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Agri-town: Combining Urban Agriculture and Affordable Housing for Food, Farm and Fortune

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Agri-town
Combining Urban Agriculture and Affordable Housing
for Food, Farm and Fortune

By

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Bachelor of Architectural Science, Ryerson University, 2008

A Design Thesis Project
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Abstract

Agri-town: Combining Urban Agriculture and Affordable Housing for Food, Farm and Fortune

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Master of Architecture, 2011

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As global population and migration to cities continue to increase, urban poverty and shortages of affordable housing have become significant issues in Toronto, making it necessary to develop a model to mitigate these issues. This book focuses on incorporating urban agriculture with affordable housing, and proposes a building typology that combines the two. The idea is to provide accommodation along with space for low-income households to grow their own food. It is expected that by making these elemental needs accessible and affordable, the problem of food security will be offset, improvements will be made to the food system, and housing shortages will be alleviated within the city of Toronto.

I dedicate this thesis to all my friends, family, and supervisor.

This work would not have been possible without your infinetly support.

Thank you.

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1.0 Introduction

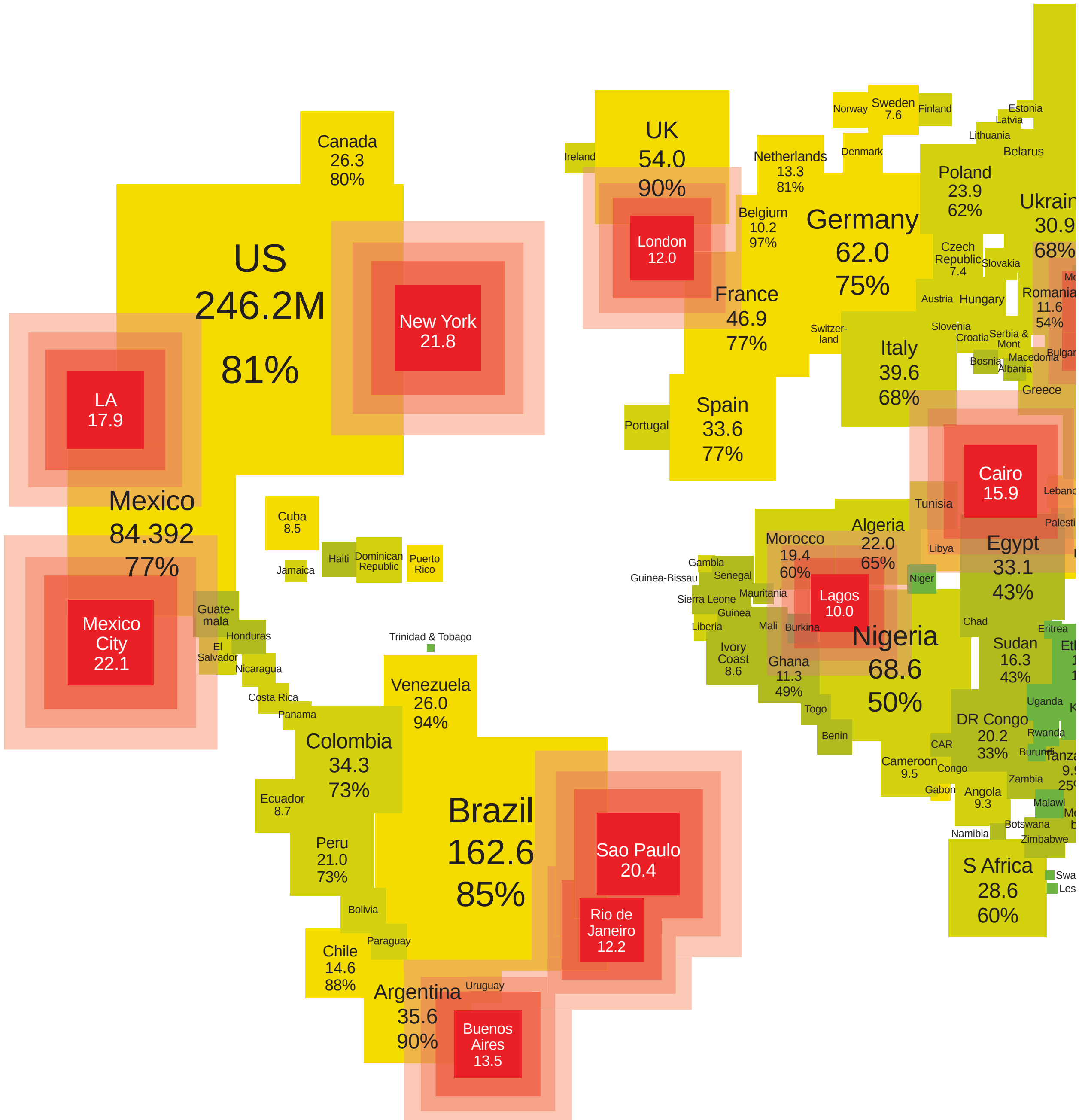
Food and shelter are two basic necessities for every person. These essentials are in acute shortage both regionally and globally, due to the exponential growth of population and migration towards cities. In the City of Toronto, nearly 1 million people are food bank users as of 2010 (DBFB, 2010). Government-assisted housing has been in short supply for fourteen consecutive years since 1997 (City of Toronto, 2004). The city has struggled to resolve these two critical issues throughout the past decade. This study focuses on incorporating urban agriculture with affordable housing as a building typology in order to create architectural models that not only provide shelter, but allot space for low-income households to grow their own food. It is expected that by making these elemental needs available, accessible, and affordable, the problem of food security will be met, the food system will improve, and the housing shortage within the City of Toronto will be eased.

Urban agriculture has facilitated self-sustenance for both developing and developed cities, as demonstrated by case studies of cities such as Havana and Sydney. The capital of Cuba managed to produce 3 million tons of vegetables in 2003 (which was 1.3 million tons more than their previous year’s produce) and created 35,000 new jobs in that same year (Steel, 2009). Sydney regional agriculture produced and supplied 8 percent of mushrooms, 70 percent of tomatoes, and 95 percent of spring onions within the Sydney region for consumption within the city (TFPC 1999, 8). The city of Toronto has a policy of promoting urban agriculture within the metropolitan area, yet this has not proved to have any significant impact on food productivity, distribution and security. On the contrary, what has been on an increase in recent years is the reliance on food banks and imported foods and the emission of greenhouse gases. Along with fourteen years of shortage in government-assisted housing supply (City of Toronto, 2001), this data illustrates that the City of Toronto is not self-sustaining in terms of meeting the two basic needs of food and shelter for low-income Torontonians.

1.1 Background

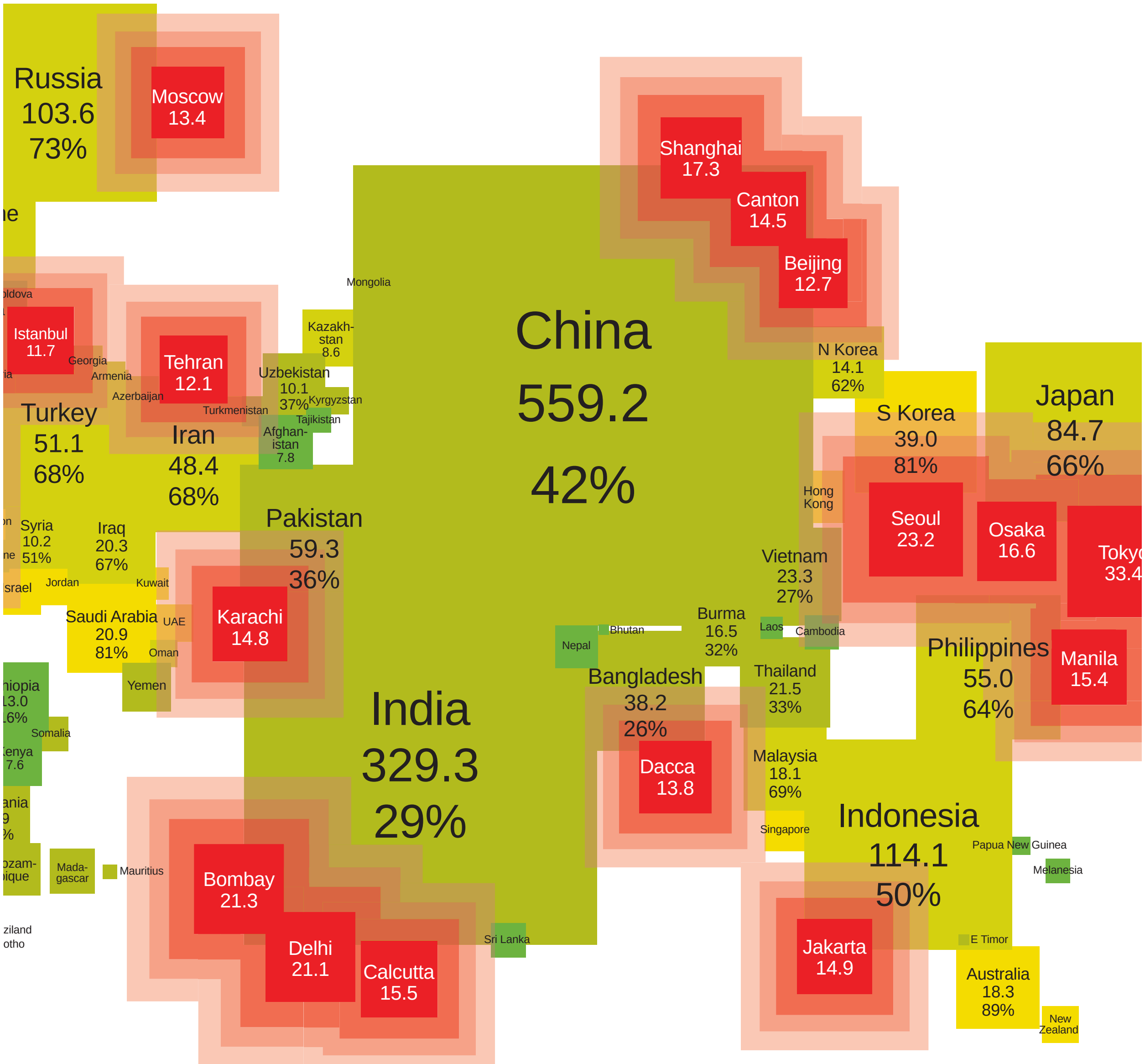
As of 2008, the Greater Toronto Area (GTA) has been home to over 6 million people. The province of Ontario alone is projected to receive 125,000 foreign immigrants each year, which makes up more than half of Canada's total annual immigration (Statistic Canada 2006). The census trend shows that over 50 percent of new Ontario immigrants decide to live in Toronto (Statistic Canada 2006). According to the Ontario Ministry of Public Infrastructure Renewal Schedule (Lister 2007), the GTA's projected population by 2031 will reach close to 8.6 million. This makes the GTA one of the fastest growing metropolitan cities in North America. Furthermore, from 2001 to 2006, 46 percent of new immigrants were considered as low income (Finance & Administration 2006).

Shelter, food, and transportation are the main expenses for a Canadian family (see Figure 1.1). The lowest-income Canadian household with an average income of $17,064 spends an average of over 32 percent of their total income on shelter, over 18 percent of their income on food, and about 13 percent on transportation. The percentage of income saved by the wealthy class is a positive 13.1 percent and 3.1 percent for the average income class in Canada; for the low-income group, it is a negative 30.9 percent. For the latter group, after expenses are deducted from earnings, there is little or no money left to be saved, which makes this group vulnerable to crisis and at higher risk of poverty. Over the years, urban poverty in Toronto has increased to such an extent that about 1 in 5 people live in poverty. About 552,300 households have incomes under the poverty line (Toronto Real Estate Board 2003) and many of these are new immigrants. In 2004, 95,750 Toronto households spent more than 50 percent of their income on rent (City of Toronto 2004). Consequently, a new affordable housing typology must be developed which not only provides accommodation, but also generates opportunities for employment and self-sufficiency in food production. It would help the city overcome its housing shortage, scale up urban agriculture, offset food expenses for the low-income population, and provide opportunities for these groups to improve their quality of life.



Legend

Predominantly urban
75% or over



TOTAL WORLD'S URBAN POPULATION IN 2030

6,615,900,000

(SOURCE: UNFPA _United Nation Population Fund)

Predominantly urban 50—74%	Predominantly rural 25—49% urban	Predominantly rural 0—24% urban	Cities over 10 million pec (greater urban area)

Figure 1.0.1 - World Population Growth & City Migration

1.2 Food Related Issues in Toronto

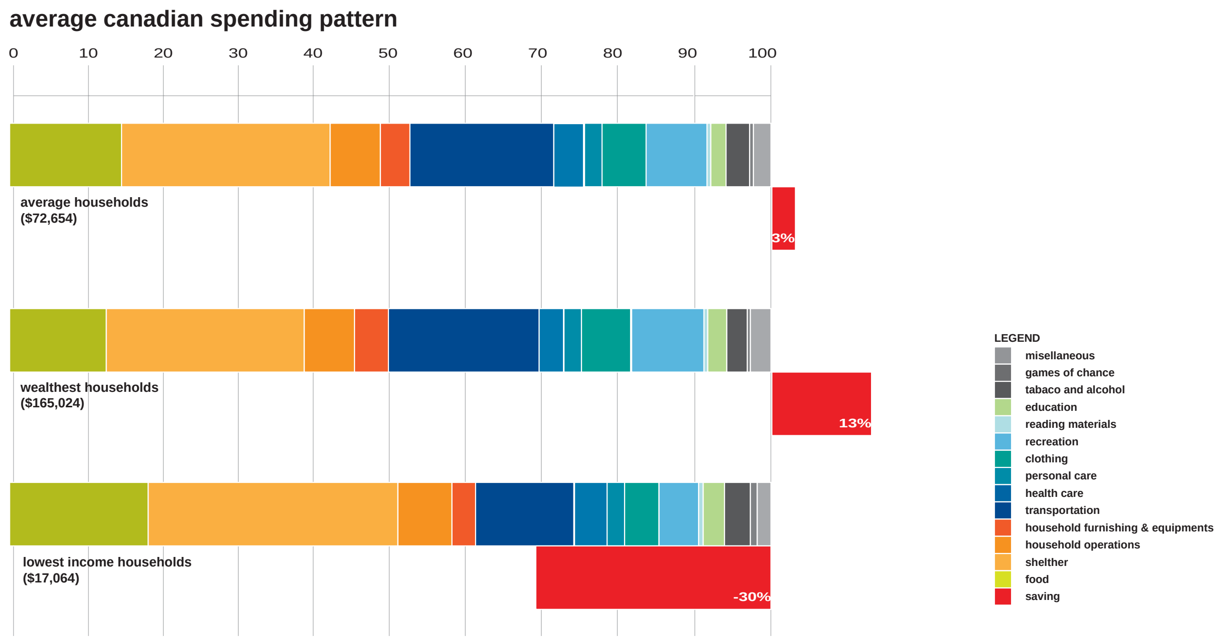


Figure 1.1.1 - Canadian Spending Pattern

The following is a brief definition of some terms that will be used in this paper. A food system is defined as a complex set of activities and relationships related to every aspect of the food cycle, including production, processing, distribution, retail, preparation, consumption and disposal (TPH 2010). A food shed is defined as the place that collects the food products grown in local farms surrounding a given urban area, and routes them into the city to be made available to the population that will consume them (Lister 2007).

The current food system in Toronto is ridden with many issues which make it unsustainable, especially in relation to food import and accessibility problems. Production occurs in the GTA, mainly around the peripheral cities within a 200-kilometer radius. However, there is no significant scale of crop production within the City of Toronto. This illustrates the city's reliance on imported food, and it follows that food availability, accessibility and adequacy are not under control. Adequate food and health are directly related (see Fig 1.2.1).

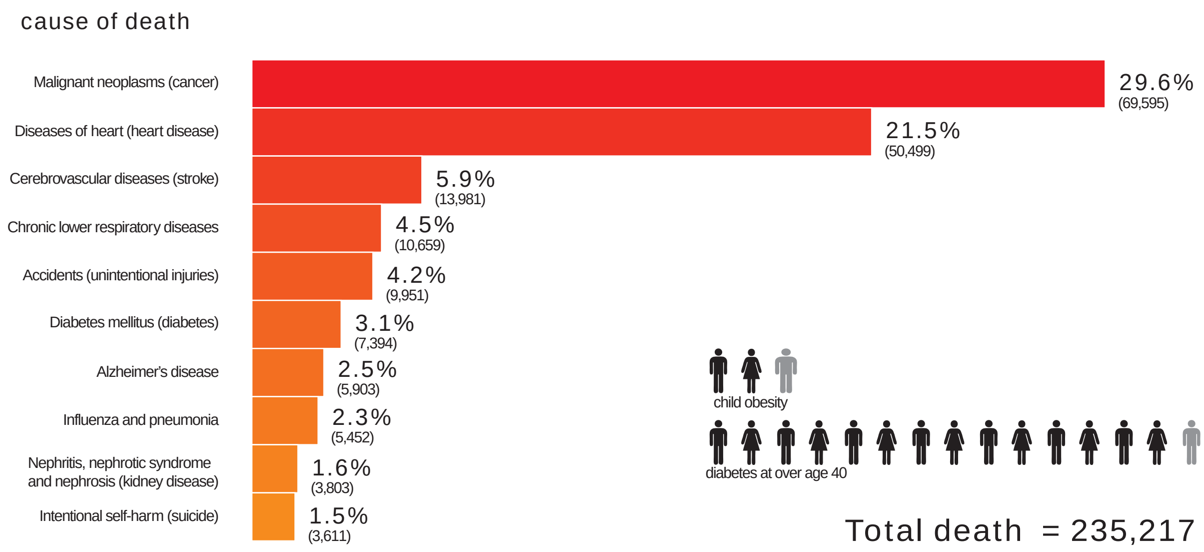


Figure 1.2.1 - Cause of Death 2004, Statistic Canada

Toronto's residents and government spend $7 billion on food annually (FHAC 2001). Though the city is located on the best agricultural land in Canada, $4.8 billion worth of food is actually imported (OMAFRA 2007), and 50 to 60 percent of produce imports come from Florida, California, and Mexico (McCartney 1998). Ontario had a $3 billion deficit in fruits and vegetables in 1998 (TFPC 1999, p. 8) since many crops could not be delivered and were wasted before they reached the marketplace. Canada's average food module travels about 2000 kilometers (TFPC 1999, p. 29). In Toronto the average food item travels nearly 4,500 km (Xuereb, 2005), which is double the Canadian average. Also, the city's food system contributes 30 percent of the pollution and greenhouse gas emissions of the city (Tukker, Huppes, Geerken, Nielsen, et al., 2006). Furthermore, the agriculture industry in Canada takes up almost two-thirds of the overall fresh water consumption (see Figure 1.2.2 & 1.2.4).

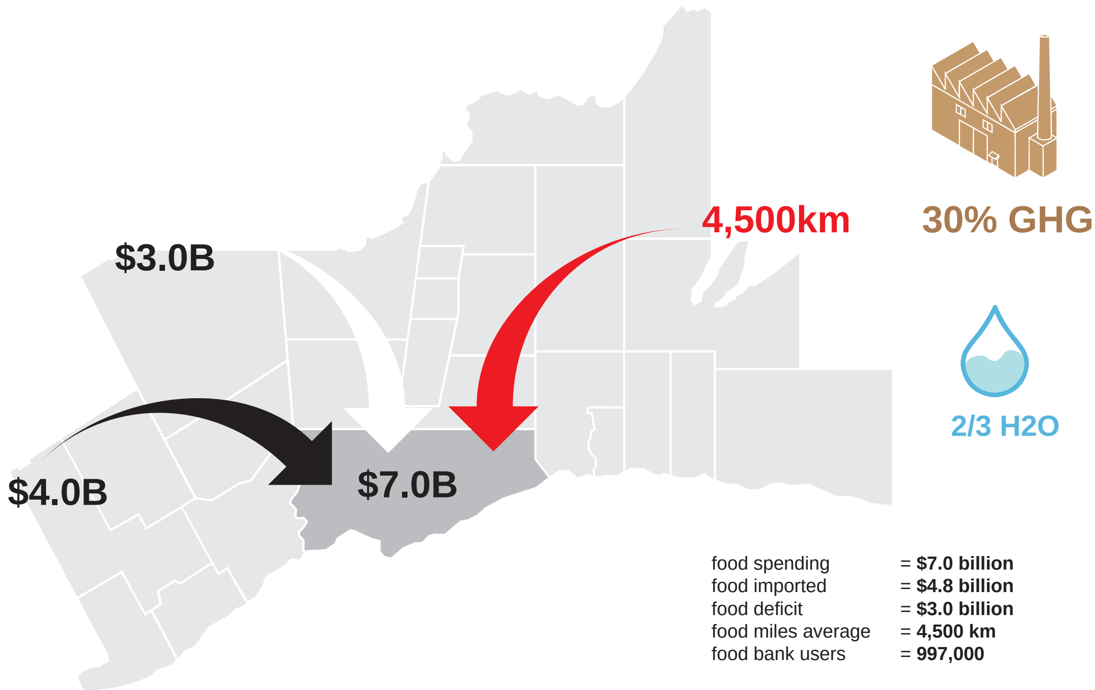


Figure 1.2.2 - Toronto Food System

Overall food bank access has steadily increased each year in Toronto (see Figure 1.2.3). In 2010, the count went up to 997,000 users (DBFB 2010, p. 12). Community food programs serve almost 20,000 meals per day in order to cater to those in need (DBFB 2007). Among food bank users, 54 percent of individuals do not eat for a whole day in a week due to the lack of money. The duration of their reliance on food banks is an average of 18 months (DBFB 2010, p. 5). Amongst regular food bank users, 34 percent are children and youth under the age of eighteen (DBFB 2010, p. 4). However, more than 1 in 3 Toronto children are overweight or obese (TPH 2004) and many are from poor families and suffer from drastic imbalances in nutrition. In Toronto, 1 in 14 residents over the age of 40 is affected by a heart-related disease, and 1 in 15 has diabetes (TPH 2005). This indicates that poverty and poor health are interconnected. Inadequate nutrition is related to a predisposition to obesity among the poor (Laurie, 2008). Thus poverty leads to both malnourishment and obesity and access to healthy food is an essential part of any solution.

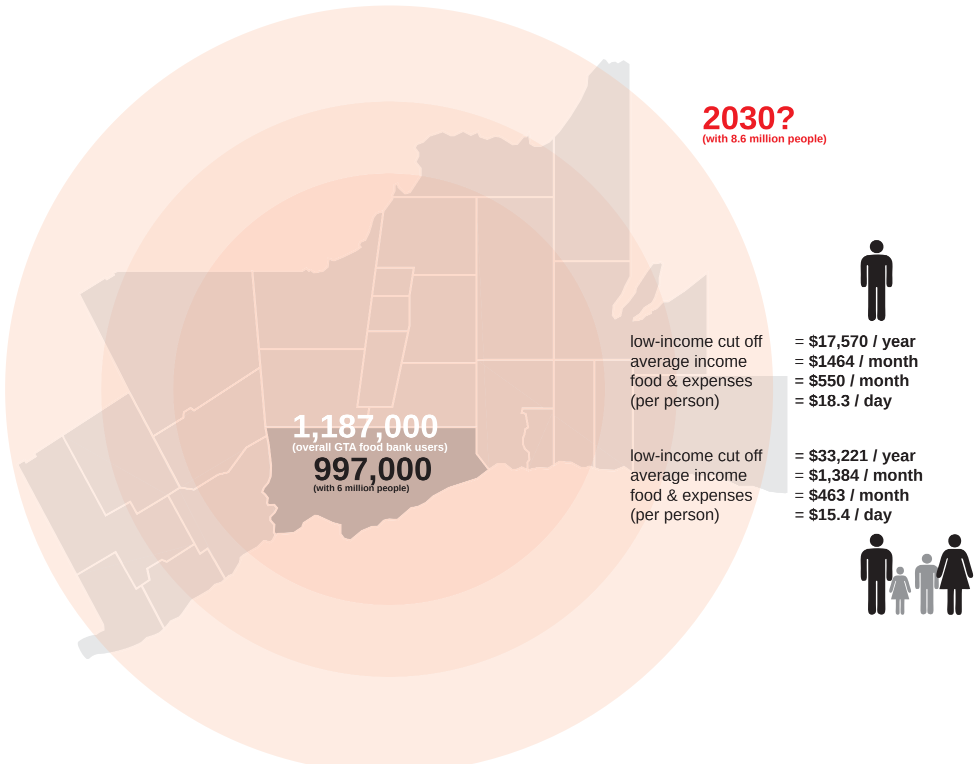


Figure 1.2.3 - Food bank users and expenditure for low-income family in Toronto

The difficulty with providing food access is further demonstrated in the food desert map of Toronto. Food deserts are defined as large areas in the city where it is difficult or impossible to find a grocery store or supermarket within walking distance, thus making fast-food outlets and higher-priced convenience stores the most frequented places for food purchases (Lister 2007). This means there is unsatisfactory food distribution in some neighborhoods in Toronto. On the other hand, many downtown areas have food available within walking distance, though it may not necessarily be affordable for the local residents. Hence, low-income groups, especially near the city center, still suffer as a consequence of high food prices.

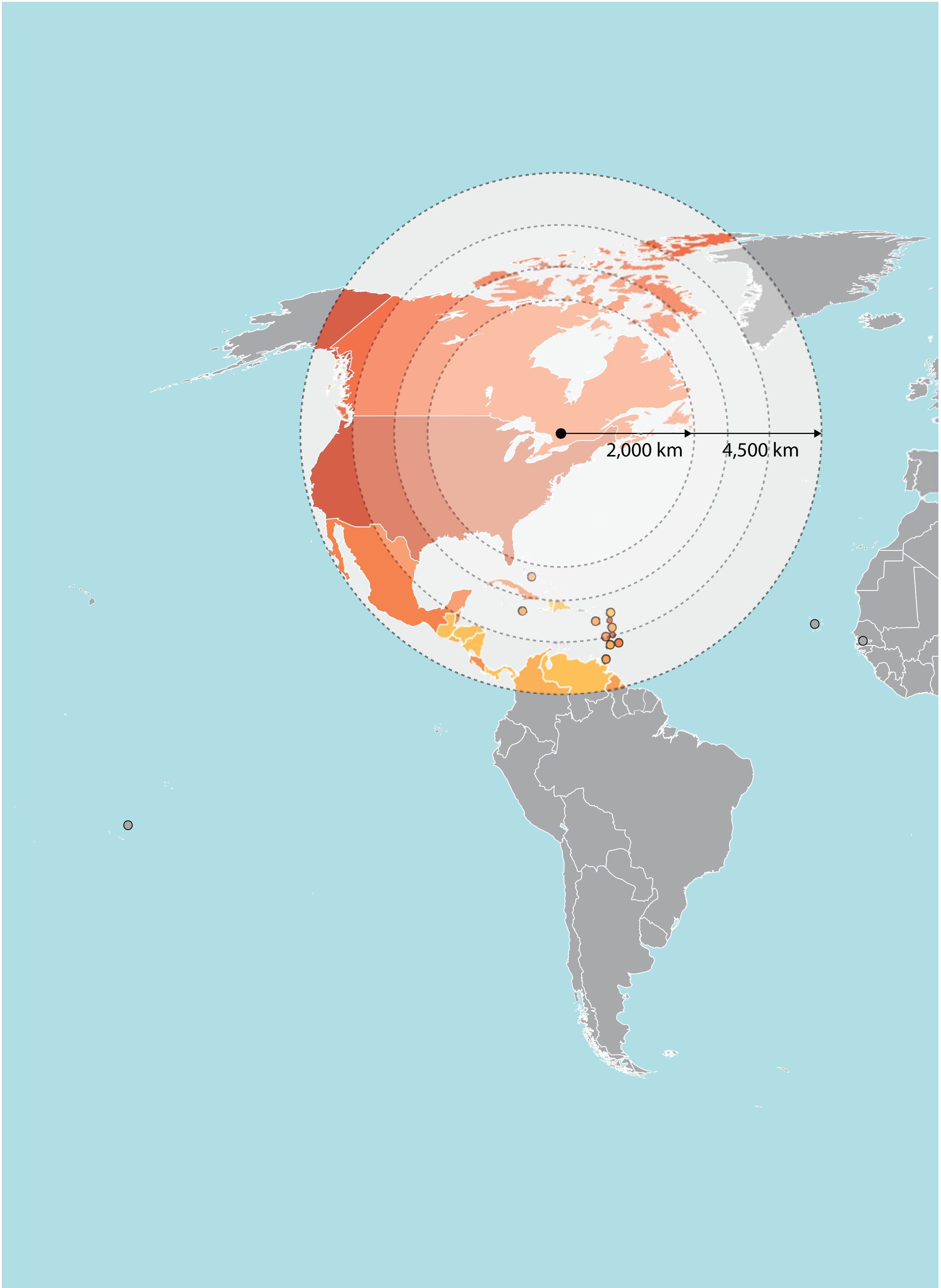

2,000 km
4,500 km

Figure 1.2.4 - Toronto Food Miles Distance

1.3 Issues on Housing in Toronto

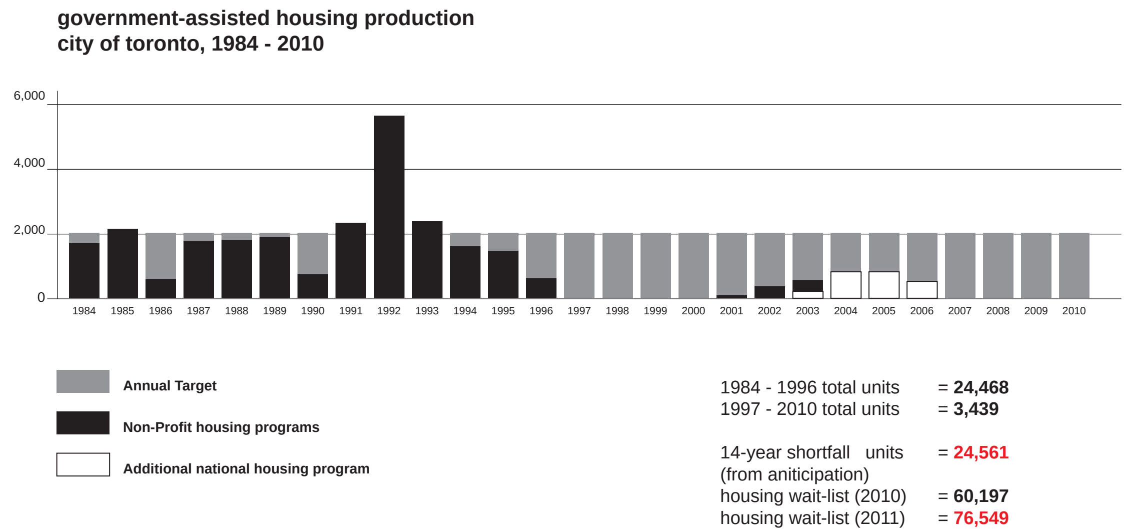


Figure 1.3.1 - Toronto Government-assisted Housing Production

The lack of affordable housing in Toronto also contributes to inadequate food and nutrition for a part of the population (Lister 2007) One of the effects of decreased availability of arable land within the city and rising rent prices is that low-income families struggle to pay for food. Toronto Policy Food Council (TPFC) estimated that the GTA would lose 40 percent of its farmland between 1976 and 2026 (Cheema, G. S., Smit, J., Ratta, A., & Nasr, J. 1996). By 2001, 47 percent of farmland was already lost, far exceeding TFPC's original estimation. Farmland was bought and used for development, especially of a residential type, in order to meet the needs of the population growth and migration to the city. Furthermore, urban farmers have been facing severe challenges to the structure operation of their business because of extreme highland costs (TFPC,1999, p. 9). For the farmer who owns a piece of farmland in the city area, it is far more profitable to sell the land than it is to try and maintain the farmland at unreasonably high costs that will only increase the debt.)

According to the notes of the Mayor's Affordable Housing Summit in 2004, Toronto has endured a consistent 14-year shortfall of government-assisted housing production since 1997 (City of Toronto 2004). The government has failed to satisfy the demand for affordable housing, and this gap has been widening every year. Between 1997 and 2010, this shortfall of government-assisted housing has accumulated to 24,561 units (see Figure 1.3). There were 76,549 households on the social housing wait list in 2010; this was an increase of 5,051 more households than the previous year (City of Toronto 2010). These are modest estimates; in reality there could be more Torontonian families who are at risk of facing the realities of poverty and homelessness.

At a national level, the Canadian lowest income household spends 32 percent of income on shelter, whereas at the regional level, 95,750 households in Toronto spend more than 50 percent of their income on rent (City of Toronto 2001). As for the GTA food bank users, the rental costs account for an average of 73 percent of their income, which is double the proportion for the country.

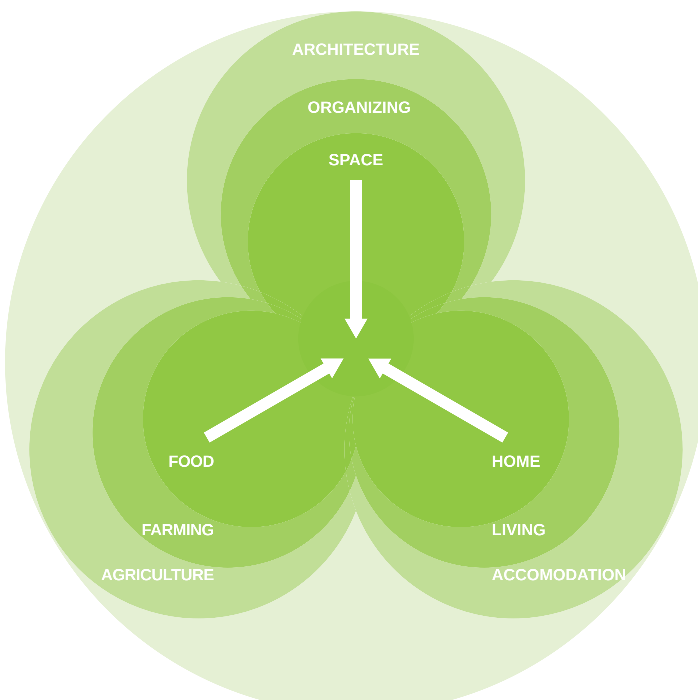


Figure 1.5.1 - Research Conceptual Model Diagram

1.4 Research Questions

The research documented here investigates how the ideas of agriculture and housing could be integrated into urban areas. There are two critical dimensions of information on food, agriculture, and housing to be assessed and analyzed. The synthesis should be evaluated against quantifiable measures and qualitative considerations in order to determine a set of evidence and approaches that will structure the design response and validate the development of arguments for further research and development.

The first premise raises questions regarding quantifiable parameters of typical food consumption, agricultural production and affordable housing in terms of volume, types and sizes:

a. What are the measuring units for foods and farms?
b. What are the foods that can be grown in different seasons in the climatic conditions of the site?
c. How much yield could be expected for each food item if conventional farming methods were used?
d. How much food is required in order to feed the focus group?
e. How much space is required to grow all the food types needed by the focus group?
f. What is the ratio between public and private edible space?
g. What is the ideal size of the housing complex and of individual units?
h. Can urban agricultural productivity reach the yield levels of rural agriculture?

The second premise raises questions regarding qualitative factors that will reinforce the quantifiable data on spaces for growing, eating and living, in terms of program, system, and technology implementations:

a. What are the possible programs to enrich the integration and relationship between farming and living space?
b. What are the possible technologies that can be integrated?
c. How can we grow a variety of crops and provide safe food with multiple

nutrients to users?

d. How can we make a closed-loop system in the building community and the city for self-sustainability?

e. How can a strategy be developed in order to secure the viable combination of urban agriculture and affordable housing, covering both short-term and long-term prospects?

1.5 Methodology

This research project involves establishing a strategy and system to amalgamate food and shelter as one single force to counter urban poverty and housing shortages in a city. The process of analysis, exploration and synthesis is conducted in the urban, community and building scales. The research methodology employs selected theories on agriculture, case studies, and data from various sources. Such information is used to support the research intention and provide a design framework for the thesis.

The report is structured into three parts consisting of nine chapters. The first part provides background information, summarizes basic knowledge and theories past and present, and puts forth a proposal for urban agriculture. The second part explores a set of design considerations and parameters, and synthesizes a strategy to define the typical design requirements for food production spaces and low-income housing. The third part focuses on site investigation, consolidates the findings and parameters into a design proposal, and concludes the research with a design intervention.

This research will develop a conceptual framework (see Figure 1.5) to integrate knowledge and principles of agriculture and architecture in an urbanized district of a city; this frames the design intention of maximizing agricultural productivity along with affordable accommodation in an urban setting, thus making food and shelter available, accessible, and affordable for low-income groups. This thesis demonstrates a model that could help cities alleviate concerns of urban poverty, improve food security and increase the supply of housing wherein both agriculture and housing could co-exist.

1.6 Location

Toronto’s Chinatown neighborhood has been chosen as the study area for this research investigation, based on its income statistics: this neighborhood has the lowest median income and the highest average percentage of low-income families and single adults below Low-Income Cut-Off Rate (LICO), as well as the highest percentage of households within downtown Toronto that spend over 30 percent of income on rent. In addition, 41 percent of homes in this neighbourhood require major and minor repairs, one of the highest figures in this category (Statistic Canada 2006).

Chinatown is the poorest district near the urban core of Toronto. Implementation of urban agriculture and new affordable housing development in the neighborhood will provide safe food access and shelter for the individual low-income household. Further, the growing and harvesting process promotes farming education, social engagement, and cultural exchange within the community. At a macro level, the model scales up local food production, supplying local food market and restaurants with fresh food and reducing their dependence on imported food. The design is also intended to be a closed loop system, recycling waste and water, minimizing the environmental impact, and enabling the district to sustain itself.

2

2.0 Urban Agriculture & Food Security

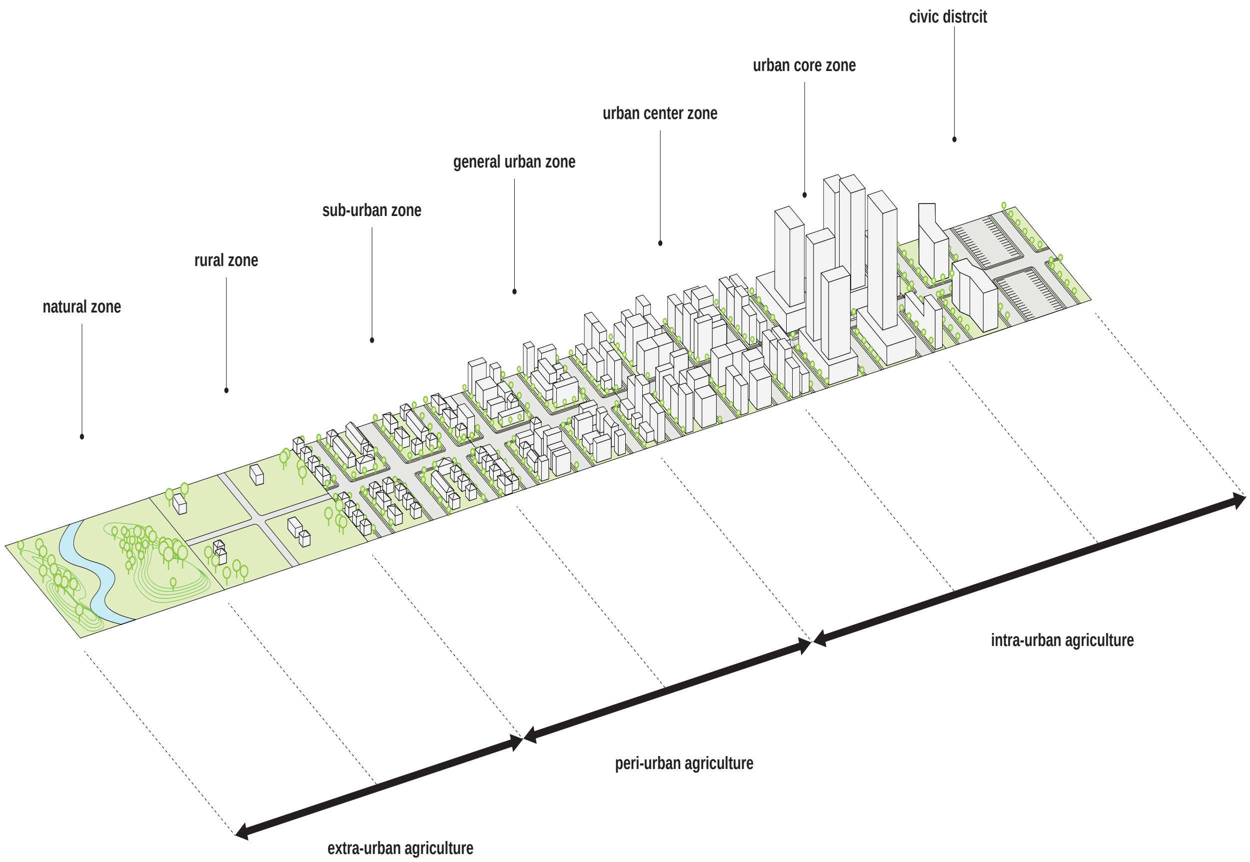


Figure 2.1.1 - Rural-Urban-Transect Diagram

After gaining an understanding of the food and housing issues in the current urban conditions, Chapter 2 addresses the essential elements that will determine design objectives. This chapter is structured into two sections. Sections 2.1 and 2.2 define the term urban agriculture and explain its benefits. Sections 2.3 and 2.4 elaborate on the elements that need to be considered for food security. This chapter is intended to develop a conceptual framework by addressing the basic criteria of the design project, in order to identify the future role and potential of urban agriculture in architecture.

2.1. Definition of Urban Agriculture

The idea of urban agriculture has been previously explored. The concept of growing food in urban areas has been reintroduced in the years after WW2. Many urban thinkers have begun to wonder how to continue feeding the population that throngs cities. Perhaps the answer is literally embedded within the cities, in the form of a new system of urban agriculture. There is no rigid definition of urban agriculture; it could mean something as simple as the growing of plants and the raising of animals for food and other uses within and around cities and towns (Veenhuizen 2006). Urban agriculture is defined as an industry that produces, processes, and markets food and fuel within a town, city or metropolis on land and water dispersed throughout the urban and peri-urban area (Cheema, Smit, Ratta, & Nasr, 1996). Urban agriculture as a system is concerned with urban culture, use of natural resources, land-use planning, food production and security, education and leisure, social relationships and income generation (TFPC 1999, p/ 6).

These processes may take place in locations that are within intra-urban and peri-urban zones within a rural-urban-transect (see Figure 2.1.). A transect is defined as a geographical cross-section, which has distinct characteristics of a region and reveals a sequence of environments. Urban agriculture can be viewed as a continuum with landscape stretches from backyard and community gardens to small, medium or large-scale commercial farming facilities (TFPC 1999, p. 6). In short, there is no restriction of place nor limitation in size for urban agriculture, allowing it to be accommodated anywhere within a city or town.

The majority of players involved in urban agriculture are the urban poor. These groups include immigrants, HIV-AIDS affected households, disabled people, single, divorced or widowed women with children, elderly people without pensions and unemployed youngsters. The integration of these groups into an urban agricultural network helps to provide decent livelihood and prevent social problems (Veenhuizen, 2006).

In both urban and peri-urban zones, agricultural land could take on a significant role in providing educational and recreational functions and in rejuvenating natural landscape biodiversity in a larger context (Veenhuizen, 2006). The three main streams of urban farming are ecologically, socially or economically oriented (Veenhuizen, 2006).

Urban farming, in any of these orientations, not only facilitates food provision and generating income, but also yields other advantages besides the basic functions (see Figure 2.2). Ecologically oriented urban agriculture (Environmental Healthy City) typically has a multi-functional character. The farm design encompasses features like decentralized composting, reuse of organic wastes, wastewater treatment, economic use of water and nutrients, pollutant reduction, shading, improvement of urban climate, and provision of leisure and recreational activities (Vennhuizen 2006). The social function of an urban agricultural model refers to a subsistence-oriented approach (Inclusive City), which focuses on producing food and medicinal plants for home consumption (Vennhuizen 2006). The households involved in this type of farming usually need other sources of income to survive. Any surpluses of production are sold to generate additional income for the family's food and medical expenses (Vennhuizen 2006). Although this model demonstrates only an indirect profitability to the disadvantaged group, it does make a more positive social impact on their livelihood.

The economically driven urban agricultural model refers to a market oriented system (Productive City). It comprises both small-scale family-based enterprises as well as larger scale entrepreneurial farms run by private investors or associations of producersl (Vennhuizen 2006). This commercial system involves delivery, processing, and marketing, all planned for profit and efficiency. However, the intensive production pace and scale of these farms are associated with the risks of soil and water contamination and intensive use of agro chemicals on crops (Vennhuizen, 2006), inevitably affecting the safety and quality of the food.

2.2. Benefits of Urban Agriculture

Urban agriculture requires systems synergies, efficiencies and cost-savings; the potential benefits cover a broad range of multiple inter-linked aspects influencing a city environmentally, socially, and economically (TFPC, 1999). This section illustrates some of the environmental, societal and economical benefits of urban farming in relation to the overall framework (see Figure 2.2.1).

In the environmental context, urban agriculture can reduce the overall ecological footprint of a city. By shortening the distances between the locations of production and consumption, energy consumption and greenhouse gas (GHG) emissions can be reduced. This subsequently lowers costs of storage and transportation of produce. By using farms and organic soils as carbon sinks, the local microclimate is also improved. Urban waste such as organic matter and wastewater can be recycled as compost and biogas (TFPC, 1999).

According to a study conducted by ICF International along with the Toronto Atmospheric Fund and Toronto Environment Office in 2007, the City of Toronto released 23.4 megatons of CO2 (IFCI, 2007, 38). Buildings and other facilities represented 76 percent of the overall GHG emission (IFCI, 2007, 8). Statistics Canada Census 2006 recorded that the City of Toronto had a land surface area of about 63,180 hectares; the total carbon footprint extended to about 370 times the city space. The Greater Toronto Area (GTA) had over 6 million of people as of 2008; with the projected GTA population to reach 8.6 million people by 2031 (Lister, 2007). the situation will only worsen, as densification continues and the settlement of new immigrants accelerate the rate of consumption, use of resources and pollution.

In the social context, urban agriculture can facilitate employment opportunities, diverse cultural integration, education and sharing of knowledge. In addition, green spaces provide scenic, lifestyle, and recreational value at the community level (TFPC 1999). At the domestic and personal levels, urban farming makes fresh and safe food available, securing nutrition and health. This could ensure nutritious food for children, enhance health status and empower women, as most of the urban farmers are female.

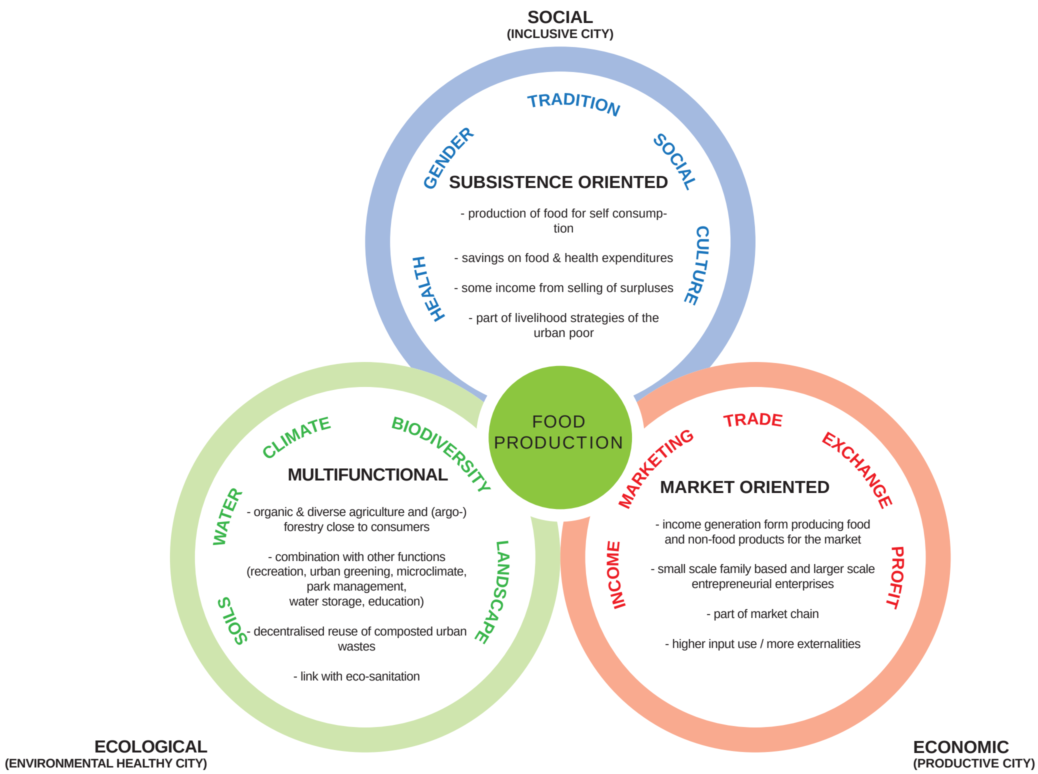


Figure 2.2.1.- Urban Agriculture Streams & Benefits

In the economic context, urban agriculture can reduce a family's expenditure, allocating more income for healthcare and education (Cheema, Smit, Ratta, & Nasr 1996). Urban agriculture thus influences a broad range of inter-linked aspects of ecological, social, and economic well-being. The benefits will also positively affect various interconnected levels of the population, from the individual to the nation, in both short-term and long-term. Therefore urban agriculture influences the health and well being of both individuals and the community as a whole.

Food quantity, quality, stability, and nutritional balance (Cheema, Smit, Ratta, & Nasr, 1996) are the four major determinants that have been classified as measuring factors for the quality of urban agriculture. Furthermore, these measurements are assessed by both quantitative and qualitative parameters in order to determine the effectiveness of urban agriculture within a specific site. The term urban agriculture in this research paper applies to food productivity, security, and distribution related to the urban, community, and building scale. This research thesis provides both quantitative and qualitative measuring factors for food quantity, quality, regularity, and nutritional balance, to design a new typology that benefits low-income communities socially, economically, and environmentally.

2.3. Food Security

According to the Food and Agriculture Organization of the United Nations (FAO), Food Security "exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food which meets their dietary needs and food preferences for an active and healthy life." (FAO 2006). Food insecurity "exists when people do not have adequate physical, social or economic access to food as defined above." (FAO 2006).

In order to achieve food security for each person, there are three major criteria that need to be met both qualitatively and quantitatively. The three criteria are quantity, safety and quality. These three factors must be evaluated, based on the physical, social, and economic aspects of food. The Centre for Studies in Food Security at Ryerson University (RU, 2009) has subdivided the definition of food security further into five interconnected yet distinguishable components. The five components that form the framework of food security are availability, accessibility, adequacy, acceptability, and agency (RU 2009). Each component is further defined to explore the several facets in depth. The following discussion will address some factors that affect each component of food security both quantitatively and qualitatively.

Food Availability

Food availability is defined as sufficient food for all people at all times (RU 2009); it also means sufficient quantities of food available on a consistent basis (FAO 2006). Availability refers to supply and consumption. An average estimated minimum daily energy requirement for a human is 2,200 kcal / day (calories per day), according to FAO. The calorific intakes are uneven in a global perspective (see Figure 2.3.1); some countries suffer from malnourishment or over-consumption, leading to obesity. Food consumption around the world ranges from below 1600 kcal / day to over 3600 kcal / day. Therefore, it is essential to quantify what is a sufficient amount of food to be produced and consumed, in order to ensure that sufficient amounts of food are made available equitably.

Other factors that affect the availability of food are directly related to the climate and weather, resulting in the varying of the yield and harvests each year. Food types and choices also differ according to the geographic location. Furthermore, inadequate storage facilities in most circumstances lead to heavy product losses, significantly affecting the seasonal availability of food.

Food Accessibility

Even if a city can ensure food availability and consumption, it cannot be assumed that people have access to the food. Food accessibility is defined as having sufficient resources to obtain appropriate foods for a nutritious diet (FAO 2006). Food accessibility exists when physical and economic access to food for all at all times is ensured (RU 2009). Physical and economic accessibility of food refer to distance and price, and are both quantifiable in numbers.

The physical aspect of food access is determined by the distance between the consumer's location and the place where food is available. A food desert, as mentioned in Chapter 1, is one where healthy food is unreachable for the people. Furthermore, food security from the economic aspect of accessibility means that food also needs to be affordable for people. (Refer back to the food deserts map in Toronto for examples). Downtown areas have various opportunities for creating accessibility to healthy food; however the green zone does not necessarily mean that the foods offered are affordable for everyone, especially for the urban poor. Therefore, food security is concerned with the question of whether foodstuffs are socially accessible. The average weekly cost of basic nutritious food for a family of four in Toronto in 2008 was $136.28 (this is equivalent to $590.09 per month). This is an increase of 2.4% since 2007. The cost of the Nutrition Food Basket has increased by approximately 9.4% over the past two years (NBF 2008).

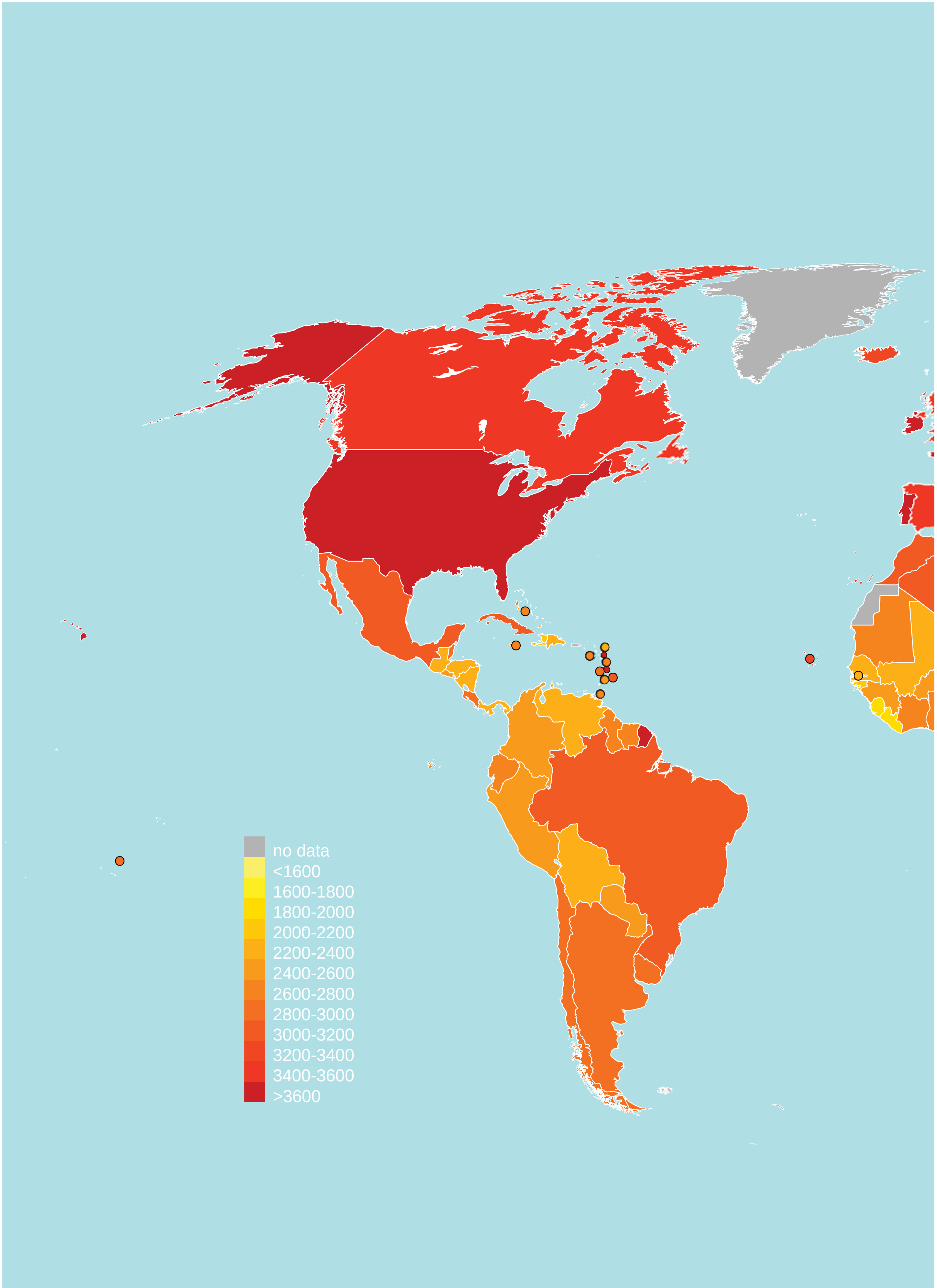
Food Adequacy

Even if people are able to access affordable food, it does not necessarily follow that the food is adequate in quantity or contains all of the required nutrients (FAO 2006). Food adequacy exists when people have access to food that is nutritious and safe, and produced in environmentally sustainable ways (RU 2009). Individual citizens need knowledge of basic nutrition and care, adequate water consumption and sanitation. Inadequate, inopportune selling in an unfavorable market can have a detrimental effect on food security (FAO 2006).

Food quality depends a great deal on the food distribution system. In the case of an imported food item, the longer the item travels, the higher the risk of that item losing its freshness and nutrients. For urban farming, it is important that households use adequate water for irrigation and grow food organically. Thus, eliminating the use of chemicals and pesticides could also ensure food adequacy.

Food Acceptability

A component of food adequacy is food acceptability, which is defined as culturally acceptable food which is produced and obtained in ways that do not compromise people's dignity, self-respect or human rights (RU 2009). Different ethnic groups hold different traditions and religious beliefs, so ethno-specific food might not always be available. Therefore, it is important to provide specific alternatives for a community to choose from. According to the International Service for the Acquisition of Agri-Biotech Applications, the Global Status of Biotech Crops data for 2004 (see Figure 2.3.2) shows that a total of 13.3 million acres of land in Canada produce genetically modified crops. This makes Canada the third largest producer of genetically modified crops in the world. If urban areas are used for food production to grow a variety of crops, this could make organic food produce in urban areas a more acceptable agriculture method.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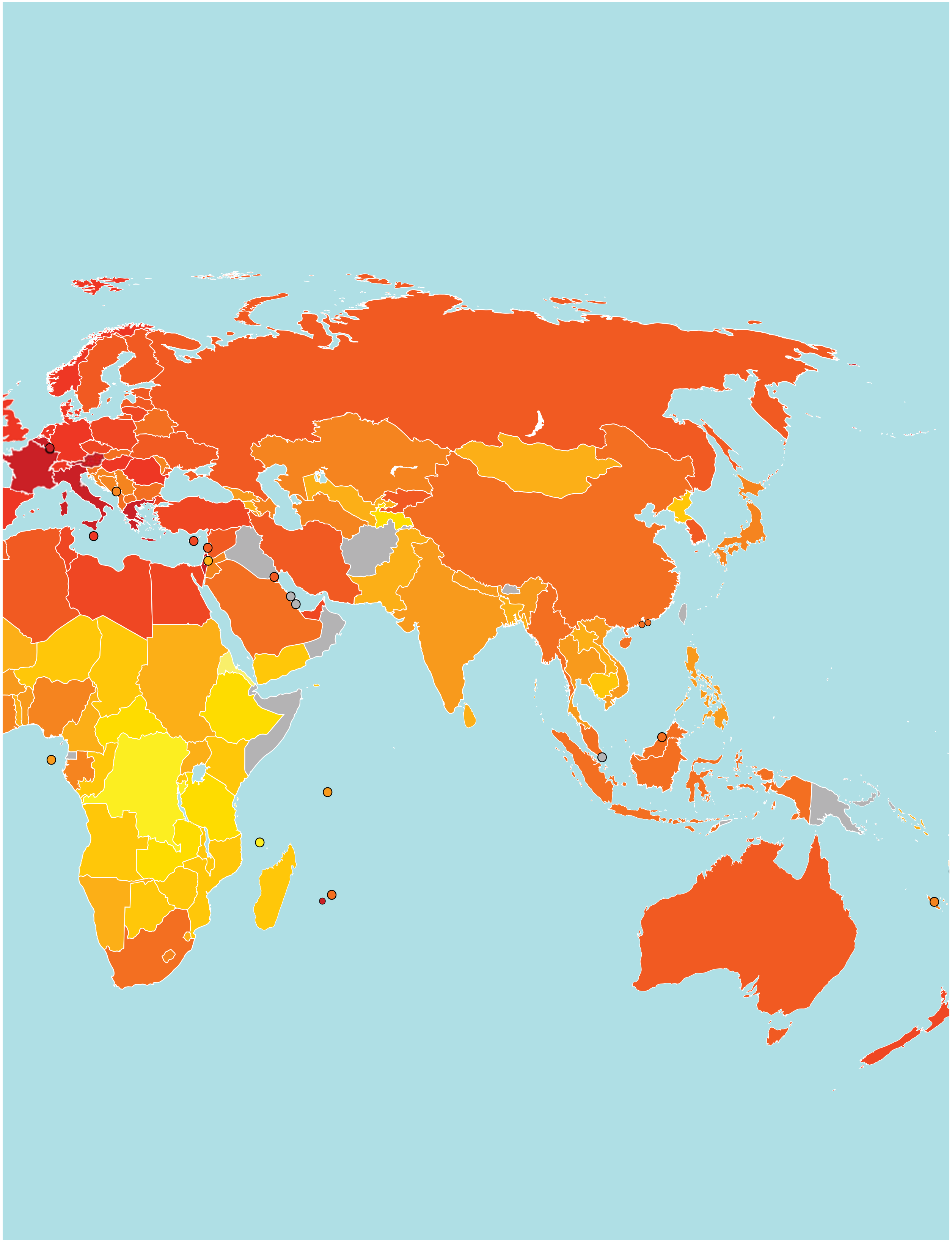


Figure 2.3.1 - Map of Energy consumption (kcal/person/day) per country in 2001-2003

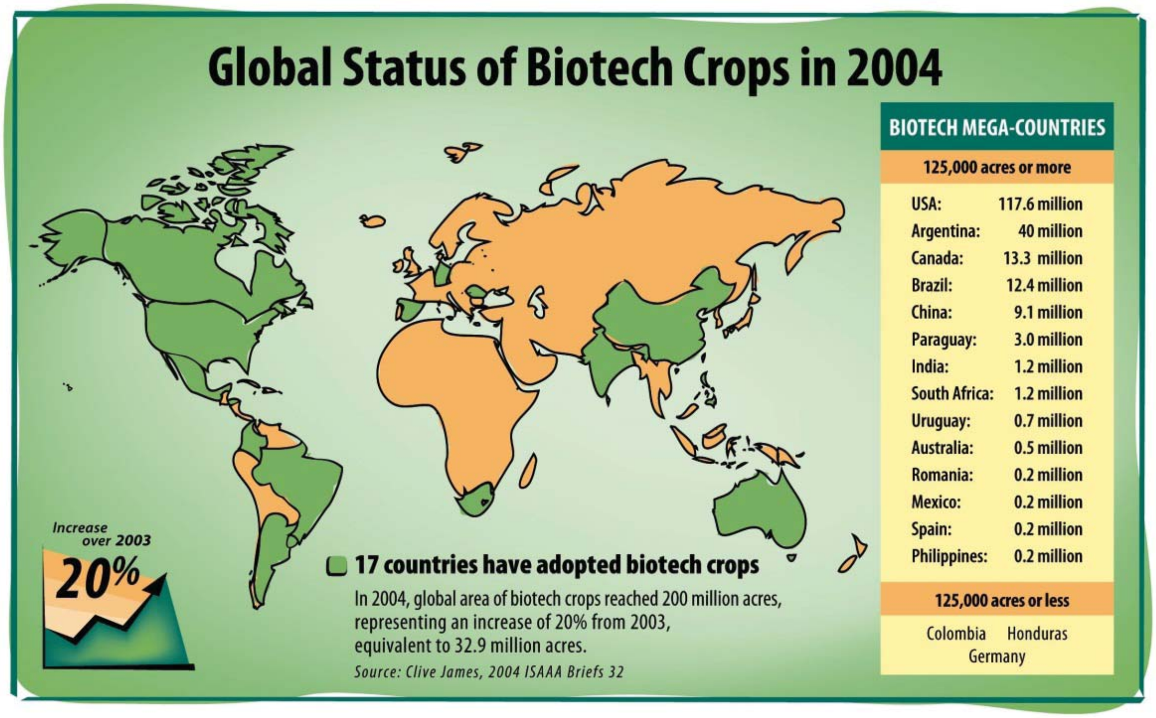


Figure 2.3.2 - Global Status of Biotech Crops in 2004

Food Agency

Food agency, in brief, is defined as the policies and processes that enable the achievement of food security (RU 2009). The City of Toronto introduced the Green Roof policy by-law in May 2009, stipulating that all commercial, institutional and residential developments with a minimum Gross Floor Area (GFA) of 2,000m2 must have green coverage on the roof of the building. The requirement applies to 20 to 60 percent of buildings that have more than 6 floor levels or 20m in height (City of Toronto 2009). This legal stipulation opens up a huge potential for urban agriculture to expand, by making the building roof a productive and edible landscape.

3

3.0. Urban Agriculture and Theories

In the context of urban agricultural design, a farm is defined as a site where architects develop new concepts for sustenance and sustainability and find new physical connections between people and the products they consume (Tenhoor 2010). This engagement started from utopian architectural farm-cities during the eighteenth and nineteenth centuries. This section documents several agricultural and urban models that have been proposed. The intention is to establish a framework for the design of a self-sustaining and self-sufficient community and society on an urban scale. The following section describes each model's vision and layout; it also indicates the land area, population, density and the agricultural products associated with each proposal. Furthermore, the information will be summarized and compared, to evaluate what data, principles and characteristics can be adopted and implemented in the current and future urban settings.

3.1 Urban Agriculture in Urban Scale

This section examines several visions on an urban scale which have incorporated agriculture and food into their proposed plan, influencing the social, environmental and economic performance for different communities in the city. Through the analysis, this section intends to establish the criteria to be applied in the final design intervention.

The Phalanstere (1808) – Charles Fourier

The Phalanstere was proposed by Charles Fourier, a French utopian socialist and philosopher. Fourier envisioned a model with a single building complex comprising all types of agricultural and manufacturing work to build a utopian community (see Figure 2.3.1), that could be self-sufficient (England 2009). He believed in a collective social order, where individuals create mutual benefits through shared effort. He described diverse types of working facilities and environments for different groups of individuals in

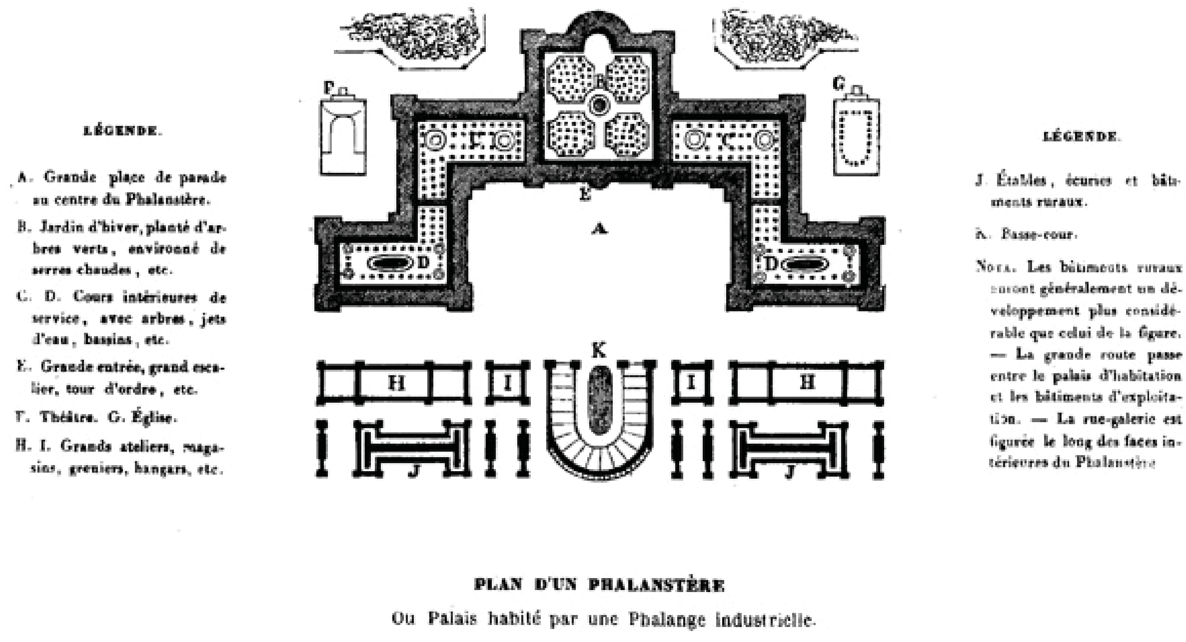


Figure 3.1.1 - The Phalanstere Floor Plan

the Phalanstere. These activities included agriculture, manufacture and applied science and arts (England 2009).

Fourier used the term Phalanx, meaning a rectangular military-like formation, to describe the community of Phalanstere. The organization of the building is capable of integrating kideal urban and rural features (England 2009). The Phalanstere is constructed in three compartments with a central core and two lateral wings (see Figure 3.1.1). The central compartment, surrounded with apartments, dining rooms, meeting rooms, libraries, study areas and winter garden space planted with trees in the courtyard area, is designed for quiet activities.

One lateral wing consists of units to accommodate labor and noisy activities, whereas the other lateral wing is used for visitors, and has venues for social activities such as ballrooms (England 2009). The middle of the plan is a grand square for large-scale

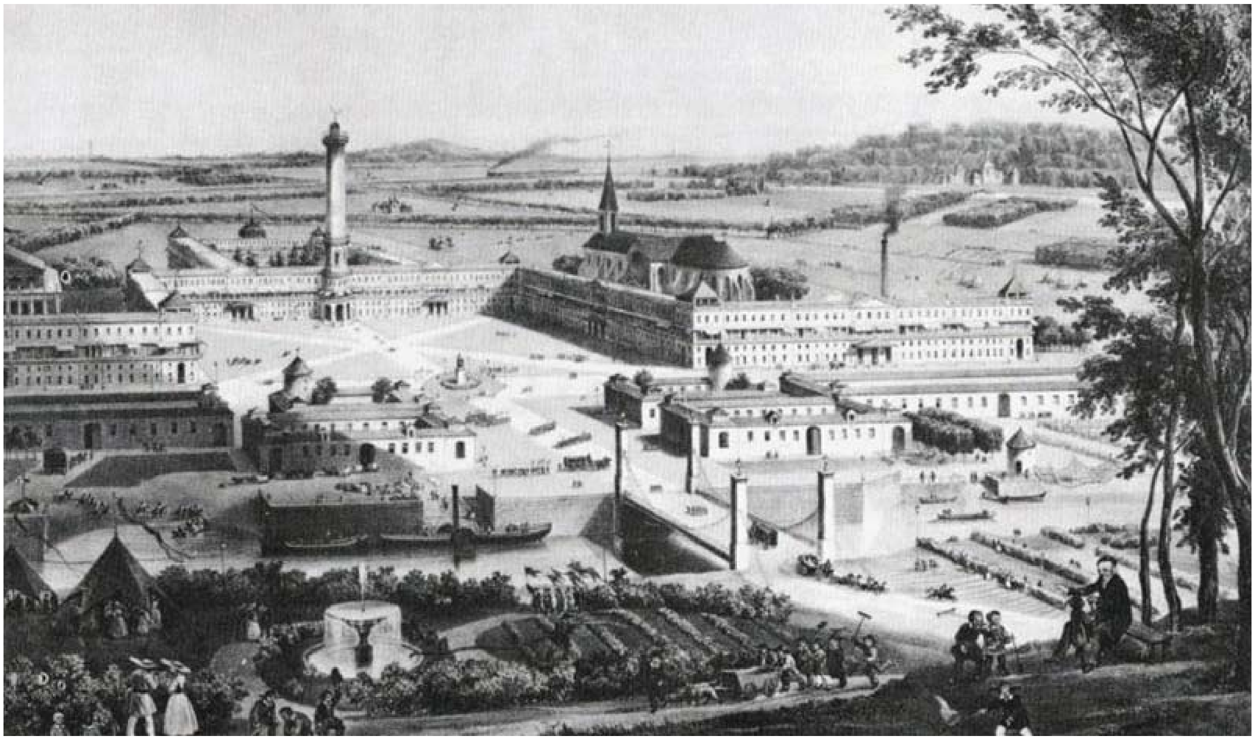


Figure 3.1.2 - The Phalanstere by Charles Fourier

events. The backyard section holds workshops, warehouses, sheds, barns and farming facilities. The farming facilities are ideal for growing a variety of crops on hilly slopes (see Figure 3.1.2).

The size of the Phalanstere is about 1920 acres (7.770, 000 m2) and houses 1620 individuals, with a density of 0.21 units per acre. The model includes all types of agricultural products (England 2009). The vision of Phalanstere suggests designing a community where different classes live in proximity and harmony. The organizing principle is to distribute programs and functions according to the individual labourer's skills and aptitude. It creates opportunities for different classes and occupations to interact and share efforts and ideas. In the plan, the housing units are laid out as a ring that wraps around the area forming perimeter blocks with courtyards. This formation reserves spaces for growing in both the exterior and interior sections of the complex.

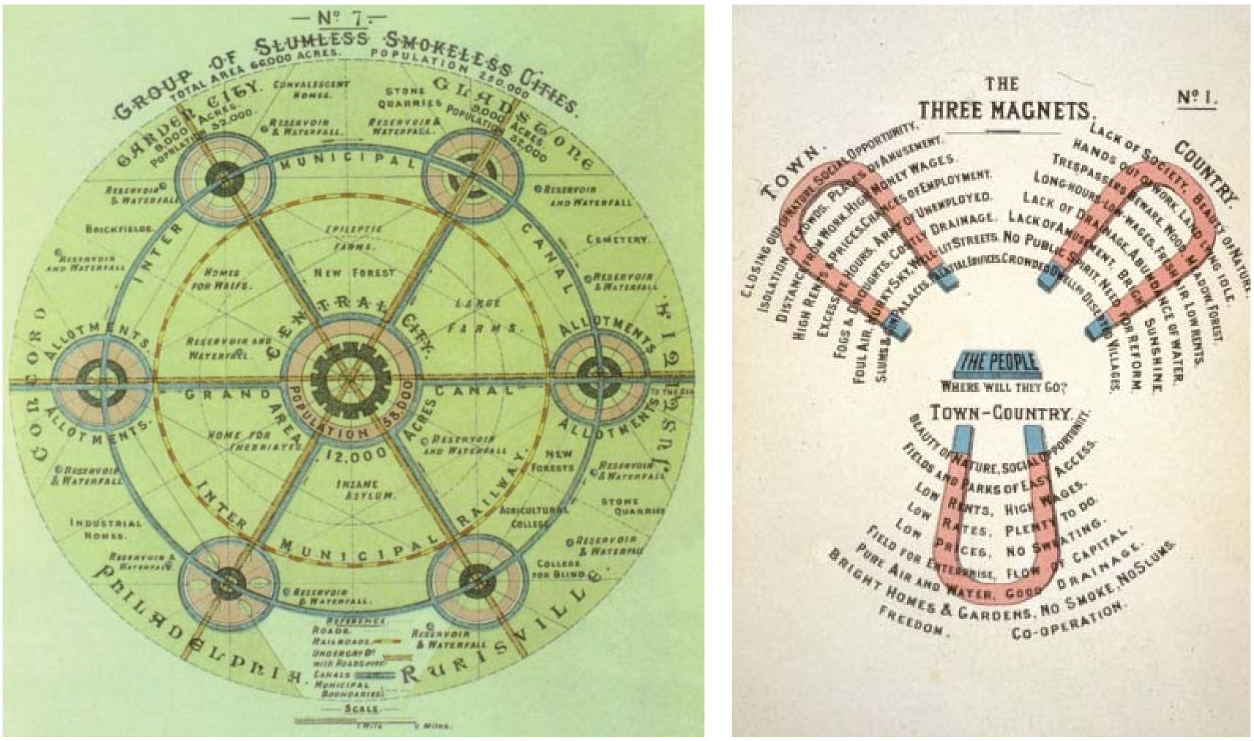


Figure 3.1.3 - The Garden Cities Planning by Ebenezer Howard

<u>The Garden City (1902) – Ebenezer Howard</u>

The Garden City was proposed by Ebenezer Howard, a British urban planner and philosopher. He envisioned that people in a utopian city should live in harmony with nature. In his publication, Garden Cities of To-morrow, he deemed that the current ideals of town and country themselves created social tragedy and argued for a human scale. As a remedy, Howard proposed the concept of “Town-Country”, a combination of the two ideals, which would create a balanced environment (England 2009).

His Three Magnet Diagram (see Figure 3.1.3), illustrates the advantages and disadvantages of town and country. With the combination of town-country, new cities could adopt the social advantages of cities while the design’s countryside atmosphere eliminates their disadvantages (England 2009). This in turn would create slum-free, smokeless cityscapes.

The Garden City addresses land ownership, population and functions as the three key points of its vision. Firstly, land development should be held by common authority and not parceled out for individual ownership. In other words, the Garden City must be reserved for the community (England 2009). Secondly, growth and population of the city must be controlled and limited. The city must contain areas that are permanently reserved for open country, which is used for agriculture and recreation. The agricultural belt not only serves as a green wall against encroachment of surrounding communities, it also provides opportunity for local food production (England 2009). Thirdly, the region's political, social, and recreational functions should be in balance, with the internal developments addressing home, industry and market areas (England 2009).

The size of a Garden City is about 6000 acres (24,281,000m2), housing 32,000 individuals, with a density of 1.3 units per acre. The model includes all types of agricultural products (England, 2009), with 5000 acres reserved for agricultural production. In the detailed plan of a Garden City, there are four offset green zones illustrated in between human settlements; from the inner to the outer zones they are garden, park, grand avenue and farms. Farms have always been pushed to the periphery of the city. However, going by the Garden City design, it is possible to plan farm space and productive landscape in the inner urban areas instead of only in the outer zones of a city. Green patches of space are difficult to find in the current urban setting, but the radial organization of Garden City suggests that green space could be subdivided and deconstructed into smaller rings and bands. This strategy seems more suitable for the context of the GTA.

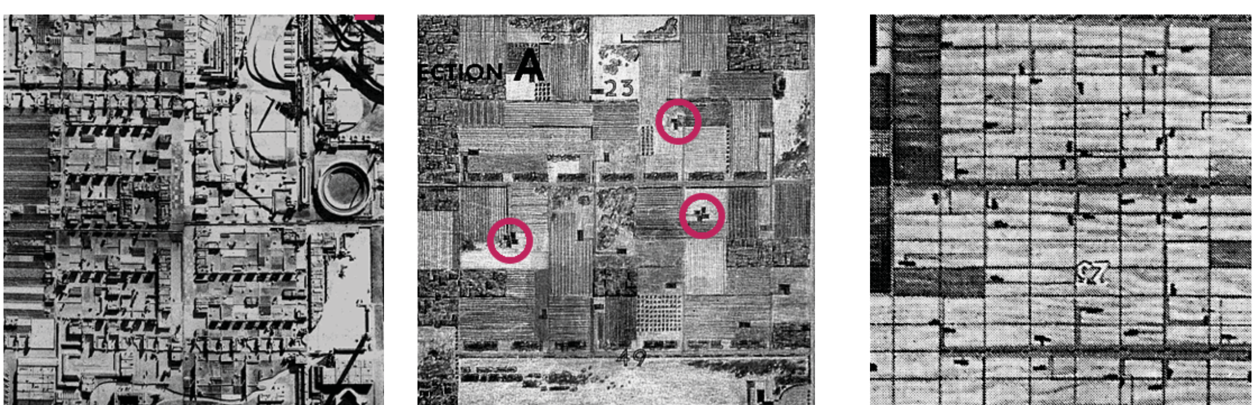


Figure 3.1.4 - Broadacre City Plan View

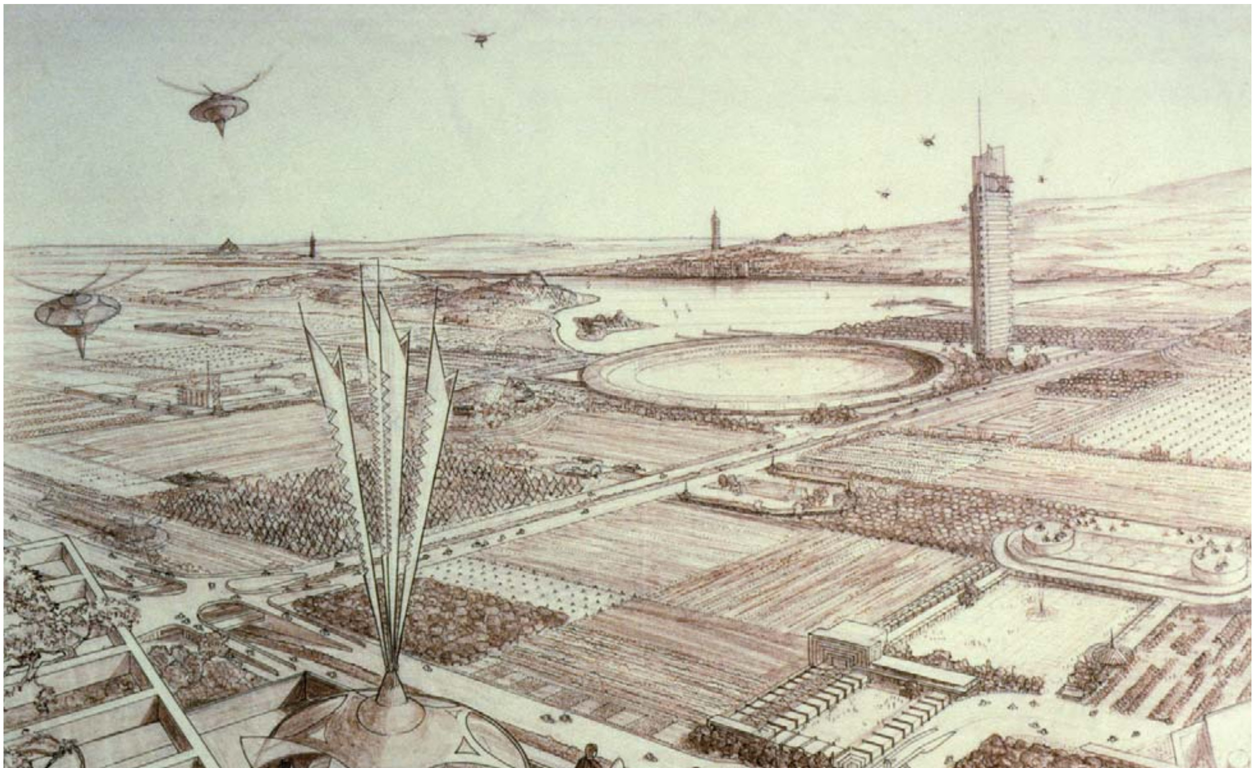


Figure 3.1.5 - Broadacre City by Frank Lloyd Wright

<u>Broadacre City (1932) – Frank Lloyd Wright</u>

Broadacre City was a utopian vision for America proposed by Frank Lloyd Wright. The Broadacre City model suggests a new community plan for America, by providing each citizen with at least one tillable acre of land, a homestead for the household and their own car for transportation. This model aims to develop a community where members would be partially, if not wholly, responsible for their own-self-sufficiency (England 2009). Standardized machines, radio, telephone, telegraph, and automobiles were the inventions that built the old cities (Wright 1935). Wright foresaw that, in the future, individuals would not be limited in range. The proposal is to view the whole country as a continuous grid, and thus restore citizens to a fundamentally agrarian landscape (England 2009). According to this model, each family would require one acre within a confined boundary (see Figure 3.1.4).

Broadacre City has attempted to bring about social equality and interaction between classes by empowering the citizens with three inherent social rights, which were: the use of gold as a commodity for exchange; land held for use and improvements; and the public ownership of inventions and scientific discoveries concerning the life of the people (Wright 1935). The land could be developed with the occupants' freewill as the coordinating and organizing principle; the land could become "little farms, little homes for industry, little factories, little schools, a little university going to the people mostly by way of their interest in the ground, little laboratories on their own ground for professional men" (Wright 1935), which allows the Broadacre to expand and evolve organically and naturally. In this model, each household would be allotted one acre of land for accommodation, while ensuring that the development does not overshadow the biosphere. "Here architecture is landscape and landscape takes on the character of architecture by way of the simple process of cultivation" (Wright 1935)

The size of a Broadacre City is about 2,560,000 acres (10,359,950,000m2), housing 5,600,000 individuals, with a density of 0.55 unit per acre. The model accommodates all types of agricultural products (England 2009). The Broadacre City introduces a self-sufficient, self-productive, and self-governing system for a person and household. The household or person could be self-sufficient by growing their own food and thus securing food quality and choices according to their preference. A person or a family could be self-productive, since the land could be developed according to the interest of the occupants. The idea is that if the person is doing something that he or she likes or wants, this will lead to self-motivation and better productivity. The land also gives enormous freedom and control for an individual, and this self-governing system could change its appearance based on the individual's freewill from time to time.

In retrospect, the self-sufficient, self-productive, and self-governing model promoted in the Broadacre City model has certain flaws in its conception. Due to the size of land required for all the possible activities to take place within their own acre of land, the distance separating each unit is relatively vast. The transit system was heavily dependent on the automobile, as Wright proposed that each person would have his or her own car (see Figure 3.1.5). Consequently, this system not only negatively impacts the environment, but also limits the opportunity for each unit to interact with neighbours. This decentralized vision, while promoting individuality, has the risk of leading people to social disorder and isolation.

3.2 Urban Agriculture in Community Scale

This section examines different cases in which agriculture and food have been integrated as part of the design, making an impact socially, environmentally, and economically at the community level. The aim for this section is to analyze and identify the possibilities and potential ingredients of the final design response, such as programs and systems that could be incorporated as well as their direct and indirect benefits to the community.

Victory Gardens

During the world war periods, Victory Gardens largely contributed to the food supply of different countries. During WW1 in 1917, Europe was facing food shortages and Americans were asked to voluntarily reduce their consumption of exportable foods through conservation, substations, buying from local growers, and gardening (Lawson, 2005). By the end of 1918, there were 5,258,000 gardens planted. The name, Victory Gardens, celebrated the success of the scheme in producing food, promoting civic involvement and patriotism (Snowdon 2010). After the war, those lands were repurposed to their former functions and eventually they became vacant (Lawson 2005). During WW2, the Americans re-launched the Victory Gardens campaign. (see Figure 3.2.1) It is estimated that there were about 20 million Victory Gardens providing approximately 40 percent of all vegetable production for the entire nation (Snowdon 2010).

In the City of Toronto, there were similar movements during the Great Depression and World War periods. In 1934, Toronto Mayor William James Stewart turned an 8-hectre plot on St Clair Avenue into community gardens, providing land for 5,000 unemployed families to grow food. In 1918, the Toronto Vacant Lots Cultivation Association had 2,000 gardens and managed to grow $75,000 ($980,000 in 2009 dollars) worth of food in profits (Palassio& Wilcox, p. 60).

In 1934, Toronto Mayor Fred Conboy encouraged Torontonians to “dig for victory” by planting vegetables on every available bit of land (Palassio & Wilcox 2009, p. 58). Throughout the Ontario province, there were 700 gardens. The Ontario Hydro

Figure 3.2.1 Victory Garden Posters

Horticultural Club's Victory Garden Committee cultivated 425 gardens in Toronto. The land donated by municipal and private owners grew $26,000 ($331,000 in 2009 dollars) worth of food. Major streets, such as Bayview Avenue, Queen Street, Keele Street and Cosborne Ave, together cultivated food equivalent to $30,940 ($385,741 in 2009 dollars). During these periods, Canada had more than 200,000 wartime gardens, each producing an average of 225 kilograms (Palassio & Wilcox 2009, pp. 58-59).

These data demonstrate that if people work together as a community during difficult periods and crisis, the collective force manages to produce unimaginable results. The bonding between individuals in the community is also strengthened as the entire group is working towards common goals.

Artscape Wychwood Barns (2008) – du Toit Allsopp Architects Ltd

The Wychwood Green Art Barns is a community multi-use park located at Christie Street in the St Clair and Bathurst neighborhood of Toronto. It was designed by du Toit Allsopp Architects Ltd. The project is intended to foster art and culture, environmental leadership, heritage preservation, urban agriculture and affordable housing, site remediation and revitalization of the neighborhood. The barn was originally a maintenance facility for TTC streetcars. It was redesigned using adaptive reuse and passive sustainability approaches, maintaining connection to the site's past through conserving resources and reusing the site's materials (RU 2010). The sustainable system combines passive adaptation and high-tech applications, using computer-controlled windows for venting, drip-watering system and maximized natural light in the 1,000m2 greenhouse within the barn, which is designed for year-round food production (RU, 2010).

The total area of the complex is about 5600m2. This area contains public green space, a greenhouse, farmer's market, a beach-volleyball court and an office for community groups and housing for artists. In addition, there is a compost area, an industrial kitchen that can accommodate both indoor and outdoor events and gatherings, as well as a sheltered court that houses fruit trees and sensitive large plants (RU 2010).

Figure 3.2.2 - Wychwood Green Art Barns Greenhouse Interior & Exterior

Everygreen Brick Works (2010) – Claude Cormier, du Toit Alsop Hillier, Diamond+Schmidt Architects Inc., E.R.A. Architects Inc.

Toronto’s Everygreen Brickworks is a 40-acre multi-use park located near the ravine system of the city, showcasing urban sustainability and heritage preservation. Brickworks introduce extensive landscaping within the complex, which incorporates urban agriculture as a core design element to encourage community engagement, education and recreation, and promote a healthy lifestyle (RU 2010). Buildings and pavilions have been repurposed into spaces reserved for a farmers’ market, plant nurseries and a playground for children with fruit trees and berry bushes.

Discovery Garden (see Figure 2.3.11) is an open-air pavilion, incorporating landscape designs and a year-round garden which accommodates various activities during the different seasons, throughout which its appearance naturally transforms the space. The Demonstration Garden is not only a place to buy plants, seeds, organic soils and fertilizers; here visitors can also learn about growing plants and vegetables organically (RU 2010).

Figure 3.2.3 - Brickworks Discovery Garden in winter

Figure 3.2.4 - Brickworks Discovery Garden Aerial

Figure 3.2.5 - Brickworks Discovery Garden in summer

3.3. Urban Agriculture in Building Scale

This section examines buildings that have incorporated agriculture and food as key elements of their design. The intention is to investigate how spaces for food and accommodation could be integrated to benefit the users of the buildings socially, environmentally, and economically.

Figure 3.3.1 - 60 Richmond East Community Garden

60 Richmond East – Teeple Architects

60 Richmond East is a co-operative housing project located in downtown Toronto. The building consists of 85 units with one-, two-, three- and four-bedroom apartments distributed throughout the 12-storey complex. There are 59 units in the complex dedicated to the relocation of Regent Park residents. Most of the residents are employed in the hospitality and restaurant industry. This affordable housing project is an example of environmentally and socially sustainable development. It is an exploration of an urban form that integrates in its food-growing spaces urban permaculture along with other green technologies.

The community garden located on the sixth floor is one of the key features of the building. The terrace space is a productive garden tended by the residents. A metal framework placed on the east side of the central void is used as a vertical growing

Figure 3.3.2 - 60 Richmond East Exterior & Sectional Perspective

wall for landscaping and contributes to natural ventilation by having climbing vines cascading down the atrium space. These designs demonstrate one effective way in which community space could be used for dual functions.

The garden space is not only utilized for social interaction, it is also a productive garden where fresh herb, fruits, and vegetables are grown. 60 Richmond East has been designed to consider the occupations of the resident group. The elevated, linear, productive gardens eventually supply food for the restaurant and training kitchen on the ground floor. The organic waste from the restaurant is compost and is re-used as nutrients for the garden, making it a small-scale full cycle ecosystem. Other spaces such as classrooms, conference halls and amenities support social activities and interactions, as well as offering opportunities for the residents to share and exchange their skills and knowledge.

A ventilation stack effect has been created in the building to eliminate the need for air conditioning. The building is made up of 60% solid matter, with mostly insulating fiber cement panel cladding, and 40% glass. The green roof also minimizes the gain of heat island effect. 60 Richmond East demonstrates how social housing and food production could be planned concurrently in the present urban conditions. However, the limited amount of green space in this model can only contribute to a small scale of food production.

Rotterdam Market Hall (2009) – MVRDV

The Rotterdam Market Hall designed by MVRDV is a residential project combined with a food market hall. The design uses a synergetic and sustainable approach combining food, leisure, living and parking together. The building responds to the new hygienic stipulations of Dutch law that require market spaces to be covered. It also responds to the challenge of whether a city can use a market hall typology to densify the city, providing housing and food at the same time. The complex is designed for 246 residence units, with kitchen, dining and storage rooms positioned close to the market hall, establishing a connection. The ground floor provides a 3,000m2 retail space along with a 1,600m2 catering area. The first level houses a 1,800m2 supermarket. The building is designed in an arch shape, using the housing units as a shelter for the food market. The interior façade of the hall is covered with LEDs, which could be interchanged for future advertisement purposes. The hall is multifunctional; during the opening hours the building serves as a central market hall, and at night it is animated by the restaurant on the ground level.

Figure 3.3.3 – Rotterdam Market Hall interior

Figure 3.3.4 – Rotterdam Market Hall by MVRDV

Public Farm / P.F, 1 (2008) – Work AC

The Public Farm 1 (PF1) is designed by WORK Architecture Company as a public installation piece for the New York Museum of Modern Art and its sister institute, the PS1 Contemporary Art Center. PF1 is an experiment in “rurbanization”, a model in which rural, high-density and open spaces, food production and consumption, town life and cosmopolitanism could all coexist (RU 2010). The design of PF1 is an attempt to densify a city by bringing together the different systems and infrastructure that sustain the city from its periphery to its heart. It appropriates and transforms these elements in order to create social interaction and engaged play. and thus reinvents the city (RU, 2010). The design of PF1 consists of 6 unconventional components and materials—structure, planting, program, power, irrigation, and livestock. The design uses cardboard tubes that are recyclable and biodegradable as the structural material. A grouping of seven planter-tubes in hexagonal pattern, with the middle one purposely left out to allow access to the crops by the urban farmers, act as structural columns. Each tube is planted with a single species, with a total mixture of 23 types and 51 varieties. PF1 uses eighteen arrays of photovoltaic modules for power supply and a drip irrigation system fed by a 6,000-gallon rainwater cistern to deliver controlled amounts of water for the plants. Chickens have been introduced on site for the duration of the exhibition period to demonstrate how livestock could be incorporated.

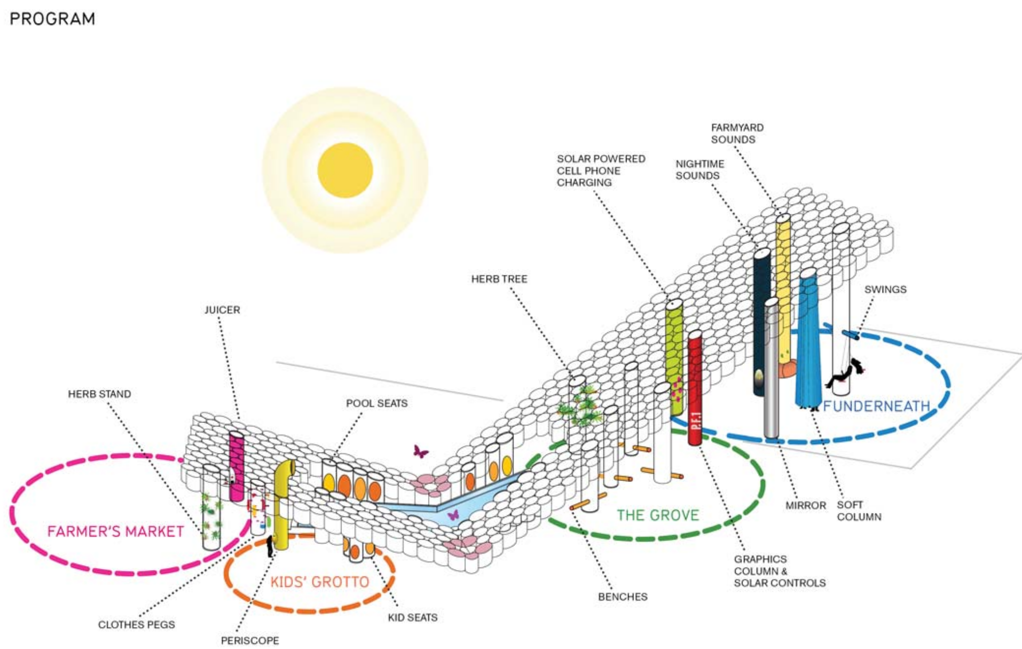


Figure 3.3.5 - Public Farm 1 in P.S.1 Program Distribution

Figure 3.3.6 - Public Farm 1 in P.S.1 MoMa New York by WORK AC

3.4 Urban Agriculture Strategies

This section focuses on the three food-oriented theories. The three distinctive models are theoretical-oriented, conjectural-oriented, and factually-oriented. The first model is the Continuous Productive Urban Landscape (CPUL), developed by architects Katrin Bohn and André Viljoen, using an interlinking strategy to connect edible landscapes in urban areas as a green infrastructure network that is spread across the city. The second model is Vertical Farming developed by Dickson Despommier. Agricultural production in a vertical format will not only solve food shortage issues but it also fits appropriately into the urban setting. The third model, the Food City developed by architects MVRDV and Why Factory, proposes a systematic approach to estimate food produced and consumed. These methods will collectively help qualify and quantify parameters to design Agri-town.

Vertical Farming (2010) – Dickson Despommier

Vertical farming, proposed by Dickson Despommier (2010), is intended to solve the food, water, and energy crises. The idea is to adopt a closed loop agricultural system. All the water and nutrients are recycled within the building by using suitable applications and technologies. One of the original forms used in current vertical framing is the hydroponics method, which strategically stacks greenhouses in a logical manner, based on site requirements.

There are multiple social, environmental, and economic benefits to adopting vertical farming in urban areas, whereby agriculture and development could coexist. Vertical farming allows food be produced 24 hours a day, 365 days a year. Crops and livestock are protected from unpredictable and harmful weather, preventing agricultural runoff, which secures availability of food for the neighborhood (Despommier 2010).

From the environmental perspective, vertical farming reduces the ecological footprint of agriculture, especially in urban areas where land availability may be limited. Having agricultural production centralized in one area of the site at a time allows the damaged ecosystem to naturally restore and replenish itself (Despommier 2010). Since the environment is under controllable conditions, organic growing is possible and the

Figure 3.4.1 - Vertical Farming Proposal & Water System

need for pesticides, fertilizers, and herbicides is eliminated. The food miles and hence dependence on fossil fuels could also be reduced drastically (Despommier 2010).

Vertical farming introduces a water collection system where water from an indoor environment and grey water are collected and recycled into potable water. The difference in water consumption between vertical farming and conventional farming is 70 to 95 percent (Despommier 2010). Animal and livestock are fed from post-harvest plant materials. Waste produced by humans and livestock could be treated and re-used as an energy source to contribute to the generation of power (Despommier 2010).

Vertical farming facilitates food safety and security. It also prevents crop loss due to shipping or storage, thus improving food adequacy. From the social perspective, vertical farming provides employment opportunities for the local residents as they actively participate in their community's efforts to create a sustainable living environment. (Despommier 2010).

Figure 3.4.2 - Continuous Productive Urban Landscape

<u>The Edible City (2005) – Katrin Bohn and André Viljoen</u>

Continuous Productive Urban Landscape (CPUL) is a coherent design strategy that introduces interlinked productive landscape into cities (Viljoen, A., Bohn, K., & Howe 2005). CPUL is a sustainable urban infrastructure that uses both spatial and occupational components in order to redefine open urban space usage. Some key features of CPUL are urban agriculture, leisure outdoor space, commercial outdoor space, natural habitats, ecological corridors and circulation routes for non-vehicular traffic (Viljoen, A., Bohn, K., & Howe 2005). CPUL recognizes that each site requires a distinct solution due to their unique site conditions. The concept impacts a city qualitatively in respect to citizens' experience as well as quantifiably by reducing negative environmental impacts (Viljoen, A., Bohn, K., & Howe 2005). In a city such as London, for instance, simply introducing urban agriculture on all the abandoned and leftover space within the city could produce about 30 percent of all fruit and vegetable needed to feed their current population. Growing fruit and vegetables is the most high-yield and space-efficient method in this instance. In Western Europe and North America, urban agriculture takes the form of urban farms, community gardens, or allotments (Viljoen, A., Bohn, K., & Howe 2005).

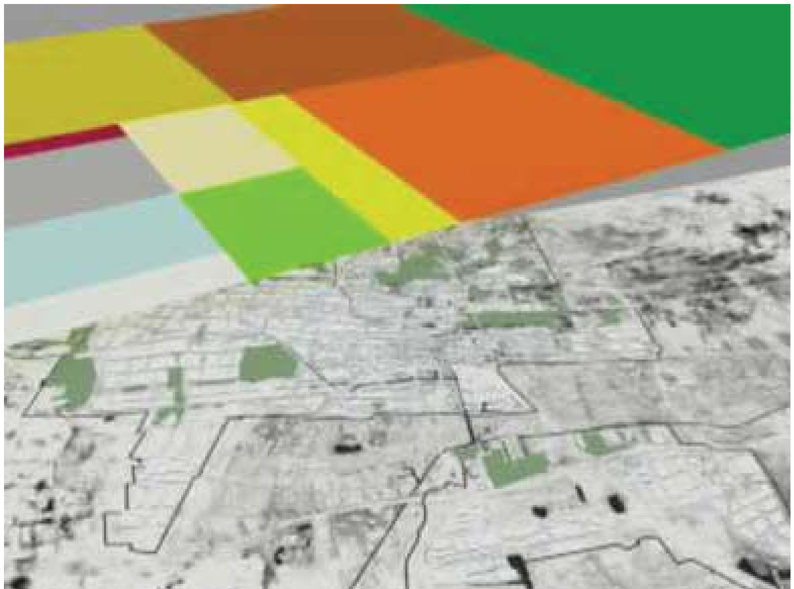


Figure 3.4.3 - Food City Study by MVRDV, the Why Factory

Food City (2009) – MVRDV + Why Factory

The Food City is an experiment proposed by MVRDV with the Why Factory in response to the current food crisis. The model estimates the food mass that an average person needs for a year, the land required to grow all of the food for that person, as well as the requirements for livestock and its feed and laydown in a flat area. The model has also shown that significant diet changes take place based on available land area. In the United States, for example, areas where people consume a lot of beef require about double the area of land to grow animal feed, compared to that of Japan. The Food City study used the city of Hangeul in Netherlands as an example to test whether urban agriculture would be feasible as an application. The proposal has been tested in 2 formats: first, by occupying all available vacant land, the city would require about 41.5 storeys to grow all of the necessary food to feed the city. In the second format, tower formations, the city would require multiple towers as tall as 35km. The conclusion of the experiment is that it may not be feasible for a city to achieve total food self-reliance. Although Food City is just an experiment, it provides a framework and outlines the factors to consider when executing an estimation of food consumption, as is done in the following chapter.

4

4.0 Food, Farming, and Housing Standards

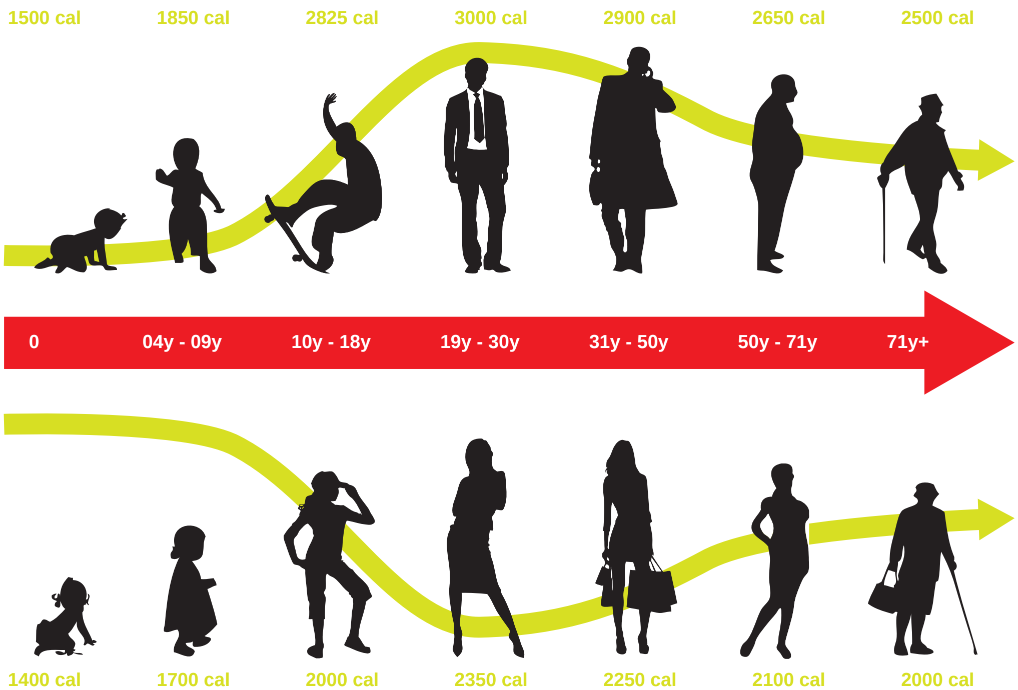


Figure 4.1.1 - Daily Average Calories Intake of Male and Female Canadians- Trends

This chapter is divided into three parts, each addressing the general standards and measurements pertaining to food, farm and housing. The following data is intended to establish a set of typical rules and design criteria for incorporating food, farm, and housing together as building typology. It is interpreted to demonstrate how this concept could improve food security, productivity and living conditions in order to ensure healthy food access, self-grown food to offset food expenditure, and provide opportunities for cultural exchanges for the low-income groups living in the city. Sections 4.1– Food Consumption, 4.2 – Food Types, and 4.3 – Food Servings determine the quantity and quality of crops and livestock to be consumed and produced, based on dietary recommendations. Ensuring the right amount and types of food promotes the individual's health. Sections 4.4 – Farm Yield, 4.5 – Farm Types, and 4.6 – Farm Sizes address conventional farming and determine what new possible farming methods and technologies could be implemented. Sections 4.7 – Affordable Housing Types, 4.8 – Affordable Housing Unity Sizes, and 4.9 – Affordable Housing Program, assess the current low-income housing designs and structures, laying out possible modifications, adjustments and improvements.

4.1 Food consumption

Food consumption is the first determinant that influences building design, and is concerned with food, farming, and housing. The daily food consumption of a person is measured in terms of energy intake. The unit of energy in the International System of Units (SI) is the joule (J), and large amounts of energy are measured in kilojoules (kJ = 103J). However, nutritionists and food scientists use calories and kilocalories to measure food energy in a regulatory framework. The conversion factors between joules and calories are as follows: 1kJ is equal to 0.239 kcal, and 1kcal is equivalent to 4.184 kJ (FAO 2002). The mass of food is expressed in grams (g). Food contains multiple components that provide energy to body; the main components are protein, fats and carbohydrates and other components, which include alcohol, polyols, organic acids and vitamins and minerals (FAO 2002). The number of calories contained in a unit varies from component to component within food. For example, the energy value of 1 gram of carbohydrate is 16 kJ (4 cal); 1 gram of fat is equivalent to 37kJ (9 calories); 1 gram of protein provides 17kJ (4 calories) and 1 gram of alcohol contains 29kJ (7 calories) (Otten, Hellwig, & Meyers 2006).

By determining the amount of food energy an individual or a household needs each day, the data suggests the amount of food that needs to be grown within the residential site. According to Health Canada's statistics (see Table 4.1), the average calorie intake for a male Canadian is about 2441 calories per day; for a female Canadian, it is about 2016 calories per day. This rate pertains to a moderately active person who carries out typical daily living activities for at least 60 minutes per day (Health Canada 2007). The average calorie intake varies between individuals depending on age, height, weight, gender, activity levels, genetics and body constitution (Health Canada 2007).

The nutrient ratio is fairly similar across genders and different age groups; the proportion curve does not change. Only the total food consumption per individual varies, depending on geographic location, ethnic background and eating habits. Individual food consumption in developed countries is usually much higher than the consumption for people living in the developing countries. However, the required intake could be similar; perhaps there are omissions in the available data regarding wasted or excessively

Figure 4.1.2 – Daily and Annual Total Calories Intake of Male and Female Canadian

consumed food. In general, the required calorie intake per day has a significant increase from the stage of childhood into teenage years. After the age of 18, or upon reaching adulthood, the energy requirement gradually decreases with age. For children, women of childbearing age and men and women over 50, it is vital to ensure proper nutrition (Health Canada, 2007).

As stated earlier in this chapter, an active male requires an average total of 2441 calories intake per day (890,965 calories per year), and an active female requires an average of 2016 calories intake per day (735,840 calories per year) to acquire enough energy to perform typical daily activities. Using the annual average intake per person, the amount of food that needs to be grown for a person can be determined. In later sections of this chapter, in-detail analysis of farm sizes will be conducted to calculate the area of cropland required per head.

In summary, if a property or living unit can harvest 890,965 calories of food each year, this could provide enough energy for daily activities and offset the food expenditure of a single male Canadian. The target for a single female Canadian is 735,840 calories per capita. However, simply securing the quantity of energy intake does not necessary ensure that the person is eating well and receiving the proper nutrients. A person needs to absorb different kinds of nutrients from various kinds of food each day in order to stay healthy and maintain proper functioning of bodily metabolic processes.

4.2 Food Types

This section determines the possible food types that can be produced in sufficient quantities within the City of Toronto to establish food availability and accessibility during different seasons. As well as the quantity of food, the quality of food is essential to an individual's health. One healthy meal should include a portion of each category of food—vegetables and fruits, grain products, milk or alternatives and meat or alternatives (Health Canada 2007). This is explained in detail in the food-serving chapter. The ideal scenario is to grow and harvest all four types of food within a property. However, this may not be feasible and one needs to identify what can be grown under the climate conditions.

According to statistics issued by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA),there are 22 community groups of agri-food trading business in Ontario (OMAFRA 2010) (see appendix for details of groups). The statistics also show that the proportions of food export and import are imbalanced within the province. Ontario has exported over $9.3 billion (35 percent) of food outside the province, and imported over $16.8 billion (65 percent) of food from other places. The province made more than one third of its potential local food inaccessible to the people living in Ontario.

Foodland Ontario, a consumer promotion program of OMAFRA, has partnered with producers to achieve maximum penetration of the Ontario market for local agricultural products. The program indicates 70 different kinds of crops and livestock that can be grown either on fields or greenhouses within the province (see Figure 4.2.1). Among the wide range of available foods in the region are 40 types of vegetables, 18 types of fruits, 7 types of meat and fish, 3 types of dairy and eggs products, and 2 types of specialty food (see appendix for details) (Foodland Ontario, 2010). The wide range of food types commonly grown in Ontario demonstrates that ecological and natural conditions are conducive to providing a good variety of local food supply.

The calendar of Ontario's seasonal availability (see Figure 4.2.2) illustrates the growing seasons of each type of crops and livestock. This calendar indicates that several vegetables and fruits can be grown during different seasons, making them accessible throughout the year. Some recommended foods that can be grown in the

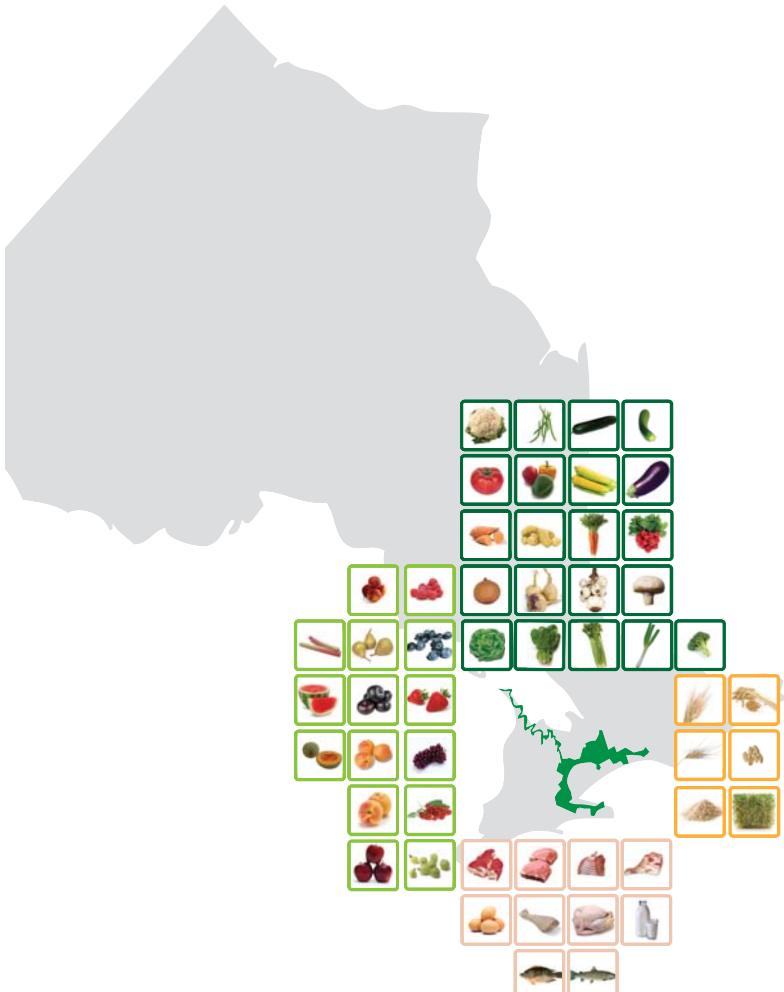


Figure 4.2.1 – Ontario Availability of Food Groups and Greenbelt

time frame of 6 months or more within the region are: bok choy, carrots, cauliflower, mushroom, onions, potatoes and rutabaga in the vegetable group, and apples and rhubarb in the fruit group (Foodland Ontario 2010). Further, some vegetables that can be easily grown in a greenhouse environment are cucumbers, lettuce and tomatoes. Chicken, duck, geese, and goat are the common livestock and poultry in the region. The breeding and gestation periods for these cover two seasons (England 2007). Therefore, choosing one of the mentioned animals for a domestic diary/poultry farm, egg, meat and dairy product supply can be ensured for a certain period of time for each year. The chart shows that there are food items from each 4 major categories that can be made available locally for more than half of a year. This way, the food and nutrient supply for each individual in a household can be secured by better managing of food cultivation.

Apart from climatic constraints and weather conditions, which dictate all types of agriculture productions, the most challenging part of urban agriculture is finding open spaces to grow food in a city with high population density. Finding spaces to grow vegetables and fruits is relatively easy, as these are more flexible in size and scale requirements. However, it is more difficult to accommodate animal, livestock, feedstock and farming equipment, as land values in urban area are very high. In summary, the food items possible to be grown locally within individual residential spaces are bok choy, carrots, cauliflower, mushroom, onions, potatoes and rutabaga, apples and rhubarb. Chicken and duck farming can be incorporated for dairy, egg and meat in control conditions. The items that could be grown in indoor spaces are cucumbers, lettuce, and tomatoes. However, further investigation is needed to determine whether these food choices alone could make a good serving for an individual’s health.

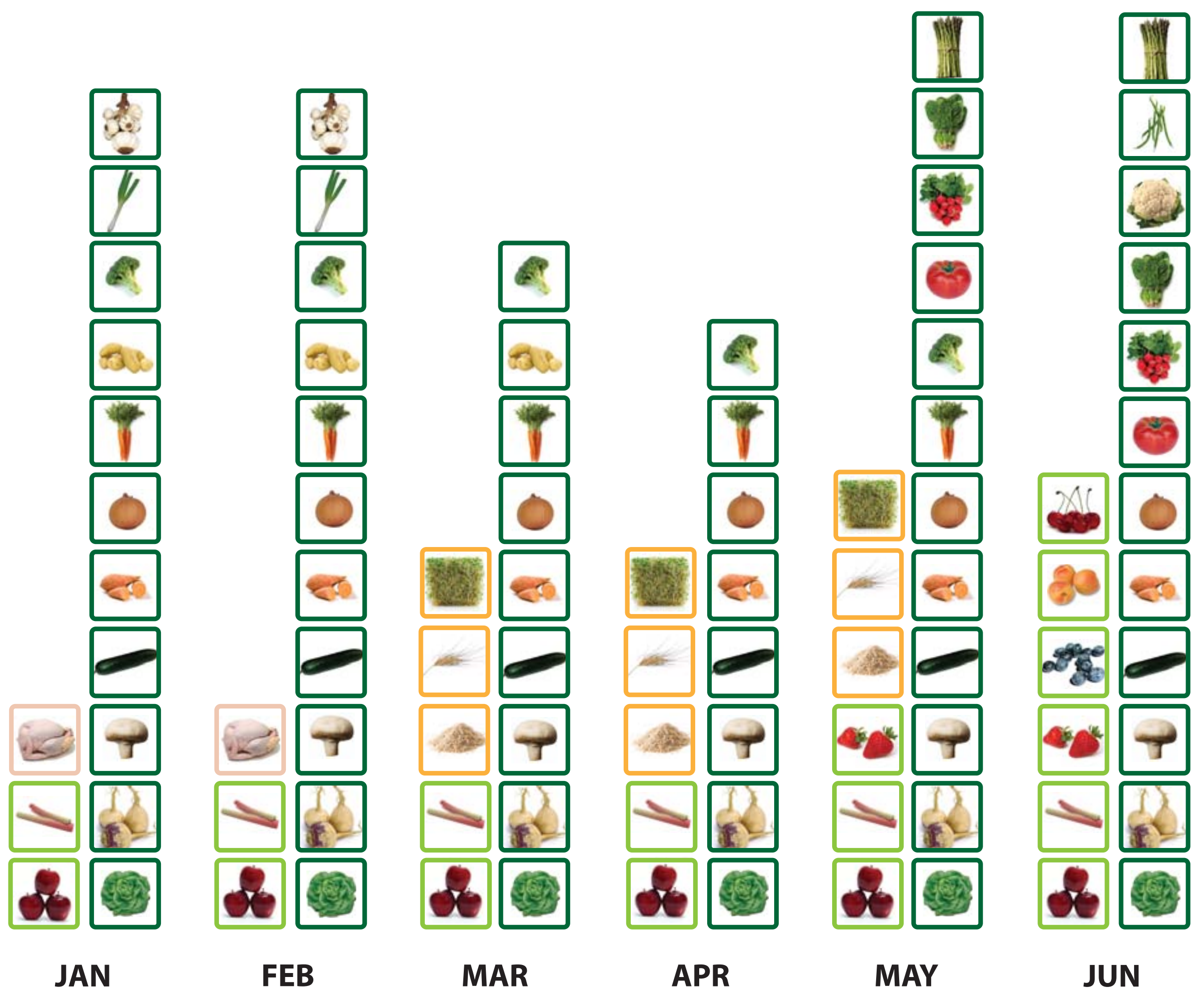
4.3 Food Serving

To further reinforce the adequacy in food security, it is important to determine whether the food grown locally would be enough to supply healthy food servings per meal, fulfilling the nutrients and energy requirements of each individual. This section addresses the recommended quantity and quality of food that a person needs in each meal in order to maintain a nutritious diet. Furthermore, it will suggest how many healthy servings and volumes of food each person needs to produce in their living unit either individually or as a community in larger garden spaces, in order to offset their food bills without compromising their balanced diets.

Much like calorie intakes, the definition of a good serving varies depending on individual‘s age, height, weight, gender, and activity levels as well as genetics and body consumption (Health Canada 2007). The healthy food pyramid (see Figure 4.3.1) shows the food products and the proportion of different food types a person needs to vegetable fruit grain* meat*

*harvesting season

*livestock breeding season



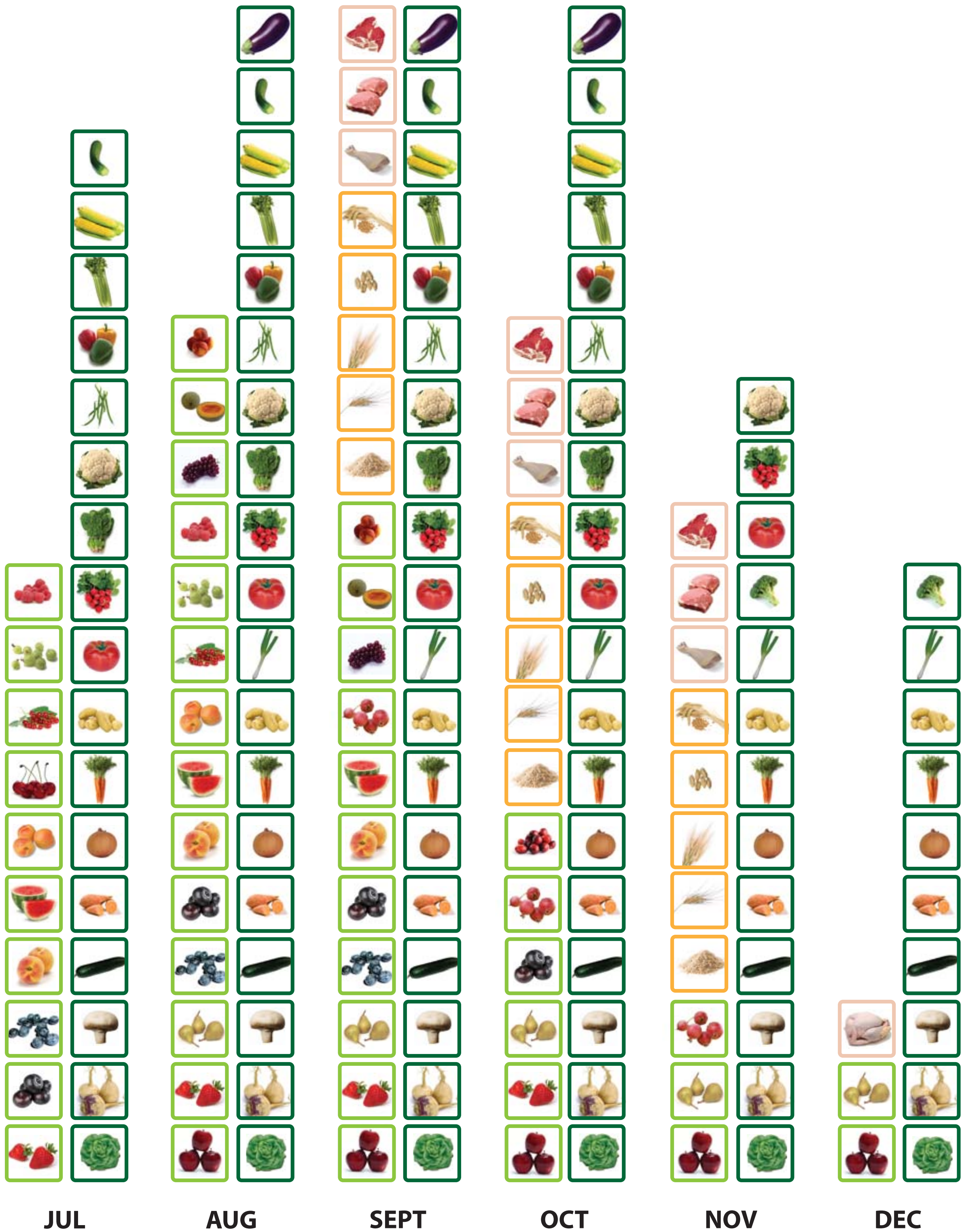


Figure 4.2.2 – Ontario's Seasonal Availability Calendar

	children			teens	adults		children			teens	adults	
	2-3	4-8	9-13	14-18	19-50	51+	2-3	4-8	9-13	14-18	19-50	51+
vegetable fruit	4	5	6	8	8-10	7	4	5	6	7	7-8	7
grain	3	4	6	7	8	7	3	4	6	6	6-7	7
dairy	2	2	3-4	3-4	2	3	2	2	3-4	3-4	2	3
meat	1	1	1-2	3	3	3	1	1	1-2	2	2	3

Figure 4.3.1 – Food Serving Count Unit in Food Guide

eat per day in order to stay healthy. One should eat more foods from the bottom part of the pyramid, such as vegetables and whole grains products, and less from the top such as red meat, sugary drinks, salt and refined grains. A certain amount of alcohol and additional vitamins might be necessary for some people as optional or supplemental products, but are not applicable to everyone (Willett, Skerrett, Giovannucci, & Callahan 2001).

The quantity of food servings is calculated differently for each food item. Food-measuring units are expressed in milliliters and grams. The quantity and the number of servings in the recommended chart guide are determined based on the volume contained per serving cup(s). Each serving of vegetables is equivalent to 125 milliliters (mL) or half a cup, 1 serving of meat is equivalent to 75 g and 1 serving of fruit is equivalent to 1 fruit in quantity (see Figure 4.3.2).

Following the recommended food guide will help meet the daily-required intake for vitamins, minerals, and other nutrients. In addition, eating well could reduce the risk of obesity, Type 2 diabetes, heart disease, certain types of cancer and osteoporosis, and contribute to the individual’s overall health and vitality (Health Canada, 2007). However, males and females require different amounts of food servings per day, as do children, teens and adults (see Figure 4.3.3). A typical adult male between the age ranges of 19 to 50 needs 8 servings of vegetables; 8 servings of grain; 2 servings of dairy and 3 servings of meat per day. Converting to food volume and mass, this amounts to 1000mL of vegetables, 1000mL of grain, 250mL of dairy and 225g of meat each day. A typical female in the age ranges of 19 and 50 needs 7 servings of vegetables; 6 servings of grain; 2 servings of dairy, and 2 servings of meat per day. When converted to food volume and mass, this equals 875mL of vegetables, 750mL of grain, 250mL of dairy, and 150g of meat.

For practical purposes, (since 1mL of water has a mass of 1 g, let us assume similar density for all the food types) we may conclude that a male Canadian needs to consume about 2475g per day (903,375g per year), and a female Canadian needs to consume about 2025g per day (739,125g per year) (see Figure 4.3.4). With this information, the arable area each person needs to secure for food production so that his or her food requirements can then be determined.

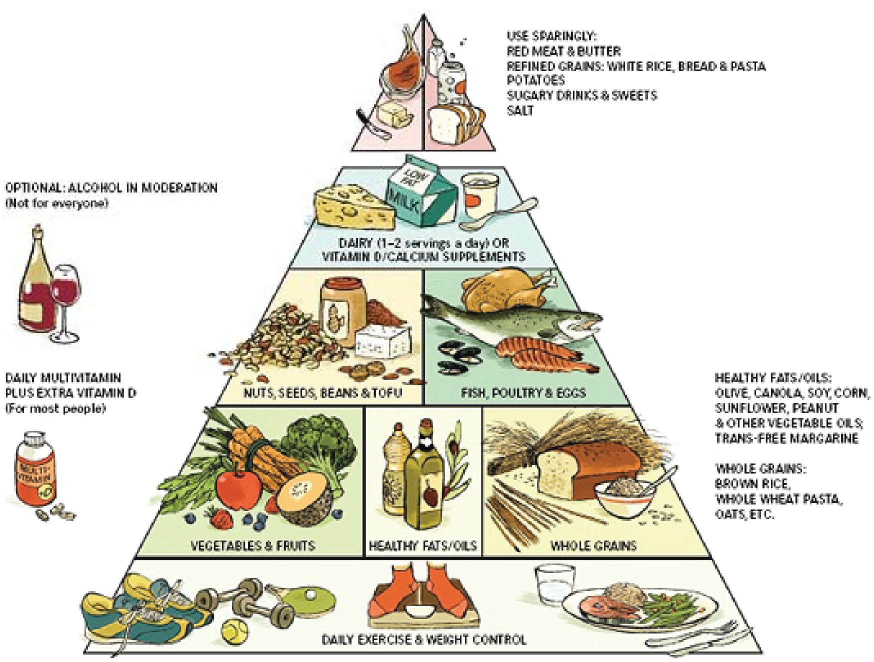


Figure 4.3.2 – Food Pyramid

4.4 Farm Yield

The quantity and quality of food per person have been determined in previous sections. The following section will address the yield for each local food type in order to estimate the area a person would need to secure for food production to meet their daily and annual energy intake and volume of food. Each food item requires different amounts of space to grow and to process. The area considerations for the growth and harvest of vegetables, fruits, grains and livestock differ from species to species. This section will use a number of charts as reference to explain the growth and time requirements for each of the food types that are cultivable in Ontario through the conventional agricultural method of field growing and harvesting. This guide will provide rough estimations of area that one needs to reserve in order to grow multiple foods within the city, that will meet the energy intake and amount of food required per person.

The reference charts are separated according to their food groups. For vegetables, fruits and grains, each label identifies the common and biological name, class, seeding season, time to maturity, harvest period, water requirement level, ratio of calories input and output, as well as conventional yield, from top to bottom respectively. In a similar format for livestock and poultry, each label identifies the common and biological name, class, breeding seasons, gestation period, time to maturity, temperature, ratio of calories input and output, average water requirement, and average feed requirement (see Figure 4.4.1 to 4.4.4).

Space is one of the four basic considerations in growing food, in addition to sunlight, water and nutrients. There are no specific restrictions for plant growing, as long as a container or pot holds the growing medium, accepts and drains water and gives the plant sufficient space to grow (Tracey 2011). Seed spacing is the only consideration that differs for each species; this estimation can be calculated based on their yield, which is expressed in kilograms per square meter (kg/m2) in the charts.

Food production under Canada‘s cold climate could start in early February, and plants could be transplanted easily from outdoor to indoor and vice versa throughout different seasons (Tracey 2011).

Based on prevailing conditions, the potential for including livestock in urban agriculture is relatively low. This is because their water consumption, feedstock, nutrient, and waste storage require ample space and energy. In addition to the space required for growing crops, animals also need space to exercise. Thus, poultry like chicken and ducks, which are small in size and require the least amount of water and food per day, are the easiest livestock that can be included in domestic farming.

In this section, the required space and yield for each agricultural product that is available in Ontario are determined. This data can further be explored to compare between the productivity of the conventional field lawns growing method in the rural areas and the compact growing method in the urbanized districts.

Making the assumption that an adult male and an adult female will eat only rice in a year for every meal, to produce the amount of rice to cover all the energy for their daily activities, the male requires 477 m2 of growing space and the female requires 395m2 of growing space (see Figure 4.4.6).

Calculations are shown below:
Given: kcal / year for male = 890,965 kcal / year for female = 735, 840 kcal ratio (output : input) of rice = 2.5 : 1 rice yield = 747g / m2 Formula: growing area = [(person kcal / year) / (crop kcal ratio)] / crops yield]
Male scenario: (890,965 / 2.5) / 747 = 477.0896921017403m2 = (477m2)
Female scenario: (735,840 / 2.5) / 747 = 394.0240963855422m2 = (394m2)

However, in order to calculate the required growing area with multiple crops for each person, both the food mass and the ratio of caloric input and output of the crop item must be taken into consideration. If we consider only the overall average of food mass, the answer will be inaccurate with figures either over or below the food energy level standard for each person.

Cauliflower
Brassica botrytis
C

ND - 24 8 32
1880 g/ m^2

Beans
Phaseolus spp
L

0.345:1 - 24 8 32
859 g/ m^2

Zucchini
Cucurbita pepo
V

ND - 24 8 32
1318 g/ m^2

Cucumber
Cucumis sativus
V

0.35:1 - 24 8 32
1918 g/ m^2

Tomato
Lycopersicon esculentum
F

0.60:1 - 24 8 32
3720 g/ m^2

Pepper
Capsicum annuum
F

0.14:1 - 24 8 32
3354 g/ m^2

Corn
Zea mays
M

2.5:1 - 24 8 32
1318 g/ m^2

Eggplant
Brassica oleracea
C

1:1 - 24 8 32
2690 g/ m^2

Sweet Potato
Brassica botrytis
C

1:1 - 24 8 32
2825 g/ m^2

Potato
Solanum tuberosum
R

1.23:1 - 24 8 32
4110 g/ m2

Carrot
Daucus carota
R

ND - 24 8 32
3540 g/ m2

Radish
Raphanus sativus
R

1:1 - 24 8 32
2475 g/ m^2

Blueberry
Vaccinium corymbosum
P

0.075:1 - 24 8 32
430 g/ m^2

Raspberry
Rubus idaeus
P

0.34:1 - 24 8 32
600 g/ m^2

Strawberries
Fragaria virginiana
P

0.21:1 - 24 8 32
5000 g/ m^2

Grapes
Vitis spp
P

0.174:1 - 24 8 32
1543 g/ m^2

Cranberries
Vaccinium macrocarpon
P

1:1 - 24 8 32
1680 g/ m^2

Gooseberries
Ribes uva-crispa
P

1:1 - 24 8 32
336 g/ m^2

Nectarines
Prunus persica
T

1:1 - 24 8 32
1408 g/ m^2

Apples
Malus domestica
T

1.1:1 - 24 8 32
2510 g/ m^2

Pear
Pyrus communis
T

0.51:1 - 24 8 32
3250 g/ m^2

Plum
Prunus domestica
T

0.765:1 - 24 8 32
1303 g/ m^2

Apricots
Prunus armeniaca
T

1:1 - 24 8 32
2225 g/ m^2

Peaches
Prunus persica
T

1:1 - 24 8 32
2607 g/ m^2

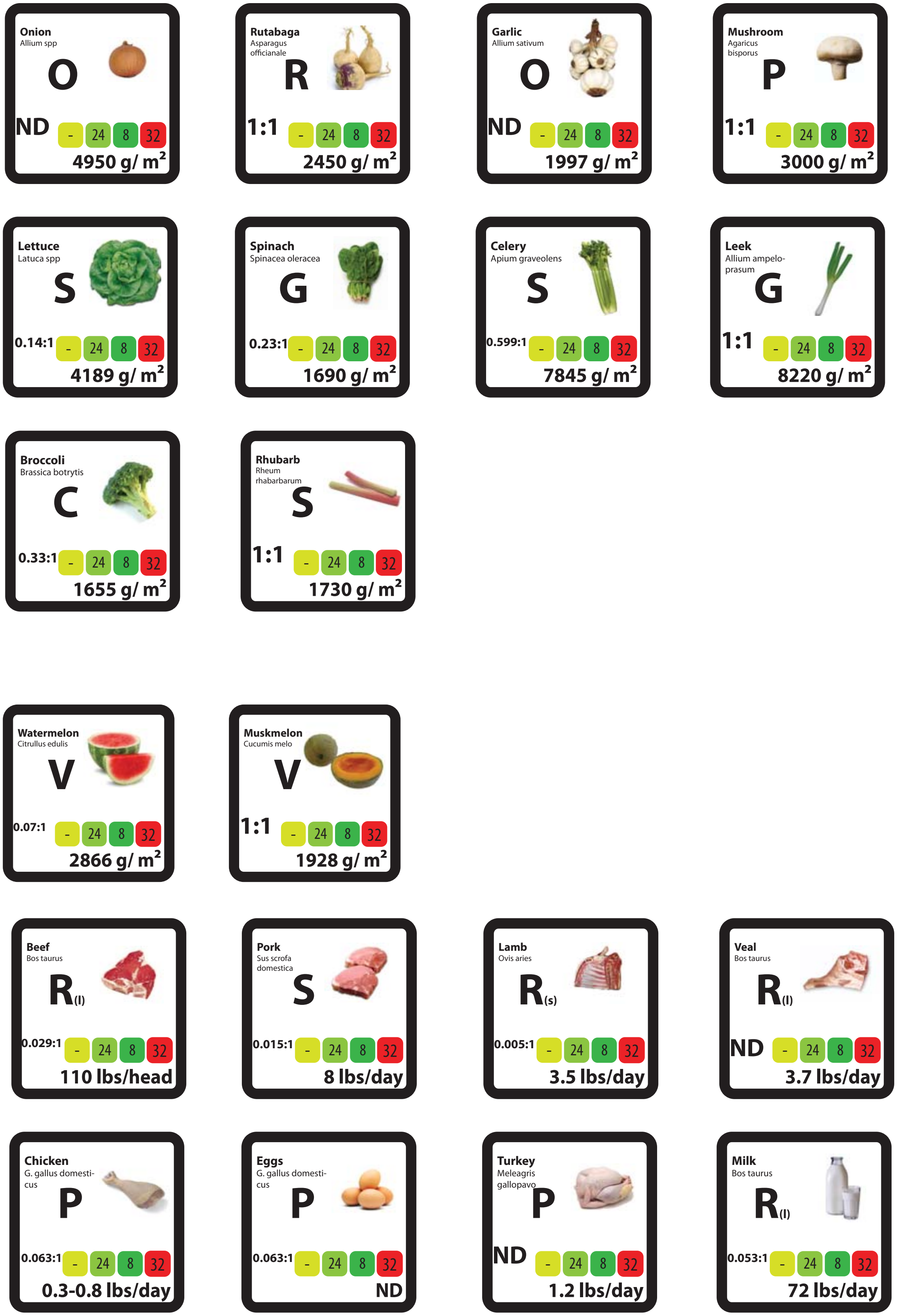
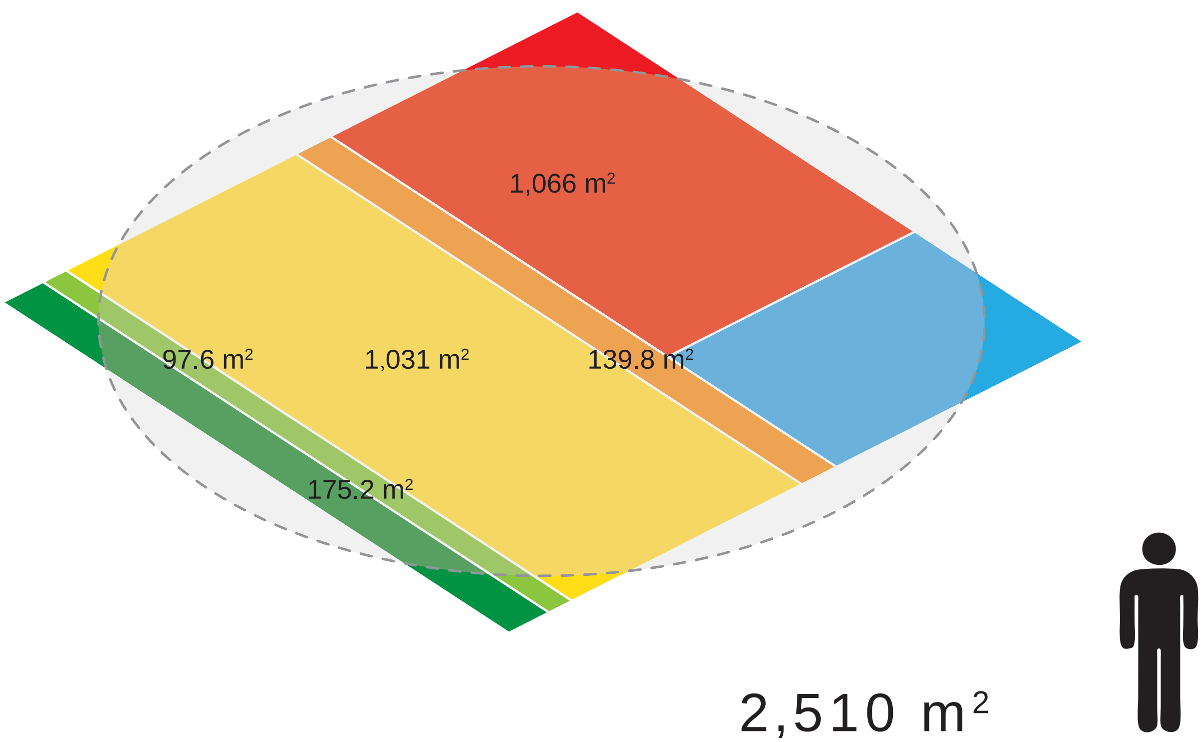


Figure 4.4.1 – Food Crop Yielding

Male Serving	Vegetables (g)	Fruits (g)	Grain (g)	Dairy (mL)	Meat (g)	Fish (g)	Approximation
How much food does 1 Canadian consume per day?	6 (1500g)	2 (500g)	8 (1000g)	2 (500mL)	2 (150g)	1 (75g)	3650g
How much food does 1 Canadian consume per year?	547,500	182,500	365,000	182,500	54,750	27,375	1,332,250
	Area (m2)	Area (m2)	Area (m2)	Area (m2)	Area (m2)	Area (m2) [Volume (m3)]	Area (m2)
How much land do 1 Canadian need to grow their consumption per day?	0.48	0.27	2.82	0.38	2.92	3.48 [0.2]	10.35
How much land do 1 Canadian need to grow their consumption per year?	175.2 (7.0%)	97.6 (4%)	1031 (40%)	139.8 (6%)	1066 (43%)	1271 [71.2]	3780 (100%)



Female Serving	Vegetables (g)	Fruits (g)	Grain (g)	Dairy (mL)	Meat (g)	Fish (g)	Approximation
How much food does 1 Canadian consume per day?	5 (1250g)	2 (500g)	6 (750g)	2 (500mL)	1 (75g)	1 (75g)	3650g
How much food does 1 Canadian consume per year?	456,250	182,500	273,750	182,500	27,375	27,375	1,332,250
	Area (m2)	Area (m2)	Area (m2)	Area (m2)	Area (m2)	Area (m2) [Volume (m3)]	Area (m2)
How much land do 1 Canadian need to grow their consumption per day?	0.40	0.27	2.12	0.38	1.46	3.48 [0.2]	8.11
How much land do 1 Canadian need to grow their consumption per year?	146.9 (7.0%)	97.6 (4%)	773.3 (40%)	139.8 (6%)	532.9 (43%)	1271 [71.2]	2510 (100%)

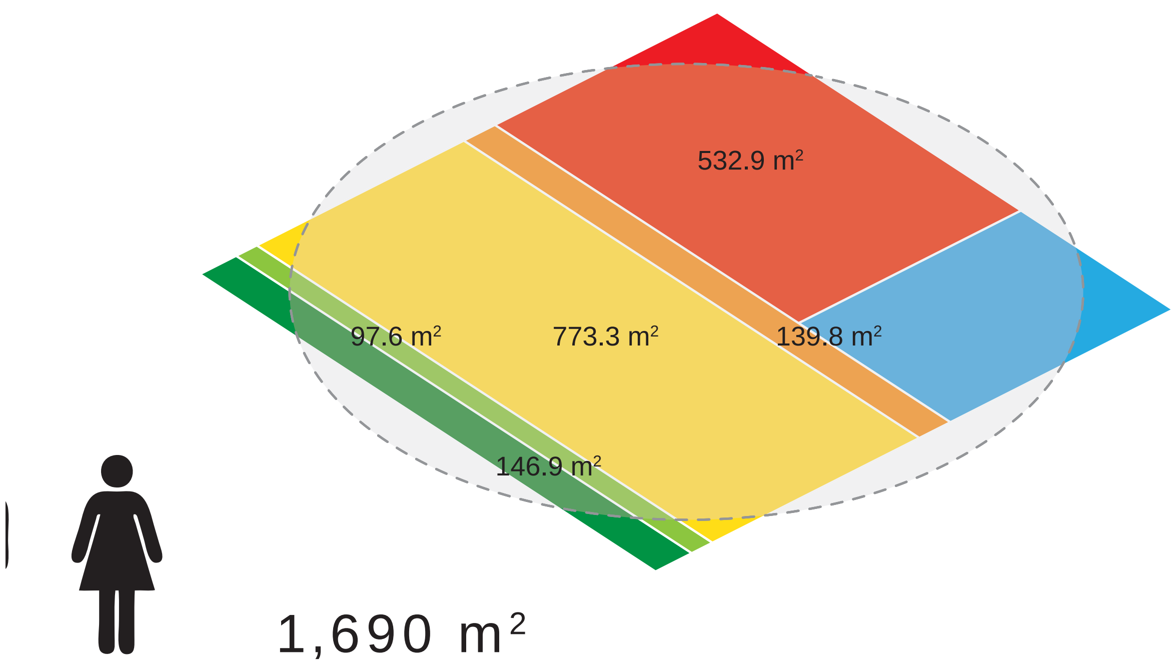


Figure 4.4.2 – Annually arable area per person

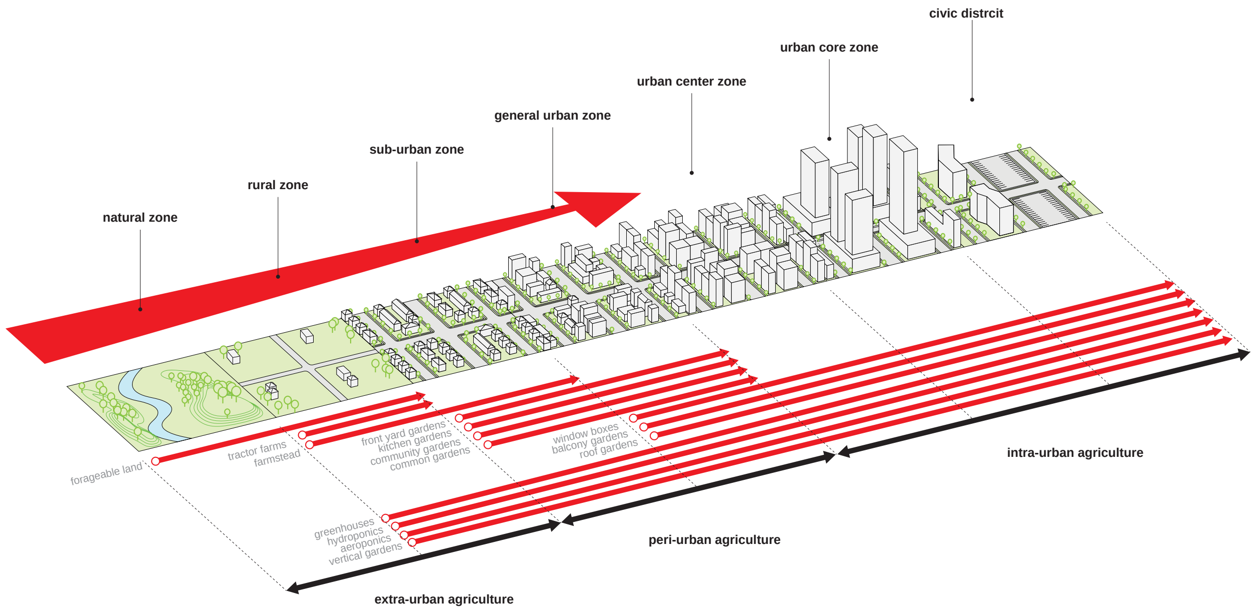


Figure 4.5.1 – Current Agriculture System

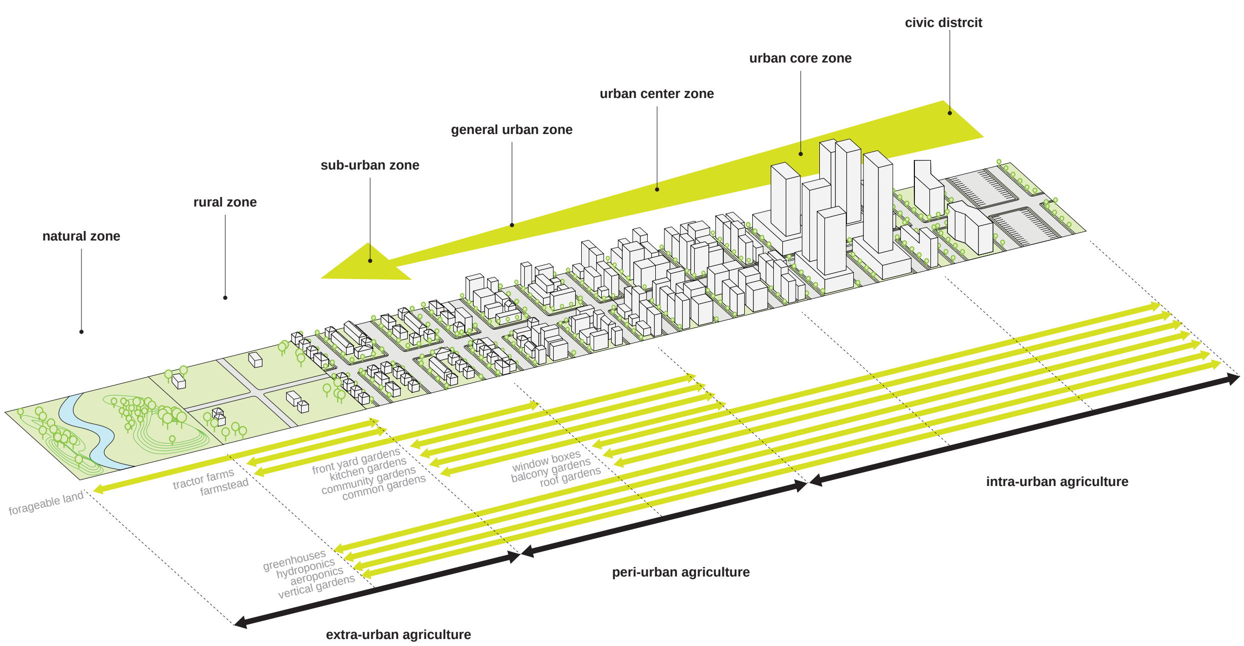


Figure 4.5.2 – Agricultural Urbanism

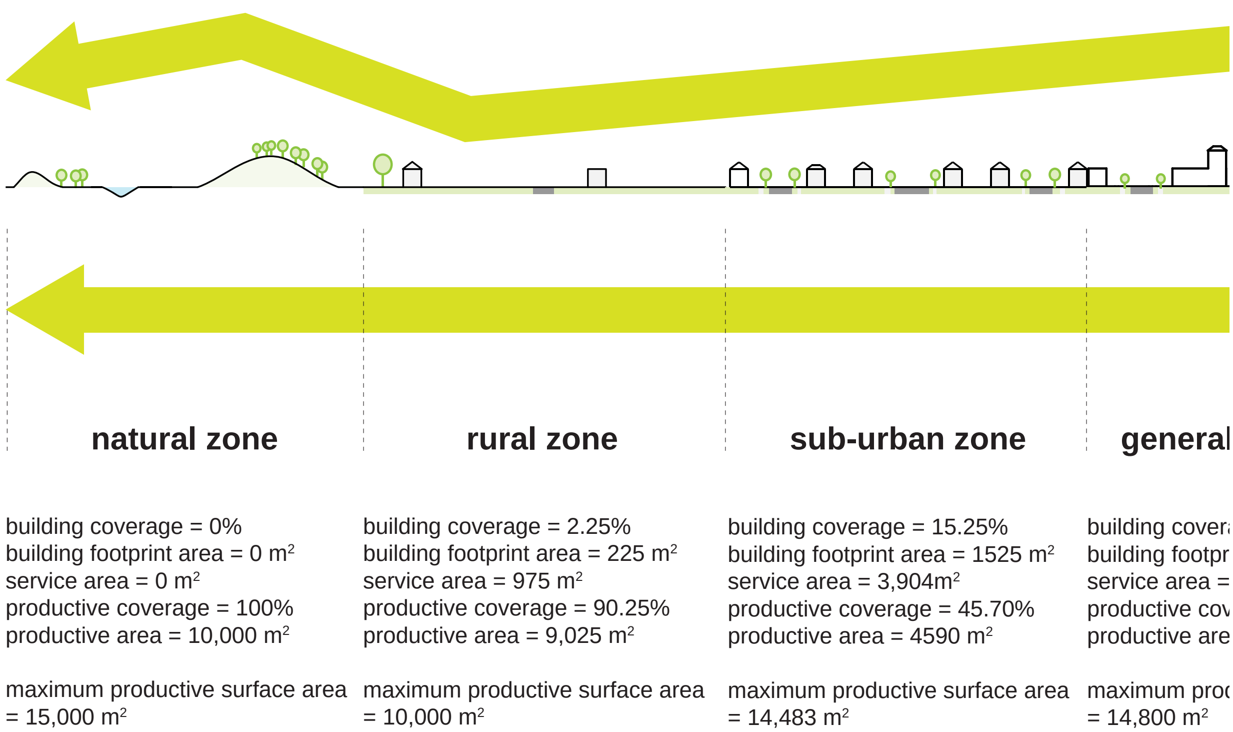
4.5 Current Agricultural System

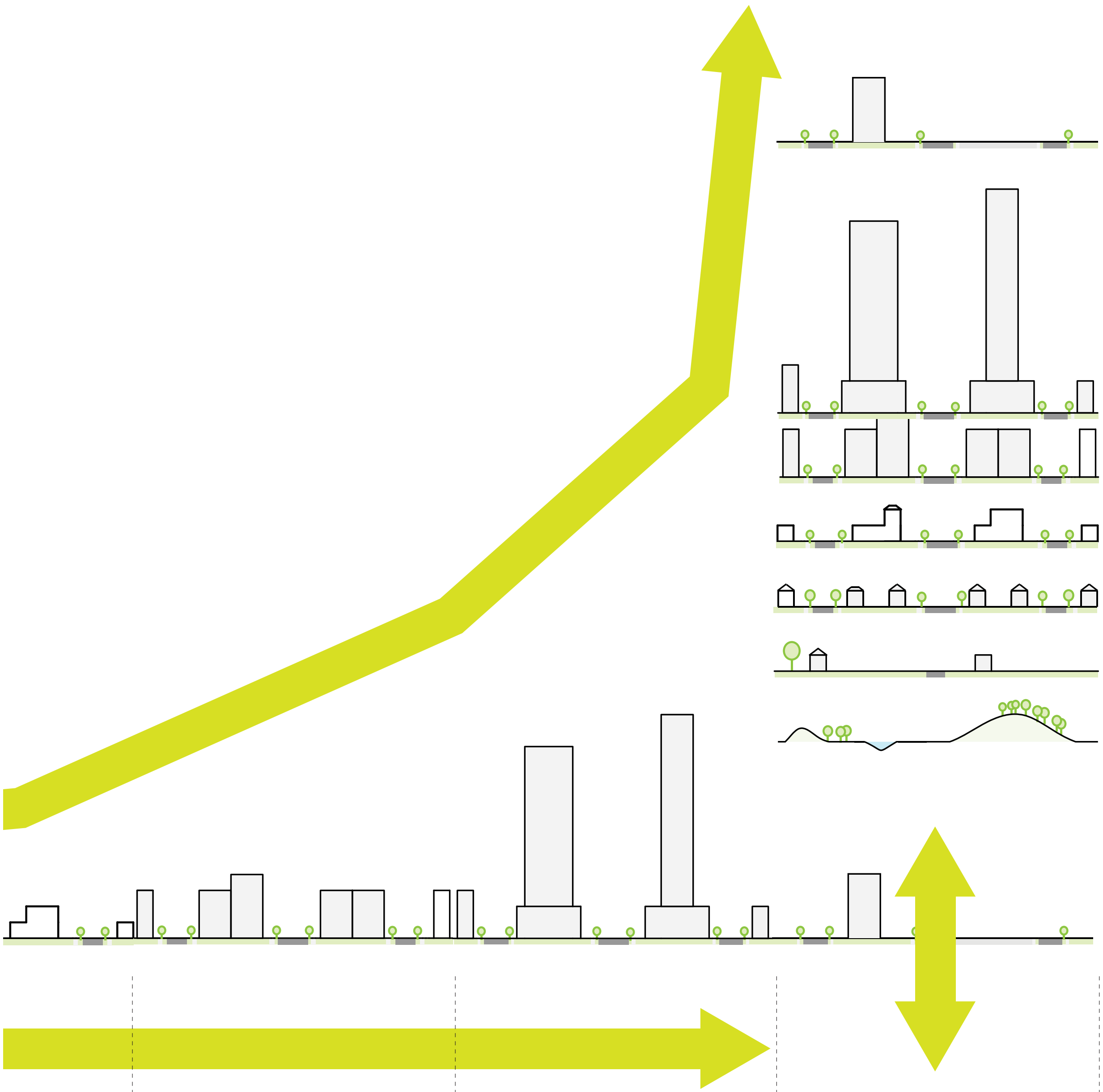
The current agricultural system for a city resembles a unidirectional flow from the rural zone to the urban core (see Figure 4.5.1). Food and waste travel the same distance before they are processed. Thus, the current system and processes end up adding food miles and greenhouse gas emissions as the city expands. Agricultural Urbanism is a theory that proposes to bring all the agriculture processes into closer proximity. Here, food serves as the prime infrastructure element that connects the various activities together. The idea of agricultural urbanism may be applied to different scales and sizes of food production zones along the transect. The concept of agricultural urbanism is subdivided into 3 streams; extra-urban agriculture, peri-urban agriculture and intra-urban agriculture (see Figure 4.5.2). The flow of product and processes will emerge from both directions and food production and waste treatment will take place locally in both the rural and urban zones.

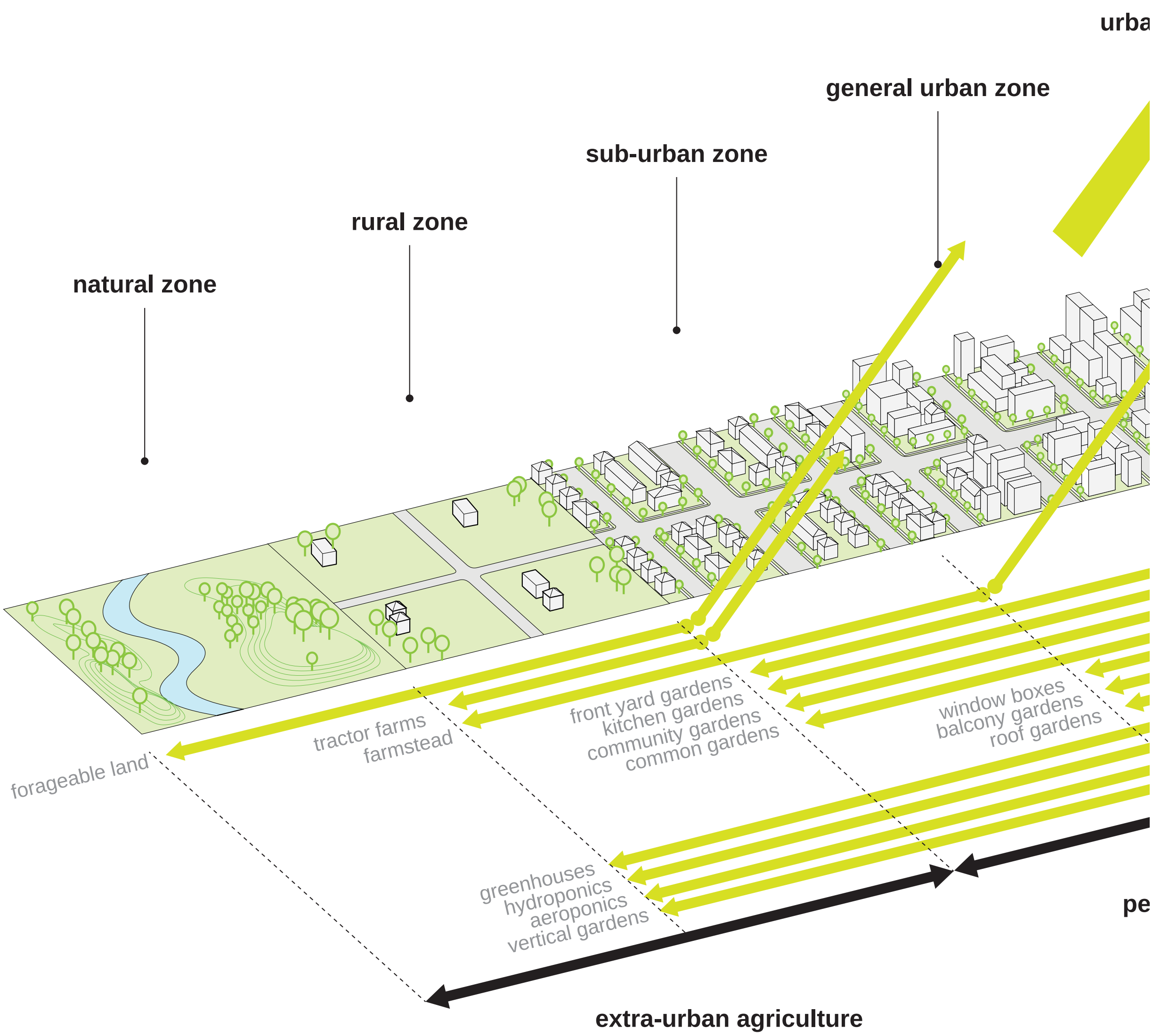
4.6 Vertical Agriculture Urbanism

Vertical agricultural urbanism is the stream that explores agricultural systems in the vertical manner within the urban zone of a city. This concept is an extension of the transect model proposed by Andre Duany, which stacks different zones with unique characteristics together, to allow food production to occur in three directions—horizontally, vertically and diagonally. With the integration of greenhouse technologies and farming applications such as hydroponics and aeroponics growing methods, as well as living wall systems, vertical agricultural urbanism would alter the appearance of buildings, regardless of whether it uses a high-tech or low-tech solution. This organizing principle enables food production and inhabitable space to be shared within the same site, thus optimizing spaces for food and shelter to make up a new lifestyle together.

In order to investigate the idea further, a simple study (see Figure 4.5.3) is conducted by comparing the different zones along the transect proposed by Andre Duany. The objective of this study is to determine how urbanization affects arable space by estimating the maximum productive surfaces and planes based on a typical 100 meter by 100 meter block on each zone along the transect. The determinants are categorized into building coverage, building footprint areas, service and road area, productive coverage and total productive surface area. These are estimated by adding building façades, open spaces and side walks within the block. The findings of this experiment suggest that the agricultural opportunities of a site increase in correlation with its density. This proves that agricultural production can co-exist with spaces for habitation without any conflicts. The concept of vertical agricultural urbanism is subdivided into 3 major areas as follows: low-urban agriculture, mid-urban agriculture, and high-urban agriculture (see Figure 4.5.4). If different zones are stacked and mixed together in three different directions on each floor, the level creates its own microclimatic conditions, which are suitable and controllable for a variety of different programs and growing strategies.






urba
general urban zone
sub-urban zone
rural zone
natural zone
forageable land
tractor farms
farmstead
front yard gardens
kitchen gardens
community gardens
common gardens
window boxes
balcony gardens
roof gardens
greenhouses
hydroponics
aeroponics
vertical gardens
pe
extra-urban agriculture

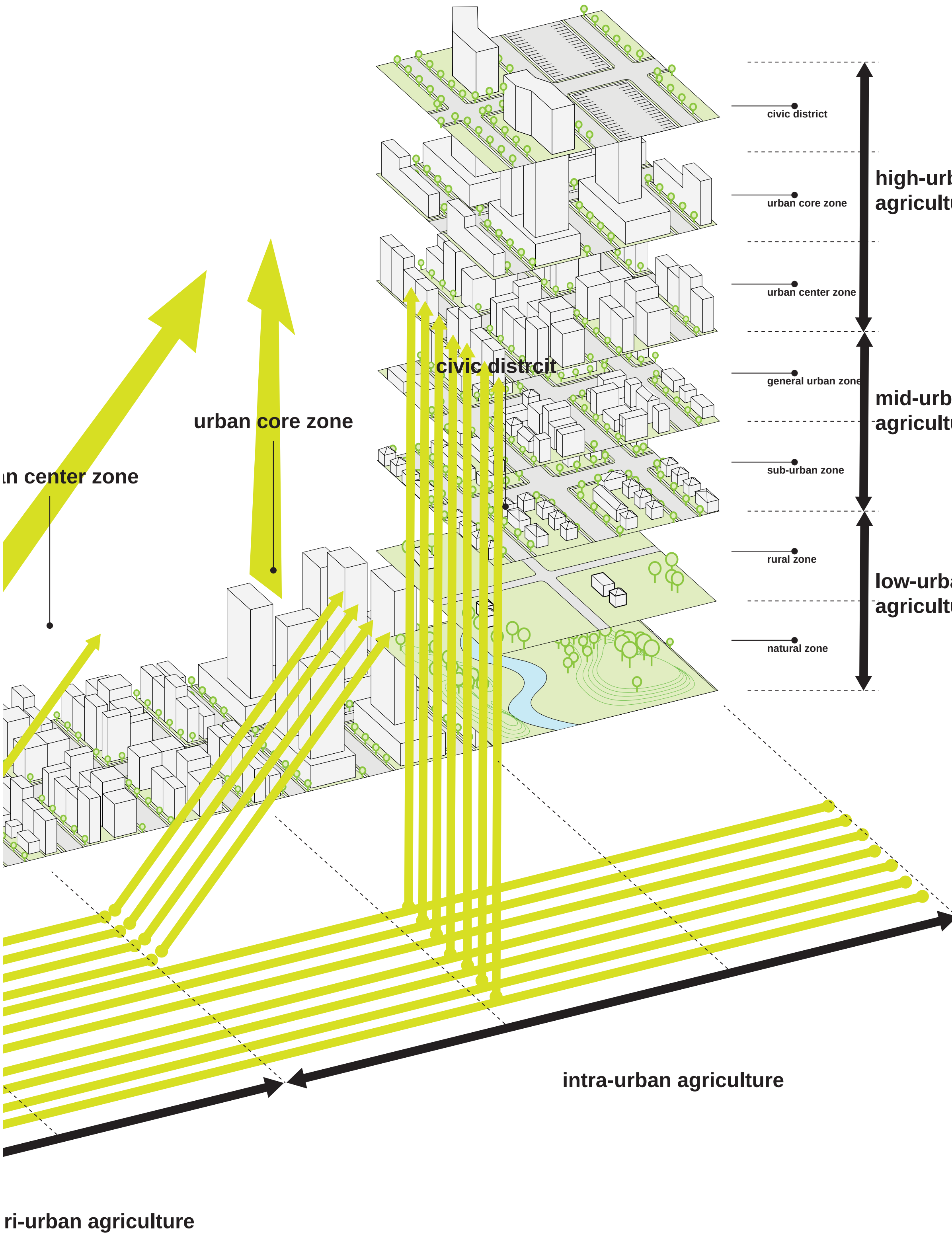
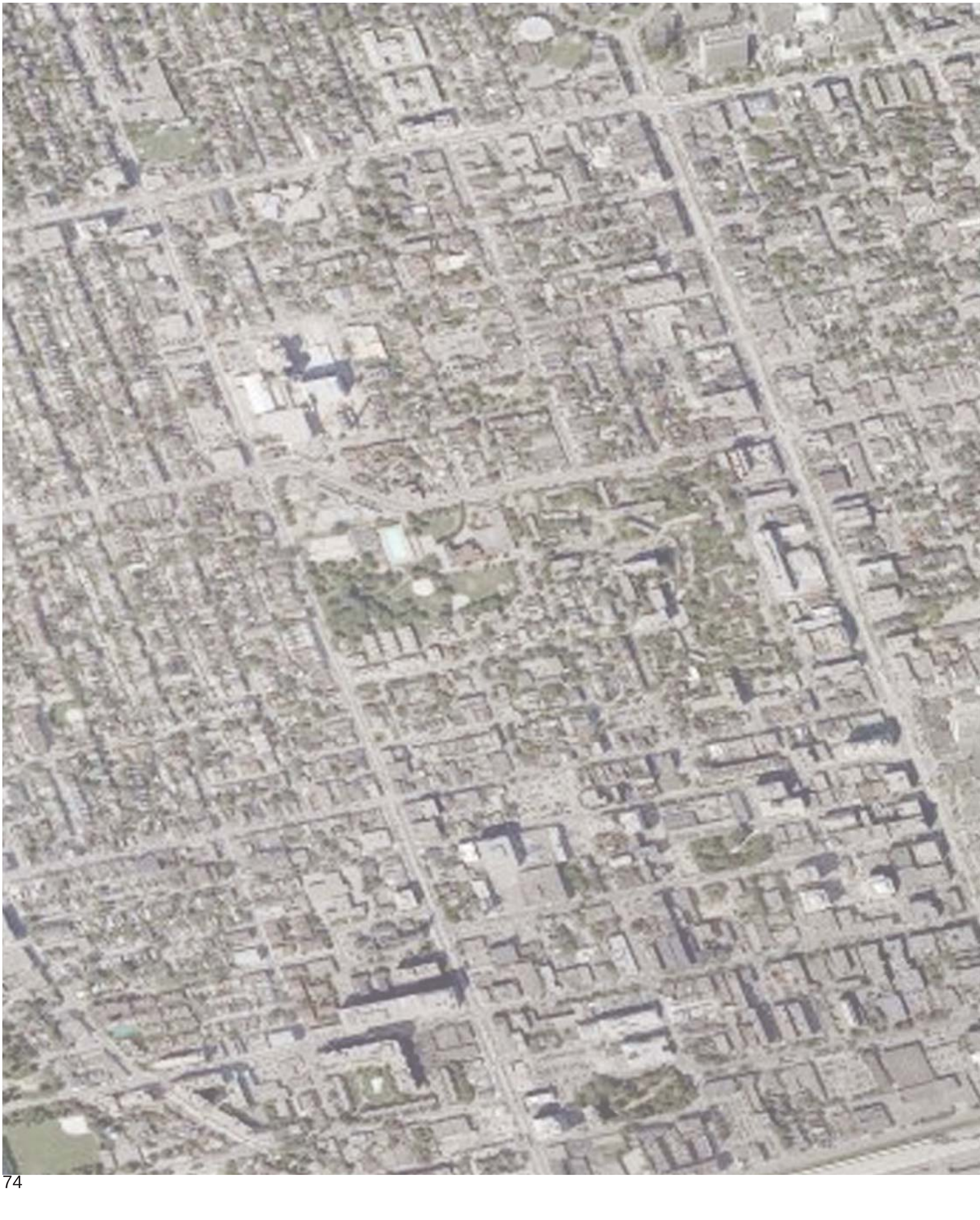
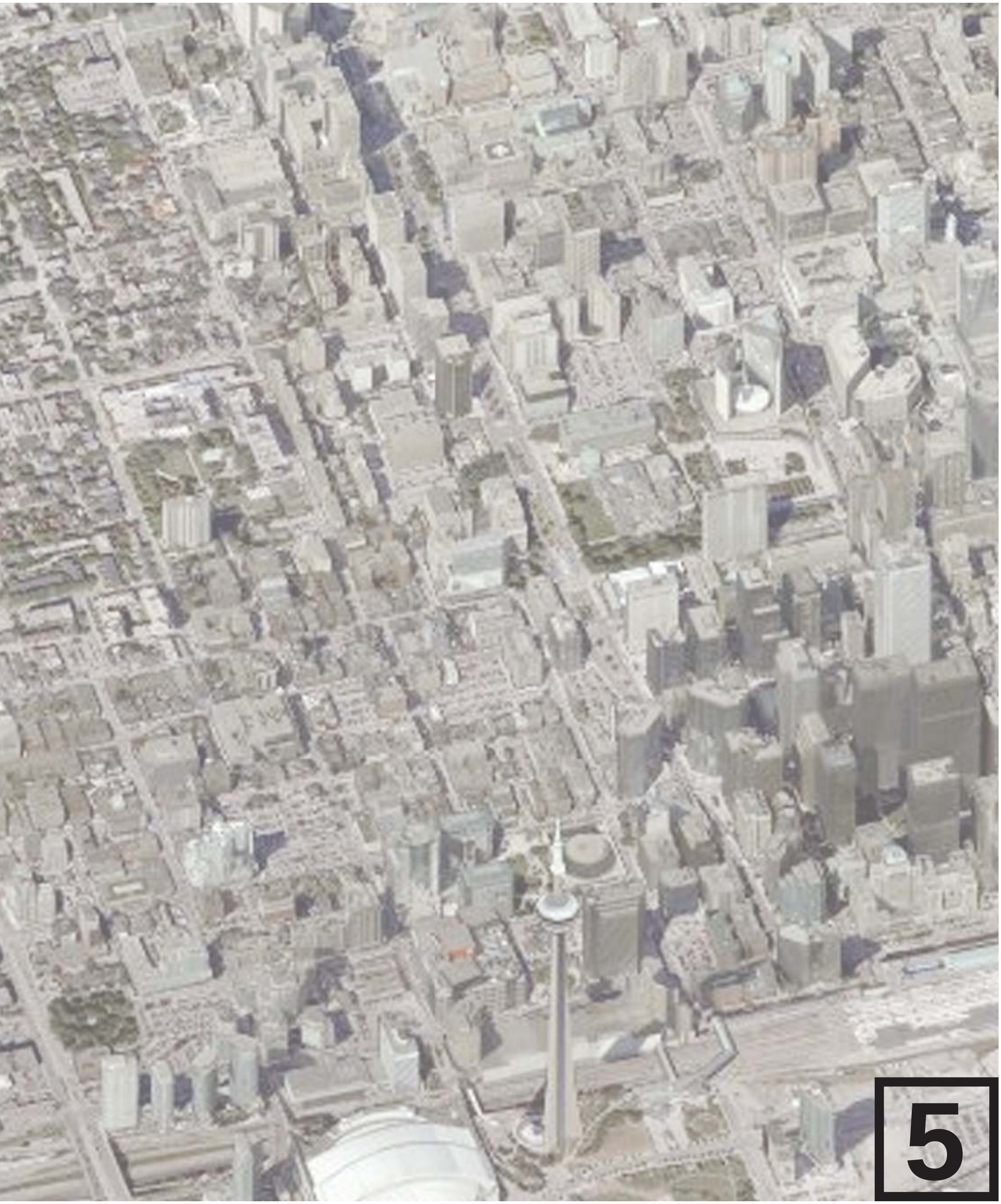


Figure 4.5.4 – Vertical Agricultural Urbanism

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5.0 Design Proposal

The research proposal is to design a self-sufficient Chinatown for the City of Toronto, called Agri-town. The study area is located between University Avenue to Bathurst Street in east-west direction, and College Street to Queen Street West in north-south direction. The design incorporates elements from continuous productive urban landscape (CPUL) and vertical farming models, and will be executed at three different scales: urban, community, and building.

Firstly, for the urban scale design investigation, the factors being considered must be evaluated for viability vis-à-vis the low-income population as well as the total population of Chinatown. The design will proceed by first following the Food City estimation method and then will use the nutrition and yield information determined in Chapter 4 as a reference guide to estimate the food energy intake, food mass, food choices and required area for agricultural production.

Secondly, for a community-scale investigation, the study area will consist of a 1-hectare block (100m x 100m). Reference will be made to the studies covered in chapter 4.5. The aim here is to investigate possible functions and programs the block could incorporate for the focus group, as well as to determine the program distribution and proportion between productive areas and occupant activity areas. The investigation would determine the location of the productive landscape on the city block as well as the basic massing for different buildings.

Finally, for the building scale investigation, the focus is to develop a sustainable closed-loop system incorporating elements from the different sustainable systems discussed earlier. The model illustrates how food production and housing could be integrated within a building design, to conclude the Agri-town research.

5.1 Urban Context

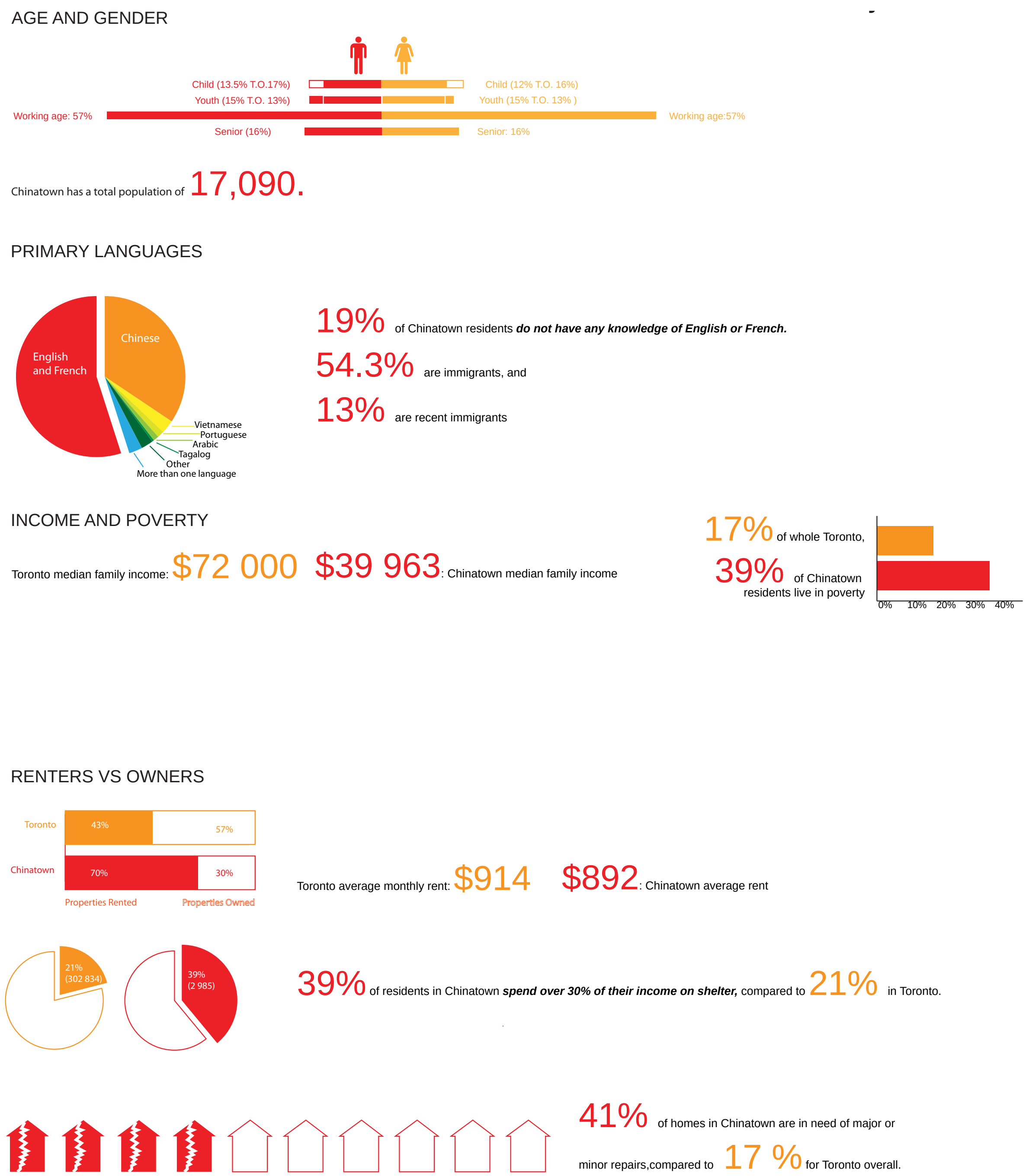


Figure 5.1.1 – Chinatown statistic

5.2 Site Selection

The site chosen to test the research is the Alexandra Park neighbourhood in Toronto's Chinatown district. The site is bounded by Dundas Street West and Queen Street West in the north-south direction and Augusta Avenue to Cameron Street in the east-west direction. This site is one of the locations selected to implement the new revitalization plan.

The new master-plan is proposed by the staff of Toronto Community Housing Committee and Urban Strategies Inc. The revitalization plan includes the development of new housing, community facilities and recreational park spaces at the basic program level. The proposed plan has an estimated 2346 units to be accommodated within the site. It has been proposed that 40 percent of the newly developed property will be distributed as public housing and 60 percent will be market housing.

The site is designated to become a food sourcing center, as the surrounding areas within walking distances are full of street markets such as: Kensington Market towards the north; Spadina Avenue's Chinese Street Market towards the east; affluent park spaces towards the west; and small scale restaurants and grocery stores towards the south. In addition, the adjacent area across Queen Street was where the erstwhile Saint Andrews Market was located. The Market was demolished due to the lack of use over time, early in the twentieth century. The market hall is intended to serve the western downtown district, in a similar way to how the St. Lawrence Market acts as an anchor point and food destination in the eastern downtown district. Therefore, focusing food production within Alexandra Park would be the ideal way to service and support the current market.

The current master-plan addresses the issues of housing shortages and the dire need for building repairs. However, the large numbers of low-income families and households that are going to move in to the Alexandra Park neighbourhood require the supply of basic necessities, especially food. In order to prevent urban poverty and slum-like conditions to take place in this redevelopment, it is necessary to develop an infrastructure system oriented to food. The infrastructure system must be designed in such a way as to support the large amount of residents with food, shelter and job availability.

14 times of the size of Chinatown to supply the whote district

Figure 5.1.2 – Potential area for Agricultural production

Figure 5.3.1 – Site Photos Location


1)


2)


5)


6)


9)


10)


13)


14)

3)

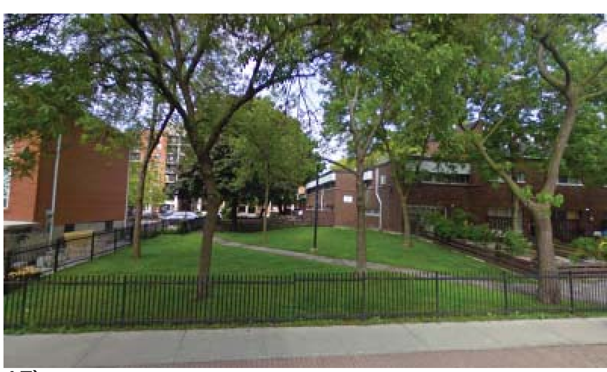
4)

7)

8)

11)

12)



15)

16)

Figure 5.3.2 – Site Photos

5.3 Existing Urban Condition

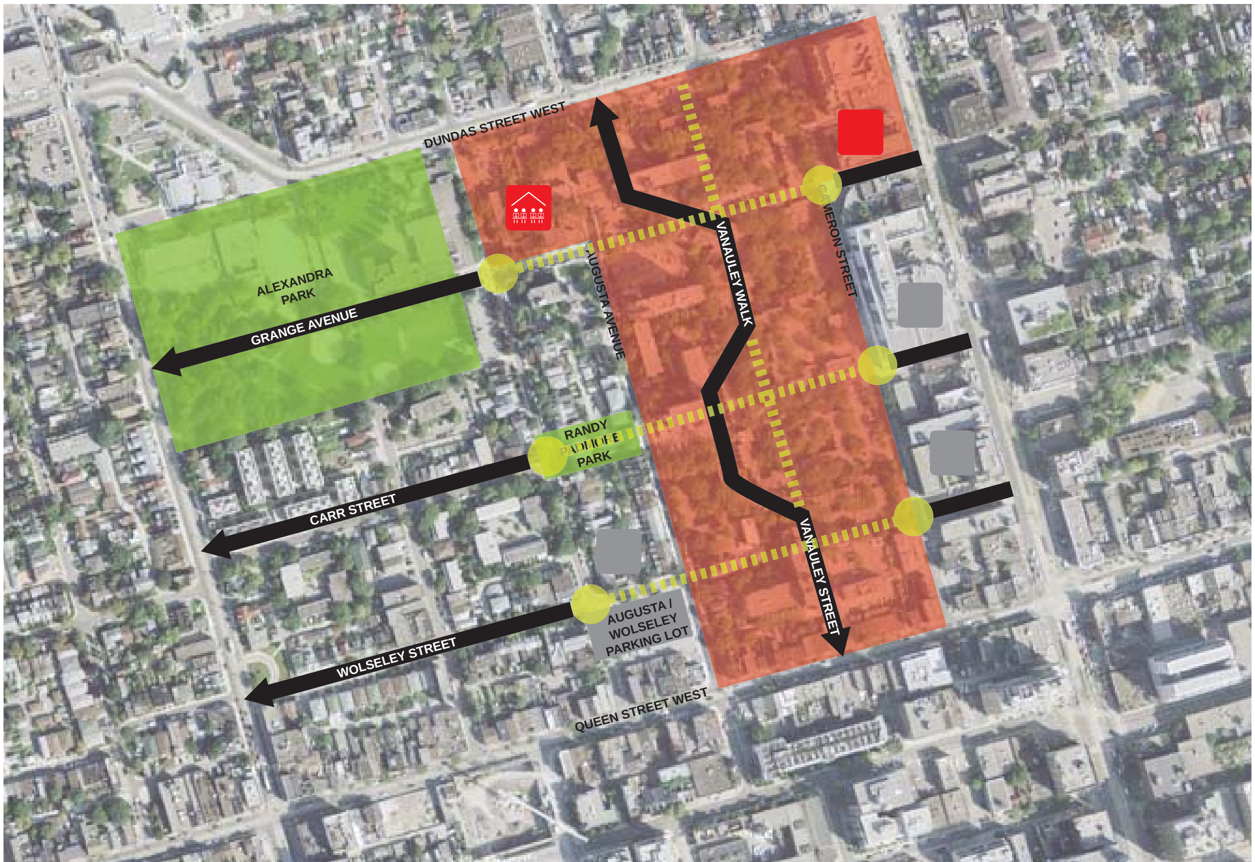


Figure 5.3.3 – Connections with urban condition

The current Alexandra Park neighbourhood has adopted typical town planning principles observed in the suburbs. Due to inaccessibility along the street edges, the site has become isolated, separating the community physically and socially from the rest of the city fabric and major roads. Vanauley Street and Vanauley Walk have isolated the site, preventing direct north-south access with their meandering structure (see Figure 5.3.1 & 5.3.2). The streets in between Spadina Avenue and Bathurst Street, running in an east-west direction, only make ambiguous connections with the city block. Furthermore, the lack of social presence and lively activities on Grange Avenue, Carr Street, and Wolseley Street have created an impression of an encroaching Community Center and school. The inconvenient approach has kept people from fully using the facilities and services of the Community Center. Therefore, a new infrastructure system needs to be implemented in order to improve the current urban condition and connect important junctures and neighbourhoods within the city (see FIgure 5.3.3 & 5.3.4) .

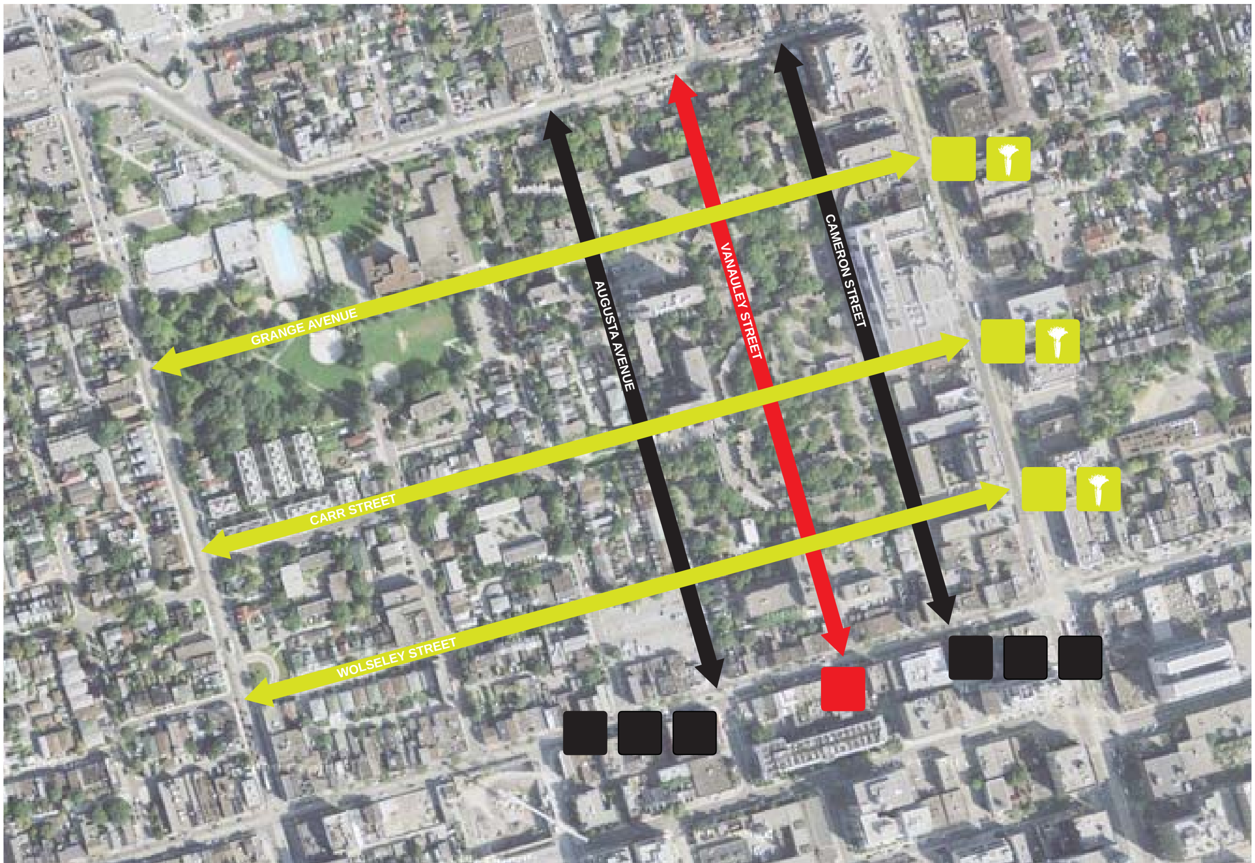


Figure 5.3.4 – Proposed Street Functions

Agricultural urbanism, as the core strategy in the design development, will not only benefit the residents living in the new Alexandra Park neighbourhood by offsetting food expenses through growing their own food, it will also support other food-related industries beyond Chinatown. Its benefits will also affect the financial district and other downtown areas of the city. Placing food at the core of the program organization and system approach, the closed loop system would develop from considerations of how food is produced, processed, transported, stored, distributed, consumed and celebrated. Waste recovery would complete the sequence of the closed loop sustainable system at the individual, community and urban scales.

5.4 Zoning and Connectivity

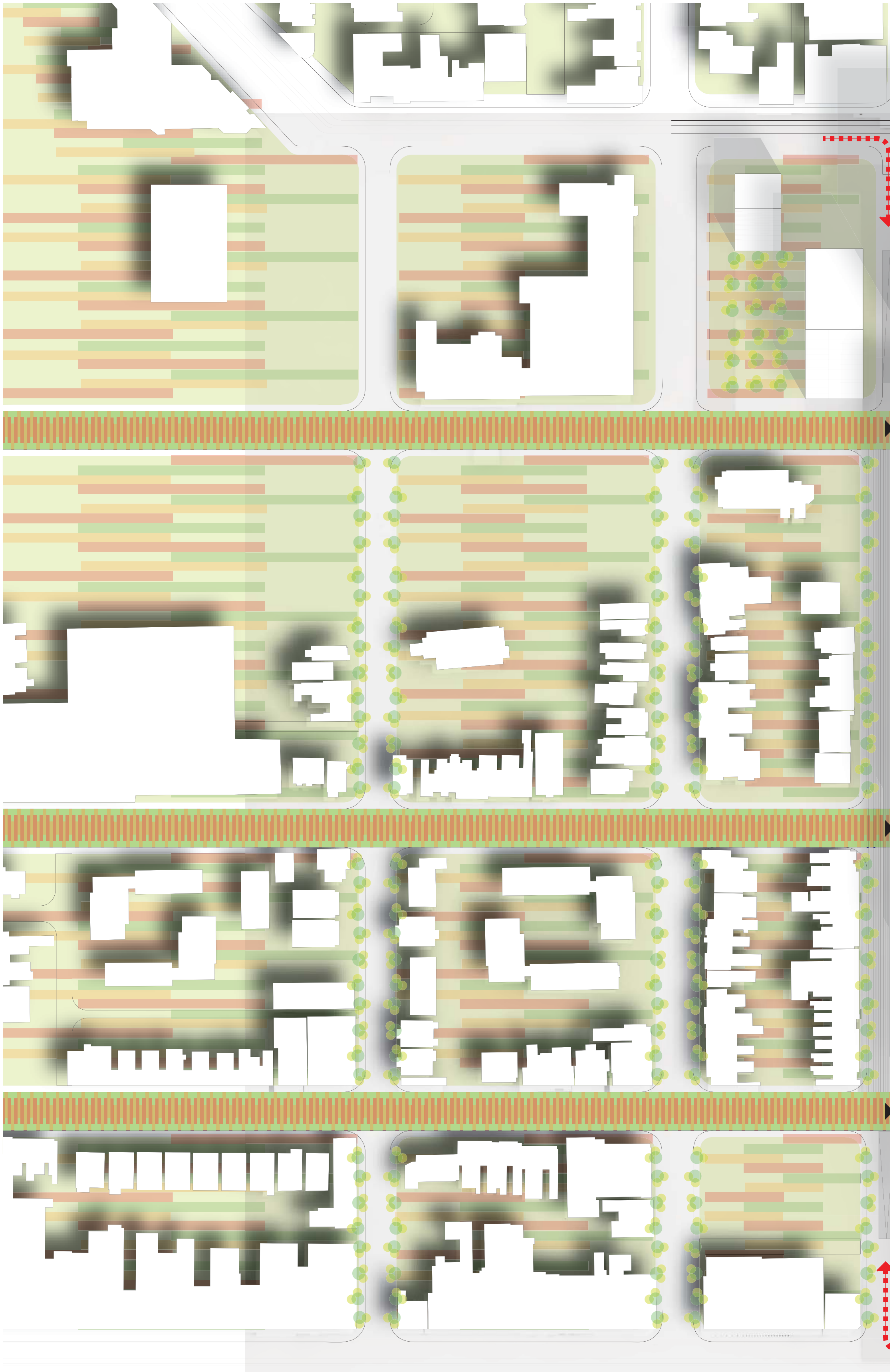
As optimization of local food production is one of the major goals of this design experiment, new zoning should focus on taking full advantage of natural resources, particularly natural daylight, and simultaneously, should push the boundary to increase site density. The orientation of the sun angle for Toronto is approximately 70 degrees Celsius in the summer and 22 degrees during winter. If we apply the winter angle throughout the site as the zoning requirement for building design, the height differences of the volume, starting at ground from the south phase, incrementally progress to the tallest point of the north phase at 150 meters (see Figure 5.4.1).

Further, cutting out the street grid and terracing of the volume would prevent over-shading issues for the building complex. In addition, these moves would create courtyard spaces on each plot for balconies towards the center, as well as extra edible surfaces for food production and circulation. Carrying on with the principle of continuous edible landscape, Grange Avenue, Carr Street and Wolseley Street will be extended

Figure 5.4.1 – Zoning and Massing

east-west from Bathurst Street to Spadina Avenue. They will be widened and dedicated to become a 15-meter farm strip with bike paths and pedestrian trails. Furthermore, this will connect the Community Center and school in Alexandra Park and Randy Padmore Park with the rest of the city.

In addition, it is suggested that the parking lot at the intersection of Augusta Avenue and Wolseley Street could also contribute to the food system as well as improve connectivity throughout Alexandra Park in east-west direction. In the north-south direction, Vanauley Street will be widened to 40 meters and developed as a promenade with sufficient spaces reserved as temporary venues for events, with the landscape component acting as a spine anchoring the design. This would improve connectivity and alleviate the site isolation. Augusta Avenue and Cameron Street would become the service streets with entrances for loading and parking underground, to facilitate the transportation and delivery of food from the site to the stores and restaurants along Spadina Avenue.



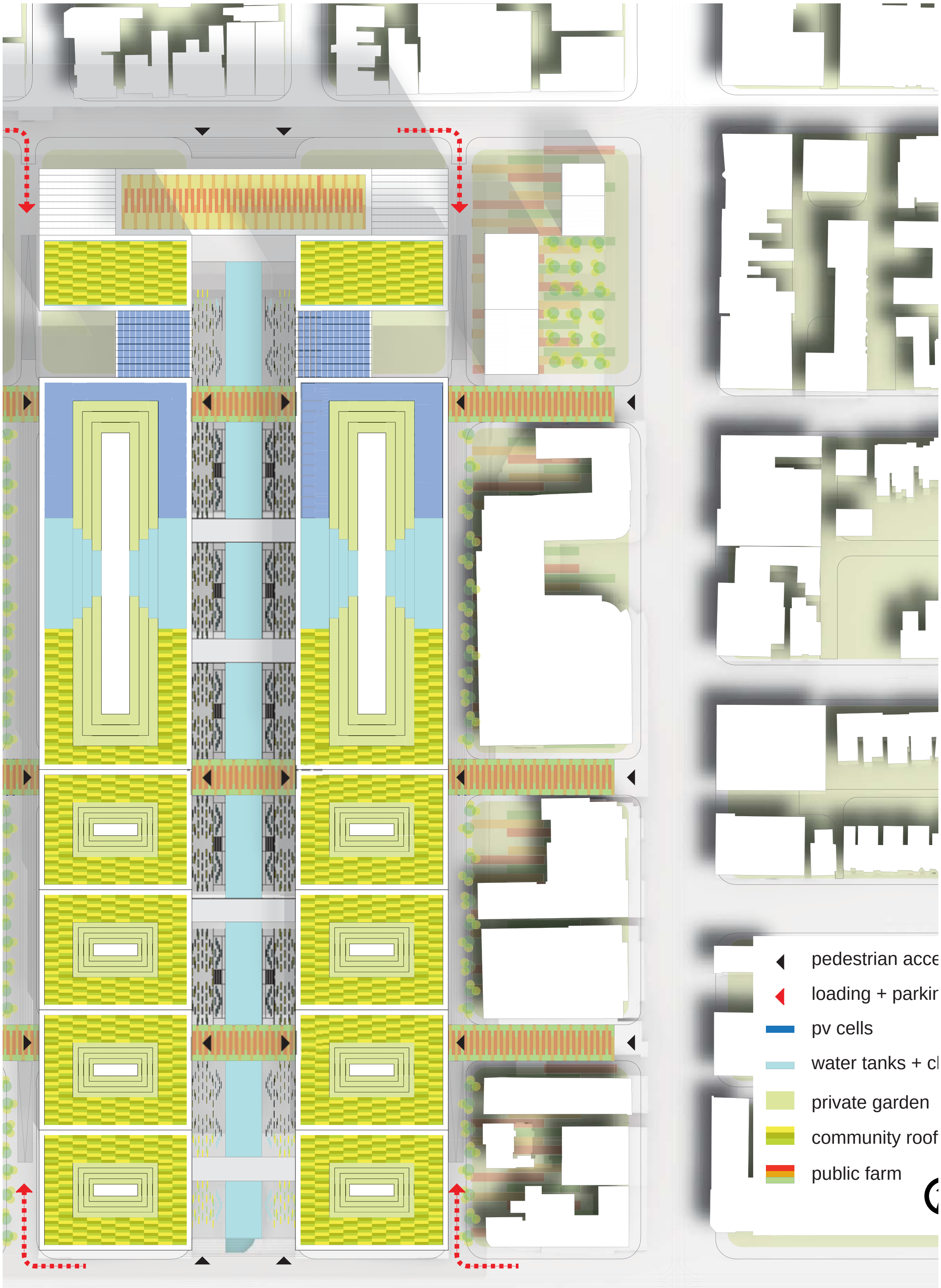


Figure 5.4.2 – Site Plan

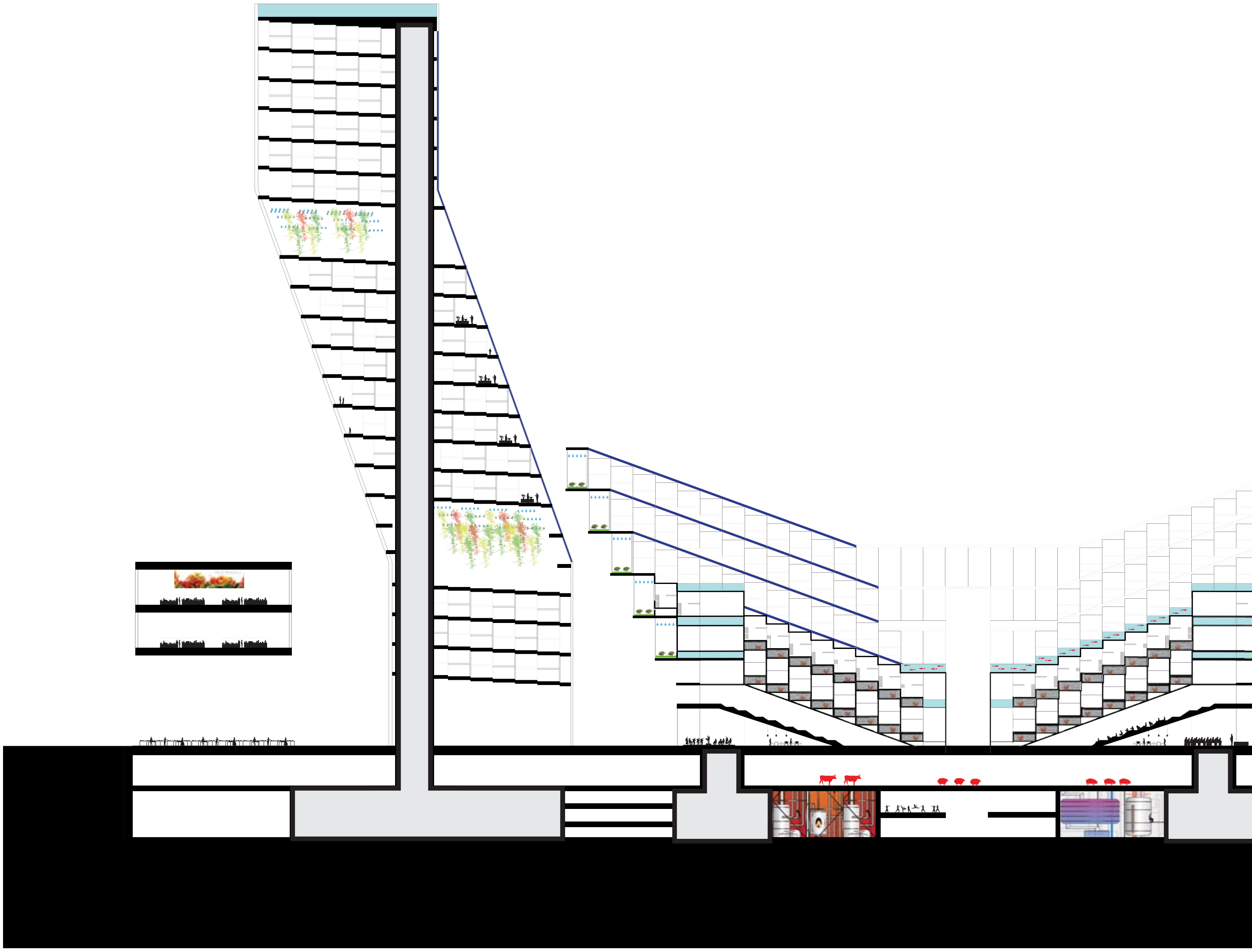
5.5 Programing

The proposed functions and space layout of Agritown will be an ultra-mixture of conventional housing development programs with agricultural related systems as the utopian concept. The design of Agritown has assumed that the future residents of the site would acquire similar needs and lifestyles, resulting in the application of a modular unit throughout the entire site. The position of this modular system is designed to blend the public units and market units together without projecting any initial differentiations in terms of size, space, and status. All residents would be treated equally with the same amount of living and growing space. The only differentiation among each of the units and spaces would be the variation in food types and species that are grown on the different surfaces. Vegetables, fruits, grain products, and herbs will be placed depending on the species' growing properties and nursery environment required. The design has used food crop as the core material that changes the appearance of each unit; this natural aesthetic will contribute to the transformation of the complex's overall appearance over time, as the plants flourish.

Agritown has adopted an interest-based model similar to that learned from the Broadacre city and Phalanstere as a social structured model. The development is a type of co-operative housing in which all the residents carry a social responsibility and social duty of contributing to the overall farm productivity and yield. With this mandate becoming a part of their daily jobs and leisure activities, this model resonates a cultural movement like that of the Victory Gardens during the World War periods. Each unit is a simple rectangular volume with the dimension of 4.5 meters in width; 9 meters in depth; and 4.5 meters in height. The total floor area of each unit is 81 square meters. Surfaces within the units are subdivided into 3 distinct spaces with a collective of residential (60.75 m2), commercial (20.25 m2), and agricultural (324.2 m2, maximum) compartments provided, including balconies, front yard, a rooftop and courtyard spaces (see Figure 5.5.1).

In the current design, 2906 units can be provided. Another 560 units could be provided, in addition to the original masterplan proposed by Toronto Community Housing Committee for the same site. If the density and amount of units are to be maintained, the additional areas can be turned into open-air and enclosed community gardens, as well as hydroponic and aeroponics greenhouses, contributing to the overall agricultural production of the site. This would provide extra amenities spaces within the buildings, thus encouraging the exchange of knowledge and interaction amongst residents.

Figure 5.5.1 – Unit Arable Space



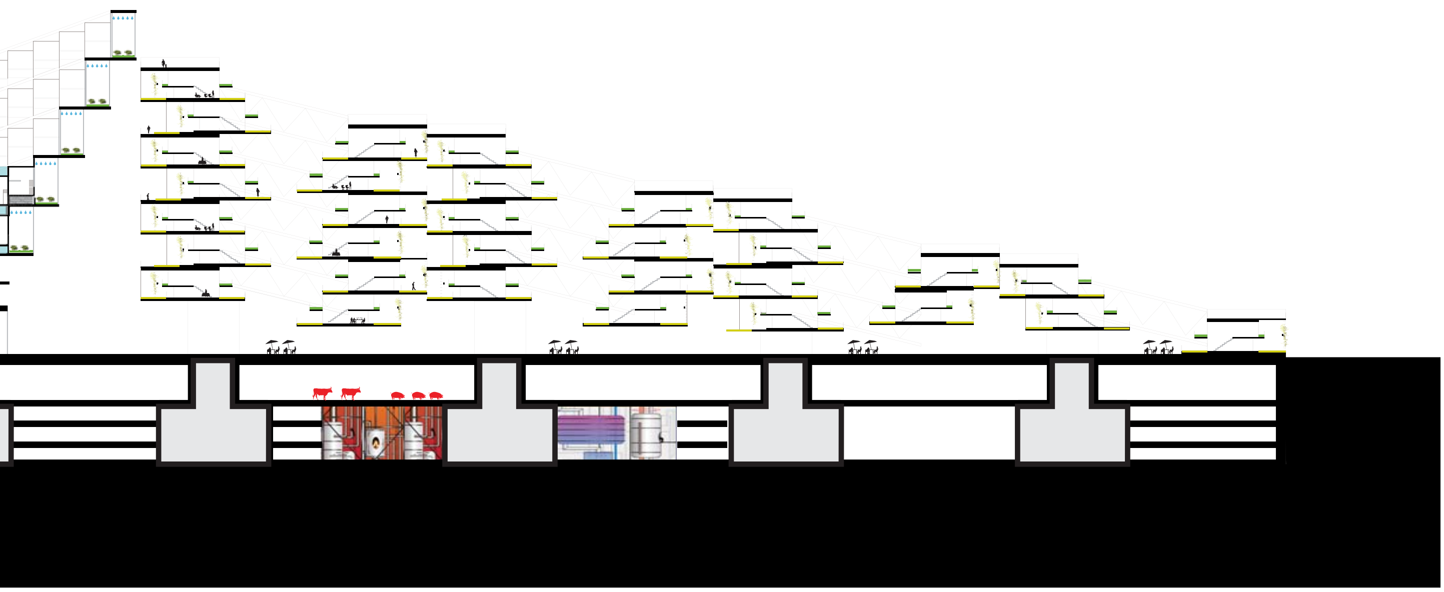


Figure 5.5.2 – Building Section

5.6 Circulation Loop

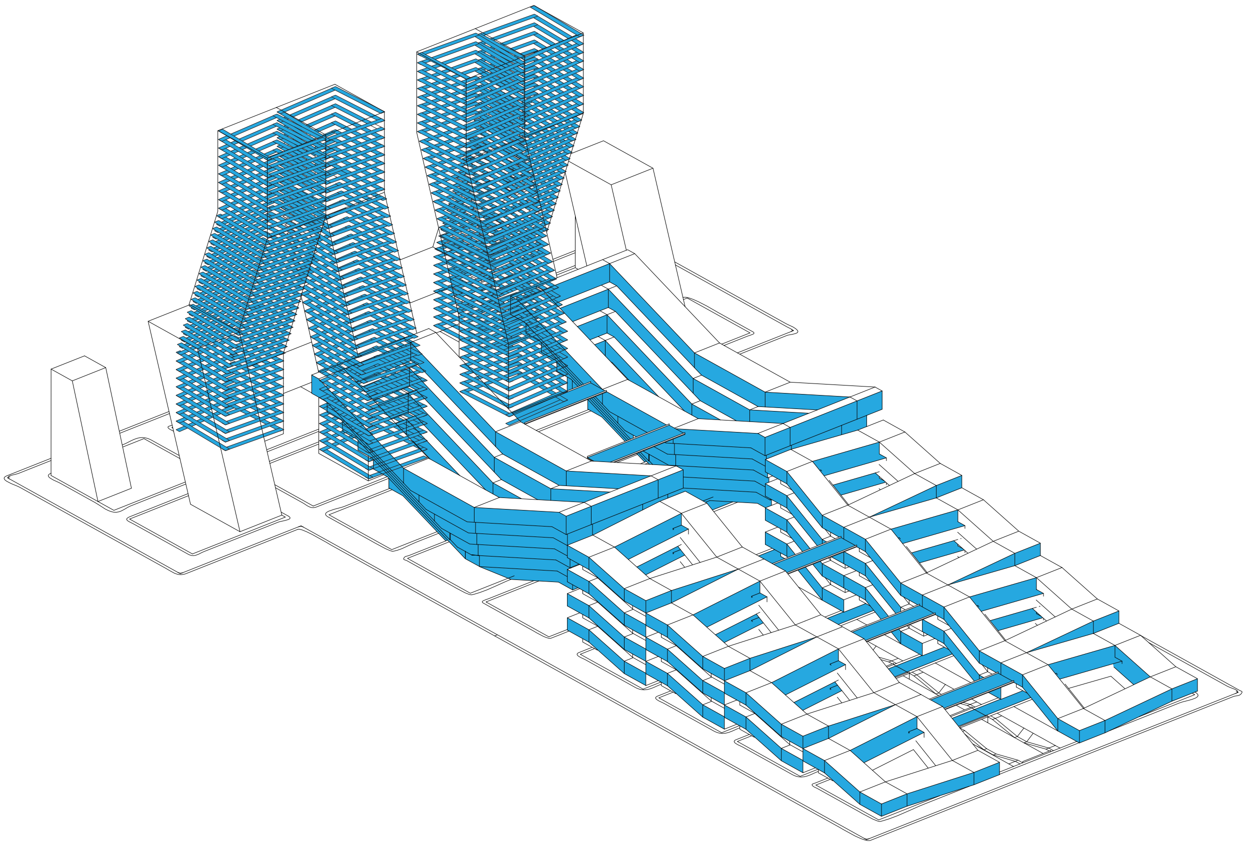


Figure 5.6.1 - Loop Criculation

The main circulation system of Agritown is based on a loop system. The network consists of a series of ramps that are linked together into a single barrier-free corridor, where people can circulate from the grade level at the south end of the Queen Street entranceway, and travel along this path to reach the rooftop garden of the towers, located at Dundas Street on the north. The terracing and sloping of the buildings' volumes create two routes, with an outdoor ramp and an indoor ramp. As the ramps wrap around the perimeter of the plot, they create different vistas from within, offering interesting views and varying experiences in all directions along their journey. The corridor's width of 4.5 meters is consistent throughout the whole system. With the clearance height of the ceiling at 4.5 meters, the inner side of the ramp becomes an indoor strip mall where people will pass by the commercial components of each unit. These commercial spaces become storefronts on the inner surface of the corridor. Each unit will be converted into different working spaces and stores depending on the residents' skills or household interests.

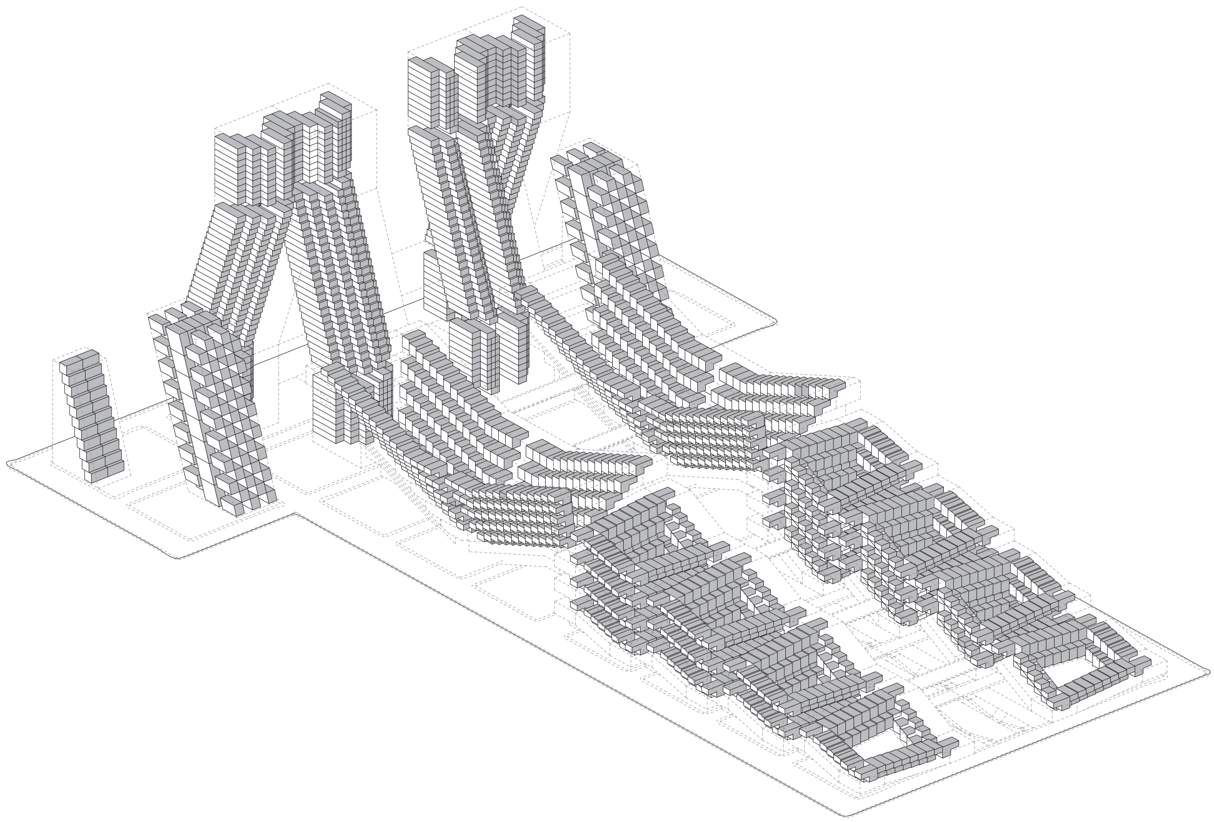


Figure 5.6.2 - Residential Units

On the outer side of this corridor, towards the exterior, the building façade has incorporated hydroponic tubes for the growing of vegetables and plants, such as lettuce and bok choy. The walking surface is a green lawn with fixed planters and movable trays, to allow growth of a variety small-scale food crops, such as chilli peppers and tomatoes. The transitional spaces between each turn of a ramp are areas that are used as nodes within the loop. These nodes become significant hubs of interchanging functions, accommodating a mix of animated programs similar to that of the Public Farm 1 project. In addition to the generous airspaces in this circulation system, the lush greenery provides a human-altered landscape in the city that uses food as the alternative to typical landscaping material such as trees, grasses and flowers. Furthermore, the food hydroponic façade on the outer boundary functions as a natural shading device.

loop corridor interior


loop corridor exterior

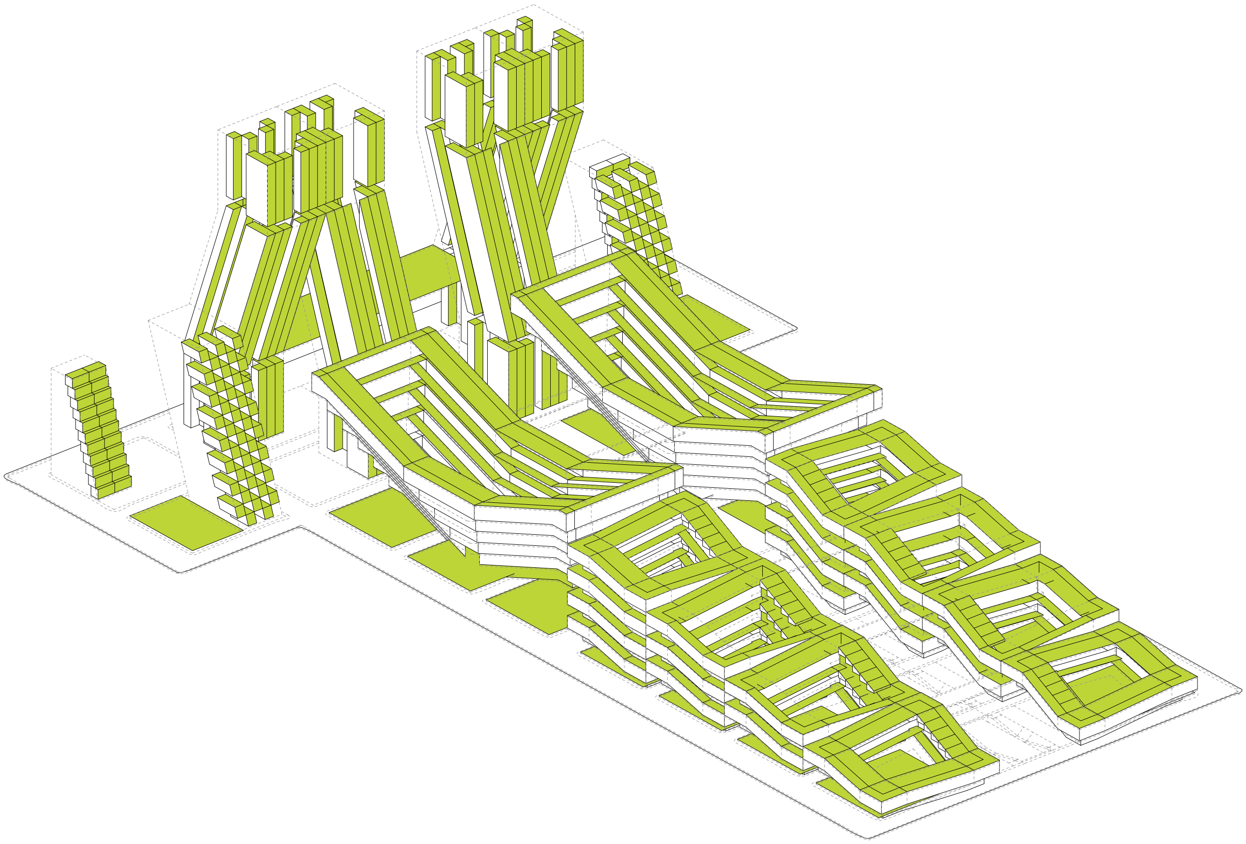


Figure 5.6.5 - Agriculture Production Area

Large-scale commercial agriculture production that requires certain food processes before being transported to consumers, requires a continuous landscape in which to grow. This type of growth, for grain products for instance, could take place on the connected rooftops of buildings, which can be allocated to become a series of wetlands like corn or rice fields. Crops that are tall by nature are more suitable for growth in outdoor climatic conditions. Thus, they will not only benefit from this system and contribute to the food production, but will also help in sustaining the building design environmentally. Due to the tall nature of the species, this layer of camouflage on rooftops could reduce the heat island effect of the building, while providing an elevated landscape with accessible trails for people, insects, animals, and birds. In this sense, the rooftop becomes a tractor point that encourages biodiversity to occur within the site.

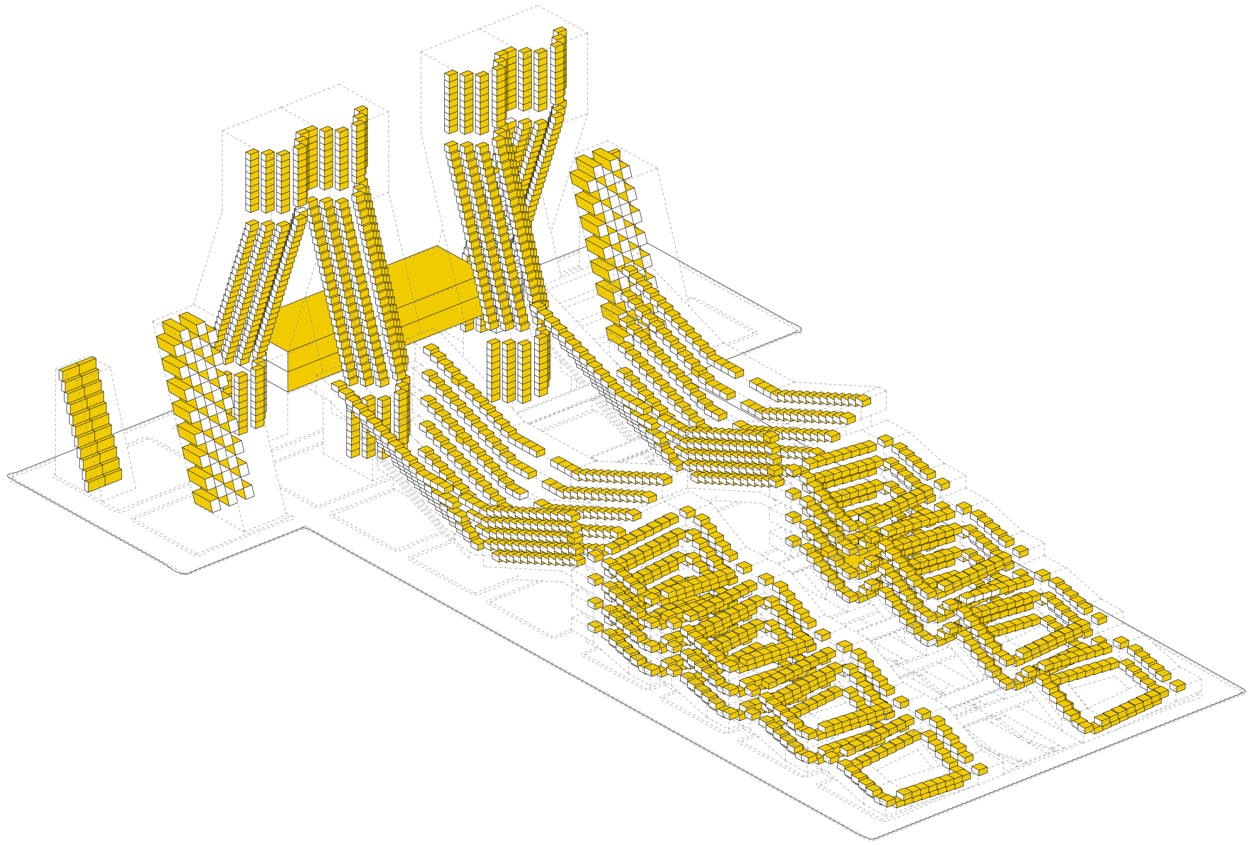
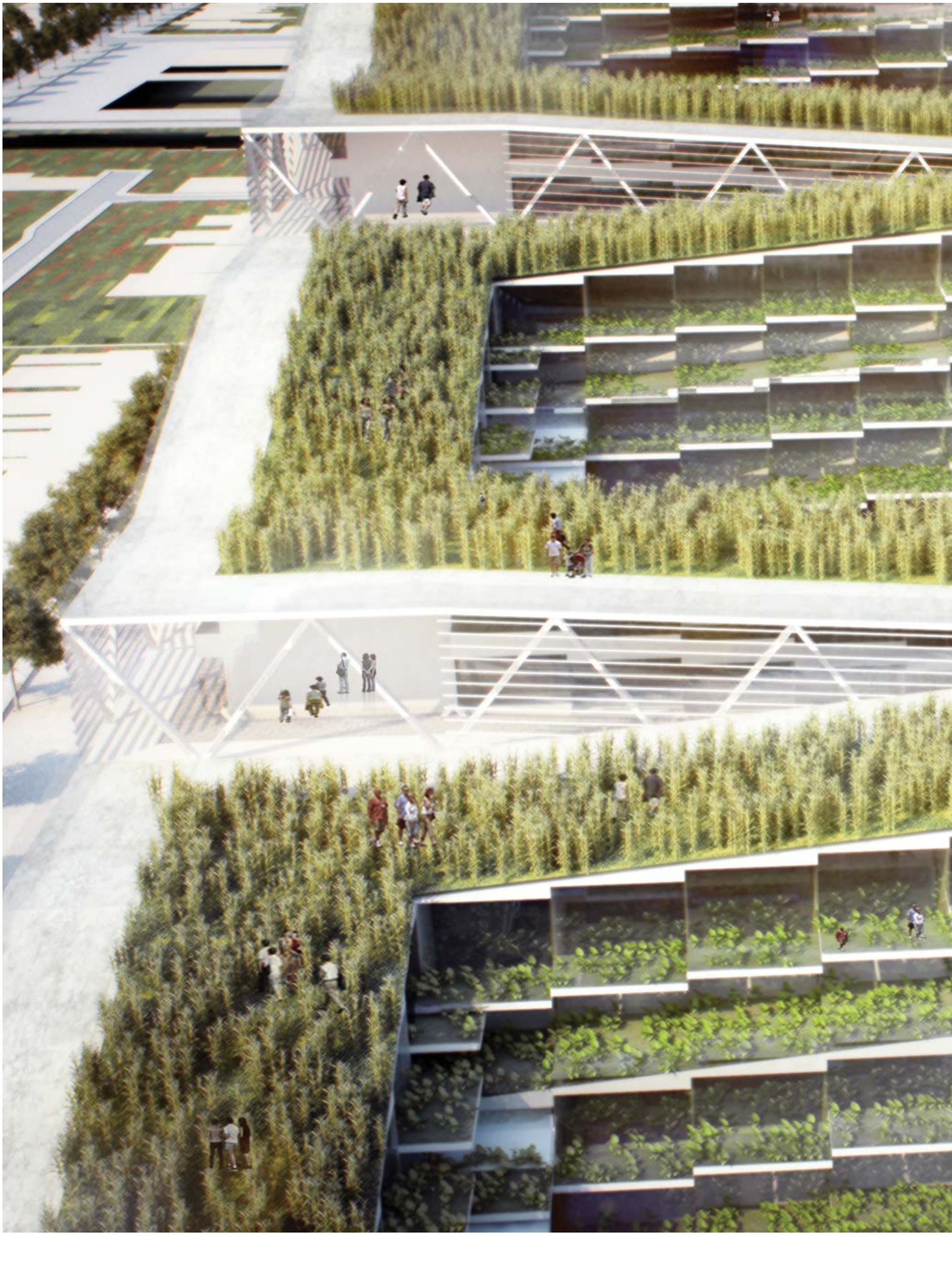


Figure 5.6.6 - Commercial + Retail Area

The entire loop system serves various functions including a greenhouse and a continuous linear park. Similar to the Wynchwood Barn and Evergreen Brickworks, Agritown's circulation is a complex and diverse system composed of farm, market, retail, office, social, and recreational activities. Functions of daily life in work, play, growth, and eating are fully compacted and integrated as a holistic integrated system.




low-rise rooftop

5.7 System Integration

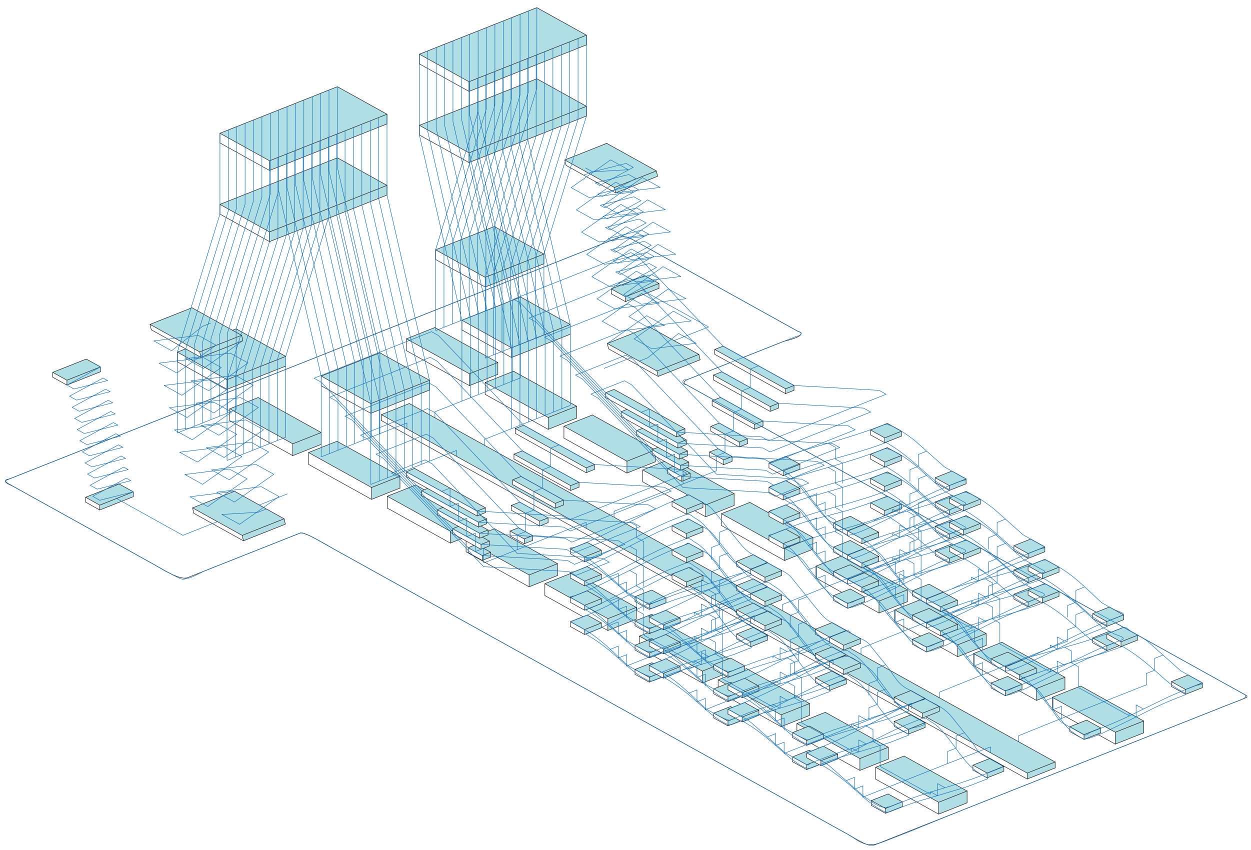


Figure 5.7.1 - Water Flow + Irrigation system

The transportation, storage, distribution, and waste recovery of the food system typically stretches along an entire transact from the rural to urban core. Agritown has attempted to integrate these systems together by organizing them into layers within the site.

The rooftops of each of the buildings will be integrated with storm water collection tanks. Through the façade system of water pipes, sprinkler heads and metal, the storm water is filtered and cleansed by way of the looped ramp system. The vegetables will also contribute to the filtration system, cleansing while being irrigated at the same time. The greater the distance the water travels through the hydroponic system, the cleaner the water will become. Therefore, the 400m-long water channel along Vanauley Street is very clean and safe for people to swim in during the summer and doubles as a skating rink during the winter.

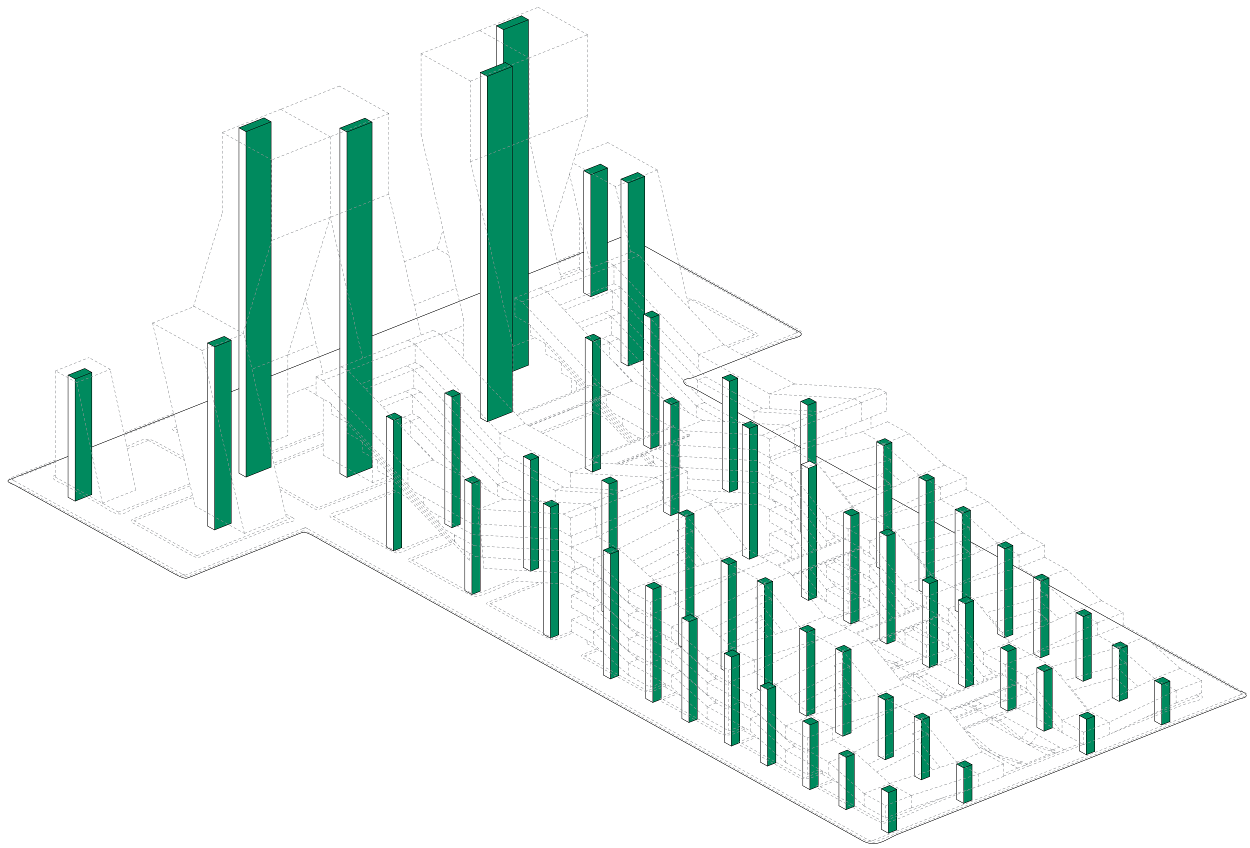


Figure 5.7.2 - Vertical Circulation + Distribution System

As mentioned in the above sections, the vegetables growing on the water channels are used as a natural shading system. During the summer, with high seasonal availability and yielding, the growth rate and cycle of crops are generally faster. Due to the climatic condition in which the crops receive more natural light, the sunlight will stimulate the growing process, resulting in a more opaque façade and thus becoming a passive shading device for the buildings. On the contrary, during the winter when the productivity of plants is much lower, the slower growth of the food crops will result in a more transparent façade, allowing more desired light to enter through the buildings.

The building envelope of the towers' façades will integrate photovoltaic films in between the layers of glazing. The building rooftop will also be dedicated for hot water solar panel systems that will harvest solar energy to provide additional shading of the interiors as well as generate electricity for the dwelling units.

central promenade & water channel

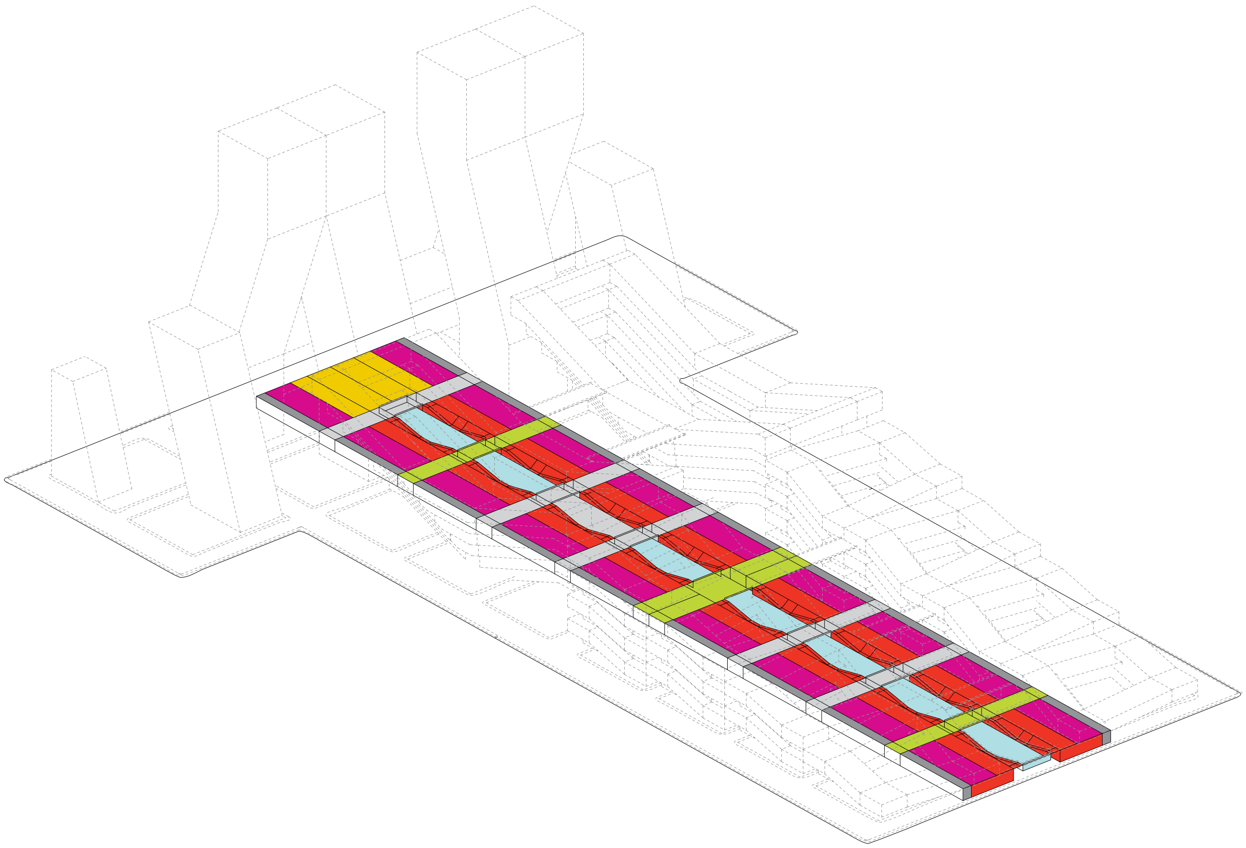


Figure 5.7.4 - Social + Recreational Area

The rooftops of the midrise buildings are programmed for grain and corn production. The elevator cores, besides serving use by residents, will provide extra shaft spaces for distributing the harvest to the basement level where they will be processed. After processing is complete, the crops are stored in another shaft. These vertical shafts act like silos, storing food crops within the vertical distribution system for Agritown. These shafts will be also linked with the loading corridor along Augusta and Cameron in order to distribute food to further locations in the city.

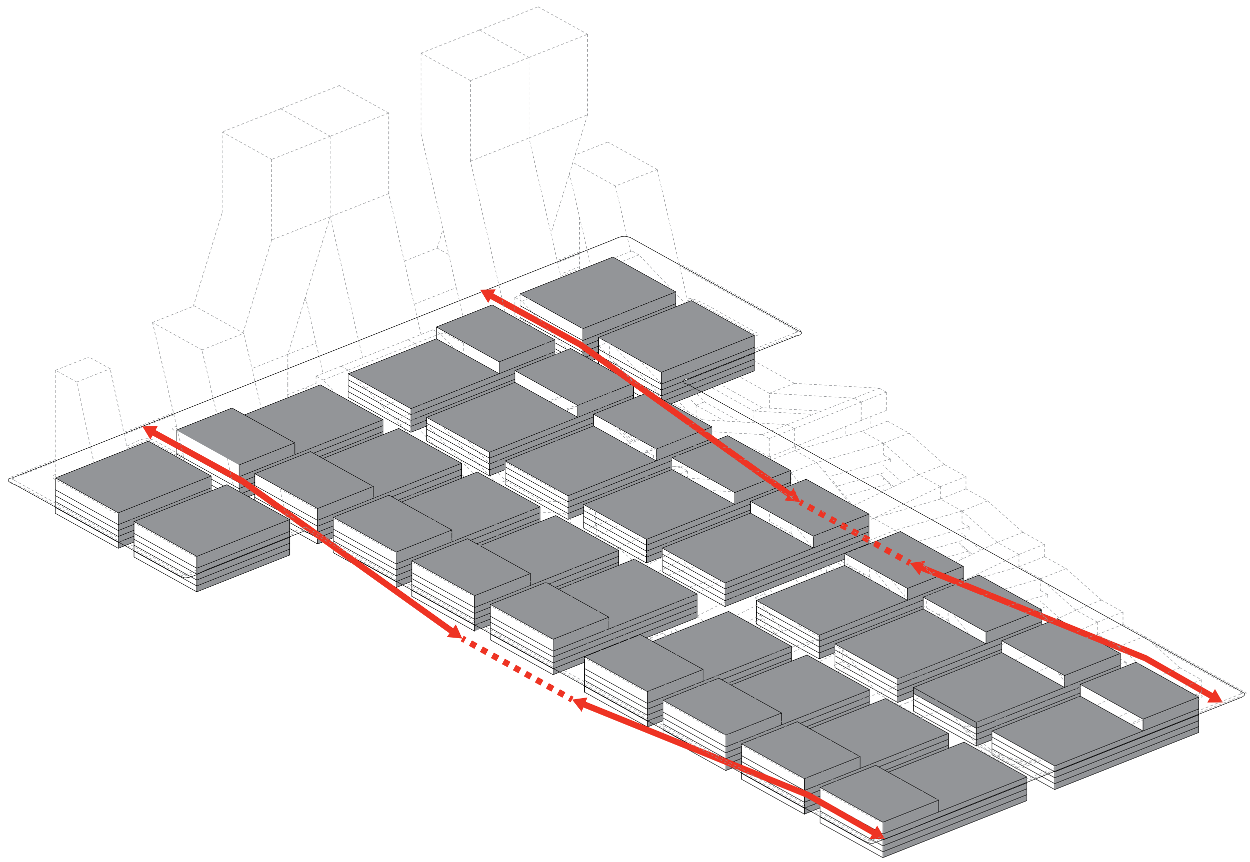


Figure 5.7.5 - Technical + Service Area

To accommodate for waste treatment, the basement levels on each plot will have a series of incinerators as part of the mechanical system to process methane from both human and food waste. The waste is reused and regenerated into energy, supplying electricity for the neighbourhood. This method is an example of repurposing waste as an input resource and regenerating nutrients as the output resource.

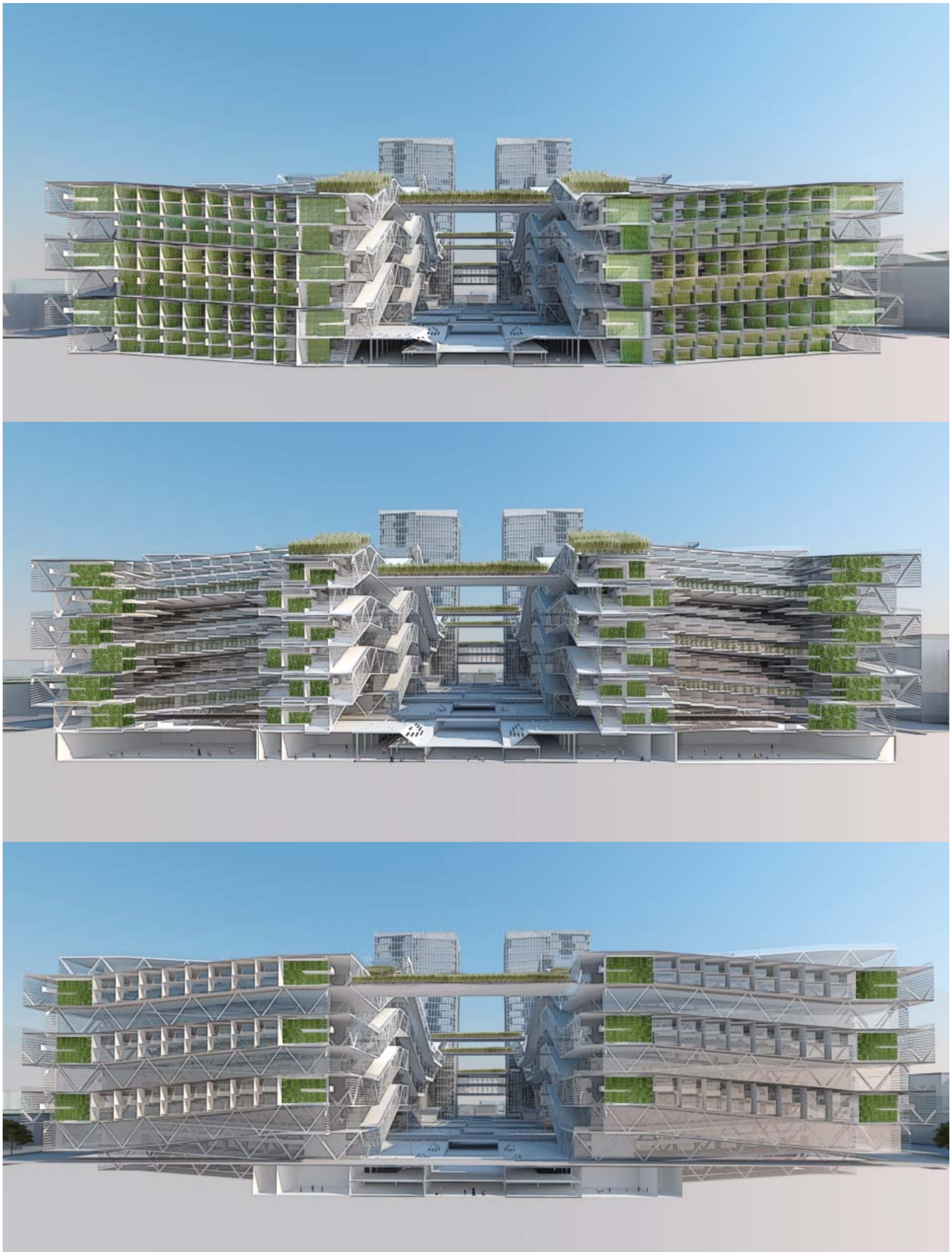


Figure 5.8.1 – Low-rise Sectional Experience

Figure 5.8.2 – Mid-rise Sectional Experience

Figure 5.8.3 – High-rise Sectional Experience

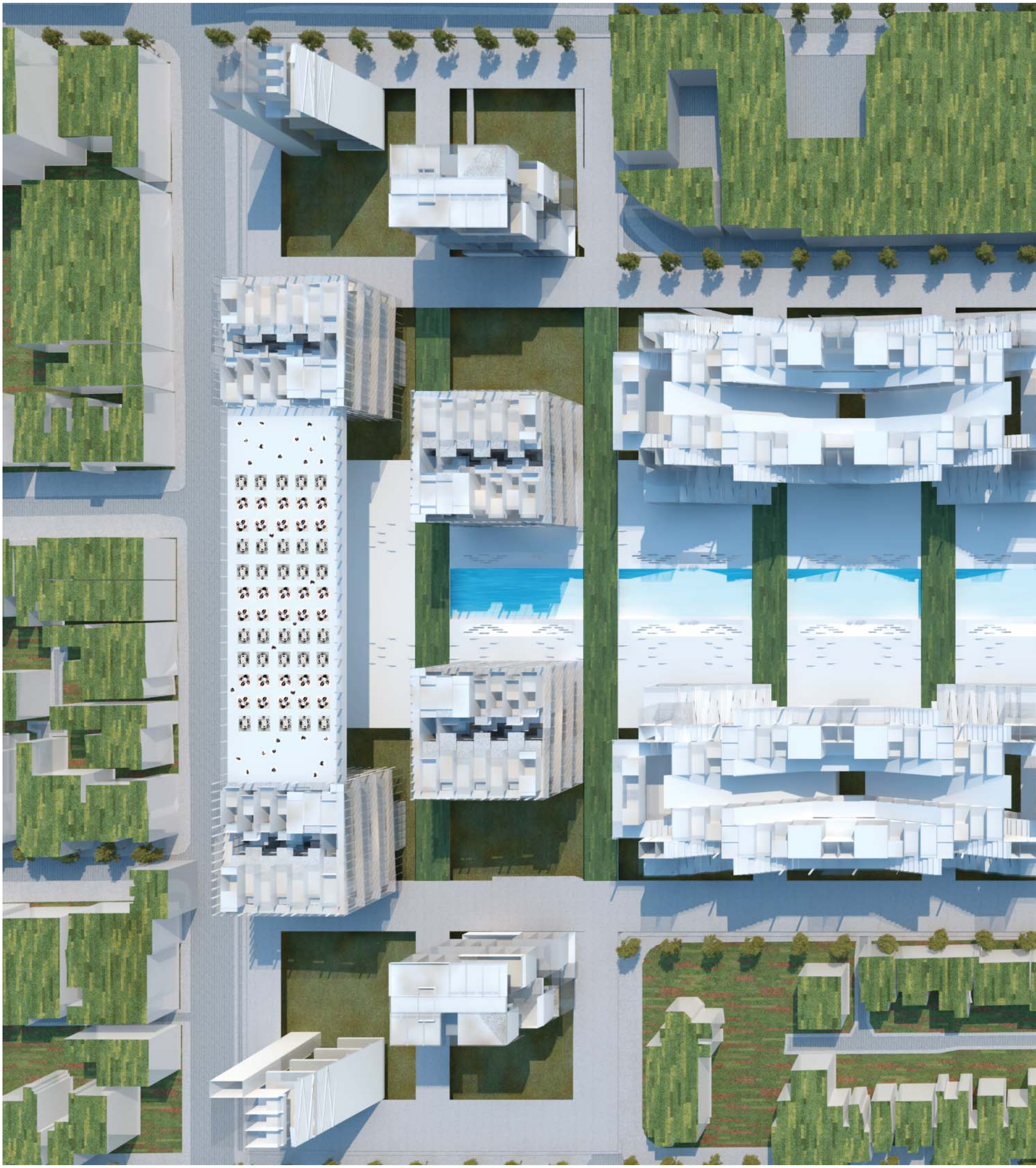


Figure 5.8.4 – Plan Experience

Conclusion

In the previous chapters and design proposal of Agritown, a conceptual framework has been established by demonstrating several elements that need to be considered in order to incorporate agriculture together with architecture. The elements have both qualitative and quantitative parameters.

First of all, Agritown bases its estimates on the target population that needs to be fed. It has been found that an average Canadian requires about 2100 square meters of farmland to grow all the food that meets their annual energy and nutritional requirements.. The research explored whether livestock and meat processing is feasible on site and found that, for this specific design, livestock such as cattle and pigs need to be eliminated on account of space constraints.

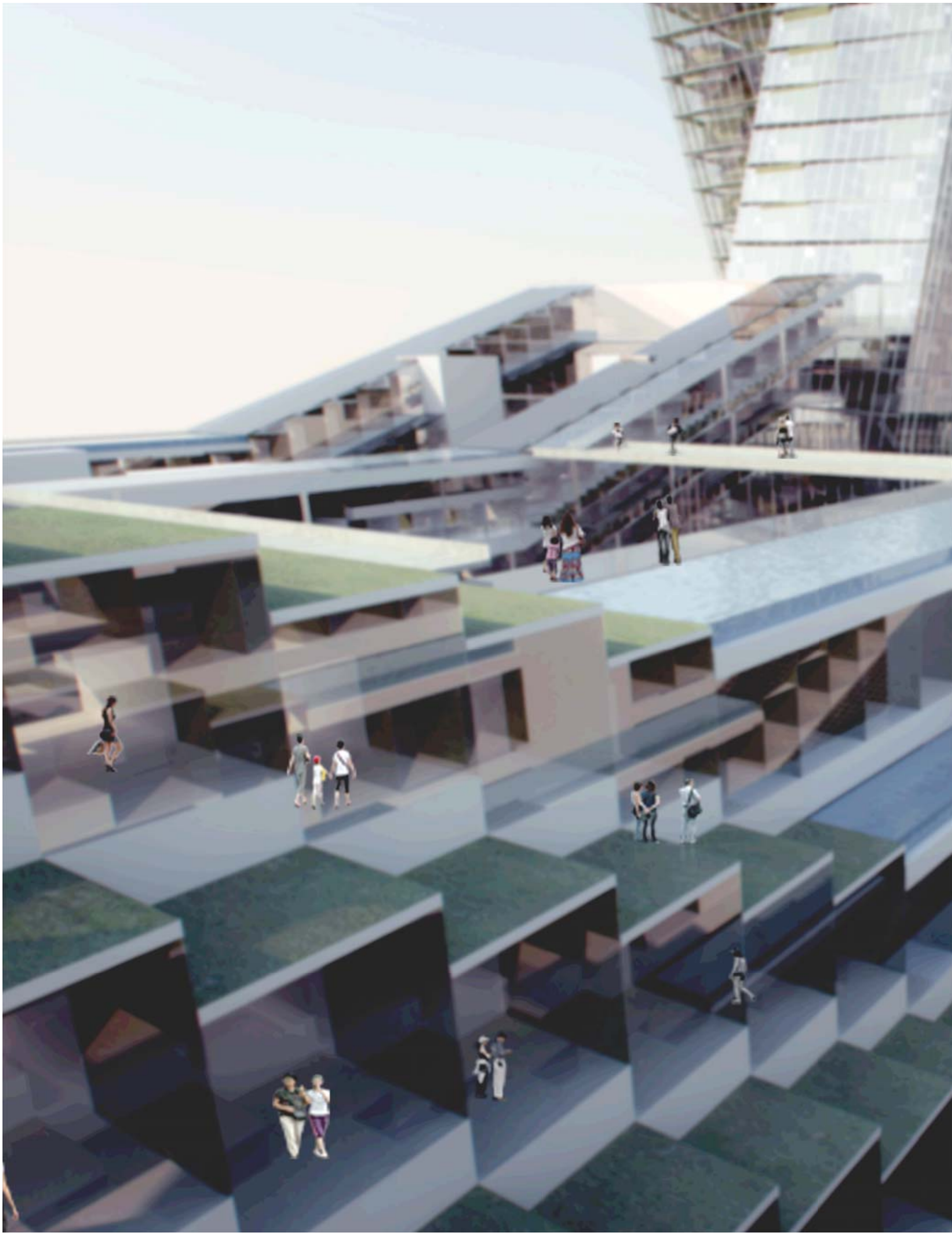
Secondly, In the Agritown proposal, each suburbia style units with 81 square meters of floor area could provide about 324 square meters of surface area dedicated for food production. With the amount of surface area available, the unit can produce about 1.2 times an individual's annual vegetable and fruit consumption (272.8m2). If the unit is only designed for one person, this could in result cover 12% of his or her total annual food expense. However, if each unit accommodates a family, more service areas need to be discovered, as all the interior flooring, wall and ceiling areas will be fully dedicated to food production. This also raises a further question as to what is the most ideal and effective building geometry and orientation for food growing in urban areas. Since this investigation applies to vertical agricultural urbanism, a simple rectangular structuring has been found to be the best match to farm effectively and efficiently.

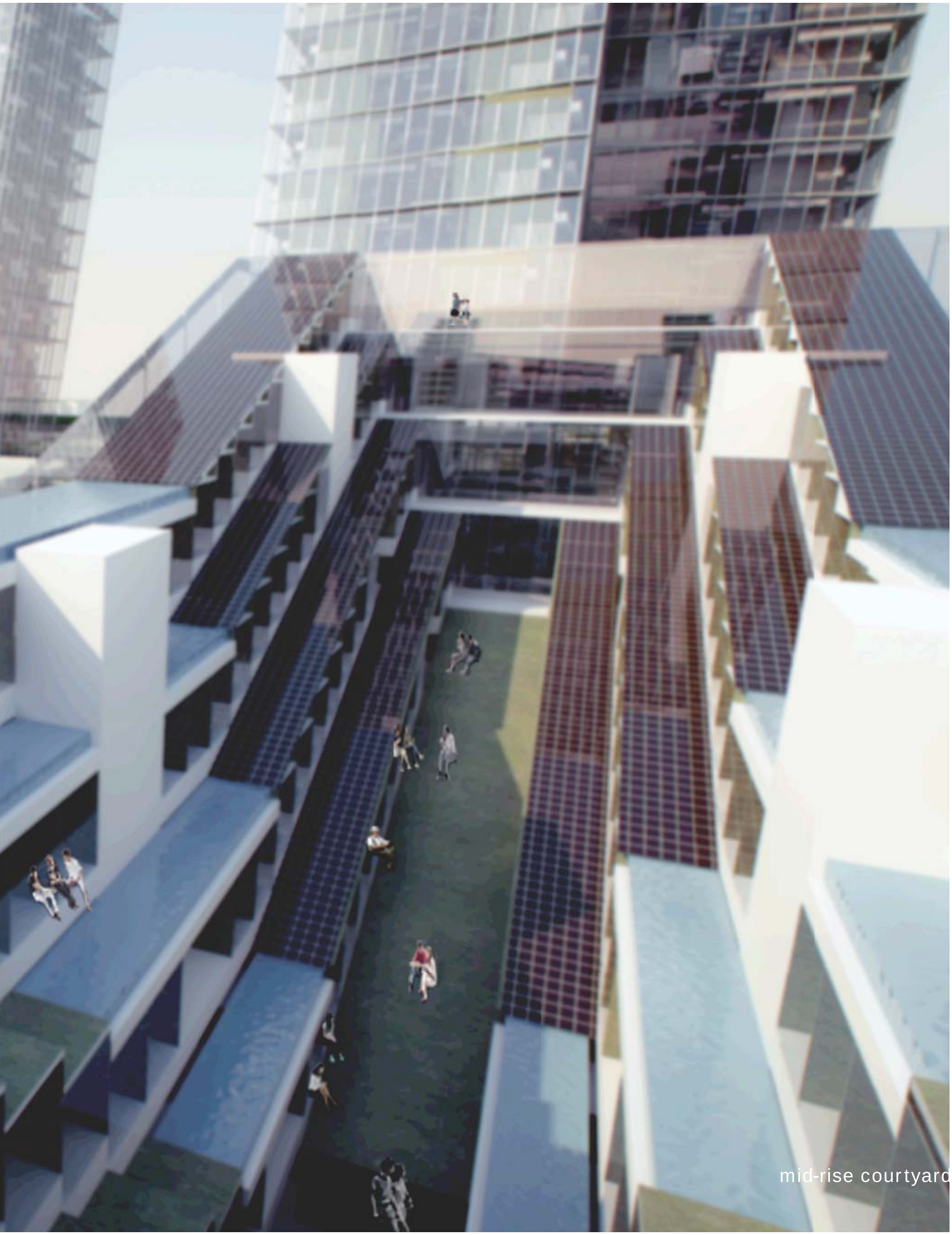
Thirdly, Agritown suggests the relationship between space and the location for growing different types of food. Further investigation is required to evaluate how much energy is required in order to produce the targeted quantity of food. If technical systems and material selection could be better integrated, it is expected that factors such as material properties and lighting illuminations can have a positive effect on a household's expenses on energy and utilities. This could further enable them to make savings from food expenditure and rent.

In conclusion, Agritown as a Utopian experiment integrates the parallel systems of agriculture and housing development closer together. It systematically develops the argument that both agriculture and other activities could share the same spaces and take place simultaneously without conflict. . Further, Agritown provides a model by whereby food system and living spaces could coexist in the urban areas of a city, offsetting a portion of food expenditure and housing shortages for the low-income demographic. Vertical agricultural urbanism thus provides precisely the solutions the city needs in order to solve the problems of food production and housing due to population growth and city migration that a city will continue to face in the future.

aerial view


queen street entranceway





mid-rise courtyard


dundas street entranceway


grocery store& rooftop farm


community sky garden


hydroponic sky garden

view from context rooftop

appendix

Good Things Grow in Ontario

Nutrition Guide



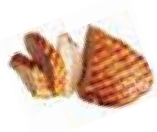




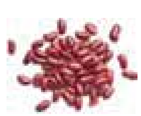

FOOD GROUPS	SERVING	CALORIES	CARBO-HYDRATES (grams)	DIETARY FIBRE (grams)	A SOURCE OF	ONTARIO AVAILABILITY J	F	M	A	M	J	J	A	S	O	N	D
VEGETABLES						J	F	M	A	M	J	J	A	S	O	N	D
Artichoke	125 mL cooked	45	10	3	Magnesium, Folate								•	•	•		
Asparagus	125 mL cooked	21	4	2	Vitamin C, Folate					•	•						
Bok Choy	125 mL cooked	11	2	1	Vitamin A, Folate						•	•	•	•	•	•	
Broccoli	125 mL raw	16	3	1	Vitamin C, Folate						•	•	•	•	•		
Carrots	125 mL raw	28	8	2	Vitamin A, Folate	•	•	•	•	•		•	•	•	•	•	•
Cauliflower	125 mL raw	13	3	1	Vitamin C, Folate						•	•	•	•	•	•	
Corn	125 mL cooked	70	17	2	Vitamin C, Folate							•	•	•	•		
Cucumbers	125 mL	9	2	1	Vitamin C, Folate												
Field											•	•	•	•	•		
Greenhouse						•	•	•	•	•	•	•	•	•	•	•	•
Lettuce	250 mL	9	2	1	Vitamin A, Folate												
Assorted											•	•	•	•	•		
Greenhouse						•	•	•	•	•	•	•	•	•	•	•	•
Mushrooms	125 mL raw	11	2	1	Niacin	•	•	•	•	•	•	•	•	•	•	•	•
Onions	125 mL raw	36	9	1	Vitamin C, Folate	•	•	•	•	•	•	•	•	•	•	•	•
Potatoes	125 mL cooked	63	15	2	Vitamin C, Folate	•	•	•				•	•	•	•	•	•
Rutabaga	125 mL cooked	35	8	2	Vitamin C, Folate	•	•	•	•	•	•	•	•	•	•	•	•
Tomatoes	125 mL raw	17	4	1	Vitamin C, Folate												
Field												•	•	•	•		
Greenhouse								•	•	•	•	•	•	•	•	•	•
FRUITS						J	F	M	A	M	J	J	A	S	O	N	D
Apples	1 med	72	19	3	Vitamin C	•	•	•	•	•	•		•	•	•	•	•
Blueberries	125 mL	44	11	2	Vitamin C							•	•	•			
Cherries	125 mL	78	20	3	Vitamin C						•	•					
Grapes	125 mL	55	15	1	Vitamin C								•	•			
Nectarines	1 fruit	60	14	2	Vitamin C								•	•			
Peaches	1 med	38	9	2	Vitamin C							•	•	•			
Pears	1 med	96	26	5	Vitamin C, Folate								•	•	•	•	•
Plums	1 fruit	30	8	1	Vitamin C							•	•	•	•		
Raspberries	125 mL	34	8	4	Vitamin C							•	•	•			
Rhubarb	125 mL	14	3	1	Vitamin K, Vitamin C	•	•	•	•	•	•						
Strawberries	125 mL	28	7	2	Vitamin C						•	•					
Watermelon	125 mL	24	6		Lycopene							•	•	•			

Note: 250 mL = 1 cup







FOOD GROUPS	SERVING	CALORIES	PROTEIN (grams)	FAT (grams)	IRON (milligrams)	VITAMIN B12 (micrograms)	CARBO-HYDRATES (grams)	CALCIUM (milligrams)
MEATS								
Beef Inside Top Round Roast	75 g	123	24	2	2.0	1.71		
Eye of Round	75 g	148	24	5	2.0	1.44		
Sirloin Tip Roast	75 g	156	25	5	3.0	1.84		
Pork Tenderloin	75 g	108	21	2	1.0	0.41		
Veal Leg	75 g	112	21	3	1.0	0.88		
Shoulder	75 g	142	23	5	1.0	2.5		
Lamb Leg	75 g	184	19	12	2.0	1.95		
POULTRY								
Turkey Dark Meat Cooked (Skinless)	75 g	140	21	6	2.0	0.28		
Light Meat Cooked (Skinless)	75 g	118	22	2	1.0	0.28		
Chicken (Skinless)	75 g	119	25	2	0.5	0.26		
FISH								
Fish Fresh Trout	75 g	127	18	5	0.3	3.73		
DAIRY								
Cheese Reduced Fat Cheddar	50 g	141	14	9		0.83		452
Cheddar	50 g	202	12	17		0.42		360
Eggs	2 large	155	13	11	1.0	1.11		
Milk 2%	250 mL	129	9	5		1.19	12	302
GRAINS								
Bread Whole Grain	1 slice	88	4	1	1.0		16	
LEGUMES								
Beans Lentils	175 mL	135	11	1	4.0		23	
Kidney	175 mL	161	10	1	2.0		30	

- All serving sizes align with Canada's Food Guide recommendations, while all nutrition information aligns with the Canadian Nutrient File.
- To help improve your health quality and make healthier food choices, please visit and/or contact EatRight Ontario and Foodland Ontario.
- As 'Your Friend in the Kitchen', Foodland Ontario offers wonderful recipes, tips and food facts, and cooking videos featuring fresh Ontario foods.
- EatRight Ontario is your first stop for trusted information and advice on nutrition and healthy eating from Registered Dietitians, including meal planning and healthy eating tips and recipes.

Contact a Registered Dietitian for free.
EatRight Ontario | 1-877-510-510-2
www.Ontario.ca/EatRight

Foodland ONTARIO

1-888-428-9668 | foodlandontario.ca

Table 1. Amount of Dependable Agricultural Land, Canada and Provinces

Province / Territory	Class 1	Class 2	Class 3	Dependable land (Class 1-2-3)	Total land area	Dependable agricultural land - as percent of total land within each province	Dependable agricultural land - as percent of Canada's total agricultural land
	*** square kilometres ***						
Newfoundland	-	-	19	19	405,720	-	-
Prince Edward Island	-	2,616	1,415	4,031	5,660	71.2	0.9
Nova Scotia	-	1,663	9,829	11,492	55,490	20.7	2.5
New Brunswick	-	1,605	11,511	13,116	73,440	17.9	2.9
Quebec	196	9,071	12,772	22,039	1,540,680	1.4	4.8
Ontario	21,568	22,177	29,088	72,833	1,068,580	6.8	16.0
Manitoba	1,625	25,306	24,407	51,338	649,950	7.9	11.3
Saskatchewan	9,997	58,745	94,247	162,989	652,330	25.0	35.9
Alberta	7,865	38,371	61,053	107,289	661,190	16.2	23.6
British Columbia	211	2,355	6,920	9,486	947,800	1.0	2.1
Yukon	..	..	..	..	483,450	..	..
Northwest Territories	..	..	..	..	3,426,320	..	..
Canada	41,461	161,908	251,261	454,630	9,997,610	4.5	100.0

Notes:

Figures may not add up due to rounding.

The Canada Land Inventory soil capability classes:

Class 1 - Soils in this class have no significant limitations for crops.

Class 2 - Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation

Class 3 - Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation

Sources:

McCuaig, J.D. and E.W. Manning (1982)

Statistics Canada. Environment Accounts and Statistics Division.

Urban land use

Canada's cities and towns expanded steadily between 1971 and 1996, consuming more than 12 thousand square kilometres in this 25-year period (Table 2). This expansion is equivalent to more than twice the land area of Prince Edward Island and represents an increase of 77 percent in urban land over the 25-year period. Much of the expansion occurred around smaller cities (cities with populations less than 100 thousand persons) where it was not uncommon to record a doubling in the area of urban land. In terms of sheer size, Ontario and Quebec contain over 55 percent of Canada's urban land, and not surprisingly between 1971 and 1996, these two provinces also grew the most in terms of the absolute increase in land used for urban purposes. In fact, Ontario's urban area grew by 3,472 square kilometres – this amount is larger than the total urban area found in any province outside Quebec.

Appendix - Daily Food Severing & Calories Intake

Males (Calories per day)

Age	Sedentary[1] Level	Low Active[2] Level	Active[3] Level
2-3 y	1100	1350	1500
4-5 y	1250	1450	1650
6-7 y	1400	1600	1800
8-9 y	1500	1750	2000
10-11 y	1700	2000	2300
12-13 y	1900	2250	2600
14-16 y	2300	2700	3100
17-18 y	2450	2900	3300
19-30 y	2500	2700	3000
31-50 y	2350	2600	2900
51-70 y	2150	2350	2650
71 y +	2000	2200	2500

Females (Calories per day)

Age	Sedentary[1] Level	Low Active[2] Level	Active[3] Level
2-3 y	1100	1250	1400
4-5 y	1200	1350	1500
6-7 y	1300	1500	1700
8-9 y	1400	1600	1850
10-11 y	1500	1800	2050
12-13 y	1700	2000	2250
14-16 y	1750	2100	2350
17-18 y	1750	2100	2400
19-30 y	1900	2100	2350
31-50 y	1800	2000	2250
51-70 y	1650	1850	2100
71 y +	1550	1750	2000

These values are approximations calculated using Canadian median heights and weights that were derived from the median normal BMI for different levels of physical activity. Your individual values may be different. The requirement for energy varies between individuals due to factors such as genetics, body size and body composition. These values are not for women who are pregnant or breastfeeding.

1 Sedentary: Typical daily living activities (e.g., household tasks, walking to the bus).
2 Low Active: Typical daily living activities PLUS 30 - 60 minutes of daily moderate activity (ex. walking at 5-7 km/h).
3 Active: Typical daily living activities PLUS At least 60 minutes of daily moderate activity.

Estimated Energy Requirements - Canada's Food Guide - Health Canada, 2007

Weekly Cost of the Nutritious Food Basket in Toronto (May 2010)

How to Calculate Your Food Costs Using the Nutritious Food Basket*

Follow the steps below to find out the cost of a weekly nutritious food basket for your household.

STEP 1:
Write down the age and gender of all the people you are feeding. For example:
Man, 37 years old and Woman, 37 years old
Boy, 15 years old and Girl, 8 years old

STEP 2:
Refer to Table 1 to find the cost of feeding each person. Write down the cost of feeding each person.

STEP 3:
Add these costs together to find your subtotal.

STEP 4:
Since it costs a little more to feed a small group of people and less to feed a large group, the total weekly cost may need to be adjusted using the following factors:

Household Size	Adjustment Factor
1 person	multiply by 1.20
2 people	multiply by 1.10
3 people	multiply by 1.05
4 people	make no change
5-6 people	multiply by 0.95
7 or more people	multiply by 0.90

STEP 5:
To determine the cost per month, multiply by 4.33

Table 1

Gender/Age (Years)		Cost Per Week
Males	2 – 3	$21.91
	4 – 8	$28.24
	9 – 13	$37.44
	14 – 18	$52.75
	19 – 30	$50.92
	31 – 50	$46.04
	51 – 70	$44.49
	Over 70	$44.03
Females	2 – 3	$21.49
	4 – 8	$27.39
	9 – 13	$32.08
	14 – 18	$38.29
	19 – 30	$39.43
	31 – 50	$39.01
	51 – 70	$34.61
	Over 70	$33.98
Pregnant Women	18 & younger	$42.68
	19 - 30	$43.08
	31 - 50	$42.04
Breastfeeding Women	18 & younger	$44.46
	19 - 30	$45.67
	31 - 50	$44.63

Example

Step 1		*Step 2*
Gender	**Age (Years)**	**Cost per week ($)**
Man	37	$46.04
Woman	37	$39.01
Boy	15	$52.75
Girl	8	$27.39
Step 3	Subtotal	$165.19

Step 4
Multiply your subtotal by the adjustment factor.
(4 people – make no change)

$165.19 x no adjustment = $165.19

Step 5
Multiply your total weekly cost from Step 4 by 4.33.
$165.19 x 4.33 = $715.27/month

Use the following chart for your household

Step 1		*Step 2*
Gender	**Age (Years)**	**Cost per week ($)**
Step 3	Subtotal	

Step 4
Multiply your subtotal by the adjustment factor.

Step 5
Multiply your total weekly cost from Step 4 by 4.33.

*The cost of the Nutritious Food Basket is based on the 67 food items collected from 12 stores across the City. The software program automatically adds 5% to the basket cost to cover the cost of miscellaneous foods used in meal preparation, e.g. spices, seasonings, condiments, baking supplies etc.

Appendix - Spending Pattern Breakdown

TABLE THREE: SPENDING PATTERNS FOR AVERAGE CANADIAN HOUSEHOLD AND LOWEST INCOME QUINTILE, 2007

	AVERAGE HOUSEHOLD	WEALTHIEST HOUSEHOLDS	LOWEST INCOME HOUSEHOLDS	SHARE ACCOUNTED BY IMPORTS
Average Income	$72,654	$165,024	$17,064	
Total expenditure as a % of Income	96.3	86.9	130.9	
	PERCENTAGE OF TOTAL CONSUMPTION			
Food	14.7	12.7	18.2	MEDIUM
Shelter	27.4	26	32.8	LOW
Household Operation	6.6	6.6	7.1	LOW
Household Furnishings and Equipment	3.9	4.5	3.1	HIGH
Clothing	5.9	6.9	4.5	HIGH
Transportation	18.9	19.5	12.9	LOW TO MED.
Health Care	3.9	3.2	4.4	MEDIUM
Personal Care	2.3	2.3	2.3	EST.
Recreation	8	9.5	5.2	EST.
Reading Material	0.5	0.5	0.6	EST.
Education	2	2.5	2.8	LOW
Tobacco and Alcoholic Beverages	3.1	2.7	3.4	LOW
Games of Chance	0.5	0.4	0.9	LOW
Miscellaneous Expenditure	2.2	1.2	1.8	EST.
Total Current Consumption	100	100	100	
	PERCENTAGE OF INCOME			
Personal Taxes	19.9	25.4	3.4	
Personal Insurance and Pension Contributions	5.4	5.3	2.4	
Gifts of Money and Contributions	2.5	2.3	3.6	
Discretionary Savings	3.7	13.1	-30.9	

holds that have lost an adult earner to illness or death during the year; by households that have lost a job during the year; and by a statistical quirk resulting from the fact that Statistics Canada does not count the subsidy built into subsidized housing as income.

But even if the high rate of dissavings for the lowest income quintile as a whole can be explained away by these special factors, the large proportion of income needed to provide the basic necessities of life suggests that very few households in the bottom income quintile can afford to save. Indeed, given the heavy reliance of low-income households on food banks to get by, they cannot even afford to meet their basic needs on the incomes that average just over $17,000 a year.

Precise estimates of import leakages associated with spending by low-income households unfortunately are unavailable as the necessary underlying data does not appear to exist. Accordingly, we were forced to take a more conjectural approach based on what is known about the spending patterns of low-income households and the breakdown that exists for imports by spending category.

The last column of Table Three provides a qualitative assessment of the import content of the goods and services purchased by households in the low-income quintile. A full description of the determination of import penetration in expenditure categories can be found in Appendix One.

Together our estimates, as outlined in the appendix, suggest that the import leakage from spending by low-income households is a relatively low 10.7 per cent. Carrying out a similar process for the average Canadian household yields a rate of import leakage of 15 per cent.

This difference in import leakage rates suggests that increases in income from the $17,064 average for the bottom quintile would cause imports to grow slightly faster than current consumption. For a small increase in income, in the order of say five (5) per cent, imports would grow less than one per cent faster, and thus, 89 per cent of a modest increase in transfer payments to the average low-income Canadian household would, in the first instance, end up being spent on Canadian-made goods and services.

By contrast, only 82 per cent of an identical transfer to an average household would, in the first instance, wind up being spent on Canadian goods and services. And for the average household in the highest income quintile only 66 per cent of the same transfer payment would, in the first instance, be spent on domestic goods and services. These impact differences imply that the overall increase

FACT

EXPENDITURE PATTERNS

Low-income households spend more of their income and buy local

The import leakage from spending by households in the lowest income quintile is a relatively low 10.7 per cent.

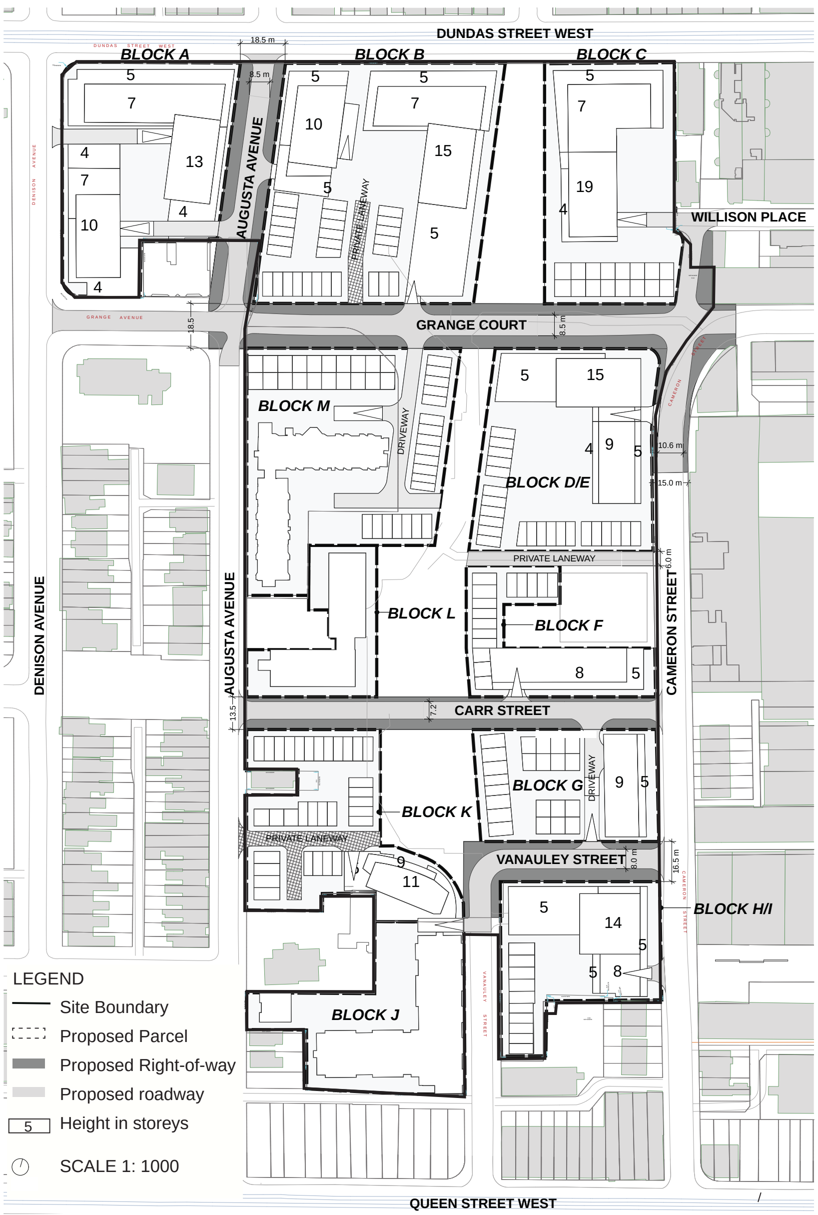
Wealthy households spend less of their income and buy fewer local goods and services

The import leakage from spending by households in the highest income quintile is over twice the rate of the lowest income quintile at 23.5 per cent.

Alexandra Park Revitalization

Recommended Master Plan

Site Plan



GFA and No. of Units by Block:

Block A
- 315, 640 sq. ft. / 29, 324 sq. m.
- 367 units (proposed)

Block B
- 379,641 sq. ft. / 35, 270 sq. m.
- 392 units (proposed)

Block C
- 264, 457 sq. ft. / 24, 569 sq. m.
- 292 units (proposed)

Block D/E
- 240, 131 sq. ft. / 22, 309 sq. m.
- 271 units (proposed)

Block F
- 104, 377 sq. ft. / 9, 697 sq. m.
- 77 units (proposed)

Block G
- 96, 617 sq. ft. / 9, 004 sq. m.
- 97 units (proposed)

Block H/ I
- 186, 441 sq. ft. / 17, 320 sq. m.
- 209 units (proposed)

Block J
- 14,004 sq. ft. / 1, 301 sq. m.
- 139 units (existing)

Block K
- 138, 300 sq. ft. / 12, 848 sq. m.
- 128 units (proposed)

Block L
- 7,992 sq. ft. / 742 sq. m.
- 77 units (existing)

Block M
- 53, 291 sq. ft. / 4, 950 sq. m.
- 257 units (existing)
- 40 units (proposed)

Total existing units:	**473**
Total units proposed:	**1873**
Total units on site:	**2346**

OFFICIAL PLAN AMENDMENT AND REZONING APPLICATION | March 16, 2011

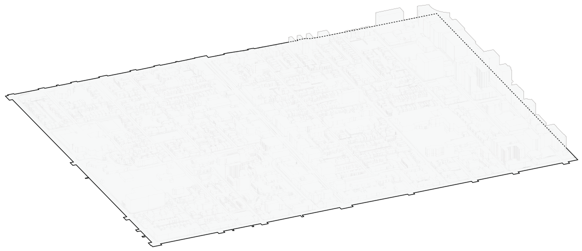
URBAN STRATEGIES INC.

Alexandra Park
Building Great Neighbourhoods

Appendix - Chinatown Yielding Calculation Exercise

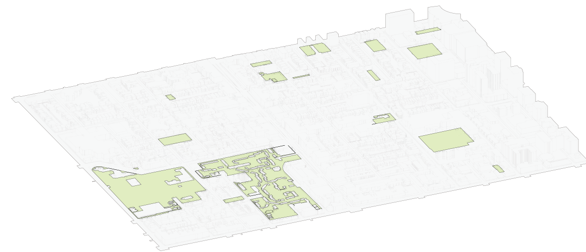
CHINATOWN SITE AREA:

1 559 870 SQ. M



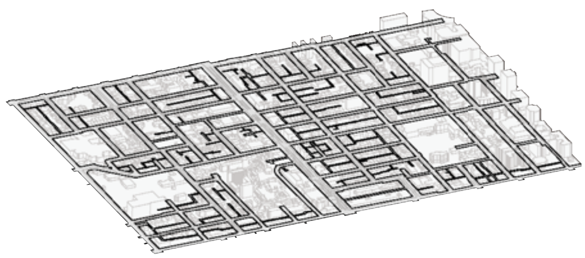
CHINATOWN TOTAL GREEN SPACE:

147 740 SQ. M



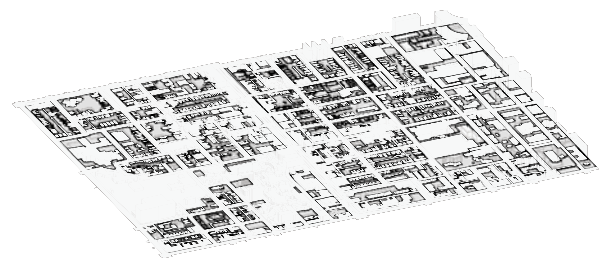
CHINATOWN TOTAL VEHICLE ROAD AREA:

267 460 SQ. M



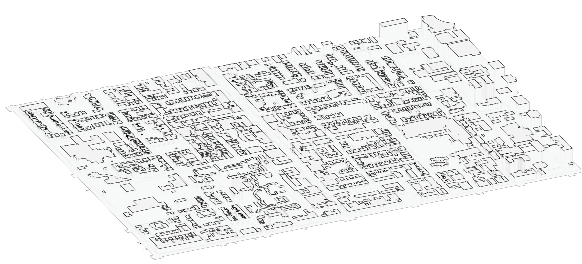
CHINATOWN TOTAL VACANT AREA:

402 490 SQ. M



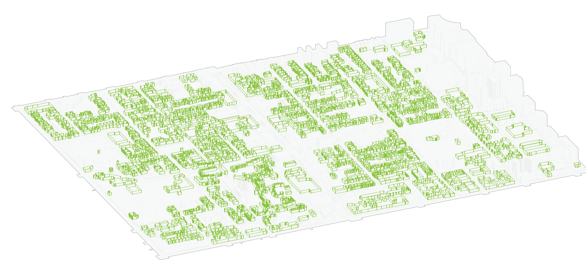
CHINATOWN TOTAL ROOF COVERAGE:

546 620 SQ. M



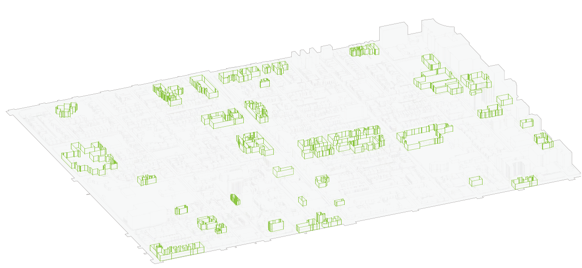
CHINATOWN TOTAL LOW-RISE FACADE AREA:

742 510 SQ. M



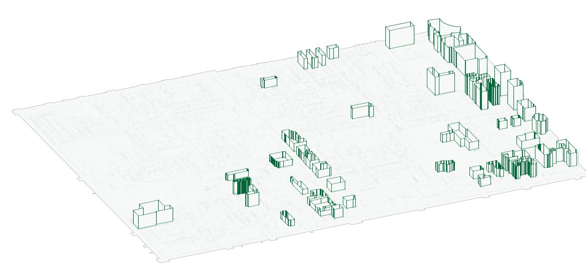
CHINATOWN TOTAL MID-RISE FACADE AREA:

245 750 SQ. M



CHINATOWN TOTAL HIGH-RISE FACADE AREA:

395 230 SQ. M



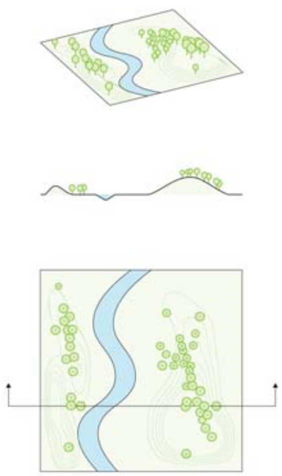
Appendix - Transect Zone Design Studies

ZONE 1

natural zone

building coverage = 0%
building footprint area = 0 m²
service area = 0 m²
productive coverage = 100%
productive area = 10,000 m²

maximum productive surface area = 10,000 m²

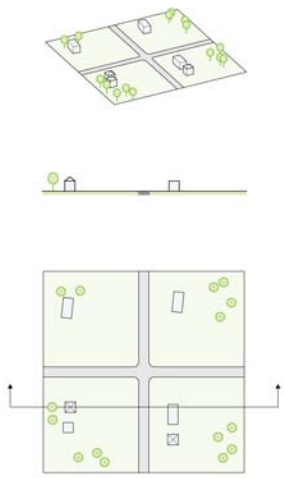


ZONE 2

rural zone

building coverage = 2.25%
building footprint area = 225 m²
service area = 975 m²
productive coverage = 90.25%
productive area = 9,025 m²

maximum productive surface area = 10,000 m²

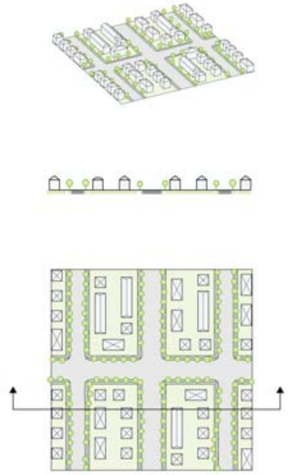


ZONE 3

sub-urban zone

building coverage = 15.25%
building footprint area = 1525 m²
service area = 3,904m²
productive coverage = 45.70%
productive area = 4590 m²

maximum productive surface area = 10,000 m²

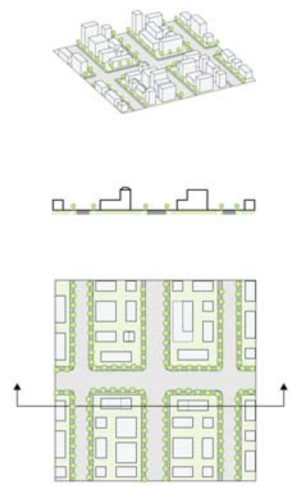


ZONE 4

general urban zone

building coverage = 21.4%
building footprint area = 2140 m²
service area = 3904m²
productive coverage = 39.55%
productive area = 3955 m²

maximum productive surface area = 10,000 m²

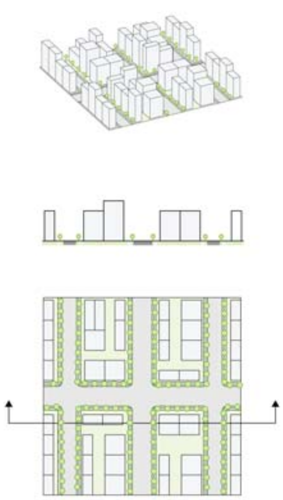


ZONE 5

urban centre zone

building coverage = 29.75%
building footprint area = 2975 m²
service area = 3904m²
productive coverage = 31.20%
productive area = 3120 m²

maximum productive surface area = 10,000 m²

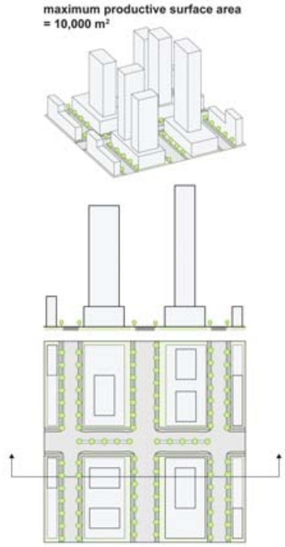


ZONE 6

urban core zone

building coverage = 40%
building footprint area = 4000 m²
service area = 3,904m²
productive coverage = 20.95%
productive area = 2095 m²

maximum productive surface area = 10,000 m²

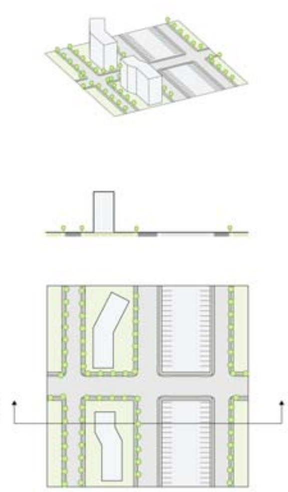


ZONE 7

special zone

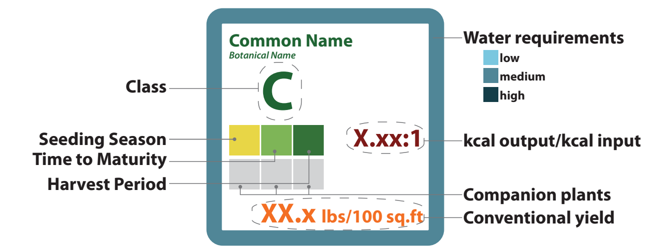
building coverage = 6.80%
building footprint area = 680 m²
service area = 5978m²
productive coverage = 33.41%
productive area = 3341 m²

maximum productive surface area = 10,000 m²

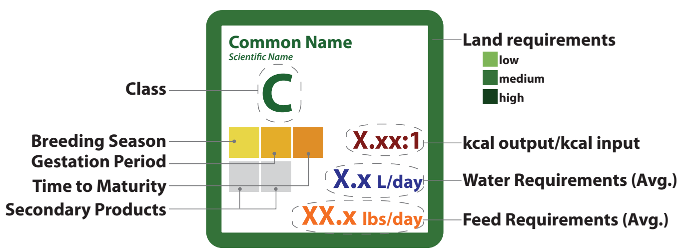


CROP & LIVESTOCK REFERENCE GUIDE

Fruits, Vegetables, & Field Crops



Livestock



Class Notations

Fruits & Vegetables

- **C** - Cole/Cabbage
- **F** - Fleshy-fruited
- **G** - Greens
- **O** - Onion group
- **P** - Perennials
- **S** - Salad
- **V** - Vine
- **L** - Legumes
- **T** - Tree
- **R** - Root
- **M** - Miscellaneous

Field Crops

- **Ce** - Cereal
- **F** - Forage
- **L** - Legumes
- **Gr** - Grain
- **O** - Other

Livestock

- **RL** - Ruminant, large
- **Rs** - Ruminany, small
- **P** - Poultry
- **W** - Waterfowl
- **S** - Swine
- **A** - Alternative

Letter Codes

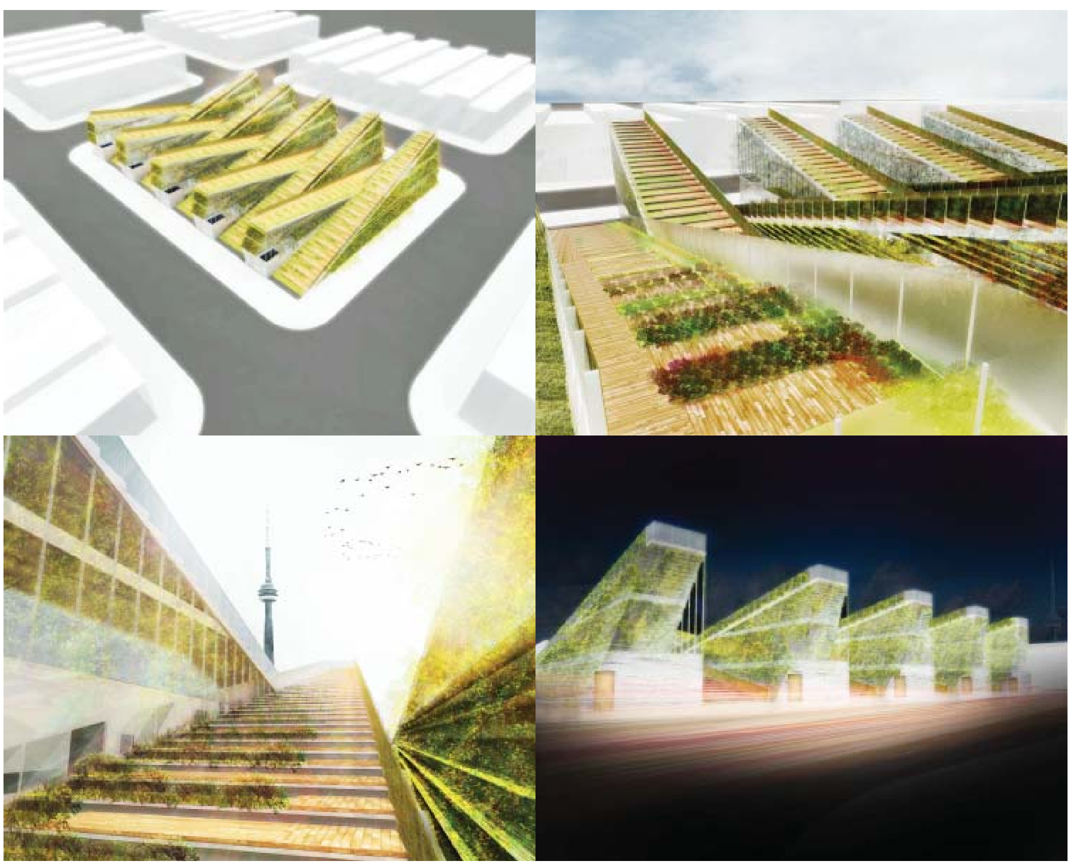
Seasons

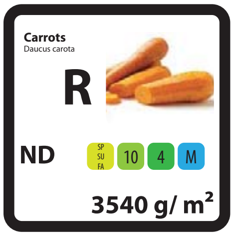
- **SP** - Spring
- **SU** - Summer
- **FA** - Fall
- **WI** - Winter

Other

- **ND** -Not Determined

4.17 Crop & Livestock Reference Guide - Legend





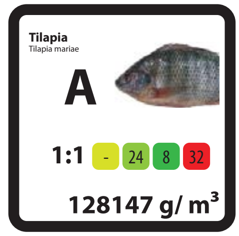
1ml = 1gram[1]

1 lbs / (sq. ft) = 4 882.42764 g / (sq. m)[2]

125ml = 28 calories[3]

Food energy
According to Foodland Ontario data, every 125ml of raw carrots corn contains 28 calories. Therefore, 1 square meter of carrots contains about 793 calories. If 2.5 cycles of growing and harvest period is possible for each year, the area requires to provide all the energy for a male and female Canadian is 450m^2 and 371m^2 respectively serving with only carrots every meal.

[1] http://www.convertunits.com/from/ml/to/gram
[2] http://www.simetric.co.uk/si_k.htm
[3] http://www.foodland.gov.on.ca/english/index.html
[3] AGRARIA an agrarian vision



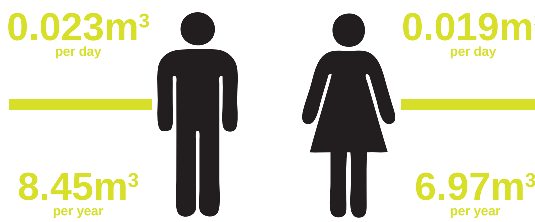
1lbs = 453.59237gram[1]

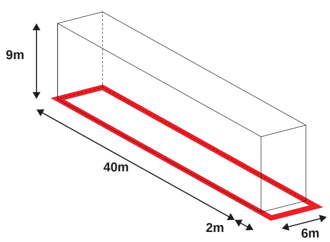
1 lbs / cubic feet = 16018 g / cubic metres[1]

113g = 93 calories[3]

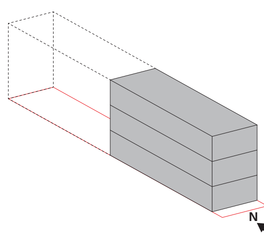
Food energy
According to fish farming manual[1], the growing capacity of talipia is 8 pounds per cubic foot. 500 talipia require about 62 cubic feet. which is 1.75 cubic meters approximately. Meeting the energy consumption for daily activity, a male requires 1,082,574 g of tilapia, and a female requires 894,085 g of tilapia. The volume requires to grow the amount of tilapia is 8.5m^3 for male, and 8.5m^3 for female.

[1] http://www.convertunits.com/from/ml/to/gram
[2] http://www.simetric.co.uk/si_k.htm[3] http://caloriecount.about.com/calories-market-day-tilapia-fillets-i85509
[4] Hatchery Manual Fish Farming at home for Fun and Profit, By Mike Sipe Tilapia Aquaculture International Palmetto, Florida, USA

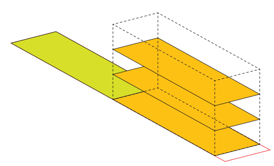




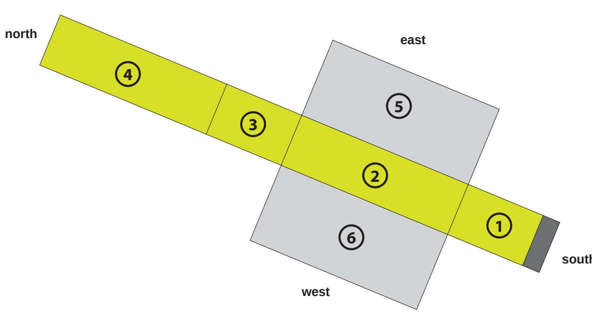
site volume
width = 6m
depth = 40m
height = 9m
(2m depth front yard)



building volume
L x W x H
= 1200m^3
site coverage is 50% of plot area; orientation is not design for growing

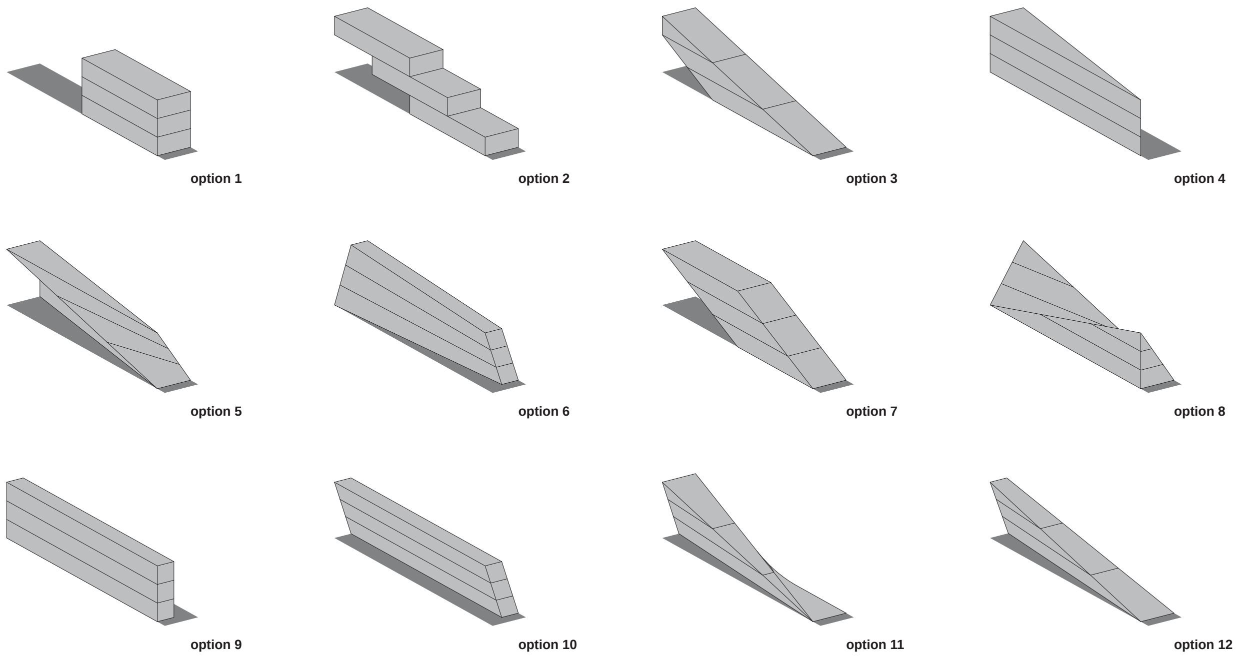


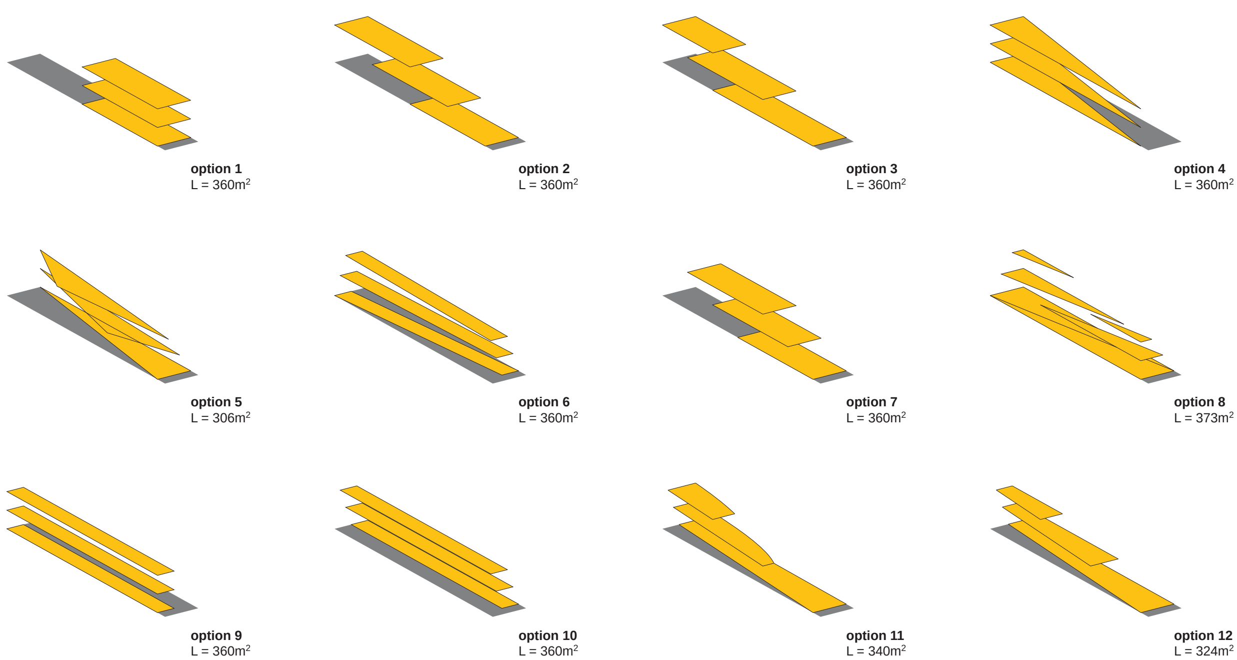
inhabitable area
Living (L) = 360m^2
Farming (F) = 120m^2
space for food growing is under utilize in the typical condition



maximum growing surface area
1) front facade = 60m^2
2) roof top = 120m^2
3) back facade = 60m^2
4) backyard = 120m^2
5) right facade = 200m^2 (attached with adjacent building face)
6) left facade = 200m^2 (attached with adjacent building fac

total surface area = 360m^2 (760m^2)


option 1
option 2
option 3
option 4
option 5
option 6
option 7
option 8
option 9
option 10
option 11
option 12


option 1
L = 360m^2
option 2
L = 360m^2
option 3
L = 360m^2
option 4
L = 360m^2
option 5
L = 306m^2
option 6
L = 360m^2
option 7
L = 360m^2
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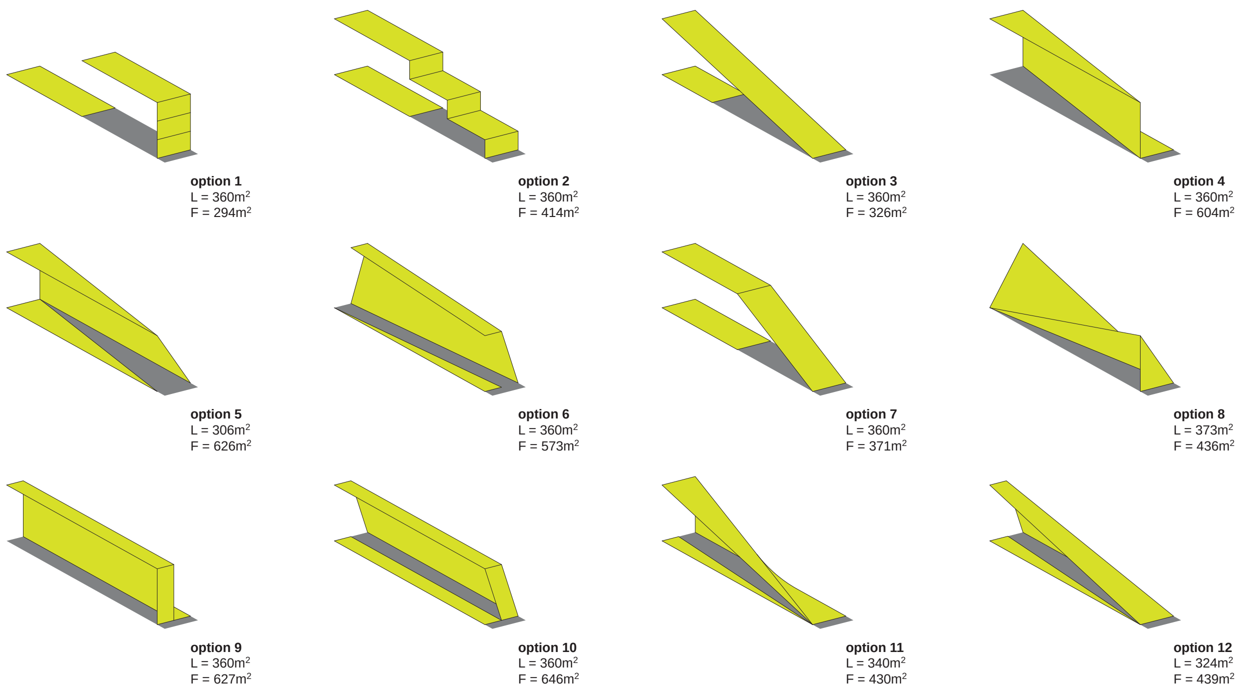
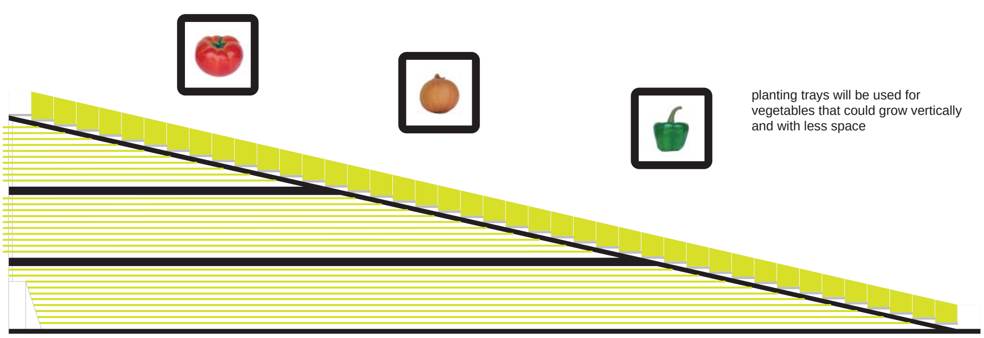
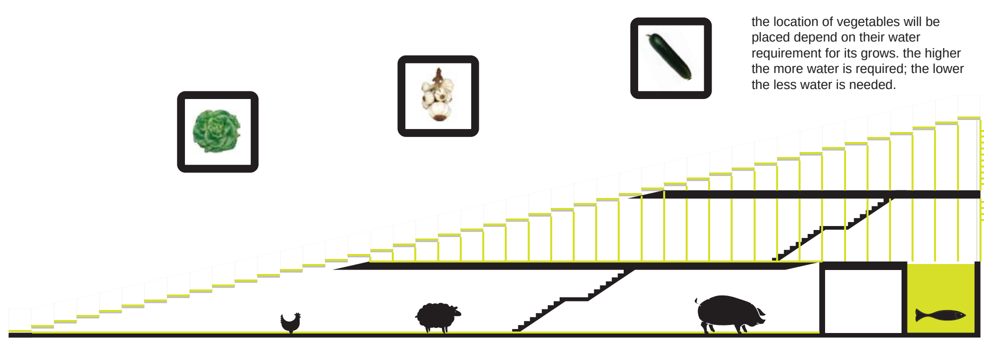
L = 373m^2
option 9
L = 360m^2
option 10
L = 360m^2
option 11
L = 340m^2
option 12
L = 324m^2

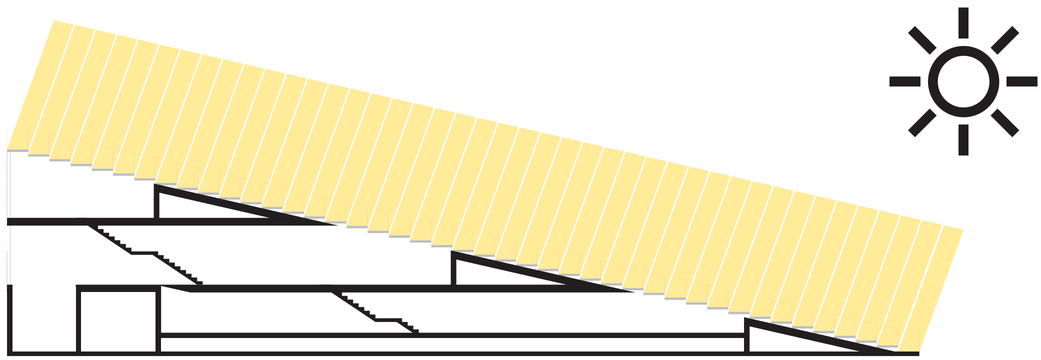




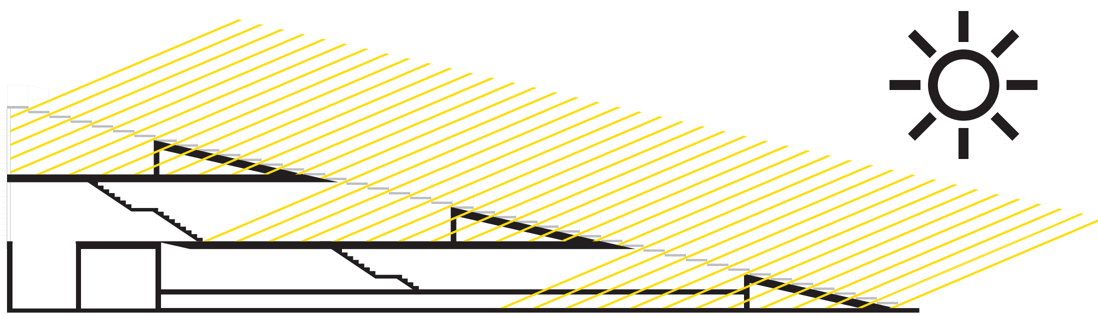
hydroponic & aeroponic growing surface



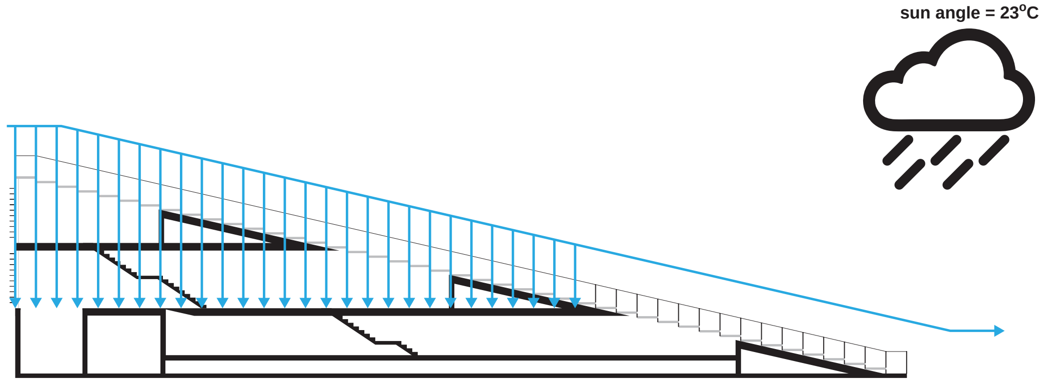
crops beds & walls live stocks area



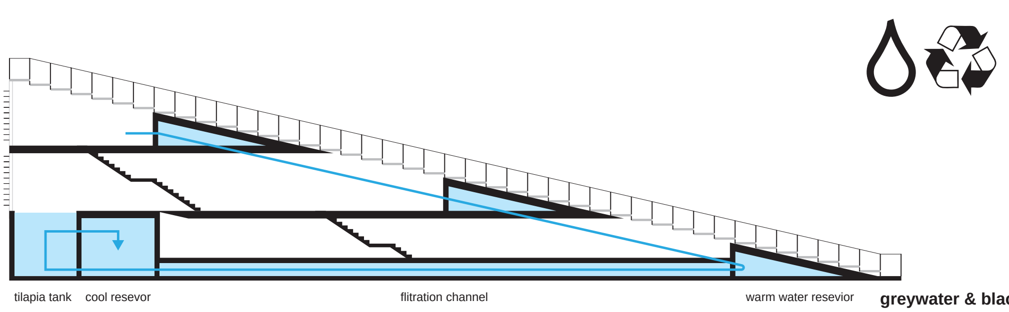
summer season
sun angle = 70^{o}C



winter season
sun angle = 23^{o}C



rainwater flow
irrigation system



greywater & blackwater
recycle system

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