T.U.R.F. (Transformative Urban Rooftop Farming):

Alleviating Food Insecurity in Toronto

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

One in every eight Canadian households is food insecure. This accounts for 12.7% of the total population of Canada. Food insecurity, which refers to inadequate and insecure access to food due to social, physical, and economic constraints, has a severe effect on an individual's health and well-being. The city of Toronto has many neighborhoods that face food insecurity within their communities. The city also has an abundance of vacant rooftop space that does not compete with other urban uses. How can urban agriculture on these vacant rooftops help in solving the problems of food insecurity in these vulnerable neighborhoods? Current urban agriculture practices in Toronto are limited to seasonal community farms aimed to feed a handful of the population and focus on enriching the community. However, research dictates that rooftops can be used for food production using the principles and technologies of building integrated agriculture (BIA). But little research is available to discuss how urban agriculture on a building can aid the food insecure population of the city. BIA on underutilized rooftops across the food insecure neighborhoods in the city of Toronto can act as an agent to alleviate the challenge of food insecurity. This research involves analyzing existing buildings in dense urban environments that have incorporated BIAs and understanding the different farming systems used by these buildings. Neighborhoods in Toronto that suffer from food insecurity are treated as test sites for implementing the researched BIA systems. The BIA proposal also aims to track the changes in the day-to-day life of the building residents. Integration of BIA within the city is beneficial for the people, the urban environment, and climate change in general. This local production of food will not only contribute towards alleviating food insecurity but also bring people closer to food production and reduce the impacts of food production on the climate by reducing food miles.

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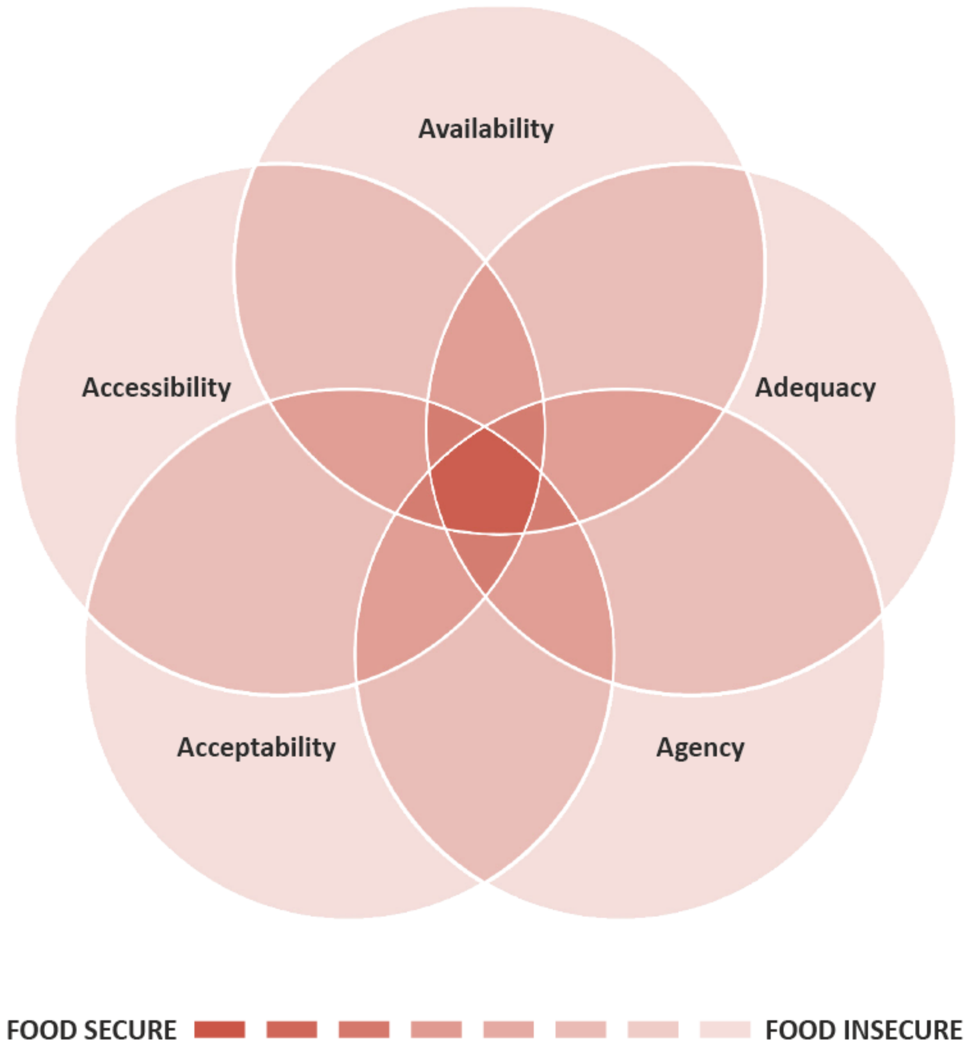
1.0 Introduction

Born and brought up in Delhi, growing fresh produce in the front yard of my house has been a family tradition. My mother and I would grow different fruits and vegetables and enjoy them for our meals. Over the year, the types of vegetables we grew changed according to seasons and so did our dinners. During the weekends, we would sow new seeds, tend to the plants, and attend workshops to help us grow better and sustainably. From an early age, I was introduced to the concepts of local farming and the benefits of eating fresh vegetables. This established my relationship with food and my interest in farming.

When I immigrated to Canada, I was introduced to a new food system. I could eat all kinds of vegetables all through the year. The grocery stores in Toronto carried imported produce from different parts of the world, like potatoes from the USA and garlic from China, but what I missed the most was my mother's recipe of fenugreek greens, something I couldn't find in the supermarkets near my apartment. Adding to that, living in a small apartment in a cold climate in Toronto, I could no longer grow vegetables like I used to. This piqued my interest in growing food in an urban setting in a cold climate. I wondered how can a city like Toronto, which houses vast typologies of supermarkets and grocery stores, benefit from localized farming or urban agriculture? This led me to look at the benefits of urban agriculture and, subsequently, the problem of food insecurity in Toronto.

Food insecurity is a leading health and nutrition issue in Toronto. The neighborhoods in Toronto that house low-income residents and have a growing immigrant population are hit the worst. During the past few years with the rising food prices, even as a developed country, Canadian households face food insecurity. The thesis uses the principles of urban agriculture to transform the food insecure communities in Toronto into being food secure.

The thesis begins by understanding food insecurity and its major causes in Canada. The next part dives into the history and current practices of urban agriculture and the impacts of local food production on the environment, people, and the city. Part three is an analysis of vacant rooftops as potential sites, in dense urban areas, for agriculture. It compares multiple rooftop farming systems (BIAs) and provides the best system to be installed in Toronto to counter food insecurity. The comparison between the different systems is achieved by developing a metric to compare them based on the amount of food produced and the area of the farming system. Part four is a design intervention in a food-insecure neighborhood in Toronto – Flemingdon Park. The intervention combines the principles of multiple BIA systems and retrofits existing residential towers in Flemingdon Park to grow food for the residents and provide spaces for the community to foster. The design hopes to create a balance between spaces for food production and creating spaces to engage the community within the tower. The thesis ends by envisioning the future of BIA in Toronto and how it can benefit not just the food insecure communities but also have a positive impact on the environment, tackling the climate crisis the world is in. The typical urban dweller today has no understanding of where or how food is produced which can be restored with the help of urban agriculture.


Availability
Accessibility
Adequacy
Acceptability
Agency
FOOD SECURE
FOOD INSECURE

2.0 Food Insecurity [relevance]

Fig. 2.01. Venn diagram showing relation of food insecurity with right to food. (Left)

2.1 What is food insecurity?

According to the World Food Summit (1996), "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."[1] Food insecurity refers to a state of failing to meet either of these requirements. It is an issue that has been prevalent in developing countries for a long time. However, in recent years, developed countries, like Canada, have also been struggling with food insecurity.

The Household Food Insecurity Survey of Canada conducted by PROOF (Food Insecurity Policy Research) defines food insecurity, as measured and monitored in Canada, "as inadequate or insecure access to food due to financial constraints."[2] PROOF is an interdisciplinary research group in Canada that is looking at household food insecurity. This study aims to find successful policy solutions for reducing household food insecurity. Using data from Statistics Canada, it issues annual reports on household food insecurity. The reports track patterns, allowing for the selection of response targets to solve this significant public health issue. These reports have been essential for increasing public awareness of Canada's food insecurity and the need for policy action.[3]

The experience of food insecurity can range from concerns about running out of food before there is more money to buy more, to the inability to afford a balanced diet, to going hungry, missing meals, and in extreme cases, not eating for whole days because of a lack of food and money for food.[4] Food insecurity is more than just a food problem, people living in these households have to compromise on a broad range of necessities like housing, healthcare, etc. Poverty coupled with a lack of affordable housing, transportation, and job opportunities forms the major determinants of food insecurity.

1 Leanna Parekh, "The Basics of Food Security (and How It's Tied to Everything)," March 23, 2021, https://www.worldvision.ca/stories/food/the-basics-of-food-security.

2 Valerie Tarasuk and Andy Mitchell, "Household Food Insecurity in Canada" (Canada: PROOF (Food Insecurity Policy Research), 2018 2017), https://proof.utoronto.ca/food-insecurity/.

3 "PROOF: Food Insecurity Policy Research," PROOF, accessed May 8, 2021, https://proof.utoronto.ca/about-proof/.

4 Tarasuk and Mitchell, "Household Food Insecurity."

It also leads to public health issues, since individuals' health is directly related to the kind of food they consume and how much food they eat. Food deficiency in youth, for example, can lead to serious chronic diseases later in life. Adults who are severely food-deprived have worse mental health than people who are food-safe. As a result, food-insecure households cost Canadian provinces 2.5 times as much as food-safe households because of the associated healthcare costs.[5]

Food insecurity is associated with the right to food which refers to "the right to feed oneself in dignity." Right to food is associated with five 'A's:

1. Availability- Sufficient quantities of food are available to all people
2. Accessibility- Food is physically accessible and affordable
3. Adequacy- Food is nutritious and safe
4. Acceptability- Food is culturally appropriate and meets dietary needs
5. Agency- People can make choices about foods they obtain, grow and consume

Food insecurity relies on these five factors, each of which is required to be fully food secure. The venn diagram in Fig. 2.01 depicts the relation between right to food and food insecurity. As we move from the darkest point in the center to the lightest point, food insecurity increases. Governments are responsible for creating an environment in which people have the physical and economic means and agency to access adequate food. Only by getting this will the residents be food secure.[6]

2.2 Reason for food insecurity

Reasons for food insecurity in Canada depend upon multiple factors, including income, cost, and racism, directly related to the previously discussed 5 As for the right to food. The following section goes through the top five reasons causing food insecurity:

5 Tarasuk and Mitchell, "Household Food Insecurity."

6 "Who's Hungry: Profile of Hunger in the Toronto Region" (Toronto: Daily Bread Food Bank, North York Harvest Food Bank, The Missisaga Food Bank, 2019), https://www.dailybread.ca/whoshungry.

1. High Cost of Food
2. Large Distance to Food
3. Poor Quality of Food
4. Lack of Culturally Appropriate Food
5. Lower Income

2.2.1 High Cost of Food

In the year 2019, food costs increased by 4% across Canada and 7.5% in Toronto in comparison to the past year, according to Toronto Public Health's 2020 Report.[7] The rising cost of food compounds the stress felt by households already struggling to manage their day-to-day expenses. People often change the way they shop for food and their consumption habits because of the increase in food prices. According to ***Who's Hungry Survey*** for Hunger in Toronto (2019), respondents reported shopping at discounted grocery stores, couponing, only purchasing sale items, reducing the amount of foods purchased, substituting preferred foods for lesser quality affordable items, and increasing the use of food banks as ways to mitigate the rising food prices. Some families skipped meals altogether to have enough money to pay for other necessities. Surveyed families revealed that they would miss a meal to pay a phone bill, rent, or transportation. Moreover, fresh and/or organic food tend to be more expensive to acquire than pre-packed, frozen, or fast food. Thus, people resort to buying cheaper lower quality products that are not as nutritious, affecting the health and well-being of the consumers.

2.2.2 Large Distances to Food

Accessibility to food that fits your dietary requirement plays an important role in being food secure. If a family has to travel more than 1 km to a supermarket or a grocery store selling fresh nutritional food, then that neighborhood is referred to as a 'food desert' as per the Wellesley Institute's Report on Food Security 2012.[8] Food deserts are traditionally defined as lower-income areas with relatively few nearby supermarkets. The large distance to food causes food insecurity since the residents are

7 "Who's Hungry."

8 "Food Security" (Toronto: Wellesley Institute, 2012), https://www.wellesleyinstitute.com.

Fig. 2.02. Stages of food insecurity. (Right)

unable to buy the food they need within their neighborhood, eventually having to either travel to other neighborhoods or resort to fast food chains readily available nearby. The burger place closer to home is an easier and comparatively affordable option after a busy day than the grocery store 2 kilometers away by transit. In Toronto, finding new, inexpensive, and nutritious food is becoming increasingly difficult. Urban sprawl makes it difficult to shop for food without a vehicle, and traffic congestion in the area limits the number of farmers' markets. Take-out that is fried, spicy, salty, and sugary is a quick fix gaining popularity.[9]

2.2.3 Poor Quality of Food

The quality and freshness of food are a concern for every household. Purchasing fresh produce in bulk from supermarkets and grocery stores is always cheaper which leads to families buying produce in bulk eventually compromising on the quality. Moreover, expired food, or near the expiry date is sold for cheaper, and families on a budget often have to buy these rather than full-priced products. They are forced to choose between either the price or the quality of food and the former always wins. Food insecurity is exaggerated in the immigrant households that face the problem of lower quality culturally rich food which is generally imported, as the locally grown international fresh produce is expensive and scarcely available.

2.2.4 Lack of Culturally Appropriate Food

As of the 2016 Census, 51% of Toronto's metropolitan area population were identified as a "visible minority," which Statistics Canada defines as "persons other than Aboriginal peoples, who are non-Caucasian in race or non-white in color." Immigrants in Canada face food insecurity due to the lack of availability of culturally appropriate food. People immigrating to Canada, during the early years in a new country, have to get accustomed to the produce natively available here and change and/ or adapt the food they have been eating in their home country. This change in dietary requirements, in the new country, often leads to food insecurity. Historically, immigrant wages have tended to increase with the number of years spent in Canada, yet wages among immigrants remain

9 "Food Security."


STAGE 01
LOW INCOME
STAGE 02
COST OF FOOD
TYPE OF FOOD
DISTANCE TO FOOD
QUALITY OF FOOD
STAGE 03
FOOD
INSECURITY

Fig. 2.03. Food insecurity statistics and demographic data for Canada. (Left)

lower on average than the Canadian-born population.[10] The distance to the available culturally rich food also matters. Newly immigrated families do not have the luxury to drive and traveling to far-off neighborhoods in search of food adds to the food insecurity. The lower-income aids to the cultural shock of food faced by the immigrant families, making them, even more, food insecure. An immigrant from Nigeria living in the Flemingdon Park neighborhood in Toronto states:

"Nigerian foods are not here. I eat whatever they have here. If I want to eat my cultural food, I have to travel out of the neighborhood. I go to the West End to get the stuff, maybe once a month. I use fruits and vegetables in this area to support the food I get once a month in the West End."[11]

2.2.5 Lower Income

Income is at the heart of food security. Poverty is described as a situation in which an individual lacks the wealth, means, options, and power to attain and sustain a basic living standard.[12] A household with low income is food insecure because they lose the ability to buy the food they want for their dietary requirements and instead have to buy cheap to support their families, often resigning to buying cheaper fast food options as the main source of their diets. This is due to their inability to afford fresh fruits, vegetables, and dairy which tend to be expensive than chain stores. Another resident of Flemingdon Park states:

"Like for potato and rice, it is cheaper and it fills our stomach, right? and fresh nutrient-rich vegetables and fruits are expensive and even if we eat much, we still feel light so it is costly."[13]

Lower-income is the root cause of food insecurity and directly relates to all the other causes. (Fig. 2.02) Poverty brings with it the inability to travel to distant grocery locations, buying expensive organic and fresh nutritional products, and spending more on culturally specific items.

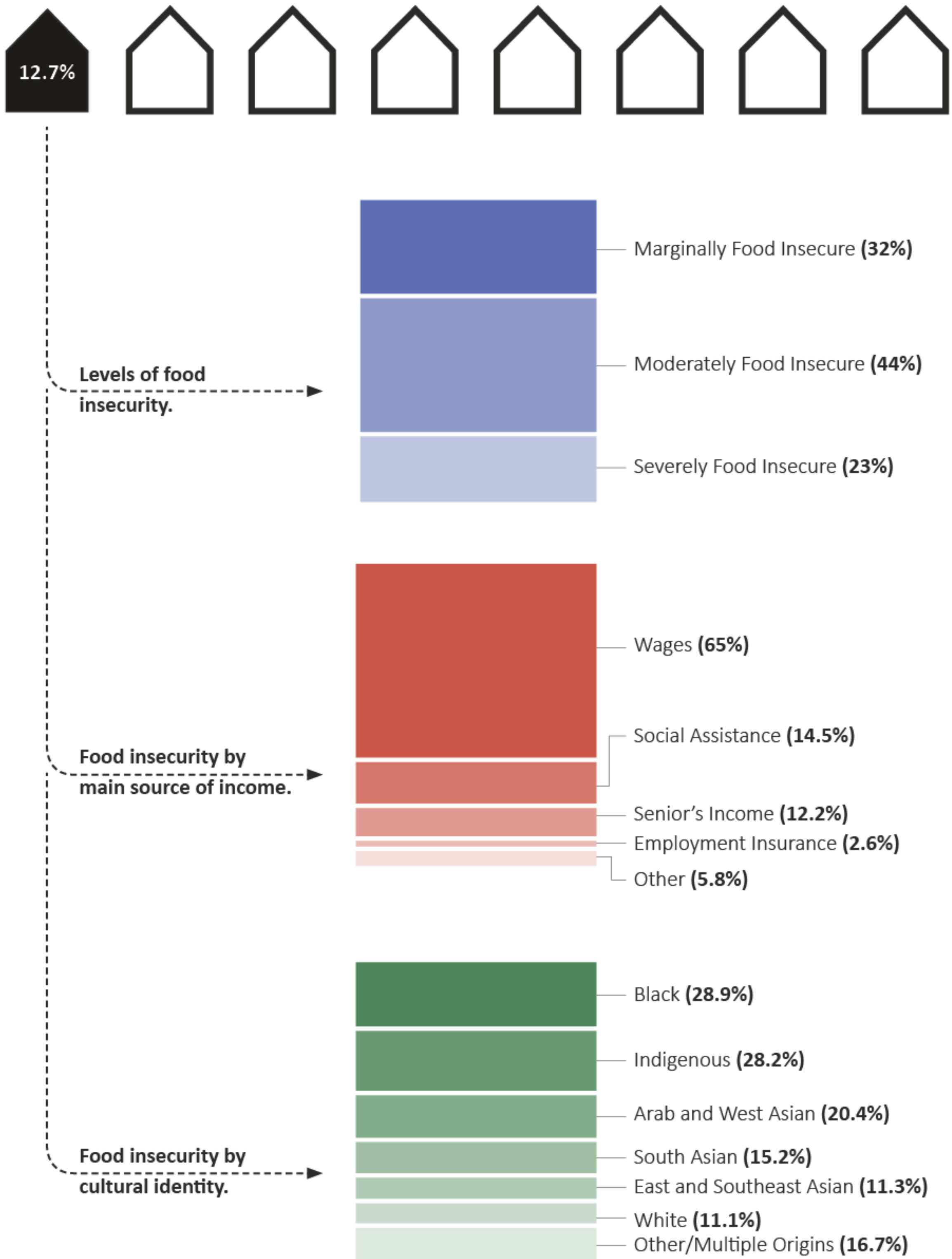
10 "Who's Hungry."

11 Haiat Iman et al., "Closing the Food Access Gap in the Flemingdon Park & Thorncliffe Park Neighbourhoods of Toronto, Canada," 2015.

12 "Who's Hungry."

13 Iman et al., "Closing the Food Access Gap in the Flemingdon Park & Thorncliffe Park Neighbourhoods of Toronto, Canada."

1 in 8 households in Canada are food insecure.



2.3 Food Insecurity in Canada

Fig. 2.03 translates the data provided by PROOF for food insecurity in Canada. On average 1 in every 8 Canadian households is food insecure.[14] This accounts for 12.7% of all households or 1.8 million families across Canada. These households are classified into three levels of food insecurity that are marginally, moderately, or severely food insecure.[15] Those who are marginally food insecure have reported some concern or problem with food access over the past twelve months. Households classified as moderately food insecure have reported compromises in the quality and/or quantity of food consumed among adults and/ or children. Those classed as severely food insecure have reported more extensive compromises, including reduced food intake among adults and/ or children because of a lack of money for food. Two-thirds of the 1.8 million households fall in either the moderate or the severe food insecure levels.[16]

The majority of food-insecure households are working. 65% of the food-insecure households declared their main source of income as wages or income from employment. Simply getting a career isn't enough; low wages and insecure work mean that many people in the workforce don't have enough money to eat.[17]

When food insecurity is sorted by cultural identity, the trend becomes very clear. The highest rates of food insecurity were found among households where the respondent identified as Indigenous or Black, at 28.2%, and 28.9% respectively. The report showcases that the immigrant population of Canada is also affected by food insecurity. The prevalence of food insecurity differed with the respondent's immigration status, among households where the respondent was a recent immigrant to Canada (less than 5 years) was 17.1%, but the rate for households where the respondent had immigrated to the country five or more years ago was 13.8%, approaching the rate for Canadian-born respondents (12.2%).[18]

14 Tarasuk and Mitchell, "Household Food Insecurity."

15 Tarasuk and Mitchell, "Household Food Insecurity."

16 Tarasuk and Mitchell, "Household Food Insecurity."

17 Tarasuk and Mitchell, "Household Food Insecurity."

18 Tarasuk and Mitchell, "Household Food Insecurity."

2.4 Conclusion

Even as a developed country, Canada has a growing problem of food insecurity among its residents. The data provided by PROOF and ***Who's Hungry Survey*** provide us with the validation of how serious the problem is. With the growing immigrant population and rising food prices in Canada, the problem of food insecurity in Canada will only grow from here on. Is it possible to produce local food within the city for the urban population, thus providing them with affordable food, to alleviate the problem of food insecurity? The research examines utilizing the opportunities in local food production within the city to solve the problems of food insecurity among the food insecure communities.

3.0 Existing Solutions for Local Food Production [context]

Fig. 3.01. Rooftop Urban Farming in Chicago.
(Left)

Food insecurity is directly tied to access to fresh, good quality, low-cost food. Food production within the city boundaries enables the city to produce food closer to the people that consume food. The residents get access to food that is locally produced within their neighborhood. Growing local food helps in alleviating food insecurity by reducing the cost due to transportation of fresh produce as it grows in the city, unlike conventional rural farming. The food grown locally does not undergo large travel from the farm making it fresher and of higher quality. Local production of food gives residents the authority over what is produced, giving them access to produce as per their dietary requirements. The lower-income population, who form the majority of the food insecure population, benefit from locally grown produce by finding a cheaper and fresher alternative to neighborhood supermarkets.

But, what does it mean to grow local? 'Local' here refers to being closer to where people reside. Local Food production within a city landscape is referred to as 'Urban Agriculture' or 'Urban Farming'. This term has been commonly used when describing farming practices of varying scales in the urban area. Humans have been cultivating crops and raising livestock in and around towns since they started organizing themselves into long-term communities, over 5,000 years ago. For centuries, there has been a natural convergence of urbanization and food production, as the farming activities that enabled cities to survive spilled over into the cities themselves. However, as a global revival in urban agriculture takes hold, this is evolving once more. According to the United Nations Development Program, only 15% of food eaten in cities was produced in cities in 1993. However, by 2005, the percentage had risen to 30%. In just over 15 years, urban food production has doubled.[1] Canada is no stranger to this growing trend of urban agriculture with dedicated policies and governing bodies for urban agriculture within its provinces.

1 "Urban Agriculture," Urban Farmer, accessed April 19, 2021, http://www.theurbanfarmer.ca/urban-agriculture.

Fig. 3.02. Urban Agriculture on vacant city owned plots in Havana, Cuba. (Left)

Today's average city dweller has no idea when or how food is processed or delivered. We've become reliant on large, profit-driven companies to transport vast amounts of food from industrial farms to our supermarkets – but the whole mechanism is clandestine, massively complicated, and fundamentally unsustainable.[2] Urban agriculture helps in bridging this gap and bring the urban dwellers closer to the process of food, restoring the lost connection. The past and present situation of urban agriculture plays a vital role in understanding the concepts of local food.

3.1 Urban Agriculture

The United Nations Development Program defines urban agriculture as "an industry that produces, processes, and markets food, largely in response to the daily demand of consumers within a town, city, or metropolis, on land and water dispersed throughout urban and peri-urban areas."[3] In the report "Cities Feeding People" Luc J.A. Mougeot submitted a revised definition, wherein urban agriculture is defined as "an industry located within (intraurban) or on the fringe (periurban) of a town, city or metropolis, which grows or raises, processes, and distributes a diversity of food and non-food products, (re-)using largely human and material resources, products, and services found in and around that urban area, and in turn supplying human and material resources, products and services largely to that urban area." The definition by Mougeot is an improved version of the one by United Nations as it not only includes the growing of produce but also includes the distribution and other processes involved in making food reach from the farm to the mouth.

3.2 Historic Movements

Through the years, there have been many examples where local food production in urban areas, i.e. urban agriculture, has helped communities become food secure and saved lives of millions of people. Urban Agriculture practices for the food security of the population have taken place in developing and developed countries alike.

2 Vanessa Quirk, "Urban Agriculture Part I: What Cuba Can Teach Us," ArchDaily, May 24, 2012, https://www.archdaily.com/237526/urban-agriculture-part-i-what-cuba-can-teach-us.

3 Kathrin Specht et al., "Urban Agriculture of the Future: An Overview of Sustainability Aspects of Food Production in and on Buildings," *Agriculture and Human Values* 31, no. 1 (2014): 33–51, https://doi.org/10.1007/s10460-013-9448-4.

3.2.1 Cuba

In Cuba, urban agriculture has quickly grown into an important source of fresh produce for the country's urban and suburban populations. In reaction to the crisis brought about by the lack of trade after the fall of the socialist bloc in 1989, Cuba became entirely responsible for feeding its population – including the 2.2 million people who live in Havana. Due to this, a vast number of urban gardens sprouted in Havana and other major cities as a grassroots movement.[4] By 1998, Havana had over 8,000 officially recognized gardens, ranging from small family plots to vast state-run plantations, many of which were organic and produced about half of the country's vegetables. But what's interesting about Cuba is how, out of desperation, food has become a driving force in the development of the country's capital.[5] [6]

After the Soviet Union fell apart in 1989, Cuba entered an era of economic and food shortages known as the Perodo Especial en Tiempo de Paz, or "Special Period of Peace." The estimated daily per-capita caloric intake decreased to 1900 calories from 3,000 at the onset of the Special Period. The Cuban government was concerned that civil discontent would lead to increased economic uncertainty and, eventually, political instability. As a result, a series of internationally unparalleled economic and agricultural policy changes aimed at achieving national food security began. The creation of the Urban Agriculture Program (UAP), which offered seeds, equipment, property, and technical assistance to individuals and groups, was the first major Special Period change. Even though UAP gave these services to urban gardeners, it delegated decision-making authority to local Peoples' Councils to serve farmers' interests. The reform of the property rights scheme, which now allows individuals and organizations to gain legal rights to use barren, urban land for food production, was also very important.[7]

Although the number of home gardens in Havana (Patios and Parcelas) increased, the small grower cooperatives (UBPC) that had been so successful in using larger vacant parcels in the city of Havana for food production began to decline sharply. In the year 2000, the government

4 Miguel A. Altieri et al., "The Greening of the 'Barrios': Urban Agriculture for Food Security in Cuba," *Agriculture and Human Values* 16, no. 2 (1999): 131–40, https://doi.org/10.1023/A:1007545304561.

5 Quirk, "What Cuba Can Teach Us."

6 Sinan Koont, *Sustainable Urban Agriculture in Cuba*, Book, Whole (Gainesville: University Press of Florida, 2016).

7 Charles French, Mimi Becker, and Bruce Lindsay, "Havana's Changing Urban Agriculture Landscape: A Shift to the Right?," *Journal of Agriculture, Food Systems, and Community Development* 1, no. 2 (2010): 155–65, https://doi.org/10.5304/jafscd.2010.012.013.

developed “The Official Movement of Patios and Parcelas” to boost demand in small spaces around people’s homes while preserving bigger, more valuable urban spaces. Between 1996 and 2005, the number of Parcelas and Patios nearly doubled. The growth of urban farming in Havana has inspired gardeners, NGOs, and scholars all over the world.[8]

3.2.2 Victory Garden

Local food processing was seen as ammunition to fight the war in the United States and the United Kingdom. During World War I, German and British military strategists devised strategies to win the war by destroying their adversary’s civilian food supply. To explore the strengths and limitations of local food production, this history evaluates the food durability of a nation that imported food (Great Britain), one that produced food locally (Germany), and one that exported surplus (the United States).[9]

Following the outbreak of the war, Britain developed a program to train new gardeners and farmers in local food production. On “slacker ground,” gardeners developed “war gardens,” later called “victory gardens,” and by 1917, there were half a million garden plots. Since men had gone off to war, the Woman’s Land Army taught women to become “farmerettes” in two-week and four-week courses.[10]

Ultimately, World War I was fought for food security. Each country assessed the strengths and weaknesses of their own and their adversary’s food systems to devise policies that would cause their adversary’s food system to fail. Food blockades were an extremely common defensive tactic used by both Germany and the United Kingdom. When the Allies failed to distribute food to the German civilians after the Armistice, it was the most heinous mistake in foreign diplomacy.[11]

3.2.3 Soldiers of the Soil

“Every boy and every girl . . . should be a producer. The growing of plants . . . should therefore become an integral part of the school program.” The United States School Garden Army (USSGA) was established with these words by the federal Bureau of Education, during World War I, to encourage urban and suburban youth to engage in urban agriculture. Agriculture

8 French, Becker, and Lindsay, “Havana’s Changing Urban Agriculture Landscape.”

9 Alesia Maltz, “‘Plant a Victory Garden: Our Food Is Fighting:’ Lessons of Food Resilience from World War,” *Journal of Environmental Studies and Sciences* 5, no. 3 (2015): 392–403, https://doi.org/10.1007/s13412-015-0293-1.

10 Maltz, “‘Plant a Victory Garden: Our Food Is Fighting:’”

11 Maltz, “‘Plant a Victory Garden: Our Food Is Fighting:’”

Fig. 3.03. "Soldiers of soil" advertisement poster from the world war.
(Right)

Fig. 3.04. "National War Garden Commission" advertisement poster from the world war.
(Next Page Left)

Fig. 3.05. "Victory Garden" advertisement poster from the world war.
(Next Page Right)

and gardening activities were tied to national security due to concerns about the security of America's food supply. More than two million young people worked as "soldiers of the soil" by the end of the war, engaging in urban farming in their backyards and neighborhood community gardens. For the duration of the war, the USSGA campaign built a lively network of gardens and gardeners that changed the American food system.[12]

The USSGA was a first-of-its-kind government initiative to make agricultural education a structured part of public school curricula throughout the country, with additional taglines that stated, "he who produces is a patriot—a good citizen" and "A Garden for Every Child. Every Child in a Garden." It also offered an incentive to instill a typical American "producer" mentality in a city community that was becoming heavily dominated by popular media and consumerism, and becoming increasingly disconnected from its food system.[13]

The fragile state of America's food system on the eve of the country's entrance into WWI, as well as the need to increase agricultural productivity on the home front, were the driving forces behind the formation of the USSGA. The food infrastructure in the United States was antiquated. The country lacked the necessary structures and processes to effectively control its food supplies. The yield per acre was on the low end of the scale.[14] This fragile state led to urban farming initiatives in schools across the country to make American food secure amidst the war.

Another driving factor behind the USSGA was the issue of feeding European allies who were in a precarious position in terms of food supplies. By 1917, almost every able-bodied European man had enlisted in the army. Due to severe labor shortages and the utter destruction inflicted by the war on large swaths of agricultural territory, Europe faced a third consecutive year of extremely reduced agricultural development. Food shortages in Europe were caused by a combination of falling European production and decreased American imports. Increased food production using urban agriculture helped not only the American population but also aided the Allies during the war.[15]

12 Rose Hayden-Smith, "'Soldiers of the Soil': The Work of the United States School Garden Army during World War I," *Applied Environmental Education and Communication* 6, no. 1 (2007): 19–29, https://doi.org/10.1080/15330150701319453.

13 Hayden-Smith, "'Soldiers of the Soil.'"

14 Hayden-Smith, "'Soldiers of the Soil.'"

15 Hayden-Smith, "'Soldiers of the Soil.'"


BOYS TO THE FARM
Bring your chum and do your bit
S.O.S.
"Soldiers Of the Soil"
This is the
OFFICIAL UNIFORM
Authorized by the
CANADA FOOD BOARD
Each Suit Bears
this Label
S.O.S.
Soldiers of the Soil
OFFICIAL UNIFORM
CANADA FOOD BOARD
E.Henderson
CANADA FOOD BOARD
S.O.S.
Manufactured exclusively by the
MONTREAL SHIRT & OVERALL CO
LIMITED, MONTREAL


"National...."
The Fruits
of Victory
Leonebel Jacobs
Copyright, 1918, by F. M. Lupton, Publisher, (Inc.)
MAY 29 1918
Write for Free Book to
National War Garden Commission
Washington, D.C.
Charles Lathrop Pack, President
P.S. Ridsdale, Secretary


YOUR VICTORY GARDEN
counts more than ever!
MORLEY
WAR FOOD ADMINISTRATION

Even after the success of USSGA in mobilizing urban and suburban farming across America, it was discontinued after the end of the war. In the aftermath, as Americans turned their back on the horrors of that period and embraced modernity, they simply lost interest in anything associated with the war. Moreover, as the defense funding depleted, the leaders of USSGA had no alternative funding which led to the program being decommissioned.[16]

3.2.4 Lessons Learned

All these movements of urban agriculture tackle the same problem of food insecurity, initiated due to an ongoing world war as in the case for America or due to the fall of the Soviet Union for Cuba. To become successful, urban agriculture requires several well-functioning components.

1. Education

Urban agriculture could be a larger part of urban life if we were more properly educated. The education of youth by integrating agricultural education as part of the school curriculum by the USSGA is the first step to enable a city to produce its food. By providing essential training and education to its residents, a city can rely on the residents for making it food secure especially during desperate times as demonstrated by the victory garden movement during WWI.

2. Policies

During the "special period of peace" in Cuba, the Cuban government introduced policies to enable its residents to grow food tackling food insecurity in the nation. Policies provided residents of Havana with tools, training, and the right to turn any vacant city plot into a functioning urban farm. Rules in favor of urban agriculture act as a push for the urban dwellers to grow food and turn green spaces in the city into productive urban farms.

3. Urban Land

The Cuban case also brings to light the value of urban lands. Where the small urban farms kept on increasing in Havana, the larger farms on city

16 Hayden-Smith, "'Soldiers of the Soil.'"

lands were mostly decommissioned. These vacant city lots compete with other urban functions of housing, social amenities, institutional buildings, etc., and these functions are deemed more important in comparison to an urban farm. In a dense urban city, land value and availability of land are the major determinants for the feasibility of an urban farm.

4. Infrastructure Costs

In the studies, all the urban agriculture incentives were sponsored by the city, the military, or the country. These movements were successful because the residents were asked to just farm and provide food without stressing about the costs and economics. and provide food. They did not have to ask for permission to farm or spend money on training. The state provided the necessary tools for farming and the training required to farm. In present times, this is not the case, and infrastructure costs for urban agriculture form a barrier to its success.

Our planet is very likely to face resource shortages in the new period of climate change and the cities in the Global North and South can learn from the mistakes made in the past. Urban agriculture was able to support a big part of the population both in Havana during the 'special period' and in North America and Europe during the world war. If urban farming could achieve food resilience in the past, can we achieve something similar in the present? The following sections analyze the different scales and aspects of Urban Agriculture.

3.3 Scales of practices

The following section and Fig. 3.06 compare eleven different farming scales commonly present from the most rural to the most urban based on productivity. Productivity is the yield (in kgs) per square meters of the growing area in the respective farming scale. The graph evaluates the following 11 different farming scales:

1. Commercial Farm

This is the most rural form of agriculture practiced for centuries and the dominant source of food across countries. Commercial farms are usually located far away from the city and heavily rely on pesticides and fertilizers to produce crops, deteriorating soil health. The productivity of commercial farms is lowest as compared to all the other scales of agriculture.

2. Commercial Greenhouse

Commercial Greenhouse is like a commercial farm in terms of land and location, but, with the advancements of farming technologies, it uses techniques like hydroponics that utilize less land and resources They are gaining traction among farmers due to higher productivity even after having high initial investment for setting up the greenhouse.

3. Organic Farm

Organic farms use traditional and agrarian practices to farm. They utilize no chemicals, pesticides, and fertilizers. They are often located in suburban areas and are usually small-scale farmers that sell produce to local restaurants and farmer's markets. Crop rotations and cover crops are encouraged in organic farming, as are balanced host/predator partnerships. On the farm, organic residues and minerals are deposited back into the soil leading to higher productivity than commercial rural farms, without decreasing the soil quality.

4. Edible Landscaping

Edible landscaping entails combining edible plants with ornamental ones to create a setting that is not only attractive but also profitable. Often this kind of food production is maintained by the city in public plazas and across the urban areas. This marks the transition from rural farming to urban agriculture practices in the city. Since the farming techniques are like conventional agriculture, the productivity is similar to the commercial farm, just on a smaller scale.

5. Community Garden

Community gardens are located within urban areas with the mission to serve and enrich the community and provide a place for the residents to connect. Using the principles of organic farming, community gardens aim to provide food for the vulnerable population which is fresh and nutritious. Being on city-owned lands and non-profit organizations, these farms cannot deliver high productivity of food and are often difficult to set up.

6. Edible Green Walls

Edible Green Walls are a new method of growing fresh produce that is gaining attention due to its ability to grow in smaller areas. The 'garden' can be built from repurposed materials and can produce a range of foods vertically, either indoors or outdoors. Since the edible wall also is essentially a vertical version of hydroponics, if it is inside the building, its productivity is in the medium spectrum on the graph.

7. Backyard Garden

As seen in the cases of patios in Cuba and victory gardens in the USA, backyard gardens are another form of urban farming strategy that people deploy. These are usually less productive than the hydroponics counterparts but aim to provide some level of food security to the residents growing.

8. Balcony Garden

Another small-scale agriculture practice in Urban areas is done on Balconies. In multi-unit residences where often ground space is scarce, residents grow small quantities of easy-to-grow plants like herbs, tomatoes, etc. on the balcony. That is the only open-to-air space they have legally available to grow food.

9. Intensive Green Roof

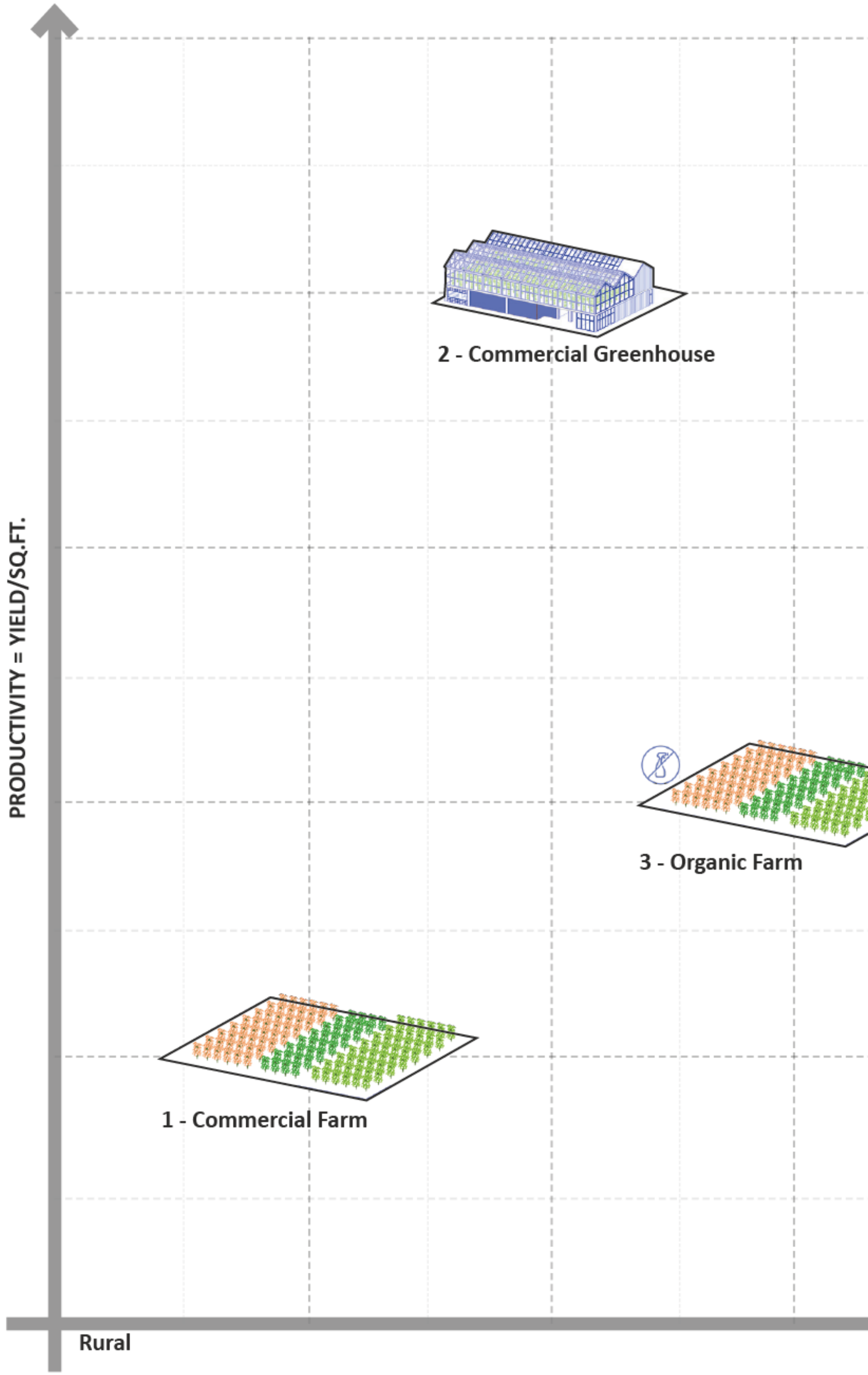
Roof space on buildings can be utilized to grow food. An intensive green roof can often be converted to a food productive one. The productivity is similar to a community farm, with the difference being the location on unutilized roof space of a building rather than vacant city-owned plots which often compete with other urban functions.

10. Building Integrated Greenhouses (BIG)

A greenhouse installed on a rooftop of a building, mostly seen on top of

Fig. 3.06. Types of agricultural practices from the most rural to the most urban arranged as per their productivity.

1- Commercial Farm
2- Commercial Greenhouse
3- Organic Farm
4- Edible Landscaping
5- Community Garden
6- Edible Green Walls
7- Backyard Garden
8- Balcony Garden
9- Intensive Green Roof
10- Rooftop Greenhouse
11- Vertical Farm



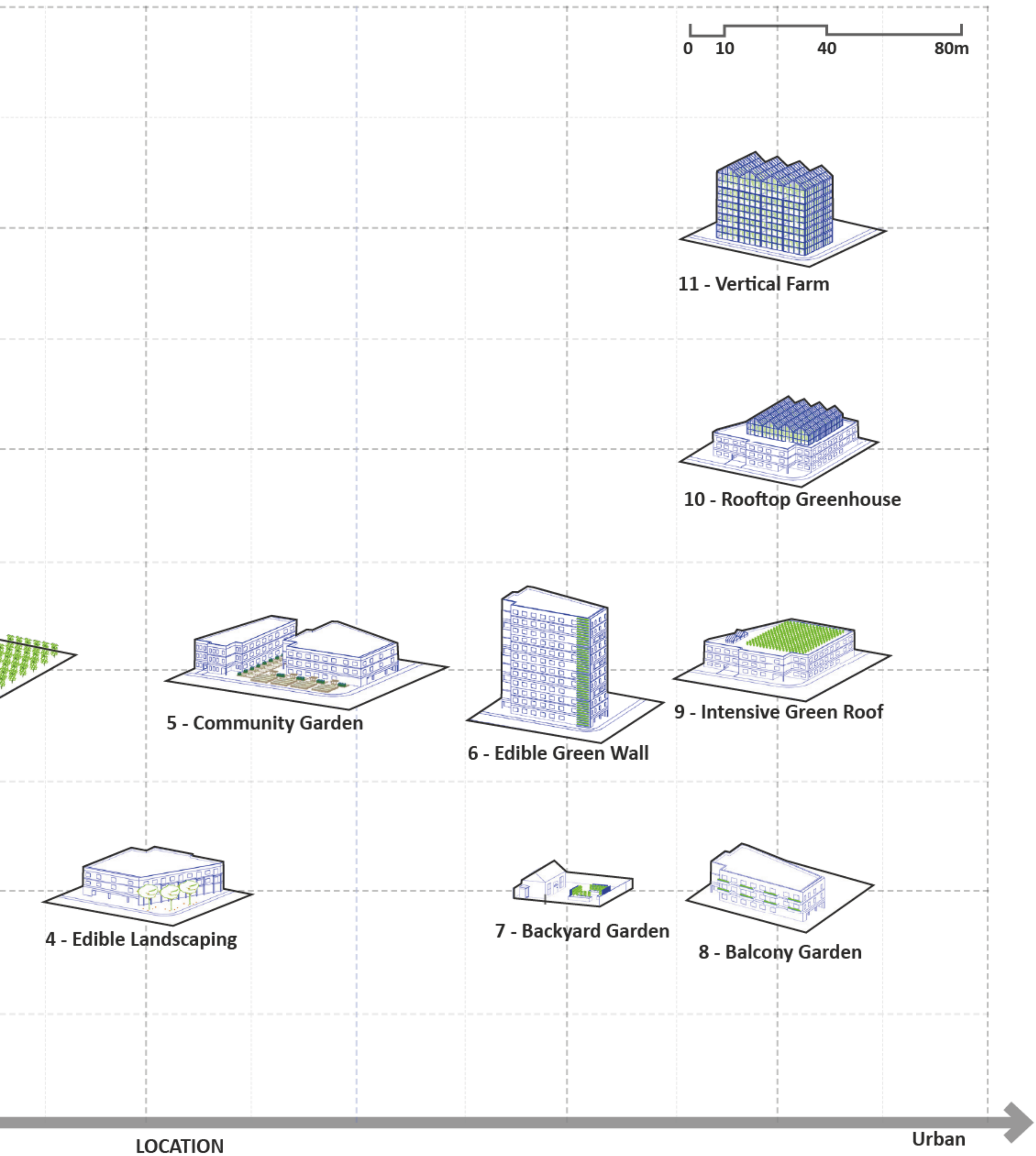

0
10
40
80m
11 - Vertical Farm
10 - Rooftop Greenhouse
5 - Community Garden
6 - Edible Green Wall
9 - Intensive Green Roof
4 - Edible Landscaping
7 - Backyard Garden
8 - Balcony Garden
LOCATION
Urban

Fig. 3.07. Percentage of Carbon Emissions due to food miles by different food groups in Canada. (Right)

large spanned industrial buildings, is referred to as a rooftop greenhouse. BIGs have higher productivity than other urban farming and are the most urban of the farming options due to the wide availability of rooftops in the city.

11. Vertical Farm

The concept of growing plants or animal life inside skyscrapers or on vertically inclined surfaces is known as vertical farming.[17] It shares similar productivity (highest) as the commercial greenhouse, both utilizing hydroponics growing systems, but within the city boundary.

3.4 Benefits

Urban Agriculture's value lies not only in the capacity to feed the population, but also in its ability to inform citizens about safe, nutritious food and the commitment required to grow it; provide lively green spaces and recreation; save the city's money required to import produce and provide environmental benefits; help create community; and, theoretically, serve as a new source of moderate economic growth.[18] These benefits can be characterized broadly as environmental, social, and economic.

Environment Benefits

The food commodity chain's environmental impact is calculated by its 'food miles' defined as "the distance the commodity travels from point of production to point of consumption, the required energy, and resulting emissions" as per Meidad Kissinger in his paper "International Trade Related Food Miles – The case of Canada."[19]

According to his report, over 30% of agriculture and food goods consumed in Canada are imported, resulting in over 61 billion tonnes km of 'food miles' and 3.3 million metric tonnes of CO2 emissions annually. Fruits and vegetables have the highest food miles based environmental impact of all the livestock and food crops surveyed as 80% of fruits and 45% of vegetables are imported into Canada (according to the statistics published by FAO) as opposed to the other food groups. Fig. 3.07 describes the carbon emissions of specific food groups for the case of Canada. Rice,

17 Specht et al., "Sustainability Aspects of Food Production in and on Buildings."

18 Vanessa Quirk, "Urban Agriculture Part II: Designing Out the Distance," 2012, https://www.archdaily.com/238382/urban-agriculture-part-ii-designing-out-the-distance.

19 Meidad Kissinger, "International Trade Related Food Miles – The Case of Canada," *Food Policy* 37, no. 2 (2012): 171–78, https://doi.org/10.1016/j.foodpol.2012.01.002.

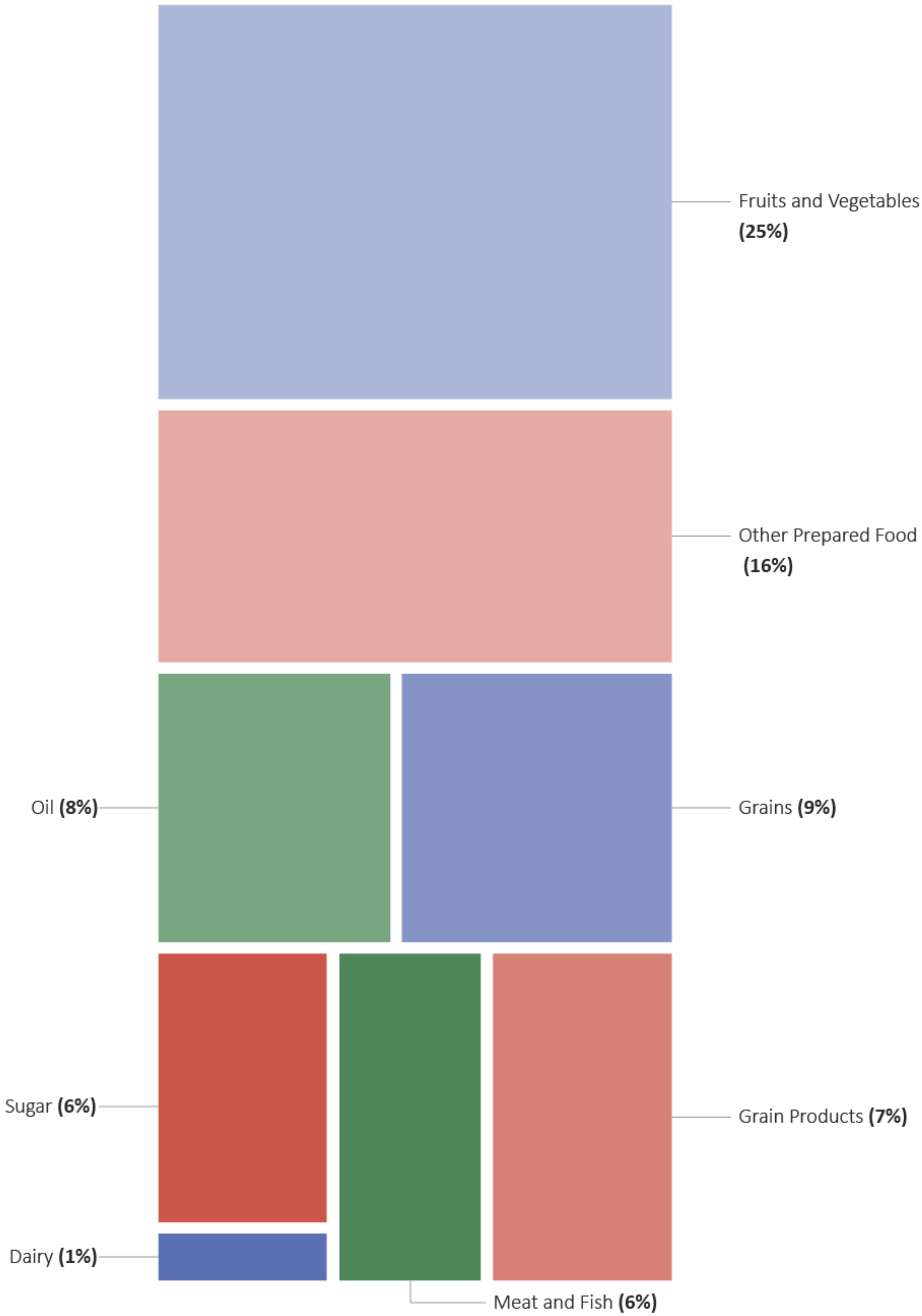

Fruits and Vegetables
(25%)
Other Prepared Food
(16%)
Oil **(8%)**
Grains **(9%)**
Sugar **(6%)**
Grain Products **(7%)**
Dairy **(1%)**
Meat and Fish **(6%)**

Fig. 3.08. Percentage of carbon emissions emitted due to food production categorized according to land use, crops, animals and supply chain. (Right)

coffee, tea, peanuts, chocolate, and a wide variety of tropical fruits were 100% imported.[20]

Fig. 3.08 measures the impact of food production on the environment as calculated by ourworldindata.[21] Food accounts for 26% of the worldwide carbon emissions of which food miles from the transport of food totals to 18% of the emissions. Food networks rooted in local ecologies and responsive to customer demands for quality food are needed to minimize these food miles, as shown by the advantages of a more decentralized food supply system as in the case of urban agriculture practices.[22] Fig. 3.09 compares the flow of food from the farm to the mouth of an urban dweller for the local food system and the conventional food system.

More broadly, urban agriculture also serves as a backbone for transforming abandoned lands and brownfields into urban services.[23] Community farms and gardens cultivated on these lands cool down urban areas, reducing the impact of the urban heat island effect. These green lands in the urban concrete jungles absorb rainwater and provide a natural habitat for fauna, including bees and birds, to thrive. These environmental benefits mitigate sewage system burden, lower energy demand on hot days, and promote biodiversity.[24]

Social Benefits

The majority of food is grown outside of cities, resulting in a disconnect between city dwellers and the larger food system that sustains the populations. This great divide can be bridged by urban farming. Community gardens, school gardens, market farms, and even the neighborhood beehive would provide opportunities for food system education and appreciation by the community.[25] These farms on both public and private lands, apart from providing fresh produce, act as vibrant green spaces for city residents.

Urban Agriculture projects provide social cohesion by bringing people together in these natural ecosystems merged within the built fabric.[26] Farmers, gardeners, and their neighbors share more than just fence lines within a neighborhood. Urban agriculture schemes, which have

20 Kissinger, "International Trade Related Food Miles."

21 Hannah Ritchie and Max Roser, "Environmental Impacts of Food Production," *Our World in Data*, no. Journal Article (2020), https://ourworldindata.org/environmental-impacts-of-food.

22 David Coley, Mark Howard, and Michael Winter, "Local Food, Food Miles and Carbon Emissions: A Comparison of Farm Shop and Mass Distribution Approaches," *Food Policy* 34, no. 2 (2009): 150–55, https://doi.org/10.1016/j.foodpol.2008.11.001.

23 François Mancebo, "Gardening the City: Addressing Sustainability and Adapting to Global Warming through Urban Agriculture," *Environments (Basel, Switzerland)* 5, no. 3 (2018): 1–11, https://doi.org/10.3390/environments5030038.

24 Eli Zigas, "Public Harvest: Expanding the Use of Public Land for Urban Agriculture in San Francisco" (San Francisco: SPUR, April 2012), https://www.spur.org/publications/spur-report/2012-04-23/public-harvest.

25 Zigas, "Public Harvest."

26 Zigas, "Public Harvest."

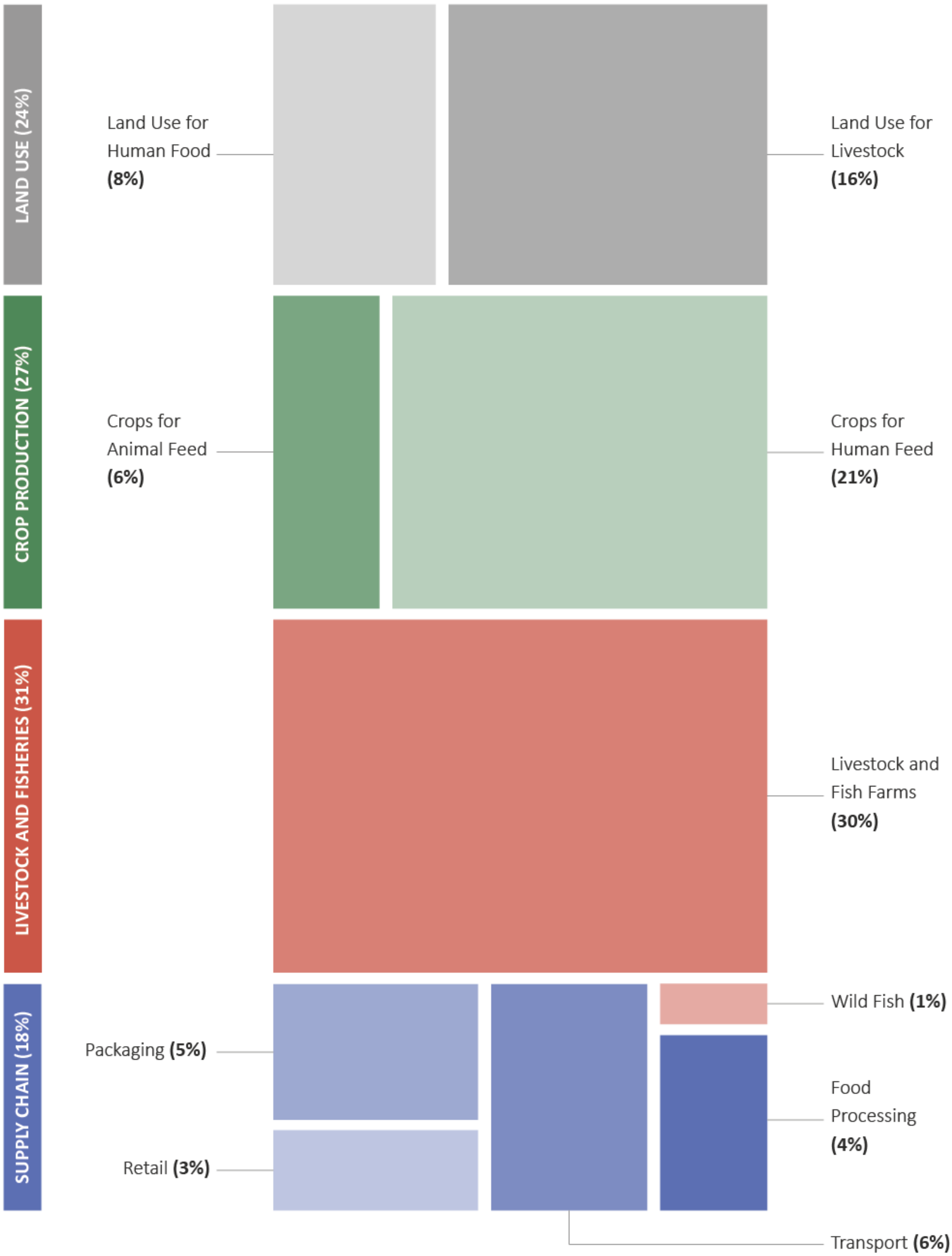
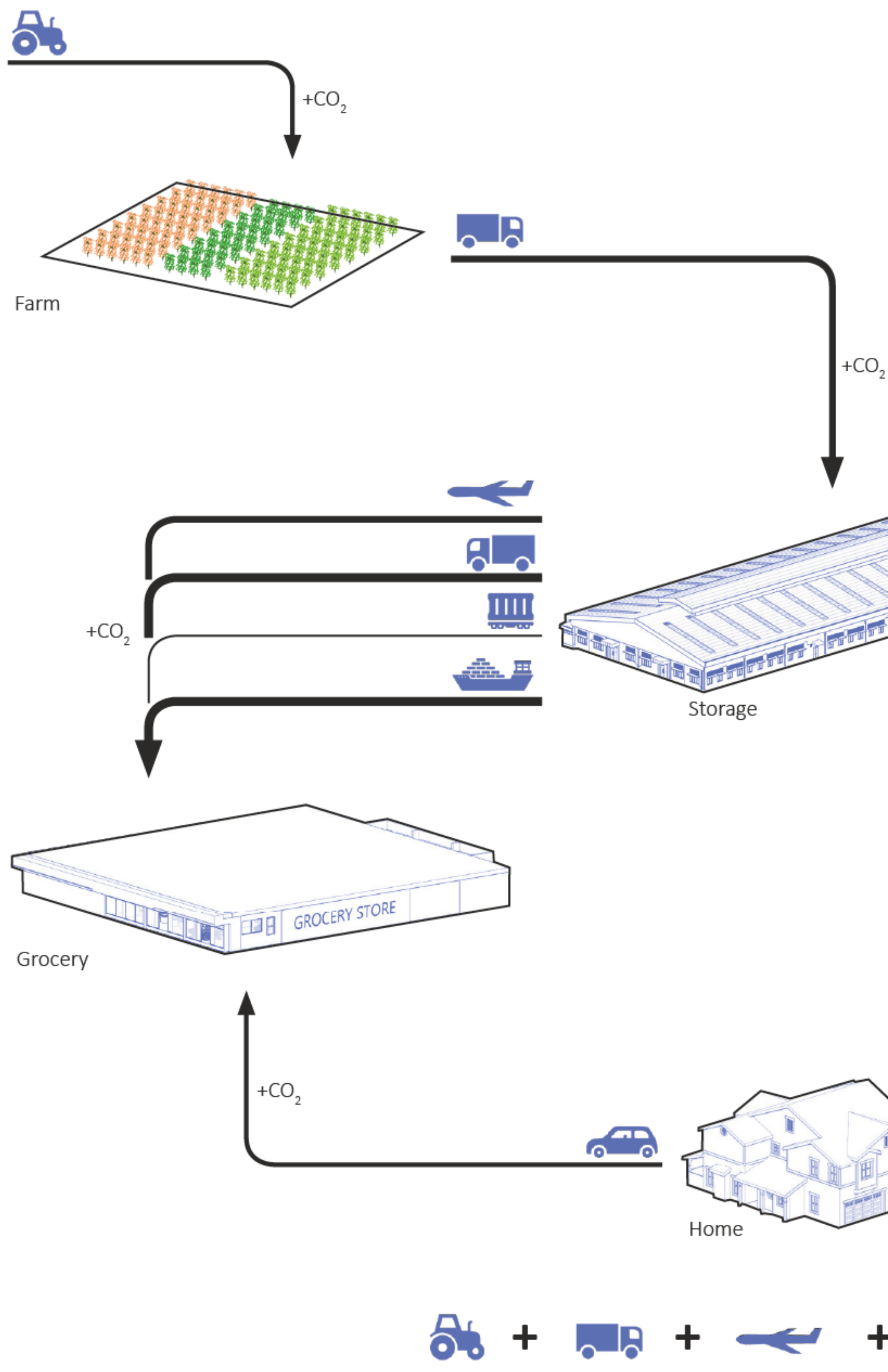
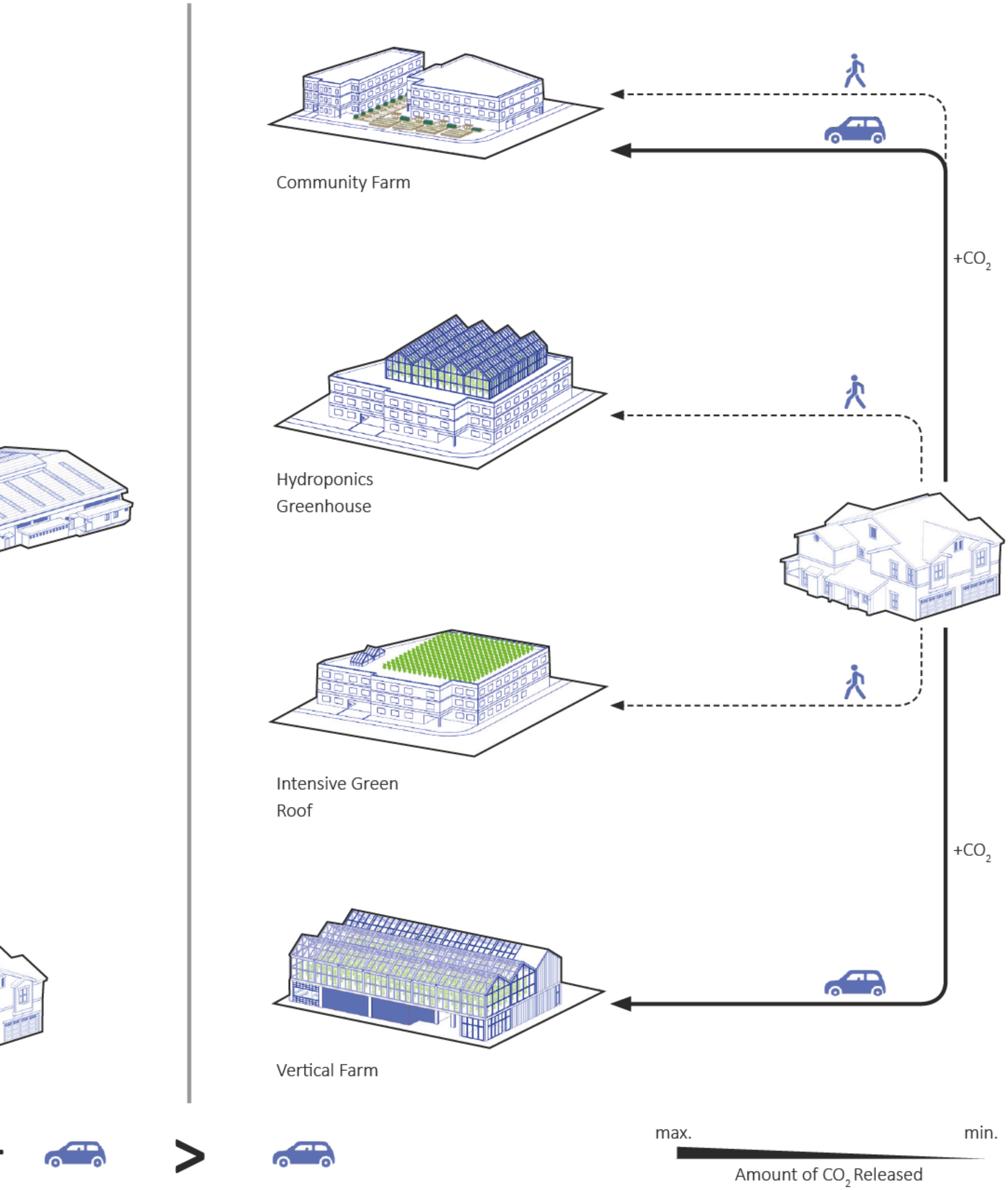

LAND USE (24%)
Land Use for Human Food (8%)
Land Use for Livestock (16%)
CROP PRODUCTION (27%)
Crops for Animal Feed (6%)
Crops for Human Feed (21%)
LIVESTOCK AND FISHERIES (31%)
Livestock and Fish Farms (30%)
SUPPLY CHAIN (18%)
Wild Fish (1%)
Packaging (5%)
Food Processing (4%)
Retail (3%)
Transport (6%)

Fig. 3.09. Comparison of food miles between rural food production and urban food production.




Community Farm
+CO2
Hydroponics
Greenhouse
Intensive Green
Roof
+CO2
Vertical Farm
max.
min.
Amount of CO2 Released

proliferated since the turn of the century, often lead to the reshaping of urban environments, if not the whole urban fabric. Many examples across the planet illustrate how urban agriculture projects allow people to try out new ways of living in cities. They often create a new commons by bringing citizens together and reinventing urbanity by dialogue—and often conflict—between growers, gardeners, private players, city governments, neighbors, and other residents.[27]

Economic Benefits

Gardens and urban farms on public property will help the city save money on landscaping, weeding, and upkeep. Community associations that take on the task of maintaining formerly empty lots will help keep them from being unofficial dump sites, saving the Department of Public Works a ton of money.[28] Not only this but urban farming creates jobs and helps in supporting the local economy by deploying the residents of the same neighborhood to help in producing food for the community.

3.5 Challenges

Local food production requires multiple things to fall right in place to be successful. There are many challenges faced by urban agriculture. First is the cost associated with organic produce generated by urban farming. As Micheal Pollen puts it "we have a system where wealthy farmers feed the poor crap and poor farmers feed the wealthy with high-quality food." As discussed before low-income neighborhoods suffering from food insecurity are not able to benefit from the healthy produce provided by urban farms due to the higher costs.[29] Another is the lack of government policies and incentives related to urban agriculture. Without initiatives by the lawmakers to train and educate the residents in urban farming, transforming urban land into a productive space to grow food is always going to remain a challenge. Currently, urban farming on vacant city plots takes a lot of effort and money, consider the example of Flemingdon Park Community Farm (Flemo Farm) where the permit process took 5 years from conceptualization to operation of the farm. Lastly, urban agriculture programs promise low-cost local food, community engagement, and at

27 Mancebo, "Addressing Sustainability and Adapting to Global Warming through Urban Agriculture."

28 Zigas, "Public Harvest."

29 Vanessa Quirk, "Urban Agriculture Part III: Towards an Urban 'Agri-Puncture,'" 2012, https://www.archdaily.com/239677/urban-agriculture-part-iii-towards-an-urban-agri-puncture.

the same time profit for the grower. This becomes the most challenging part for the feasibility of urban farming. Will Valleya & Hannah Wittman in their paper "Beyond feeding the city: The multifunctionality of urban farming in Vancouver, BC" discuss the "unattainable trifecta of urban agriculture", which is, providing affordable locally grown food while utilizing the local workforce and still generating positive revenue to fund the entire operation.[30]

30 Will Valley and Hannah Wittman, "Beyond Feeding the City: The Multifunctionality of Urban Farming in Vancouver, BC," *City, Culture and Society* 16, no. Journal Article (2019): 36–44, https://doi.org/10.1016/j.ccs.2018.03.004.

3.6 Conclusion

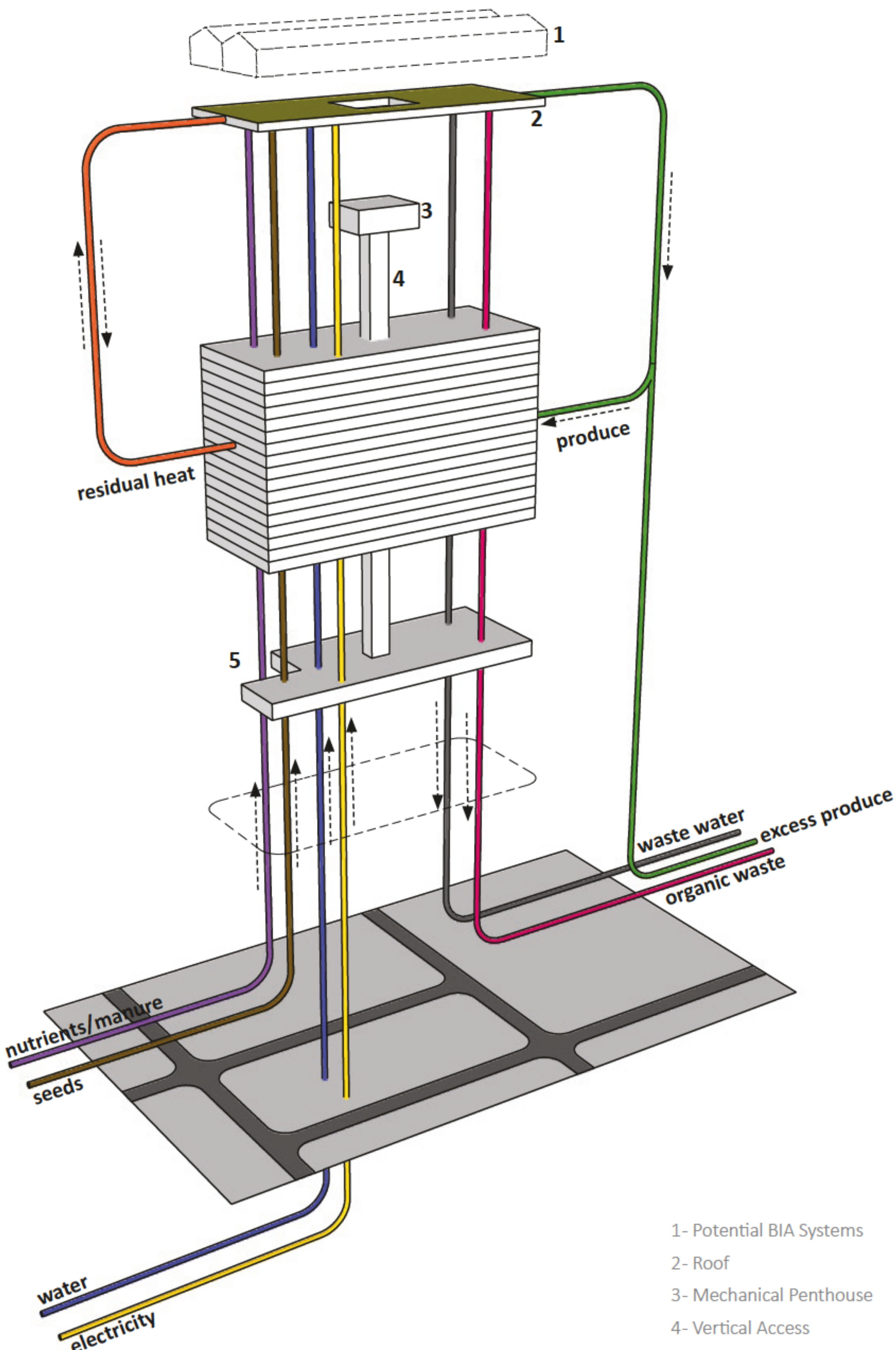
Is it possible to achieve this "trifecta of urban agriculture"?[31] The cost associated with urban agriculture practice forms the biggest hurdle in the path to affordable local food. Urban agriculture practices are often situated on city-owned lands which compete with other urban uses that take priority over urban farming. However, the city also has an abundance of vacant rooftop space that does not compete with any other urban use and can very well be used for farming in the dense urban fabric. Urban Agriculture systems like an intensive green roof, building integrated greenhouses, modular farming systems, etc. have been installed on rooftops of existing buildings across North America in cold climates. These form the category of agriculture referred to as building-integrated agriculture (BIA). According to a 2006 Columbia University report on rooftop photovoltaics capacity, there is more than 5000 ha of un-shaded rooftop area in New York City's five boroughs. Based on the calculations of hydroponic food production yields done by Caplow and Nelkin in the 2008 paper "Building-integrated agriculture: a new approach to food production", the roof space available in New York can feed the entire population of 30 million people with yearly consumption of fresh vegetables.[32] Installation of BIAs on rooftops enables higher food productivity, by using hydroponics growing systems, and utilizes land that does not compete with any other urban use. It is an environmentally friendly urban food production strategy that decreases our carbon footprint, lowers transportation costs, improves food protection and safety, cools homes, and combats global warming.[33] [34] The "unattainable trifecta" can be achieved using BIA which produces cheap locally grown food, produced by the building residents. The next part uncovers the components, benefits, and challenges of BIA systems in cold climates.

31 Valley and Wittman, "The Multifunctionality of Urban Farming in Vancouver."

32 D. Gould and T. Caplow, "8 - Building-Integrated Agriculture: A New Approach to Food Production," in *Metropolitan Sustainability*, ed. Frank Zeman, Woodhead Publishing Series in Energy (Woodhead Publishing, 2012), 147–70, https://doi.org/10.1533/9780857096463.2.147.

33 Gould and Caplow, "8 - Building-Integrated Agriculture."

34 Valley and Wittman, "The Multifunctionality of Urban Farming in Vancouver."



1- Potential BIA Systems
2- Roof
3- Mechanical Penthouse
4- Vertical Access
5- Loading

4.0 Building Integrated Agriculture [state of the art]

Fig. 4.01. Inputs and outputs of building integrated agriculture (BIA). (Left)

4.1 Definition

Kathrin Specht along with a team of 19 other researchers defined building integrated agriculture (BIA) in their journal article "Urban Agriculture of the Future: An Overview of Sustainability Aspects of Food Production in and on Buildings" as "The method of locating high-performance hydroponic greenhouse systems on and in mixed-use buildings to maximize the synergies between the building environment and agriculture-like energy and nutrient flows."[1] BIA is a novel approach to food production focused on the concept of installing high-performance farming systems on and within buildings, powered by sustainable materials, local energy production, and water conservation.[2]

As a new approach to sustainable urban food production, BIA consists of three parts to work:

1. the use of residual resource flows to incorporate the idea of symbiosis between the farm and the building (energy, water, and CO2).

2. environmental impact of the materials for construction of the farm and the high resource efficiency

3. facilitation of high-quality food production on building rooftops and food production generation for urban food security and self-sufficiency.

BIA is primarily a design principle that establishes a nexus or symbiosis between building energy flow and food supply, given the global need for responsible energy use in buildings and the need to provide food security in growing urban areas. As a result, expanding cities should be seen as an advantage rather than a barrier to maintaining a stable food supply and energy production.[3] Another important term to describe BIA is "z-farming" or "zero-acreage farming". According to Zachary Turk from Yale Environmental Review z-farming is defined as "a new branch of agriculture involving production in or on urban structures."[4]

1 Kathrin Specht et al., "Urban Agriculture of the Future: An Overview of Sustainability Aspects of Food Production in and on Buildings," *Agriculture and Human Values* 31, no. 1 (2014): 33–51, https://doi.org/10.1007/s10460-013-9448-4.

2 D. Gould and T. Caplow, "8 - Building-Integrated Agriculture: A New Approach to Food Production," in *Metropolitan Sustainability*, ed. Frank Zeman, Woodhead Publishing Series in Energy (Woodhead Publishing, 2012), 147–70, https://doi.org/10.1533/9780857096463.2.147.

3 Ana Nadal et al., "Building-Integrated Rooftop Greenhouses: An Energy and Environmental Assessment in the Mediterranean Context," *Applied Energy* 187, no. Journal Article (2017): 338–51, https://doi.org/10.1016/j.apenergy.2016.11.051.

4 "The Promise and Challenges of 'Zero-Acreage Farming,'" Yale Environment Review, April 11, 2017, https://environment-review.yale.edu/promise-and-challenges-zero-acreage-farming-0.

Fig. 4.02. Standard Template for Precedent Studies. (Right)

Fig. 4.03. Annual Canadian food requirements per year in kilograms. (Next Page Left)

Fig. 4.04. Mouths fed per unit area (MFUA) calculations. (Next Page Right)

4.2 Scope and Metrics

This thesis examines the different BIA systems focusing on precedents based in a cold climate similar to Toronto (humid continental). The research involves analyzing buildings in dense urban areas that have incorporated the concepts of urban farming and understanding how and if they succeed to produce a significant amount of food for the residents? The first step to analyze the productivity of different projects is developing a 'metric' that can be used to compare the amount of food produced by the different farming systems in the given area available for farming. The number of people (referred to as 'mouths') that the urban farm can feed annually is available, in most cases, in the precedent analysis. The calculation assumes a vegetarian diet thus only fresh fruits and vegetables are considered for annual consumption of a mouth fed. Data available on a typical Canadian diet from Statistics Canada is used in Fig. 4.03. Fig. 4.04 showcases the development of mouths fed per unit area (MFUA), based on the typical Canadian intake of 80 kgs of fruits and vegetables per year.[5] This new metric helps in comparing farming systems from hydroponics greenhouses to intensive green roofs under one umbrella. Moreover, MFUA is a metric that can be understood by the common public, unlike the existing productivity standards which compare the amount of food produced by the respective farming area.

5 "Food Statistics: Analysis," Statistics Canada, accessed April 20, 2021, https://www150.statcan.gc.ca/n1/pub/21-020-x/2009001/part-partie1-eng.htm.

Images of building integrated agriculture

Intensive Green Roof

Rooftop Greenhouse

Vertically Integrated Greenhouse

Vertical Farming

Modular Farming Systems

BIA System Used

Location

Year

xx,xxx m²

MFUA = ____

Type of Zoning

Commercial Farm

Office Building

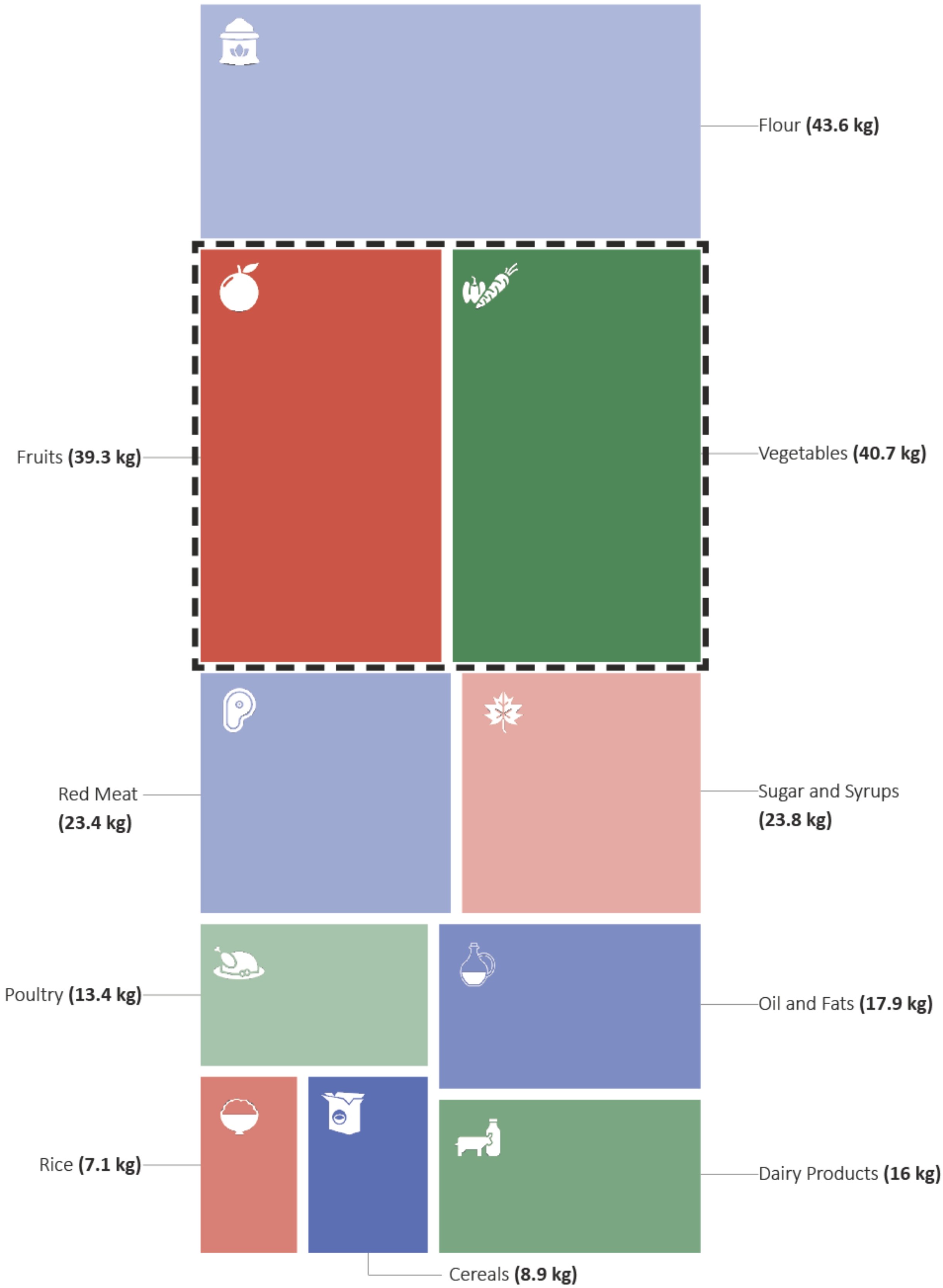
Institutional

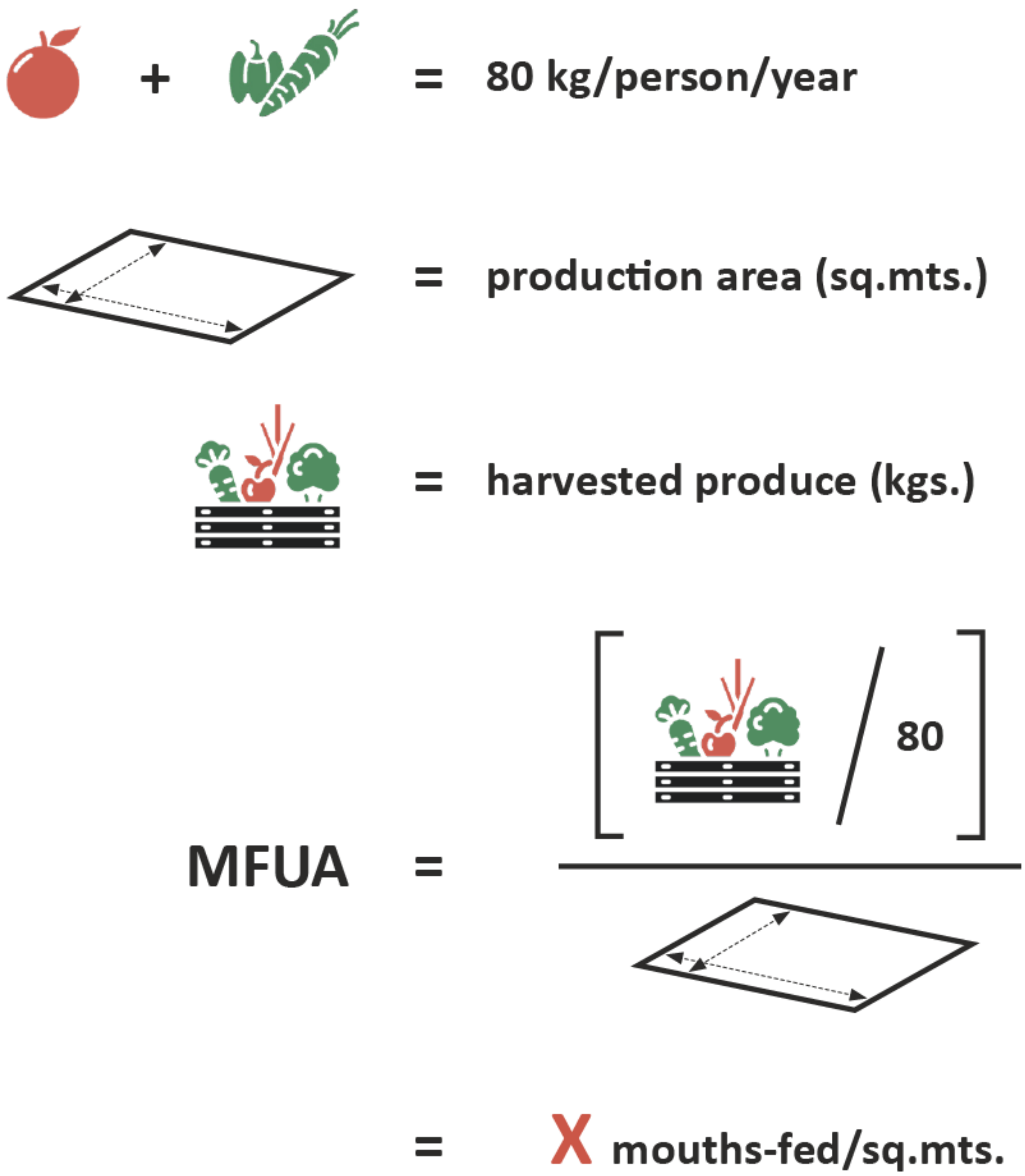
Residential

Available Area
for farming

Mouths Fed per Unit Area

New Metric
for Comparing
BIA Systems
across projects


Flour **(43.6 kg)**
Fruits **(39.3 kg)**
Vegetables **(40.7 kg)**
Red Meat **(23.4 kg)**
Sugar and Syrups **(23.8 kg)**
Poultry **(13.4 kg)**
Oil and Fats **(17.9 kg)**
Rice **(7.1 kg)**
Dairy Products **(16 kg)**
Cereals **(8.9 kg)**


+
= 80 kg/person/year
= production area (sq.mts.)
= harvested produce (kgs.)
80
MFUA =
= X mouths-fed/sq.mts.

Canadian Diet Per Day

BIA has the capability to produce 50% of the food consum

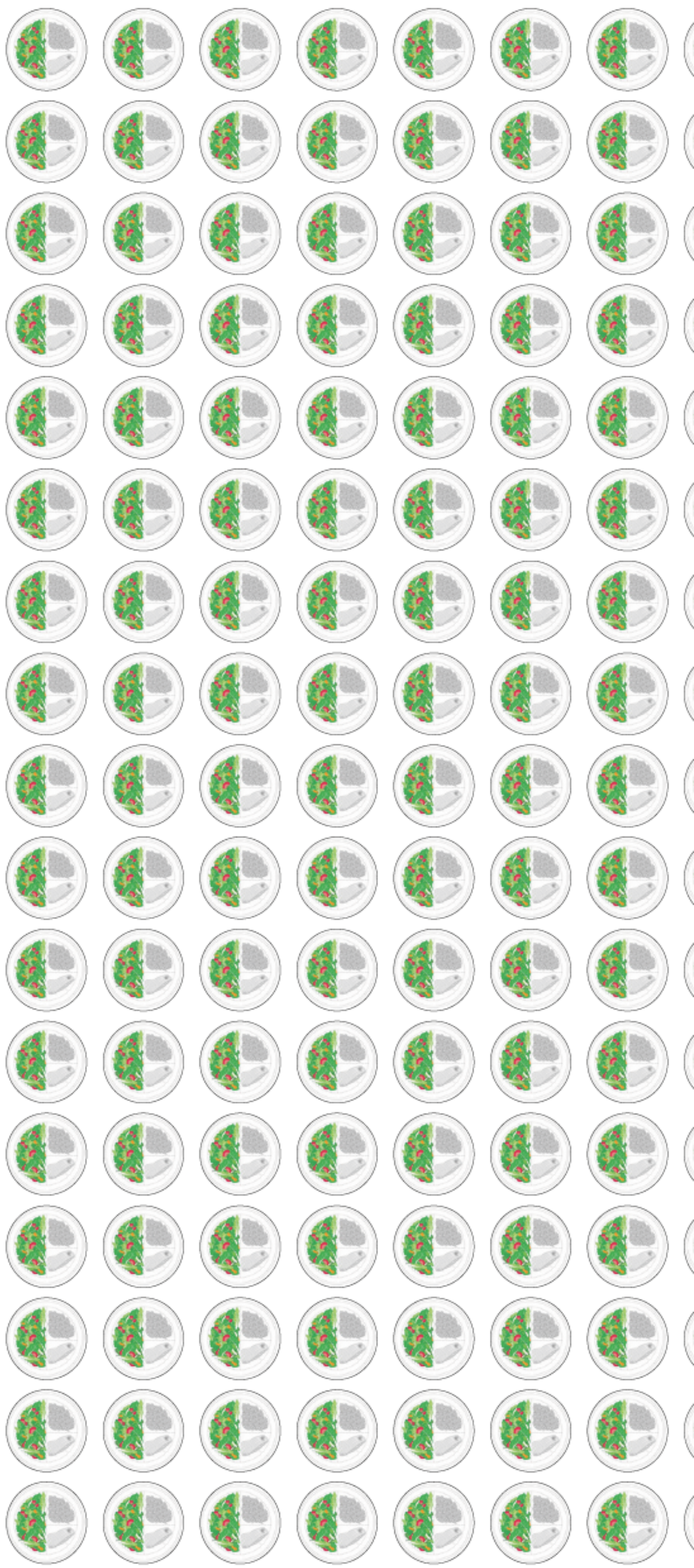


Fig. 4.05. Canadian food plate and illustration of food that BIA can grow in 365 days.

ned by a person in 365 days.

Fig. 4.06. 1 sq. mts. cross-section of intensive green roof BIA system. (Left)

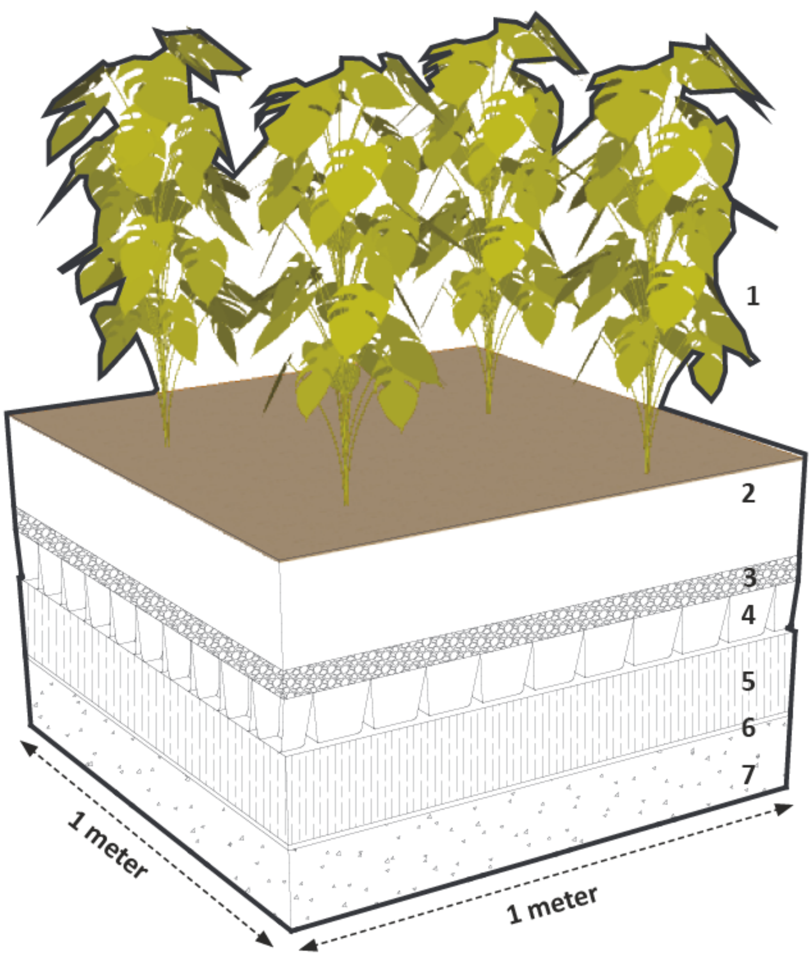
1- Vegetation
2- Growth Medium
3- Sedum
4- Drainage Plane
5- Insulation
6- Roofing Membrane
7- Structural Slab

Fig. 4.07. Intensive green roof sankey diagram showing inputs and outputs of the system. (Right)

4.3 Different BIA Systems

4.3.1 Intensive Green Roof

Intensive green roofs are commonly seen on commercial and residential buildings where the owners want vast green areas with a variety of plant sizes. Grass, field covers, herbs, shrubs, and even some types of trees can be planted on these roofs. Paths and walkways often connect various architectural elements to provide room for pedestrians to communicate with the natural environment. To accommodate planting, the intensive green roof uses planting mediums of larger depths. This deeper soil allows for large plants and dramatic plant groupings on intensive roofs. They are also known as "rooftop gardens." Vegetable and herb gardens



6 Admin, "Intensive vs Extensive Green Roofs: What's the Difference?," *Green Roof Plan* (blog), July 31, 2010, https://www.greenroofplan.com/intensive-vs-extensive-green-roofs/.

are most commonly planted on these rooftops, and they're a little easier to maintain than ground-level gardens because fewer rodents and weeds make their way up on the roof. Fertilizer and water will be required by all plants, and many will need clipping and pruning for regular maintenance.[6]

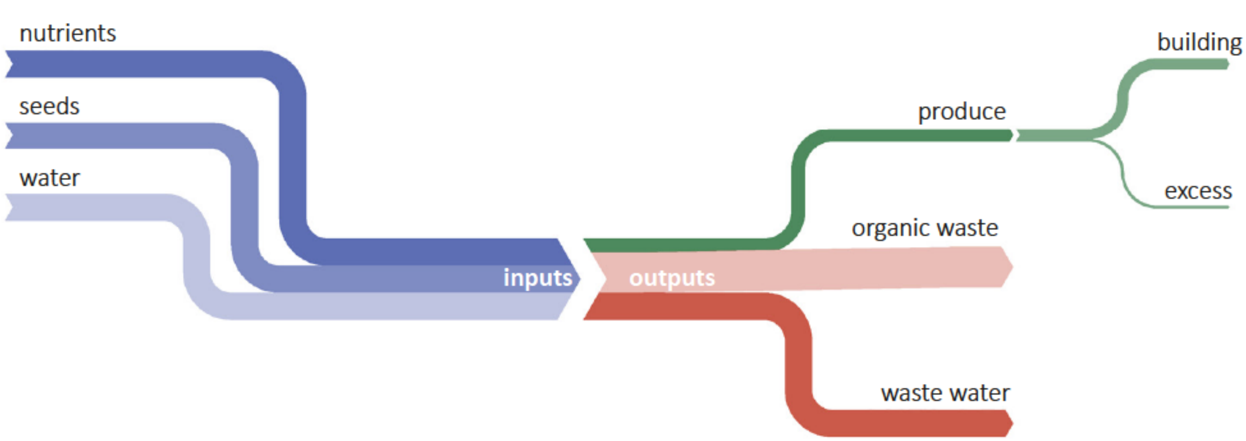
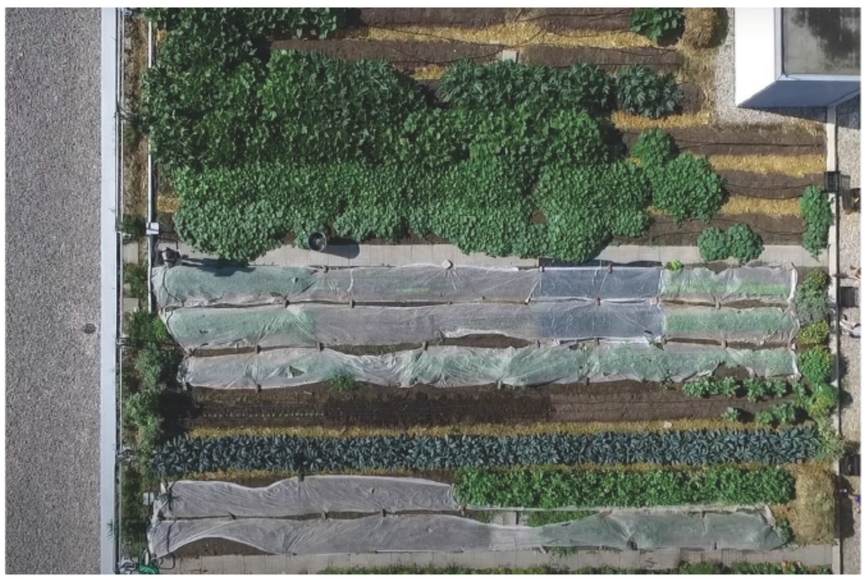


Fig. 4.08. Ryerson urban farm. (Top Left)

Fig. 4.09. Ryerson urban farm top view. (Bottom Left)



Toronto 2013 930 m^2 MFUA = 0.06

Ryerson Urban Farm

With over 50 crops and more than 100 cultivars, as well as three rooftop beehives, the farm is built in the market garden tradition. Because of Toronto's green roof bylaw[7], the farm is a working prototype that takes advantage of the potential of empty building rooftops and the facilities to grow food.[8] [9]

7 Penny Kaill-Vinish, "Toronto's Green Roof Policy and Rooftop Food Production," *Plan Canada* 49, no. 2 (2009): 39, https://search.proquest.com/docview/195847010.

8 Ryerson, "Ryerson Urban Farm," Ryerson, accessed April 23, 2021, https://www.ryerson.ca/university-business-services/urban-farm/.

9 Exploring Alternatives, *Growing Food in the City - Urban Rooftop Farm in Downtown Toronto*, Exploring Alternatives, 2019, https://www.youtube.com/watch?v=0SzTSepQuMU.

Fig. 4.10. Brooklyn Grange urban farm. (Top Right)

Fig. 4.11. Brooklyn Grange urban farm. (Bottom Right)

New York 2010 3,995 m^2 MFUA = 0.07

Brooklyn Grange

The rooftop farm is situated on the sixth floor of the Standard Motor Products building, which has an industrial structure. The loading capacity of the farm's 40 lbs per square foot of materials is well exceeded by this robust 1919 frame, which has a thick reinforced concrete slab. Planting beds are about 7.5 inches wide, with 1 inch deep walkways. Oats, buckwheat, and clover are used as winter cover crops.[10]

10 greenroofs.com and Brookly Grange, "Brooklyn Grange Rooftop Farm (Flagship Farm) #1 at Standard Motor Products," GreenRoofs, accessed April 23, 2021, https://www.greenroofs.com/projects/brooklyn-grange-rooftop-farm-flagship-farm-1-at-standard-motor-products/.

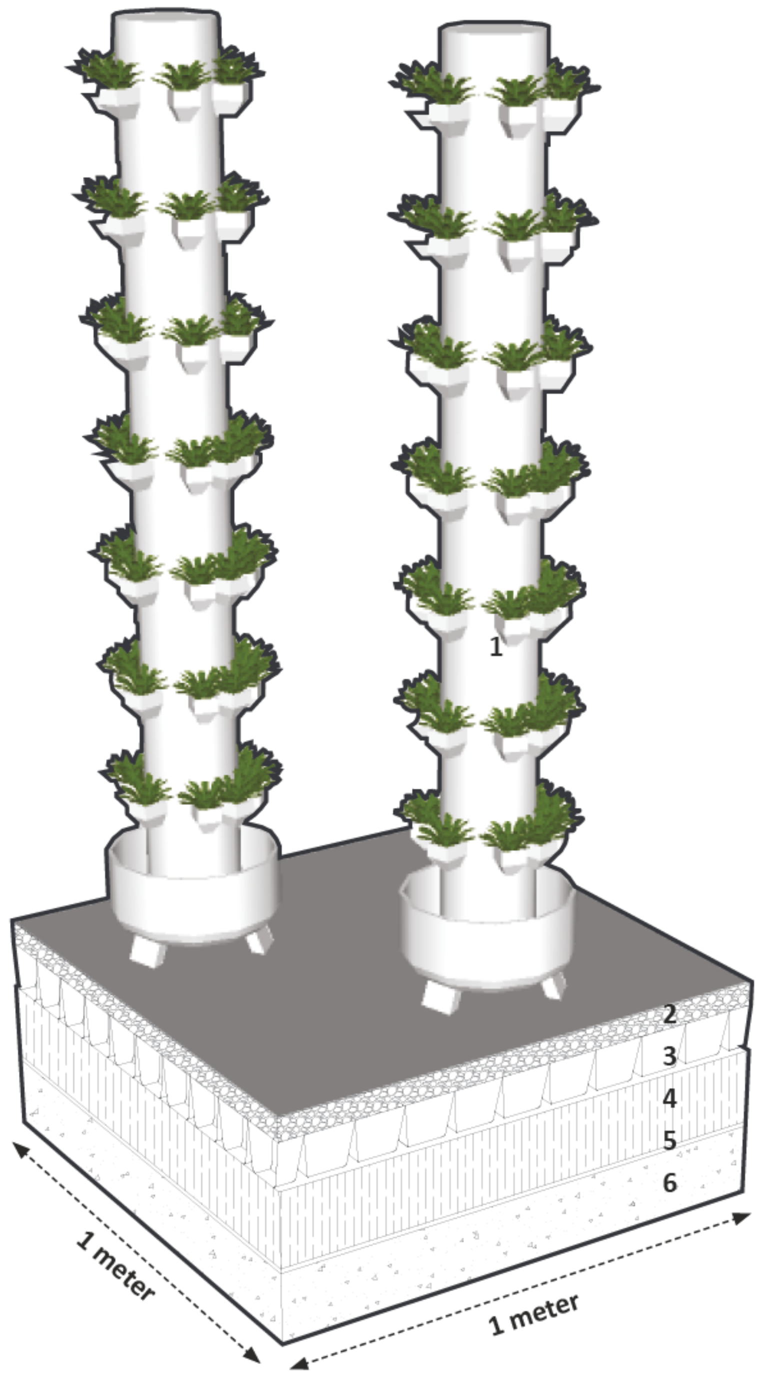
Fig. 4.12. 1 sq. mts. cross-section of rooftop hydroponics BIA system.
(Left)

1- Hydroponics Towers
2- Roof Paver
3- Drainage Plane
4- Insulation
5- Roofing Membrane
6- Structural Slab

Fig. 4.13. Rooftop hydroponics sankey diagram showing inputs and outputs of the system.
(Right)

4.3.2 Rooftop Hydroponics

Over the years many rooftop hydroponics practices have evolved that offer the productivity of hydroponics or an aeroponics growing system without the hassle of constructing a greenhouse on top of a building. These



systems work on the same principles but food production is limited to a few months rather than year-long productions in the case of hydroponics inside a rooftop greenhouse.

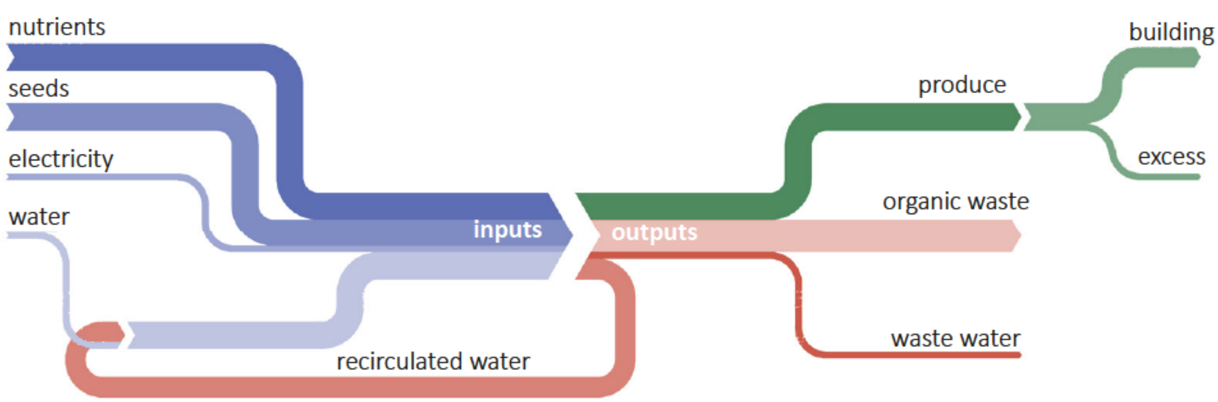


Fig. 4.14. Denizen Bushwick Aerial View of the farm. (Top Left)

Fig. 4.15. Denizen Bushwick rooftop hydroponics system. (Bottom Left)

New York 2018 399 m^2 MFUA = 0.15

Denizen Bushwick

Green Food Solutions built a 79 Tower Farm in this 900-unit residential building in Bushwick, Brooklyn. The Denizen also has a deal with Green Food Solutions for their all-Inclusive farming operation. Green Food Solutions produces over 50 kinds of vegetables and fruits and supplies directly to building customers. Residents have a say in what is grown and have the opportunity to volunteer on the farm in their spare time.[11] [12] [13]

11 Green Food Solutions, “The Denizen,” Green Food Solutions, accessed April 23, 2021, https://www.greenfoodsolutions.com/portfolio.

12 Lucy Wang, “Rooftop Farm Grows on Award-Winning Denizen Bushwick Building,” INHABITAT, February 28, 2020, https://inhabitat.com/rooftop-farm-grows-on-award-winning-denizen-bushwick-building/.

13 ODA-Architecture, “Denizen Bushwick,” oda-architecture, accessed April 23, 2021, http://www.oda-architecture.com/projects/denizen-bushwick.

Fig. 4.16. Paris exhibition center rooftop hydroponics farm. (Top Left)

Fig. 4.17. Paris exhibition center hydroponics system. (Bottom Left)

Paris 2020 3,995 m^2 MFUA = 0.16

Paris Exhibition Center

The farm is situated on top of a major exhibition complex in the 15th arrondissement that is currently undergoing renovation. It will have a restaurant and bar on the premises, with a capacity of about 300 people. The farm also offers a variety of programs, such as educational tours and team-building sessions. The residents also get the opportunity to lease small vegetable plots of their own in specially devised wooden crates.[14]

14 Caroline Harrap, "World's Largest Urban Farm to Open – on a Paris Rooftop," 2019, https://www.theguardian.com/cities/2019/aug/13/worlds-largest-urban-farm-to-open-on-a-paris-rooftop.

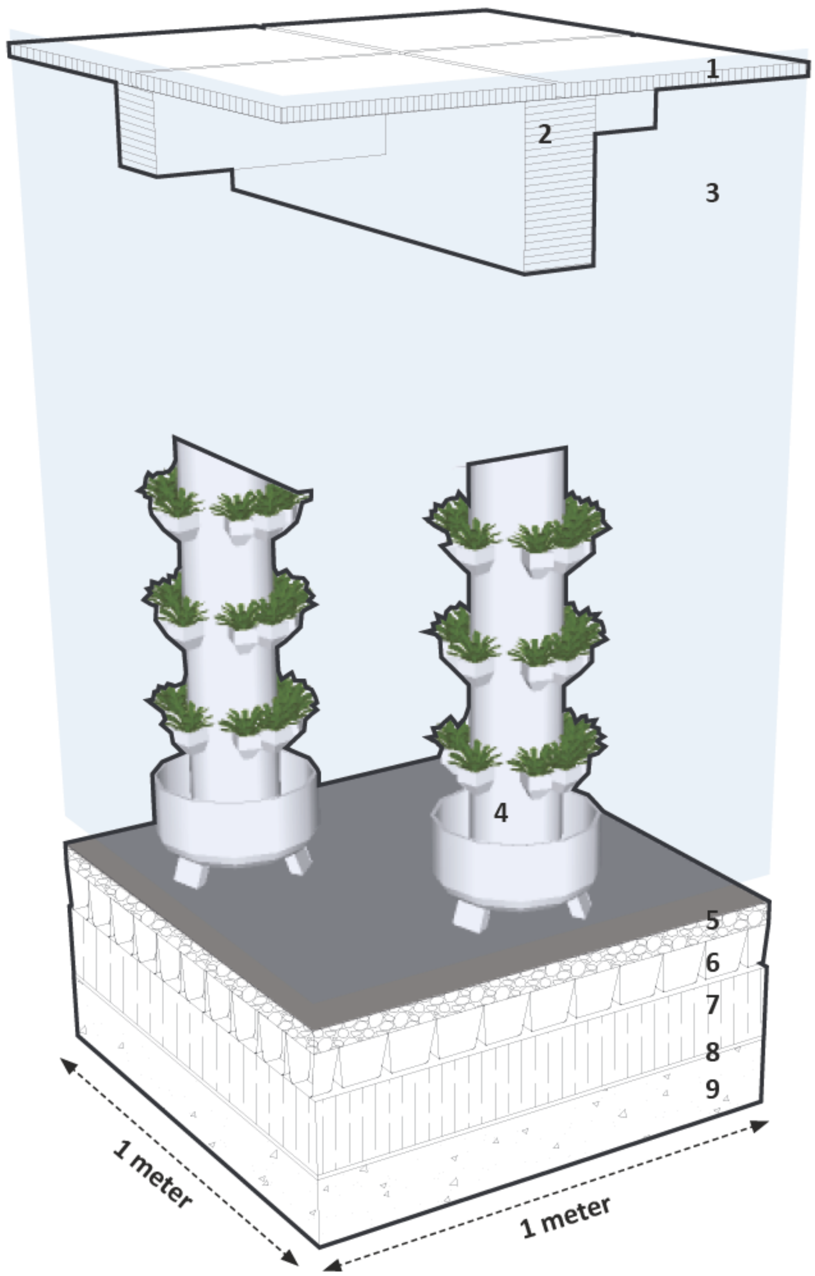
Fig. 4.18. 1 sq. mts. cross-section of hydroponics greenhouse BIA system. (Left)

1- Greenhouse Glass (DGU)
2- Roof Structure
3- Climate Controlled Space
4- Aeroponics / Hydroponics Towers
5- Roof Paver
6- Drainage Plane
7- Insulation
8- Roofing Membrane
9- Structural Slab

Fig. 4.19. Hydroponics greenhouse sankey diagram showing inputs and outputs of the system. (Right)

4.3.3 Hydroponics Greenhouse

A hydroponics greenhouse is a regulated environment where plants, including vegetables, are grown in nutrient-rich water. There is no need for the soil because water contains all of the mineral nutrients that plants require. Water is recirculated until the nutrients are exhausted, and then the depleted nutrients are added back in. In contrast to traditional



15 Gould and Caplow, “8 - Building-Integrated Agriculture.”

farming methods, this results in the processing of food with higher yield and quality while using fewer resources.[15]

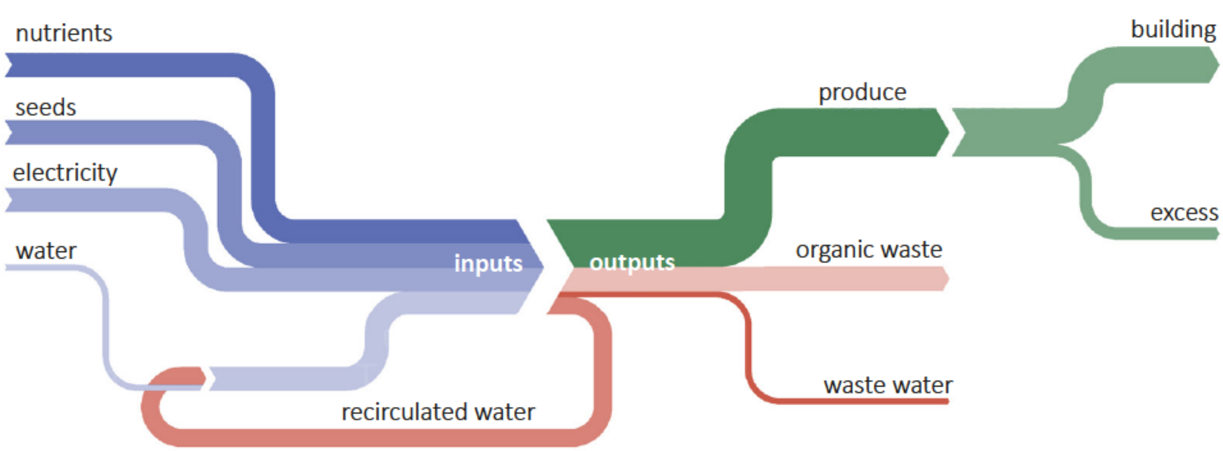


Fig. 4.20. Sky View of Lufa farms. (Top Left)

Fig. 4.21. View of hydroponics growing systems at Lufa Farms. (Bottom Left)

Montreal 2020 15,145 m² MFUA = 0.49

Lufa Farms

Lufa Farm is a commercial hydroponics rooftop farm on an industrial building. It offers residents of Quebec access to an online farmer's market that grows a variety of tomatoes and other vegetables. These fresh vegetable varieties will be impossible to cultivate using traditional farming methods. "What we find in grocery stores is a subset of what will transport well!" – Mohamad Hage[16] [17]

16 TEDxUdeM, *How a Rooftop Farm Feeds a City | Mohamed Hage | TEDxUdeM*, TEDxUdeM, 2012, https://www.youtube.com/watch?v=kSQm09twKEE.

17 Lufa Farms, "We Grow Food Where People Live and Grow It More Sustainably," Lufa Farms, accessed April 23, 2021, https://montreal.lufa.com/en/about.

Fig. 4.22. Sky View of Sun works center.
(Top Right)

Fig. 4.23. Sun works center interior view.
(Bottom Right)

New York 2014 120 m^2 MFUA = 0.36

Sun Works Center

This greenhouse serves as a classroom for sustainability education as well as a place to grow food. 40 children focus interactively on growing vegetables in the greenhouse, dubbed the "Greenhouse Laboratory," while learning about climate change, sustainability, noise, waste management, and other subjects. Worm composting, a tilapia basin, solar panels, rainwater collection, and a kitchen are all included in the greenhouse.[18]

18 New York Sun Works, "Sun Works Center, New York," Urban Green Blue Grids, 2011, https://www.urbangreenbluegrids.com/projects/sun-works-center-new-york/.

Fig. 4.24. Research Center ICTA-ICP View.
(Top Left)

Fig. 4.25. Research Center ICTA-ICP greenhouse hydroponics system.
(Bottom Left)

Barcelona 2014

Research Center ICTA-ICP

The research center's top floor is dedicated to hydroponic agriculture and crop research in a building-integrated greenhouse. During the winter months, the greenhouse used the building's residual heat to keep rising temperatures warm.[19]

19 Research Center ICTA-ICP · UAB / H Arquitectes + DATAAE, "Research Center ICTA-ICP · UAB / H Arquitectes + DATAAE," June 4, 2015, https://www.archdaily.com/636587/research-center-icta-icp-uab-h-arquitectes-dataae.

Fig. 4.26. Rice crops in the lobby at Pasona urban farm. (Top Right)

Fig. 4.27. Tomato vines on top of conference room at Pasona office. (Bottom Right)

Tokyo 2010 3,995 m^2 MFUA = *

Pasona Urban Farm

The plant-filled tower reduces tension in the office and reduces the building's carbon emissions by 7-8 tonnes a year. The interior space is devoted to growing more than 200 kinds of crops. The food grown annually offers over 10,000 meals in the employee cafeteria.[20 21 22]

20 konodesigns, "Pasona Urban Farm," konodesigns, accessed April 23, 2021, http://konodesigns.com/category/architecture/urbanfarm/.

21 Katherine Allen, "In Tokyo, A Vertical Farm Inside and Out," ArchDaily, September 29, 2013, https://www.archdaily.com/428868/in-tokyo-a-vertical-farm-inside-and-out.

22 Patrick Sisson, "Glorious Green Office in Tokyo a Showpiece for Urban Agriculture," Curbed, November 28, 2016, https://archive.curbed.com/2016/11/28/13763652/green-building-office-urban-farm-tokyo-pasona.

Fig. 4.28. Sky vegetables rooftop greenhouse. (Top Left)

Fig. 4.29. Sky vegetables seeding hydroponics system. (Bottom Left)

New York 2014 743 m²

Sky Vegetables

The hydroponic farm is located on the roof of an eight-story affordable housing building. Sky Vegetables, headquartered in Boston, runs the greenhouse, and 40 percent of the produce is distributed to residents, schools, hospitals, and markets nearby.[23] [24]

23 skyvegetables, "Year-Round, Fresh, and Local," Skyvegetables, accessed April 23, 2021, http://www.skyvegetables.com/bio-1.

24 Christine Serlin, "Bronx Development Encourages Healthier Lifestyles," Affordable Housing Finance, July 2, 2013, https://www.housingfinance.com/management-operations/bronx-development-encourages-healthier-lifestyles_o.

Fig. 4.30. Gotham greens rooftop greenhouse. (Top Right)

Fig. 4.31. Gotham green basil plants. (Bottom Right)

New York 2020 5,575 m^2

Gotham Green

Gotham Green is a commercial hydroponics farm with numerous plants throughout the United States, both rooftop and ground-level, offering mostly a variety of leafy greens.[25]

25 Gotham Greens, "About," Gotham Greens, accessed April 23, 2021, https://www.gothamgreens.com/.

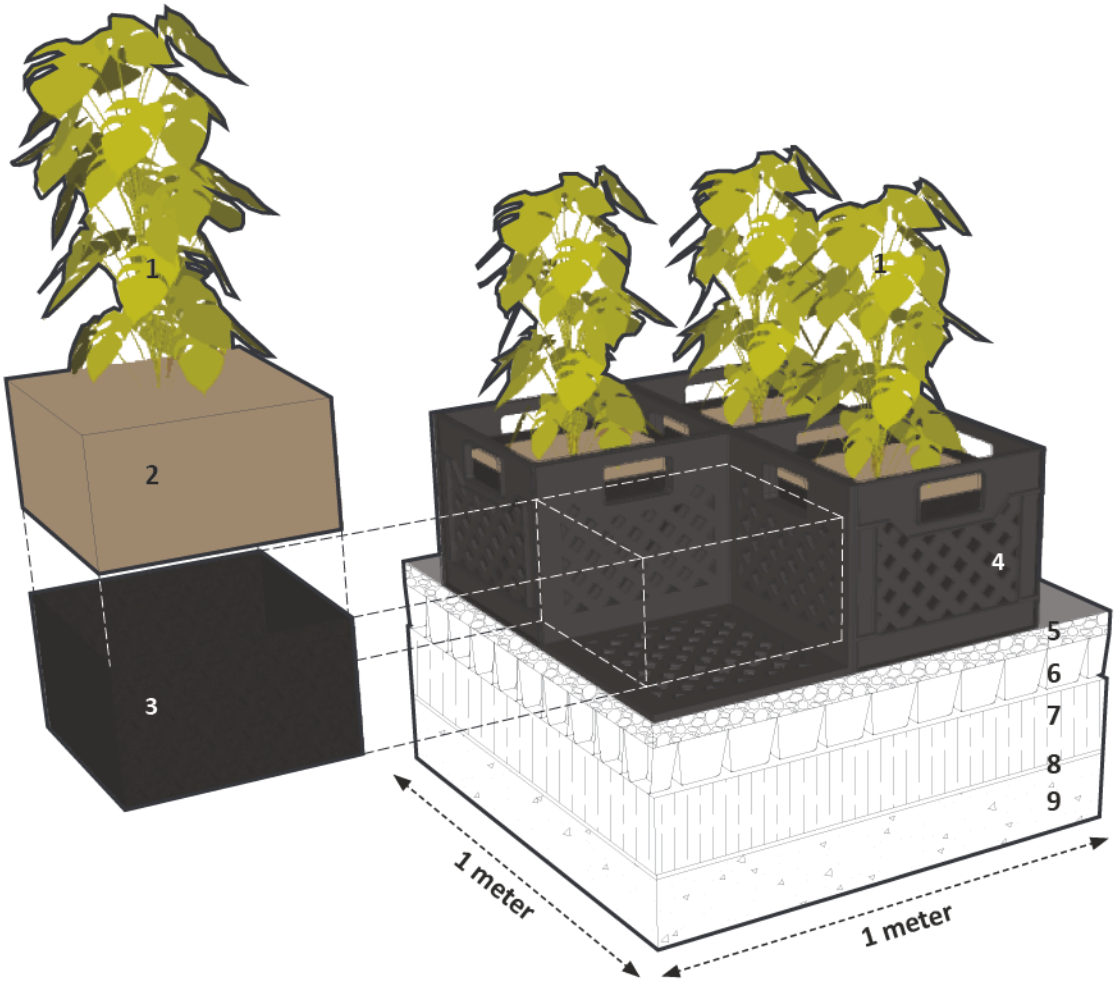
Fig. 4.32. 1 sq. mts. cross-section of modular farming BIA system.
(Top Right)

1- Vegetation
2- Growing Media
3- Textile Sheet
4- Recycled Milk Crate
5- Roof Paver
6- Drainage Plane
7- Insulation
8- Roofing Membrane
9- Structural Slab

Fig. 4.33. Modular farming sankey diagram showing inputs and outputs of the system.
(Bottom Right)

4.3.4 Modular Systems

Modular systems essentially consist of similarly sized planting beds which make the farm easily deployable on any rooftop. The planting beds usually 300-600 mm deep and the construction material varies from recycled milk crates to wooden raised beds to metal containers on wheels. The bed has a geotextile sheet that keeps the roots within the container and an irrigation system is installed on the surface of the roof, unlike intensive green roofs where the irrigation is mostly embedded within the layers of the roof.


1
2
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1
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1 meter
1 meter

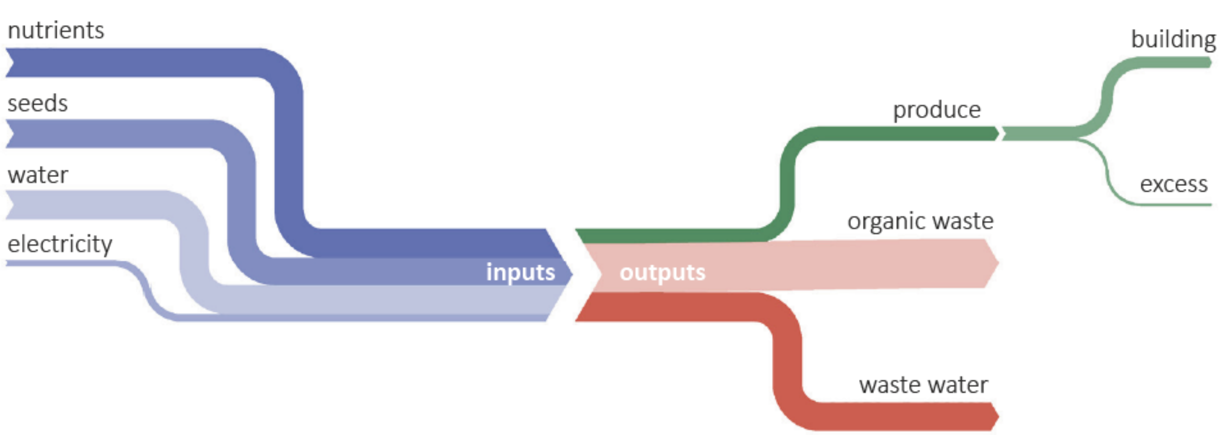

nutrients
seeds
water
electricity
inputs
outputs
produce
building
excess
organic waste
waste water

Fig. 4.34. Milk crate modular farm at Riverpark Farm in New York. (Top Left)

Fig. 4.35. Milk Crate system details. (Bottom Left)

New York 2011 1,395 m^2 MFUA = *

Riverpark Farm

Riverpark's team saw an opportunity to turn the vacant rooftop into a farm, supplying their restaurant's cooking needs with fresh, locally grown produce. The influence of design scalability using modular modules was the most important lesson gained from this project. The milk crate is designed to be transported and is tough enough to support the weight of soil and plants in terms of height, content, and shape.[26] [27]

26 ORE Architecture, "Riverpark Farm," ore-design, accessed April 23, 2021, https://ore-design.com/project/riverpark-farm/.

27 Sara Jacobson, "An Empty Lot Becomes a Riverpark Farm in NYC," Core77, October 17, 2011, https://www.core77.com/posts/20795/An-Empty-Lot-Becomes-a-Riverpark-Farm-in-NYC.

4.4 Benefits

BIA has benefits on multiple ends from people to the environment. The following are a few ways showing how BIA is a superior form of farming technology to conventional rural farming.

4.4.1 Reducing Energy Consumption

The integration of food production and building energy use, as demonstrated by rooftop greenhouses in Mediterranean cities, has led to improved building insulations which in turn reduces the building heating and cooling loads. Specific case studies conducted by Ana Nadal across Europe reported a reduction of energy used for heating and cooling by 40% due to BIAs.[28] BIA forms a link between building resources that are wasted and food production, thus developing a "small scale resource-saving system".[29]

4.4.2 Food-borne Illness

In recent years, the incidences of food-borne diseases have risen dramatically. In 2021, there was a semolina outbreak in Canada in the red onions imported from the United States. The greenhouse's in a BIA have monitored atmosphere which minimizes pathogen damage and food-related illnesses. BIA is a pesticide-free food production that keeps the fruits and vegetables we eat away from chemicals.[30] Also, food manufactured in a city for local consumption does not have to move more than a few kilometers, which reduces handling. This helps maintain the freshness of produce and keep them pest-free.

4.4.3 Sustainability Teaching and Community Engagement

BIA provides a one-of-a-kind, hands-on learning experience for students and members within the community who are interested in environmental management, food processing, and wellness. They benefit from having access to live plants and natural biological processes in the greenhouse or green roofs.[31] BIA is used as a teaching aid to introduce the benefits of local and sustainable food production offering opportunities for social integration within the production processes. The rooftops can be utilized

28 Nadal et al., "Building-Integrated Rooftop Greenhouses."

29 Specht et al., "Sustainability Aspects of Food Production in and on Buildings."

30 Gould and Caplow, "8 - Building-Integrated Agriculture."

31 Gould and Caplow, "8 - Building-Integrated Agriculture."

as a space for educational programs, job training, recreational family gatherings, and many more activities to help nourish the community relationship and allowing city dwellers to reconnect with their food's origins.[32] [33]

4.4.4 Land Value

Land availability is becoming extremely sparse in rural and many urban areas as the population grows and our cities expand. Climate change, demographic pressure, and soil erosion have resulted in a reduction of available agricultural space, even though food demand continues to increase. BIA does not use any new land for food production, instead redefines the enormous capacity of underutilized urban areas like abandoned sites and vacant rooftops. Integrating food processing into the urban housing stock is a novel approach to addressing land shortages and food security concerns. BIA enables urban areas to grow as far and still be able to feed their population.[34]

4.4.5 Higher Yields

Yield is one of the biggest factors for the success of BIAs. The use of modern farming techniques like hydroponics and aeroponics leads to very high yields as compared to conventional rural farming. Food produced in BIA uses less water, is of higher quality, and grows faster as it is grown in controlled environments. Hydroponic systems on rooftops without a greenhouse are also highly productive during the growing seasons in cold climates. High yields and productivity rates lead to low land requirements which is a blessing for urban food production especially on rooftops.[35] [36]

4.4.6 Year Long Production

BIAs also offers year-long food production especially in cold climates where the growing season is limited to a few months in the year. The heated space of a greenhouse allows producing food 365 days a year. The greenhouse can utilize the waste heat from the building heating systems to keep itself warm and solar-powered electric heating systems are often used to keep the entire system of food production as carbon neutral as possible.

32 Susanne Thomaier et al., "Farming in and on Urban Buildings: Present Practice and Specific Novelties of Zero-Acreage Farming (ZFarming)," *Renewable Agriculture and Food Systems; Renew.Agric. Food Syst* 30, no. 1 (2015): 43–54, https://doi.org/10.1017/S1742170514000143.

33 Khadija Benis and Paulo Ferrão, "Commercial Farming within the Urban Built Environment – Taking Stock of an Evolving Field in Northern Countries," *Global Food Security* 17, no. Journal Article (2018): 30–37, https://doi.org/10.1016/j.gfs.2018.03.005.

34 Thomaier et al., "Farming in and on Urban Buildings."

35 Khadija Benis et al., "Putting Rooftops to Use – A Cost-Benefit Analysis of Food Production vs. Energy Generation under Mediterranean Climates," *Cities* 78, no. Journal Article (2018): 166–79, https://doi.org/10.1016/j.cities.2018.02.011.

36 Sharanbir S. Grewal and Parwinder S. Grewal, "Can Cities Become Self-Reliant in Food?," *Cities* 29, no. 1 (2012): 1–11, https://doi.org/10.1016/j.cities.2011.06.003.

4.5 Challenges

As a new and upcoming technology, BIA faces criticism on various ends. The following factors showcase the barriers posed by BIA.

4.5.1 Energy Demand

Greenhouses, the most commonly practiced BIA system in cold climates, is one of the most energy-intensive parts of the farming industry because they produce optimal climatic conditions for plant growth by carefully regulating internal temperature and humidity levels. To leverage the opportunity to grow year long, during the winter months BIAs use energy to heat the growing areas within the greenhouses.[37]

4.5.2 Initial Capital

Aside from the higher urban rents, high-tech commercial urban farming is a capital-intensive industry, as it necessitates the adaptation of the host building for agriculture, all while adhering to local municipal laws and building codes. For instance, in Ontario, the building code regulates that any kind of construction over 10 square meters needs to go through a permit process. The legal process often costs more than constructing the greenhouse itself, which includes, the cost for hiring the architect and engineers to make required drawings to apply for a building permit and then the high costs for construction of a structure in the middle of a city on a rooftop.[38] [39]

4.5.3 Higher Energy and Water Costs

Farms in rural areas often receive subsidized water and energy for irrigation, while farms in urban areas must incur the urban costs of water and energy, as determined by zoning. As a result, manufacturing costs per unit of output in urban environments are higher.[40]

4.5.4 Urban Constraints

The technical incompatibility with the farm's immediate surroundings, which are mostly residential, was one of the key urban integration constraints with BIA. Though crops use complementary artificial

37 Nadal et al., "Building-Integrated Rooftop Greenhouses."

38 Benis and Ferrão, "Commercial Farming within the Urban Built Environment."

39 Jennifer Zurko, "The Engineering Behind Rooftop Greenhouses," February 26, 2016, https://www.growertalks.com/Article/?articleid=22119.

40 Benis and Ferrão, "Commercial Farming within the Urban Built Environment."

illumination in the winter but due to light pollution the rooftop greenhouse farms are not permitted to use the lighting during the evening. This is the case especially when the greenhouse is in close proximity to a residential tower. Other urban constraints include transportation of produce, construction material storage, noise pollution, etc.[41]

4.5.5 Professional Farmers

A high volume of production, as well as high-quality produce, necessitates a significant amount of horticultural expertise. As a result, the majority of BIAs have to be managed by professionals. Though this creates local jobs but still adds to the cost of running a commercial farm on top of an urban rooftop. [42]

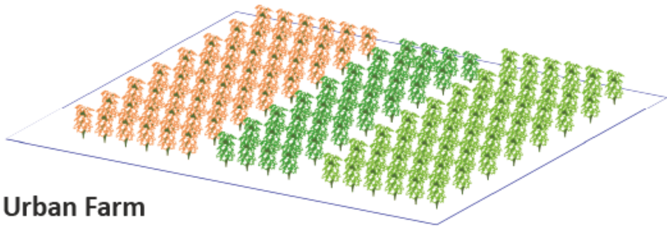
4.6 BIA vs Urban Farm

After understanding the working, benefits, criticisms, and precedents of BIA, one question that still needs addressing is why should one choose BIA to grow food in urban areas instead of using urban farms on vacant city plots, something urban dwellers have been doing for centuries. Fig. 4.36 lists the benefits that a BIA has over an urban farm. Urban areas have multitudes of vacant rooftops, at the moment, they are being used for housing mechanical and electrical services for the building. However, city land's value is way higher than the vacant rooftops and they compete with other urban functions. A vacant plot cannot remain in that state for long and will be developed sooner or later into a recreation park or a building. BIA can be installed on any rooftop and the owner of the building is the owner of the farm, unlike an urban farm where city permits are required to start the farming operations. Often the farm is operated by the community but the rights and permit processes take a very long time, like the case of Flemo Farm where the permit process took 5 years. The Building Permit process for an integrated greenhouse, however, is much faster and for an intensive roof, the permit process is required only for setting up the irrigation lines. Moreover, the cost of land in urban areas is skyrocketing, and setting a farm on top of a building is negligible. Another factor in favor of BIA is the MFUA which is higher for BIA compared to the

41 Benis and Ferrão, "Commercial Farming within the Urban Built Environment."

42 Devi Buehler and Ranka Junge, "Global Trends and Current Status of Commercial Urban Rooftop Farming," *Sustainability (Basel, Switzerland)* 8, no. 11 (2016): 1108, https://doi.org/10.3390/su8111108.

MFUA for urban farms due to modern growing methods of hydroponics and aeroponics. Thus in a dense urban fabric food production through rooftop farms is the logical step towards achieving food security and reducing the distance between the mouth and the production.



Urban Farm

- Availability of Land
- Less Productive
- Higher Land Cost
- Land Ownership

V/S

BIA

- Underutilized Roof
- Higher Productivity
- Farming by Owner

Fig. 4.36. Comparison of BIA and an urban farm.

Fig. 4.37. Barriers Table for the four systems.
(Next Page)

4.7 Barriers

The table in Fig. 4.37 responds to the barriers across four BIA systems that are analyzed across the various precedents researched for this thesis. The four systems analyzed are the intensive green roof, rooftop hydroponics, modular growing systems, and hydroponics greenhouse. All four of these systems offer innovative ways that integrate agriculture into an existing building. The table aims to offer all moving parts within these four systems.

	INTENSIVE GREEN ROOF	MODULAR SYSTEMS
CONSTRUCTION	0.6 (additional roof layers) + 8.15 kPa (500 mm thick growing media) Installation on existing rooftop requires stiffening of building structure.	0.6 kPa (additional roof layers) + 5.7 kPa (movable modular boxes of crops) Installation on existing rooftop possible without any structural alterations to the building.
SERVICES	Irrigation plumbing, food storage, and water pump. Vertical movement of soil, organic waste after harvest, and manure/fertilizer.	Irrigation plumbing, food storage, and water pump. Vertical movement of soil, organic waste after harvest, and manure/fertilizer.
CROPS	Any crop that can be grown in soil.	Any crop that can be grown in soil.
ENERGY USE	Little energy required to run the pump.	Little energy required to run the pump.
IRRIGATION	Open Loop system (Water drained after irrigation)	Open Loop system (Water drained after irrigation)
LEGAL ISSUES	No legal permits required for growing. Permits required to retrofit the building for farming.	No legal permits required for growing. Permits required to retrofit the building for farming.
SET-UP COST	Moderate cost for construction of green roof and related services.	Lowest cost for procurement of reused/recycled modular farming boxes and related services.
MFUA	Lowest MFUA. (0.06- 0.07)	Lowest MFUA. (0.06-0.07)

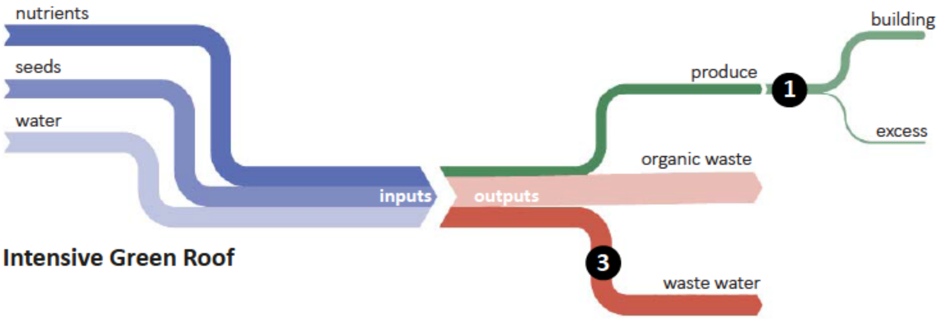
	ROOFTOP HYDROPONICS	HYDROPONICS GREENHOUSE
CONSTRUCTION	0.6 kPa (additional roof layers) + weight of hydroponics equipment Installation on existing rooftop possible without any structural alterations to the building.	0.6 kPa (additional roof layers) + 0.5 kPa (weight of greenhouse) + weight of hydroponics equipment Installation on existing rooftop requires stiffening of structure.
SERVICES	Irrigation plumbing, food storage, water pump and storage tank for recirculation. Vertical movement of soil, organic waste after harvest, and nutrient bags/solutions.	Irrigation plumbing, food storage, water pump, storage tank for recirculation, HVAC system, and growing lights. Vertical movement of soil, organic waste after harvest, and nutrient bags/solutions.
CROPS	Potatoes, large root vegetables and large vine crops cannot be grown.	Potatoes, large root vegetables and large vine crops cannot be grown.
ENERGY USE	Moderate energy required for irrigation.	High energy requirement for HVAC and irrigation. Possibility to become net zero by installation of solar panels.
IRRIGATION	Closed Loop system (Nutrients replenished after each irrigation cycle) 10 times less water use as compared to open-loop irrigation system.	Closed Loop system (Nutrients replenished after each irrigation cycle) 10 times less water use as compared to open-loop irrigation system.
LEGAL ISSUES	No legal permits required for growing.	Legal permit required for construction of greenhouse and installation of services and strengthening of the building structure.
SET-UP COST	Moderate cost for procurement hydroponics tower and related equipment.	Highest cost for building permit, construction cost, consultant fees and operating costs.
MFUA	Higher MFUA than intensive green roof and modular systems. (0.15-0.16)	Highest MFUA due to year long production. (0.36-0.49)

Pros Cons

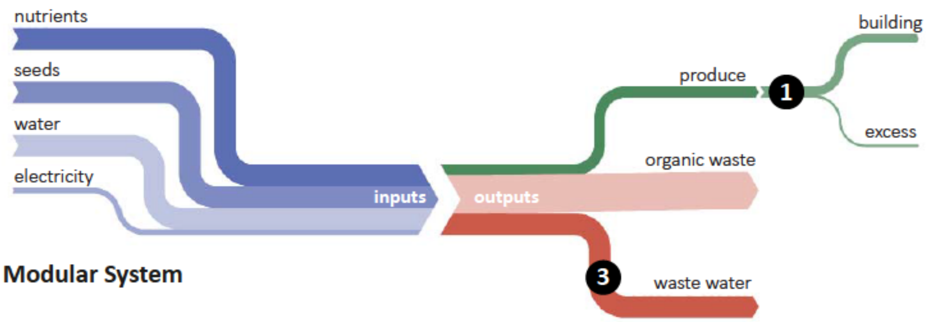
Fig. 4.38. Sankey Diagram for the four systems.
(Next Page)

4.8 Conclusion

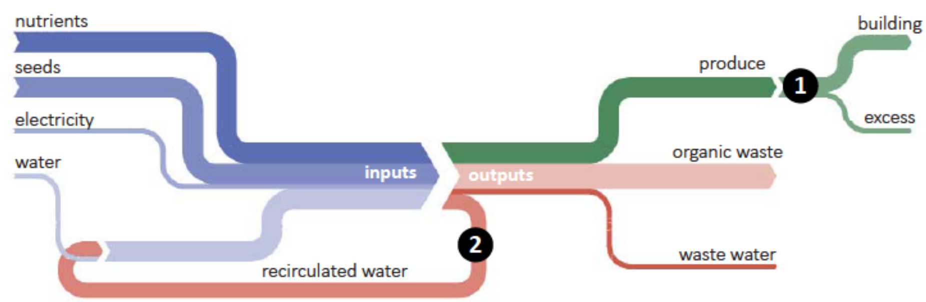
The four systems for BIA discussed in this chapter have the potential to be installed on any vacant rooftop. They have their pros and cons when it comes to construction, installation, services, cost, etc. Considering the cold climate of Toronto, a rooftop greenhouse seems like the most logical step as it allows for maximum year-long food production out of the available area as orchestrated by MFUA calculations. But the cost and permit processes required for setting up a greenhouse have been the major barriers to their success in urban centers across the world. Due to their presence for the longest, intensive green roofs are the simplest to construct and procure materials for all four systems. However, it has the lowest MFUA values making it not the ideal system. Therefore, using a hybrid system that combines the benefits of both intensive green roofs and hydroponics greenhouse can help us achieve a balance between cost, production, and amenity spaces. Using parts of the rooftop as greenhouse and other parts as green roofs allows to utilize the systems to their fullest. Where hydroponics lacks in growing root vegetables, the intensive green roof fills that gap while also providing residents with public spaces that they never had access to. BIA is a complex and fairly new technology with high setup costs in comparison to traditional urban farming systems, but the advantages discussed before and the ability to produce large quantities of food from lower land areas justifies the cost. The next part of the thesis tries to identify food deserts in Toronto to select a suitable site for BIA design that tackles food insecurity within the community. These areas can be benefited by retrofitting and adding BIA systems to the existing buildings as a measure to provide residents food that is cheap, readily available, culturally appropriate, and freshly produced. The future of BIA resides in food deserts where it would provide fresh food for the people and the community. BIA on underutilized rooftops in food deserts across the city of Toronto can act as an agent to alleviate the challenge of food insecurity in such vulnerable neighborhoods.



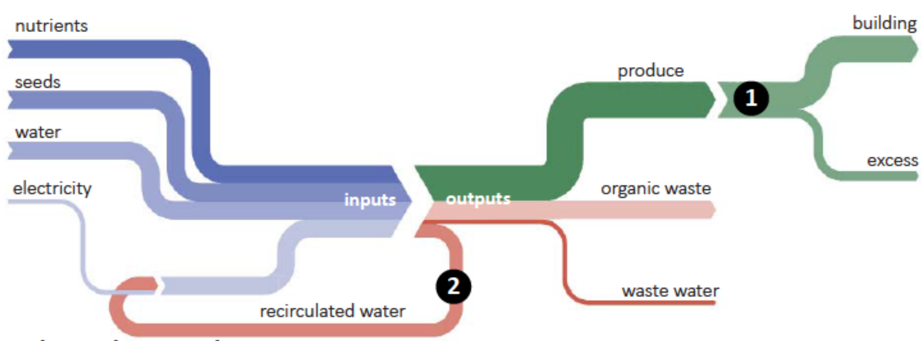
Intensive Green Roof



Modular System



Rooftop Hydroponics



Hydroponics Greenhouse

1 Food produced by the systems.

2 Water recirculated in the systems.

3 100% of the irrigation water drained.

5.0 BIA Design in a Neighborhood [method & product]

Fig. 5.01. Profile of city of Toronto. (Left)

5.1 Food Insecurity in Toronto

5.1.1 Food Deserts in Toronto

As discussed previously, food security is directly linked to the access and availability of food which in turn is defined by active food deserts in the city. Food deserts are areas or neighborhoods in a city that are far away from a supermarket leading to a lack of access to healthy food. These areas are large gaps in the city where it is difficult to find a grocery store within a 1 km walking radii and the predominant source for food is overpriced convenient stores or unhealthy fast food eateries.[1] Various neighborhoods in Toronto fall under this category. Food deserts are characterized by areas that house low–income communities and areas that are devoid of grocery stores. To pinpoint the food deserts in Toronto, GIS mapping is used where point data for grocery store locations[2] in the city is overlayed onto the shapefile data for median household income.[3] Fig. 5.02 showcases 1 km grocery catchment radii overlayed onto the median household income and the gaps created in this process point towards the potential food deserts within the city. The yellow areas in Fig. 5.03 denote the eight possible neighborhoods in Toronto that have food deserts within them.

5.1.2 Site Selection

One of these eight neighborhoods has to be selected for implementing a BIA design, to improve the food security within a community. The selected site needs to tickmark three constraints for selection which are:

1. A low-income neighborhood
2. A residential landuse
3. A mid to high rise building with adequate roof area for BIA

1 Canadian Environmental Health Atlas, "Food Deserts," Canadian Environmental Health Atlas, accessed June 26, 2021, http://www.ehatlas.ca/built-environments/food-deserts.

2 *Food Distributon Point* (DMTI Spatial Inc.), accessed July 2, 2021, http://geo2.scholarsportal.info.proxy.lib.uwaterloo.ca/#r/details/_uri@=6272129.

3 *Profile of Income by Dissemination Area - Greater Toronto Area, 2016 Census* (The Regional Municipality of York, n.d.), https://hub.arcgis.com/datasets/york::profile-of-income-by-dissemination-area-greater-toronto-area-2016-census?geometry=-79.660,43.638,-79.007,43.724.

Fig. 5.02. Grocery catchment areas overlay on median household income for the city of Toronto.

1 km radii grocery catchment area

Road Hierarchy

Collector

Expressway

Major Arterial

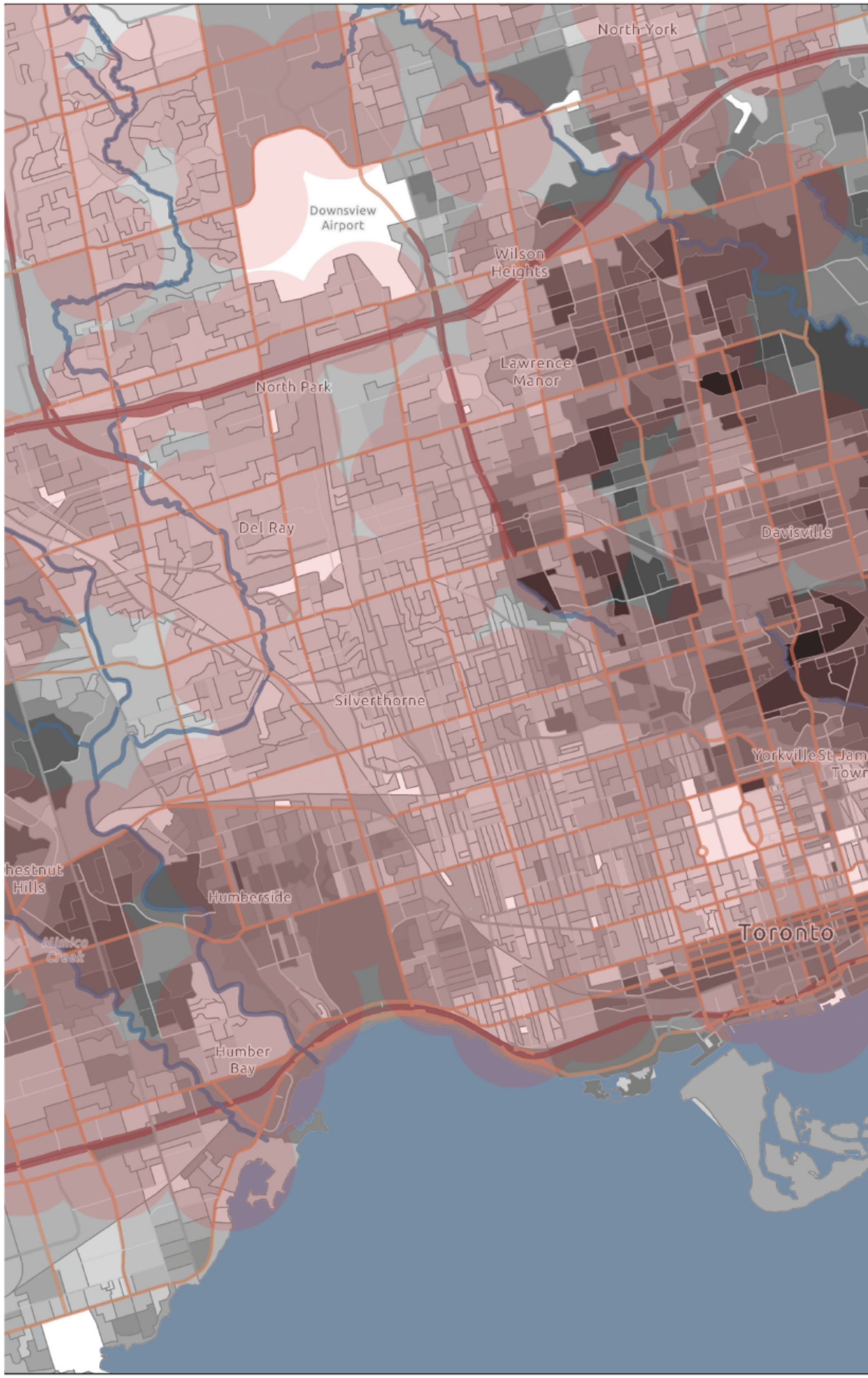
Minor Arterial

River

$0

Median Household Income

$110,000



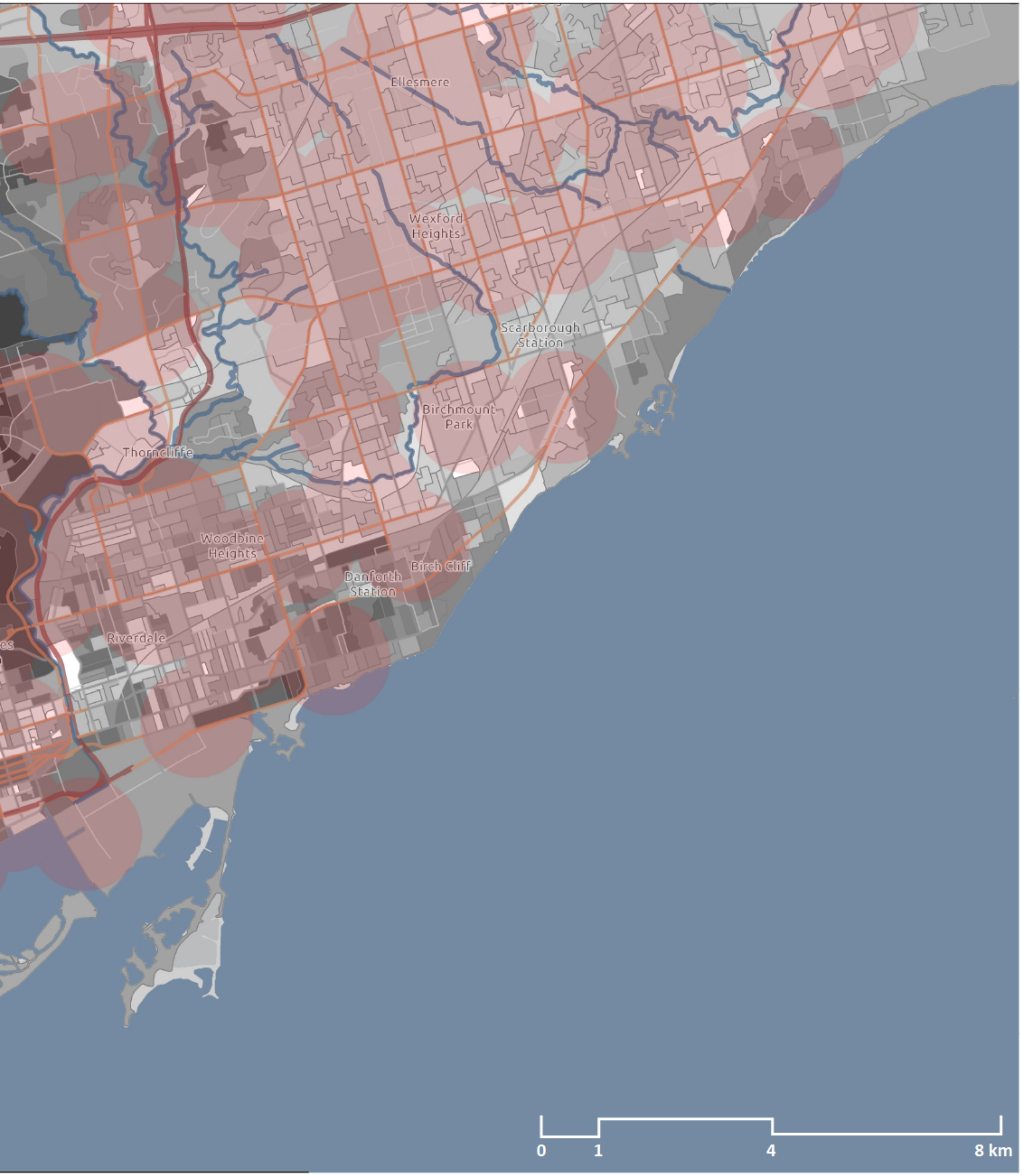

Ellesmere
Wexford Heights
Scarborough Station
Birchmount Park
Thorncliffe
Woodbine Heights
Birch Cliff
Danforth Station
Riverdale
0
1
4
8 km

Fig. 5.03. Food deserts in city of Toronto.

1 Downsview Airport

2 Toronto Island

3 Studio District

4 Windfields

5 Banbury- Don Mills

6 Flemingdon Park

7 Toronto Beaches

8 Forest Hill South

Food Deserts

Road Hierarchy

Collector

Expressway

Major Arterial

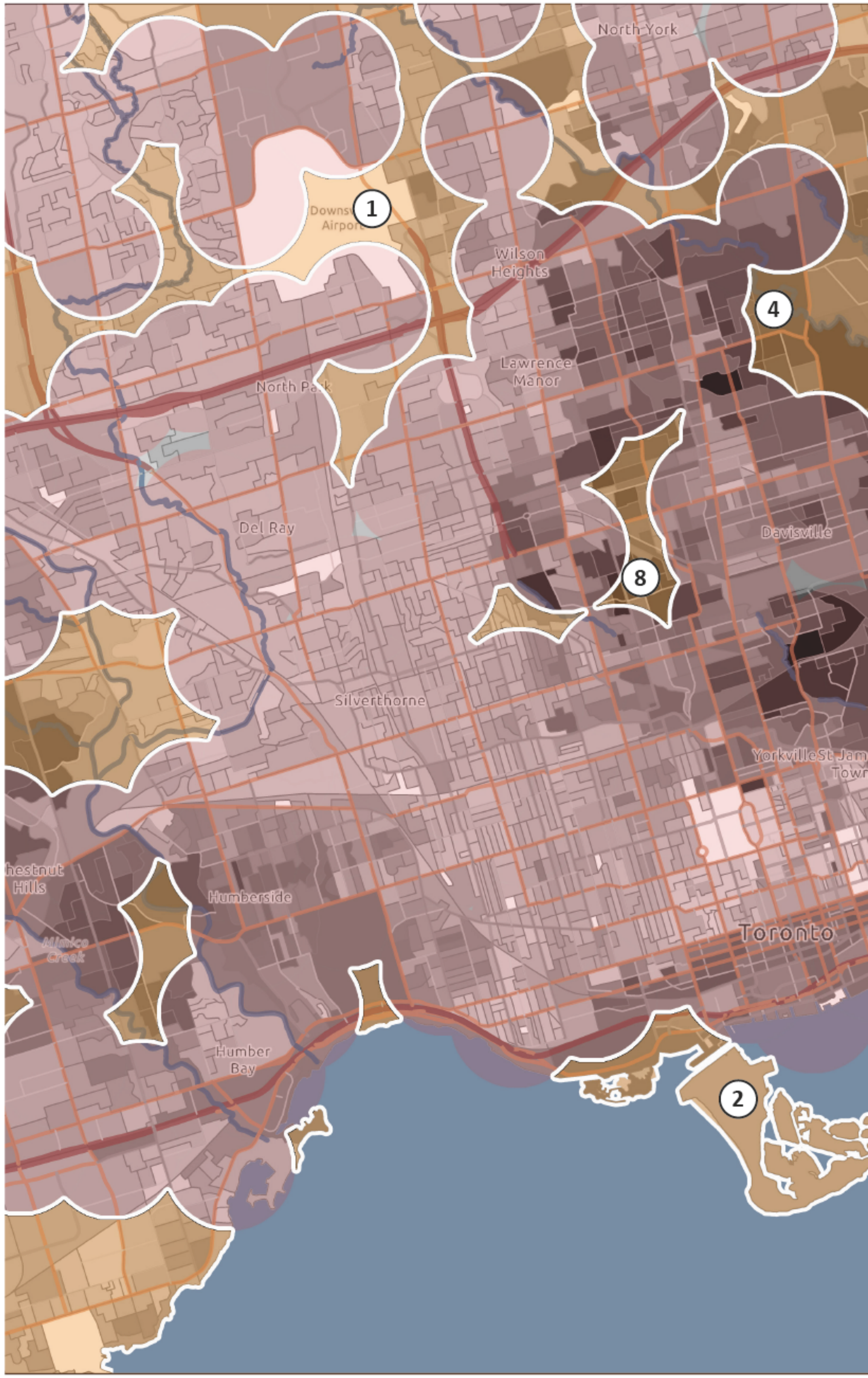
Minor Arterial

River

$0

Median Household Income

$110,000



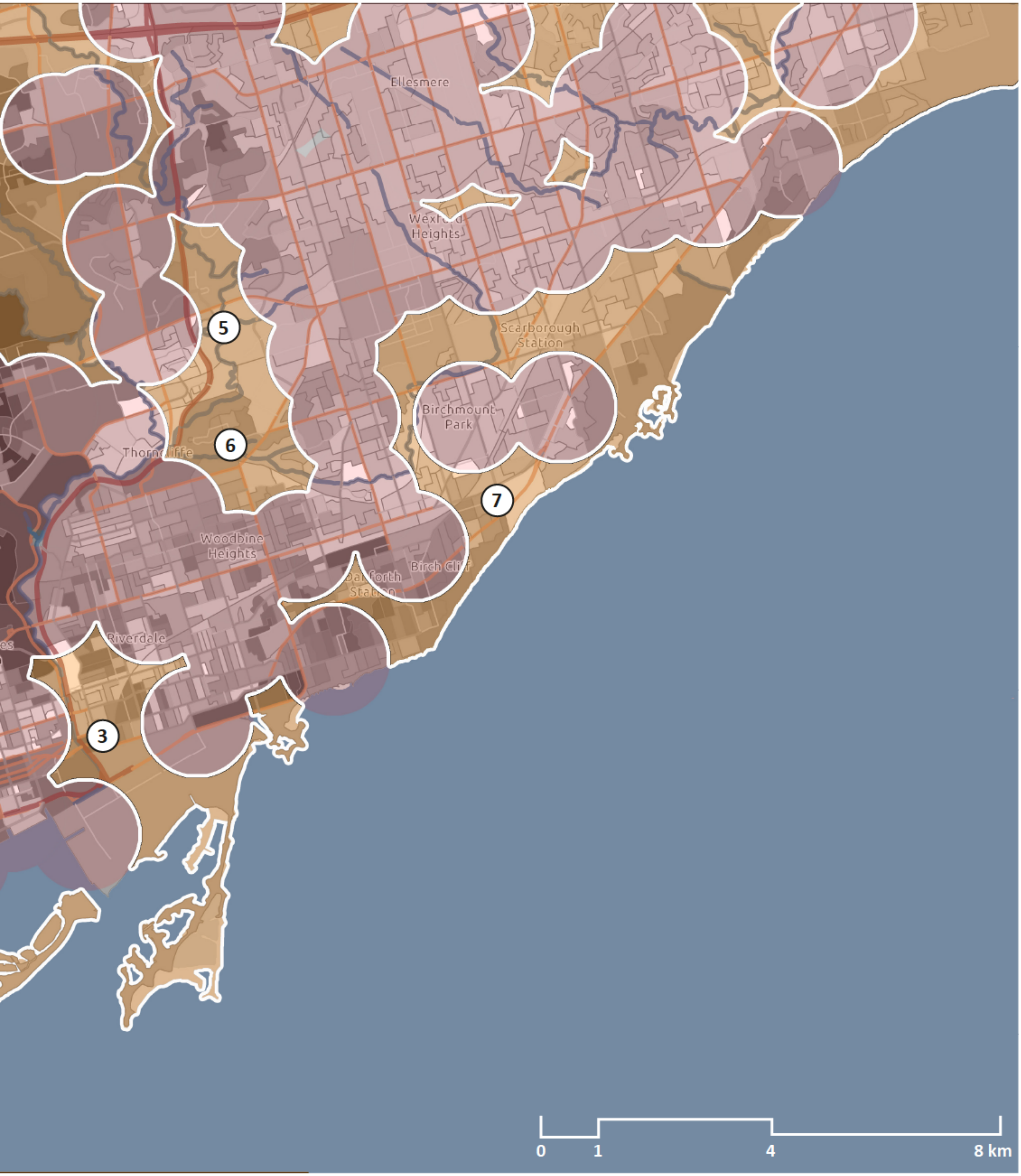

Ellesmere
Wexford Heights
Scarborough Station
Birchmount Park
Thorncliffe
Woodbine Heights
Birch Cliff
Danforth Station
Riverdale
5
6
7
3
0
1
4
8 km

Fig. 5.04. Site selection for design intervention.

Fig. 5.04 compares these neighborhoods as per the criteria above. Neighborhoods like Windfields and Forest hill south are disregarded due to high median household income. While neighborhoods like Toronto island do not have residential land use to become a site for intervention. Both Flemingdon Park and Banbury Don-Mills neighborhoods tick mark all the three selection criteria. To demonstrate BIA design, a post-world-war built apartment complex housing three residential mid-rise buildings (Edgeclifff Condominiums) within Flemingdon Park is selected as the site for design intervention.

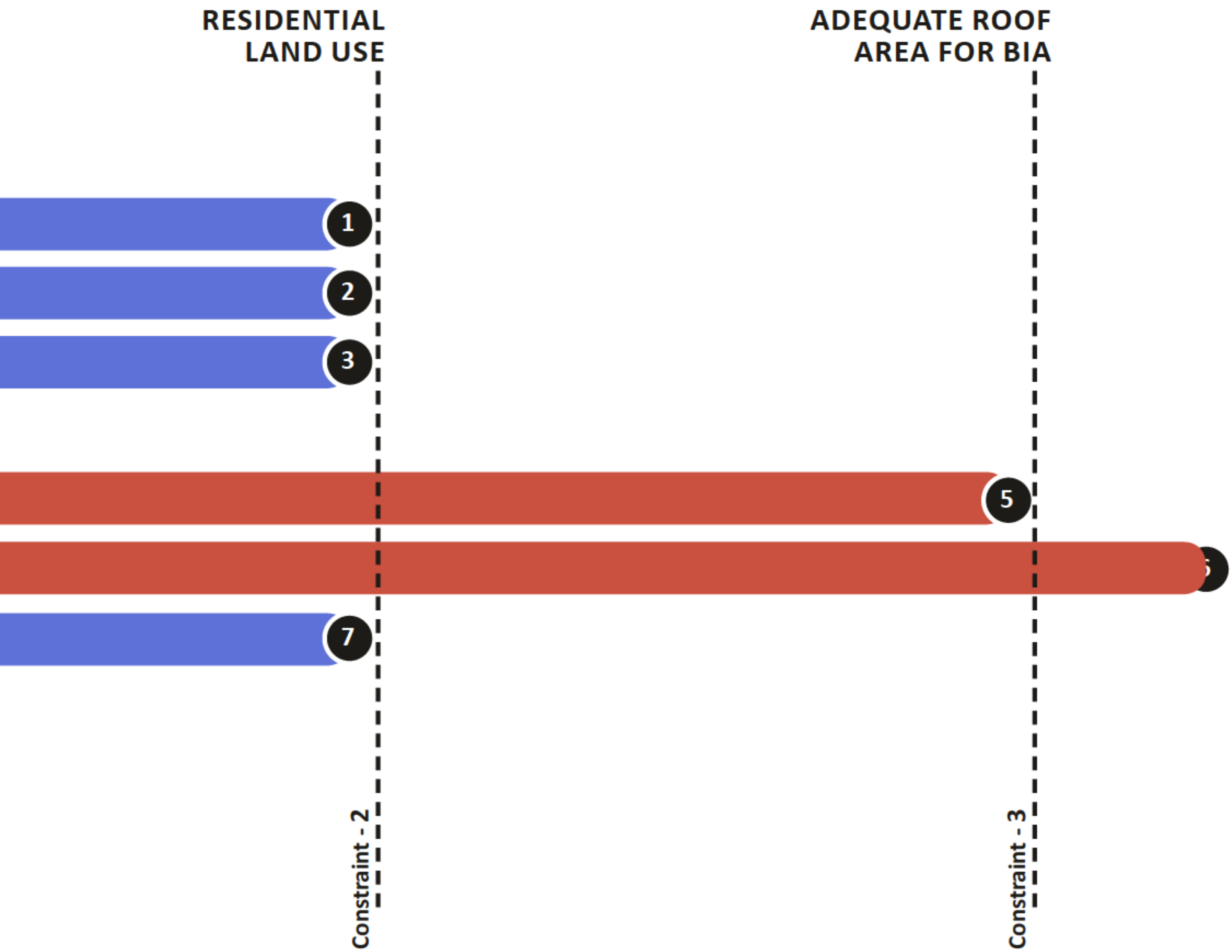

RESIDENTIAL
LAND USE
ADEQUATE ROOF
AREA FOR BIA
1
2
3
5
7
Constraint - 2
Constraint - 3

Fig. 5.05. Sunny food market in Flemingdon Park. (Top Right)

Fig. 5.06. Real Canadian Superstore in Flemingdon Park. (Bottom Right)

5.2 Flemingdon Park

5.2.1 How is it a Food Desert?

The site selected for intervention is one of the prominent food deserts in Flemingdon Park. The site lies between the Don Valley Parkway on the west, the Don River on the east, and Flemingdon Park golf course on the north and south sides. The real Canadian superstore and a Chinese supermarket – sunny food market are the two nearest grocery stores. Fig. 5.07 marks the 5 minutes and 10 minutes walk circles for the two stores, showing that both are far from the housing complex. The sunny food market is a 17 minutes walk (1.5 km) and the Real Canadian superstore is 22 minutes walk (1.7 km) from either of the three condominium buildings.

5.2.2 Site Massing

Edgecliff condominiums are disconnected from Flemingdon Park due to Don valley Parkway separating it from the overall neighborhood. Residents have to walk through the underpass on St. Dennis drive to reach the neighboring grocery stores- across the parkway. The three buildings are condominiums built in the 1970s rising 19 storeys. They have an approximate 2000 sq.mts. of roof area per building. The three buildings are completely identical except for the southmost tower which is rotated by 60 degrees. The south of the site also houses a small townhouse community. A golf course engulfs the site from the east.

5.2.3 Tower Renewal in "Arrival Cities"

Flemingdon Park is an "arrival city" for the immigrants coming to Toronto. The term was coined by journalist Doug Sanders and is defined as a transitional area where families would establish themselves economically and socially before merging into the general population.[4] Arrival cities are located towards the outskirts of the cities where land value is less and it takes fewer resources for immigrants to start their new life. These tower communities and 'arrival city' neighborhoods, according to Saunders, are a launchpad to the middle class. The arrival city fosters immigrant success by providing the newcomer with the essential "conditions for investment" in a hopeful future: housing, employment, and a path to citizenship or full

4 Dylan C. Robertson, "Examining Toronto's Arrival Cities," The Varsity, November 15, 2010, https://thevarsity.ca/2010/11/15/examining-torontos-arrival-cities/.


SUNNY
food mart
陽光超市
KABUL
RESTAURANT
Dine-in and Take-out - 416-423-4445
& BAKERY


REAL CANADIAN
Superstore
WHEEL-TRANS
W117

Fig. 5.07. Grocery store distances from the design site.

1 Real Canadian Store

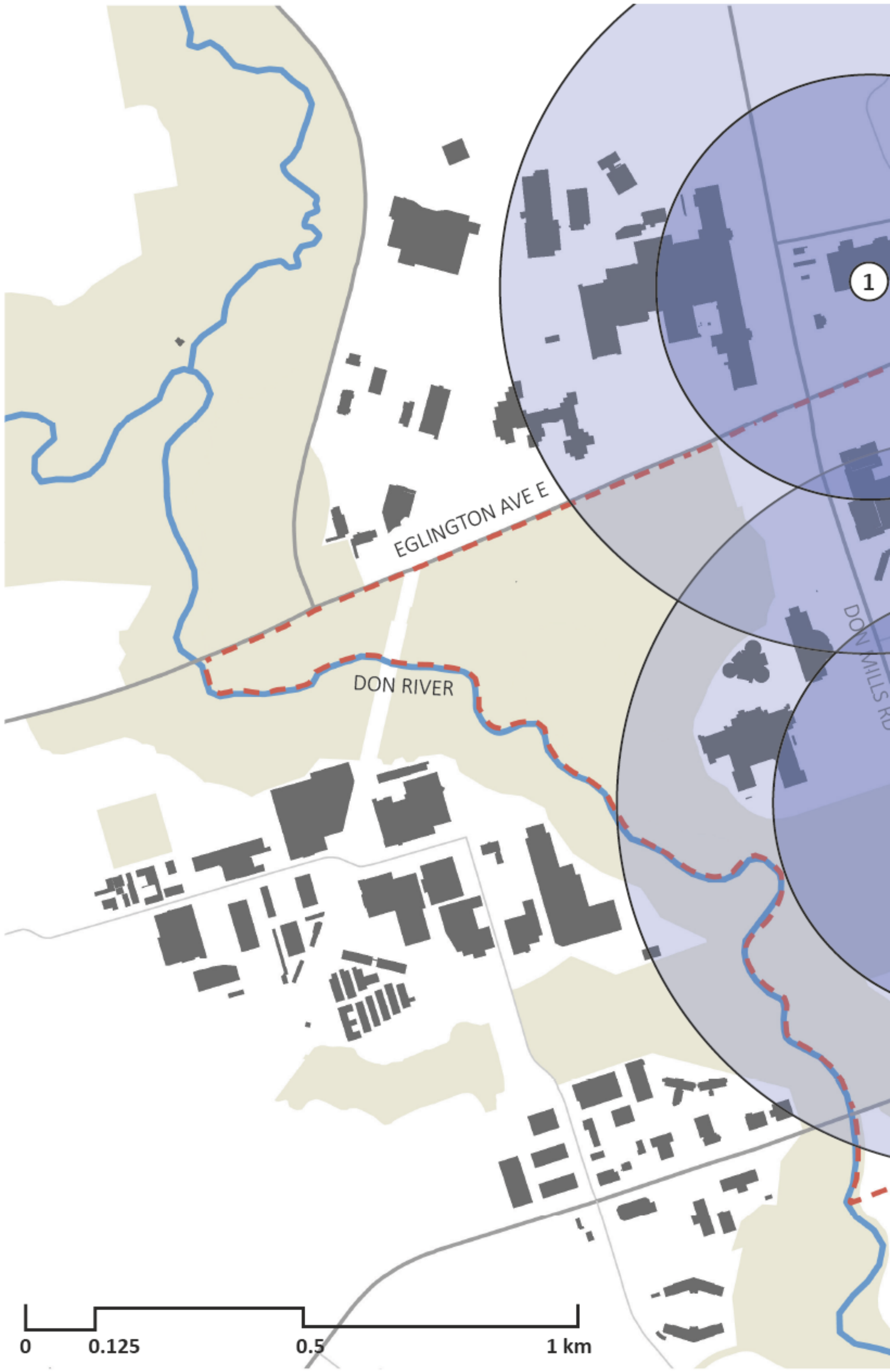
2 Sunny Food Market

Flemingdon Park

Design Site

5 minutes walk

10 minutes walk




DON RIVER
DON VALLEY PKWY

Fig. 5.08. Site massing diagram.

1. 10 EdgeCliff Golfway Condos
2. 5 EdgeCliff Golfway Condos
3. 20 EdgeCliff Golfway Condos
4. Windy Golfway Town Houses
5. Neighborhood across Don Vally Parkway
6. Flemingdon Park Golf Club
7. Don River

- - - Access Roads


19 STOREY
3
19 STOREY
2
7
6
4
WINDY GOLFWAY
LINKWOOD LN

Fig. 5.09. Edgecliff condominiums elevation view. (Top Left)

Fig. 5.10. Edgecliff condominiums view from street. (Bottom Left)

Fig. 5.11. Edgecliff condominiums view from street. (Top Right)

Fig. 5.12. Edgecliff condominiums view from Don river. (Bottom Right)

Fig. 5.13. Flemingdon Park demographic data. (Right)

inclusion in the host community.[5]

Arrival cities often have a surplus of apartment towers built during the city's post-war expansion in the 1970s. Edgecliff Condos are among the 1200 towers identified under Toronto's tower renewal project led by Graeme Stewart.[6] Apart from the building needing renewal, Flemingdon Park is also part of Toronto's list of priority neighborhoods. These neighborhoods urgently require social development, economic opportunities, healthy lives, and access to better physical surroundings.[7] The tower renewal project helps in achieving these goals by retrofitting towers and their surroundings in such priority neighborhoods.

Another important factor to consider for the revitalization of priority neighborhoods is the new Residential Apartment Commercial (RAC) zone of 2014 that permits several small-scale commercial and community uses on apartment sites. Fig. 5.14 maps out all the different commercial amenities close to Edgecliff condominiums. There are only a handful of commercial amenities available to the large population living in Flemingdon Park. This lack of commercial infrastructure can very much benefit from the RAC zoning which will allow the ground level of these residential towers to be commercial and thus provide for the residents by increasing the commercial amenities in the neighborhood.[8]

5.2.4 Demographic Data

Fig. 5.13 enlightens on the demographic data of Flemingdon Park. It houses a majority of immigrants with 4 in 5 people being immigrants, according to the census data by Statistics Canada.[9] Indians and Pakistanis are the most common ethnicities found in the neighborhood. Being a food desert the median household income of the neighborhood is less than Toronto's average by 25%. According to the figures posted by walk score,[10] Flemingdon park is a car-dependent neighborhood with one of the lowest walk scores amongst the neighborhoods of Toronto. This dependency on cars exaggerates the food insecurity within the residents that are already subjected to lower incomes and now have to either drive or take public transport to complete daily tasks.

5 ERA Architects, "Tower Neighbourhood, Tower City | Cities of Migration," accessed June 26, 2021, https://citiesofmigration.ca/good_idea/tower-renewal/.

6 ERA Architects, "Tower Neighbourhood, Tower City | Cities of Migration."

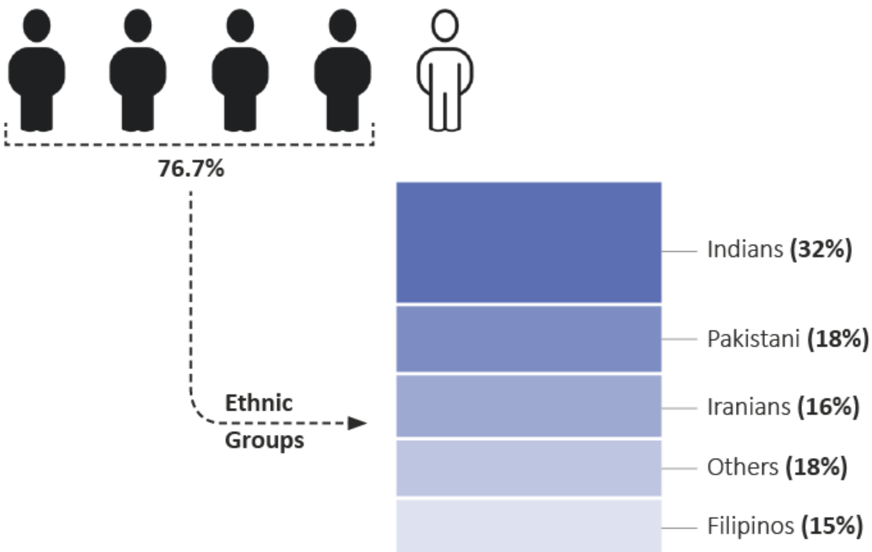
7 Toronto.ca, "Neighbourhood Improvement Area Profiles" (City of Toronto, 2017), https://www.toronto.ca/city-government/data-research-maps/neighbourhoods-communities/nia-profiles/.

8 ERA Architects, "Tower Neighbourhood, Tower City | Cities of Migration."

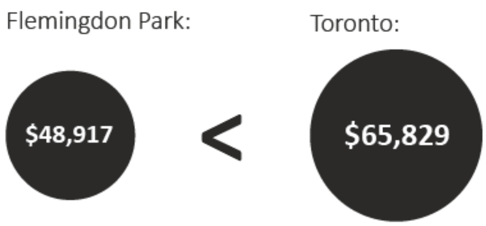
9 Statistics Canada Government of Canada, "Census Profile, 2016 Census - Toronto, City," February 8, 2017, https://www12.statcan.gc.ca/censusrecensement/2016/dppd/prof/details/Page.ins&SearchPR=01&B1=All&type=0.

10 Walkscore, "Walk Score of Flemingdon Park," Walk Score, accessed June 26, 2021, https://www.walkscore.com/CA-ON/Toronto/Flemingdon_Park.

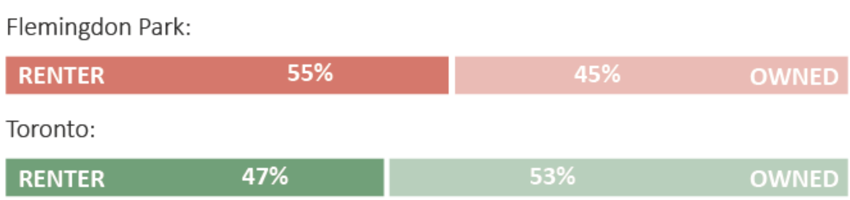
4 in 5 people in Flemingdon Park are immigrants.



Comparison of Median Household Income



Home Ownership



Car-Dependent Neighborhood.

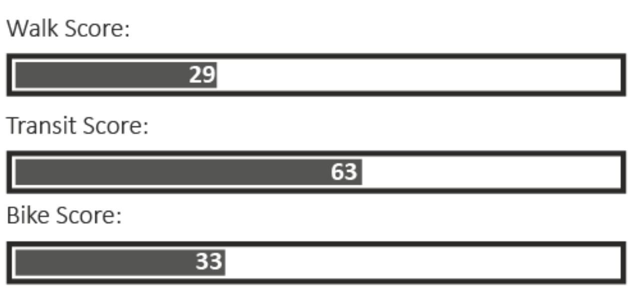
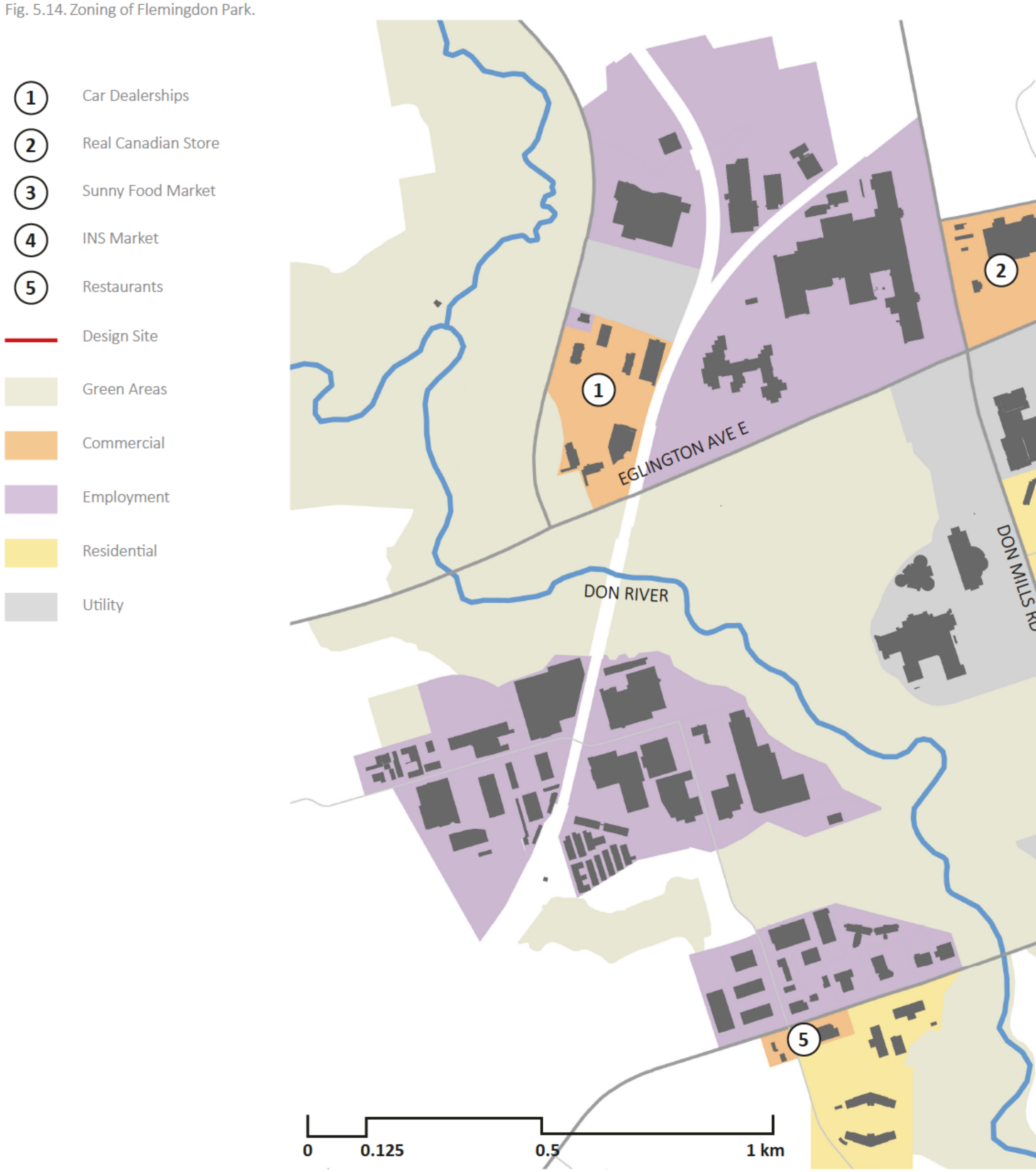


Fig. 5.14. Zoning of Flemingdon Park.




DON RIVER
DON VALLEY PKWY
3
4

Fig. 5.15. Common Table urban farm in Flemingdon Park. (Top Right)

Fig. 5.16. Flemo Farm in Flemingdon Park hydro corridor. (Bottom Right)

5.2.5 The Community

In Flemingdon Park, access to healthy food has been a known problem and addressed within the community through multiple initiatives. These initiatives involve community farms, neighborhood farmer's markets, and community meetings to spread education about food.

The Common Table

The common table is an urban farm and market project initiative of Flemingdon Park Ministry that ensures healthy produce for local families within the community.[11] Since 2017, the common table urban farm is responsible for distributing fresh vegetables, herbs, and small quantities of fruits to the residents. Underutilized church land is used to grow healthy produce for the ones in most need. The farm operates volunteer work by the residents. The Common Table market takes place on Friday afternoons, and registered customers shop with points based on their family size. Not only is fresh produce making its way to tables, but friendships and communities are being formed as well. There are children's games available at the market, people exchange recipe cards, and get the opportunity to meet new neighbors.[12]

Flemo Farm

The Flemingdon Health Centre had community discussions for the farm started in 2015. The farm is now coming to life after a five-year struggle to secure the necessary finance and licenses in a hydro corridor in the neighborhood.[13] Unlike the common table, the food produced by the flemo farm will be available for sale to everyone. A half-acre space on the farm will be reserved for producing culturally rich produce that can be sold locally within the community.[14]

Kitchen Table Community Meetings

In the life of many Flemingdon Park residents, community kitchens play an important role. They provide people with the chance to learn how to prepare nutritious foods that they may not have previously encountered. It's also a location where people learn about the best cooking methods

11 "The Common Table," May 9, 2021, https://www.flemingdonparkministry.com/the-common-table/.

12 "The Community Table at Flemingdon Park | Church of St Mary Magdalene (Anglican)," n.d., https://www.stmarymagdalene.ca/the-community-table-at-flemingdon-park.

13 CBC News · Posted: Sep 26 and 2020 5:00 AM ET | Last Updated: September 28, "New Farming Project in Hydro Corridor Aims to Bring Healthier Food to Flemingdon Park | CBC News," 2020, https://www.cbc.ca/news/canada/toronto/new-farming-project-in-hydro-corridor-aims-to-bring-healthier-food-to-flemingdon-park-1.5739910.

14 Sula Greene, "Urban Farmers Want More Places to Grow and Sell Food in the GTA," October 21, 2020, https://www.tvo.org/article/urban-farmers-want-more-places-to-grow-and-sell-food-in-the-gta.


Roots

Fig. 5.17. Food insecurity concerns in the community.
(Bottom Right)

Distance to food

Cost of Food

Freshness of Food

Community Engagement

for the dishes they prepare at home.[15] Many immigrants also learn how to navigate the food system in a new country.

Challenges faced by the community

In the paper "Closing the Food Access Gap in the Flemingdon Park & Thorncliffe Park Neighbourhoods of Toronto, Canada" authors Haiat Iman, Tahseen Sughra, Nazmun Arif, and Shannon Scott prove the vulnerability of the residents of Flemingdon Park towards food security. They conducted interviews within the community identifying almost half of the participants in the neighborhood had difficulty putting food on the table for their family.[16] The main problems identified through their interviews within the community were as follows:

1. Access to culturally rich produce
2. Distance to grocery stores
3. Access to fresh and healthy food
4. High cost of healthy food

Fig. 5.17 unites the concerns of the community regarding food security, color-coded based on different problems they face daily.

15 Haiat Iman et al., "Closing the Food Access Gap in the Flemingdon Park & Thorncliffe Park Neighbourhoods of Toronto, Canada," 2015.

16 Iman et al., "Closing the Food Access Gap in the Flemingdon Park & Thorncliffe Park Neighbourhoods of Toronto, Canada."

"17 years ago when I came here, we would go shopping and a whole grocery cart full of food would be $100. Now, there are only four bags and nothing inside them and it costs $100"

"We buy the things usually from there but after bringing home, if something is not fresh, we can't go there to return it as instead of exchange or refund they start arguing. So I don't go there for exchange or refund because if there's a dispute, I won't be able to go to the store further but I need to go there for most of my groceries."

"Family, friends and a feeling of belonging to a community give people the sense of being a part of something larger than themselves. Satisfaction with self and community, problem-solving capabilities and the ability to manage life situations can contribute to better health overall.98 The extent to which people participate in their community and feel that they belong can positively influence their long-term physical and mental health."

"Nigerian foods are not here. I eat whatever they have here. If I want to eat my cultural food, I have to travel out of the neighbourhood. I go to the West End to get the stuff, maybe once a month. I use fruits and vegetables in this area to support the food I get once a month in the West End."

"Like for potato and rice, it is cheaper and it fills our stomach, right? and this kind of vegetables and fruits are expensive and even if we eat much, we still feel light so it is costly."

"Sometimes my husband buys onion and potato and I found that most of the potato and onions are rotting. It's inside the bag and you cannot tell. After 2-3 days you find rotten foods."

"I cannot take whatever I want. I have to have Halal so my grocery bill is always higher than other families."

"They are taking our money but they are not giving us hygienic, healthy things."

"We are cooking healthy foods and we are learning how we eat healthy foods to have a good life. I learn a lot of things about the community. I learn about the nutrition. You learn about how much it has in calories, sodium which is good. How much you should eat, drink. This is good because when I come here before when I was sick. I have high blood pressure. I have cholesterol but now I am ok because I volunteer many places and I come here. Now I cook at home. Not too much oil. I eat a lot of vegetable."

"You do not find organic here. Lactose free or almond milk is difficult. (One store) carries it but half the time it isn't there."

"Some people are going into debt trying to feed their families."

"...and then it costs us more because we jump from here and jump there. You pick up a certain amount here and then you go there..."

5.3 Design Intervention

5.3.1 Design Program

The main idea for the design intervention in Flemingdon Park is to integrate a system for BIA within the Edgecliff condos. The design program has five levels of interaction starting from the macro-level of the city to the micro-level of a unit (Fig. 5.18). To improve food security within the community, farming systems are not just limited to utilizing underutilized terraces but also aim to use the vertical façades of the three residential towers. Since the buildings sit without being overshadowed by neighboring buildings, the vertical surfaces allow for food production using vertical hydroponics systems and balcony gardens. The design principles try to create a balance between the production of food (using four different BIA systems) and creating spaces for the residents that promote community interaction. Interaction involves kitchen table meetings that already occur within the community, spaces for communal dining, and amenity spaces on the roof for the residents to farm, barbeque, etc.

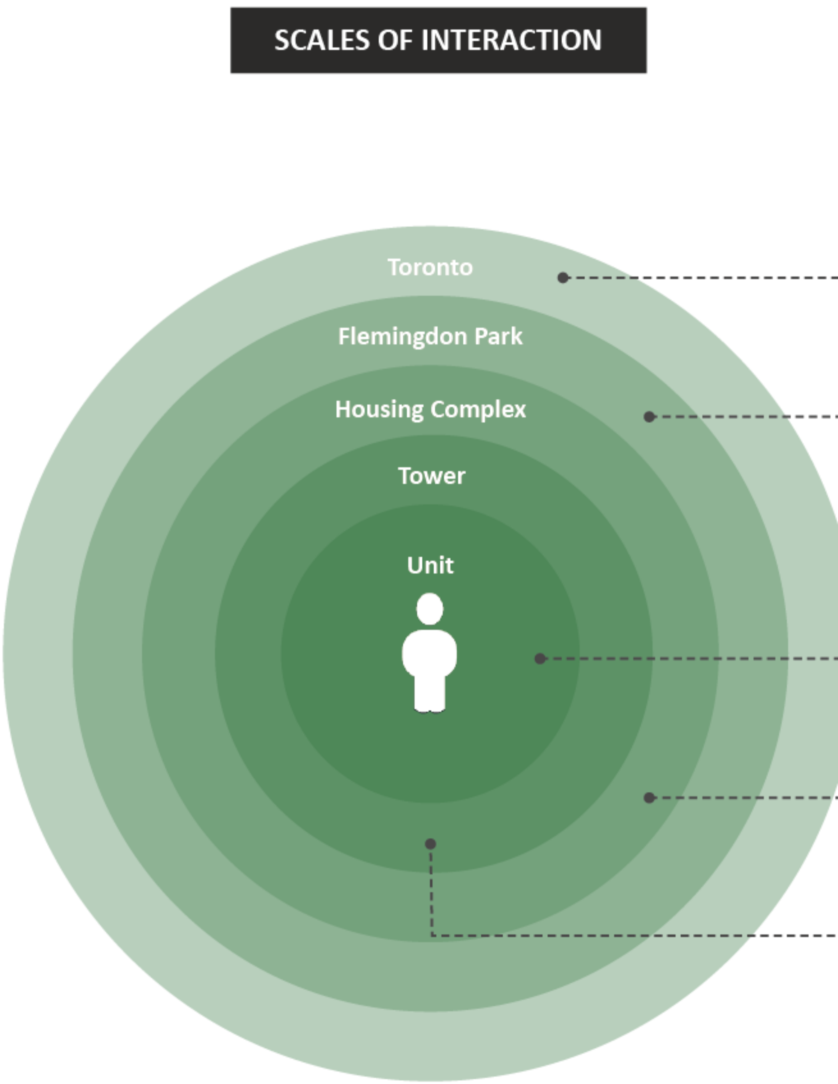
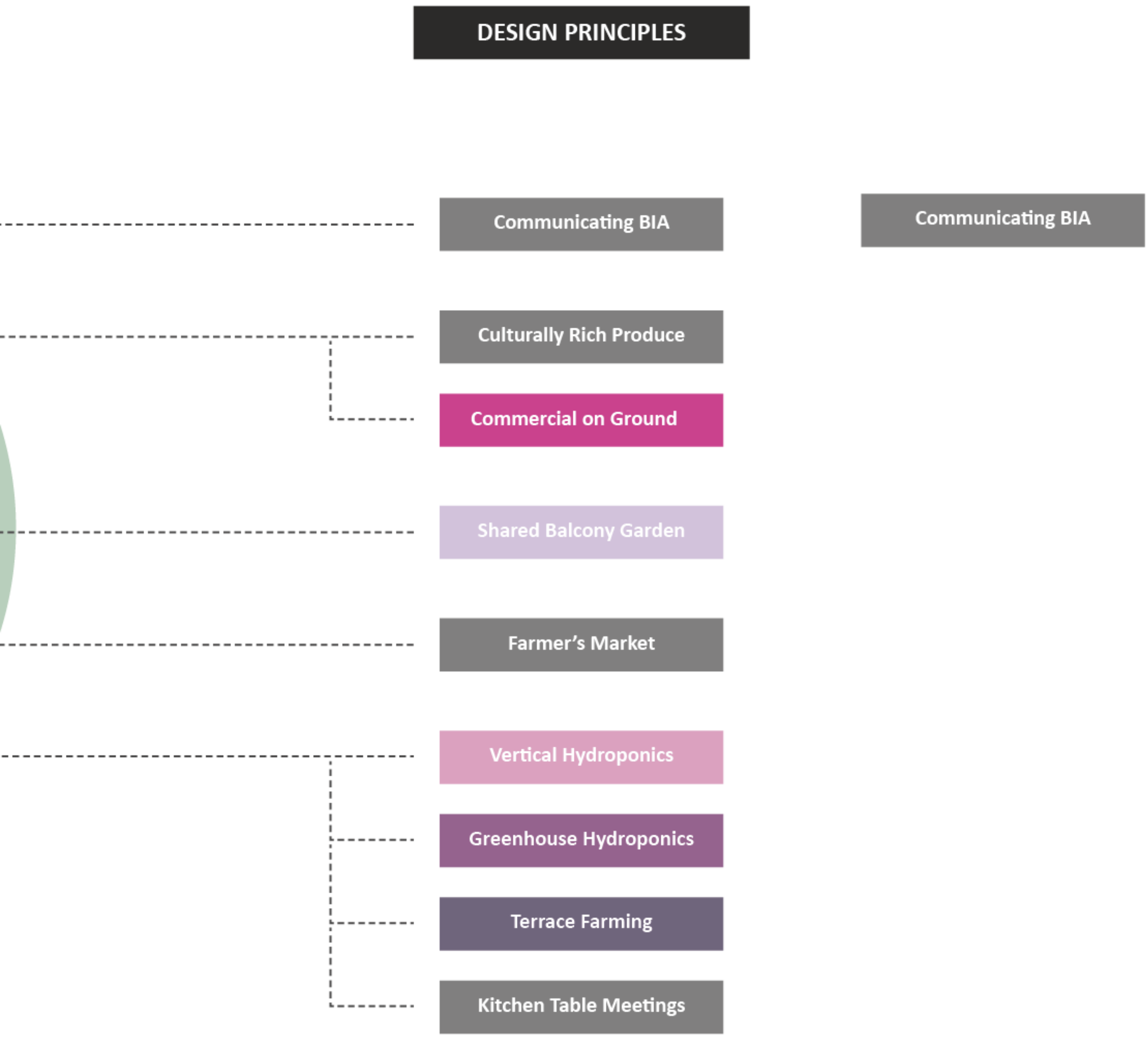


Fig. 5.18. Design intervention bull's eye program diagram.



5.3.2 Façade Shadow Analysis

Sunlight plays a very important role in making balcony gardens and vertical farming successful. The site plan in Fig. 5.19 distinguishes between the facades of the three towers based on the best direction for plant growth to the worst. South, south-west, and south-east receive the most amount of sun followed by west and east and thus are the only directions suitable for plant growth. The plant species varies with the amount of sunlight received by the façade. The roof is always sunlit and hence the entire slab can be used to grow any plant type.

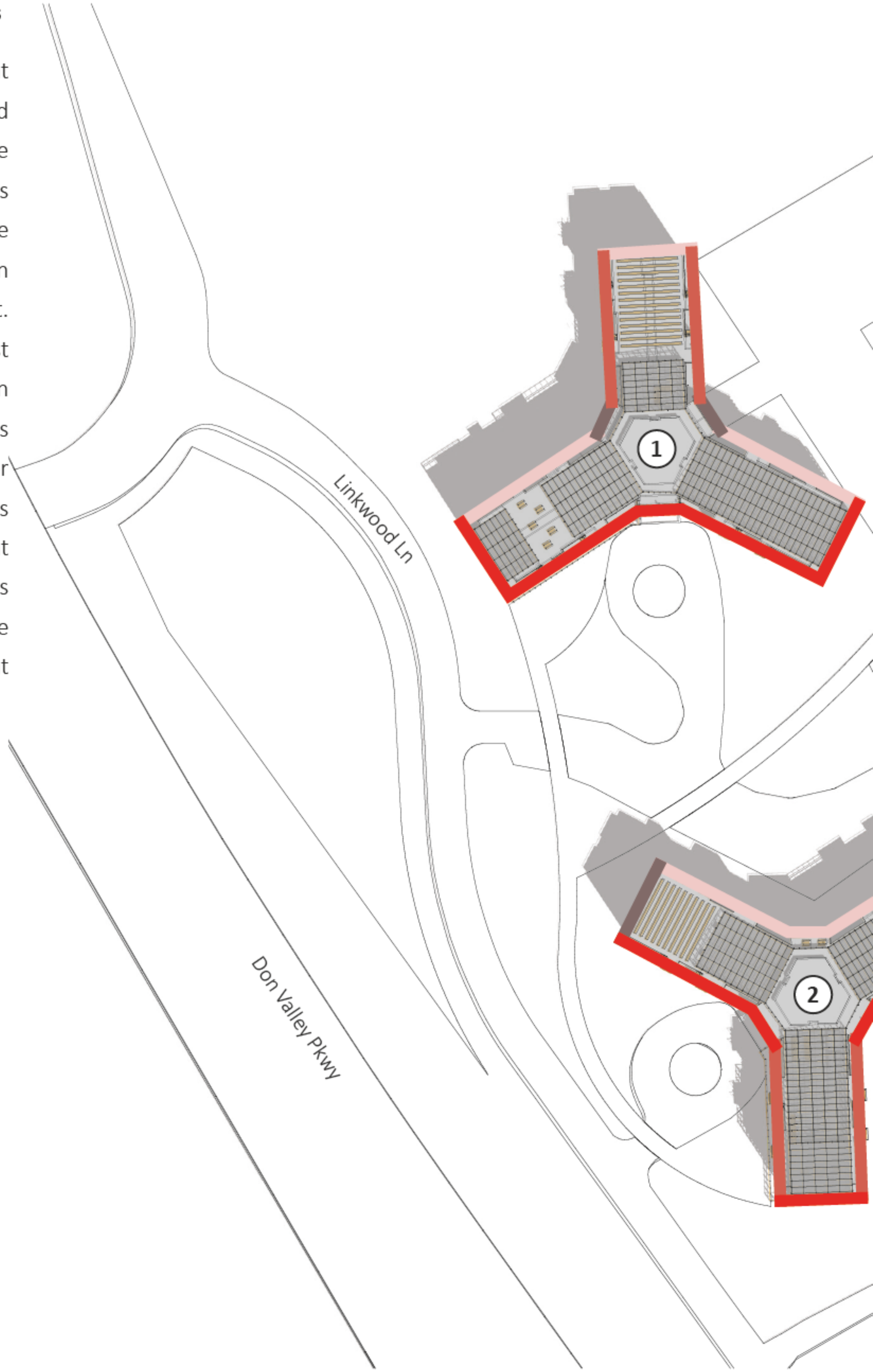


Fig. 5.19. Shadow analysis for the design site.

1 10 EdgeCliff Golfway Condos

2 5 EdgeCliff Golfway Condos

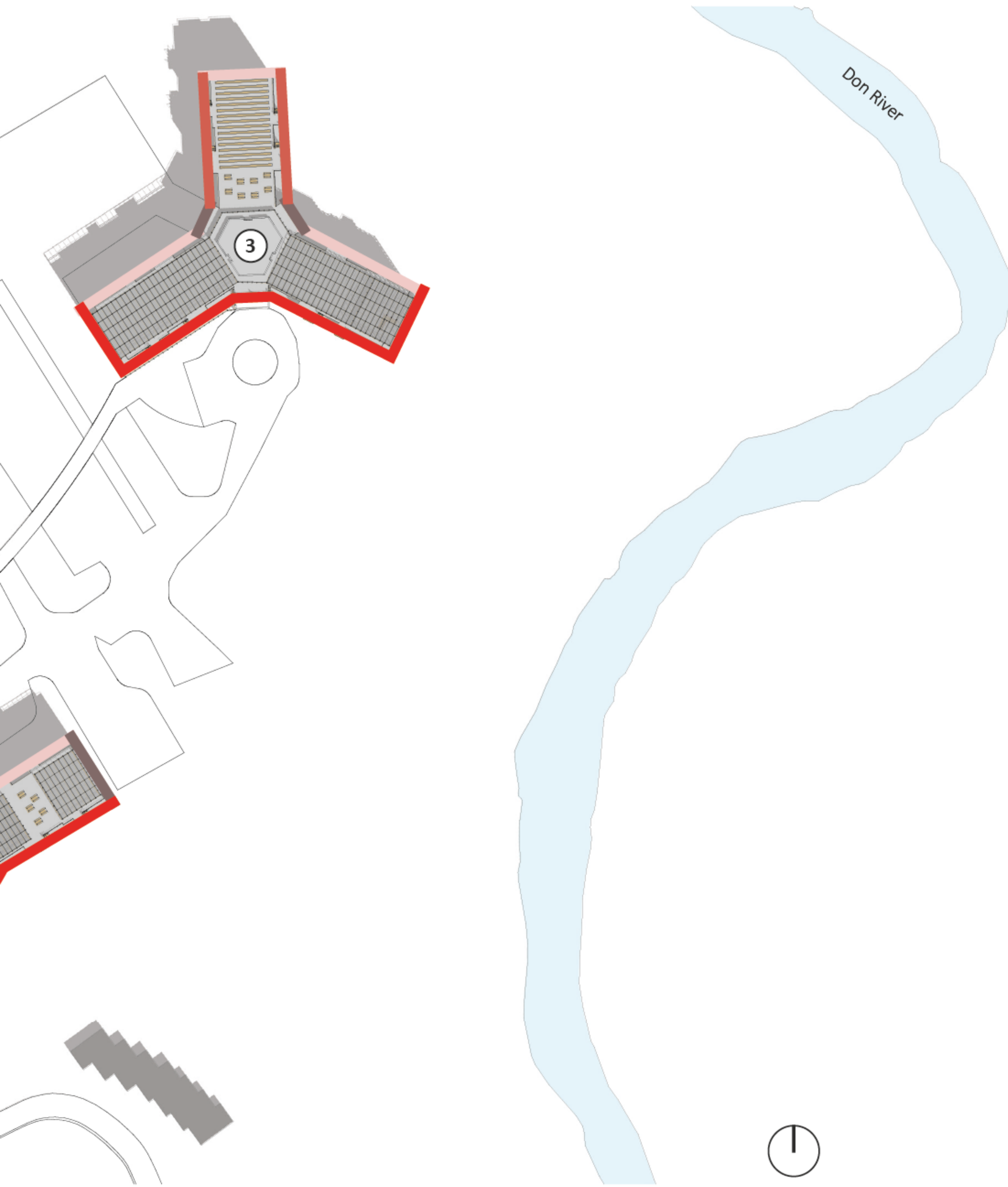
3 20 EdgeCliff Golfway Condos

High Sun- S, SW and SE (avg. 7-8 hrs of sunlight)

Medium Sun- W and E (avg. 5-7 hrs of sunlight)

Low Sun- NW and NE (avg. 3-4 hrs of sunlight)

Not Suitable- N (indirect sunlight)


Don River
3

5.3.3 Design Massing

Fig. 20 describes the various BIA systems and the ground-level commercial spaces designed for the towers. Of the three wings of each tower, one is converted into commercial spaces that can be accessed by all.

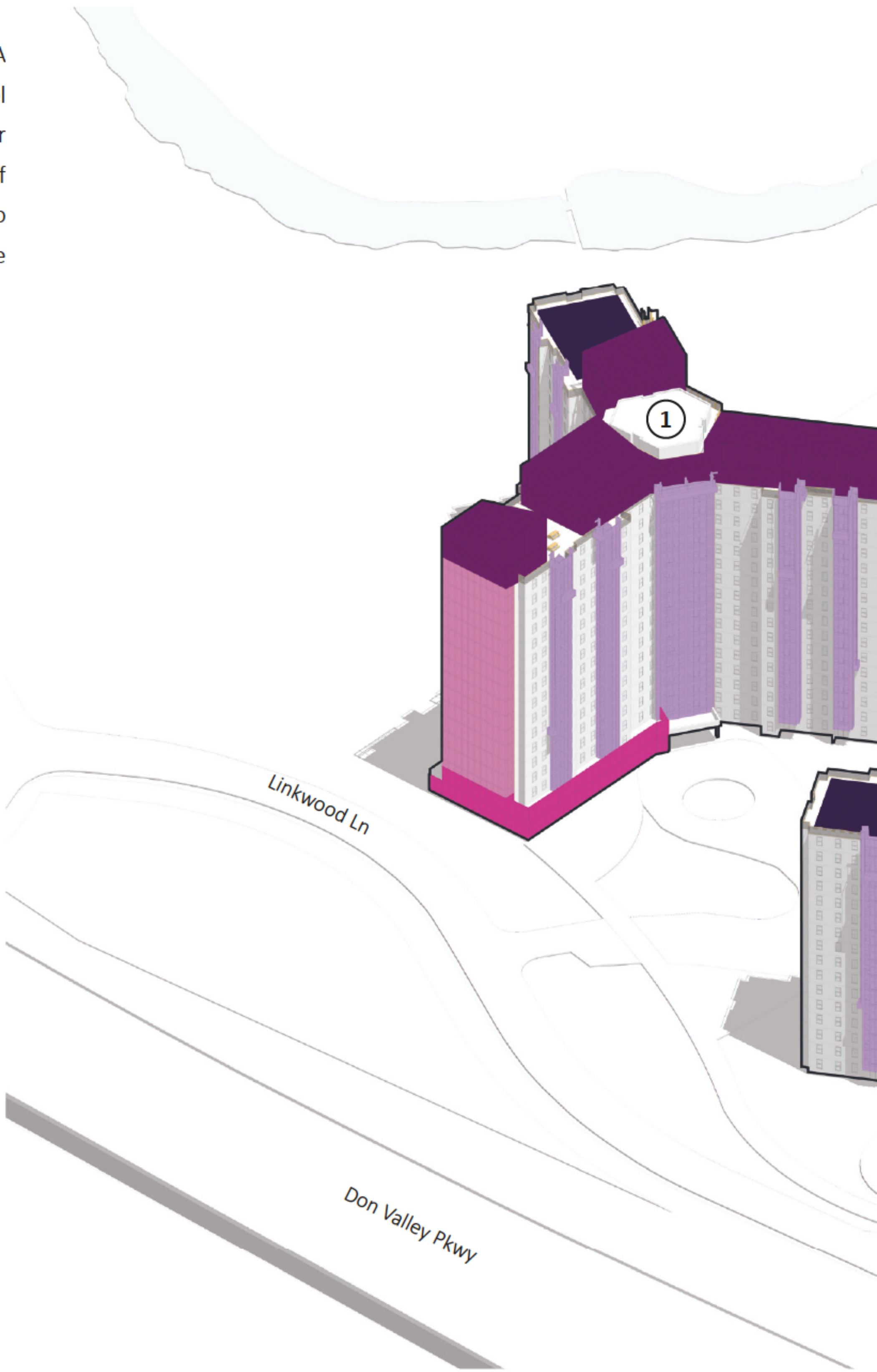


Fig. 5.20. Massing showing design elements.

1 10 EdgeCliff Golfway Condos

2 5 EdgeCliff Golfway Condos

3 20 EdgeCliff Golfway Condos

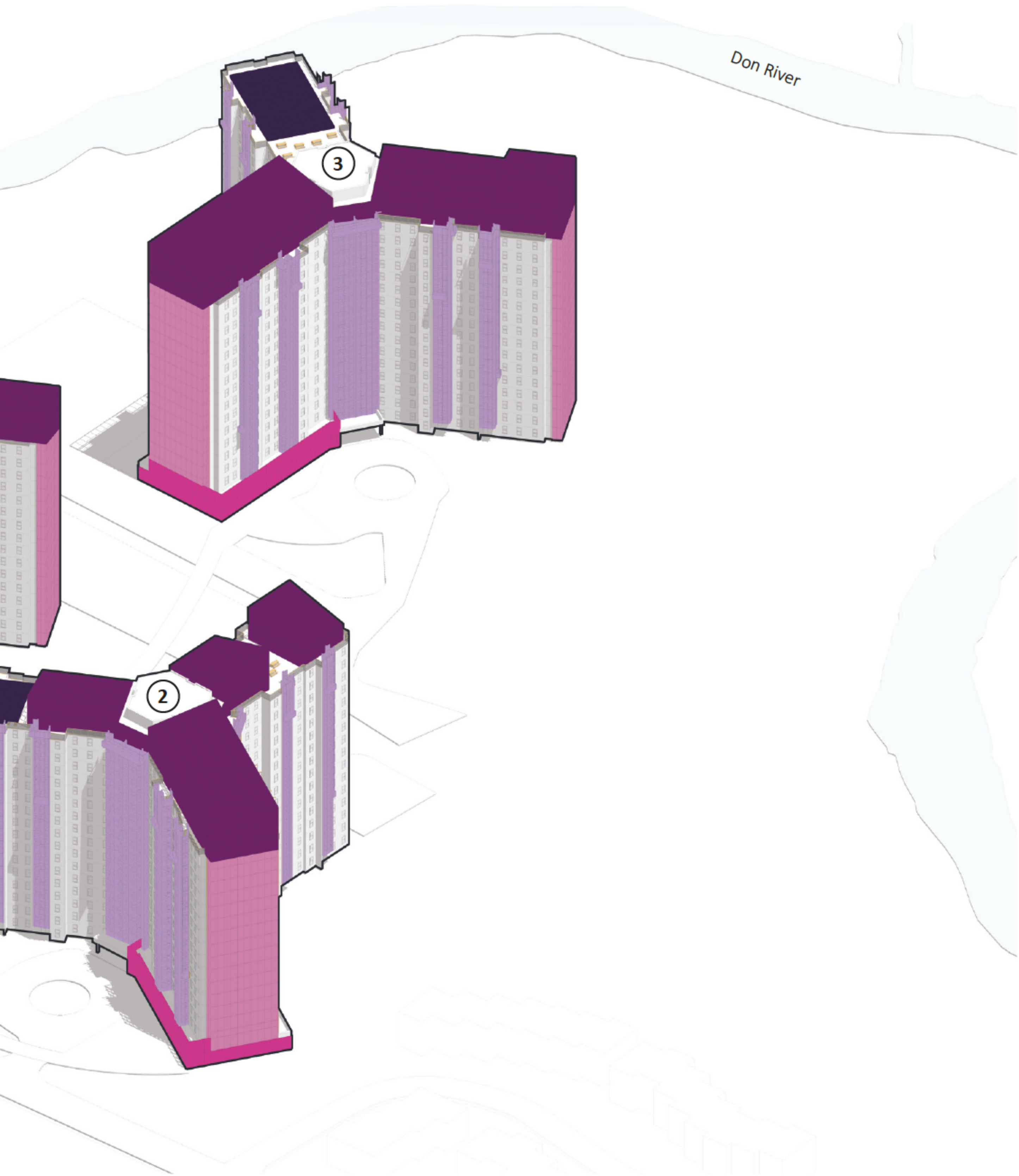
Commercial

Shared Balcony Garden

Vertical Hydroponics

Greenhouse Hydroponics

Terrace Garden


Don River
3
2

5.3.4 Landscape Connection

Commercial spaces for the three towers are connected by a distinct paved path. The spaces include farmer's markets, restaurants that utilize food grown above, cafes, and small commercial spaces.

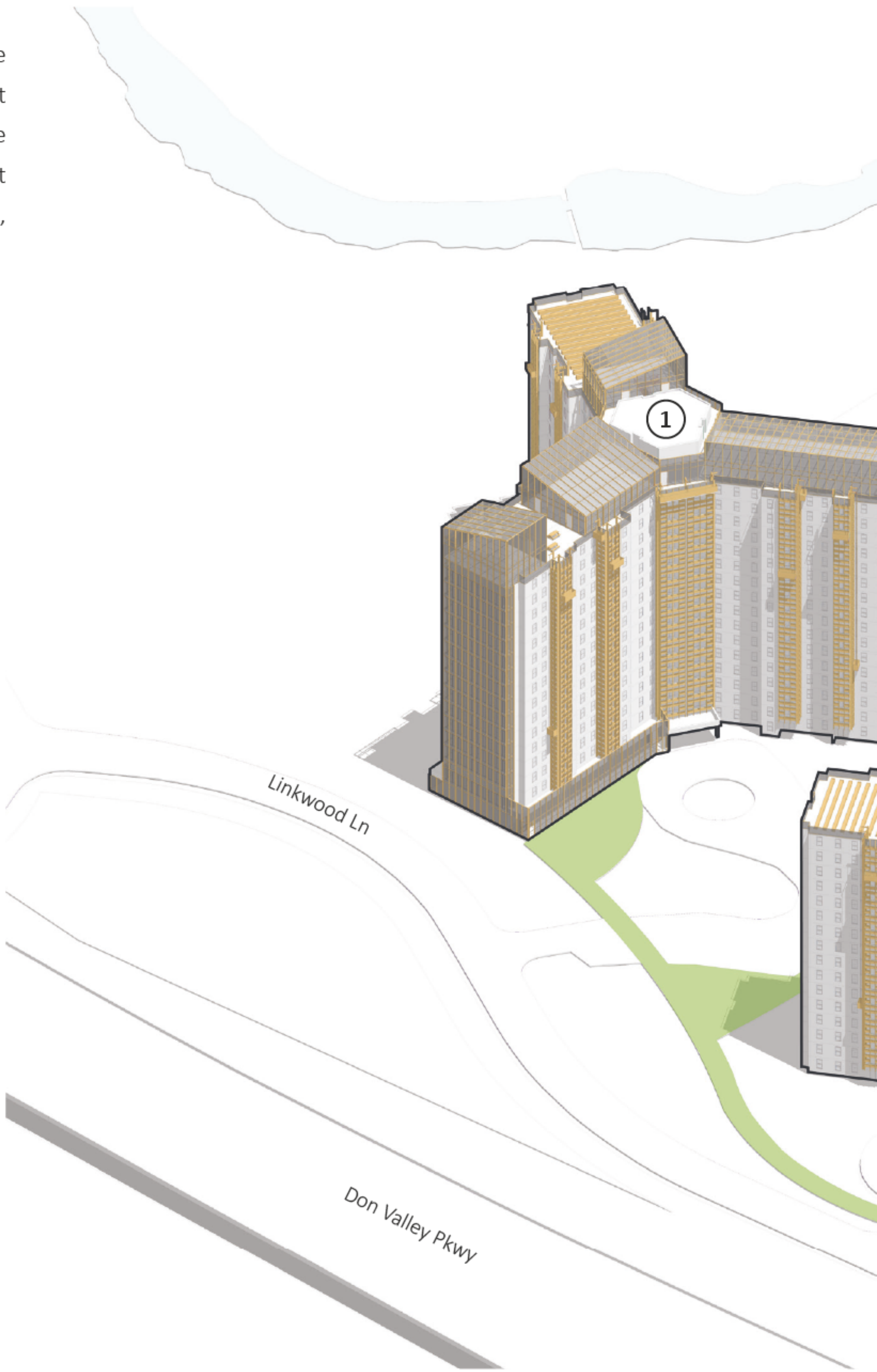


Fig. 5.21. Landscape connection to ground level commercial spaces.

1 10 EdgeCliff Golfway Condos

2 5 EdgeCliff Golfway Condos

3 20 EdgeCliff Golfway Condos

Landscape Connection


Don River
3
2

5.3.5 Distribution Network

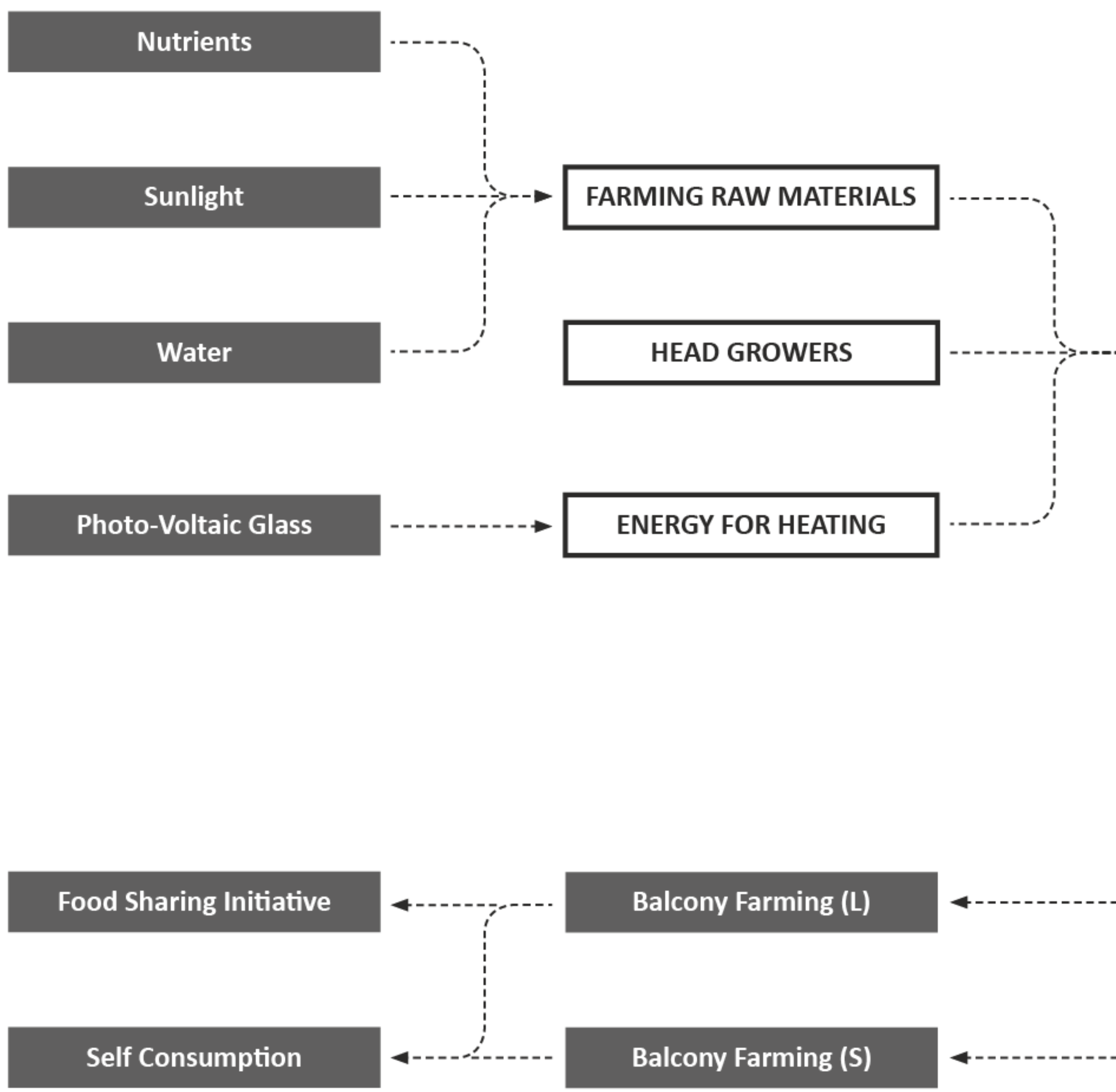
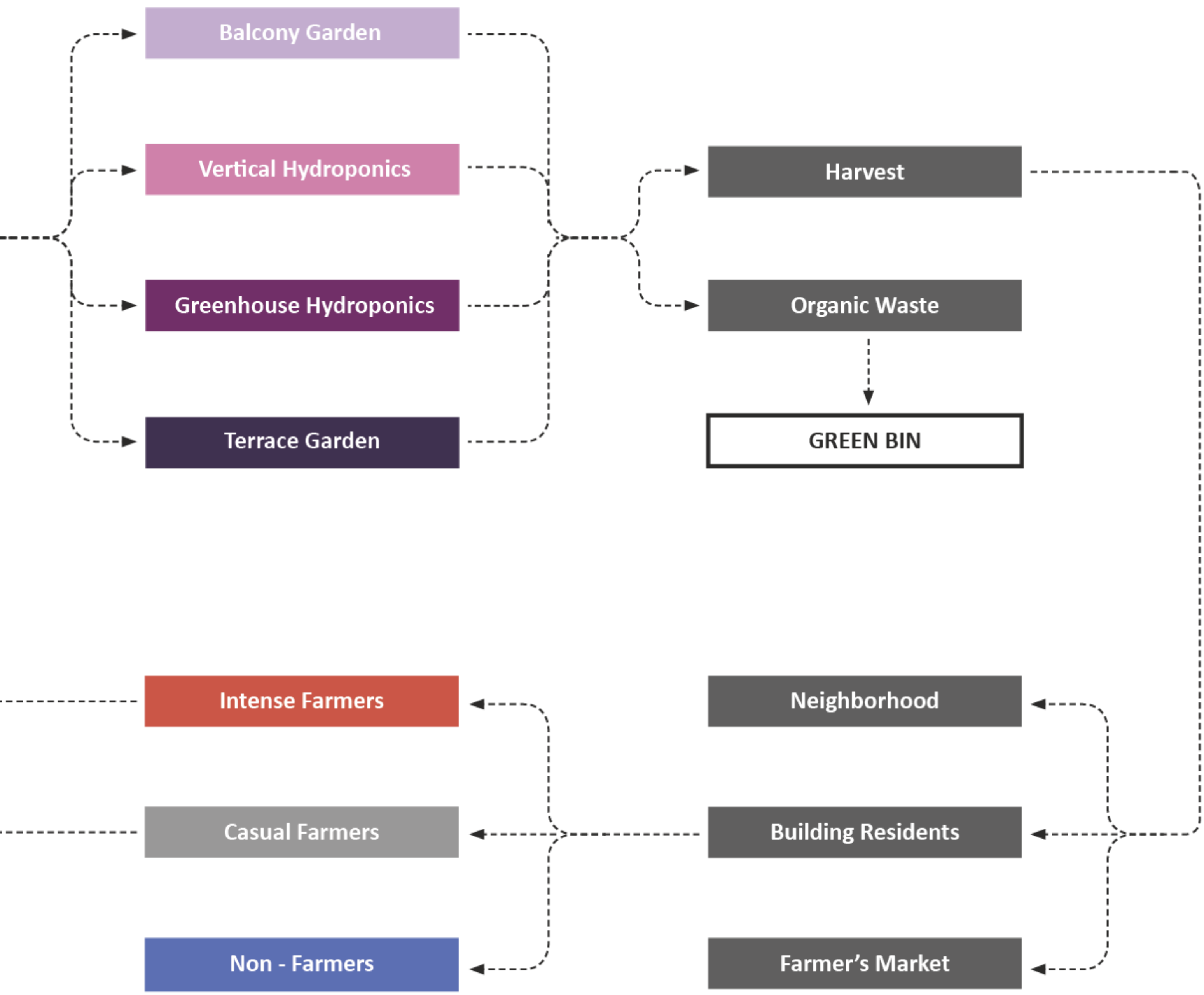


Fig. 5.22. Food, resources and system distribution flow diagram in the apartment complex.



Balcony Garden
Vertical Hydroponics
Greenhouse Hydroponics
Terrace Garden
Harvest
Organic Waste
GREEN BIN
Intense Farmers
Casual Farmers
Non - Farmers
Neighborhood
Building Residents
Farmer’s Market

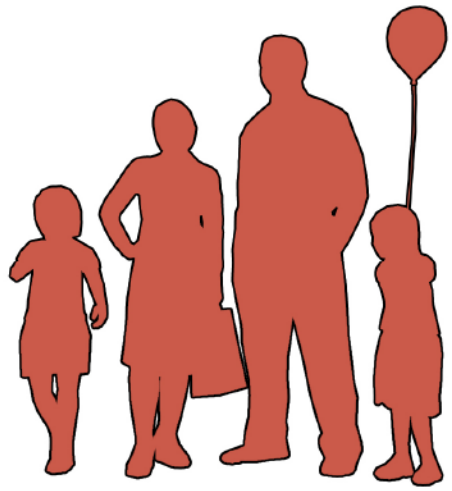
Fig. 5.23. Intense farming household. (Right)

Fig. 5.24. Casual farming household. (Next Page Left)

Fig. 5.25. Non farming household. (Next Page Right)

5.3.6 A day in the life of people of Flemingdon Park

To understand the working of the various BIA systems integrated within the towers, consider the example of three different households. First being an immigrant Indian family (denoted by) that practices intense farming and contributes to the overall building level produce, distributed among the residents of the building. The second household consists of a retired professor (denoted by) who is a casual farmer growing vegetables for self-consumption. Finally, the last household is a student couple (denoted by who do not have time to farm and rely on the building to give them healthy produce. These three households - immigrant families, single retired seniors, and working young adults form the major demographics living in Flemingdon Park. The following section takes you through a day in the life of these families and how they would interact with the growing systems spread across the buildings.



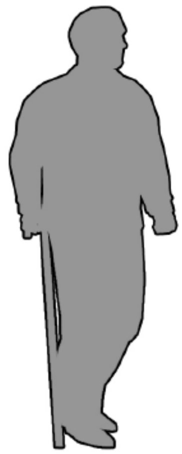
Name: Gupta Family (Mom, Dad , 2 children)

Age: 39 | 42 | 10 | 8

Occupation: Home maker | IT Support

About: The Gupta's immigrated from India 1 year ago and rent a 2 bedroom apartment in Edgecliff Golfway. Rahul Gupta (Dad) is a IT Support for an architecture firm downtown. He is a busy man works 6 days a week to support his family. Enjoys barbeque's during the summers with his friends and family. Meena Gupta (Mom) is a home maker and enjoys a stroll in the morning. She takes care of the kids while Rahul is away and volunteer's her time in Flemo farm during the weekdays when the kids are at school and gets some fresh vegetables. Rohit their elder son goes to school and loves to help his mom when she goes to the farm. Divya being the youngest is the pampered one in the family.

Worries: The Gupta's can only afford one car and Meena has to take a TTC to get any last minute groceries while Rahul is away working, but this is the cheapest apartment they could find near Rahul's work.



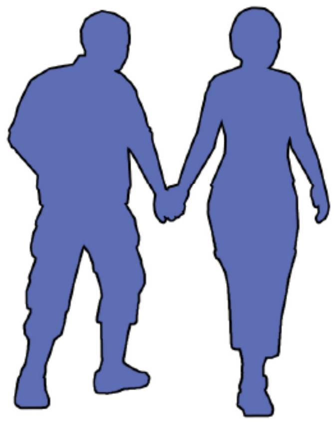
Name: Rob

Age: 75

Occupation: Retired Engineering Professor

About: Rob was born in Toronto and been teaching civil engineering in UofT for 35 years before retiring 2 years ago. Rob and his wife are separated and he lives alone in a 3 bedroom apartment that he owns. He is visited by his two children atleast once a month. Rob is a plant lover and enjoys taking care of a few indoor plants to liven up his apartment.

Worries: Rob being alone and a senior has to travel via car to get his weekly groceries. There are times when his arthritis and age don't allow him to function and he relies on his children to care for him.



Name: Sarah & Farzad

Age: 24 | 26

Education: Graduate Students

About: Sarah and Farzad are graduate students at University of Toronto who immigrated from Iran on a study permit to finish their education. They rent a studio unit in the building which they got for very cheap considering the distance from downtown. They work part time as teaching and research assistants to support their rent and monthly expenditure. They have a simple lifestyle and try to reduce their impact on the planet by reducing their waste. With completing their thesis and the part time work they do not have a lot of free time on their hands. Though they enjoy spending time outside with evening runs.

Worries: Since they do not own a car, doing weekly grocery runs, with their busy schedule and far off grocery stores, becomes a challenge. The nearby store does not have the freshest and cheapest produce and being on a tight budget, they have to travel to other grocery stores.

A visit to the Flemingdon Park BIA...

Don and Marrie have been married for 15 years and are traveling to the Edgecliff Farmer's Market with their daughter Katy. They live 20 minutes from Flemingdon Park and planned to visit the farmer's market after seeing an advertisement online.

Fig. 5.26. BIA's view from Don Valley Parkway- 1.

Fig. 5.27. BIA's view from Don Valley Parkway- 2.

After parking in the above-ground parking, they head over to one of the three connected farmer's markets in the complex.

Sarah and Farzad (non-farmers) can also be seen roaming around in the market.

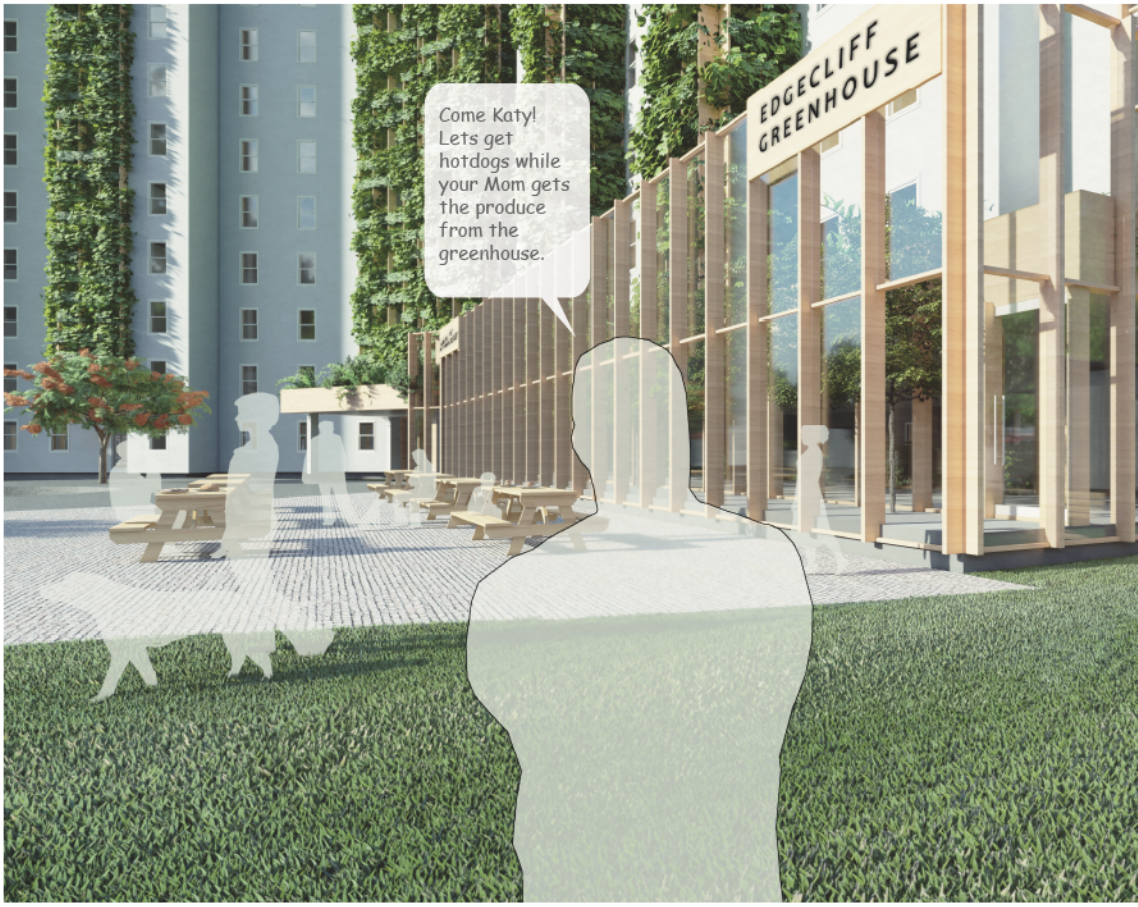


Fig. 5.28. Ground level farmer's market.

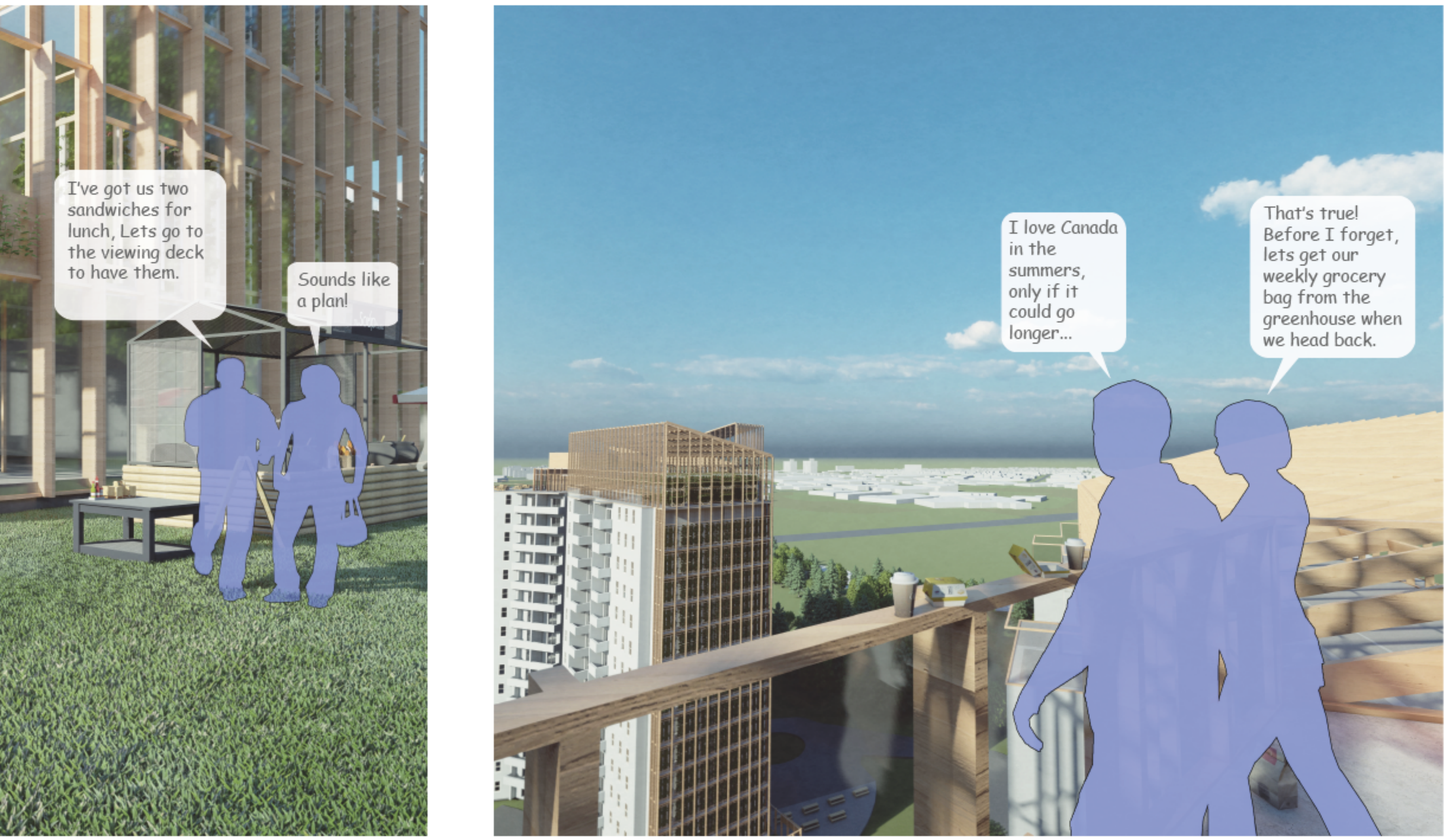


Fig. 5.29. Roof level viewing deck above the penthouse green house.

Ethan is the head grower of Tower - 2. He along with his team of 10 is responsible for seeding, harvesting, and packing the produce for the residents. Before every growing season residents are given options for various vegetables to choose from. These professional farmers use the same elevator core for transporting the raw materials, the use of no soil enables the public spaces to remain clean.

Rob (casual grower) has come up to get his weekly produce.

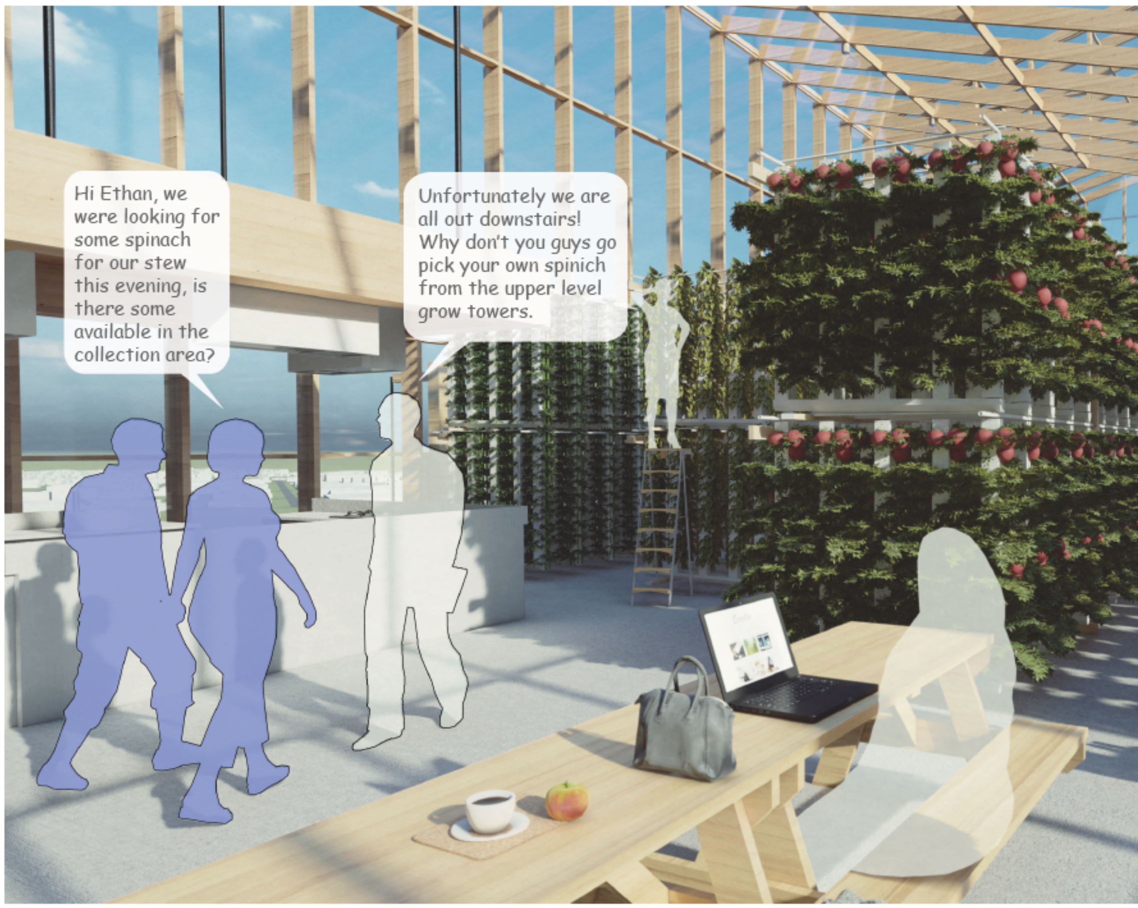


Fig. 5.30. Community kitchen + dinning surrounded by hydroponics growing towers.

Fig. 5.31. Seeding, harvesting and grocery box collection zone.

Fig. 5.32. Balcony Farming system (S).

Fig. 5.33. Corridor white boards for food sharing program.

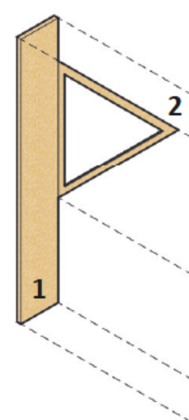
Fig. 5.34. Balcony Farming system (L).

The residents have the option to put up a flag on their balconies. The color of the flag gives the signal to the vertical harvesting professionals. A red flag instructs that the resident does not need any help in harvesting whereas a green flag is an instruction that the resident might be away or not participating in the balcony growing program, having the professionals take care of the growing.

Meena has an extensive balcony garden set up with a large plant bed extending from the facade. Rob on the other hand has only balcony planters to farm on. The following section will explain the balcony farming system and how the food sharing system works in the building.

5.3.7 Balcony Garden and Food Sharing Program

The balcony garden program is developed as a kit of parts. It has three types of kits that are made available to each tower. The kits are based on the involvement level of the user (resident) in growing produce. Fig. 5.35 reveals all the components of the kits in an exploded axonometric diagram. The first is a basic kit (kit for casual farmers) that envelopes the entire façade with timber balcony planters supported by glue-laminated fins. The planters can be used by residents to farm for self-consumption. This basic kit can be supplemented with an add-on pack of harvesting kits. This kit would enable the casual farmers to have their dedicated growing space and the rest of the planters and their produce can be harvested by growers in the greenhouse using the pulley system and the CLT deck (optional vertical harvesting kit that can be installed in the building). The final kit is for the intense farmers and it provides the users with larger growing planters that are cantilevered from the structural fins. This increases the growing area for the residents by 2 times the current one. Fig. 5.36 details each component of the system categorized into three different kits. The corridors within the apartment buildings have whiteboards installed beside the entrance door to the unit. These can be used by the residents participating in the balcony farming initiative to list the different herbs, vegetables, or fruits they might be growing. This would allow other residents, in need of any of that fresh produce, to simply knock and request for it. This enables interaction between the residents by them growing food and sharing it with the others.



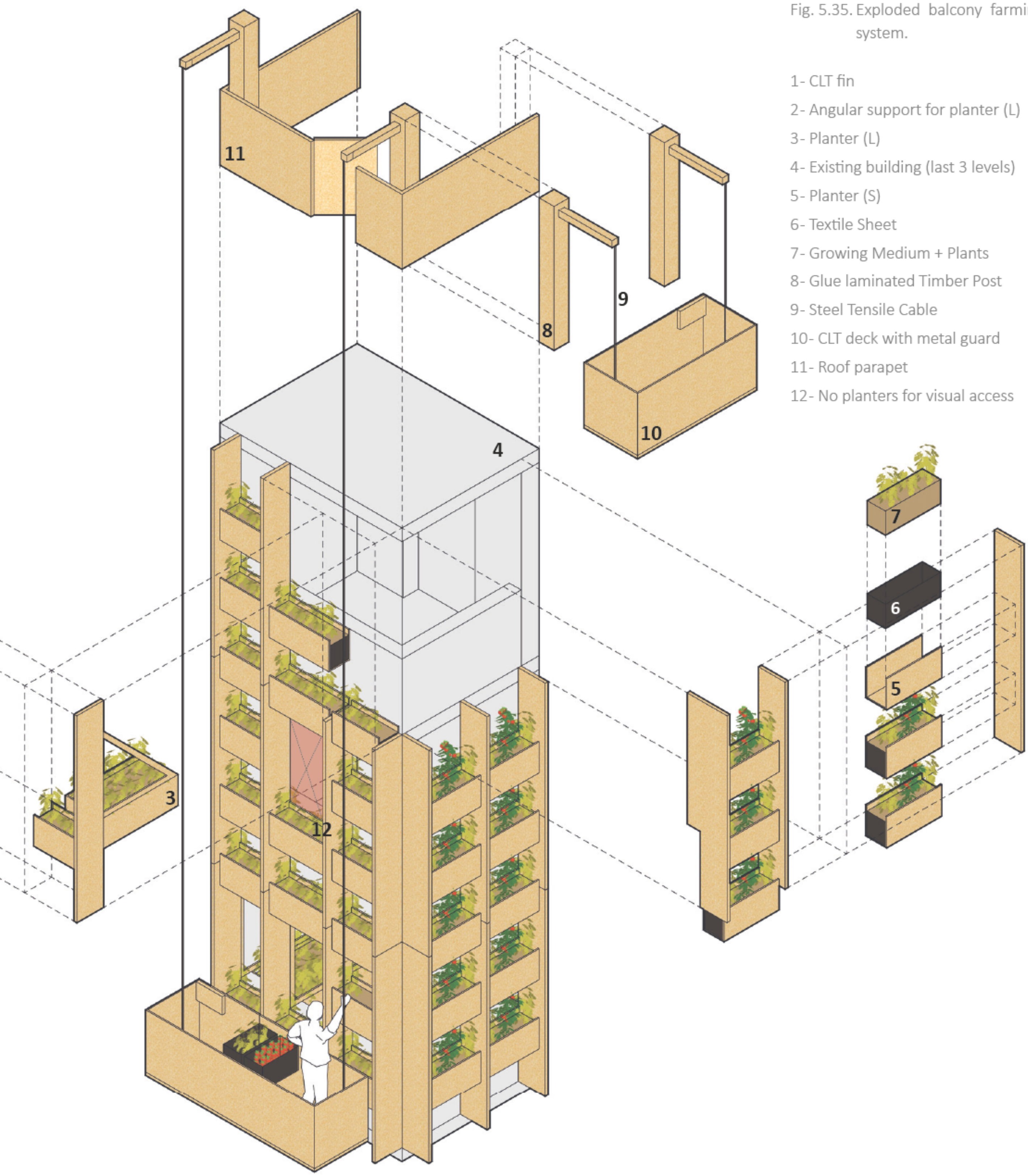
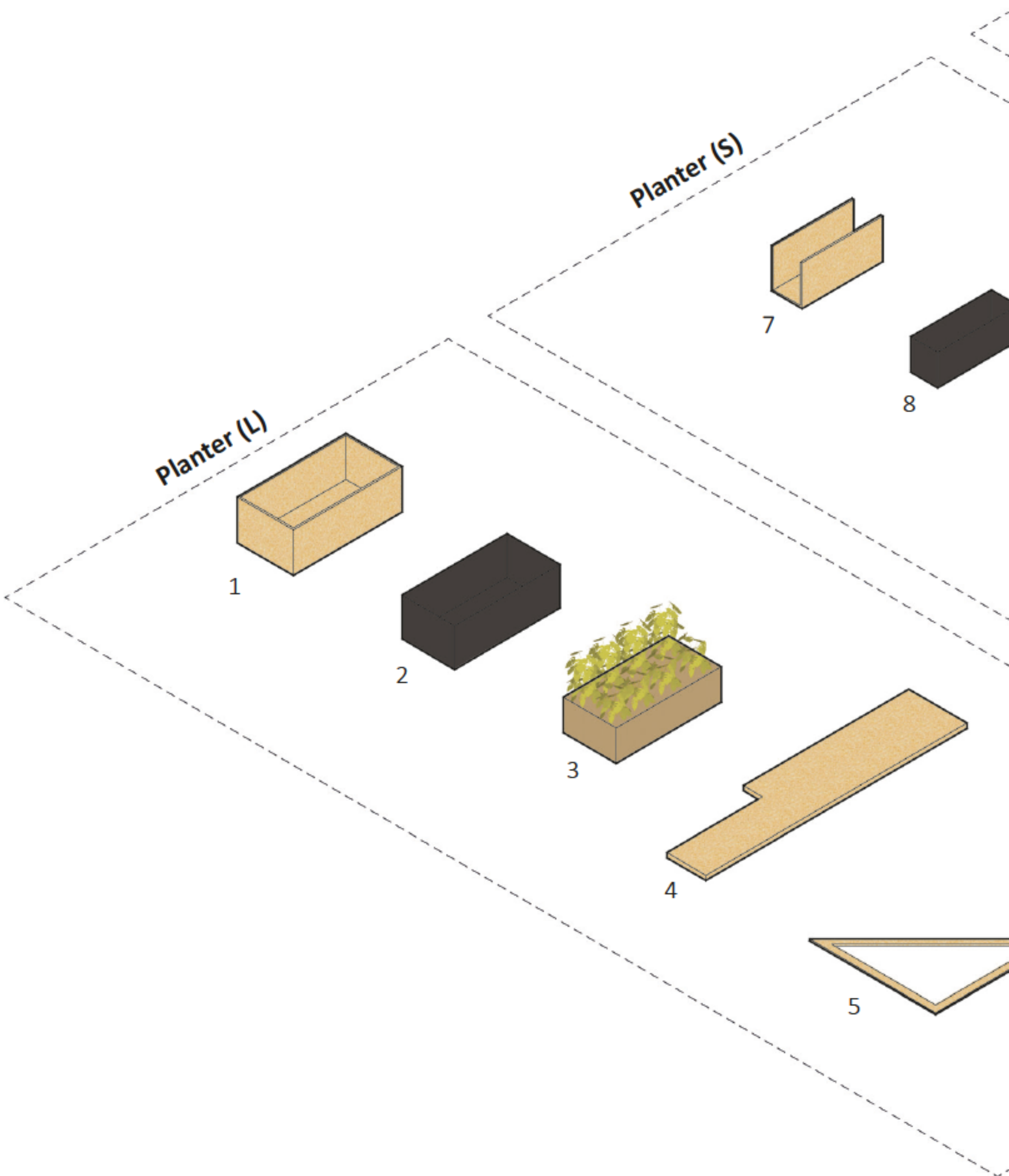


Fig. 5.35. Exploded balcony farming system.

1- CLT fin
2- Angular support for planter (L)
3- Planter (L)
4- Existing building (last 3 levels)
5- Planter (S)
6- Textile Sheet
7- Growing Medium + Plants
8- Glue laminated Timber Post
9- Steel Tensile Cable
10- CLT deck with metal guard
11- Roof parapet
12- No planters for visual access

Fig. 5.36. Balcony farming kit of parts.

1- Planter (L) **x1**
2- Geo textile Sheet **x1**
3- Growing Medium + Plants **x1**
4- CLT Fin (Type-2) **x1**
5- Angular Support **x2**
6- Nut + Bolt **x8**
7- Planter (S) **x14**
8- Geo textile Sheet **x14**
9- Growing Medium + Plants **x14**
10- CLT Fin (Type-1) **x6**
11- Nut + Bolt **x112**
12- Glue Laminated Post **x3**
13- CLT deck with metal guard **x2**
14- Steel Tensile Cable **x4**
15- Steel Gazette Plate **x3**
16- Anchor Bolts **x3**
17- Pulley System **x4**
18- U bolt plate **x4**
19- Winch **x2**



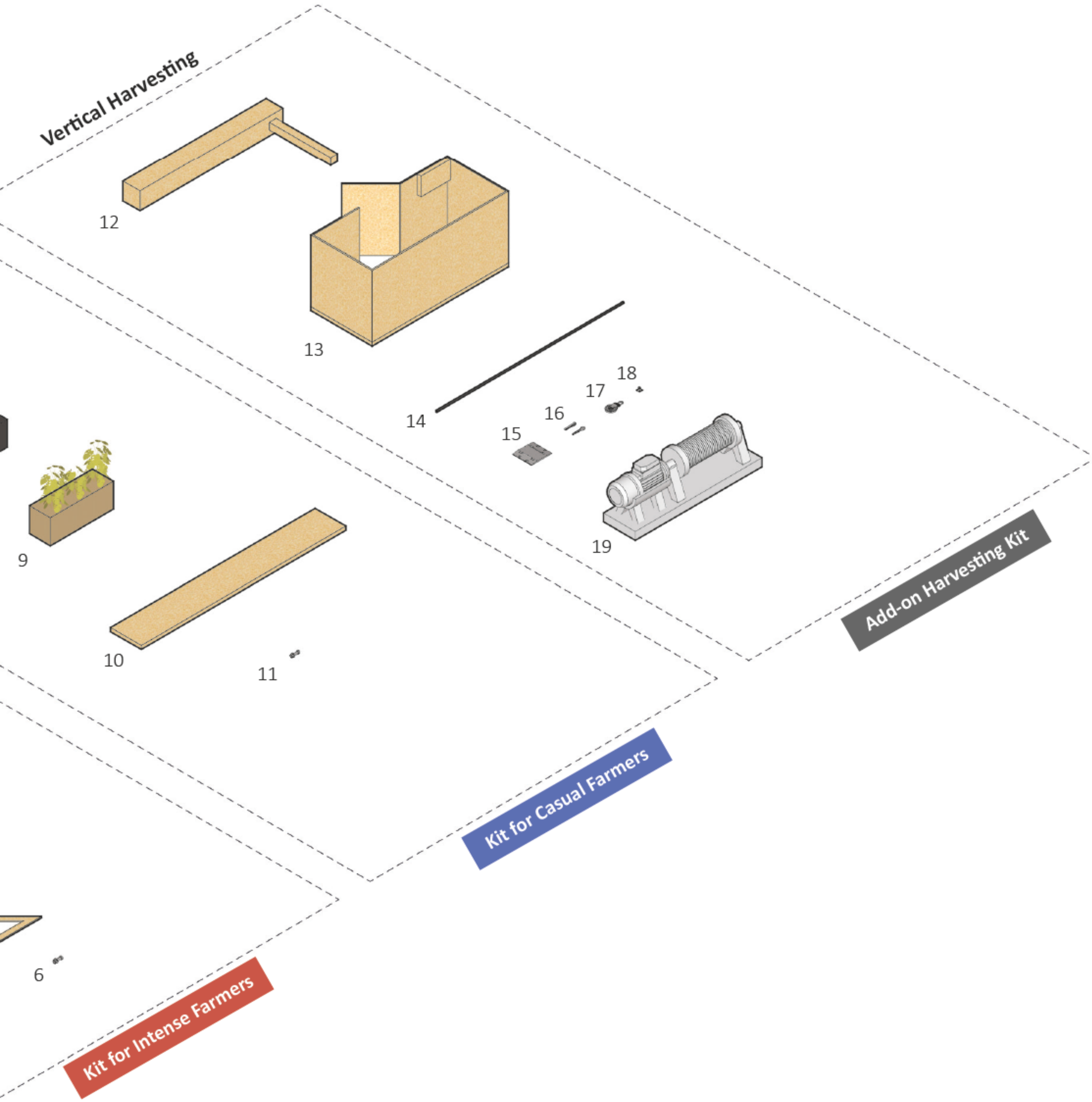

Vertical Harvesting
12
13
14
15
16
17
18
19
Add-on Harvesting Kit
9
10
11
Kit for Casual Farmers
6
Kit for Intense Farmers

Fig. 5.37. Different balcony garden growing possibilities on the basis of hours of sunlight.

n Sun Balcony Garden

Bitter Guard

Carrot

Cauliflower

Beetroot

Peas

Radish

Low Sun Balcony Garden

Mustard Greens

Spinach

Coriander

Mint

Cabbage

Fenugreek

Seeing her tomatoes being ready, Meena heads to the drop-off section in the upper greenhouse level. Here the residents who have excess produce can drop off their vegetables to be distributed among the residents.

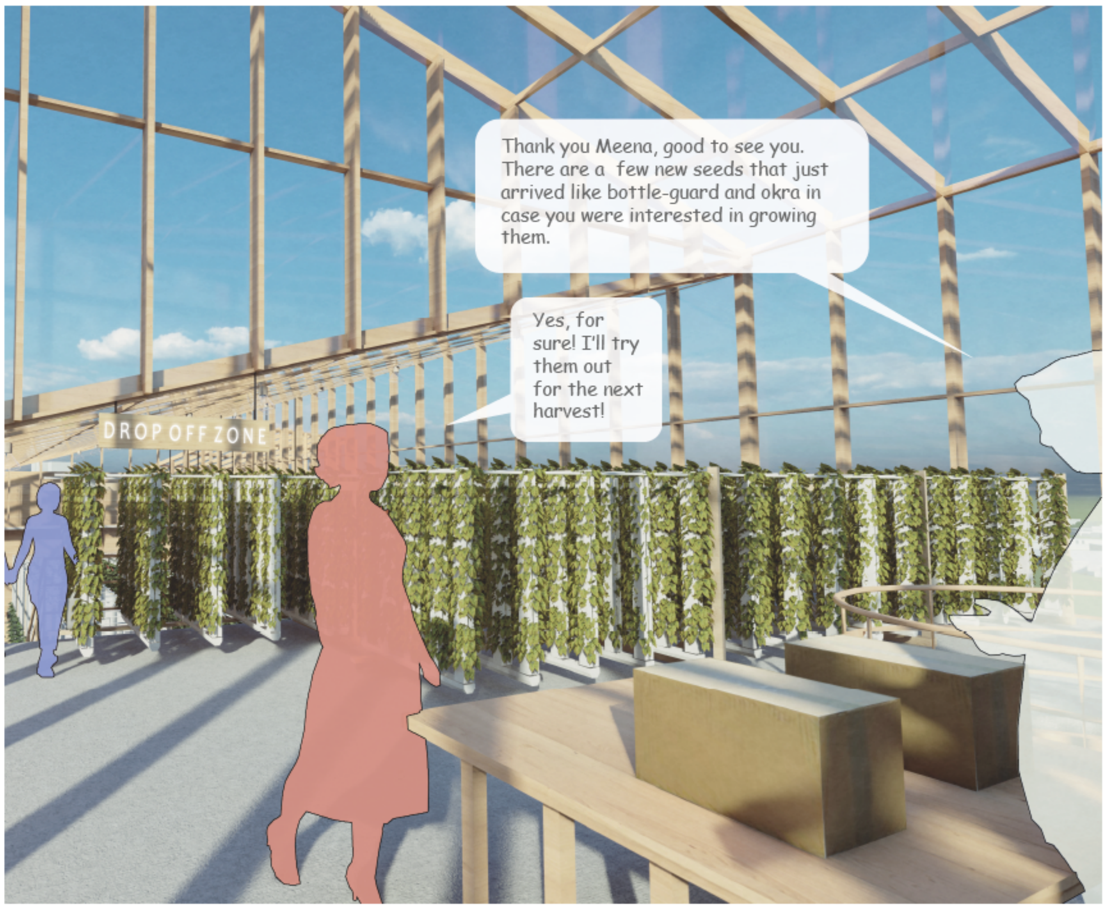


Fig. 5.38. Upper level greenhouse excess produce drop-off zone.

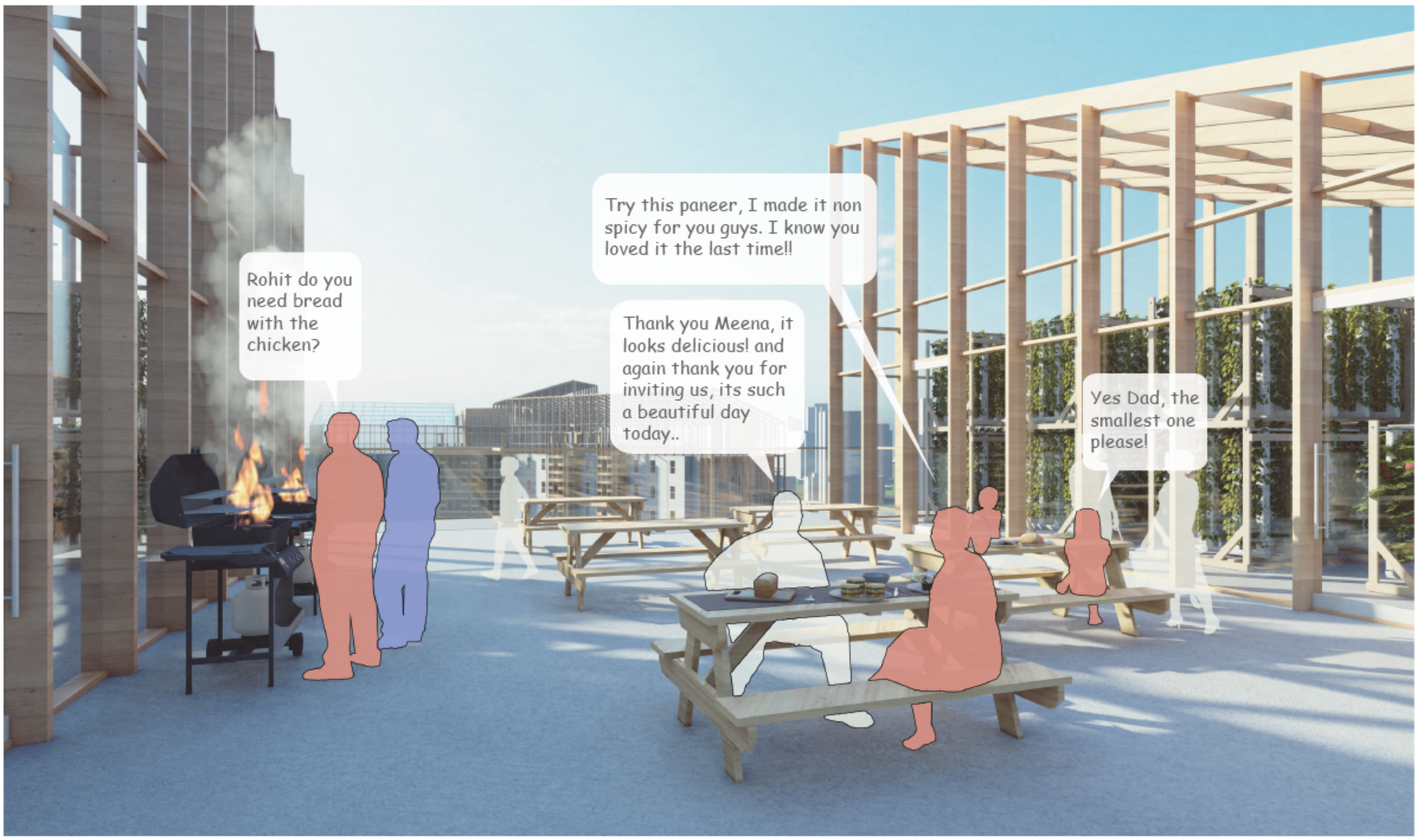
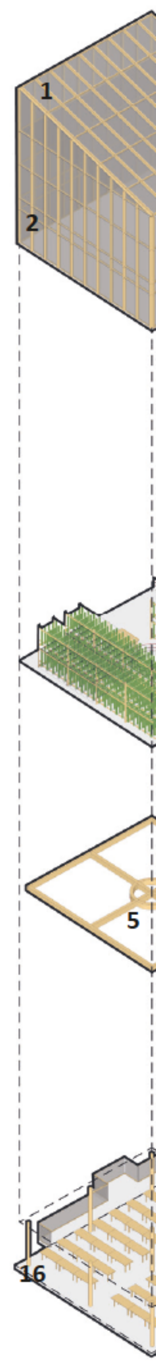


Fig. 5.39. Rooftop barbeque area with sitting space- 1.

The rooftop greenhouse is used as not only a productive space but also as an amenity space for the residents. The three wings of the greenhouse have different functions. Let's take a look at its functional division.

5.3.8 Greenhouse Zoning

The greenhouse is the heart of the BIA system. It doubles as a production space, that includes seeding, growing, harvesting, storage, collection, and irrigation, and a community amenity space with terrace gardening, outdoor barbeque spaces, and a community kitchen surrounded by the growing spaces for BIA. The aim is to create a balance between productivity per unit roof area and amenity spaces for the residents of the building. The greenhouse can hold multiple functions including small get-togethers, communal kitchen meetings, spaces for children to play, and provide hands-on farming experience to the residents and visitors. The greenhouse also has a second level with growing towers, right above the seeding, harvesting, and collection zones, that allow sunlight to reach the spaces that need it and provides partial shade to the spaces below.



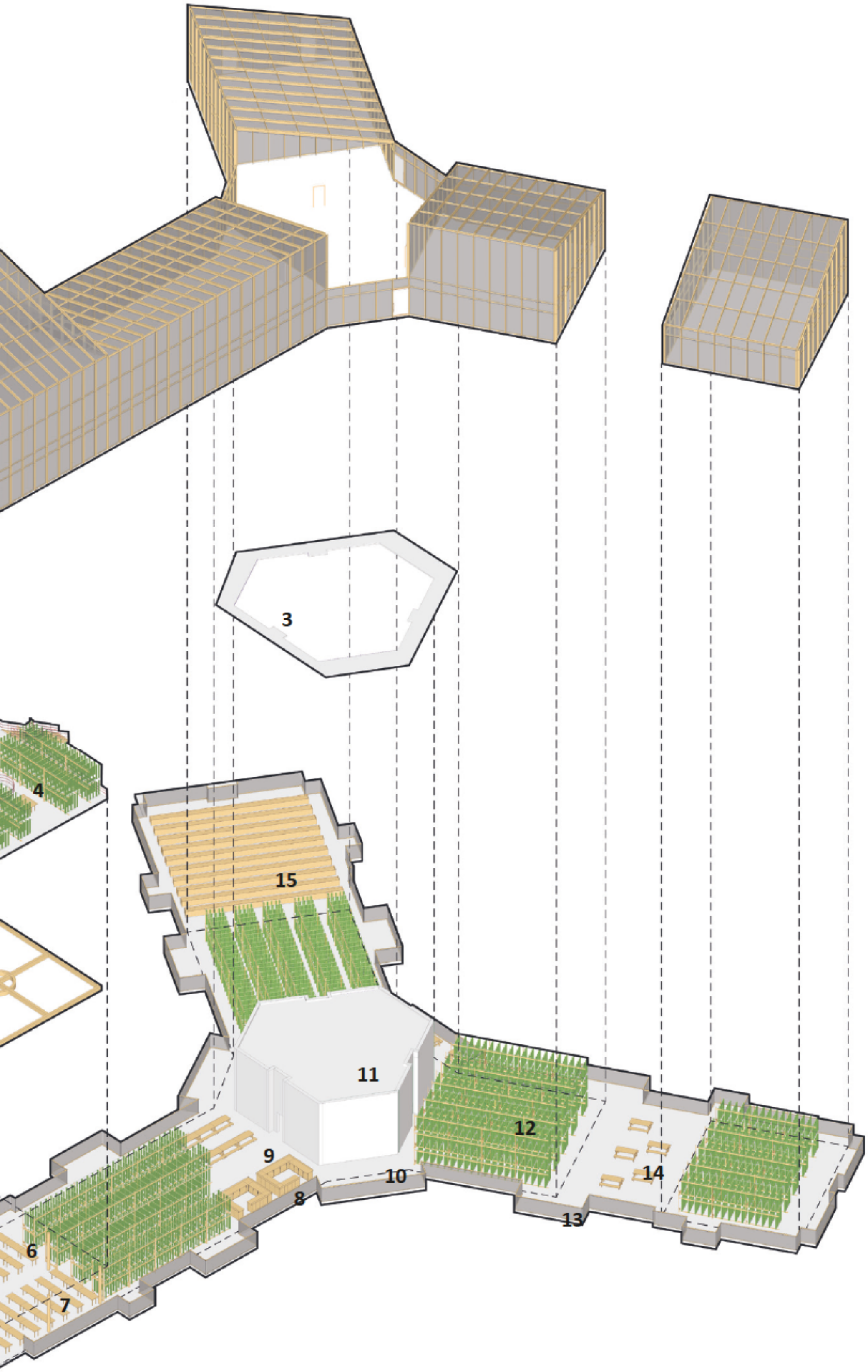


Fig. 5.40. Exploded view of rooftop greenhouse.

1 - Sloped (1:15) Curtain Roof with Glue Laminated Mullions and Photo-voltaic Glazing

2- Curtain Wall with Glue Laminated Mullions and Photo-voltaic Glazing

3- Metal deck with concrete fill over corridor connection connecting the three wings

4- Metal deck with concrete fill

5- CLT beams

6- Collection zone

7- Harvesting/Seeding stations

8- Community kitchen

9- Dinning area

10- Corridor connection

11- Existing core and penthouse

12- Growing modules

13- Service area for harvesters

14- Communal terrace

15- Terrace garden

16 - Concrete slab extension for vertical farming

The communal kitchen in the greenhouse offers space to the residents to hold the weekly kitchen table meeting. The green roof space offers the residents opportunity to grow to produce using conventional techniques which they can use to cook food during the meeting. The meetings also enable the residents to bring up what kind of produce they need to be grown which can be brought up later to Ethan.

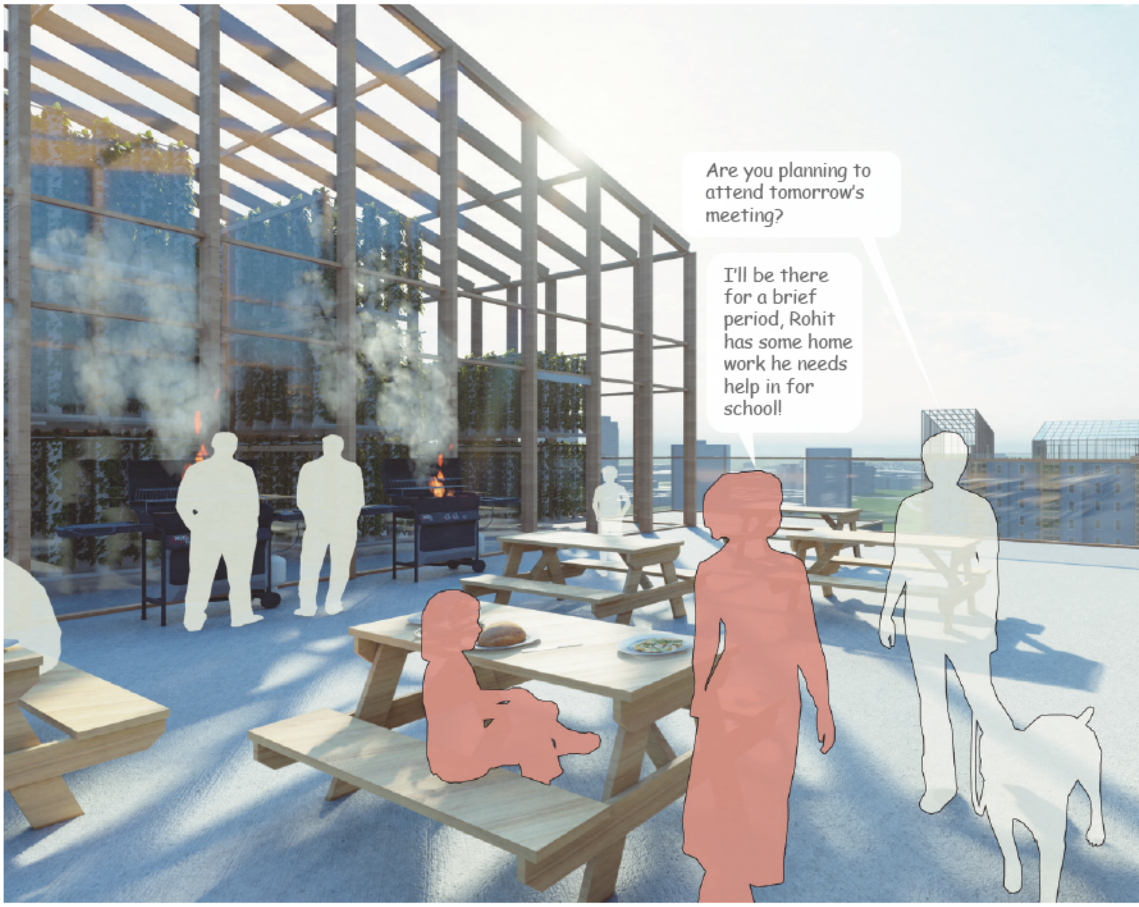


Fig. 5.41. Rooftop barbeque area with sitting space- 2.

Fig. 5.42. Kitchen table meeting in the communal kitchen zone of the greenhouse.

Fig. 5.43. Rooftop terrace garden generally used for small fruit trees.

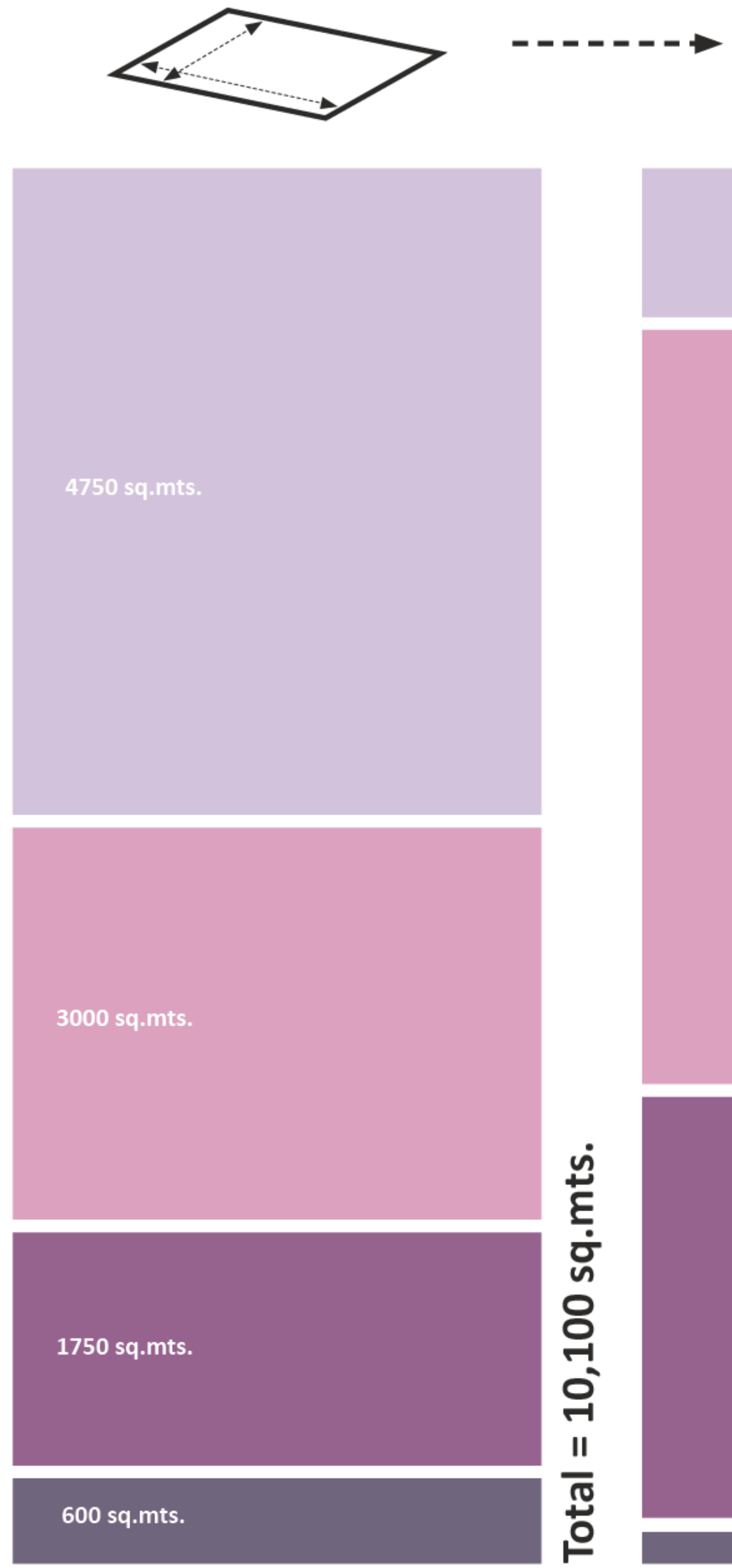
Fig. 5.44. Service aisle within hydroponics greenhouse.

Fig. 5.45. Self sufficiency calculations for designed BIA.

With the residents and the professional farmers providing food to the population of the housing complex, the diagram to the right describes the amount of self-sufficiency achieved by the various farming systems.

5.3.9 Metrics

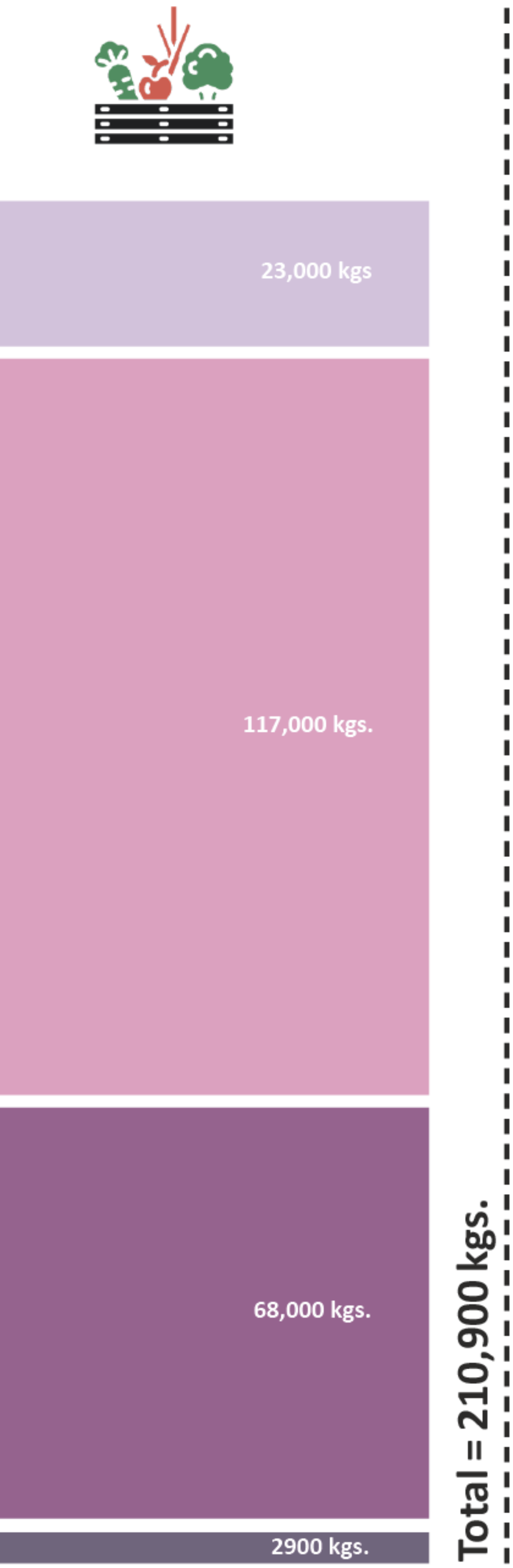
The four BIA systems have four different MFUA and the area per system varies across the towers. Fig. 5.45 visualizes the amount of food grown per system and calculates the average MFUA for the proposed BIA system for the Edgecliff apartment complex. The population of the complex is estimated as 3636 mouths (4 mouths per unit x 909 units [17 18 19]). Based on this population and the estimate of the average MFUA, the complex can become 72.5% self-sufficient in terms of the fresh fruits and vegetable needs of the residents.



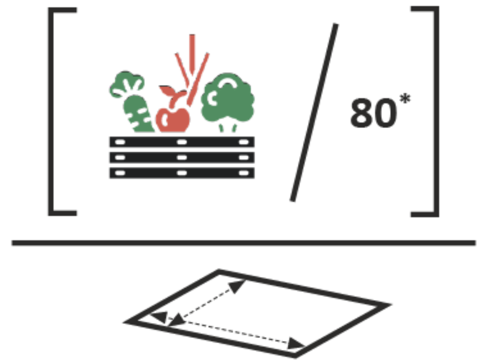
17 "10 Edgecliff Golfway," Condos.ca, accessed July 1, 2021, https://condos.ca/toronto/wynford-park-condominiums-10-edgecliff-golfway.

18 "20 Edgecliff Golfway," Condos.ca, accessed July 1, 2021, https://condos.ca/toronto/wynford-condominiums-20-edgecliff-golfway.

19 "5 Shady Golfway," Condos.ca, accessed July 1, 2021, https://condos.ca/toronto/5-shady-golfway-condos-5-shady-golfway.



MFUA =



= 0.26

Population =

x 3636

Self Reliance =

= 72.5%

(This system can provide 72.5% of the community's yearly fruit and vegetable needs.)

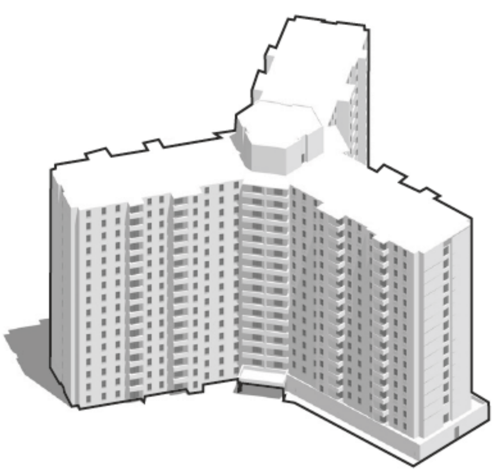
Fig. 5.46. Time line depicting the order of installation of different BIA systems and the respective self sufficiency for the community's fruits and vegetables needs.

5.3.10 Timeline for Construction of BIA

The BIA design in Flemingdon Park tries to incorporate different farming systems. These systems have varying costs, construction time, and the amount of food they can produce for the community. The timeline in fig. 5.46 lays down a plan for incremental installation of BIA systems and provides the percentage of self-sufficiency achieved by the building for each case. The timeline begins with the installation of systems that do not require any building permits from the city. Rooftop hydroponics and modular terrace farming require very little resources to begin producing food and are thus installed first, before material and energy-intensive systems like greenhouse and balcony farming.

AUG' 21

0%

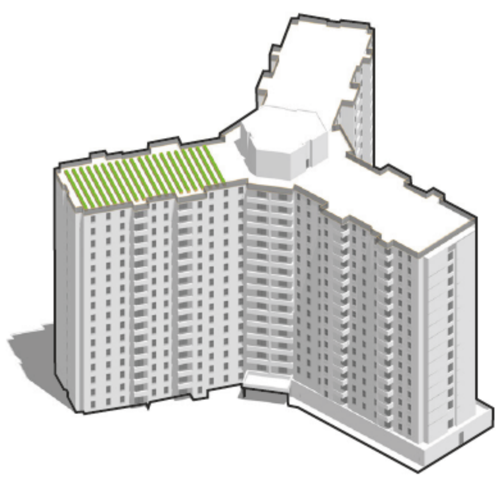


Existing

The massing of one tower of the Edgecliff condominiums without integration of BIA systems.

DEC' 21

2%



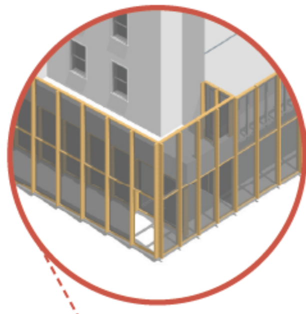
Terrace farming

After 4 months - The easiest and fastest way to start producing food for the community is starting a small community terrace garden.

JUN' 22

Rooftop hydrop

After 6 months - F
can be setup on the
existing terrace ga
increase the amount
the residents.



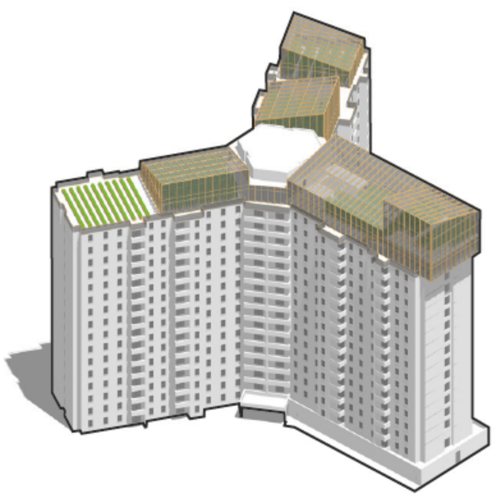
15%

onics

Rooftop hydroponics roof along with the rden which would of food produced for

JUL’ 24

42%

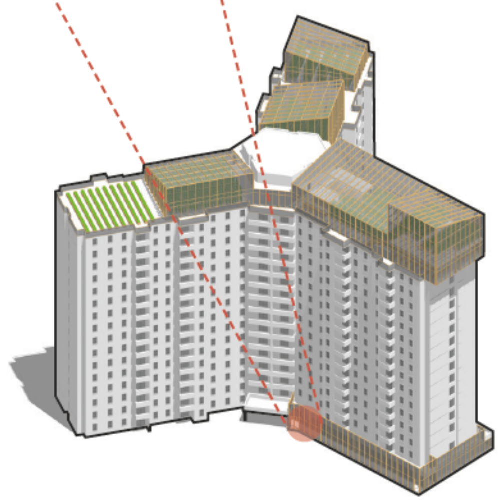


Greenhouse hydroponics

After 24 months- The set of the greenhouse to enclose the hydroponics systems would require time for premit process, material procurement, and construction. To make things affordable, alternate materials like aluminum curtain walls and roofs can be used as an alternate to mass timber.

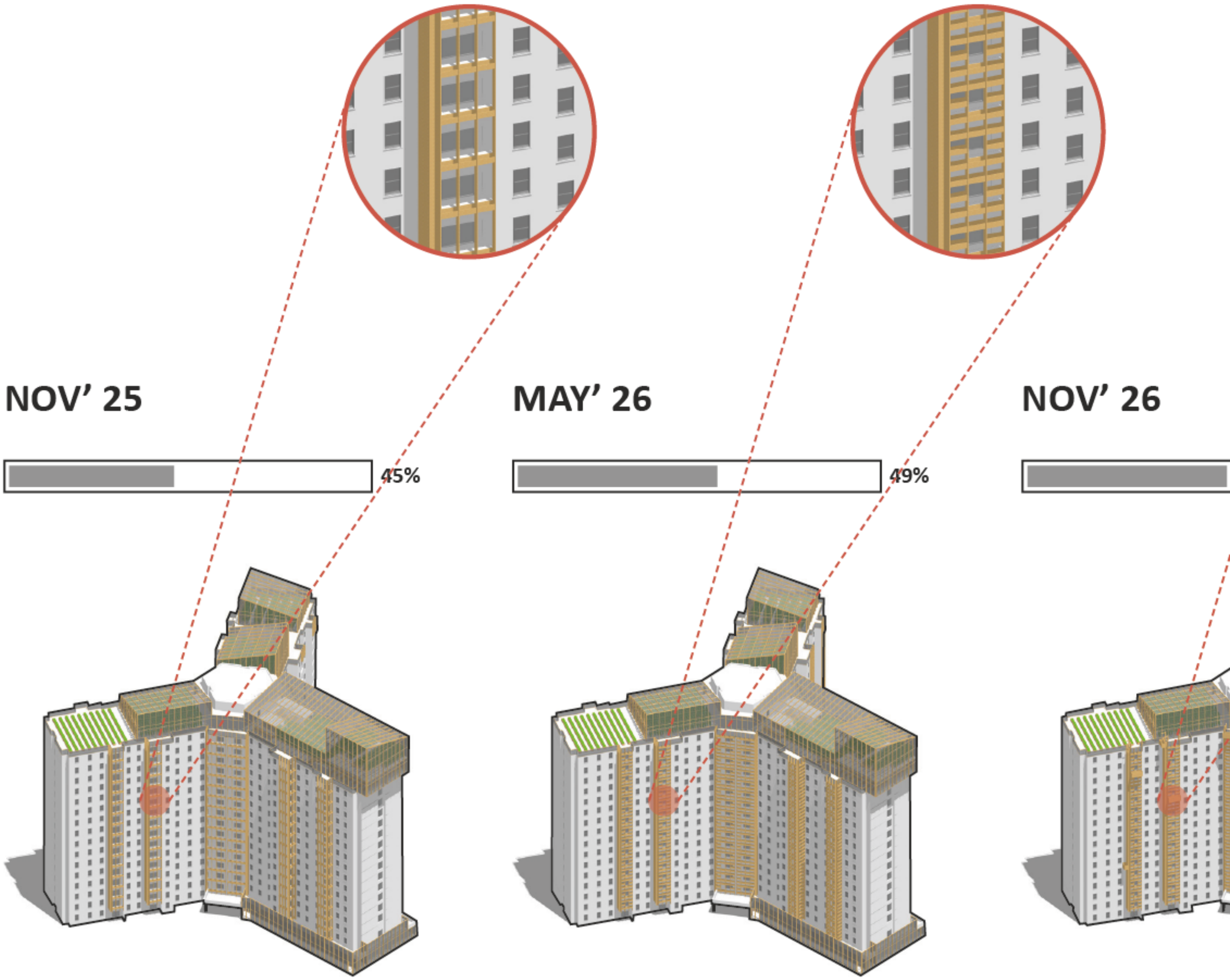
JAN’ 25

42%



Community spaces

After 6 months - Community spaces are setup which include ground level commercial spaces, community kitchens, terrace amenities, etc.



Individual balcony garden

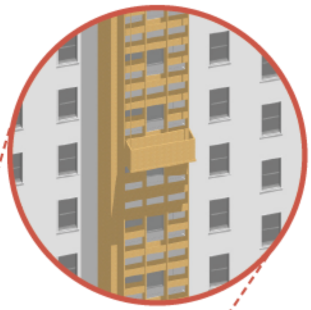
After 10 months - Individual balcony garden kit is installed on the balconies of family who are interested in farming. Both casual and intense kits are available for the residents to choose from.

Facade balcony garden

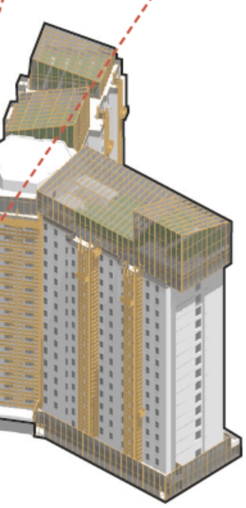
After 6 months- The kit for facade balcony garden is installed. The residents have the option to use the additional space to farm for themselves or leave the spaces for professional growers to farm for the community.

Vertical harvesti

After 6 months - Ver
installed for the eas
facade balcony garde
growers working in th



49%

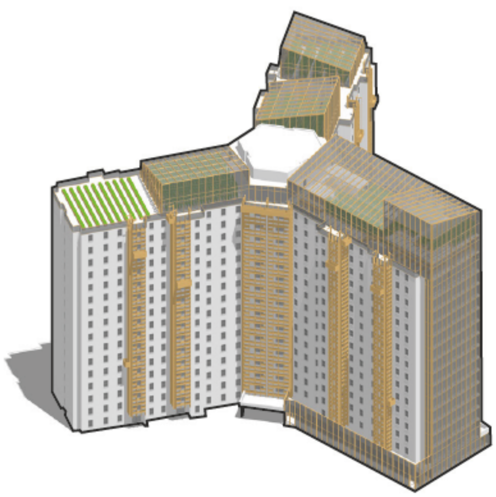


ing

tical harvesting kit if se of harvesting the ns by the professional he greenhouse.

JUL' 27

72%

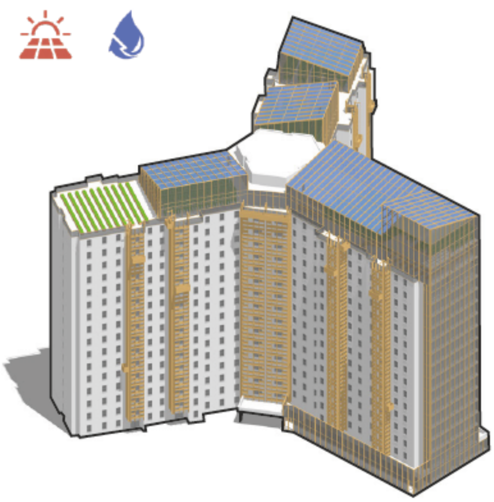


Vertical hydroponics

After 8 months - The extension of vertical farming on the staircase if complete making the community 72% self sufficient in yearly fruits and vegetable needs.

JUL' 28

72%



Possibility of a net zero system

After 12 months - The building now has wastewater treatment facility for recirculating grey water in the building and photo-voltaic panels to produce electricity. This brings the BIA system closer to being a net-zero system.

5.4 Conclusion

The design intervention in Flemingdon Park benefits both the residents and the neighborhoods on multiple levels. They are:

1. **Ground-level commercial** - It helps to revitalize the neighborhood by creating opportunities for the residents by providing ground-level commercial space under the RAC policy of 2014. This provides the neighborhood with commercial facilities that it is currently deprived of.

2. **Alleviating food insecurity** - BIA systems installed across the towers help to provide the residents with culturally rich produce that helps them become food secure.

3. **Strengthening community engagement** - The balcony sharing program enables the residents to foster the lost connection with food and in the process interact with other residents.

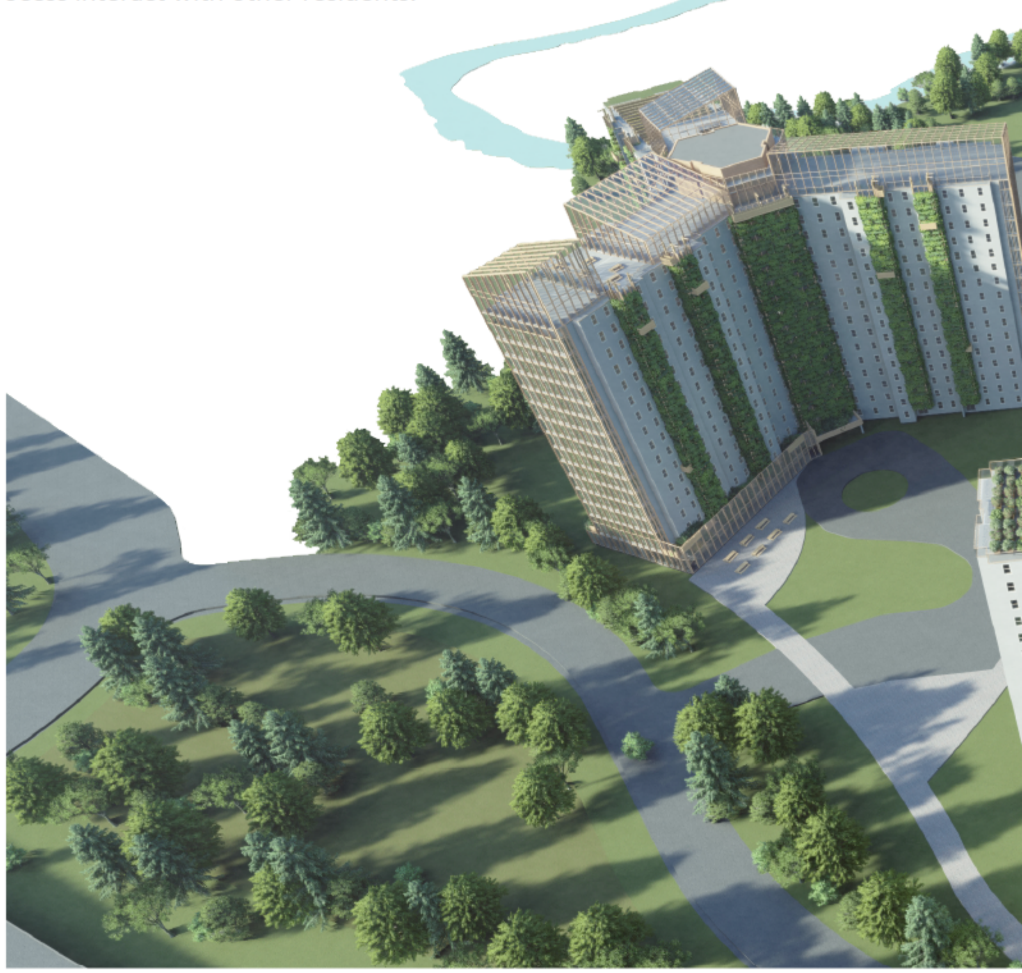
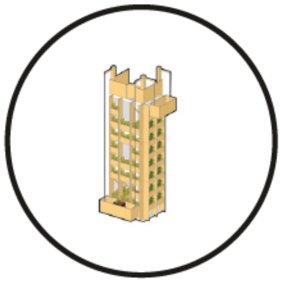


Fig. 5.47. Bird's eye view of the apartment complex with BIA.

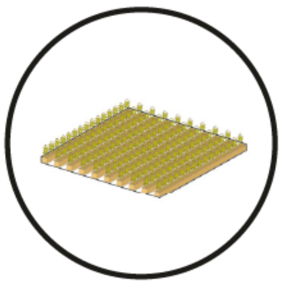
4. **Rooftop amenity space** – Apart from being a production space the roof level provides the residents with a communal kitchen, terrace barbeques, and dining areas integrated within the views of the roof level growing spaces. The residents get to enjoy the greenhouse amenities surrounded by greenery giving them a feeling of tranquility and peace.

5. **Carbon Sequestration** - The use of mass timber construction for the greenhouse and the balcony farming system makes for a carbon-sequestering design proposal. The photovoltaic panels in the greenhouse also limit the CO2 produced while the operation of the urban farm.

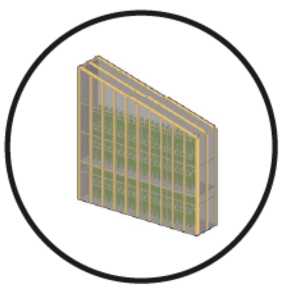
6. **Balance between production and community spaces** - The balance makes the design more attractive and viable as an option for the renewal of these old apartment buildings.



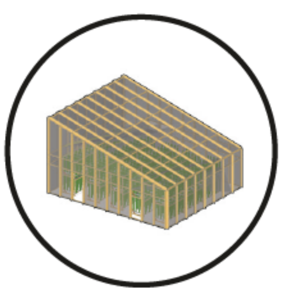
BALCONY GARDEN



TERRACE GARDEN



VERTICAL HYDROPONICS



GREENHOUSE HYDROPONICS

6.0 Future of BIA [outlook and impacts]

Fig. 6.01. BIA systems installed in the design for Flemingdon Park.
(Left)

6.1 Locations for BIA in Toronto

The previous chapter discussed four different BIA systems and how they were used to increase food security among the residents of Flemingdon Park. The future of BIA in Toronto lies firstly in other food deserts, secondly in new construction across Toronto, and lastly in all the existing buildings across the city. The four systems (Fig. 6.01)- vertical farming, hydroponics greenhouse, intensive green roof, and balcony gardens - can be utilized in any combinations depending upon the building configuration and massing.

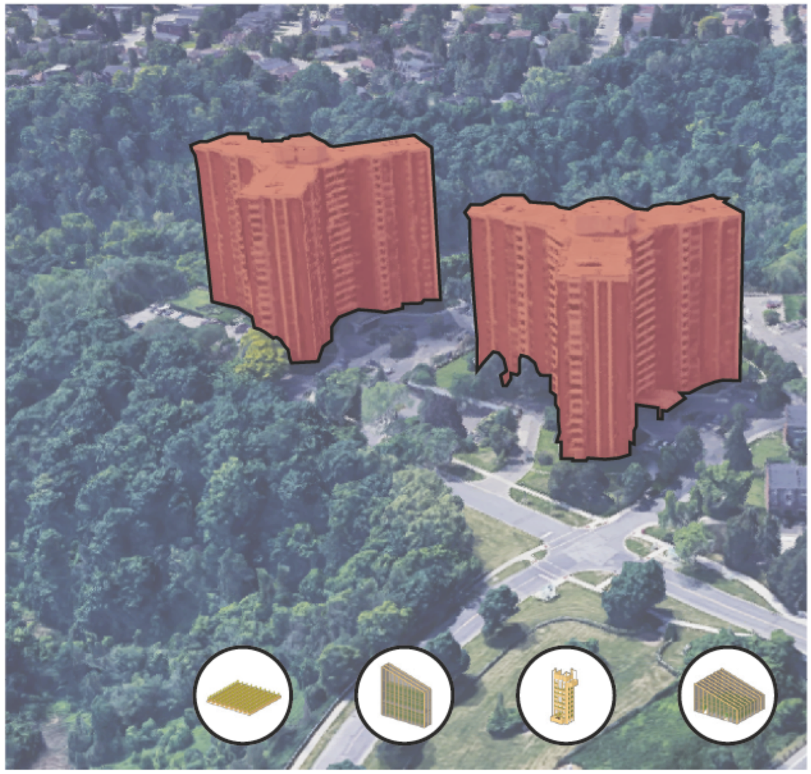
6.1.1 On Other Food Deserts

Like Flemingdon Park other food deserts, mapped in Fig. 5.03, can also benefit from BIA systems as a solution to tackle food insecurity. Fig. 6.02 lists six other food deserts and the systems that can be deployed in those sites. These sites have similar building features like the Edgecliff condominiums with the 1960s-1970s built mid-rise apartment slabs with large roof areas to accommodate greenhouses for food production. The residents living in these neighborhoods live in lower-income areas of the city.

6.1.2 On New Construction

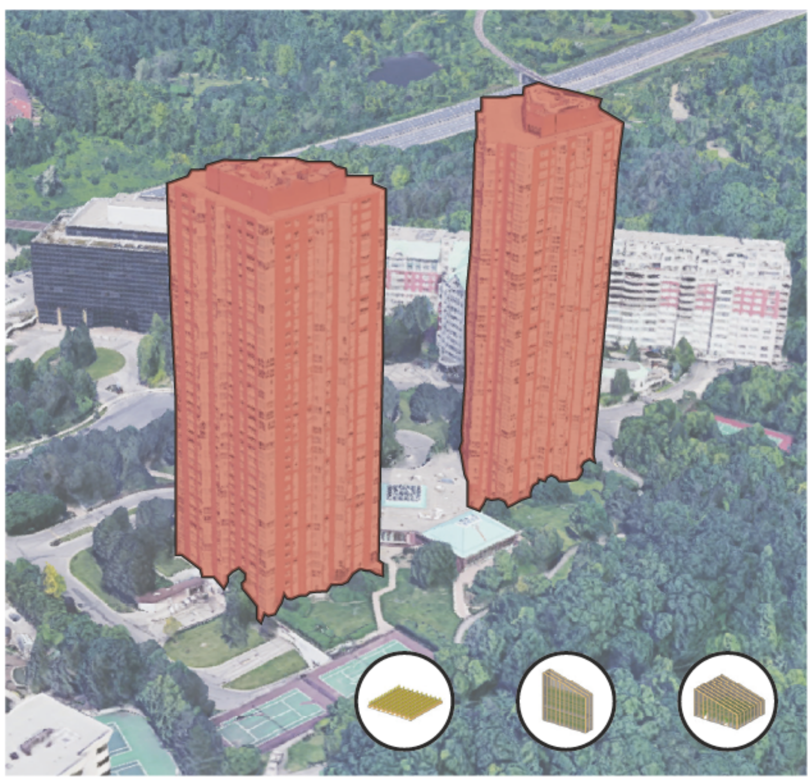
Toronto's green roof bylaw[1] states that all residential and non-residential buildings constructed after the year 2012 need to provide a certain percentage of roof area as a green roof depending upon the gross floor area for the building. Fig. 6.03 shows an edited version of the green roof bylaw. The word green roof has been replaced with "food productive greenhouse". This change tries to reimagine the future buildings where terraces are not just green but food productive and provide for the residents. Vacant roof areas of newly constructed residential and non-residential buildings can work as sites for BIA.

Flemingdon Park



Banbury - Don Mil

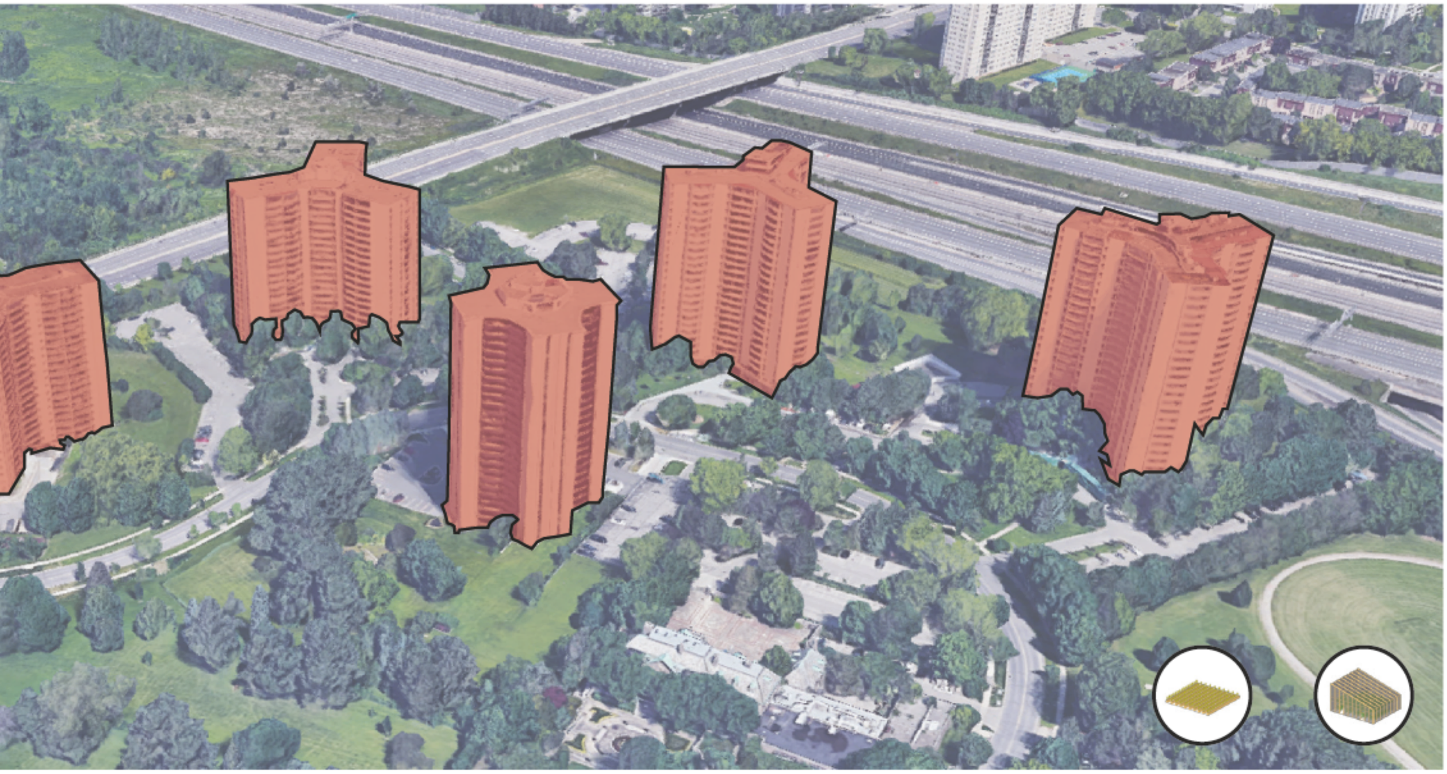
Wynford Concorde



Wynford Concorde

Fig. 6.02. Other Food desserts in the city Toronto that can benefit from BIA.

ls



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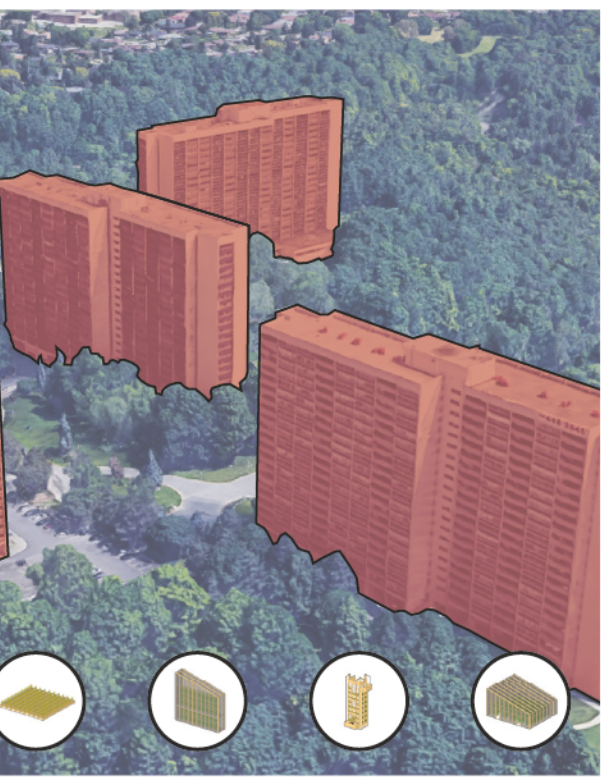


Toronto Beaches

Fig. 6.03. Edited green roof bylaw of the city of Toronto. (Right)

6.1.3 On Existing Buildings

Existing buildings in Toronto should also be seen as an opportunity for BIA. Fig. 6.04 samples a few of the many possible locations within the city that can serve as rooftops for food production. Locations include:

1. Podium and tower of condominiums
2. Institutional buildings
3. Arenas/Stadiums
4. Industrial buildings
5. Old apartment buildings

1 "City of Toronto Green Roof Bylaw" (City of Toronto, 2017), https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-bylaw/.

TORONTO MUNICIPAL CODE
CHAPTER 492, GREEN ROOFS

Chapter 492

GREEN ROOFS

CERTIFIED TRUE COPY
Ulli S. Watkiss, City Clerk
Digitally signed document
Use PDF reader to verify
2020-08-25

ARTICLE II
Requirement for Green Roofs

§ 492-2. Green roofs required.

April 30, 2021

A. Every building or building addition constructed after ~~January 30, 2010~~, with a gross floor area of 2,000 square metres or greater shall include a ~~green roof~~ with a coverage of available roof space in accordance with the following chart:

food productive greenhouse (FPGH)

492-6 **November 9, 2017**

TORONTO MUNICIPAL CODE
CHAPTER 492, GREEN ROOFS

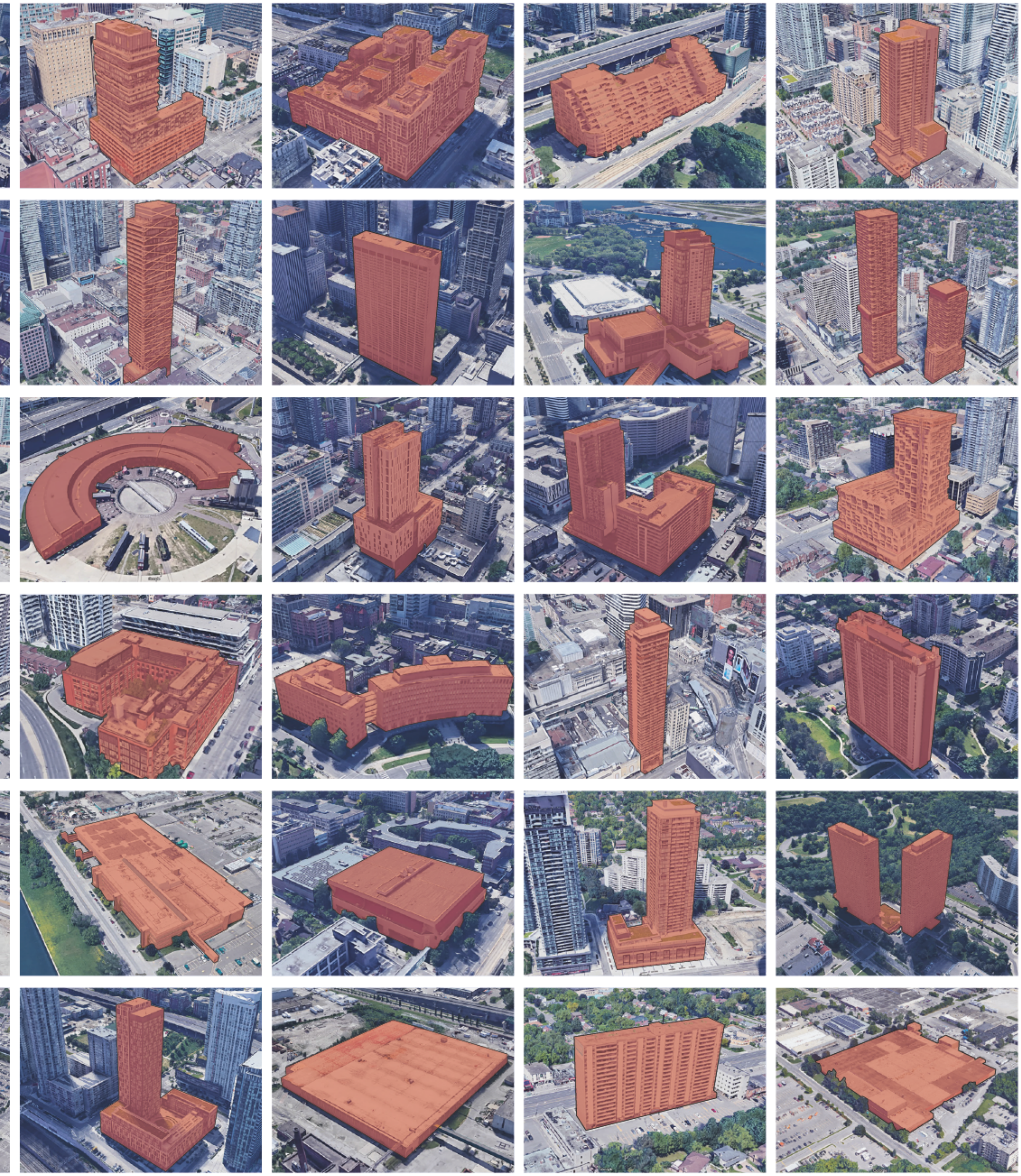
Gross Floor Area (Size of Building)	**Coverage of Available Roof Space (Size of ~~Green Roof~~)** FPGH
2,000 - 4,999 square metres	20 percent
5,000 - 9,999 square metres	30 percent
10,000 - 14,999 square metres	40 percent
15,000 - 19,999 square metres	50 percent
20,000 square metres or greater	60 percent

FPGH FPGH

and no person shall construct a ~~green roof~~ or cause a ~~green roof~~ to be constructed unless a permit therefor has been issued by the Chief Building Official. Notwithstanding the foregoing, where a development consists of two or more buildings under a Complete Site Plan Application and the buildings are to be constructed on a phased basis, the first phase of the development shall comply with the ~~Green Roof~~ requirements of this chapter for the building permit being issued and any ~~Green Roof~~ area provided in excess of the minimum ~~Green Roof~~ area required may be applied to subsequent phases of the development. **[Amended ~~2012-11-29~~ by By-law 1598-2012]**

FPGH FPGH
March 31, 2021 FPGH

Fig. 6.04. Existing buildings that can benefit from BIA in the city of Toronto.



6.2 Impacts of BIA

Integration of BIA within the city is beneficial for the people, the urban environment, and climate change in general. A city that is engaged in local food production offers many advantages to the residents, such are:

1. More green space

The green cover in the city is increased drastically with the arrival of terrace farming and greenhouses. These spaces provide the urban dwellers with places to unwind while also cooling the urban areas.

2. Connection with Food and People

With food being produced right where you live, residents can form connections with the food. These local production spaces act as spaces to socialize and provide hands-on learning experiences to the younger generations.

3. Food Security

BIA offers local food production within the city which leads to cheaper and fresher produce. Neighborhoods with food-insecure areas have the most to benefit from this local production. Residents are provided with cheap-nutritious-culturally appropriate food.

BIA also plays a vital role in providing food security in the global context. With the ongoing climate crisis across the world, local food production offered by BIA would help cities become food secure within the city boundaries. Vacant roof spaces across the world can be used to produce food for the residents of the building, as demonstrated by this thesis, thus decreasing the dependency on the import of food to feed a city's population. Impacts of natural disasters like wildfires, droughts, pandemics, etc. on the food system can be countered if buildings are used to produce food for the residents.

4. Carbon Footprint

Local production leads to lower food miles thus having a vast impact on carbon emissions due to transport (import and export) of food. As discussed in Chapter 3.0, fruits and vegetables account for 25% of the total carbon emissions emitted due to the import of food products in Canada. Local production aims to reduce this number drastically by cutting the distance between a farm and a mouth from food being transported across countries to being produced within the city.

50% of the world's habitable land and 70% of freshwater reserves are used for agriculture.[2] The conservation of resources of land and water, as offered by BIA in comparison to rural farming, makes it a suitable candidate in freeing up land used for agriculture and transforming them back into forests. This would have a positive impact on global warming and restore the natural carbon cycle that has been disrupted due to human activities over the last century.

Like the post-war built buildings in the city of Toronto, urban centers spread throughout the world have assets of old buildings that require retrofitting to make them energy efficient. These buildings can act as carbon sequestering nodes if they are retrofitted to incorporate BIA systems and utilize solar energy to power the systems. This would help in creating cities that have a smaller carbon footprint and thus help in tackling the ongoing climate crisis.

6.3 Vision of Toronto in 20 years

Fig. 6.05 calculates the number of mouths that can be fed under two different scenarios. Under scenario 'A', rooftops of all 1189 towers[3] under the tower renewal program are converted to food productive greenhouses. Under scenario 'B', all green roofs[4] in the city from the year 2010-2020 are converted to food productive greenhouses. Using the productivity value from the precedents, 15% of Toronto's population[5] can be fed daily with fresh fruits and vegetables, if both scenarios 'A' and 'B' turn into reality. Fig. 6.06 tries to imagine this reality in a small two-block by four-block chunk in of the city. The visualization of the city includes roofs of all buildings participating in local food production providing for the residents.

2 Hannah Ritchie and Max Roser, "Environmental Impacts of Food Production," *Our World in Data*, no. Journal Article (2020), https://ourworldindata.org/environmental-impacts-of-food.

3 "Enabling Complete Communities," Tower Renewal Partnership, accessed July 2, 2021, http://towerrenewal.com/research-reports/enabling-complete-communities/.

4 *Building Permits - Green Roofs (Open Data Dataset)* (Toronto: Toronto Building), accessed July 2, 2021, https://open.toronto.ca/dataset/.

5 "Toronto Population 2021 (Demographics, Maps, Graphs)," accessed June 25, 2021, https://worldpopulationreview.com/world-cities/toronto.

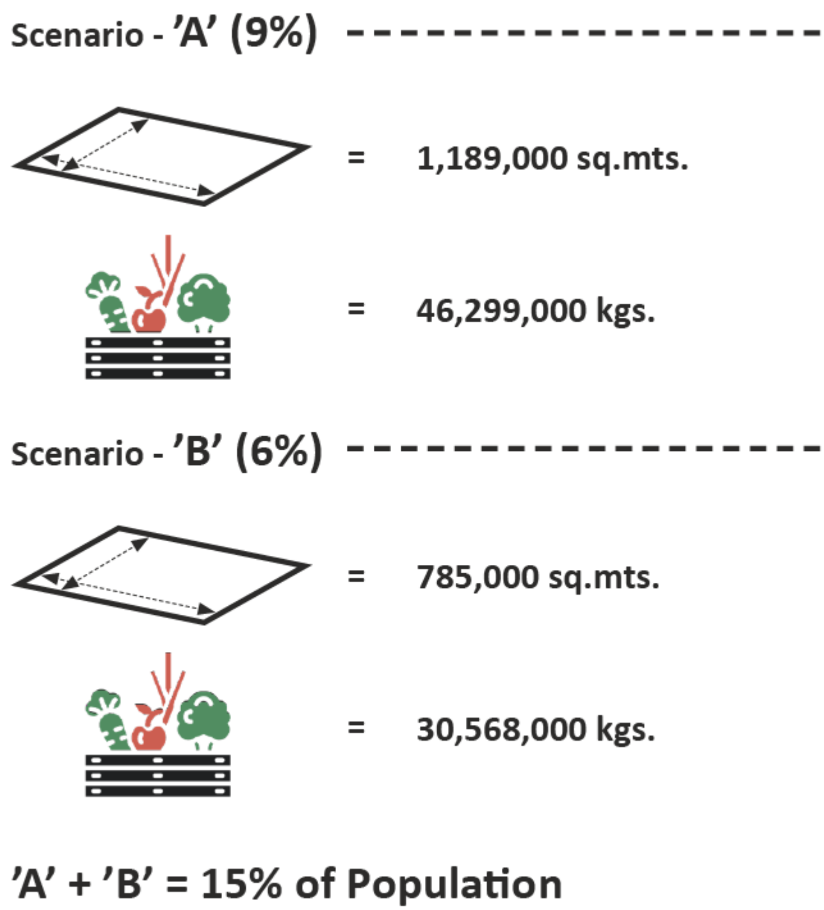


Fig. 6.05. Population of Toronto that can be fed by BIAs on all green roofs and existing old buildings within the city.

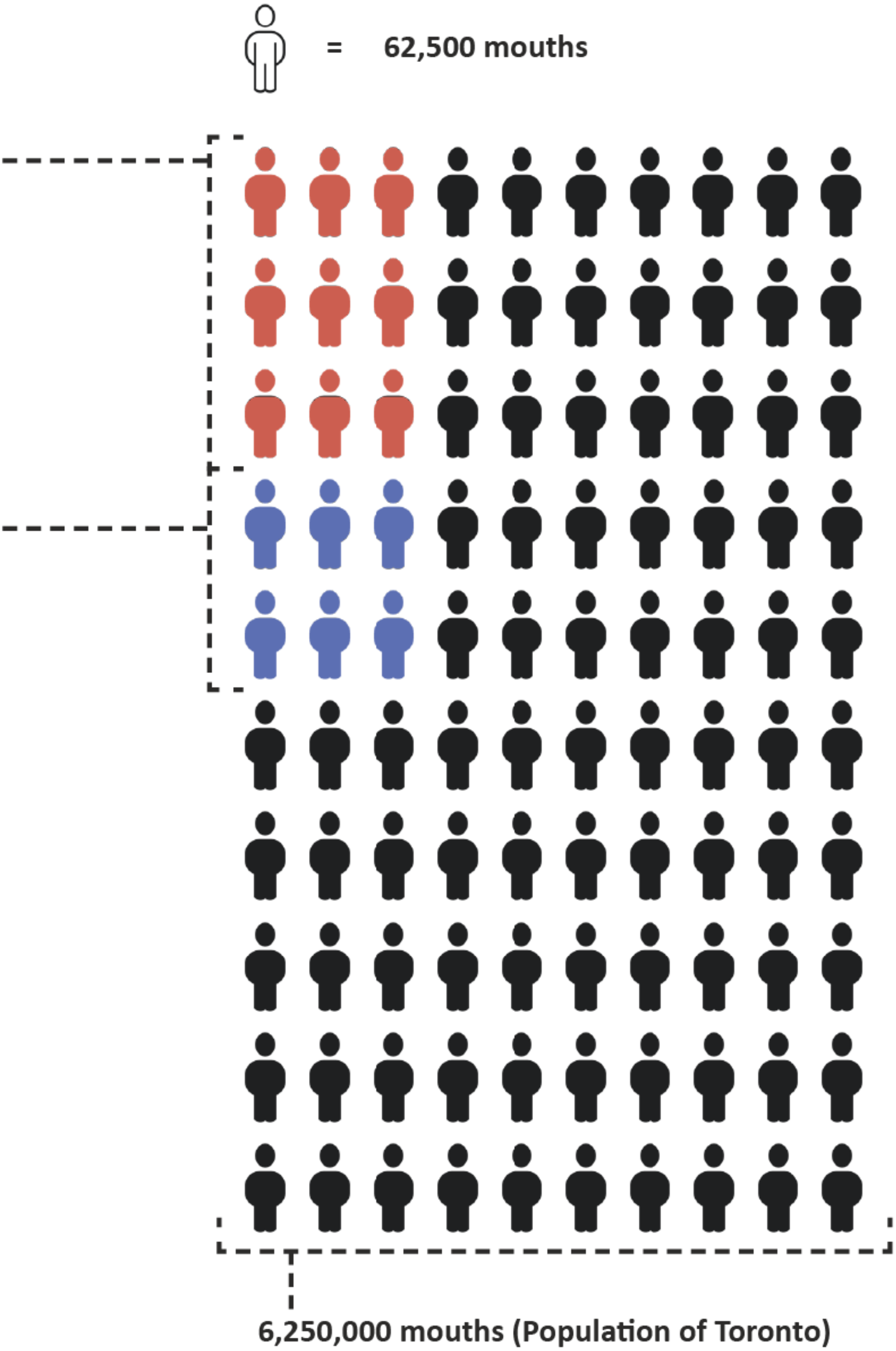
Scenario 'A' - Rooftops of all 1189 towers under the tower renewal program are converted to food productive greenhouses.

Scenario 'B' - All green roofs in the city are converted to food productive greenhouses.

= Mouths fed through conventional farming

= Mouths fed through Scenario 'A'

= Mouths fed through Scenario 'B'


= 62,500 mouths
6,250,000 mouths (Population of Toronto)

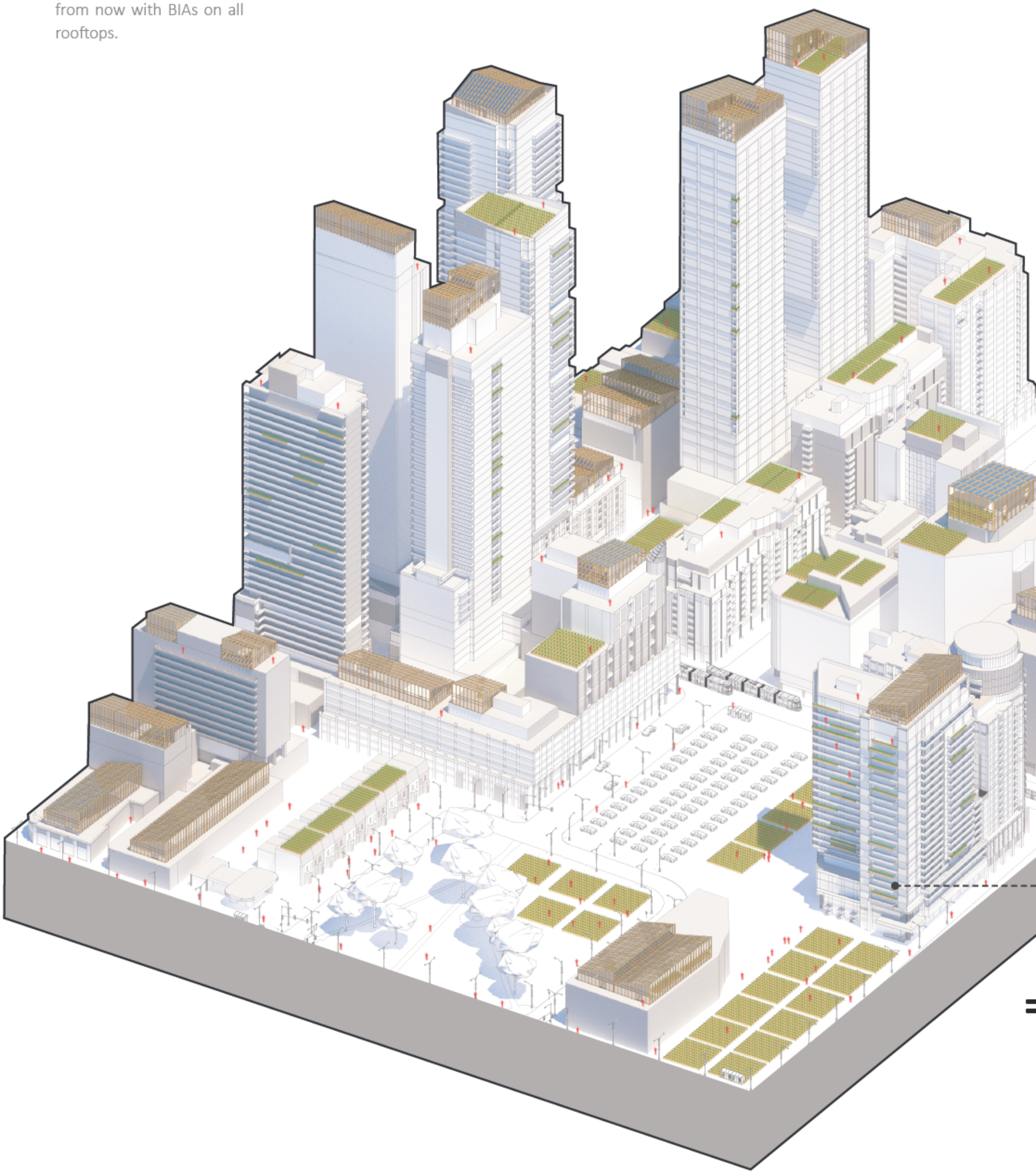
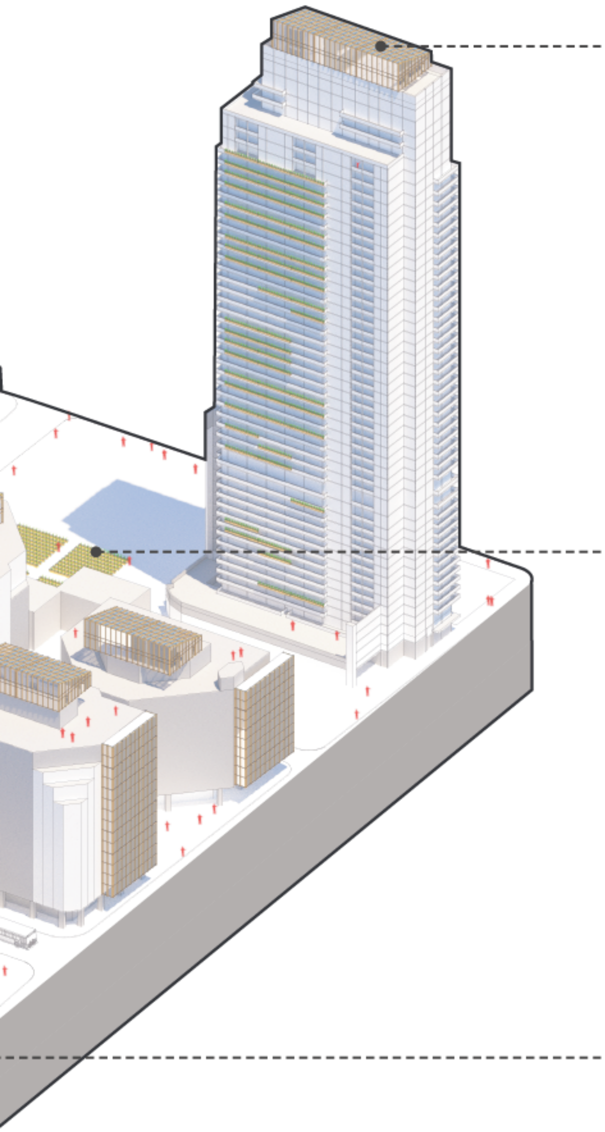
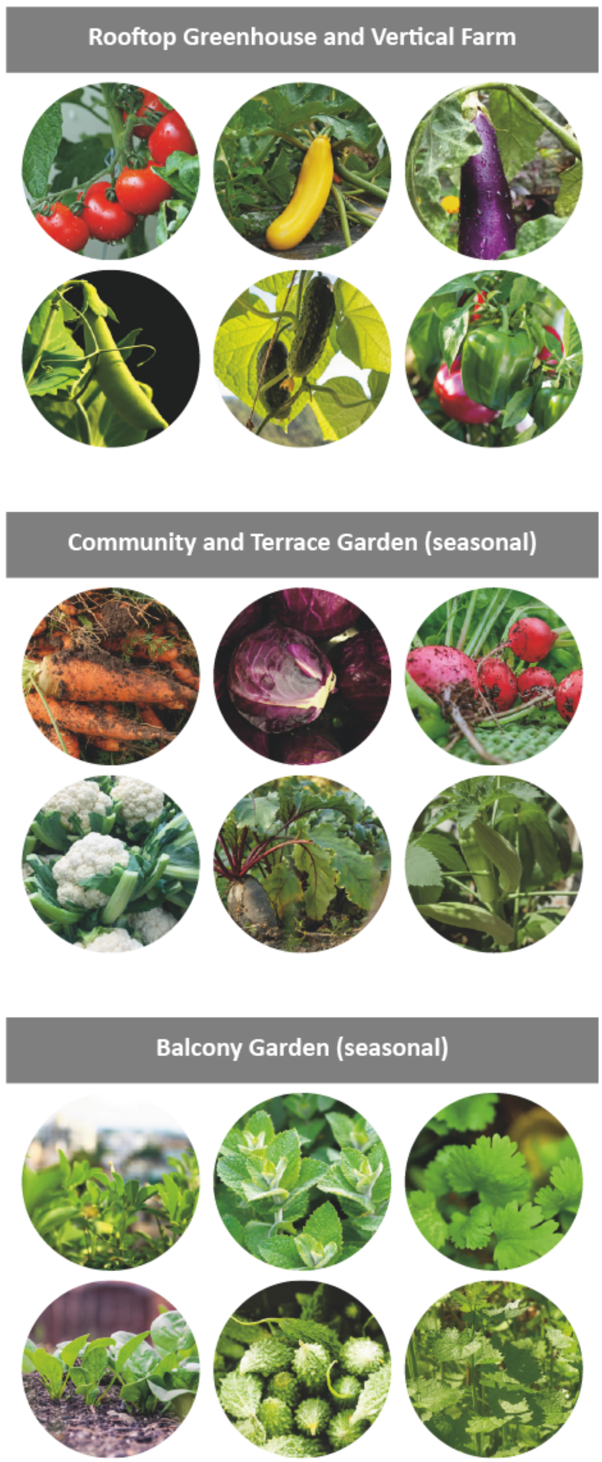


Fig. 6.06. Vision of Toronto 20 years from now with BIAs on all rooftops.





= **15%** **of fruits and vegetables consumed within the area can be produced by BIA.**

Buildings in Toronto under scenario 'A' require retrofitting to make the built environment better for the residents. BIA systems proposed in this thesis can be used in collaboration with the city's tower renewal program to retrofit buildings in these priority neighborhoods. By integrating BIA systems in the tower renewal schemes not will the residents achieve better homes and neighborhoods to live in but also get an opportunity to interact with food production. The residents will get educated on the importance of local food towards the environment, being food secure, and enhancing community engagement.

6.4 Future Opportunities

Moving forward the current research can be expanded by looking at systems that can make the building net-zero. Part of the ground floor of the building can be used to house a wastewater treatment plant that could help in recycling the greywater released by the units and the farming systems within the building. Apart from installing photovoltaic panels to generate electricity, the ground plane can be used to house bio-digestors. They digest the organic waste generated from the harvest of produce to release methane gas which in turn is used to produce electricity. The combination of the production of clean energy and recycling of water can make the building achieve net-zero. Further research can also help in understanding the impacts on food production due to pests which include insects, animals, and birds. Balcony farming systems will have produce that might be damaged by birds, squirrels, etc. and pest control systems can help in mitigating these losses.

BIA is the future of sustainable farming in urban areas around the world, but this radical shift in the production of food will require assistance from every resident to do their part in making this a reality.

Letter of Copyright Permissions

Re: Permission to use images in Master's Thesis

G g.kiss@kisscathcart.com
To Prateek Wason
Cc info@kisscathcart.com

Reply | Reply All | Forward

Tue 2021-06-29 6:51 PM

You replied to this message on 2021-06-30 3:09 PM.

Hello,

Yes, feel free to use the images and credit the first to: **Kiss + Cathcart**, the second to **Ari Burling**

Good luck with the project!

Gregory Kiss
Kiss + Cathcart, Architects

www.kisscathcart.com

On Jun 29, 2021, at 6:08 PM, Prateek Wason <pwason@uwaterloo.ca> wrote:

Hi Professor,

Hope you and your family are well!

I am a graduate student at the University of Waterloo. I am currently pursuing a master's level thesis to complete my Master's of Architecture degree. I wanted to seek permission to use the attached images that I found on the website(s) mentioned below. The images will be used for educational purposes only and appropriate referencing will be given to the authors of the images. My thesis topic is "Systems for Urban Farming: Alleviating Food Insecurity in Toronto". The images will be part of a system study and are used as precedents to the existing solutions for urban farming. Let me know in case you have any questions or concerns. Hope to hear from you soon.

https://kisscathcart.com/rooftop_greenhouse/overview.html#

Thanks
Prateek Wason
Graduate Student
Pronouns: He/Him

University of Waterloo, School of Architecture

Re: Permission to use images in Master's Thesis

CA Comunicació Adrià Goula Photo <comunicacio@adriagoula.com>
To Prateek Wason

Reply | Reply All | Forward

Wed 2021-06-30 1:46 PM

You replied to this message on 2021-06-30 3:10 PM.

Hi Prateek,
since this is a educational use, go ahead.
Thanks for your mail.
regards and good luck!

El 30 juny 2021, a les 0:11, Prateek Wason <pwason@uwaterloo.ca> va escriure:

Hi,

Hope you and your family are well!

I am a graduate student at the University of Waterloo. I am currently pursuing a master's level thesis to complete my Master's of Architecture degree. I wanted to seek permission to use the attached images that I found on the website(s) mentioned below. The images will be used for educational purposes only and appropriate referencing will be given to the authors of the images. My thesis topic is "Systems for Urban Farming: Alleviating Food Insecurity in Toronto". The images will be part of a system study and are used as precedents to the existing solutions for urban farming. Let me know in case you have any questions or concerns. Hope to hear from you soon.

https://www.archdaily.com/636587/research-center-icta-icp-uab-h-arquitectes-dataae

Thanks
Prateek Wason
Graduate Student
Pronouns: He/Him

University of Waterloo, School of Architecture

Re: Permission to use images in Master's Thesis

MN Melodie Ng <melodie@flemingdonparkministry.com>
To Prateek Wason
Cc Esey Tewolde; hello@thecommontable.org

Reply | Reply All | Forward | ...

Fri 2021-07-09 7:53 AM

Hi Prateek,

Thanks for clarifying which image! You don't need to blur the face - it's mine. I give permission! :o)

If you need further context to the photo - it's of the greenhouse at Marc Garneau Collegiate Institute, a high school in Toronto. The school uses this greenhouse, but at the time of this photo in Mar 2020, the school was generous in lending us (Flemingdon Park Ministry) some space for starting our seedlings. Flemingdon Park Ministry serves the surrounding neighbourhood of Flemingdon Park in a variety of ways, one being the urban farm project The Common Table Farm. The farm grows produce for the community in an effort to combat the food insecurity in the neighbourhood.

Hope that helps and all the best with your research!
Melodie

FPM **Melodie Ng | CT Farm Assistant**
Flemingdon Park Ministry

On Wed, 7 Jul 2021 at 16:46, Prateek Wason <pwason@uwaterloo.ca> wrote:

> Hi Melodie,
>
> Thank you for the reply. Attached is the image I wanted to use. I could also blur out the face of the girl in the image as I want to focus on the greenhouse itself. Let me know if it works this time. Hope to hear from you soon.
>
> Thanks
>
> **Prateek Wason**
>
> Graduate Student

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