we rethink our agricultural production such that maintains a continuous food supply for the Greater Toronto Area? (Figure 3)

1.2. Statement of the Issue – Climate Migration and Corporatization of Small Farms

Southern Ontario is known for its thriving dairy production, corn cultivation for pasture feeding, and extensive greenhouses (Figure 4) (Bunce & Neptis, 2005). However, the projected climatic shift will lead to an increase in Growing Degree Days (GDD), transforming the environment from what was suitable to grow berries to corn into the cultivation of corn to winter wheat. This shift will have a significant impact on biodiversity, disrupting habitats and wildlife corridors that are currently shared by various bee and bird species in the region's farmlands. Additionally, communities relying heavily on agricultural water use will face the challenges of drought within the next few decades due to a gradual decrease in precipitation (Figure 5) (Kurukulasuriya & Rosenthal, 2003).

Coupled with the climate-induced migration challenges, Southern Ontario is witnessing a concerning trend of agricultural corporatization. Rental rates for land in municipalities near the urban core have surpassed 50%, leading to a phenomenon akin to modern feudalism where farms are consolidating, and many local farmers are resorting to renting their lands for production (Bunce & Neptis, 2005). This trend is further exacerbated by the increasing prevalence of corporate-owned greenhouses, which raises apprehensions among small-scale farmers and pushes them away from adopting agricultural practices that may be essential for their future viability (Figure 6) (Kitts, 2017).

2. Research

2.1. Research Objective - Self-sufficiency in the Greater Toronto Area

With the Greater Toronto Area's population projected to reach 20 million by 2100, the combined factors of population growth, climate migration, and the corporatization of small farms call for transformative measures in Southern Ontario's agricultural sector to safeguard food security. In 2021, Ontario's average yield stood at 2.9 kg/m², while

individuals consumed an estimated 331 kg of food per year according to the “Canadian Food Guide” (Canada, 2019). This equates to approximately 110 m² of farmland needed to sustain one person. Considering the current farming models, meeting the demands of 20 million people would require securing a productive land area exceeding three and a half times that of Toronto. Moreover, it is important to note that this estimate is contingent upon the existing land productivity and will likely escalate with impending threats (Figure 7).

Despite the projected challenges in ensuring food security, Ontario’s current food trajectory shows a shift away from local supply, relying more on international imports since the establishment of North American Free Trade Agreement (NAFTA). The vulnerability of such global transactions has come to light during the recent pandemic, exposing our inability to maintain food security in times of crisis and emphasizing the significance of self-sufficiency. Presently, Ontario heavily relies on imports, with 75% of fresh vegetables and 37% of fresh fruits being sourced from outside of Canada (Figure 8) (Reliance, n.d.). Faced with the precarious future posed by climate catastrophes, it is crucial to address these unstable dependencies and prepare for uncertainty. As we navigate inevitable changes, we can view this as an opportunity to reform our land conservation and agricultural practices resiliently, ensuring a more sustainable and secure future.

2.2. Typical Farm Models in Southern Ontario

In Southern Ontario, nine typical farm models can be identified and studied to understand the variations in agricultural characteristics based on types and scales. At small scales, croplands primarily consist of field vegetables, while pasture farming focuses on pigs, chickens, and greenhouses specialize in floriculture. Medium-sized crop lands include mass production with grain elevators for crop storage, beef cattle farming for pastures, and greenhouses with increased production, requiring robust water tanks and rainwater management systems. Larger-scale croplands are located near the Canada Pacific Railway for the ease of exports, as the pasture farms are often dairy farms at its largest scale, and greenhouses do not necessarily expand larger but are replicated in multiple locations (Figure 9).

2.3. Research Methodology

Understanding the existing agricultural models in Southern Ontario, the proposal is to develop a hypothetical demonstration farm of four archetypes for resilient farming near Milton, Ontario. Based on Jim Dator’s notion of possible ‘alternative futures’ — Continuation, Transformation, Limit and Discipline, Decline and Collapse — the four scenarios examined in this project explore diverse approaches to achieve varying levels of dietary self-sufficiency.

3. Proposal

3.1. Demonstration Farm

The proposed demonstration farm will be a research outreach of Ontario Agricultural College (OAC) in Guelph to test against the encroaching slow-moving climate catastrophes and to expand on how they can be used as windows to promote self-sufficiency in the Greater Toronto Area (Figure 10 - 14).

3.3. User Group

The facility provides a range of engagement opportunities for different user groups, including daily tourism, overnight stay for external students, incubation support for Ontario farmers, and research collaboration with OAC researchers. This approach enables diverse and widespread participation in the initiative, fostering connections and knowledge exchange throughout the various user groups (Figure 15).

3.4. Speculated Scenarios

The Town of Milton serves as the testbed for the four speculated scenarios, providing a platform to demonstrate the propositions. Correspondingly, suitable farming prototypes have been conceived for each scenario (Figure 16 - 23).

3.5. Operations of the Demonstration Farm

Each scenario includes its own dedicated research station to effectively manage the unique water management, harvest, and maintenance cycles associated with the different farming models. In terms of water operations, the ‘Continuation’ scenario relies on rainwater collection from its extensive horizontal farms, while the ‘Transformation’ scenario draws water from municipal water pump stations and functions as a water distribution infrastructure for the Greater Toronto Area (GTA). The ‘Limit and Discipline’ scenario operates using flooded water, and the ‘Decline and Collapse’ scenario relies on a locally shared irrigation pond (Figure 24). Additionally, the harvest and maintenance cycles also vary significantly between the scenarios. For instance, the smaller farms prioritize shorter harvest, seeding, and monitoring periods as they are intended for daily dwelling and self-sustenance, while the vast industrial farms operate on a broader scale and schedule (Figure 25).

4. Conclusion

The implementation of the four resilient farming archetypes in the demonstration farm represents a proactive approach in preparing the Greater Toronto Area (GTA) for the challenges posed by climate catastrophes. While these catastrophes are typically seen as negative due to their disruptive nature, it is important to recognize their potential as catalysts for addressing the shortcomings of our anthropocentric society. The four future archetypes remind us that there is no singular predetermined future, presenting an opportunity to shape a more resilient and forward-thinking path. By embracing uncertainty and drawing lessons from these events, we can forge a future characterized by resilience and the ability to adapt.

5. Figures

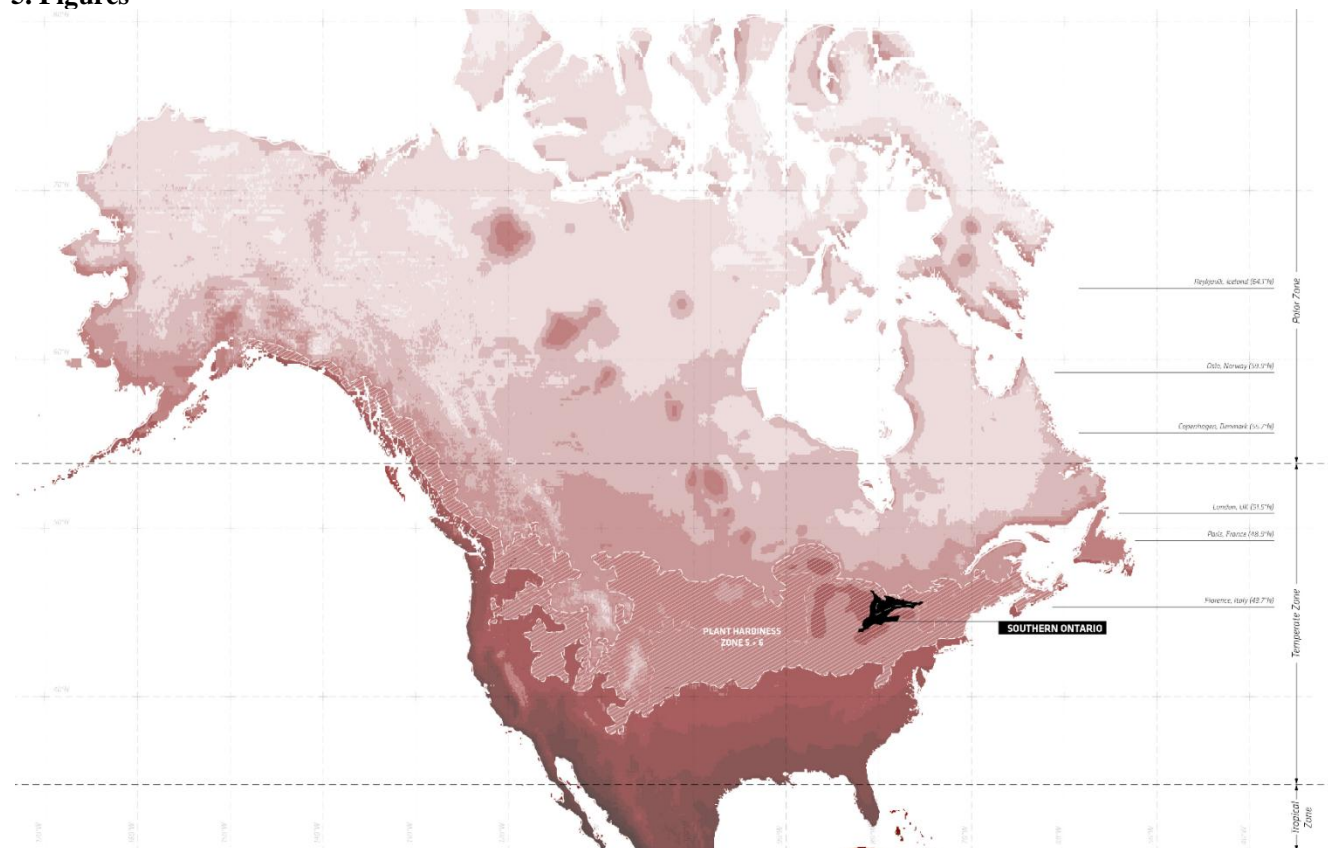


Figure 1. Plant Hardiness Zone (2023)

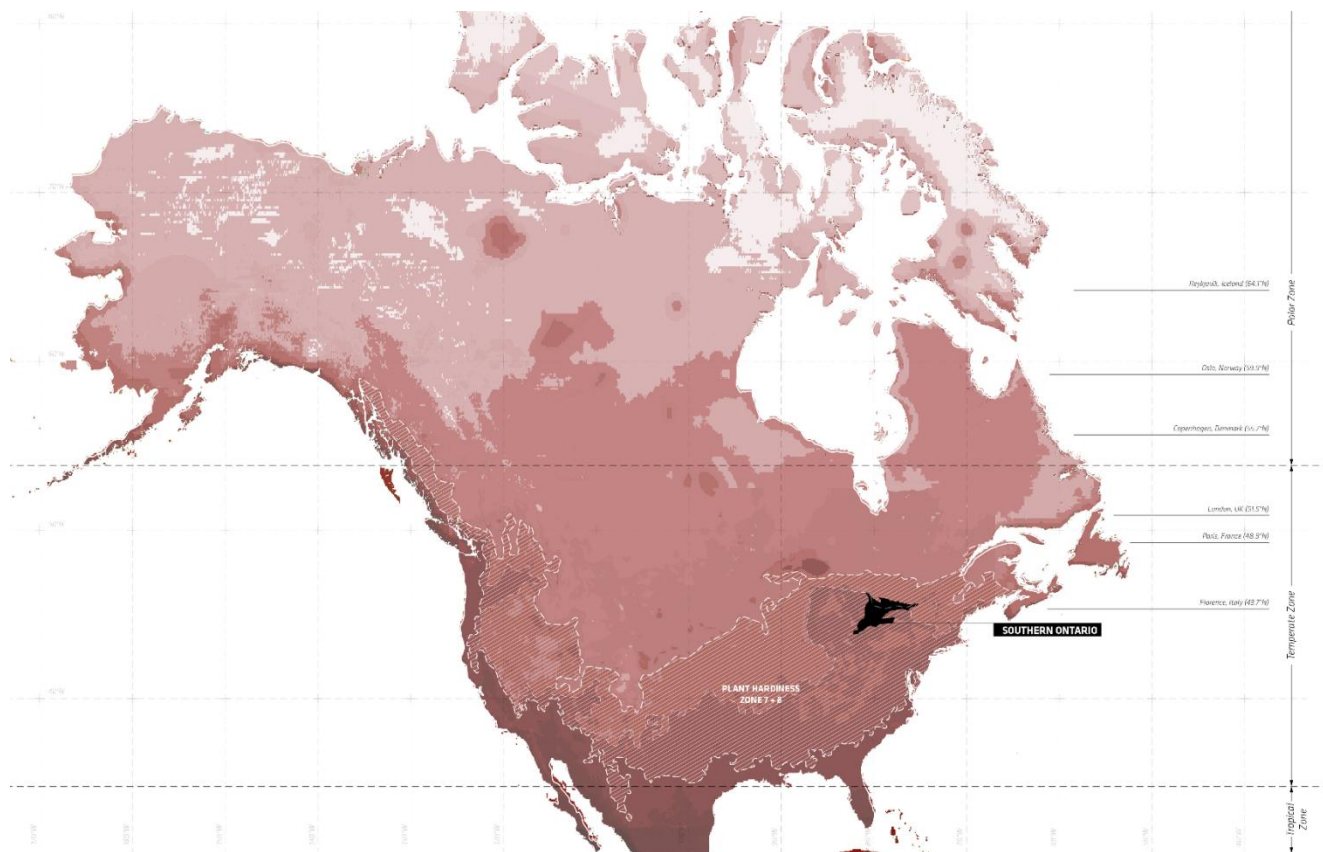


Figure 2. Plant Hardiness Zone (2100)

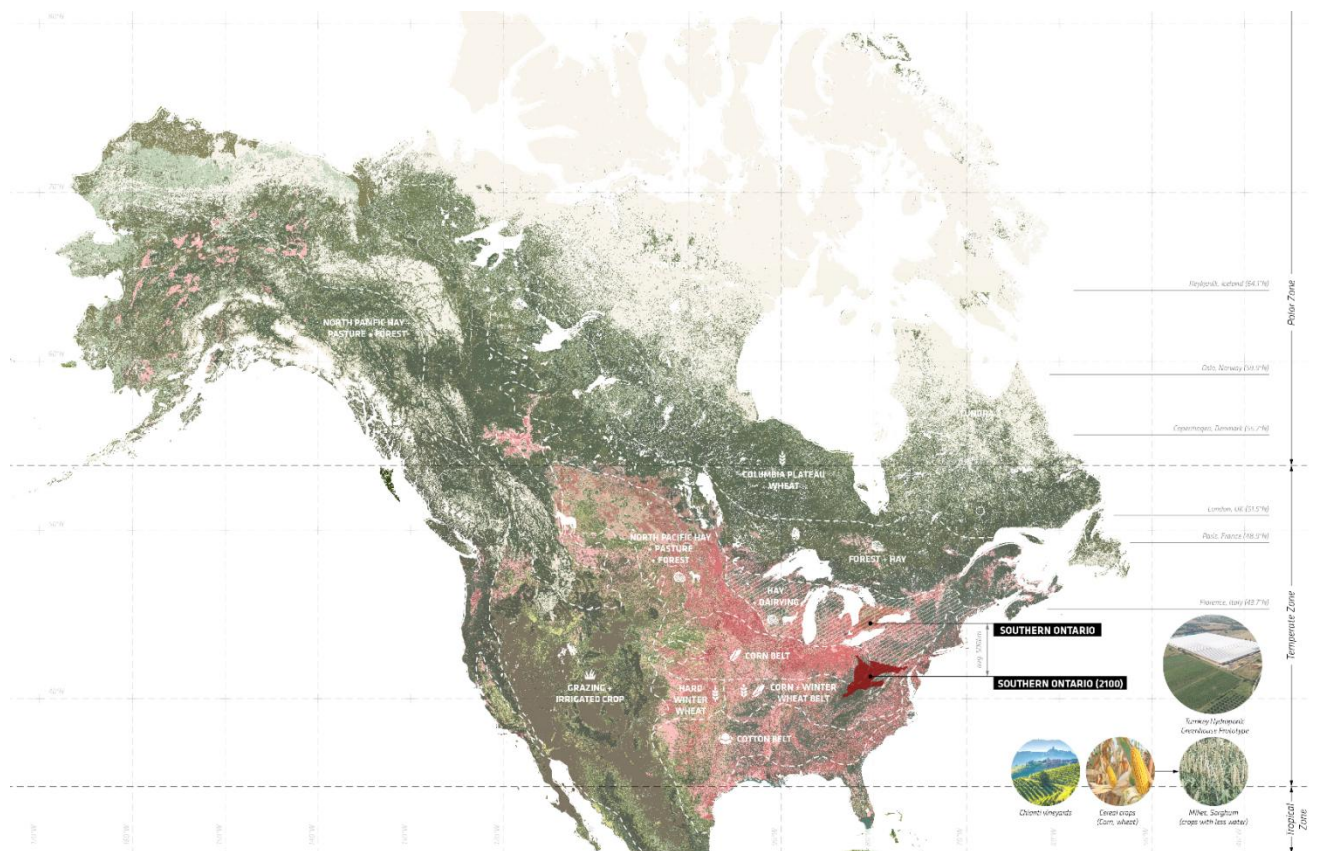


Figure 3. Agricultural belts in North America

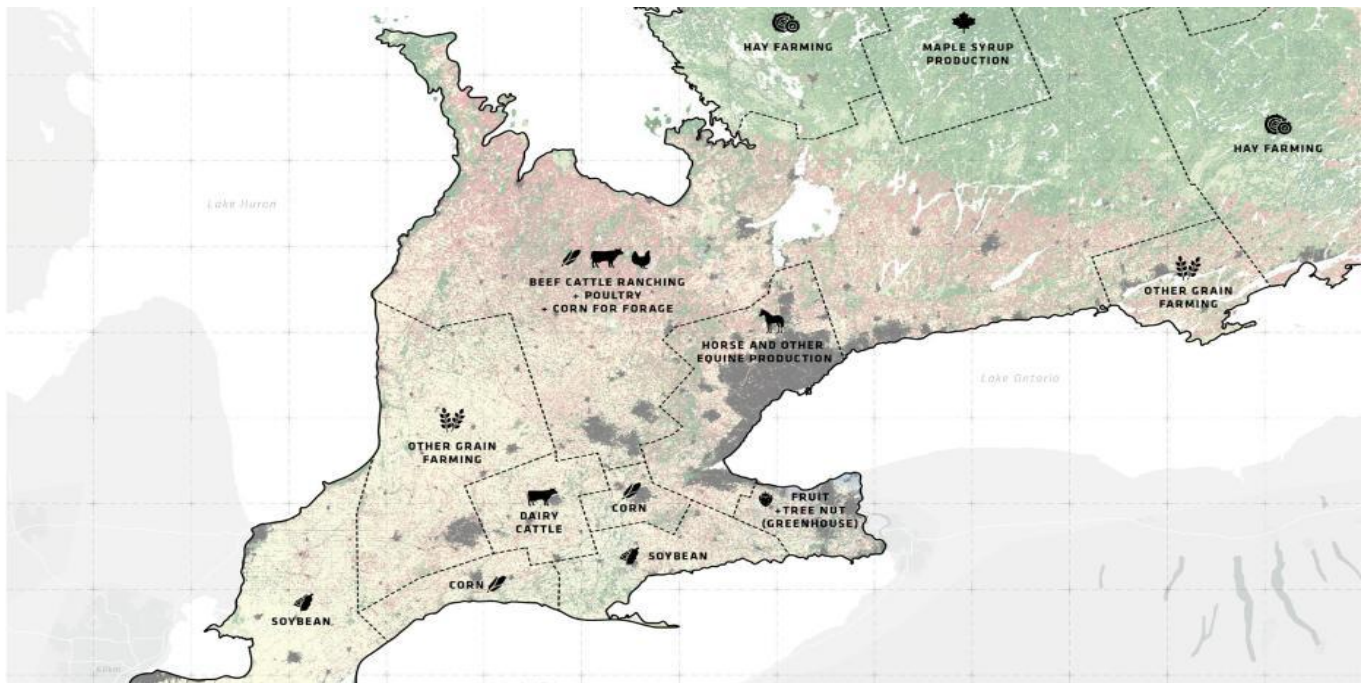


Figure 4. Present primary agricultural regions in Southern Ontario

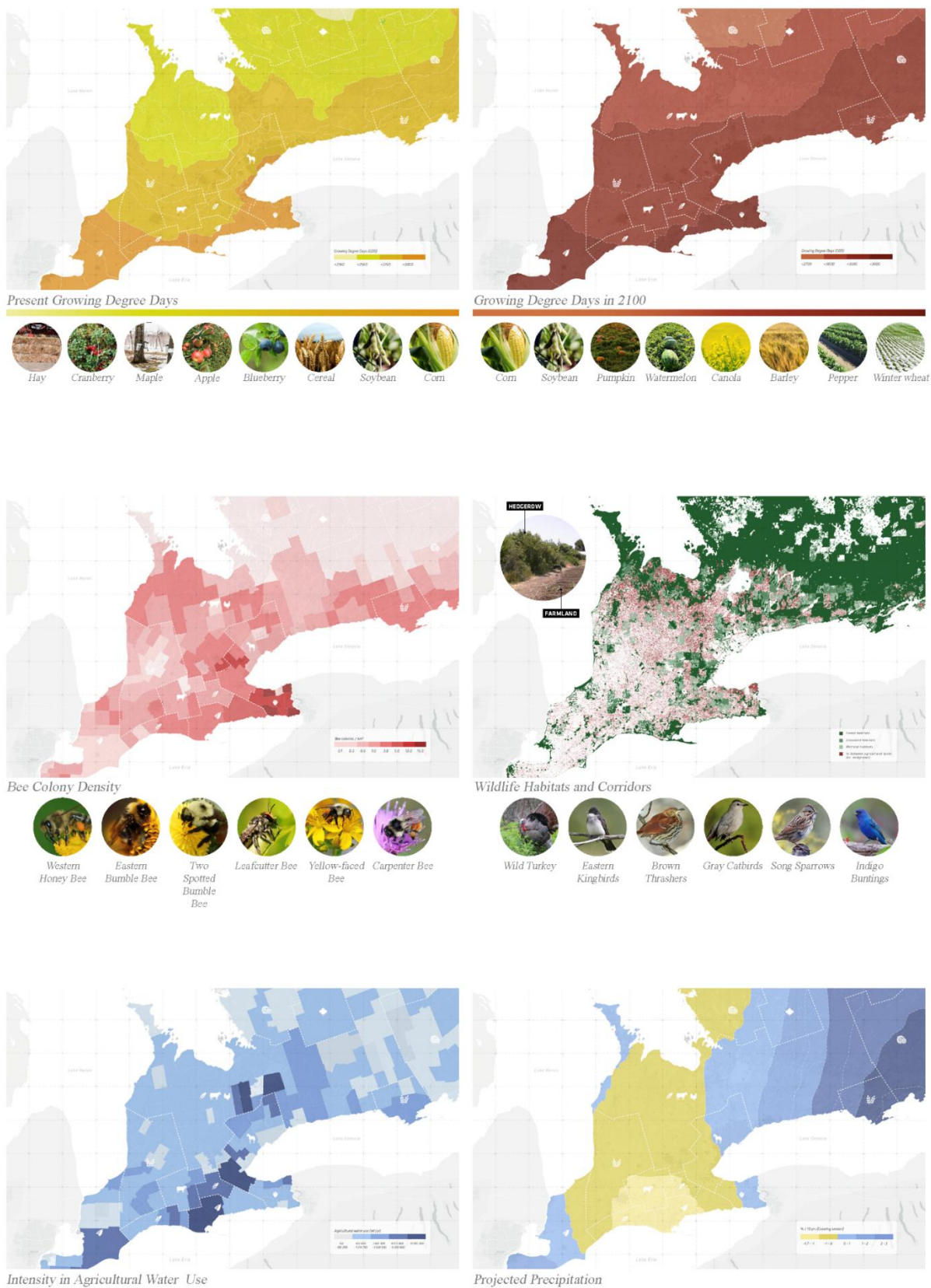
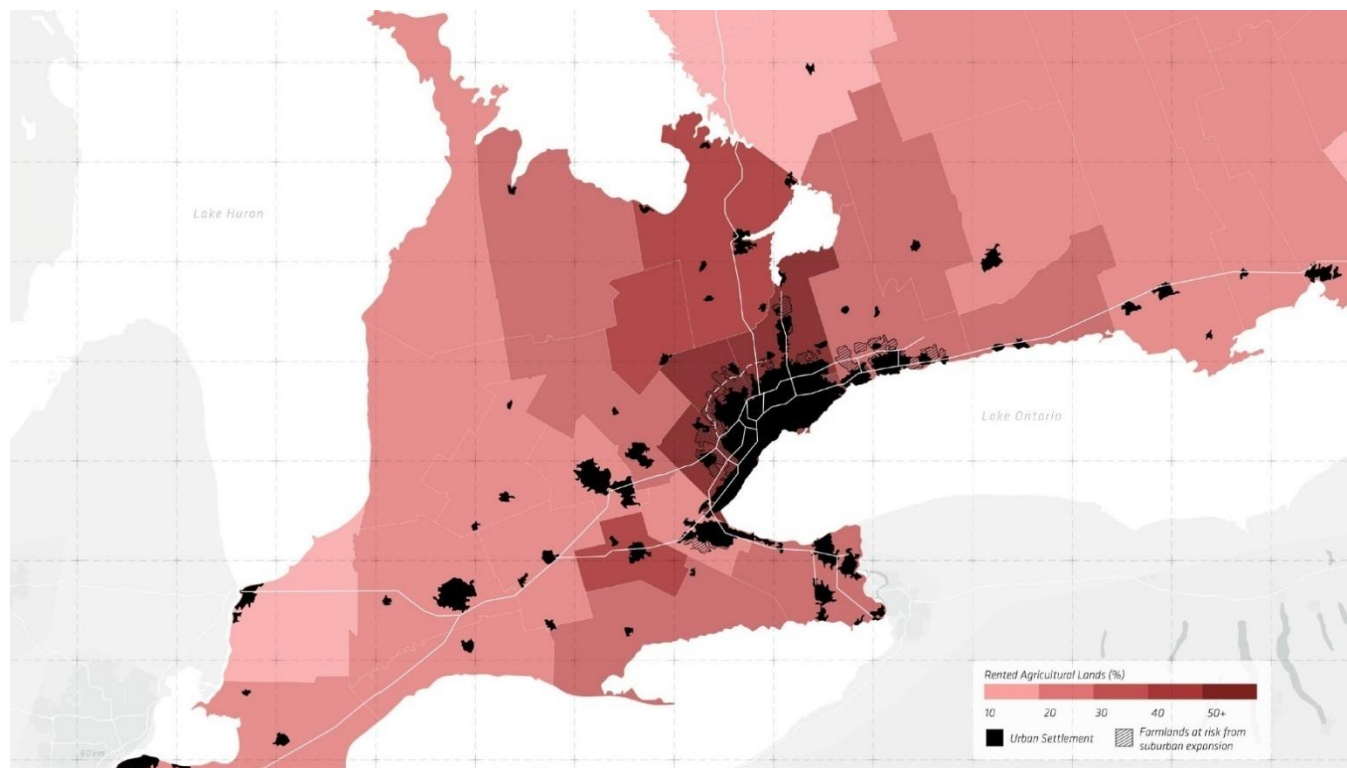
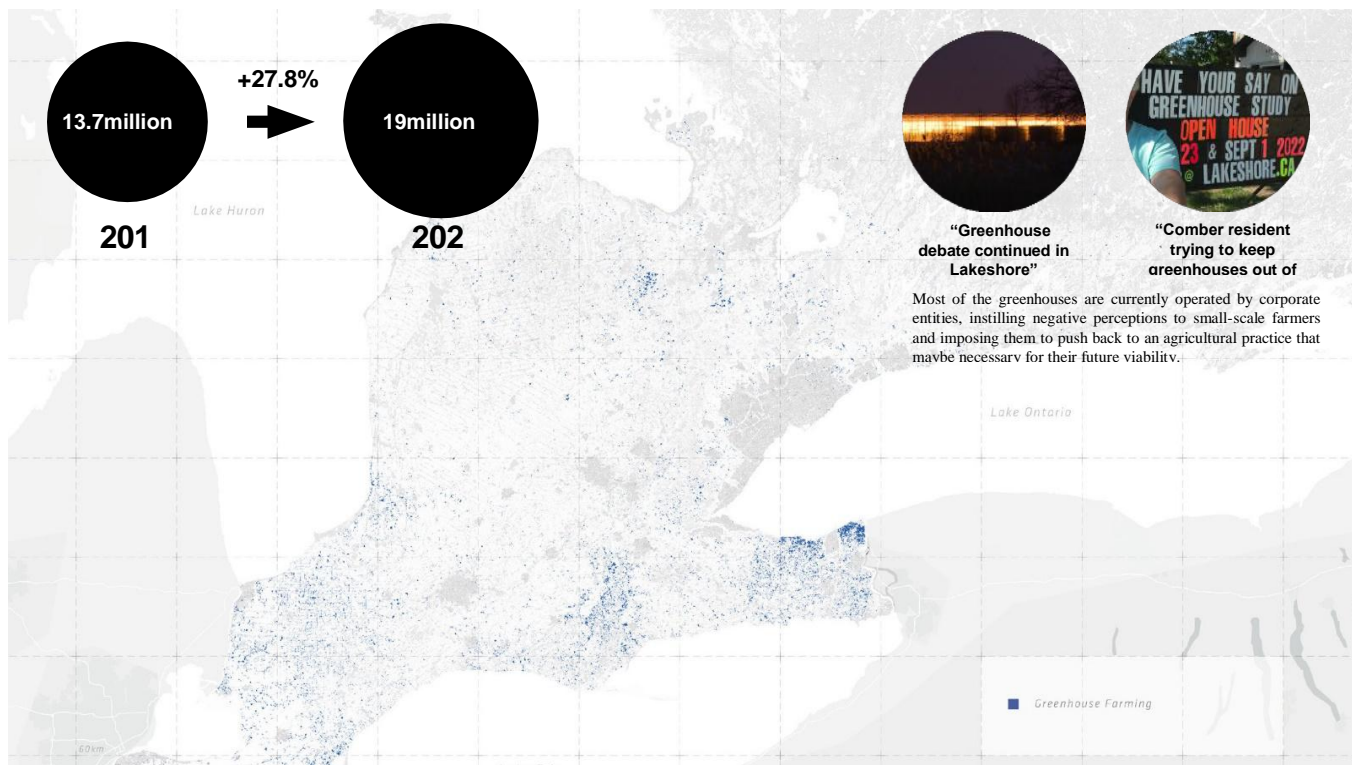


Figure 5. Climate-induced migration in Southern Ontario



Trend of Modern Feudalism



Greenhouse Booming

Figure 6. Trend towards corporatization in Southern Ontario

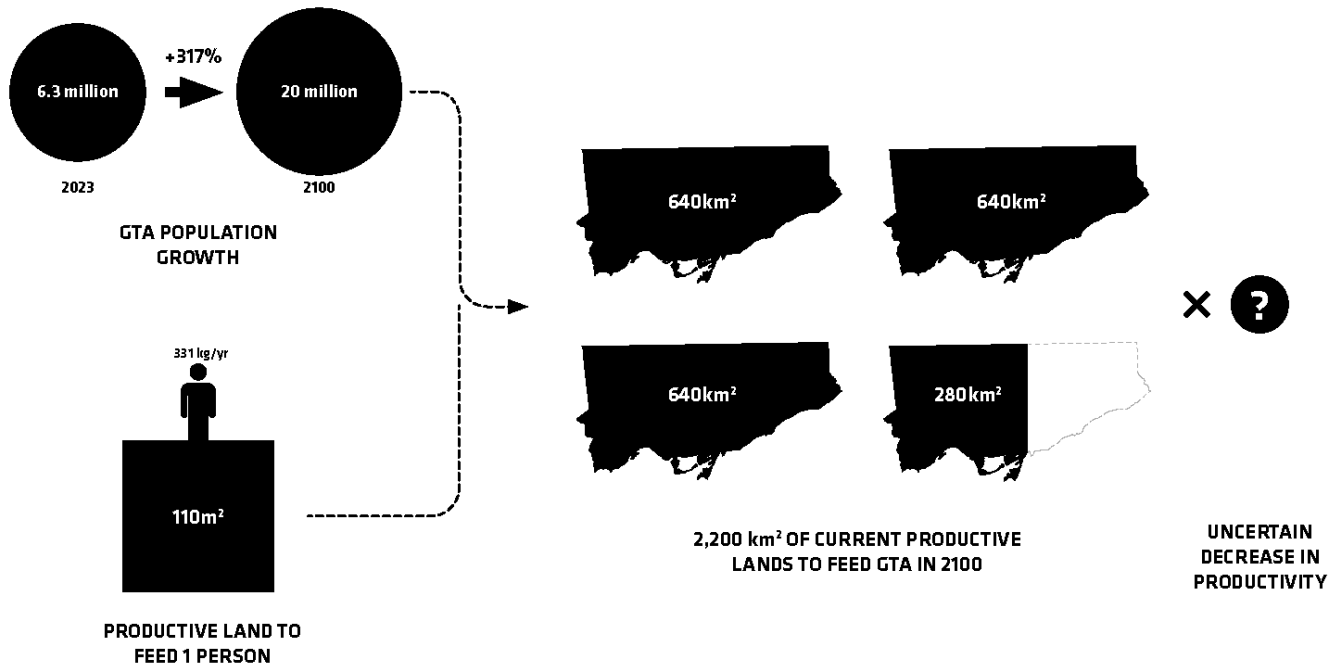


Figure 7. Future population growth (2100) and food security

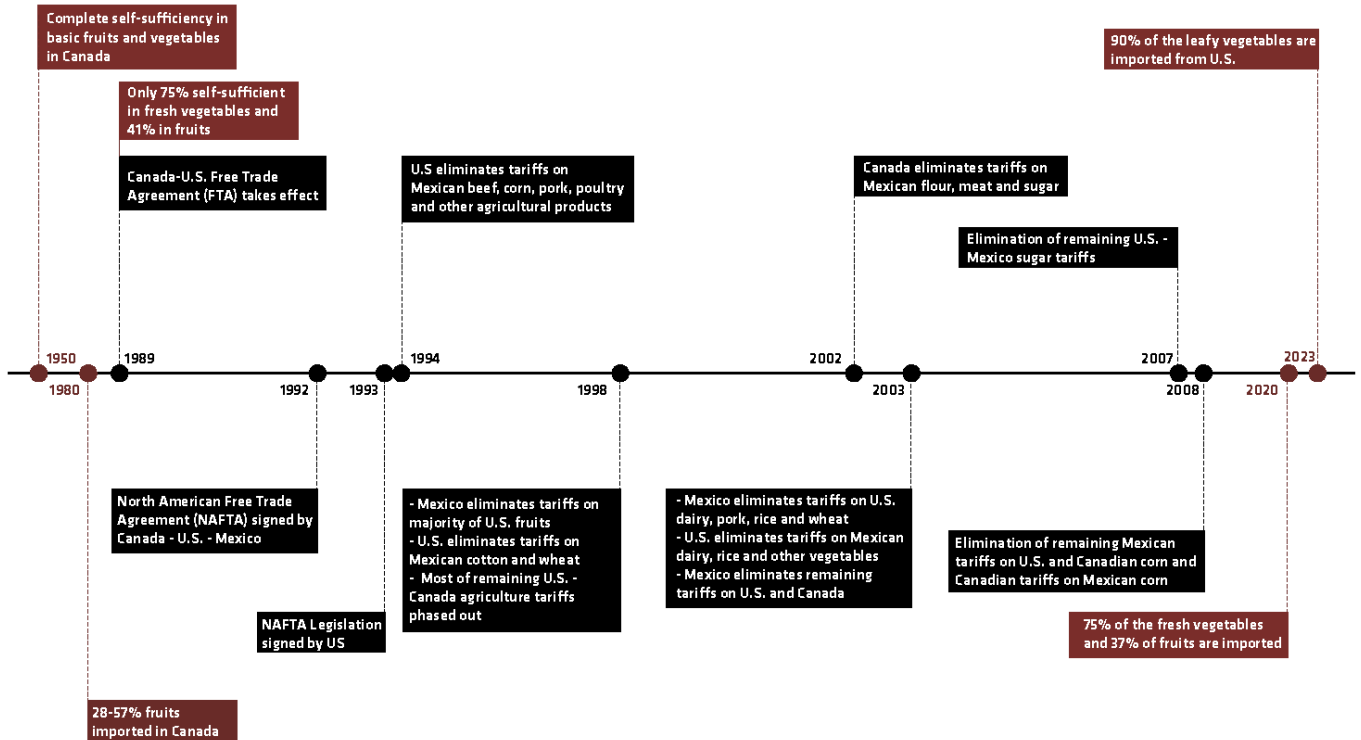


Figure 8. NAFTA timeline & changes in Canada's import / export

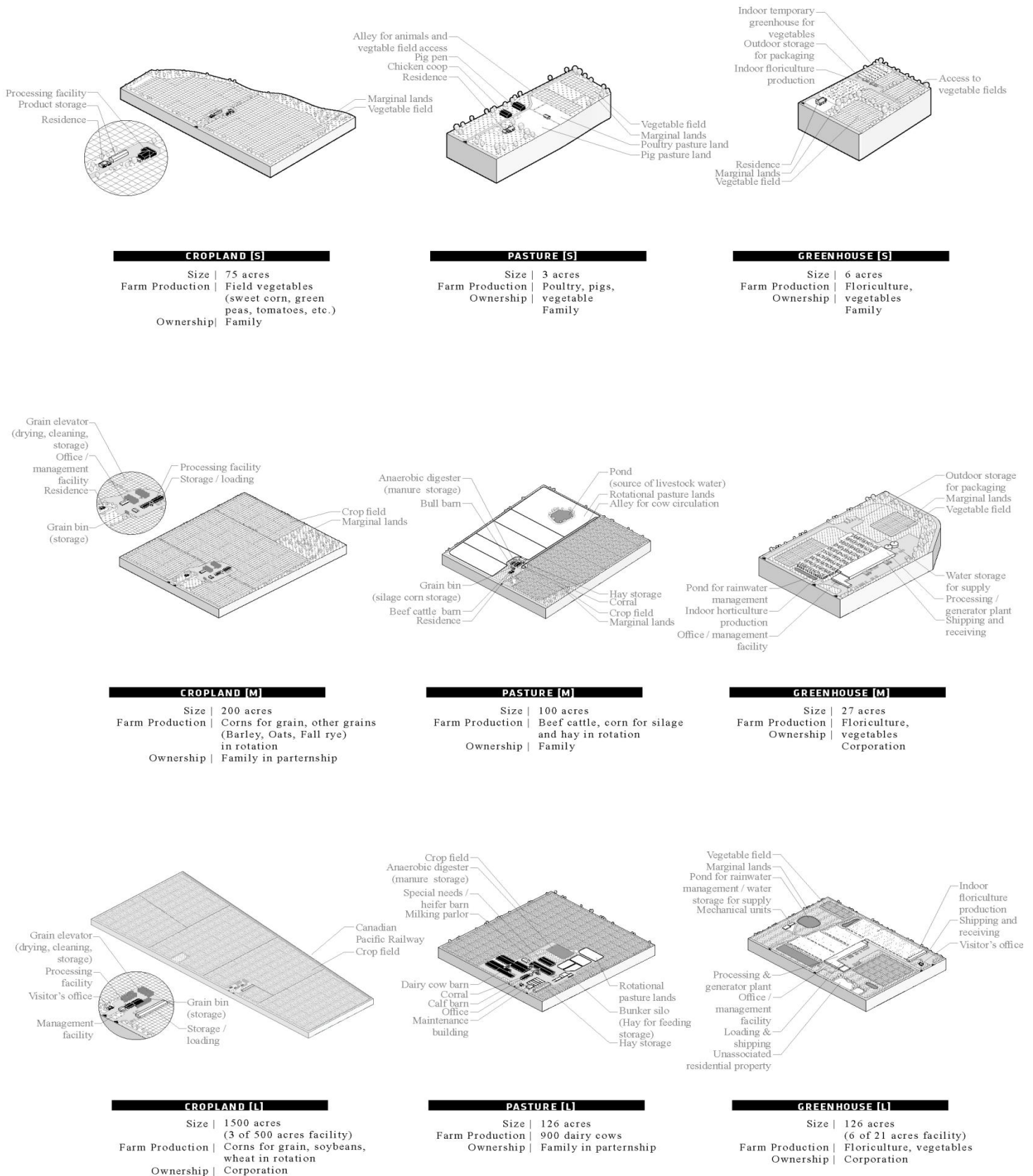
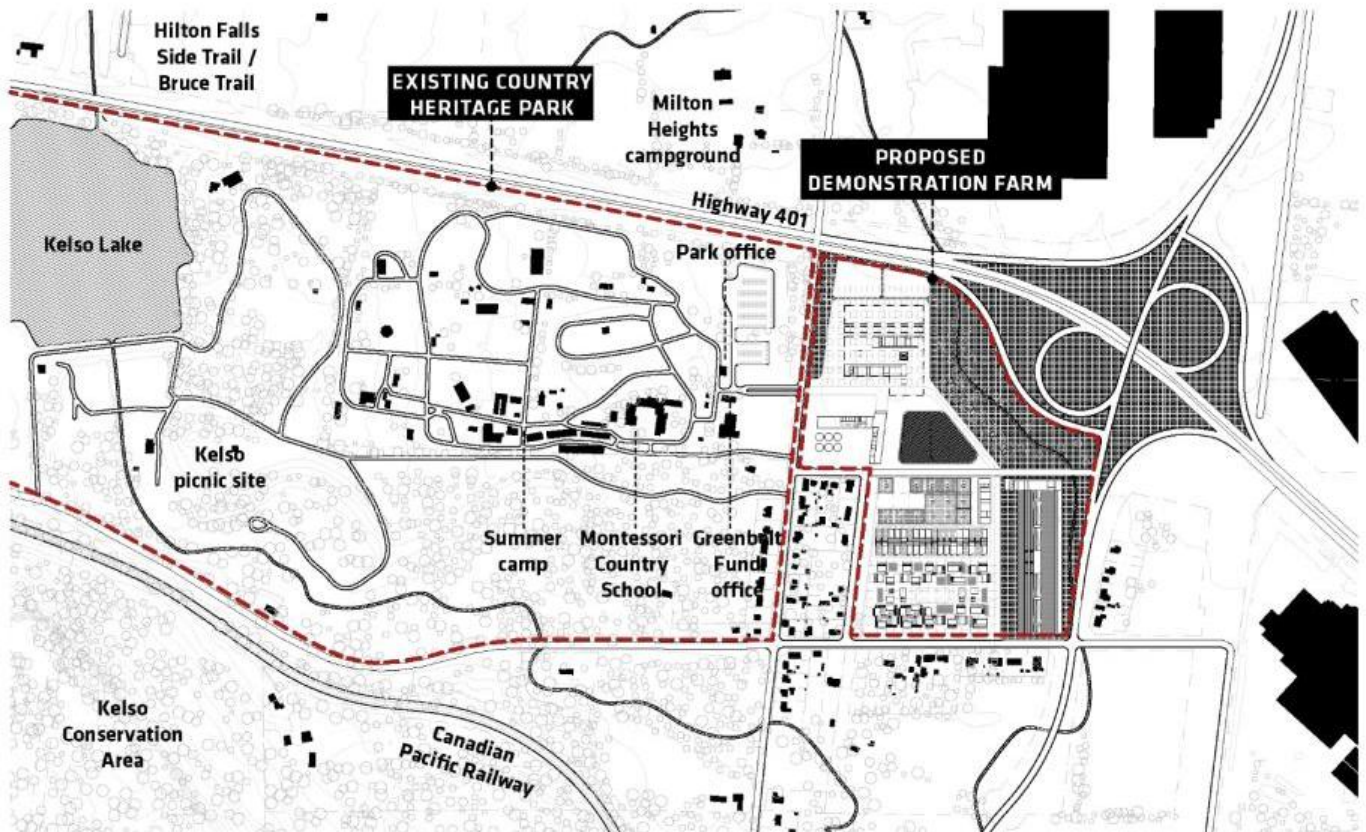


Figure 9. Typical farm models in Southern Ontario



Country Heritage Park
(Formerly Ontario Agricultural Museum in 1975)

Figure 10. Site plan – Country Heritage Park and the proposed demonstration Farm

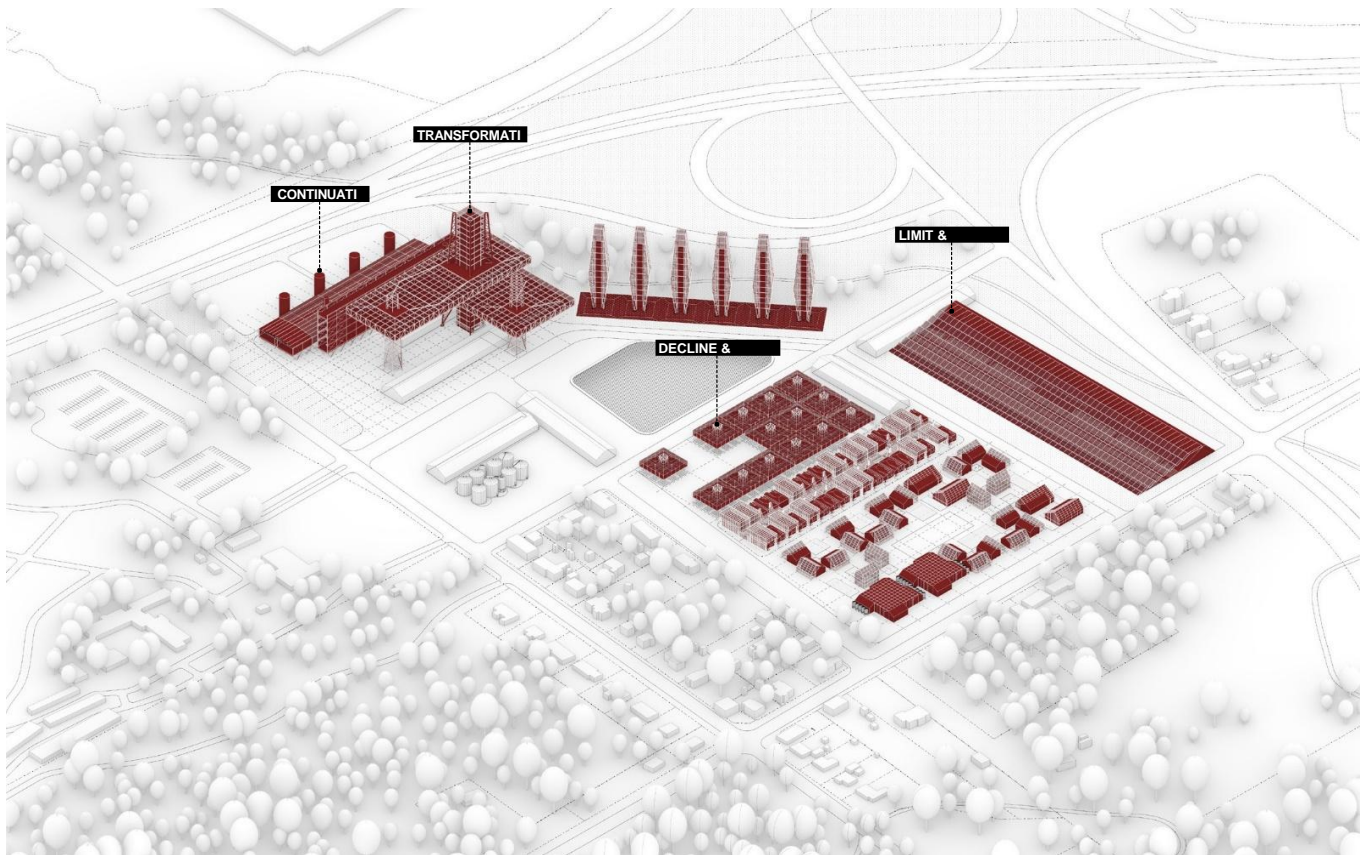


Figure 11. Hypothetical demonstration farm proposal



Figure 12. View from the Country Heritage Park entrance

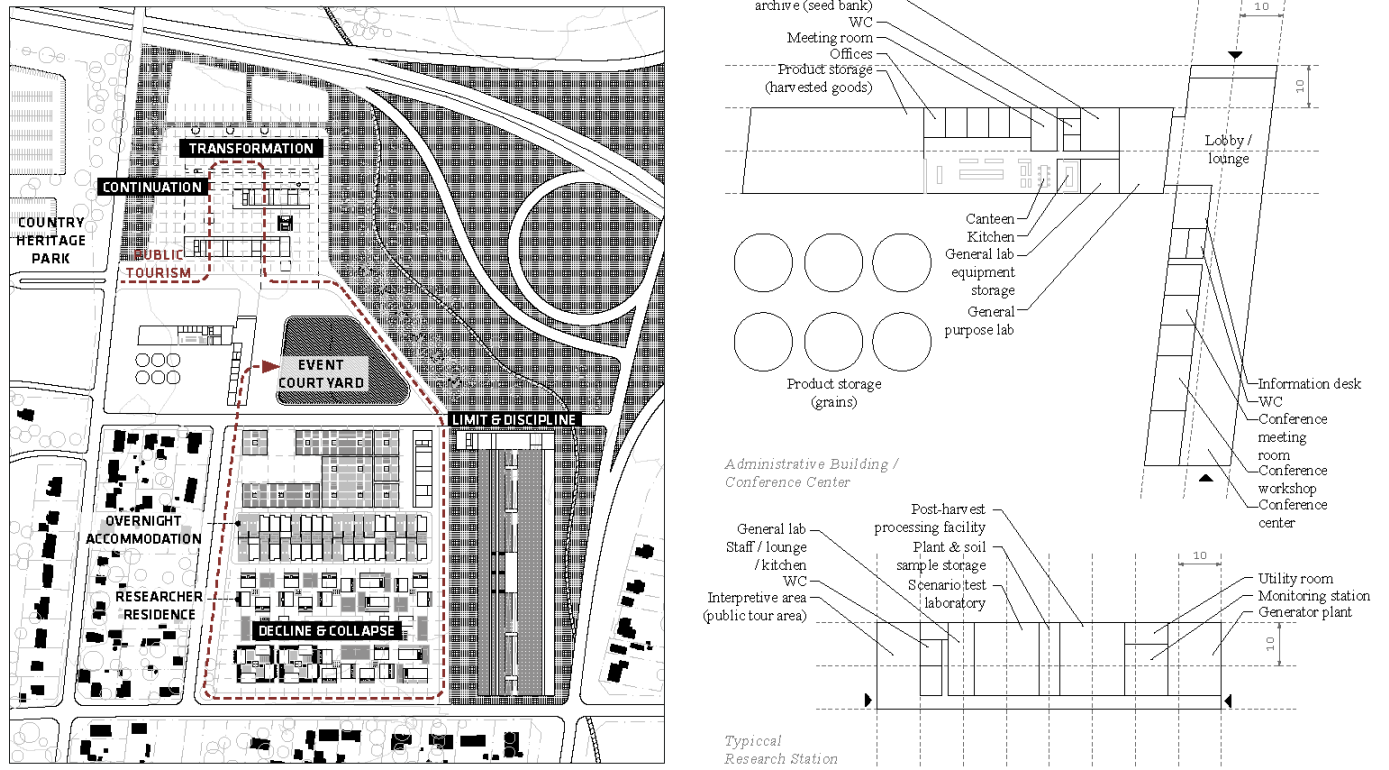


Figure 13. Floor plan – Administrative building & research station



Figure 14. Section through Transformation, Continuation, Decline & Collapse farm prototypes

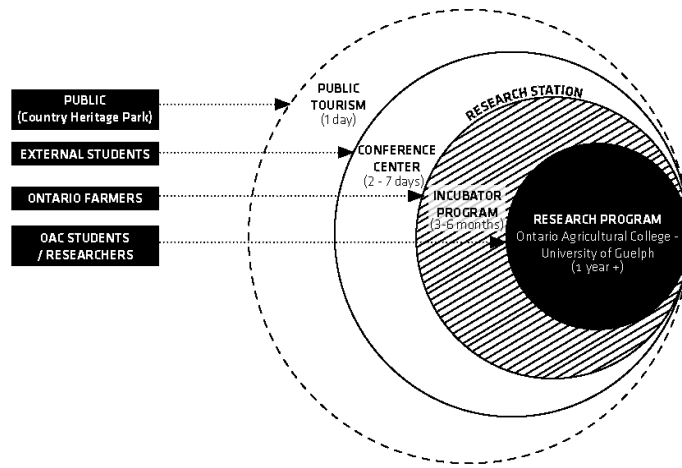
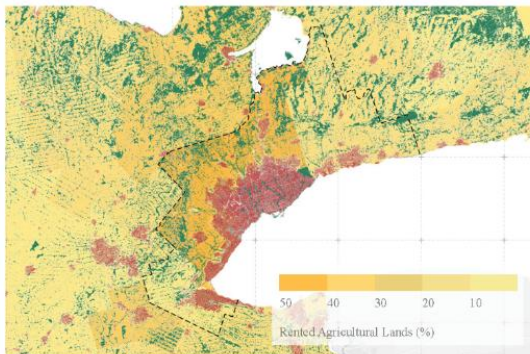


Figure 15. User group and varying range of engagements

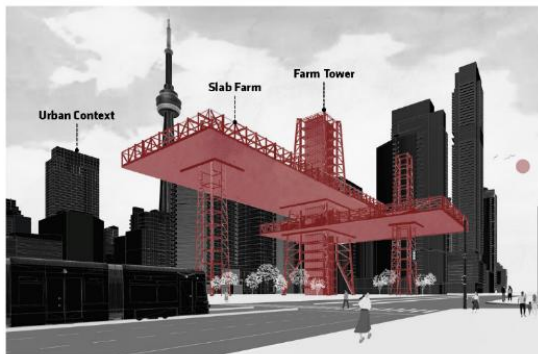


CONTINUATION

The line of present is followed as predicted by the government and the predominant economic powers of today. How do we maintain food security and small-scale farms in face of the growing industrial agriculture?



Projected reconfiguration of the GTA



View of farm prototype implemented



Farm prototype

A form of urban agriculture where a vast industrial agriculture exists in an urban context through the use vertical towers (residential or farms) as structure to hover over the settlements.

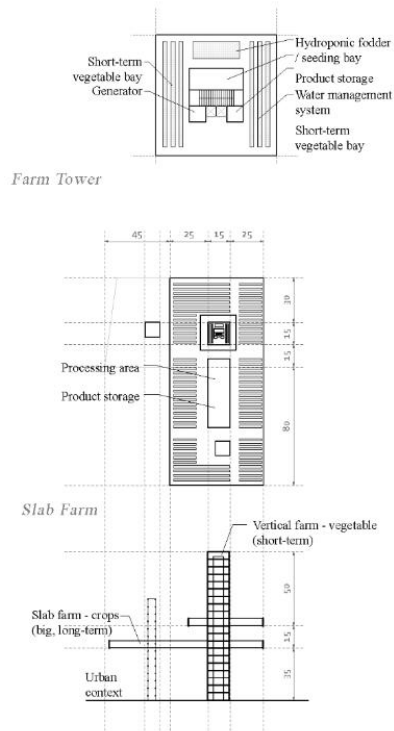
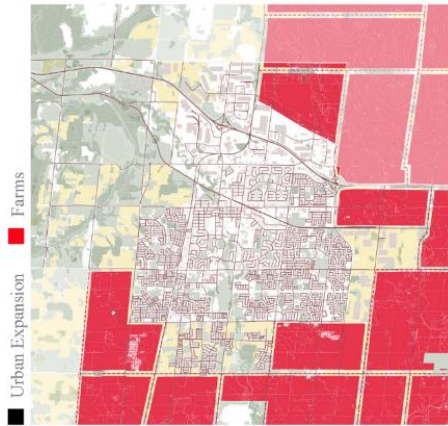
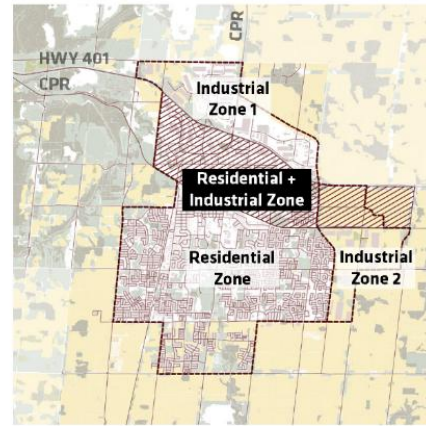


Figure 16. Scenario 1 – Continuation



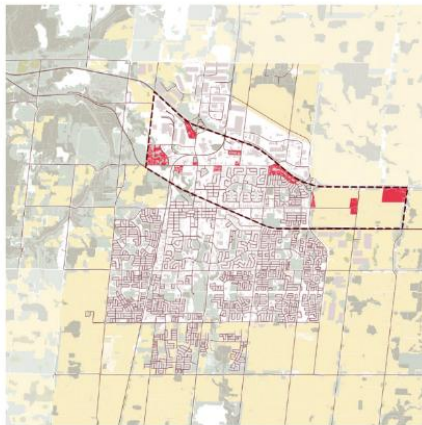
2040 | CONTINUED INDUSTRIAL AGRICULTURE

As the urban settlement continues to expand, the trajectory of amalgamation in small farms is followed, leading to the domination of industrial agricultural production that displaces small-scaled farms.



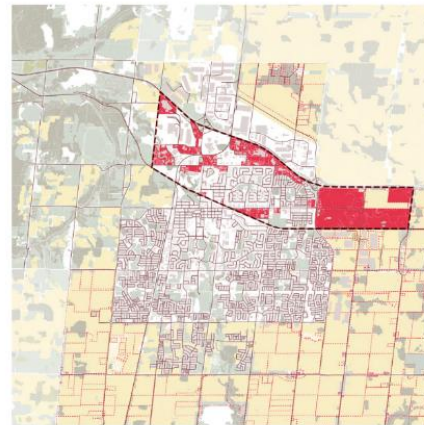
2060 | REZONED INDUSTRIAL & RESIDENTIAL AREAS

Meanwhile, the urban growth encroaches upon the vacant and under-utilized lots in industrial areas, resulting in rezoning of the area that accommodates both the residential and industrial facilities.



2080 | EMERGENCE OF URBAN AGRICULTURE II

As rural farmlands suffer from volatile weather patterns, corporations turn to urban industrial areas for compact and controlled farming environments. This new typology of urban agriculture emerges alongside residential towers, becoming the norm for industrialized agriculture.



2100 | RURAL LAND SUBDIVISION

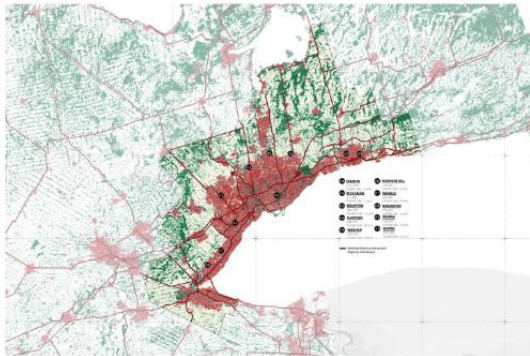
The landholdings from the corporates are released back to the small-scaled farmers and subdivided into their own indoor farming environments for viability.

Figure 17. Scenario 1 – Narrative

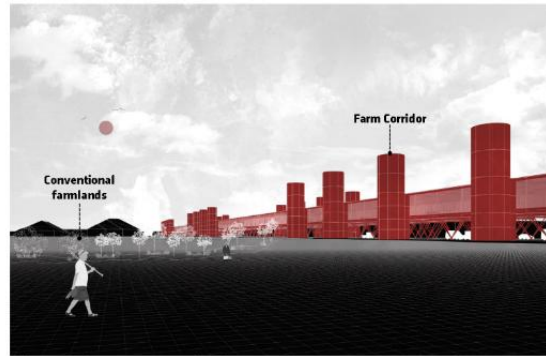


TRANSFORMATION

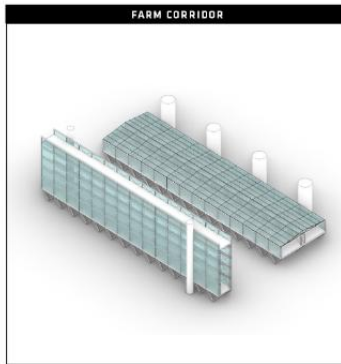
Innovations in the future prompt a radical transformation of our lifestyle such that provides resolutions to the uncertain future. How do we drastically change our agricultural lifestyle for an ecological future?



Projected reconfiguration of the GTA



View of farm prototype implemented



Farm prototype

A form of infrastructural agriculture where the farms on the highway will host species with short-term growing season for local fresh goods and the railway will include long-term species.

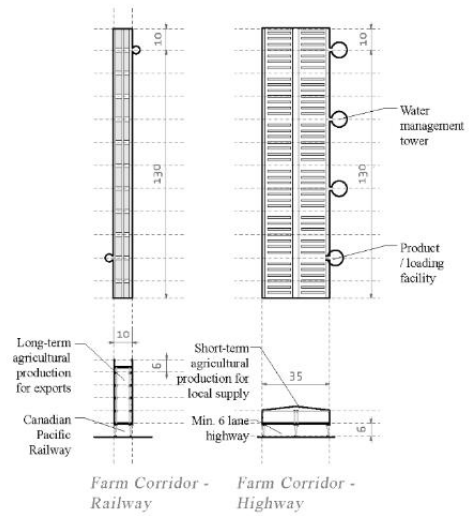
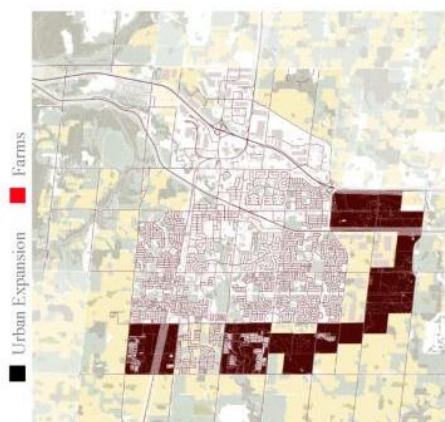
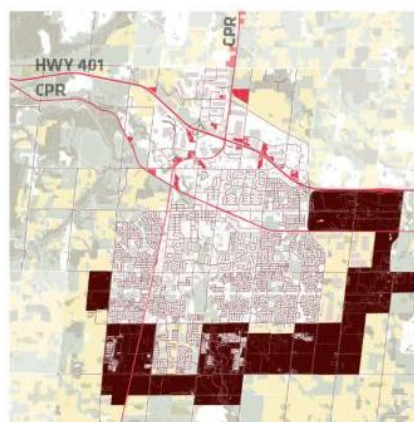


Figure 18. Scenario 2 – Transformation



2040 | URBAN GROWTH & DECREASE IN PRODUCTIVITY

As the urban settlements expand, the productivity of the agricultural lands is declining at an alarming rate due to the adverse effects of climate change.



2060 | EMERGENCE OF URBAN AGRICULTURE I

To ensure food security in ever-growing metropolis, urban agriculture in a controlled environment with consistent yield gains popularity, centered around infrastructure systems for efficient distribution to the city.



2080 | EMERGENCE OF URBAN AGRICULTURE II

As the urban agriculture becomes more prevalent, marginal lands near infrastructural systems become privatized and transformed into a new trend of “**Farm Corridors**,” which are narrow strips of controlled environments that create a new agricultural market for the displaced farmers.



2100 | REWILDING OF RURAL LANDS

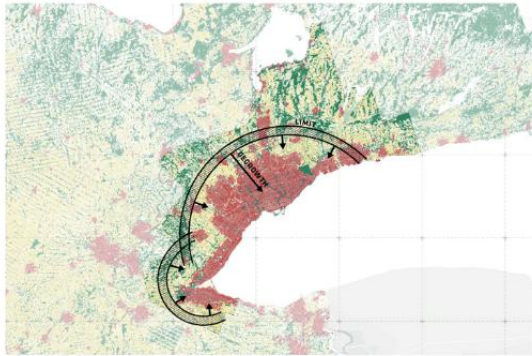
The remote unproductive rural lands, left vacant for long periods, are gradually rewilded into ecologically significant natural areas and recognized as environmentally protected zones by local conservation authorities to prevent future developments.

Figure 19. Scenario 2 – Narrative

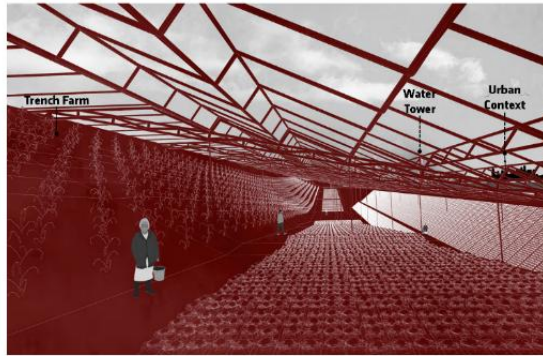


LIMIT & DISCIPLINE

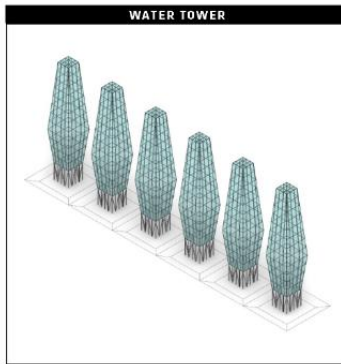
As the unbridled growth and consumption that currently exist ceases, the civilization foresees a trend of ‘zero growth’ with the aim of protecting ‘nature’. How do we reform our agricultural production such that ensures food supply but in ways that refrain further harm to ‘nature’?



Projected reconfiguration of the GTA

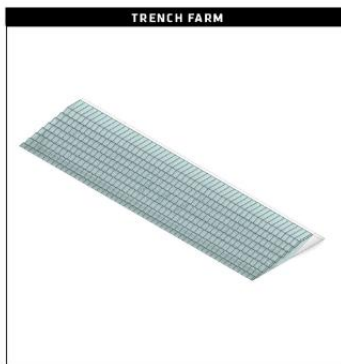
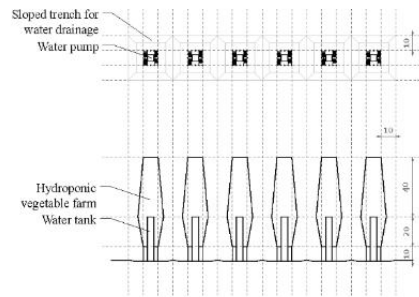


View of farm prototype implemented



Farm prototype

An infrastructural agriculture system of the vertical hydroponic farms that function as a storm water management system in the urban areas.



Farm prototype

An intensive farming system that optimizes conventional farms through angling the land to gain greater productive land area and create microclimate zones, tailored for the different needs of the agricultural species.

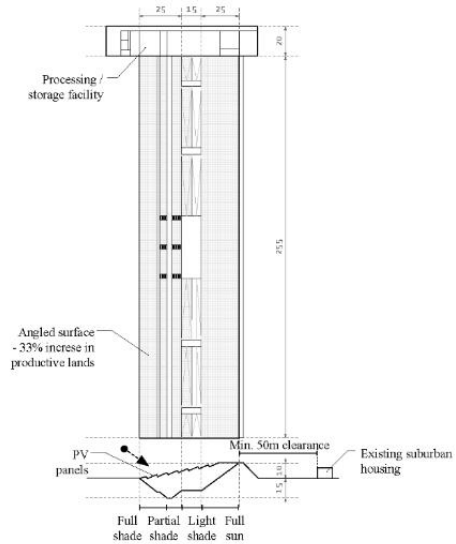
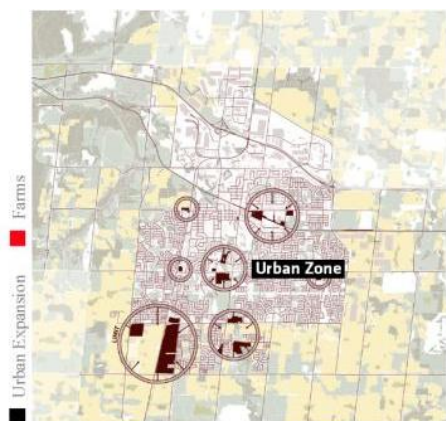
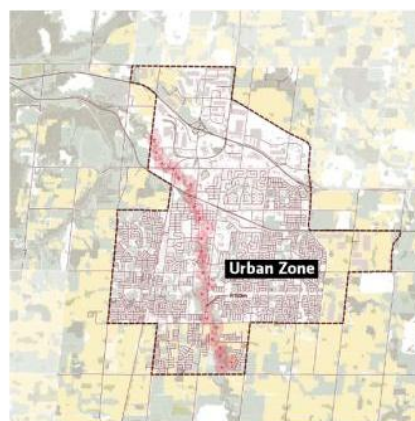


Figure 20. Scenario 3 – Limit & Discipline



2040 | LIMITING OF URBAN DEVELOPMENTS

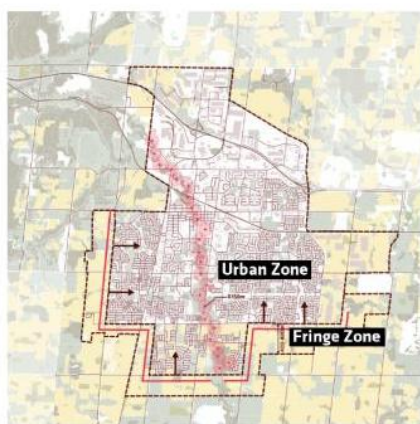
The government becomes increasingly alarmed by the frequent climate catastrophes that threaten agricultural production, prompting to firmly cease urban developments and take measures to limit the environmental damage caused by them.



2060 | CONTAINED FARMING SYSTEM I

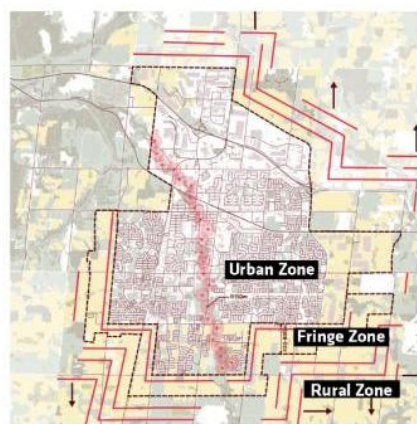
To address severe food insecurity, a new infrastructure system of contained farming is introduced by the government.

Water towers – These farming systems are strategically placed within the city limits along the flood plain of Sixteen Mile Creek to ensure continuous productivity while also providing protection from the adverse impacts of climate catastrophes.



2080 | CONTAINED FARMING SYSTEM II

Trench farms – Energy self-sufficient farm system is established at the periphery zone for agricultural lands to prioritize the local sustenance.



2100 | CONTAINED FARMING SYSTEM III

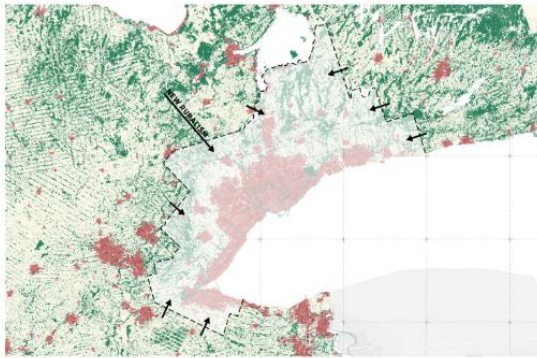
Trench farms – Trench farms are expanded beyond the periphery zone to produce surplus food for exports.

Figure 21. Scenario 3 - Narrative

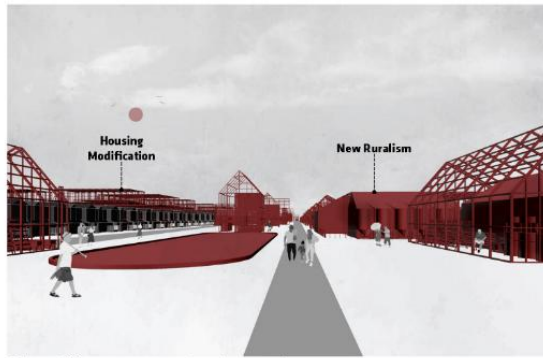


DECLINE & COLLAPSE

The gradual decline of our civilization leads to a complete collapse of the world. How do we restart when the urbanization collapses from ecological failures?



Projected reconfiguration of the GTA

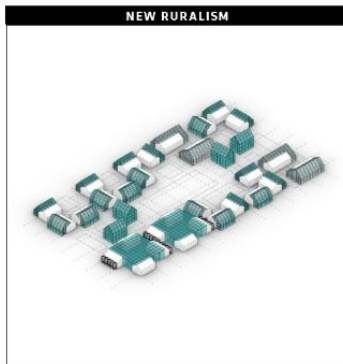
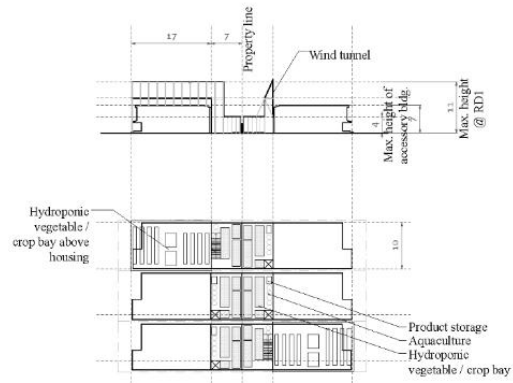


View of farm prototype implemented



Farm prototype

A form of suburban housing modification to include farming for their own sustenance.



Farm prototype

A form of new rural living where the different homesteads contain their own farm production for self-sustenance.

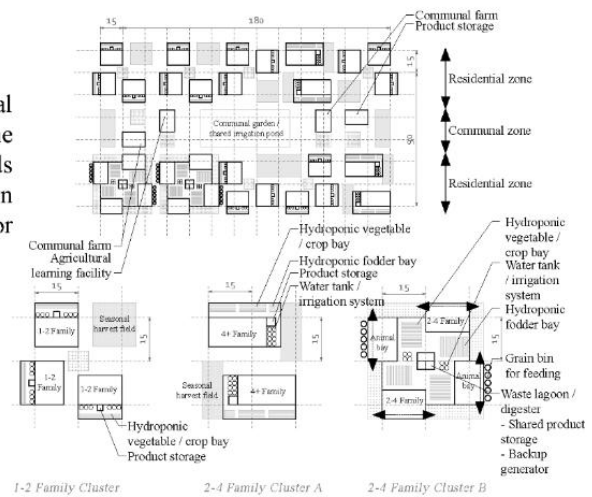
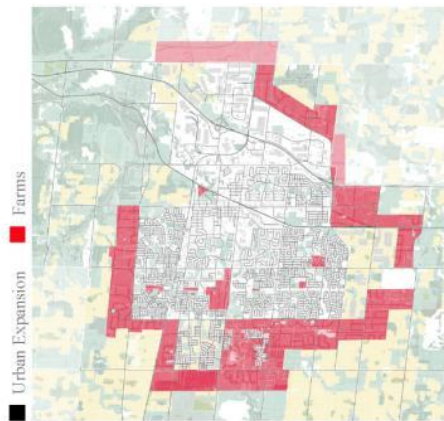
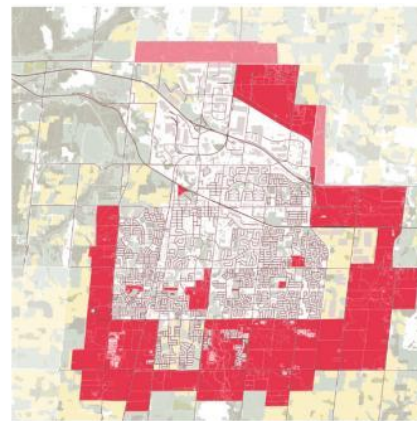


Figure 22. Scenario 4 – Decline & Collapse



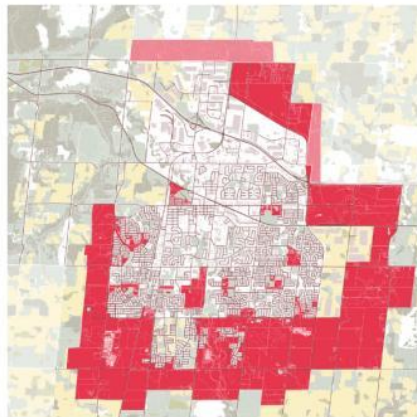
2040 | LIMITING OF URBAN DEVELOPMENTS

The catastrophic failure of once-productive lands and the ensuing collapse of the agricultural industry have led the government to repurpose urban parks for farming. The social unrest triggered a new trend in rural communities adopting microclimatic agricultural production at the periphery of urban settlements for self-sustenance.



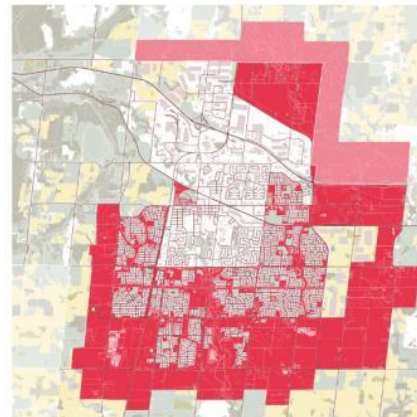
2060 | CONTAINED FARMING SYSTEM I

As unpredictable weather patterns make crop cultivation untenable, vast croplands in remote rural areas are subdivided to make way for the expansion of the new ruralism movement.



2080 | CONTAINED FARMING SYSTEM II

In response to the persistent scarcity of food and resources, the **new ruralism** expands inwards, occupying vacant lots and public parks within the urban settlement for agricultural production and self-sufficiency.



2100 | CONTAINED FARMING SYSTEM III

The complete failure of food supply to urban areas prompts the abandonment of existing suburban settlements, which the government requisitions for demolition and reallocation to promote a normative rural lifestyle.

Figure 23. Scenario 4 – Narrative

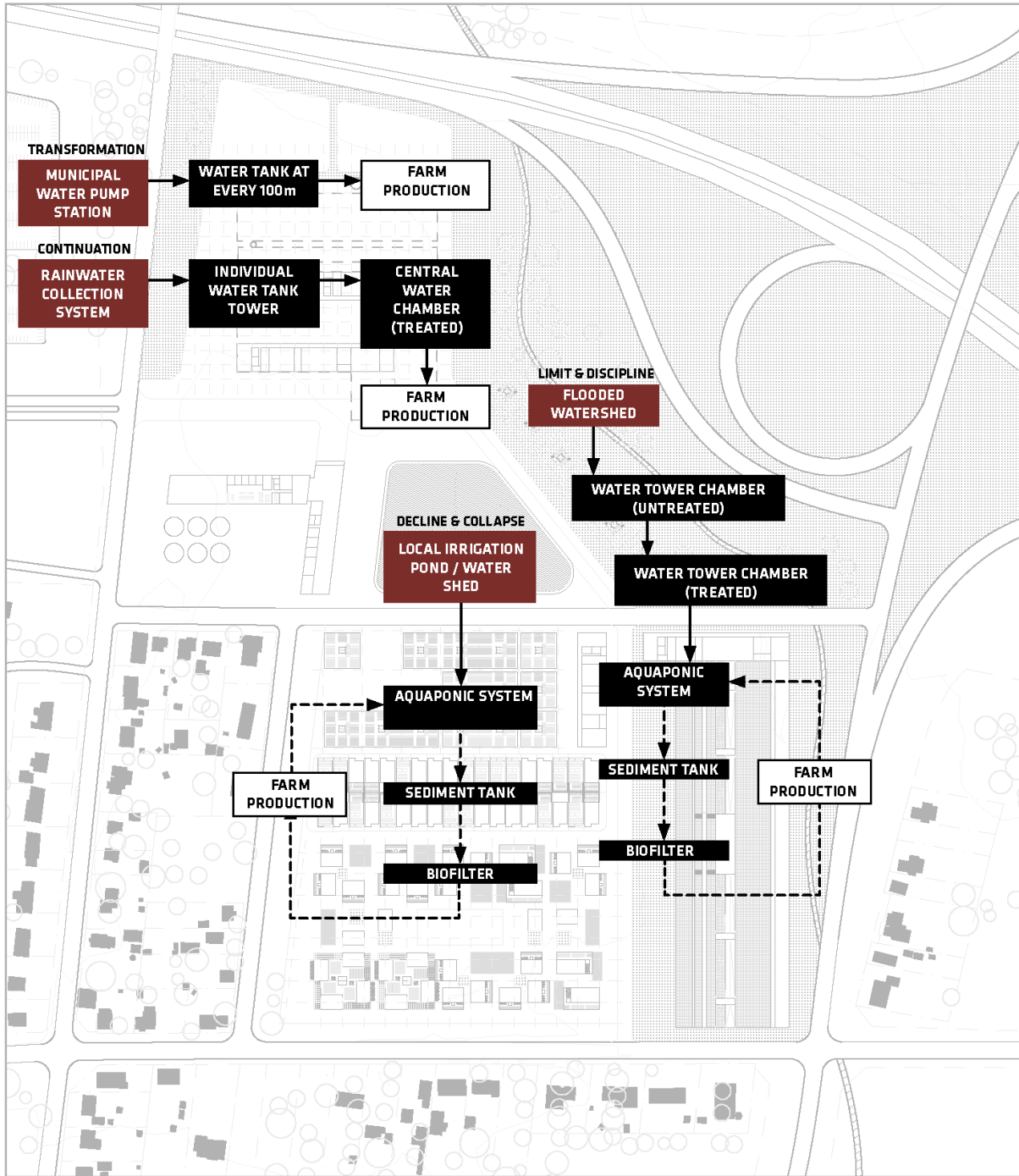


Figure 24. Water operations

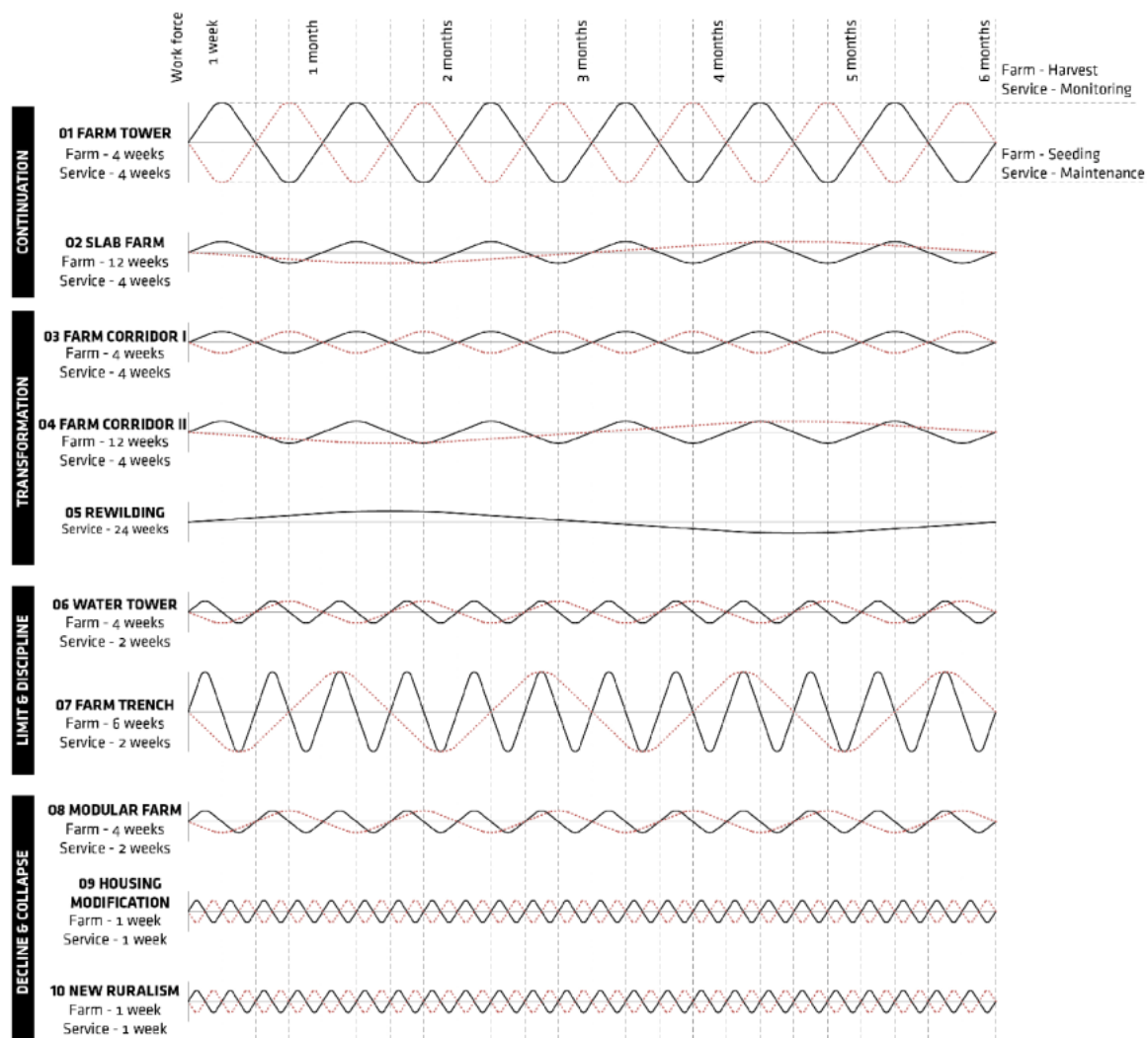


Figure 25. Harvest & maintenance cycles

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