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What Impacts Does Urban Farming Have on Sustainability in Highly Populated Cities

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Content

1	Introduction	1
2	Background & Literature Review.....	6
3	Methodology.....	15
3.1	Research Design	15
3.2	Data Collection.....	16
3.2.1	Document Analysis	16
3.2.2	Interview	18
3.2.3	Data Analysis	21
4	Analysis	26
4.1	Environmental Sustainability	26
4.1.1	Resource Consumption	26
4.1.2	Biodiversity.....	29
4.1.3	Waste Production	32
4.1.4	Urban Environment Improvement	35
4.2	Social Sustainability	40
4.2.1	Community Improvement.....	40
4.2.2	Food Security	44
4.2.3	Education	47
4.3	Economic Sustainability.....	50
4.3.1	Food Production.....	51
4.3.2	Employment.....	54
4.3.3	Community Economic Growth	58
4.4	Challenges and Opportunities.....	61
4.4.1	Challenges.....	61
4.4.2	Opportunities.....	65
5	Discussion.....	70
6	Conclusion.....	74
	References	77
	Appendix	95

1 Introduction

Urbanization, the process of people moving from rural areas to cities in search of better opportunities, has been a trend worldwide for several decades. It is a complex and dynamic process that is driven by factors such as economic development, population growth, and technological advancements. By 2050, it is estimated that more than 60 % of the population in both developed and developing countries will reside in urban areas (McDonald et al. 2011). In 2018, approximately 23% of the global population lived in cities with a population of at least 1 million. By 2030, 28% of the world's population is projected to be concentrated in such cities. Over the span of 2018 to 2030, the urban population is predicted to grow while the rural population is estimated to decrease slightly. In 2018, 45% of the world's population resided in rural areas, which is expected to drop to 40% by 2030. Although a small portion of the global population currently resides in megacities, these cities are expected to become home to a larger percentage of the population as they grow both in size and number. In 2030, it is estimated that 752 million people, or 8.8% of the world's population, will reside in cities with a population of at least 10 million (Wormald 2015).

As cities grow, they tend to become more diverse, economically dynamic, and culturally rich. At the same time, the economic growth that often accompanies urban expansion can lead to the development of new businesses, industries, and job opportunities (Scott 2007). However, while many advantages can be seen in the development of urbanization, there are also many social, economic, and environmental disadvantages that accompany these demographic changes as well. These disadvantages can have long-lasting and far-reaching effects, affecting individuals' health, well-being, and quality of life, as well as the social, economic, and environmental conditions of their communities (Cohen 2006; Sukhdev et al. 2013). People tend to move into cities as they offer access to better education, healthcare, employment opportunities, and a higher standard of living. They also provide a platform for cultural exchange, creativity, and innovation. However, with the increasing population density in cities, addressing these social, economic, and environmental disadvantages is crucial.

One of the main concerns is environmental protection. Highly populated cities are often centers of high pollution levels, air pollution being a major issue, is caused by a range of sources, including vehicles, industrial activities, and heating and cooling systems (Grimm et al. 2008). Air pollution can have serious health impacts, including respiratory and cardiovascular disease, and is also a major contributor to climate change (Mayer 1999). In addition, Urbanization also leads to the destruction of natural habitats, deforestation, and soil degradation that further results in biodiversity loss. Biodiversity

loss can result in ecological disruption, increasing the risk of extinction for many species and having cultural and economic impacts (Bradley and Altizer 2007; Sukhdev et al. 2013). The loss of species can alter relationships between species in an ecosystem, leading to imbalances and declines in ecological health and impacting crucial ecosystem services. The decrease in species also decreases the overall resilience of the biosphere, making it harder for ecosystems to adapt to changing conditions and increasing the risk of widespread extinctions. Additionally, the loss of genetic diversity can result in difficulty for species to adapt and increases the risk of disease outbreaks (LACY 1987). Biodiversity loss poses a serious concern and requires action to protect the world's remaining biodiversity.

Another challenge is social harmony. The influx of people from different cultures, backgrounds, and socioeconomic statuses can lead to social tensions and conflicts (Buhaug and Urdal 2013; Patterson et al. 2003). The lack of affordable housing, employment opportunities, and overcrowding can also contribute to a breakdown in social cohesion. To achieve social harmony, it is important to promote understanding, tolerance, and acceptance of diversity (Marsella 1998). This can be achieved through education, open communication, and community participation, which can help to dispel misunderstandings and break down barriers between different groups. The concept of community participation is rooted in the belief that people have the right to shape their own lives and the communities in which they live and that their contributions are valuable in creating a better and more just world. Effective community participation requires a supportive environment, including access to information, opportunities for meaningful engagement, and the ability to influence decisions (Ochoa et al. 2018). When communities are truly engaged, they can bring a wealth of knowledge, creativity, and passion to bear on the issues that affect their lives.

One major employment issue in highly populated cities is competition for jobs. With such a high concentration of people, there are simply more people than there are available jobs, leading to high levels of unemployment and underemployment (Wang and Li 2021). Additionally, many of these cities are home to large industries and corporations, which often prefer to hire highly educated and skilled workers, leading to a further disadvantage for those without advanced degrees or specialized training. Many workers may find themselves unemployed or underemployed because they lack the skills or training needed for jobs in high-demand industries. This can be particularly problematic in rapidly changing fields, such as technology and healthcare, where new skills are constantly in demand (Amani 2017). In addition, some workers may find themselves displaced by automation and other technological advances, which can make it difficult for them to find new employment (Van Roy et al. 2018). Despite overall

economic growth, many workers continue to earn low wages, making it difficult for them to make ends meet and support their families. This is particularly problematic in high-cost areas, where the cost of living is high, but wages are low.

Furthermore, Cities are major consumers of resources due to their high population density and the demand for energy, water, and other resources needed to support urban lifestyles. Urban resource consumption has significant impacts on the environment and on resource availability for future generations (Kalmykova et al. 2016). For example, cities consume a disproportionate amount of energy compared to rural areas due to their high demand for lighting, heating, cooling, and transportation. This energy consumption contributes to greenhouse gas emissions and climate change, as well as putting pressure on global energy supplies (Kennedy et al. 2009; Satterthwaite 2008). In addition, cities often face resource scarcity, particularly in terms of water and food. Food scarcity is a major issue in many parts of the world, particularly in developing countries, where millions of people suffer from malnutrition and hunger (Chaudhry and Castle 2011). Lack of access to adequate food can have serious consequences for health and well-being, including stunted growth, weakened immune systems, and increased vulnerability to disease. Food scarcity can also lead to social and political unrest as people compete for limited resources and struggle to meet their basic needs.

As more and more people are going to live in urban areas and the challenges are becoming more imminent, cities play a critical role in promoting sustainability, as they are home to a large portion of the world's population and are significant sources of greenhouse gas emissions and other environmental impacts (Newman 2006). Therefore, cities must address the interlinked economic, social, and environmental challenges facing the world and seek to strike a balance between economic growth and social well-being while preserving the natural environment to ensure benefits for mankind. The idea behind sustainable development is to find a way to improve the quality of life for everyone while preserving the planet and its resources for future generations. It is an ongoing process that involves multiple stakeholders, including governments, businesses, communities, and individuals (Steurer et al. 2005). Achieving sustainable development requires a concerted effort from all these actors, working together to create a more sustainable future.

However, most of the megacities in the world are not self-sufficient as they import a large proportion of food, energy, and other resources elsewhere to meet the needs of their inhabitants (Minaei 2020). Food is a fundamental aspect of human life as it is essential for survival and overall well-being. Without adequate access to food, people may suffer from malnutrition, hunger, and various health issues that can impair their

physical and cognitive development, reduce their productivity and income, and increase their vulnerability to diseases and other adverse outcomes. Furthermore, lack of food will lead to instability in society and death. Many incidents around the world killed people who had no access to food. For example, the Great Famine in China killed more than 30 million people from 1959 to 1961, and the same number of births were either lost or postponed (Smil 1999). Nowadays, many people are still facing a shortage of food. According to the United Nations World Food Program, more than 265 million people did not have stable food resources in 2020 (Lal 2020).

In densely populated cities, finding ways to improve sustainability is especially crucial. One of the key areas of focus is the role of urban green spaces in promoting sustainability (Jennings et al. 2016; Lee et al. 2015). Research has shown that these spaces can have a positive impact on the environment, the economy, and the well-being of city residents. Urban green spaces can take many forms, including city parks, roof gardens, and urban farming, and they offer a variety of benefits. For example, they can improve air quality by removing pollutants from the air, reduce the urban heat island effect, and help conserve energy by providing shade and cooling (Kuttler and Strassburger 1999). Additionally, green spaces can enhance the quality of life for city residents by providing them with opportunities for recreation and relaxation, and they can also play a role in mitigating the effects of climate change by storing carbon and reducing greenhouse gas emissions (Kothencz et al. 2017). By investing in urban green spaces, cities can take an important step towards becoming more sustainable and providing their residents with a healthy and livable environment.

Urban farming is a type of green space that can be found in urban areas, and it offers many of the same benefits as other forms of vegetation. One of the main advantages of urban farming is that it can provide city residents with a reliable source of fresh, healthy food, which is essential for food security and the well-being of the people (Melissa N Poulsen et al. 2017). This is particularly important in urban areas where access to fresh produce can be limited and where poverty and food insecurity are often more prevalent. Urban farming can also play a role in promoting sustainable development in urban areas. For example, by reducing the need for transportation to bring in food from outside the city, urban farming can help to reduce greenhouse gas emissions and other environmental impacts associated with the food supply chain (Ackerman et al. 2014). Additionally, urban farming can create jobs and promote economic growth, and it can also provide opportunities for education and community building.

Despite the many benefits of urban farming, there are still challenges and limitations to constructing these projects in urban areas. For example, many cities lack the necessary

infrastructure and resources to support urban farming and zoning and regulations can also make it difficult to establish these projects (Bisaga et al. 2019a; Kalantari et al. 2018). However, as more and more cities recognize the importance of urban farming and invest in this type of green space, it is likely that these challenges will be overcome and that urban farming will continue to play an important role in promoting sustainable development in urban areas.

The research aims to find the implications of urban farming on sustainability in highly populated cities, and the findings can serve as a reference for various stakeholders, such as urban planners and policymakers, to facilitate sustainable urban agriculture initiatives that have the potential to improve urban sustainability and the quality of life for city residents while mitigating environmental impacts. This paper aims to assess the impact of urban farming on sustainability, together with its challenges and opportunities in highly populated cities by answering the following research questions:

How can urban farming make highly-populated cities sustainable?

First, this paper will examine the current status and trends of urban farming and then critically analyze its implications on social, environmental, and economic sustainability. Additionally, to better address and guide the research, some sub-questions are included as follows:

What social impacts does urban farming have?

What economic impacts does urban farming have?

What environmental impacts does urban farming have?

What are the challenges and opportunities of urban farming?

This paper will answer these questions by first analyzing existing literature related to urban farming and sustainability and then conducting interviews with key persons in the selected urban farming projects. As the results might be influenced by local factors such as climates and policies, these projects are therefore carefully chosen so that they can be located in different parts of the world. In addition, the limitations and challenges of constructing urban farming will also be discussed based on the document analysis and the interviews.

2 Background & Literature Review

Cohen (2006) predicted the development of urbanization for the next 30 years and how most cities will face tremendous challenges as they are outstripping the capacity to provide proper services to their inhabitants. He pointed out the challenges for urban agglomeration as the world population is increasing steadily, and most choose to settle in urban areas. Almost 20 years after Barney's prediction, it seems like his prophecy is correct, as most cities cannot achieve self-sufficiency in many aspects despite technology increasing productivity in various industries (Park et al. 2013). Indeed, cities worldwide face various social, economic, and environmental dilemmas, especially in cities with huge populations (Faivre et al. 2017). As urbanization challenges are becoming more evident, enhancing sustainability is crucial for future urban development.

For the development of cities in the future, it is crucial to improve sustainability because it allows cities to address pressing environmental, social, and economic challenges while ensuring long-term resilience and livability (Kuhlman and Farrington 2010). Cities account for a significant proportion of global greenhouse gas emissions, and their continued growth is exacerbating climate change, especially in cities with huge populations. In addition, urbanization places enormous pressure on natural resources, leading to resource depletion and environmental degradation (Li et al. 2012). At the same time, urbanization can exacerbate social inequality, as marginalized communities often lack access to basic services such as clean water, sanitation and food (Kasarda and Crenshaw 1991). Enhancing sustainability is therefore crucial for future urban development, as it allows cities to address these challenges in a holistic and integrated manner. By promoting sustainable urban development, cities can reduce their environmental impact, promote social equity, and foster economic growth, all while ensuring long-term resilience and livability.

In recent years, many social challenges have appeared in the process of urbanization. For example, people face unemployment problems due to a lack of job opportunities, particularly for individuals with lower levels of education or training (Cohen 2006). As the urban population grows, the demand for jobs increases, but the supply of employment opportunities may not keep up. This can lead to unemployment, underemployment, and poverty. In addition, community participation can also be a challenge, as urban areas can be highly fragmented and disconnected, making it difficult to foster a sense of community engagement and participation (Ochoa et al. 2018). Furthermore, education problems can also arise in urban areas due to a lack of exposure to the natural world. The densely populated urban environment can make it challenging

for students to access natural spaces and experience the outdoors, leading to a limited understanding of biodiversity, ecosystems, and environmental issues.

Apart from social challenges, highly populated cities face a multitude of economic dilemmas that can impact the well-being of residents and the sustainable development of urbanization. As cities grow and evolve, the demand for resources, infrastructure, and services increases, which can lead to high costs and strain on existing systems (Glaeser 2020). As more people flock to cities, housing prices tend to rise, making it difficult for individuals with lower incomes to afford a place to live. Additionally, the cost of goods and services can be higher in cities due to the concentration of businesses and the higher cost of operating in urban areas (Handbury 2019). For many people, access to economic opportunities is limited by social and economic barriers, such as poverty, lack of education, and discrimination. This can result in some individuals and communities being left behind, unable to benefit from the city's economic growth (Tafazzoli et al. 2019). In addition, the high population density in urban areas can create issues such as overcrowding and traffic congestion, which can exacerbate social and economic problems.

Additionally, urbanization has significant environmental implications that are intertwined with social and economic factors, leading to resource consumption, pollution, and biodiversity loss (Bhuvandas et al. 2012; Dodman 2017). As populations grow and cities expand, the demand for resources such as energy, water, and raw materials increases exponentially. This can result in the overexploitation of natural resources, leading to the depletion and degradation of ecosystems (Li et al. 2012). In addition, environmental pollution, including air, water, and noise pollution, is also a significant challenge associated with urbanization. Polluted environments can have a detrimental effect on human health, leading to respiratory and cardiovascular diseases and more. Furthermore, urbanization often involves the destruction, fragmentation, or degradation of natural habitats, leading to the loss of biodiversity and ecosystem services (Kampa and Castanas 2008a). The loss of biodiversity can have far-reaching consequences, including the loss of ecosystem services that support human well-being, such as water purification, air quality regulation, and climate regulation.

Urban populations in cities of different sizes are defined by various factors, and understanding these factors is crucial for effective urban planning, especially in highly populated metropolitan areas. Urban populations in cities of different sizes are determined by factors such as population density and commuting patterns, which more accurately reflect a city's economic role and administrative boundaries (Parr 2007). The definition of a city varies from country to country. For instance, Denmark defines urban

areas as having at least 200 inhabitants, whereas China defines its urban areas as having at least 100,000 inhabitants (Paddison et al. 1998). The Organization for Economic Cooperation and Development (OECD) defines a large metropolitan area if it has a population of 1.5 million or more (Brezzi et al. 2012). In the context of cities with a small population, their markets can easily satisfy the needs of the inhabitants, and there is usually a big amount of farmland surrounding most of the small cities or towns. Therefore, the study of urban farming in highly populated cities is more meaningful and can provide more useful insights and implications for future planning of urban farming in large metropolitan areas.

Achieving urban sustainability is a complex process that requires a multi-dimensional approach since no single element can ensure sustainable development (Klauer 1999). Numerous studies have explored various aspects that can contribute to sustainable urban development. Although different countries may adopt different paths towards achieving sustainability, the ultimate objective of creating sustainable development remains the same. The task of providing adequate housing and food for all urban dwellers without harming the environment is a considerable challenge (Goodland 2003). Recent studies have identified the implementation of green spaces as a vital aspect of sustainable development. Urban green spaces offer numerous benefits, including a positive impact on the ecosystem and our physical, psychological, and societal health (Jennings et al. 2016). By incorporating green spaces into urban design, we can create a sustainable environment that leads to the sustainable development of urbanization.

People define green spaces differently yet seldom provide a clear and precise definition (Taylor and Hochuli 2017). For instance, Tavernia and Reed (2009) define green spaces as “combined areas of open land, cropland, urban open land, pasture, forest, and woody perennial”, whereas Almanza et al. (2012) give the definition of green spaces as “greenness describes the level of vegetation, ranging from sparsely-landscaped streets to tree-lined walk-ways to playfields and forested parks.”. Although most published research fails to give a clear definition of green spaces, urban farming, as one of the forms of green space, is clearly defined and widely accepted by the definition of the following. This definition is also used as the standard urban farming definition for this research:

“An industry located within (intra-urban) or on the fringe (peri-urban) of a town, a city or a metropolis, which grows or raises, processes and distributes a diversity of food and non-food products, (re-)using mostly 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 mainly to that urban area.” (Mougeot 2000)

In recent years, urban farming has been examined in many types of research because it is seen to have social, economic and urban environmental benefits (Othman et al. 2017). This is especially true compared to traditional farming, as it has many disadvantages. First of all, the success of traditional farms is closely tied to weather conditions, which are often unpredictable and challenging to manage (Pimentel and Burgess 2014). Droughts, for instance, are a significant problem in many regions worldwide and can have devastating consequences on crops. Insufficient water supply can cause crops to fail to grow or produce smaller yields, leading to substantial financial losses for farmers. The lack of water can also force farmers to use more water than is available in the area, resulting in the overexploitation of water resources and worsening water scarcity over time (Devereux 2007). This situation can cause environmental degradation and make it harder for farmers to sustain their livelihoods in the long term.

Secondly, soil degradation is a multifaceted issue that can have significant negative consequences for traditional farming. Constant farming without proper soil management practices can deplete soil quality, leading to reduced productivity and difficulties in growing crops (Hartemink 2006). Soil degradation can be caused by various factors, including the overuse of chemical fertilizers and pesticides, soil erosion, compaction, and the loss of organic matter (Lal 2001). These factors can impact soil structure, decrease nutrient content, and reduce the soil's ability to retain water, leading to lower crop yields and an increased risk of soil erosion (Issaka and Ashraf 2017). Moreover, soil degradation can have long-term environmental impacts, including reduced biodiversity and carbon sequestration capacity, leading to significant environmental problems (Montgomery 2007).

Apart from soil degradation, traditional farming is usually associated with deforestation as farmers clear forests to create new fields or expand existing ones. One example of deforestation for traditional farming is the practice of slash-and-burn agriculture, also known as shifting cultivation, which involves cutting down and burning trees and vegetation to clear land for cultivation (Tinker et al. 1996). This can lead to a number of negative environmental consequences, such as soil erosion and loss of biodiversity. Additionally, traditional farming is a significant concern for greenhouse gas emissions because the use of synthetic fertilizers, which are commonly used in conventional farming, can contribute to the release of greenhouse gasses such as carbon dioxide and nitrous oxide (Wakeland et al. 2012). Finally, the transportation of agricultural products, especially to a long or international destination, can also contribute to carbon emissions. In some cases, farmers may need to transport their crops long distances to reach consumers, which can increase the carbon footprint of the food (Kulak et al. 2013; Wakeland et al. 2012).

Traditional farming methods may not lead to the sustainable development of mankind due to their disadvantages. In 1987, the United Nations Brundtland Commission defined sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” (Wu and Clark 2016). The Brundtland Report prioritized human needs and desires and aimed to create a fair distribution of resources for future generations. This included redirecting resources to less developed nations to support their economic development and provide basic necessities for all people. In addition, the report stated that it is possible to have a balance of social fairness, economic development, and environmental preservation, which it defined as sustainable development. This concept is composed of three main elements - the environment, economy, and society which later became known as the triple bottom line (Du Pisani 2006).

Achieving social sustainability requires systematic community participation and a strong civil society which consists of continual food security, employment and education (Goodland 2003). Some researchers argue that social sustainability is the most important of the three. For instance, Basiago (1998) believes that social sustainability essentially means a system that helps to reduce poverty, and it is a precondition for environmental sustainability. Indeed, people cannot live without food, and there is no need to talk about sustainability if humans do not exist. Social sustainability in urban farming is mainly shown through community involvement, food security, and education. This includes volunteering, co-managing community gardens, attending workshops, and providing paid positions for marginalized individuals (Feenstra and Lewis 1999; Ober Allen et al. 2008; Yusoff et al. 2017). Urban farming also offers opportunities for education on sustainable agriculture and food security through workshops and classes (Booker 2012; Eigenbrod and Gruda 2014). These aspects of social sustainability help to build social cohesion, reduce social inequalities, and promote self-sufficiency and resilience in communities.

The concept of ‘economic sustainability’ was invented by Hicks. In his book *Value and Capital* 1939, Hicks defined ‘income’ as ‘the amount one can consume during a period and still be as well off at the end of the period’ (Hicks 1939). This definition emphasizes the maintenance and stability of capital. In addition, economists in the past, who thought natural resources were unlimited, put too much faith in the market's ability to distribute resources effectively. They thought that economic growth would lead to advancements that could restore any natural resources depleted during production (Basiago 1998). Nowadays, it's widely understood that natural resources are finite, and the expanding economic system is putting pressure on these resources. In the case of urban farming, economic sustainability can be seen as community economic growth,

food production, and providing employment opportunities (Okoro 2017; Rivas-Aceves and Schmidt 2022).

Regarding environmental sustainability, which originates from social concerns, aims to enhance human welfare by preserving resources and preventing waste overload, thus avoiding harm to humans (Goodland 2003). In addition, economic sustainability concentrates on the section of natural resources, including both renewable sources, such as forests and exhaustible ones, like minerals, that are utilized as physical inputs in the production process. Achieving environmental sustainability requires humans to make responsible decisions about the use of resources, reducing waste and pollution, and protecting ecosystems and biodiversity (Dudley and Alexander 2017). It also requires balancing human needs with the health of the planet to create a sustainable future. In the case of urban farming, environmental sustainability can be enhanced by reducing waste production, resource consumption (e.g., water and soil), biodiversity, and overall urban environment improvement (Dodman 2017; Levis and Barlaz 2011; Sayara et al. 2016).

Urban farming is a sustainable solution that offers many benefits to highly populated cities. By implementing urban farming, cities can reduce their carbon footprint by sourcing produce locally instead of transporting it from remote rural areas. In addition, urban farming can promote a sense of community, providing opportunities for people to connect with nature and each other while also contributing to the health and well-being of urban residents (Othman et al. 2018; Poulsen et al. 2017). Indeed, M Hui (2011) pointed out that urban agriculture is realistic and can have various positive effects on environmental, social, and economic sustainability by examining the implementation of rooftop farming projects and initiatives in places like Hong Kong, Singapore, and Thailand. However, their research did not focus on the perspective of urban farming organizations and companies, as no qualitative data was collected from the people related to the projects. However, their theory of urban rooftop farming is supported by Xi et al. (2021), as their research shows that new material science can be applied to improve the productivity of urban farming on rooftops.

Yusoff et al. (2017) and Othman et al. (2018) found that urban farming can bring positive changes into communities, and people are motivated to participate as it can provide various benefits like a healthy lifestyle, community bonding and reduced financial burden. Indeed, people are willing to participate in urban farming activities because urban farming increases welfare and strengthens the capacity of communities in addition to providing business capital support (Surya et al. 2020). However, their research only focused on the individual urban farming projects in communities, and it did not examine social, economic, and environmental aspects systematically. Despite

the limitations, both studies pointed out the importance of government policies and support for the implementation of urban farming and how government initiatives and policies can play a crucial role in urban agriculture.

In addition, implementing urban farming can positively affect the surrounding air quality as it can reduce the PM_{2.5} concentration (Gustavsen et al. 2022; Tong et al. 2016). Urban farming acts as one type of green space. It can absorb carbon dioxide and produce oxygen and therefore improve air quality. This is especially helpful in the context of highly populated cities, as high-quality air is hard to come by for their inhabitants. Furthermore, the case study conducted by (Enyinnaya Okoro 2017) showed that urban farming could be used as means of meeting the food demand and increasing domestic income, which can lead to economic benefits and community independence. However, their study lacks important insights and implications from the environmental aspect as they only focused on the economic and social aspects. Othman et al. (2017) also pointed out in their research that urban farming can strengthen community independence and engagement as people are motivated to take part because of all benefits provided by urban farming. However, their research results might be less applicable to corporate urban farming projects as it is only based on individual farming projects.

In their study on urban farming and business opportunities, Feenstra and Lewis (1999) pointed out that urban farming can have a positive impact on the expansion of business opportunities by creating fresh market avenues such as community-supported agriculture, institutional food purchasers, and government food schemes. However, their study did not go to the social and environmental aspects of urban farming, as only economic implications were discussed in their research. Similarly, Ober Allen et al. (2008) conducted research on urban farming in a community setting, and the results show that community gardens offer constructive activities and opportunities to contribute to the community, develop interpersonal skills and relationships, explore cognitive and behavioral competence, and improve nutrition.

Indeed, involvement in these programs promoted developmental assets among youth while also increasing their access to and consumption of healthy foods. Their research is supported by Yusoff et al. (2017), as their research suggests that engaging the community in urban farming can foster stronger bonds between communities and the farming industry. By participating in farming activities, individuals can develop a sense of partnership and camaraderie, promoting community cohesion and cultural diversity among growers and farmers. However, both studies were not conducted in a highly

populated urban area and did not touch upon environmental and economic aspects, as only the social aspect was mentioned in their research.

Apart from the advantages, some research shows that there are some challenges and limitations to urban farming. People face various challenges, such as land availability, government support, and proper materials for urban agriculture construction (Kalantari et al. 2018; Surls et al. 2014). Some places face limitations as their government does not have clear regulations for urban farming, and some even ban citizens from constructing urban gardening (Rivas-Aceves and Schmidt 2022). In addition, farmers do not have sufficient relevant information on how to carry out an urban farming project, and professional assistance is hard to come by (Surls et al. 2014). Furthermore, as each city has its own microclimate and the characteristics of a specific region are different, correctly managing and growing vegetables on an urban farm can be difficult (M Hui 2011). However, there is a lack of studies and comparisons on the challenges, limitations and opportunities of urban farming in different highly populated cities in the world, especially from an urban farming business project aspect. A single case study in a certain region might be less meaningful to cases in other regions as it is easily influenced by local factors (Gustafsson and Gustafsson 2017).

Although some existing studies have examined the impact of urban farming on social, economic, and environmental sustainability, most did not provide a holistic view of the three pillars of sustainability, as only one or two of them are studied separately. This separation might fail to provide a comprehensive viewpoint for future urban farming planning. By conducting a comprehensive analysis of the social, environmental, and economic sustainability aspects of urban farming, this paper makes a valuable contribution to the existing body of literature. It aims to provide meaningful insights on the implications of urban farming on all three pillars and thereby enhance our understanding of the overall impact of urban farming practice. The paper also aims to provide a holistic view of urban farming's potential benefits and challenges through these three pillars.

In addition, there is a lack of studies about the sustainable impact of urban farming, specifically focusing on highly populated areas. Studies on urban farming in a small urban area might not be as meaningful because, with a low population, the local markets can readily meet the needs of residents. Therefore, these studies might not be meaningful and suitable in a highly populated city context. As more and more people are going to live in cities in the future, there is a need for more research in highly populated regions to provide more insights. As a result, this research can contribute to the existing literature by focusing specifically on the impact of urban farming in highly

populated cities. As urbanization continues to progress, the relevance of understanding the implications of urban farming in highly populated areas becomes increasingly significant. The paper seeks to bridge this gap in knowledge by offering insights and information that are more applicable and suitable for addressing the unique circumstances and challenges faced by highly populated urban areas.

Furthermore, few studies have collected and compared qualitative data based on people from urban farming projects in different highly populated cities worldwide. This paper, therefore, further contributes to the existing literature by incorporating perspectives from various stakeholders involved in urban farming projects. It also enhances the depth of understanding and provides a comprehensive and evidence-based analysis of urban farming. The research brings valuable first-hand perspectives and insights to the existing literature by capturing insights from individuals directly engaged in these initiatives.

3 Methodology

The upcoming chapter of this study will focus on the specific research design and methodology that were utilized to gather data. The chapter will provide a thorough analysis of why these methods were chosen as the most appropriate for addressing the research question and addressing the identified gap in the literature review. The main objective of this research is to examine the influence of urban farming on sustainability in a densely populated urban setting. To accomplish this goal, the study is founded on the principles of sustainability as defined by the United Nations Brundtland Commission, and the three pillars of sustainability, namely social, economic, and environmental, are used as the framework to guide the research (Kuhlman and Farrington 2010). By utilizing this framework and methodology, the research seeks to contribute to the current understanding of the role of urban farming in promoting sustainable development in urban areas.

3.1 Research Design

This paper will examine multiple urban farming projects in highly populated cities around the world to assess the impact on social, economic, and environmental sustainability. The research will be more meaningful and provide more useful insights into future urban farming planning in large metropolitan areas if it is conducted in a highly populated city context. As a city is defined differently in different countries and regions in terms of population, this paper used the population definition of large metropolitan areas from the OECD. As a result, the selected urban farming projects are all located in cities with a population of 1.5 million or more. Although there are many cities that can be qualified as large metropolitan areas based on the OECD definition, the selected cities are spread out over three continents. This is due to the fact that urban farming projects might have different implications on the research outcome because of local factors. In addition, both the document analysis and the semi-structured interviews are used to conduct this research. However, the core of this paper is the interviews with people from the selected urban farming projects. This allows the research to gain a better understanding of urban farming and study its impact on social, economic, and environmental sustainability in a holistic way.

The data collected from the document analysis will be used to compare with the interviewee's responses. This comparison can help to identify any inconsistencies or discrepancies in the data and to ensure that the findings are well-supported and reliable. By combining and comparing the data from different sources, the research paper can achieve more credibility and reduce the potential for biased views. Moreover, the

triangulation of data can help to provide a more complete and nuanced understanding of the research topic (Flick and Flick 2017). It can reveal different perspectives, opinions, and experiences that may not be fully captured by a single source of data. Triangulation can also help to identify common themes and patterns across different data sources, providing a more robust and comprehensive analysis (Thurmond 2001). Therefore, the triangulation of data can strengthen the overall quality and validity of the research findings. The final results will be combined in the conclusion chapter.

3.2 Data Collection

The mixed-methods approach to be used in the research paper on urban farming will involve a two-pronged approach to data collection. First, a document analysis will be conducted to gather existing literature and research on the topic of urban farming, particularly its impact on social, economic, and environmental sustainability in densely populated cities. This literature review will provide a comprehensive overview of the topic, highlighting past research findings, trends, and knowledge gaps. Second, in-depth interviews will be conducted with relevant stakeholders to gain insights into the challenges and opportunities associated with implementing urban farming initiatives in densely populated areas. The interviews will provide a more nuanced and qualitative understanding of the subject matter, uncovering the complexities of urban farming and the various factors that impact its potential for success. By combining both quantitative and qualitative data collection methods, this research aims to provide a more holistic understanding of the potential benefits of urban farming in densely populated cities. The findings of this research paper could have implications for urban planning and policy, as well as for the development of sustainable and resilient urban communities.

3.2.1 Document Analysis

Document analysis is a systematic process of reviewing and evaluating documents to generate data, which is then analyzed and interpreted to derive meaning, gain insights, and create empirical knowledge. It is a form of qualitative research that involves interpreting documents by the researcher to provide context and meaning around a particular topic being studied (Bowen 2009). Despite the fact that documents can take various forms, this paper mainly focused on the existing academic research papers and newsletters about sustainability and urban farming. The selection of the targeted research papers was conducted mainly through Google Scholar. In addition, these documents are carefully chosen using first-round keywords. They include “sustainability” and “urban farming”. As “urban agriculture” is used interchangeably in many previous kinds of literature, it is still included as one of the first-round keywords

as well. Thirty-seven research papers were first identified through Google Scholar, and then they were further selected in a concept table using second-round keywords as tables and figures serve as valuable tools for conveying significant discoveries and insights (Webster and Watson 2002). They include “social sustainability”, “environmental sustainability”, “economic sustainability”, and “urbanization”. Additionally, to better understand the challenges and limitations of urban farming, the keywords “challenges”, “limitations”, and “opportunities” are also used for the second-round document selection.

After the first two rounds of selections, 25 research papers were selected in the end. Not all of them contain social, economic, and environmental sustainability at the same time, as the three pillars were most studied separately. As a result, in order to conduct a thorough study of the three pillars, each of them is studied separately in detail. This provides important implications about what is needed to include in this paper. In the end, “Community Improvement”, “Food Security”, and “Education” were selected as the sub-sections of “Social Sustainability”. In addition, “Food Production”, “Employment”, and “Community Economic Growth” were selected as the sub-sections of “Economic Sustainability”. Finally, “Resource Consumption”, “Biodiversity”, “Waste Production”, and “Urban Environment Improvement” were selected as the sub-sections of “Environmental Sustainability”. These sub-sections were chosen because they were discussed and studied by most of the existing literature. However, not every document used the exact same words in terms of these sub-sections, as various synonyms were used. For example, “education” is sometimes referred to as “cultural activities” in some documents. As a result, the final screening of these documents was primarily conducted by reading through and finding the targeted notions instead of the exact same words. This will ensure that any essential information is appropriately captured.

The data collected through document analysis is used in a variety of ways. First of all, information collected in the existing literature is used as background information for the research. This can provide a good overview of what has been done in the past relating to the subject, helping to contextualize the research question and identify potential gaps in knowledge. In addition to providing background information, the data gathered in selected documents are also used as a base to generate interview questions. This can help to ensure that the interview questions are focused on relevant and important issues and that they are tailored to the specific context of the research. In the case of urban farming, the data gathered through document analysis is used to identify the challenges and limitations of urban farming, as well as its effects on social, economic, and environmental sustainability. These issues could then be incorporated into the interview questions, helping to ensure that the interview provides a comprehensive and in-depth

exploration of the research topic. This ensures the interviews will provide a holistic view of the research topic and the research problem can be studied thoroughly as document analysis can give useful and meaningful insights and a clear view of the problems concerning the study (Bowen 2009).

Document analysis is a research method that involves the systematic examination of various types of documents to extract meaningful insights and answer research questions. While it has many advantages, such as providing a rich source of data and being a cost-effective method, it also has several disadvantages. One disadvantage is that important details may be overlooked during the analysis, which can affect the accuracy of the results. Another disadvantage is the difficulty in locating specific documents, which can be time-consuming and frustrating. Additionally, there may be potential bias in the document selection process, which can lead to incomplete or inaccurate results. Furthermore, documents were not created for research purposes, so specific skills are needed to analyze them effectively. Finally, documents may not provide all the data needed to answer research questions, and the information they do provide may be limited, inaccurate, inconsistent, or incomplete. This may require additional searches or the use of supplementary documents to supplement the analysis (Bowen 2009).

3.2.2 Interview

In addition to the document analysis, semi-structured interviews are also conducted to collect qualitative data. An interview of this type follows a list of topics as a guide, ensuring structure and consistency among respondents while allowing for extra questions and information (Kallio et al. 2016). This will make sure that additional information for a certain topic is answered deeply with useful insights. The selection of these urban farming projects is based on four criteria that are extracted from the definition of urban farming used in this paper. At first, the selected urban farming project has to be located in a city or metropolitan area where the population is more than 1.5 million people. This is an important aspect of the definition, as urban farming is often seen as a response to the challenges of food production and distribution in urban environments, where access to fresh produce or space to grow it is limited. Second, the selected urban farming project must produce a certain amount of diverse food as it provides important implications for food production, food security and biodiversity. Thirdly, the selected urban farming companies have to recycle various materials as it provides important implications for the sustainability of urban farming in a highly populated setting. Finally, the selected urban farming project must serve the people

within its urban area with the food it produces. This ensures the impact of urban farming on local sustainability is captured.

Apart from the urban farming projects being selected under three specific criteria, the respondents selected are key persons from urban farming projects that are located in highly populated cities in the world with more than 1.5 million residents. These persons are familiar with the background and are heavily involved with the daily operation of the farm. Therefore, their knowledge can provide a holistic view of the research topic.

Table 3.1 shows the general information of the interviewees. It consists of the name of the interviewees, and they are all displayed as “Interview Respondent” with a number from 1 to 5, which is based on the order in which they are interviewed. In addition, it also contains the organizations they work in and their functions. Furthermore, the cities they are located in and their respective population are also shown in Table 3.1. Finally, the date of each interview is also listed in chronological order.

Name	Function	Organization	Region	Population	Date of Interview
Respondent 1	Head of Education and Outreach Programmes	ComCrop	Singapore	5.64 million	16/03/2023
Respondent 2	Farm Manager	De stadsgroenteboer	Amsterdam, the Netherlands	2.48 million	22/03/2023
Respondent 3	Event & Communication Manager	BIGH	Brussels, Belgium	2.2 million	04/04/2023
Respondent 4	Executive Director	Urban Growers Collective	Chicago, USA	8.9 million	Written Form, received on 08/04/2023
Respondent 5	Co-Founder	Eco Green Gardens	Los Angeles, USA	12 million	19/04/2023

Table 3.1 Interviewees

The interviews are conducted online via Zoom from March to April, and the questions are all designed based on the aspects of social, economic, and environmental sustainability. However, one interviewee provided written answers to the commonly asked questions. In addition, questions about the challenges and limitations of constructing and maintaining their urban farming projects are also asked during each interview. For the aspect of social sustainability, the questions are focused on

community participation, as it is crucial to gain insights into how city dwellers take part in and engage with their farms. In addition, questions about employment are also asked as they provide implications for what kind of people are hired and other employment information. Finally, the interviewees are also asked to introduce what kind of role they play as an urban farm in the aspect of education. As for economic sustainability, the interviewees are first asked about the overall production of their farm. This is important to the research question as they can provide information about how much food is produced on a year basis. In addition, questions about community economic growth are later asked. This is mainly to evaluate how their urban farming projects can contribute to the city economically. In the end, questions about continuous development are asked as it is important to gain implications about how they develop their farms in the future.

For the aspect of environmental sustainability, questions about how their food is grown, produced, and delivered to the consumers are asked, as the current production and distribution of food affect the environment greatly. Second, questions about how resources (e.g., water) are used on the farm are also raised during the interview. The results of these questions are compared with how resources are used in traditional farming. Finally, questions about the variety of vegetation are asked because urban farming has important implications for increasing biodiversity. In the final part of the interview, each individual answered questions about the challenges, limitations and information needed for constructing and daily maintenance of their farms. This not only provides insights for governments in terms of policy making but also provides useful insights for urban farming projects in the future.

3.2.3 Data Analysis

Document Analysis

Once the necessary data has been collected for a research project, the process of examining the data and assessing its relevance, reliability, and validity is crucial to ensuring the validity and reliability of the study's findings (Bowen 2009). This step involves a careful and thorough examination of all relevant documents to determine their academic value and credibility, as well as the research methods used to produce them. To assess the academic value of the documents, the researcher considered the quality and rigor of the research conducted and the extent to which it contributes to the field. The credibility of the authors and their affiliations is also evaluated, as well as their experience and expertise in the subject area. By considering these factors, the researcher can ensure that the collected documents are of high quality and that the findings and conclusions drawn from them are well-supported.

In addition to evaluating the quality of the research and the credibility of the authors, the researcher also examined the research methods used to produce the documents. This includes assessing the data collection and analysis techniques employed, as well as the statistical significance of the findings. By doing so, it can be ensured that the data collected is reliable and valid and that any conclusions drawn from the data are grounded in sound research methods. The source of the documents is another important factor that was taken into account. The study examined the journal in which the documents were published and evaluated its reputation and impact factor. This helped to ensure that the data collected was from reputable sources and was of high quality. By carefully analyzing and evaluating the collected documents, the research can ensure that the findings and conclusions drawn from the study are sound and grounded in rigorous research methods. This step is critical to the success of the research project, as it ensures that the study's results are reliable and can be used to make informed decisions or guide future research.

After the collection of relevant documents and literature, they are carefully categorized into social, economic, and environmental aspects and their subsections, as shown in Figure 3.1. This will provide a clear picture of what has been done in the selected research. In addition, the categorization also gathers the most relevant information that is specifically important and meaningful to this research. This Code Visualization Diagram is based on the three main elements of sustainability, which were defined by the United Nations Brundtland Commission in 1984. The three elements, later known as the triple bottom line, are social, environmental, and economic sustainability. The diagram's social aspect includes research examining the impacts of sustainability practices on community participation, employment, and education. In addition, the environmental aspect of the diagram relates to resource consumption, food provision process, and vegetation variety. Finally, the economic aspect of the diagram deals with the impact of sustainability practices on community economic growth, food production, and continuous development.

To fully understand the potential impact and viability of urban farming as a sustainable method that contributes to urban development, it is essential to analyse its social, environmental, and economic sustainability and thoroughly examine its challenges and opportunities, as shown in Figure 3.1. By conducting a comprehensive study on the challenges and limitations of urban farming based on the selected documents, we can gain valuable insights into the obstacles that must be overcome to establish and maintain an urban farm and the potential opportunities that may exist. This can help to develop strategies and solutions to address these challenges and to better support the growth and development of urban farming as a sustainable and innovative approach to

food production. Ultimately, a thorough understanding of the challenges and opportunities of urban farming can help us to maximize its potential benefits and minimize its risks, and to build more sustainable and resilient cities for the future.

Figure 3.1 shows the Code Visualization Diagram, which consists of social, environmental, and economic sustainability and their subsections. In addition, challenges and opportunities are also shown in the Diagram.



Figure 3.1 Code Visualization Diagram

Interviews

Once all the semi-structured interviews have been conducted, the next step is to transcribe the recordings into text. However, this is not a straightforward process and several associated challenges can impact the quality and authenticity of the original meaning. One of the main challenges is that the transcription itself can become the main focus of the analysis, leading to the loss of the real interaction that took place during the

interview (McLellan et al. 2003). This is because the transcriptions are a decontextualized, artificial construction of the actual interaction that took place. This means that researchers may misinterpret the reality of the conversation, which can lead to a biased outcome in the results (Oliver et al. 2005). To overcome this challenge, it is crucial to find a way to preserve the real interaction that took place during the interview, perhaps by using audio or video recordings in addition to the transcriptions. It is also important to be aware of any biases that may be present in the transcription process itself and to take steps to minimize their impact. Ultimately, the goal is to create a faithful representation of the interview that accurately reflects the participant's experience and perspective.

The second challenge associated with transcribing the interviews is the level of detail in which the spoken language should be transcribed. It is essential to take into account every aspect of communication, including pauses, hesitations, and non-verbal expressions such as facial expressions and tone of voice. These elements can provide valuable insights into the interviewee's thoughts and feelings that may not be apparent in the written text. To overcome these difficulties and avoid any distortions, this research will use the verbatim technique, which involves describing the spoken text word for word, including breaks, mispronunciations, and non-verbal expressions of the respondents (Corden and Sainsbury 2006). The verbatim technique is an effective way to capture the real interaction that took place during the interview and ensures that the transcription is an accurate representation of the interview. However, it is important to note that transcribing verbatim can be time-consuming and may result in a large amount of data, which can be challenging to analyze. Therefore, the process of transcribing must strike a balance between capturing every detail and keeping the data manageable for analysis.

Once the interviews have been transcribed from spoken language to written text, the next step is to code them using a software program such as NVivo. This process involves categorizing the data into different themes or codes, which can help to identify patterns and key findings to create the code tree. For this research, a provisional coding method is used, which involves generating a preliminary list of codes based on preparatory research matters. In the case of urban farming, the preparatory research matters were the three main elements of sustainability, as defined by the United Nations Brundtland Commission in 1984. These elements include economic, social, and environmental sustainability, and they provide a useful framework for analyzing the interview data in a structured and systematic way. By using a provisional coding method and a clear framework for analysis, researchers can more easily identify trends

and insights from the interview data and use this information to develop more informed conclusions and recommendations.

While a predefined coding list can be helpful in organizing data, it can also be limiting, as it may cause researchers to overlook important information that does not fit neatly into the pre-established codes. To address this issue, this research will complement provisional coding with descriptive coding in a second coding cycle. This approach involves summarizing the qualitative data from the interviews using words or short sentences that can eventually be used to create new codes (Bryant and Charmaz 2010). By using this technique, researchers can ensure that important findings that do not fit the predefined code tree are not overlooked and that the full range of insights and perspectives from the interviews are captured and analyzed. This more flexible approach to coding can also help to uncover unexpected themes or patterns in the data that may not have been anticipated at the outset of the research. Ultimately, by combining both provisional and descriptive coding methods, this research aims to provide a comprehensive and nuanced analysis of the interview data and generate new insights and knowledge in the field of sustainability research.

4 Analysis

4.1 Environmental Sustainability

The analysis of various documents has revealed that urban farming practices can significantly impact environmental sustainability, primarily by reducing the number of resources consumed and waste produced (Kumar and Cho 2014; Sayara et al. 2016; Shamshiri et al. 2018). Furthermore, studies have shown that urban farming can also play a positive role in enhancing biodiversity and promoting a healthier urban environment (Dudley and Alexander 2017; Filazzola et al. 2019). This highlights the potential of urban farming to contribute to a more sustainable and resilient future for cities.

4.1.1 Resource Consumption

Urban farming has emerged as a sustainable alternative solution to traditional farming due to its potential to consume fewer resources. Unlike conventional farming practices that require vast areas of land and large amounts of water, urban farming operates within limited urban spaces using various innovative methods like hydroponics, aquaponics, and vertical farming. These techniques allow for more efficient use of resources such as water, land, and nonrenewable energy, resulting in reduced resource consumption. When asked about resource consumption, Interview Respondent 1 said:

“We're a hydroponic farm. So we primarily rely on, you know, water and nutrients to keep the plants growing. And all these obviously controlled by us. And we use a mixture of rainwater as well as the tap water. And we use 90% less water than traditional farming. And nutrients wise, we obviously will have to buy our own, and then we will mix it according to our own certification.”

Indeed, some research shows that the demand for water is increasing rapidly in highly populated cities, which is becoming a significant concern, particularly in areas experiencing drought or limited access to fresh water sources (Shi et al. 2018). As urban populations grow, the pressure on the existing water infrastructure intensifies, leading to water scarcity issues. This situation calls for an urgent need to find sustainable solutions to cope with the increasing water demand in cities. Urban farming practices like hydroponic farms show that there is a great reduction in the use of water. In addition, Barbosa et al. (2015) pointed out that hydroponic farming can be highly useful in urban areas due to its water and land-saving benefits. By eliminating the need for soil, hydroponic farms can save valuable land resources while using significantly less water than traditional agriculture (Barbosa et al. 2015). This can promote sustainable and

efficient food production in highly populated cities where vacant land is scarce. In addition, aquaponic farms can also reduce the use of water by recycling in their system. When asked about how the farm is watered, Interview Respondent 3 said:

“The third way so, we call in the, in the aquaponic slang, we call it the return water. So, it's water that has not been absorbed by the plants. For instance, once we launch an irrigation system, so, visually you have to see a bit maybe, but I will try to visualize it for you. So, for instance, in the greenhouses, in our hermetic herbs, we water the plants on tables. So there is a kind of drain system that brings the water and fill in the tables with water and this water that has not been absorbed by the glands goes back to the drain system and goes back to our irrigation system”

However, water is not the only resource that is saved during this process. Interview Respondent 3 also pointed out that the manure of the fish is also used for the fertilization of the plants they have on their farm. Such a system can reduce the use of traditional fertilizer and provide healthy organic food. Indeed, it is proven by existing literature that aquaponics combines a sustainable method of raising fish and vegetation in a resource-saving way. It raises fish in tanks with soilless plant culture, and the nutrient-rich water from raising fish serves as a natural fertilizer for the plants while the plants help to purify the water for the fish (Karimanzira et al. 2016).

In a highly populated urban context, both aquaponic and hydroponic farms are innovative and sustainable solutions that can help address the challenges of urban farming by eliminating the need for soil. In addition to saving other resources like water, document analysis shows these systems can save a significant amount of land as well, which is especially valuable in cities where space is at a premium (Junge et al. 2017; Kyaw and Ng 2017). However, all the urban farming projects selected for this research have shown that they use fewer resources in comparison with traditional farming. This includes urban farming that does not apply modern technologies like aquaponic and hydroponic farms. For instance, Interview Respondent 2 from De stadsgroenteboer said that they utilize foldable plastic crates that are durable and reusable to store the vegetables. At the designated pickup point, people are instructed to transfer the vegetables into their own bags while leaving the crates behind. They emphasized that they try their best to minimize waste production.

Indeed, urban farming provides a solution to reduce the environmental impact of packaging by diminishing the requirement for packaging materials. As food is grown and sold in the same urban areas, the distance it needs to travel from farm to customers is reduced, leading to lesser packaging needed for transportation and storage. This decrease in packaging not only benefits the environment but also promotes an

economical and sustainable method of delivering fresh produce to consumers (Kisner 2008). In addition, Interview Respondent 5 even emphasized that they do not package their products at all when they sell their food at the local farmer's market. This is something the customers are satisfied with because, most of the time, people come with their own bags.

Furthermore, as the food is only delivered to the local city, there is a reduction in the transportation of food. This will dramatically reduce the use of fossil fuels. Urban farming plays a crucial role in decreasing the environmental impact of transportation by shortening the distance that food needs to travel from farm to table. As food is grown within the city limits, there is no need for long-distance transportation, which results in a considerable reduction in greenhouse gas emissions and air pollution caused by fossil fuel-powered vehicles (Oliveira et al. 2021). In addition, some urban farms utilize sustainable transportation methods such as bicycles or electric vehicles to deliver produce to local markets, further diminishing the use of fossil fuels (Milestad et al. 2020). By reducing the demand for fossil fuel-powered transportation, urban farming can contribute to mitigating climate change and promote a more sustainable and eco-friendly food system. True, Interview Respondent 2 said that all their products are delivered to Amsterdam city by cargo bikes which consume zero fossil fuel and can greatly contribute to environmental sustainability.

In addition, urban farming offers an effective solution to mitigate the urban heat island effect and save cooling energy. Interview respondent 1 said that their rooftop farm serves as a natural barrier to the scorching sunlight during the summer. This is especially important as summer in Singapore is usually over 30 degrees. By incorporating greenery into urban environments, urban farming can help to decrease the reliance on energy-intensive cooling systems in urban buildings. This is especially true when urban farming is applied on the rooftop of a building. The natural shade provided by plants and other vegetation can absorb the heat directly coming from sunlight, which reduces indoor temperatures and minimizes the need for air conditioning (M Hui 2011). As a result, urban farming can help to reduce cooling costs and promote energy conservation.

Although urban farming has the potential to provide many benefits, it can also consume significant resources, such as water and electricity (Shamshiri et al. 2018). Urban farms may require more water than traditional rural farms due to factors like the climate of the farm, limited access to natural water sources, and may rely on municipal water supplies or groundwater wells, which can strain local resources and lead to higher energy use for pumping and treatment (Dorr et al. 2023).

Indeed, when asked about how the farm is watered, Interview Respondent 3 said that they work with the city of Brussels to gain access to the city's groundwater system. The reason is that their fish farm requires more high-quality water. Rainwater cannot serve as a source of water for the fish farm as it might not meet the right standards. In addition, indoor vertical farming systems commonly used in urban farming practices also require significant amounts of electricity to power lighting and other systems necessary for plant growth (Shamshiri et al. 2018). This has been confirmed by Interview Respondent 3 as they said:

“...the energy use, for instance, the electricity and so on, but we do not have any issue but the price is having an impact also on our activity and for maintaining the farm... we have we use a lot of electricity, we have a lot of automatic system that also has a cost behind so to cover these those costs, we have to also propose a price that is a bit more higher than the price that is proposed in the market.”

Despite the possible drawbacks, urban farming still is a better sustainable alternative to traditional farming because it has the potential to consume fewer resources. Unlike conventional farming, which requires vast areas of land and significant amounts of water, urban farming operates within limited urban spaces using innovative methods like hydroponics, aquaponics, and vertical farming. These techniques enable more efficient use of resources, such as water, land, and non-renewable energy, resulting in reduced consumption of resources.

4.1.2 Biodiversity

The preservation and enhancement of biodiversity are vital for environmental sustainability, as it provides numerous ecosystem services such as nutrient cycling, soil formation, water purification, and pollination (Fjeldsaå & Lovett, 1997; Tilman, 2012). These services are essential for human well-being and environmental health, especially in highly populated cities, and their loss can have severe consequences on the sustainable development of the urban environment (Elmqvist 2013). Thus, it is crucial to maintain healthy ecosystems and promote resilience to environmental changes through the conservation and promotion of biodiversity.

Urbanization and the expansion of highly populated cities have led to significant biodiversity loss in many urban areas. The conversion of natural habitats and green spaces into urban infrastructure is a major factor in biodiversity (Elmqvist 2013). In addition, invasive species that are better adapted to urban environments can outcompete native species, and fragmented habitats can make it difficult for species to move between habitats, leading to a loss of genetic diversity (Linders et al. 2019; Mollot et al.

2017). Furthermore, urbanization also leads to changes in environmental conditions, such as high temperatures, poor air quality, and lack of water availability, which can negatively impact many species' survival and reproductive success (McGlynn et al. 2019). Despite these challenges, there are initiatives to preserve and restore biodiversity in urban areas, one being incorporating urban farming and other type of green spaces in urban development. Protecting and restoring biodiversity in cities is essential for the sustainable development of ecosystems and for promoting human well-being.

Urban farming has become increasingly popular in recent years because of its benefits to the environment. One of the key benefits of urban farming is its ability to support biodiversity in highly populated cities. By creating green spaces in urban areas, urban farms can provide important habitats for wildlife, from insects to birds and even small mammals (Dudley and Alexander 2017). In addition, sustainable farming practices such as composting and avoiding pesticides can help to improve soil health and create healthier and more resilient ecosystems, which can contribute to the increase of biodiversity (Biswas et al. 2005). In addition, by incorporating native plants into urban farms, we can further support biodiversity and promote a more sustainable and equitable food system.

Many urban farms grow different kinds of vegetation, contributing to improving urban biodiversity. For instance, when asked about how many different kinds of vegetation are there on the farm, Interview Respondent 5 said:

“I can't count them, probably 200 different species. They're specifically installed to teach kids how a rain garden is. So we're focusing on the rain gardens, we're focusing on bioswale, which is essentially a rain garden. You know, if you go into I'm from Switzerland, we have the Alps, you have a lot of rocks going down a stream. That's like a rocky stream, a dry dry creek. So we built those here. First of all, it looks pretty second, when we do have water like we have this year, then it actually fills the creek and, you know, the vegetation can grow around it. And because we're in California, we only grow California native, non-invasive species.”

Incorporating native plants into urban farming can have a significant positive impact on biodiversity. Native plants are well-suited to local ecosystems, providing essential habitat and food for local wildlife. By including native plants in their farms, urban farmers can help support local biodiversity and promote ecosystem health (Burghardt et al. 2009). Therefore, incorporating native plants in urban farming can contribute to biodiversity by creating more sustainable and resilient urban ecosystems, improving the overall health and well-being of urban communities.

In addition, the use of bioswale is also beneficial in terms of biodiversity. It has the ability to create crucial habitats for wildlife by providing vegetated areas within urban environments. This enables bioswales to serve as a refuge and foraging opportunities for various species, such as birds, insects, and small mammals (Okoro et al. 2017). By doing so, bioswales increase the biodiversity of urban areas and contribute to the overall health of the ecosystem.

Bioswales have the potential to greatly enhance biodiversity in highly populated cities like Los Angeles. By providing a habitat for a variety of plants, insects, and animals, bioswales can increase the number of species present in urban areas, helping to promote ecological diversity and stability (Filazzola et al. 2019; Sam & Hui 2011; Kalantari et al. 2018). Therefore, incorporating bioswales into urban farming and planning can help create more sustainable and resilient communities that prioritize the food production and restoration of local ecosystems (Bisaga et al. 2019b).

Similar to traditional farming, pests and diseases can have a significant impact on urban farming. These impacts reduce crop yields and damage local food systems. Urban farmers use a variety of techniques to manage pests and diseases, including organic treatments, crop rotation, and the use of resistant crop varieties. However, one of the farms that was interviewed has a unique way of dealing with pests and diseases while improving biodiversity. Interview Respondent 3 said:

“We rarely use pesticides. So pesticides that are recognized by the EU, but the EU, but a daily way to fight it's with natural mechanisms. For instance, for illnesses and invasive insects we use other insects, so use biomimetics mechanisms that nature uses also, for instance, we use ladybugs, bumblebees, and mites. We also have other mechanisms, a natural mechanism to fight against those illnesses.”

Indeed, urban farmers are increasingly using certain insects for pest control, which has proven to be an effective method of managing pests and invasive species. In addition to being an environmentally friendly alternative to chemical pesticides, using beneficial insects for pest control can also promote biodiversity in urban farming systems (Kremen & Chaplin-Kramer, 2007). Beneficial insects like ladybugs can be released into the farming system to prey on pests, while nematodes can control soil-borne pests. This approach can help maintain ecological balance and sustainability while also managing pests and invasive species (Naylor & Ehrlich, 1997). Ultimately, using beneficial insects for pest control in urban farming offers a sustainable and effective solution to promoting healthy crops and ecosystems.

All of the farms selected for this research produce food in an organic and sustainable way by using natural compost, which has a significant impact on soil quality and, ultimately, biodiversity in urban areas. For the compost, they only use organic materials like food scraps, leaves, and vegetables that are not in a good state for sale, and then they are broken down into a nutrient-rich soil amendment that can be used to fertilize crops. As a result, soil quality is improved by applying compost to urban farming practices, and it can promote robust and healthy plant growth and reduce the need for synthetic fertilizers (Stockdale & Watson, 2009; Leifeld, J. 2012). In addition, organic and natural compost can also help the soil retain moisture, reducing water usage and the risk of soil erosion. By providing a habitat for soil organisms such as earthworms, beneficial bacteria, and fungi, organic and natural compost can support biodiversity, which is essential to maintaining the health and sustainability of urban farming systems (Van Leeuwen et al. 2019).

In conclusion, urban farming has emerged as a promising solution for promoting biodiversity in highly populated cities. By utilizing sustainable farming practices and incorporating urban farming with native plants and bioswales, urban farms can provide important habitats for wildlife and promote healthier ecosystems. The benefits of urban farming extend beyond environmental impact, as it also promotes a more sustainable and equitable food system. As cities continue to grow, urban farming can serve as a valuable tool for preserving and enhancing biodiversity while contributing to a sustainable environment for city dwellers.

4.1.3 Waste Production

The production of waste in highly populated urban areas can have a significant impact on local environmental sustainability and people's life. As populations continue to grow, the amount of waste generated increases, leading to challenges in waste management and potentially negative consequences for the environment, such as land pollution, water contamination, and greenhouse gas emissions (Ergen 2018). In most cities, landfills and incinerators are usually used to dispose of waste. However, such methods can release greenhouse gasses, contribute to air and water pollution, and harm biodiversity (Crowley et al. 2003).

Urban farming can help reduce waste and promote sustainability in cities by providing a local source of fresh produce and reducing the need for long-distance transportation. Additionally, by utilizing organic and natural farming methods, such as composting and avoiding synthetic fertilizers and pesticides, urban farmers can create healthier and more resilient ecosystems while minimizing negative impacts on the environment. The way how the selected urban farming projects grow food suggests that there is barely any

waste produced from the growing to delivery process. For example, when asked about waste production, Interview Respondent 1 said:

“...because we circulate the water and the nutrients as much as we can. And most of it gets taken up by the plants. So there is actually very little waste over there. There is some plastic waste and some maybe paper waste and stuff like that, we actually ship out our vegetables together with a root and a growing medium. So we reduce the wastage on that end, because that actually goes to the consumers. And when consumers are done with consuming the vegetables, they can actually take that grow medium, which is made on cocopeat, and together with the roots that are already there, they can just break it up and actually put it into the potted plant for the then compose.”

According to research, hydroponic farming is a sustainable method of growing crops in urban areas that can produce less waste compared to traditional farming methods. This is because hydroponic systems recycle water and nutrients, reducing the amount of water used for irrigation and minimizing nutrient runoff (Gentry 2019; Kumar and Cho 2014). In addition, all the farms show that they produce zero plastic waste as most of the products are either not packaged at all or packaged using reusable tools like foldable crates. This provides important implications for urban sustainability as food packaging can influence the environment greatly. Less packaging involved in food production and transportation means less raw materials used in the production process and less energy used to manufacture and transport materials. These practices show that there is a reduction in litter and pollution, as well as the amount of waste that ends up in landfills and oceans (Ncube et al. 2020).

In addition, it's been estimated that many cities in developing countries lack formal waste sorting systems or infrastructure. And while some developed cities have experience with advanced waste sorting systems, others may struggle to implement effective recycling and waste reduction systems due to logistical, financial, or political challenges (Rousta et al. 2017). As a result, the failure to sort waste can lead to missed opportunities for resource recovery and recycling, which can result in unnecessary depletion of natural resources.

Interview Respondent 1 mentioned that they ship the growing medium that is made of cocopeat, along with the roots of the plants, to the customers. This unique practice not only reduces waste but also allows customers to make compost themselves, and many of them appear to do so, according to Respondent 1. Additionally, since cocopeat is a natural, biodegradable material, it will not harm the environment even if it is disposed of. This approach demonstrates how innovative solutions can be developed to address

waste production and promote sustainability in urban agriculture. In addition, it is also a showcase for other urban farming projects to grow food without producing much waste.

Interview respondent 3 emphasized that they produce basically zero waste by adapting the “Cradle to Cradle” approach. They said that in urban farming and architecture, it is quite common to emphasize material reuse, especially before they become unusable. They try to breathe new life into materials that would otherwise be discarded or wasted. At their farm, the interviewee mentioned that they make extensive efforts to maximize material reuse, particularly with organic materials. For example, their offices are constructed from shipping containers that have been transformed into functional workspaces. Their overarching goal is to minimize organic and material waste by promoting the “Cradle to Cradle” approach.

Indeed, in the context of urban farming, the cradle-to-cradle approach can be applied to create a closed-loop system in which all waste generated from urban farming practices is reused or recycled (Schader et al. 2012). Therefore, food waste can be composted and used as fertilizer, and plant materials can be recycled to create new products. By adopting a cradle-to-cradle approach, urban farmers can reduce their environmental impact and contribute to a more sustainable and resilient food system.

However, Interview Respondent 3 pointed out that they do produce some waste when they prepare the fish on the farm. However, they also emphasized that they are working on solutions to minimize the waste produced on the farm. They said:

“There are some parts not use or they are not well cut. And this is kind of ways that we would like to say to valorize and we found a way in the future we might ask to a cook very famous cook in Brussels to transform this fish waste as as a new product transform so we say in French so it's a game of fish in I don't know if you know what is the kind of pate is a kind of fish mousse that you can put on some toast or something like this. So this is the plan that we have for the fish waste.”

Most interviewee respondents said similar things about their waste management, and they try to recycle as much as possible and provide a sustainable way of growing food. Interview Respondent 2 said that the only waste they produce on the farm is the vegetables that are not in good shape for sale, and they use them for feeding the chicken or compost. However, one of the farms selected for the research has applied something different to their waste management. They use anaerobic digestion to handle their waste. Interview Respondent 4 said that they use food waste sourced from different partners, including local municipal agencies, restaurants, and the farm itself, to divert some of the food waste away from the landfills and give it a second life through anaerobic digestion.

Indeed, anaerobic digestion can have a positive impact on waste management by providing a sustainable way to process organic farming waste and generate renewable energy. This is particularly important in highly populated cities where waste management is a huge predicament (Ahring 2003). The process of anaerobic digestion involves microorganisms breaking down organic waste without oxygen, which produces biogas that can be used as a source of renewable energy for electricity and heat production. Not only does anaerobic digestion reduce the amount of waste sent to landfills, but it also helps to mitigate greenhouse gas emissions by capturing and utilizing methane, a potent greenhouse gas that would otherwise be released into the atmosphere (Holm-Nielsen et al. 2009). Additionally, the nutrient-rich digestate that results from the process can be used as a fertilizer for agriculture, creating a closed-loop system that reduces the need for chemical fertilizers.

Overall, urban farming practices have shown that urban farming has the potential to reduce waste and promote sustainability in cities by offering a local source of fresh produce that requires little or no package. It can also reduce the waste produced in long-distance food transportation by selling locally. In addition, by employing organic and natural farming methods like composting and avoiding synthetic fertilizers, urban farming can create healthier and more resilient ecosystems while minimizing negative impacts on the urban environment.

4.1.4 Urban Environment Improvement

According to the interviews and the document analysis, urban farming offers a wide range of environmental benefits. By introducing green spaces and cooling elements into the highly populated urban landscape, it contributes to improved air quality and helps combat the urban heat island effect (Mohajerani et al. 2017; Tong et al. 2016). Moreover, urban farming plays a crucial role in reducing the carbon footprint of cities by fostering the growth of plants and vegetation that efficiently capture carbon dioxide and pollutants (Wakeland et al. 2012). Additionally, it promotes the availability of fresh, healthy, and locally sourced food, thereby minimizing food waste and cutting down on transportation emissions (Levis and Barlaz 2011). Another advantage of urban farming is its ability to enhance soil quality through organic composting practices (Brown et al. 2016; Montgomery 2007). Furthermore, it aids in purifying contaminated water and reduces reliance on synthetic fertilizers and pesticides, leading to improved water quality (Lente et al. 2012).

All of the farms selected for this research only deliver their products locally. For instance, Interview respondent 5 said:

“It's actually not even like local to LA County, or local to where the school is located. That would be the best. And because you want to reduce the co2, but also when you say that it's local to the school. And what we also do is that some of our produce is part of the school cafeteria.”

Indeed, urban farming can be particularly advantageous in terms of food transportation by reducing the carbon footprint related to the transportation process. The transportation of food over long distances is a significant source of greenhouse gas emissions, primarily caused by the burning of fossil fuels and other non-renewable resources (Enyinnaya Okoro 2017; Kisner 2008). However, by growing food within the city, urban farming can significantly decrease the distance of food transportation, thus lowering transportation emissions and the amount of fuel used.

In addition, urban farming gives opportunities for sustainable transportation as it allows customers to walk, bike, or take public transportation to the local gardens or farmers' markets. Therefore, they can reduce their dependence on vehicles that emit greenhouse gases and cause air pollution. In addition, urban farming allows the use of sustainable transportation methods such as cargo bikes or community-supported agriculture (CSA) programs that deliver fresh produce directly to consumers (Rivas-Aceves and Schmidt 2022). True, Interview Respondent 2 said:

“Our food is delivered to Amsterdam. We are located just like just outside Amsterdam. We deliver 123 kinds of vegetation by bike by cargo bikes. And it's delivered to different neighborhoods where people then pick up their weekly subscription. And I would say about 85% of all the food we produce goes to the boxes, the weekly boxes that enter the private people, families, whoever is interested, buys it. And then we have a small percentage that goes to a few restaurants that we work together with. Yeah, like we will this year start with one small shop to see how that goes. But yeah, the bulk is really there. The CSA”

In this manner, urban farming can promote clean transportation and healthier, more sustainable lifestyles while also reducing the negative impact of transportation on the urban environment.

Air pollution is a significant problem in highly populated cities, where concentrations of pollutants from traffic, industry, and other sources can damage people's living quality. Urban dwellers would suffer severe consequences if they were exposure to air pollution. The primary health concerns related to air pollution are respiratory problems such as asthma, chronic obstructive pulmonary disease, and lung cancer (Bernstein et al. 2004; Kampa and Castanas 2008b). Additionally, long-term exposure to air pollution is known

to be associated with cardiovascular diseases, such as heart attacks and strokes. Such diseases pose great challenges for both the people and sustainable urban development (Lee et al. 2014).

However, urban farming can mitigate this issue by increasing the number of plants and vegetation in an urban environment. Plants are effective at absorbing carbon dioxide through photosynthesis, converting it into oxygen, which is vital for human health. Moreover, plants can also absorb other harmful pollutants, such as nitrogen oxides and particulate matter, which are major contributors to air pollution (M Hui 2011; Tong et al. 2016). By increasing the number of plants and vegetation in the city through urban farming, the concentration of pollutants can be reduced, improving the overall air quality and contributing to a healthier environment for urban residents.

Apart from that, urban farming has the potential to significantly impact the urban environment in highly populated cities by increasing humidity and reducing temperatures. Through urban farming and the green space it provides, it can absorb heat and release water vapor through plants, a process known as evapotranspiration (Rabbi et al. 2019). This helps mitigate the urban heat island effect, which results from the concentration of concrete buildings and other heat-absorbing materials, leading to temperatures that are several degrees higher than the surrounding rural areas (Mohajerani et al. 2017; Qin 2015). In addition, urban farming can also replace impervious surfaces like concrete and asphalt, which contribute to increased temperatures and decreased humidity. In this context, urban rooftop farming is particularly useful for mitigating this problem.

Urban farming can further contribute to the urban environment by reducing the use of landfill for food waste. In many highly populated cities, food waste is a significant problem, and many cities tackle this with landfills. However, it will decompose and release methane, a potent greenhouse gas that results in climate change and affects air quality (Levis and Barlaz 2011; Liu et al. 2016). As a sustainable approach, urban farming can help reduce the amount of food waste generated by generating a local food system that emphasizes producing food locally and sustainably. By providing fresh, locally grown products to urban residents, urban farming can minimize the amount of food that needs to be transported from distant locations, minimizing the likelihood of spoilage and waste.

One thing most people neglect is the soil quality in highly populated cities, as they are mostly made up of artificial materials like metals and concrete. In addition to industrial and commercial activities, other urban human activities often lead to compromised soil quality in urban areas (Galitskova and Murzayeva 2016). The presence of contaminants

such as heavy metals, petroleum products, and pesticides pose a great challenge for sustainable urban development. In addition, these pollutants can exist in the soil for a long time and pose a threat to both human health and the environment. However, urban farming can have a significant impact on its quality in urban areas, particularly through the practice of organic composting (Calleja-Cervantes et al. 2015). This is something that all selected urban farming projects practice in the daily operation of their farms. For instance, Interview Respondent 1 said:

“Maybe like the leaves are not as green as the supermarket one or you know certain things don't look so nice you pluck it off, but what we do also is that we either you know donate that to some food rescuers or sometimes there are certain organizations that do one compost for their soil base growing so we then pass it over to them.”

Furthermore, Interview Respondent 3 also added that they actively engage in composting practices, specifically targeting vegetables and other plant materials that may not meet the criteria for sale at their farm. Apart from giving them away or getting rid of them, they transform them into nutrient-rich compost. This sustainable approach not only reduces waste but also enhances the overall fertility and health of their soil. Indeed, by composting the unsuitable produce, they contribute to a circular and regenerative system that supports the growth of future crops while minimizing environmental impact in highly populated cities.

Composting is the process of breaking down organic waste, such as food scraps and yard waste, into nutrient-rich soil that can be used to support plant growth (DEBERTOLDI et al. 1983). In urban areas, where soil quality can be contaminated due to industrial and commercial activities, composting can help improve soil health and fertility. Organic composting, which involves using only natural materials and avoiding synthetic fertilizers and chemical pesticides, can also help improve soil quality, supporting a diverse range of beneficial microorganisms that contribute to soil health (Calleja-Cervantes et al. 2015; Courtney and Mullen 2008). Moreover, by diverting organic waste from landfills, urban farming can help reduce methane emissions and contribute to a more sustainable waste management system (Adhikari et al. 2006). In this way, applying organic composting in urban farming can have a positive impact on soil quality, promoting healthier and more productive urban agriculture while also contributing to a more sustainable urban environment.

Urban farming can also have a positive effect on water quality, especially in a highly populated urban setting. In urban areas, water contamination is a major issue due to various pollutants like industrial chemicals, pesticides, and heavy metals entering into water sources through several channels, such as runoff, leaking pipes, and illegal

dumping (Shi et al. 2018). In addition, the problem is exacerbated in cities where water infrastructure is aging, obsolete, or poorly maintained, leading to further contamination. Not having access to clean water can lead to severe health problems like gastrointestinal illness, respiratory issues, and neurological damage in humans (Ercumen et al. 2014; Sankhla 2018).

Implementing urban farming in highly populated cities can have several benefits for improving water quality because plants and vegetation can play a crucial role in purifying contaminated water through a process known as phytoremediation (Materac et al. 2015). This process works as plants absorb, break down, and remove pollutants from the contaminated water. Plants can purify the pollutants through their roots and transport them to their leaves or stems, where they are broken down or stored (Cunningham et al. 1997). Some plants are particularly effective at purifying certain pollutants, such as heavy metals or chemicals. In addition, urban farms can also capture and filter rainwater, reducing runoff and soil erosion. As a result, urban farms can help filter and purify pollutants in cities by absorbing and filtering stormwater.

Moreover, sustainable farming practices in urban farming can help reduce the use of synthetic fertilizers, which can contribute to water pollution. Indeed, most of the farms selected for this research do not use synthetic fertilizers in their farms. For instance, Interview Respondent 5 said:

“It's all organically fertilized. So we use the compost, we have a program where we allow people to bring their food scraps things, and our farmer knows exactly how to create compost. It's part of somebody in the environmental studies, I think they need to know how to make soil.”

Although urban farming can provide numerous benefits, it can also have some negative impacts on the urban environment if it is implemented inappropriately. One major concern is soil contamination, as urban soils may be polluted by artificial fertilizers and other chemicals that can pose a risk to human health if absorbed by crops (Brown et al. 2016). In addition, urban farming can also contribute to water pollution if the water from the farm is not properly managed and disposed of (Falkenberg et al. 2018). Furthermore, the resource-intensive nature of urban farming can contribute to environmental problems such as water scarcity and greenhouse gas emissions (Olesen et al. 2006). However, with careful planning and management, these negative impacts can be minimized or avoided. Sustainable practices such as organic composting and rainwater harvesting can be incorporated, and soil quality can be tested and remediated so that urban farms can be designed to minimize their negative impacts.

Overall, urban farming has numerous environmental benefits, as revealed by the interviews and the document analysis. It can enhance air quality and mitigate the urban heat island effect by providing green spaces and cooling in the urban environment. In addition, it can reduce the urban carbon footprint by creating plants and vegetation that capture carbon dioxide and pollutants. Urban farming also provides healthy, fresh, and locally produced food by reducing food waste and minimizing transportation emissions. Furthermore, urban farming can improve soil quality through organic composting. It can also enhance water quality by purifying contaminated water and reducing the use of synthetic fertilizers and pesticides.

4.2 Social Sustainability

According to the interviews and the document analysis, urban farming has diverse benefits for communities in densely populated cities. It promotes community engagement, health, and development, raises environmental awareness, and strengthens social connections (Obach and Tobin 2014; Yusoff et al. 2017). It enhances urban food security by increasing access to fresh, healthy food, addressing food deserts, and improving public health (Teng 2020). Urban farming also plays a vital role in educating urban dwellers, especially students, about sustainability, biology, and the importance of being connected to nature. It fosters public awareness of food security and environmental issues while teaching practical skills such as plant biology, food preservation, and water conservation (Malberg Dyg and Wistoft 2018; Tamiru et al. 2016).

4.2.1 Community Improvement

Urban farming can have a variety of positive impacts on communities, especially for the ones located in highly populated cities. It can promote community engagement, improve community health and development, foster cultural inclusion, raise environmental awareness, provide opportunities for relaxation and outdoor recreation, promote democratic values, and foster social connection. By creating a shared platform for community members to engage with each other and participate in various activities, urban farming can help to build stronger, more resilient communities that are better equipped to tackle social challenges in urban areas.

All the interviewees responded positively when asked about the impact of their farms on the community they serve. For instance, Interview Respondent 2 said:

“We have regular days where people can come and help out at the farm to kind of feel invited, they can come and volunteer for a little bit. And twice a year, we do kind of like

a spring and fall or like, we call it a harvest party in the spring party. So it's more like an event that we do. And we will invite members of the CSA, but also their friends and their families and the kids, just like people who are interested, and then we give them tours, or we maybe make a small activity with them.”

Indeed, the document analysis shows that urban farming can play an important role in promoting community engagement in highly populated cities where they are often characterized by high social isolation and disconnectedness (Cornwell and Waite 2009; Quach and Burr 2020). The reason for that is most urban dwellers come from different places and have different backgrounds. As a result, these problems can contribute to a range of social exclusion. However, urban farming can help build social connections and relationships among community members by providing a platform to come together and be involved in growing food (Rivas-Aceves and Schmidt 2022). This can create a sense of community ownership over the food system and promote greater importance in community wellbeing. In addition, urban farming can also provide opportunities for community members to learn from one another, share cultural knowledge and skills, and build a sense of mutual support. In this way, urban farming can help strengthen social ties and build social connections, which can contribute to greater resilience and wellbeing in sustainable urban social development (Othman et al. 2018).

In addition, many urban areas have limited access to fresh food, particularly in low-income neighborhoods where residents may rely on convenience stores or fast-food restaurants for their meals (Gordon et al. 2011). However, urban farming can help provide access to fresh vegetables and other products as they are sold locally. Indeed, all of the selected farms provide a channel for fresh, healthy food by selling and delivering locally. For instance, Interview Respondent 5 said:

“Our community is a very poor community in Los Angeles County. It's one of the poorest areas in social equitable area for for our area in more or less Southern California... you take that produce, and you feed the the community with it. So you you create, you know, you take that produce, you go to the farmers market, you create, you build harvest that produce you go and do CSA programs...My intent is now to find money that will pay for the food boxes. So we can give them for free to our low and income people.”

Urban farming can provide a source of locally grown, fresh produce that is accessible to community members who may not have other options. By reducing the need for transportation and storage, urban farming can also help people consume food healthily and sustainably (Melissa N Poulsen et al. 2017). Additionally, urban farming can promote healthier eating habits and improve community health outcomes by increasing

access to and knowledge of fresh fruits and vegetables, which can help reduce the prevalence of diet-related diseases. Indeed, urban farming can contribute significantly to urban dwellers' health in many different ways. For instance, urban farming can improve people 's dietary habits and increase consumption of nutrient-dense foods by giving access to organic, fresh, and locally grown products, which can help reduce diseases such as obesity, diabetes, and heart disease (Harada et al. 2021).

Apart from providing access to healthy food, urban farming can also contribute to culture inclusion in highly populated cities where people come from different places with different cultures. People would feel less isolated if they could buy and cook their home cuisine. This is being practiced in one of the selected farms. Interview Respondent 5 said that they incorporate a wide range of vegetation in their farming practices due to the diverse cultural backgrounds of the community. With a community that includes South American and Asian residents, they intentionally cultivate a variety of Asian crops and South and Central American foods, blending them with local Californian ingredients. By acknowledging these culinary differences and connections, their farm celebrates the diversity of food and bring people from different cultural background together.

Indeed, urban farming can have numerous positive impacts on fostering cultural inclusion and exchange. Specifically, urban farming can promote different cultures by providing a platform for diverse community members to share and celebrate their own cultural heritage through food and urban gardening practices (Poulsen 2017). As a result, urban farming can contribute to promoting cross-cultural exchange and understanding so that community members can learn about different farming practices and preserve cultural heritage.

In addition, urban farming in highly populated cities can offer the opportunity for a peaceful and restful environment for community members to let go of stress and connect with nature, as cities, especially highly populated ones, often have limited access to green spaces and natural surroundings (Zasada 2011). As a result, urban farming is made an excellent way for urban dwellers to experience the privilege of spending time in a natural environment. Furthermore, with the seating areas and walking paths it provides, engaging in urban farming activities like gardening has been proven to have a soothing effect on the mind and can serve as a form of meditation for some people (Harada et al. 2021).

Apart from the mental health benefits, urban farming can also provide opportunities for physical activity and outdoor recreation. Planting, watering, and other farming-related activities are a great way to get some exercise, particularly for community members

who might not have access to other forms of physical activity (Othman et al. 2018). These activities can be an active and enjoyable way for people of all ages to stay fit and healthy. Urban farms can also provide spaces for outdoor recreational activities such as yoga, tai chi, or other exercises that promote physical health and well-being (Scheromm and Javelle 2022). Therefore, urban farming can help to improve the overall health and well-being of the people in cities by providing these opportunities for relaxation, physical activity, and outdoor recreation. Indeed, some of the selected farms stated that they organize free public tours to their farm so that people can enjoy themselves in nature while learning about how food is grown sustainably in an urban environment. For example, Interview Respondent 3 said that they do not privatize all their space because they want to create a space where the local community can have access. Therefore, they organization public tours to the farm on a regular base.

Furthermore, urban farming can have a positive impact on promoting democratic values by providing opportunities for community members to participate in decision-making related to food systems and land use that affect their lives. For many urban dwellers who do not have a voice in their community, this participation can lead to a more equitable, judicial and sustainable food system that reflects community values and addresses community needs (Obach and Tobin 2014; Sumner et al. 2011). In addition, urban farming can also create opportunities for community members to engage in political activism around issues such as food justice and urban agriculture policy, as there are still some barriers that limit access to healthy, fresh, and affordable food (Walker et al. 2010). However, urban farming can create a more engaged and judicial community by promoting democratic values such as participation, transparency, and inclusivity. It can foster a sense of civic responsibility and promote positive change for sustainable urban development as a whole. Involving urban dwellers in the decision-making process of how the farm should better serve the community has been done in one of the selected farms, as Interview Respondent 4 said:

“Urban Growers Collective is familiar with the needs of the urban communities that we serve, and we meet community members through grassroots outreach and frontline service. Additionally, for new projects, we use an inclusive approach to development through charettes and surveys to help gauge community needs. This becomes the stepping stone for our programs because being a grassroots agricultural collective requires needs-based commitment. As such, our programs are able to change with the circumstances our community partners face.”

Overall, urban farming has a multitude of benefits for communities, particularly those located in highly populated cities. It can have positive impacts on community

engagement, health and development, cultural inclusion, relaxation, outdoor recreation, democratic values, and social connection. By creating a common space for urban dwellers to interact and participate in various activities, urban farming can build stronger and more sustainable communities that are better equipped to address common social challenges in urban areas so that people can live in a sustainable environment that benefits everyone.

4.2.2 Food Security

Both the interviews and the document analysis suggest that urban farming can have a positive impact on urban food security in several ways. As food security plays a vital role in cities around the world, Urban farming can increase the availability of fresh, healthy food in urban areas, address food deserts, improve public health, improve the accessibility of food for low-income households, promote healthier eating habits for urban dwellers, and contribute to urban food production (Diehl et al. 2020; Mehta and Lal 2021). By establishing urban farms in cities, residents can have easier access to fresh products, reducing the likelihood of malnutrition and related health problems. Additionally, urban farming can provide an affordable way for low-income households to access fresh and healthy food and can reduce dependence on large-scale agricultural production, enhancing food security in a sustainable way in highly populated cities (Bisaga et al. 2019b).

All urban farming projects selected for this research showed that they contribute to urban food security as they can increase the availability of fresh, healthy food in urban areas, especially cities that import most of their food. For instance, Interview Respondent 1 said:

“While we're doing and, and also a lot about like food security, environmental sustainability, and even like, the context of production in Singapore.... the most recent update is that we actually have one main site, which is at Woodlands. And that one site has five greenhouses. So that's the only one location that we're producing at the moment, and that location will produce about 220 tonnes a year.”

Urban farming is particularly important to cities like Singapore, as the country imports 90% of its food. Singapore is a small island nation with limited land resources, and its reliance on imported food makes its food supply vulnerable to various factors like global pandemics and price volatility (Diehl et al. 2020; Teng 2020). However, urban farming can help mitigate this issue by increasing the local production of food and reducing dependence on outside resources. Indeed, urban farming can be an important source of food if it is implemented properly. It has the capacity to feed the whole

community. For instance, when asked about how much food the farm produces each year, Interview Respondent 5 said that their farm currently produces approximately 7000 to 8000 pounds of food. However, they are now preparing to launch an aquaponics system, which has the potential to yield 30,000 pounds of food. They said the implications of this increased production are remarkable because it means the community could potentially access an additional 30,000 kilos of food, and no child within the community would go hungry.

This is particularly meaningful for communities that do not have access to fresh food, as urban farming is proven to be effective in providing a reliable and affordable source of fresh products. In addition, urban farming can also contribute to addressing the issue of food deserts in low-income communities in highly populated cities. By operating underutilized spaces such as concrete rooftops, vacant lots, and also community gardens, urban farming can provide fresh and healthy produce to residents who otherwise would lack access to fresh, healthy food (Lin et al. 2017; Lovell 2010). By giving the power to communities to grow their own food, urban farming can help build self-reliable and self-sufficient food production in highly populated cities (Eigenbrod and Gruda 2014).

In addition, urban farming, especially in the form of indoor farming, such as vertical farming, can contribute to food production and reduce the dependence on traditional large-scale food production, which can be easily affected by extreme weather conditions, pests, and other factors (Benke and Tomkins 2017). Indeed, urban farming has the ability to be resilient to harsh weather conditions and contribute to food security in highly populated cities by utilizing various technologies that allow for year-round food production (Mehta and Lal 2021). For example, both hydroponic and aquaponic farming systems can be used to grow plants and fish in a controlled, stable environment, reducing the impact of weather fluctuations and other factors like global pandemics on food production (Pulighe and Lupia 2020). True, two of the farms selected for this research are hydroponic and aquaponic farms, and the interview respondents all emphasized that they can produce food efficiently without worrying about the weather condition.

Furthermore, applying vertical farming techniques to urban farming practices can not only secure all year-round food production under harsh weather conditions but maximize space utilization and allow for higher yields in a smaller environment (Al-Kodmany 2018). By using both horizontal and vertical space, vertical farms can grow crops without applying traditional methods like using soil. As a result, vertical farming can contribute to food security in an urban setting by producing more food with the same amount of space in comparison with traditional farming.

Apart from that, both hydroponic and aquaponic farming are proven to be innovative methods of growing healthy, nutritious plants in a sustainable way. With the application of a nutrient-rich water solution, hydroponic farming can grow different vegetation without soil (Alshrouf 2017; Tyson et al. 2008). At the same time, aquaponic farming can integrate certain types of fish into the system, where the fish waste provides nutrients for the plants to grow healthily (Mishra 2018). Both methods offer several benefits, including accurate control over growing conditions, year-round growing and harvesting, and reduced water usage. In addition, hydroponic and aquaponic farming ensure that the products are free from harmful pesticides and other chemicals often used in traditional farming (Sayara et al. 2016). Overall, by providing healthy and nutritious food in a stable manner, both hydroponic and aquaponic farming can contribute to food security in highly populated cities.

Despite the fact that some of the farms selected for this research are private commercial farms, all of them stated that they donate a certain amount of food to those who cannot afford healthy fresh products in low-income families. For instance, Interview Respondent 3 said that they try to give vegetables, such as tomatoes, to people with low income. At times, they donate them to nonprofit associations that collaborate with the municipality for various activities, such as arranging private cooking lessons. In addition, they also give vegetables to their team colleagues internally.

Indeed, there are many people who do not have access to healthy food because they cannot simply afford it. This is particularly true in low-income communities. Although many benefits can be found in urban farming in highly populated cities when asked about the price of their products, most of the interviewees said that their products are more expensive than the same products people can find in the supermarket. For instance, Interview Respondent 2 said that their farm's produce can be a little more expensive compared to organic supermarkets or farmers' markets. However, they also mentioned that the cost depends on the season and availability of vegetables. While prices may be higher in traditional markets and supermarkets during off-seasons, the farm maintains consistent pricing throughout the season. The interview emphasized that as a CSA, they set prices to reflect the farm's values and efforts, aiming to establish a connection with members and emphasize the value of sustainably grown vegetables. Furthermore, Interview Respondent 3 also added:

“So the pricing of our products are a bit more expensive than the pricing that you can find. For instance, in this kind of food market or so in some supermarket to the reasons why it's a bit more expensive. I'm not saying it's really expensive is a bit more expensive, because we want as much as possible so to obviously to gain from the selling of the

products but also to be as much as possible to democratize price. So something that is also at accessible for the local consumers.”

Indeed, some documents show that urban farming products are often more expensive than the same products found in supermarkets due to several factors. For instance, the cost of food is higher than traditional farming due to labor costs, specialized equipment, and technology investment (Likitswat 2021; Lucan et al. 2015). These technologies are often applied in urban farming practices such as hydroponic and aquaponic farming systems. In addition, most urban farming projects, especially the ones located in highly populated cities, operate in high-cost urban environments and have higher overhead costs, such as rent and utility bills, which drive up the price of their products (Stone 2015).

Urban dwellers cannot afford fresh, healthy products even if they are available in their communities if they don't have the purchasing power. However, governments can give out subsidies to urban farms so that the price can be reduced. This is proven efficient, as Interview Respondent 4 said:

“It's not a matter of “if” community members want access to fresh fruits and vegetables, it is a matter of purchasing power. Once we began giving out free \$10 voucher coupons with Covid Relief Emergency Funds, the number of folks being served on the Fresh Moves Mobile Market skyrocketed from 5,000 customers annually to over 36,000 in 2022. “

However, there is no doubt that urban farming has the potential to positively impact urban food security through multiple channels. Given the significance of food security in highly populated urban areas worldwide, urban farming can enhance the availability of fresh and nutritious food all year-round, tackle food deserts, advance public health, increase food accessibility for low-income families, and support urban food production. The establishment of urban farms within cities can facilitate convenient access to fresh produce for urban dwellers, thereby decreasing the likelihood of malnutrition and associated health issues. Furthermore, through government subsidies and donations, urban farming can provide access to healthy food for low-income households while reducing reliance on large-scale agricultural production and promoting sustainable food security in densely populated urban areas.

4.2.3 Education

Both the document analysis and the interviews indicate that urban farming increases public awareness about issues like food security and environmental protection. It also

has a significant impact on education, teaching urban dwellers, especially students, about various subjects such as environmental issues, biology, sustainability, and public health (Tamiru et al. 2016). Students participating in the food-growing process learn about the impact of climate change and soil degradation on urban food production, as well as sustainable farming practices to mitigate these issues (Malberg Dyg and Wistoft 2018). They learn about the importance of healthy, affordable food access and plant biology, preservation, safety, and nutrition. Urban farming also fosters a connection with nature and instills a sense of responsibility for the urban environment (Lehmann et al. 2019).

All of the farms selected for this research have different ways of working with local schools so that students can go to their farms at a certain time to learn about urban farming. For instance, Interview Respondent 5 said that they create farm labs in the schools they work with, and children can learn about growing food, nutrition, cultivating land, and nature science. Their goal is to have a lasting impact on their lives and inspire future generations through education by teaching children to change their habits in food, environment, and health. In addition, Interview Respondent 1 added:

“...sometimes giving talks at schools. And so they're getting the school kids themselves to come over to the farm and see how the operations are like. And of course, we will then tailor that according to what the school is looking to do, you know, for different programs, and all that sort of thing. We typically engage a lot more with what we call the secondary schools, which are probably your high school. Yeah, so about 14 to 1213 to 16, or 13 to 17. And we deal a lot with the tertiary education and as well, so junior colleges, polytechnics, and even universities, primary schools, we are open but of course, then the content doesn't go as deep. It doesn't become a technical.”

Indeed, urban farming is a great way to teach children about plant science, nature science, and healthy eating habits. By engaging in urban farming, children can learn about the different parts of the vegetation they eat or see in the supermarket, their growth, and what they need to survive, especially in an urban environment (Blair 2010; M. N. Poulsen et al. 2017). In addition, they can also learn about the importance of soil, water, and sunlight for plant growth, as well as the role of insects and other animals in pollination. Furthermore, urban farming helps children develop an appreciation for the natural world and the interconnectedness of living things (Lehmann et al. 2019). They can learn about the importance of biodiversity and the role of ecosystems in sustainable urban development. Observing the plants and animals in an urban garden can teach them about different species' lifecycles and the ways in which they depend on each other. Urban farming also enables children to develop healthy eating habits by teaching

them about fresh, nutritious food. They can learn about the different nutrients that are important for their bodies and how to prepare healthy meals (Ilieva et al. 2022; Tamiru et al. 2016). They can also learn about the impact of processed and fast foods on their health and the benefits of eating a balanced and varied diet.

In addition, urban farming also offers students a unique opportunity to connect with nature and develop a deep appreciation for the environment. As they engage in hands-on activities like planting, growing, and harvesting, students can experience the way of nature and how urban farming can sustain life. Furthermore, urban farming can help students to develop a sense of responsibility towards environmental protection and inspire them to work towards a sustainable future in urban areas. Indeed, one of the farms demonstrates this by building outside urban farming labs in the schools they work with. The interviewee said:

“Children who learn and who are in an environment that has trees and grasses and pollinators, and, you know, produce just green environment actually learned better than kids who are in a concrete school with maybe even bars on their windows, and they hardly see the blue sky. So there is scientific studies there that children's do better being involved having activities having learning outside as well. Um, so what it means is that we design we farm and we educate and in the entire process, children are involved.”

Indeed, through urban farming practices, students can gain a deeper understanding of the characteristics of the natural world and the importance of urban food production. By observing the different plant species from start to finish and how they are adapted to their environment, they can learn about the roles they play in ecosystems and the impact of human activity on the food production process and the environment as a whole (Malberg Dyg and Wistoft 2018). Moreover, they can learn about growing food in a sustainable and responsible manner, including the importance of conserving resources, reducing waste, and minimizing the use of harmful chemicals. By taking an active role in caring for plants and the environment, students can develop a sense of ownership and responsibility for the world around them (Blair 2010). This can inspire them to become advocates for the environment and work towards creating a more sustainable future. Whether through advocating for policy changes or making changes in their own lives to reduce their environmental footprint, urban farming can provide students with the motivation and skills needed to become responsible stewards of the environment (Skinner et al. 2011).

Furthermore, urban farming can have a significant impact on children's eating habits by teaching them about the importance of fresh, nutritious food. Through participating in urban farming practices, students can learn about the different nutrients that are

important for their bodies and how to prepare healthy meals using the food they grow. Such participation can contribute to their mental health and general well-being (van Lier et al. 2016). They can also learn about the impact of processed and fast foods on their health and the benefits of eating a balanced and varied diet. In addition, urban farming can provide an excellent opportunity for students to develop a deeper appreciation for fresh produce, encouraging them to choose nutrient-dense foods over unhealthy options like fast food (Bukhari et al. 2011). What's more, under the supervision of professionals, children can experiment with different recipes and learn how to incorporate a variety of vegetables into their meals, promoting a diverse and balanced diet. By understanding the long-term health drawbacks of a poor diet, children can develop a lifelong appreciation for fresh, sustainably grown, making more informed decisions about their diets (McAleese and Rankin 2007).

Apart from that, one of the farms emphasized that they work with culinary schools in their city so that the students can learn more about the ingredients they use. Interviewee Respondent 3 said that through the collaboration they have with the culinary school in Amsterdam, students can have a profound engagement as it provides them with a practical connection between the products they are cooking and their source. In addition, Interview Respondent 3 also mentioned that this hands-on experience enabled future chefs to gain a deeper understanding of the culinary process and appreciate the origins of the ingredients they used. This also aligns with Interview Respondent 1 as they said that their farm engages not only with students from primary school and middle school to carry out various educational activities, they also collaborate with colleges and polytechnics to engage students who are specialized in urban farming-related fields, providing them with hands-on experience which will help them in their future career.

Overall, urban farming can provide a valuable educational experience for students while raising public awareness about food security and environmental protection. Through sustainable farming practices, students can learn about various subjects such as environmental issues, food security, biology, food science, sustainability, public health, and the importance of being close to nature. Urban farming also teaches students about plant biology, food preservation techniques, food safety, nutrition, water conservation, and disease prevention. It creates an opportunity for students to connect with nature and develop a sense of responsibility for the urban environment.

4.3 Economic Sustainability

Both the interviews and the document analysis reveal that urban farming has significant economic implications for highly populated cities. It improves food production efficiency by implementing advanced technologies and techniques like hydroponics and

vertical farming, making it more resilient to extreme weather conditions (Benke and Tomkins 2017). By producing fresh food locally, urban farming reduces dependence on imports and transportation costs, helping cities lower their food deficits (Oliveira et al. 2021). Moreover, urban farming can generate year-round income through direct sales at farmers' markets, restaurants, retailers, or online platforms. It creates employment opportunities in farming, distribution, and marketing and stimulates entrepreneurship (Surls et al. 2014). Additionally, it contributes to community economic growth by attracting customers to local produce markets, supporting related businesses, increasing property values, saving municipal costs, and enhancing access to fresh food in low-income areas (Banerjee 2013; Sadler et al. 2013).

4.3.1 Food Production

Urban farming can contribute significantly to the economy by producing food more efficiently. It achieves this through implementing technologies such as hydroponics, vertical farming systems, and sensors to monitor plant health and optimize growing conditions (Alshrouf 2017; Quagraine et al. 2017). As many of these methods can be implemented indoor, urban farming can also be more resilient to extreme weather conditions such as drought and flood. Urban farming can also help cities lower their food deficits by producing fresh, healthy food locally, reducing the dependence on imported food, and reducing transportation costs (Oliveira et al. 2021). Additionally, urban farming can provide all-year-round production of fresh food through the use of indoor hydroponic systems and vertical farming systems. By selling products all year-round at local farmers' markets, directly to restaurants and other retailers, or online, urban farmers can generate income and support the local economy throughout the year (Rivas-Aceves and Schmidt 2022).

Incorporating advanced technologies is a key way for urban farming to increase its efficiency in food production. Both the interviewees and the document analysis suggest that hydroponic systems can produce higher yields of crops in less space than traditional soil-based farming (Sharma et al. 2018). Indeed, compared to traditional soil-based farming, the hydroponic system can greatly contribute to food production because of its various benefits, such as being resilient to extreme weather and using less water and space (Avgoustaki and Xydis 2020). As a result, it can generate greater crop yields per area. These systems, which involve cultivating plants in a nutrient solution instead of soil, have been demonstrated in studies to produce yields up to ten times higher than conventional soil-based farming. Certain crops like lettuce, tomatoes, and herbs have even been shown to achieve even greater yields (Barbosa et al. 2015; Song et al. 2022). Additionally, both aquaponic and hydroponic systems demand significantly less water

than conventional farming systems, making them more suitable for highly populated cities where water is scarce or of inferior quality (Sayara et al. 2016).

Indeed, when asked about food production, Interview Respondent 1 said:

“We're hydroponic farm. So we primarily rely on, you know, water and nutrients to keep the plants growing. And all these obviously controlled by us... And that one site has five greenhouses. So that's the only one location that we're producing at the moment, and that location will produce about 220 tonnes a year.”

True, based on the document analysis, urban farming can implement sensors and other technologies to monitor plant health and optimize growing conditions, including temperature, humidity, and light levels (Kyaw and Ng 2017). This allows urban farmers to produce more and higher quality crops with fewer resources. In addition, vertical farming can also be implemented to make the most efficient use of limited space in urban environments, which is particularly meaningful in highly populated cities. This technique involves stacking layers of plants on top of each other in a vertical space, which can significantly increase yield per square meter of land (Banerjee 2013).

In addition, urban farming can be a stable source of food production in urban areas as it can be more resilient to extreme weather conditions than traditional outdoor farming. The reason is that urban farming can be implemented in controlled environments. For instance, Greenhouses or indoor hydroponic and aquaponic farming systems can protect crops from extreme weather conditions like frost, heat waves, or heavy rainfall and create a microclimate that is conducive to plant growth (Despommier 2013). Additionally, urban farmers can use different technologies to adjust the environment in real-time, improving the health and yield of crops (Kyaw and Ng 2017). By creating a more controlled environment, urban farmers can minimize the impact of unpredictable weather conditions and thus ensure a more reliable supply of fresh, healthy produce all year-round. This contributes to the growth of local food systems and helps ensure that urban areas have access to fresh produce regardless of the weather.

Indeed, when asked about the food production in their indoor aquaponic farm, Interview Respondent 3 said that they produced 10 tons of salmon and trout in 2022. Additionally, their greenhouses were designed to ensure year-round vegetable production, resulting in an average of 170,000 packs of herbs and thousands of kilograms of vegetables, such as tomatoes and peppers, in the same year. Interview Respondent 3 emphasized that the consistent production of these high-quality products was made possible through the implementation of their aquaponic farm system.

With all the food urban farming can produce, it has the potential to significantly lower food deficits in cities by providing different channels for fresh, healthy food in areas where it may not otherwise be readily available (Kisner 2008; Orsini et al. 2013). This is particularly important for highly populated urban areas with limited access to supermarkets and fresh produce, also known as food deserts (Beaulac et al. 2009). By growing food locally, urban farmers can reduce the dependence on imported food, which can be expensive, and the supply chain may be interrupted by various factors, such as a global pandemic. In this sense, urban farming is crucial for countries like Singapore, where more than 90 per cent of its food is imported (Teng 2020). Additionally, urban farming can help to reduce transportation costs and associated carbon emissions, making it a more sustainable and environmentally friendly option compared to traditional farming methods (Wakeland et al. 2012).

In addition, urban farming can generate income for companies and communities by selling products all year-round. By producing food continuously, urban farming companies can have a stable source of income and then distribute it to their staff. As a result, urban farming can contribute to the sustainable economic development of the city it locates in. In addition, they can sell their products through various channels, such as local farmers' markets, restaurants, and other independent food shops (Dimitri 2012). These sales channels provide direct connections between producers and consumers, creating healthy eating habits and supporting the local food system. Furthermore, with the advent of technology, urban farmers can now sell their products online. Indeed, all of the farms selected for this research have their own website where people can browse and order the products they want. As a result, such a channel can increase its reach beyond its local neighborhood and community and diversify its revenue streams.

Indeed, companies can increase their revenue streams by providing different sales channels. Some of the farms selected for this research sale food regularly to their customers through weekly or monthly subscriptions. For instance, Interview Respondent 2 said that their food boxes are delivered to Amsterdam and then distributed to different neighborhoods where people can pick up the boxes based on their weekly subscriptions from these neighborhoods. The interviewee emphasized that about 85% of the food produced goes into these boxes.

However, some research also points out that there are some drawbacks to urban farming in terms of food production when compared to traditional farming practices. First of all, urban farms are often limited to small pieces of land or rooftop gardens, which means that the amount of food produced is constrained by space (M Hui 2011). In addition, urban soil can be contaminated with pollutants such as heavy metals and chemicals,

which can affect the quality and food production in urban farms (Goletti et al. 2000; Pandey 2012). Furthermore, urban farms, especially indoor urban farming, often rely on artificial lighting, heating, and cooling systems to maintain the ideal growing conditions for food production, which can increase energy costs and carbon emissions (Shamshiri et al. 2018).

Indeed, the increase in energy cost will have an impact on the daily operation and food production of a farm, as Interview Respondent 3 said:

“...the energy use, for instance, the electricity and so on, but we do not have any issue but the price is having an impact also on our activity and for maintaining the farm... we have we use a lot of electricity, we have a lot of automatic system that also has a cost behind so to cover these those costs, we have to also propose a price that is a bit higher than the price that is proposed in the market. “

Overall, urban farming is a highly efficient food production method that can significantly contribute to sustainable economic development. This is achieved through the implementation of innovative urban farming technologies such as hydroponics, aquaponic and vertical farming. These methods are especially efficient with the help of monitoring systems, which can optimize growing conditions and increase yields. In addition, the controlled indoor environment of urban farming makes it more resilient to extreme weather conditions, such as droughts and floods. Furthermore, urban farming also plays a crucial role in reducing food deficits in cities by producing fresh, healthy food locally, reducing dependence on imported food and lowering transportation costs. Additionally, urban farming can produce and sell healthy fresh food all-year-round, thanks to indoor farming systems. As a result, revenues can be increased through multiple selling channels such as farmers' markets and online. Which ultimately contributes to sustainable economic development and supports local economies.

4.3.2 Employment

Urban farming has the potential to impact employment in highly populated cities in several ways positively. It can create new job opportunities, particularly in low-income communities, ranging from farmers to distribution and marketing positions (Surls et al. 2014). Urban farming can also provide opportunities for entrepreneurship and small business start-ups, as there is a growing demand for innovative and sustainable farming techniques for food production and services (Hoevenaars et al. 2018). Additionally, urban farming can stimulate local economic activity by attracting customers to farmers' markets and other direct-to-consumer sales channels for urbanely grown produce, which can, in turn, create additional jobs in related industries such as food retail.

Indeed, cities, especially highly populated ones, face unique unemployment challenges due to factors such as intense competition for jobs, technology replacement, vulnerability to economic downturns, and a high cost of living (Zemtsov 2020). These challenges can make it difficult for low-income individuals to find employment and make ends meet. Addressing these issues requires a multifaceted approach, including efforts to create new job opportunities, provide support for small businesses and entrepreneurship, address systemic barriers to employment, and promote economic diversification (Parker Harris et al. 2014). Urban farming can be one way to tackle these challenges by providing entry-level positions, supporting entrepreneurship and small business development, stimulating local economic activity, and offering opportunities for workforce development and education (Cicekli and Barlas 2014; Kalantari et al. 2018). By addressing unemployment challenges in highly populated cities, we can help to create more equitable and sustainable communities.

All the farms selected for this research show that they provide employment opportunities to the city they are located in. Some of them hire older people with disabilities or mental illnesses to perform repetitive tasks on the farm. For instance, Interview Respondent 1 said:

“We try very much to you know, engage the community where we can, and this comes in multiple forms, we try to work with social service organizations to potentially look at how maybe people with disabilities could work on the farm. So we are working with an organization called Apex harmony Lodge, and they deal with elderly with dementia. And we will get them onto the farm and they will do the work that we assign, and then based on the amount of work that they complete, then we will pay them accordingly. So that's one way. We also work with another school called Great Auto school where they deal with kids with mental disabilities, and we train them with the idea that eventually when they graduate, they could potentially do work on the farm for some of the more simple or repetitive tasks.”

Indeed, people with disabilities or mental illness may face additional challenges when seeking employment in highly populated cities where competition is high. They are limit access to job opportunities because of various reasons such as lack of accessibility, stigma, and discrimination (Vornholt et al. 2017; Zyskowski et al. 2015). Inaccessible transportation and work environments can limit job opportunities and make it difficult for individuals with disabilities to travel around urban areas (Bezyak et al. 2017). In addition, the stigma surrounding mental illness can make it more difficult for individuals to seek accommodations or disclose their conditions to their employers, while the fast-paced and stressful nature of urban environments can exacerbate mental

health symptoms (Scheid 2005). Furthermore, people may face discrimination in the hiring process and thus limit their job opportunities.

As Interview Respondent 1 suggested, urban farming can provide accessible job opportunities and targeted support for individuals with disabilities or mental illnesses in highly populated cities. People with disabilities often face barriers to employment due to inaccessible work environments and transportation, while people with mental illnesses may struggle to manage their symptoms in fast-paced urban environments (Vornholt et al. 2017; Zyskowski et al. 2015). As a result, urban farming can offer entry-level positions, creating opportunities for individuals with disabilities or mental illnesses to participate in the workforce. In addition, the simple and low-stress work environment of urban farming may also be beneficial for managing mental health symptoms (Kruize et al. 2019). By promoting diversity and inclusion in the workplace, urban farming can help reduce stigma and create a supportive work environment for individuals with disabilities or mental illnesses (Triguero-Mas et al. 2020). Additionally, urban farming can provide special accommodations for disabled workers, such as modified workstations or schedules, to enable individuals with disabilities or mental illnesses to fully participate in the workforce and contribute to their communities (Friesen et al. 2010).

Indeed, urban farming can contribute to the sustainable development of the community by hiring disabled people who might not be hired elsewhere. In addition, one of the farms contributes to their community by working with specific organizations that involve immigrants who do not have citizenship yet into their farm to learn about urban food production. The skills they acquire on the farm can later help them to find a job in related fields. The interviewee said that they support individuals without jobs, including those without Belgian citizenship or with mental health issues, by teaching them agricultural skills and enabling them to adapt and find opportunities. These programs operate in multiple locations and aim to provide activity and improve their access to the job market.

In addition, one of the farms also has a similar mechanism to provide training for people to get ready for their careers. Interview Respondent 4 said that their Youth Corps program engages over 180 youth annually through partnerships with other organizations. Their farm serves as a safe space, and teens can explore interests, collaborate, learn from one another, and develop skills applicable to school, work, and life. Interview Respondent 4 said that their program offers job training and encourages leadership development. They aim to equip teens with a comprehensive understanding of

sustainable food systems and the ability to connect their farm skills to future career paths.

Indeed, incorporating youth training programs in urban farming practices can be an effective way to prepare young people for employment in highly populated cities. These programs can take the form of vocational training, internships, apprenticeships, and job shadowing, providing young people with the skills, knowledge, and practical work experience they need to enter the related work fields. In addition, engaging youth in agriculture in low- and middle-income countries can provide opportunities to address underemployment, youth disillusionment, and social unrest while also lifting individuals and communities out of poverty and hunger (Maïga et al. 2020).

Furthermore, by offering targeted support and training, youth training programs can help to address the challenges faced by young people in highly populated cities, including high levels of unemployment and lack of access to job opportunities due to intense competition (Robalino et al. 2013). Additionally, these training programs can provide networking opportunities and connections to potential employers, helping young people to establish their careers and interpersonal skills and contribute to their communities.

Apart from that, urban farming can have a positive impact on employment in densely populated cities by providing several opportunities such as entrepreneurship and small business startups, and outsourcing. The increasing demand for sustainable and innovative farming techniques like hydroponics and aquaponics has led to the emergence of businesses that specialize in designing and building urban farming systems (Hoevenaars et al. 2018; Quagraine et al. 2017). This not only creates employment opportunities but also further contributes to sustainability challenges. In addition, companies can also outsource non-essential functions like packaging to third-party companies so that more jobs can be created (Weidenbaum 2005). Such outsourcing is also being practiced by one of the farms selected for this research. By promoting urban farming, cities can address social challenges while also creating job opportunities, stimulating economic growth, and promoting sustainable urban development.

Overall, urban farming has the potential to positively impact employment in highly populated cities in several ways while also addressing the needs of people with disabilities and mental illnesses and youth training. It can create new job opportunities, particularly in low-income communities, ranging from farmers to distribution and marketing positions. Furthermore, urban farming can provide opportunities for entrepreneurship and small business startups, encouraging individuals with disabilities

or mental illnesses to be employed and involved in their communities. Youth training programs can provide young people with the skills and knowledge needed to enter the farming industry, as well as leadership training, which can lead to the development of innovative and sustainable farming techniques.

4.3.3 Community Economic Growth

Urban farming can contribute to community economic growth in various ways. Firstly, it can create job opportunities, particularly in low-income areas where unemployment rates are high (Surls et al. 2014). Secondly, it can stimulate local economic activity by creating or expanding a market for locally-grown produce, supporting local businesses and leading to the development of food-related businesses such as retailers and restaurants (Lucan et al. 2015). Additionally, urban farming can increase property values by transforming vacant lots or rooftops into productive urban farms, making the surrounding area more attractive to potential residents and businesses (Voicu and Been 2008). Furthermore, it can save municipal agencies money by utilizing vacant lots that would otherwise require maintenance or demolition and redirecting those funds to other areas of need (Slabinski 2012). Finally, urban farming can increase food production and sale in highly populated urban areas, providing a sustainable source of income for local farmers and increasing access to fresh, healthy food for residents, particularly in low-income areas where access to fresh produce is limited (Rivas-Aceves and Schmidt 2022).

Cities with high population densities encounter distinctive employment obstacles as a result of factors such as intense job market competition, technological advancements replacing certain job positions, vulnerability to economic downturns, and the high cost of living (Zemtsov 2020). However, urban farming has the potential to provide employment opportunities in highly populated cities, especially in low-income areas where unemployment rates tend to be higher (Surls et al. 2014). Both the interviews and the document analysis suggest that urban farming can provide employment opportunities for local residents. People can be hired to carry out various tasks, such as planting, watering, harvesting, and daily maintenance. In addition, urban farming can provide job openings for a diverse range of individuals, including the ones with disabilities. As a result, people can increase their general income by getting paid for working on farms in their local community.

Apart from that, urban farming can provide cost savings for consumers by reducing the money spent on food, and the money saved from food consumption can be spent elsewhere. Farmers' markets and CSAs can offer affordable and high-quality produce to low-income communities (Cooley and Lass 1998). Despite the fact that most of the

interviewees suggest that the food they produce is more expensive in comparison with the market, some studies have shown that farmers' markets in these areas often have more affordable and fresh produce compared to traditional grocery stores (Paul 2019). By growing food locally, urban farms can reduce transportation costs and minimize the need for expensive commercial farming practices, resulting in lower prices for consumers (Oliveira et al. 2021). As a result, urban farming can provide a sustainable and affordable source of fresh produce for communities, particularly those with limited access and income to healthy food options.

Urban farming also has the potential to play a significant role in stimulating local economic activity by creating or expanding a market for locally grown produce. By cultivating crops within the community, urban farming can create a demand for fresh, locally sourced food, which can help support local businesses such as farmers' markets, grocery stores, and restaurants (Sadler et al. 2013). Indeed, urban farming can create economic benefits by outsourcing some additional services to third parties. For instance, Interview Respondent 3 stated that they work closely with one intermediary company in their city to remove the thorns from the fish.

In addition, as shown by both the interviews and the document analysis, urban farming can also create employment opportunities in various sectors of the food industry, such as distribution and processing (Surya et al. 2020). Other than that, the promotion of locally sourced ingredients can also help support local food systems and reduce transportation costs, as produce does not have to travel long distances to reach consumers (Oliveira et al. 2021). In addition, urban farming can foster community engagement, creating opportunities for education and outreach and helping to build strong relationships between residents and local businesses (Obach and Tobin 2014; Paul 2019). As a result, this can help to foster a sense of community pride and identity, which can also contribute to the community's economic growth as a whole.

Urban farming has the potential to contribute to economic growth because it has the ability to produce food all year-round, regardless of the weather conditions. This can be achieved by utilizing innovative techniques such as hydroponics, aquaponics, and vertical farming, which allow farmers to grow crops in controlled environments, regardless of the season (Benke and Tomkins 2017). For example, hydroponics is a soilless farming method that involves growing plants in nutrient-rich water, which can be done indoors, making it ideal for food production in highly populated cities (Barbosa et al. 2015; Sayara et al. 2016; Sharma et al. 2018). By using these innovative techniques, urban farmers can produce high-quality, fresh produce and livestock products throughout the year, which is particularly beneficial in urban areas where

access to fresh, locally-grown food is limited (Alshrouf 2017). Through consistent production and sales, urban farming can provide a sustainable source of income for local farmers and contribute to sustainable economic development.

In addition, urban farming offers the potential to increase property values in urban areas by repurposing vacant lots or rooftops and transforming them into productive spaces. By utilizing previously unused land or rooftops for urban farming purposes, neighborhoods can be made more attractive and productive, which in turn can increase property values in the surrounding areas (M. N. Poulsen et al. 2017; Voicu and Been 2008). Furthermore, urban farming can help municipal agencies save money by utilizing vacant lots that would otherwise require costly maintenance or demolition (Surls et al. 2014). Rather than letting these lots remain vacant or abandoned, urban farming can provide more productive and sustainable use of the land (Slabinski 2012). Apart from increasing property values, urban farming can also provide economic benefits to communities by generating rental income from vacant lots or rooftops. This can provide a source of revenue for local property owners, which can contribute to local economic growth. Indeed, all of the farms selected for this research stated that they pay rent for their farms. For instance, Interview Respondent 3 said:

“Because just to let you know we are renting the space also. So the rooftop of there, but the footman is not from big, we have to pay a rent to the abattoir. Okay. And so for food for three co tenants is the point that we wanted also, to emphasize is also to not privatize all the space, but to let other organization also to have the access to the farm.”

Indeed, urban farming has the potential to increase property values and attract new residents to a community. However, it can also negatively impact low-income residents who may struggle to keep up with the rising costs of living in the area. As property values increase, rents also tend to rise, which can be particularly challenging for low-income residents who may already be living paycheck to paycheck (Surls et al. 2014). In some cases, rising property values can even lead to the displacement of long-time, poorer residents who can no longer afford to live in the area (Preis et al. 2020). This displacement can have significant social and economic consequences for these individuals and their families and ultimately impact the sustainable development of the city. Additionally, rising rents can cause financial instability and hardship for low-income residents, who may be forced to make difficult choices between paying rent and meeting other basic needs such as food, healthcare, and education (Haffner and Hulse 2019).

Overall, urban farming can promote community economic growth as it can create job opportunities, stimulate local economic activity, and increase property values by transforming vacant lots into productive urban farms. Urban farming can also save municipal agencies money by utilizing vacant lots that would otherwise require maintenance or demolition. Additionally, it can increase food production and sale in highly populated urban areas, providing a sustainable source of income for local farmers and increasing access to fresh, healthy food for residents, particularly in low-income areas where access to fresh produce is limited.

4.4 Challenges and Opportunities

4.4.1 Challenges

Urban farming faces numerous challenges that can hinder its application and success in highly populated cities. One of the key challenges is obtaining expert information and advice, as urban farming involves a wide range of specific techniques and challenges (Kalantari et al. 2018). In addition, public awareness about urban farming and its benefits is also limited, making it difficult for urban farmers to attract funding and support from the public (Specht et al. 2016). Financial resources are also a significant challenge, as starting and maintaining an urban farm requires substantial investment. Rooftop farming presents additional challenges, such as the reinforcement and maintenance of rooftop structures requiring special treatment (Nanaa 2022). Water resources and water quality can be a concern, and regulatory barriers such as zoning restrictions or building codes can make it difficult to start or maintain an urban farm (Castillo et al. 2013). Limited space and high investment in infrastructure, equipment, and labor are also significant barriers to urban farming (Murdad et al. 2022).

When asked about the challenges of constructing and maintaining the farm, Interview Respondent 2 said:

“I wish we had a bit more knowledge, or of course, now we're much more smart, and we would do things differently. So you learn a lot by kind of making mistakes and learning from them. And I think it's just when there's many challenges, but I guess it's really a job that you really grow onto.”

Indeed, not having able to obtain information about urban farming can be difficult for urban farmers due to the complexity of urban farming. Some urban farmers may lack formal training and education in agriculture, and there is a scarcity of resources focused specifically on urban farming techniques and challenges (Othman et al. 2018). This is especially true when urban farming encompasses a variety of farming techniques such

as vertical farming, hydroponics, aquaponics, and rooftop farming, which involve a diverse range of crops, including vegetables, fruits, herbs, and even fish (Goddek et al. 2015). As a result, a lack of expert and general information can pose a great challenge to the successful application of urban farming.

In addition, according to both the interviewees and the document analysis, there are still some people who are not fully aware of the potential benefits of urban farming as they are quite used to traditional farming (Specht et al. 2019; Surya et al. 2020). This lack of understanding poses a challenge for urban farming practices to attract funding and support from the public (Sanyé-Mengual et al. 2016). Without a solid understanding of the benefits of urban farming, people may not be willing to purchase urban farming products (Specht et al. 2015). Furthermore, people may be less likely to invest in urban farming projects or to support policies and initiatives that promote urban agriculture (Specht et al. 2016; Whittinghill and Rowe 2012). When asked about the challenges they face, several interviewees mentioned public awareness. For instance, Interview Respondents 1 and 3 said:

“The downstream is about getting people to understand and recognize the product, you know, to sort of support one local farms and also to support local farms that are meant to be in a sense, hyper local, right, very, very close to and productive producing within the community.”

Interview Respondent 3 also added that many people don't know much about aquaponics. When they talk to potential customers, the customers often ask questions like "What is that?" or express doubts about whether fish can be raised in cities. Therefore, Interview Respondent 3 emphasized that It's important to address these misunderstandings to help people accept and embrace aquaponic farming for its success.

Apart from that, urban farming can face financial challenges as it can be a costly undertaking to start and maintain. As the interviewees mentioned, the costs associated with urban farming can be significant, including the purchase of equipment, irrigation systems, rent, and labor. In addition, urban farmers may face challenges financially in the early stage as they need to invest in infrastructure such as greenhouses or high tunnels to extend the growing season and protect crops from pests and extreme weather conditions (Specht et al. 2014). Another financial challenge for urban farmers is the cost of land, which can be extremely expensive in many highly populated urban areas (Daburon et al. 2017). This can make it difficult for urban farmers to secure a suitable site for their farm and can limit the scale and scope of their operations and production. Indeed, some of the interviewees claimed that they face financial challenges in the process of constructing and maintaining their farms. For example, Interview

Respondent 2 said that money has always been a challenge for their farm, particularly when they started the farm from scratch.

Urban farming takes many forms in an urban environment, and some of them use the ground just like traditional farming. However, it is a different story when it comes to rooftop farming, as it requires special considerations and structural reinforcement to ensure that the building can support the additional weight of soil, water, and crops (Sanyé-Mengual et al. 2016). In some cases, buildings may need to be retrofitted with additional supports or strengthened with new materials to accommodate the weight of rooftop farms (Nanaa 2022). This can be an expensive undertaking and may require specialized engineering expertise. In addition, rooftop farming also requires ongoing maintenance and reinforcement of the rooftop structures. It requires constant work to ensure that the rooftop structures are regularly inspected, repaired, and maintained to prevent damage or collapse (Thomaier et al. 2015). Indeed, when asked about challenges faced by the farm, Interview Respondent 3 emphasized the importance of the durability of the rooftop by saying:

“Steven Bakers who is an architect, and the others investors, had to find a way to reinforce the rooftop. And so this is the main challenge is that, for instance, we cannot install more greenhouses, but we do have the space. There is one space in the in the farm where we are not putting anything because it's not well, we can work on it, but we cannot put bigger infrastructure on it because it's not well maintained. So it's the main issue at the beginning was the space. we are on a rooftop, we have to pay attention for instance, we are not using conventional soil...we have volcanic stones or so because it's not so heavy...and it's something that's on the roof that is a big challenge, we had to find a way to not put too many weight, especially in one part of the farm.”

What's more, having access to clean and reliable sources of water is crucial for urban farming, but it can be a significant challenge for some specific types of farms in highly populated urban areas (Namwata* et al. 2015). Urban farmers may face difficulties in obtaining water for their crops, either due to limited availability or high costs. Indeed, some urban farms have limited access to water for various reasons, such as the climate that they are located. For instance, Interview Respondent 5 said that they harvest water using the basin meadow and the dry swale to water their farm about two to three times a week. However, as summer is getting hotter and hotter in Los Angeles, the interviewee said they need to pay extra attention to the changing climate and take steps to address this incoming challenge.

Moreover, water quality can also be a significant concern for urban farming, particularly in highly populated urban areas where soil and water pollution may be prevalent.

Contaminants such as heavy metals, pesticides, and other pollutants can affect the quality of the water used for farming, potentially compromising the safety and nutritional value of crops (Lente et al. 2012). In addition to affecting crop health, water quality is also important for aquaponics, a popular urban farming practice that combines fish farming with hydroponics (Yildiz et al. 2017). Fish require highly water quality, and any contaminants in the water can cause significant health problems for them. Indeed, Interview Respondent 3 said this about the impact of water quality on the Salmon and Trout in their aquaponic farm:

“City of Brussels allowed us to we have an agreement with them and who has to to have a connection with this groundwater system. And to use a certain quantity not a lot of water a certain quantity of this water for fish farm. Why we're using only this water for the fish farm is because this water is more stable for the salmon trout. Just to let you know, send maturities are very sensitive fish. So this is a fish that needs water that is not too acid has not a big PH level. So we use this water for the fish farm.”

In addition, another challenge facing urban farming is the limited availability of space in highly populated urban areas. The high demand for land in urban areas often makes it difficult to find suitable areas for urban food production (Murdad et al. 2022). Additionally, the cost of land in urban areas can be extremely expensive for many urban farmers, particularly those starting out with limited financial resources (Corbould 2013). Moreover, some types of crops or farming practices require more space than others, making it more challenging to implement certain types of urban farming in densely populated areas (Li et al. 2019). For example, traditional farming methods may not be feasible in urban environments due to space constraints.

Furthermore, urban farmers may face regulatory barriers, including zoning restrictions and building codes, that can make it difficult to start or maintain their farms. Zoning laws that limit or prohibit agricultural activities in urban residential or commercial areas may require a complex permitting process or variance to operate legally, while building codes may demand expensive modifications or upgrades that require huge financial investment (Castillo et al. 2013). Additionally, policymakers may not fully understand the benefits of urban farming or may be resistant to change, making it challenging to persuade them to support these initiatives (Doreen and Dominic 2010). Indeed, when asked about challenges, several interviewees pointed out that it was difficult for them to get approval from the government. For instance, Interview Respondent 1 said that one of the challenges they encountered was obtaining the necessary approvals from the regulators in Singapore. their idea about urban farming was new and unfamiliar to many, which made the process more difficult.

In addition, Interview Respondent 5 also added that one challenge they encounter is creating policies and getting everyone on board. They said convincing the school board about the program's benefits for the school and the community at large is crucial. They pointed out the policy can spread from one school district to the State Department if successful, and it will eventually be embedded in every school. This progress can also inspire cities to establish more community farms and gardens. Interview Respondent 1 also had difficulties getting everyone on board as one of the obstacles was explaining urban farming concepts to the building owner and helping them understand its true purpose.

Overall, urban farming can face a variety of challenges that may impede its success in highly populated cities. One of the key difficulties is obtaining expert information and advice, as urban farming involves specific techniques and challenges that may not be well-known. Additionally, public awareness about the benefits of urban farming can be limited, making it challenging for farmers to attract funding and support. Financial resources can also pose a significant challenge since starting and maintaining an urban farm requires substantial investment. Rooftop farming presents additional challenges, such as the need for structural reinforcement and maintenance, while water resources and quality can also be a concern. Regulatory barriers, including zoning restrictions and building codes, can make it difficult to establish or maintain an urban farm. Moreover, limited space and high investment in infrastructure, equipment, and labor are significant obstacles to the success of urban farming in densely populated areas.

4.4.2 Opportunities

Despite the challenges, there are many opportunities for carrying out urban farming practices in highly populated cities due to various reasons. Both the interviews and the document analysis show that some governments provide financial and information support to encourage people to engage in urban farming practices (Pearson et al. 2011). Advances in technology, including vertical farming, hydroponics, and aquaponics systems, have made urban farming more sustainable and efficient, and there is also a growing demand for farming that requires fewer resources, such as water, and continuous innovative farming technologies are being developed to meet this demand (Banerjee 2013). Additionally, there is increasing interest from investors who recognize the potential for urban farming (O'Sullivan et al. 2019). Urban farming has the potential to transform cities into more sustainable and livable places, providing social, environmental, and economic benefits. The growing interest in urban farming, especially among younger generations, is leading to greater support for urban farming initiatives and awareness of the benefits.

Some governments have recognized the social, economic, and environmental benefits urban farming can provide in urban areas, especially highly populated ones. In order to encourage people to engage in urban farming, governments provide financial support in the form of grants, subsidies, tax incentives, and other financial assistance (Pearson et al. 2011). Grants can cover expenses such as land, production, tools, and training. In addition, subsidies are given to reduce the cost of inputs like water, energy, and fertilizer while also promoting the sale of urban farm produce (Cabannes 2012). Two of the farms selected for this research received subsidies from the government because of COVID. For instance, Interview Respondent 5 said:

“I get some money. Definitely during COVID I got some money from our governor Newsom. I am working with the school district to do, it's easier if would be, it's easier for connect with the school district as well, and get the money through the school district.”

Apart from that, governments can issue tax incentives for urban farming projects, and these incentives can help ease the financial burden companies have by compensating on things such as purchasing equipment or land deductions, helping offset the costs of urban farming and make it a more attractive option for potential farmers (Ahmed 2015). Through these measures, governments can support the growth of urban farming and provide more opportunities for new urban farming practices. All the interview respondents claimed that they receive financial support from their government. For instance, Interview Respondent 1 said that they receive financial support from the government, usually in the form of grants. These grants are typically meant to offset the capital investments necessary for their operations, including the construction of a large farm. In addition, they have obtained grants specifically to aid in the development of their new expansion.

In addition to financial assistance, some governments also provide access to training and practical information to help individuals and organizations to acquire the necessary knowledge and skills to successfully establish and maintain their urban farms (Prové et al. 2019). According to the interviewees, the information provided by the government covers a range of areas, including plant health, pest management, and irrigation. For instance, Interview Respondent 1 said that they receive support from the Singapore Food Agency, which provides valuable expertise in urban farming. Additionally, they receive assistance from the National Environment Agency, which focuses on plant health and related matters.

In addition, some interviewees mentioned that they work with educational institutions to get information about urban farming. For instance, when asked about where they get

general and expert information on urban farming, Interview Respondent 5 stated that they obtain information from the university as their organization is closely connected to it. They strive to establish and maintain a connection with the university's urban agriculture department. In their remarks, they mentioned that they also consults with older people in their neighborhood. Interview Respondent 1 also stated that they often get information from people who live in the community. Their comments show another way people can participate in urban farming.

In addition, advances in technology have created new opportunities for urban farming, especially in highly populated areas, making it more desirable for urban farming planners to start up their businesses and more sustainable and efficient for urban farming itself than ever before. One of the most significant technological advancements in urban farming is the development of vertical farming systems. These systems utilize stacked layers of trays or shelves to grow plants vertically and, most importantly, sustainably, allowing for high-density cultivation in small spaces, which is perfect in highly populated cities (Banerjee 2013). In addition, vertical farming also reduces energy consumption, such as water usage, as the plants are grown using a closed-loop irrigation system that recirculates water and nutrients, minimizing waste (Benke and Tomkins 2017; Despommier 2013).

Furthermore, innovative farming systems such as hydroponics system also provide urban farming activities as it has revolutionized urban farming by providing a highly efficient way to grow plants without soil (Barbosa et al. 2015). Instead, plants and other vegetation are grown in a nutrient-rich solution, which is continually circulated through the roots (Sharma et al. 2018). Hydroponic systems use significantly less water in comparison with traditional farming methods, and they eliminate the need for pesticides, herbicides, and other harmful chemicals that can harm the environment and human health (Barbosa et al. 2015; Gentry 2019). Another innovative technology used in urban farming is aquaponics. Aquaponics combines hydroponics with fish farming, creating a symbiotic relationship between plants and fish. The fish provide nutrients for the plants through manure, while the plants filter the water for the fish (Junge et al. 2017; Kyaw and Ng 2017; Sayara et al. 2016). This closed-loop system is highly efficient, and it can produce a significant amount of food in a relatively small space.

Indeed, the development of new farming technologies is likely to create even more opportunities for urban farming practices. The ongoing development of new innovative technologies, which can make urban farming more efficient and sustainable. For instance, the Internet of Things (IoT) has facilitated farming activities and enabled flexible farm operations. It can be used to monitor soil moisture levels, crop growth, and

other important variables, allowing farmers to make real-time adjustments to optimize yields and reduce waste (Madushanki et al. 2019; Podder et al. 2021). Apart from IoT, other emerging technologies are also transforming urban farming. For instance, the development of robotic systems for planting, harvesting, and monitoring crops is improving the farming process and reducing labor costs (Lauguico et al. 2019; Moraitis et al. 2022). 3D printing is also being utilized to produce customized tools and equipment that are tailored to specific urban farming needs (Crisostomo and Dizon 2021; TAN 2022). By leveraging new technologies, people are provided with more opportunities to produce more food in less space, with fewer resources, and with a lower environmental impact.

In recent years, urban farming has become a viable investment opportunity for many people. As urban farming is getting more and more popular, investors are recognizing the potential for profitability in urban farming. The fact that urban farming can benefit our cities socially, economically, and environmentally has made urban farming an attractive option for investors to look for opportunities to invest in the growing demand for sustainable food systems (O’Sullivan et al. 2019). Investors can support urban farming projects by providing capital for startup costs, such as land acquisition and the purchase of equipment and supplies. In return, they can receive a share of the profits generated by the farm. Indeed, Interview Respondent 3 said:

“Most of the funds that are invested in the farm comes from private investors. We do have some EU funds in the past. But it was not directly given to BIGH it was the abattoir who receive these funds to reinforce the rooftop of where we are located. But most of the investment comes from private companies, private investors.”

In addition, public interest towards urban farming has been increasing in recent years, particularly among younger generations. As more and more people start to realize the benefits of locally-grown produce. As a result, there are more opportunities for public engagement and support for these initiatives. This increased interest in urban farming has led to the development of various urban farming practices, such as rooftop farming, community gardens and urban farming education programs. These initiatives provide opportunities for people to learn about urban farming practices and to participate in growing food sustainably. Indeed, when asked about the future outlook of urban farming, Interview Respondent 2 said:

“I see it may be that more and more farmers that are like, let's say first generation, farmers get interested in it...I think that's just really nice if young people from different backgrounds join into farming...And it needs this young people that think differently about it or are not very, like put, don't think don't put things in a box necessarily

already from the beginning to also explore things that maybe are like, unconventional or Yeah. So I think it will grow. Definitely. “

Overall, urban farming presents a multitude of opportunities, including its potential to contribute to urban development socially, environmentally, and economically (Faivre et al. 2017). Socially, urban farming can provide benefits such as community building and education opportunities, which can foster a sense of togetherness among residents (Paul 2019). Environmentally, urban farming can help to reduce carbon emissions and promote biodiversity, improving the overall health of urban environments (Tilman 2012). Finally, urban farming can have economic benefits by providing local jobs and supporting small businesses while also addressing issues of food insecurity in urban areas (Basiago 1998; Surya et al. 2020).

5 Discussion

This paper analyzed how urban farming impacts sustainability in highly populated cities. Through the document analysis and the interviews, this research focused on the social, environmental, and economic impact, together with the challenges and opportunities of urban farming in highly populated cities.

Based on the interview observations, urban farming practices have many different characteristics in comparison with farming in general, especially traditional farming. Together with the document analysis, the results show that most urban farming practices apply innovative and efficient farming technologies, such as vertical farming and aquaponic farming, to reduce resource consumption and increase food production. In addition, all the urban farming practices are deeply involved in their communities, which is manifested through the fact that urban farming serves not only as a source of food but also as a place for urban dwellers to relax, learn, and work.

The results indicate that urban farming practices can contribute to social sustainability through community improvement, education, and food security. Urban farming can positively impact communities in highly populated cities by promoting community engagement, health, cultural inclusion, environmental awareness, recreation, and social connection. It creates a shared platform for community members to participate in various activities. These findings suggest that urban farming can lead to a stronger, more resilient community that can tackle social challenges and contribute to social sustainability. Although most of the existing literature focused on community participation as a whole, there are other factors, such as cultural inclusion, that connect to urban farming and are significant to community improvement as well.

In addition, urban farming can increase public awareness of various issues through educational activities. People can learn about environmental issues, sustainability, public health, and the importance of access to healthy and affordable food in urban areas through participation in urban farming activities. They can also learn about plant biology, nutrition, and sustainable farming practices, leading to a sense of responsibility for the urban environment. This suggests that urban farming can have a huge impact on the sustainable development of highly populated urban areas as people are educated on the importance of sustainability through urban farming.

Finally, the results also show that urban farming can positively impact urban food security by increasing the availability of fresh, healthy food in urban areas, addressing food deserts, improving public health and accessibility of food for low-income households, promoting healthier eating habits, and contributing to urban food

production. Urban farms provide easier access to fresh products, reduce malnutrition and related health problems, and enhance food security in a sustainable way in highly populated cities. This finding aligns with most of the literature that found urban farming is an ideal solution for addressing food security in highly populated cities. However, most interviewees also stated that urban farming products could be expensive for many, especially the ones from low income-communities. Most existing literature fails to highlight people's purchasing power toward urban farming products.

As for environmental sustainability, the results indicate that urban farming can contribute to the environment by consuming fewer resources as it consumes fewer resources. It operates in limited urban spaces using innovative methods like hydroponics, aquaponics, and vertical farming, which allow for more efficient use of resources such as water, land, and energy. This results in reduced resource consumption compared to conventional farming practices. The interview findings contribute to a clearer understanding of waste production in urban farming practices, especially the ones using innovative technologies. However, urban farming practices can also negatively impact the urban environment if they apply chemical pesticides and fertilizers and handle their waste inappropriately. This suggests that urban farming practices should be regulated by the municipalities and follow certain guidelines, such as what pesticides and fertilizers they can use in their farms.

In addition, both the document analysis and the interviews show that urban farming supports biodiversity in highly populated cities by creating green spaces that provide important habitats for wildlife. Sustainable farming practices such as composting and avoiding pesticides can improve soil health and create healthier and more resilient ecosystems. Incorporating native plants into urban farms can further support biodiversity and promote a more sustainable and equitable food system. As a result, biodiversity plays an important role in the sustainable development of cities, especially highly populated ones. Most literature was found to support this finding, as many of them pointed out the importance of biodiversity in an urban area and how urban farming can contribute to it.

Furthermore, urban farming can reduce waste and promote sustainability in cities by providing fresh produce locally, using organic and natural farming methods, and minimizing negative impacts on the environment. In addition, urban farming offers multiple benefits, such as improving air quality, reducing the urban carbon footprint through green spaces, and providing fresh produce to urban dwellers, minimizing food waste and transportation emissions. The data shows that urban farming can contribute to urban sustainability in highly populated areas as it provides great benefits to the

environment as a whole. These findings might provide new implications to the existing literature as many of them did not focus on waste production of urban farming thoroughly.

The results indicate that urban farming can contribute to the sustainable development of an urban area economically as it can boost the economy by producing food more efficiently with technologies such as hydroponics, vertical farming systems, and sensors. It can also be more resilient to extreme weather conditions and lower food deficits by producing fresh food locally and reducing transportation costs. In addition, it can also sell products year-round at local markets and online, and urban farmers can generate income and support the local economy. The finding also suggests that urban farming is particularly meaningful at a local community level in terms of economic sustainability.

Urban farming can positively impact employment in highly populated cities by creating new job opportunities ranging from farming to marketing, particularly in low-income communities. It can also provide opportunities for entrepreneurship and stimulate local economic activity through direct-to-consumer sales channels and related industries such as food retail. Urban farming can contribute to community economic growth by creating job opportunities in low-income areas, stimulating local economic activity through local produce markets and related businesses, increasing property values, saving money for municipal agencies, and increasing food production and sale in urban areas. While previous research has focused on economic sustainability as a whole, these results presented a unique angle from the farmers' perspective on the economic sustainability of urban farming.

On the one hand, the results indicate that urban farming faces several challenges, including limited access to expert information, limited public awareness and funding, financial resources, challenges related to rooftop farming, water resource and quality concerns, regulatory barriers, limited space, and high investment in infrastructure, equipment, and labor. This finding adds new insights from the farmers' perspective about the challenges of urban farming that have not been covered by the existing literature yet.

On the other hand, urban farming in highly populated cities presents opportunities due to government support, advances in technology, growing demand for sustainable farming, interest from investors, and potential for social, environmental, and economic benefits. The increasing interest in urban farming is leading to greater support for urban farming initiatives and awareness of its benefits. This data indicates that urban farming can contribute to sustainability in highly populated cities despite the challenges that might hinder the implementation of urban farming.

There are a few limitations to consider when evaluating the findings presented in this paper. Although the results demonstrate that urban farming can have positive impacts on urban dwellers in terms of social, economic, and environmental factors, it is important to note that only individuals associated with urban farming companies or organizations were interviewed. Therefore, the data presented in this study may not accurately reflect the experiences and perspectives of all urban dwellers. Furthermore, it is possible that the interviewees may have presented biased views when responding to certain questions, despite the fact that much of the data collected was backed up with the document analysis. The potentially biased views are likely to damage the level of accuracy of the results.

Although the selected urban farming projects represent a diverse range of approaches, from vertical farming and hydroponic farming to aquaponic farming and CSAs, the number of interviewees involved in the study is relatively low. While the data collected from these individuals provide valuable insights into the potential benefits, challenges, and opportunities of urban farming, a larger and more diverse sample size would likely yield even more insightful and nuanced results. Future studies can address these limitations by increasing the number of interviewees to gain a more comprehensive understanding of the various experiences and perspectives associated with urban farming. In addition, urban dwellers should also be included in future research so that their perspectives and views towards urban farming can also be studied as well.

6 Conclusion

This research aimed to identify what impacts urban farming has on sustainability in highly populated cities. The interviews and the document analysis show that urban farming can contribute to social, economic, and environmental sustainability in highly populated cities.

Regarding environmental sustainability, the data suggest that urban farming can reduce resources like water, land, and other non-renewable energy consumption through innovative methods like hydroponics, aquaponics, and vertical farming. These technologies enable urban farming to be a more sustainable alternative in a densely populated city in comparison with traditional farming. In addition, urban farming also contributes to biodiversity in highly populated cities by using sustainable farming practices such as organic compost and incorporating native plants and bioswales, creating habitats for wildlife and healthier ecosystems. As cities continue to grow, urban farming can be a valuable tool for preserving and enhancing biodiversity while contributing to a sustainable environment for city dwellers.

The results show that urban farming can reduce waste by minimal packaging and reducing waste from long-distance food transportation. It can also create healthier and more resilient ecosystems by using organic and natural farming methods like composting and avoiding synthetic fertilizers, minimizing negative impacts on the highly populated urban environment. In addition, urban farming has many environmental benefits, such as enhancing air quality and mitigating the urban heat island effect by providing green spaces and cooling, reducing the urban carbon footprint by capturing carbon dioxide and pollutants, and reducing food waste and transportation emissions. Urban farming can also improve soil quality through organic composting and enhance water quality by purifying contaminated water and reducing the use of synthetic fertilizers and pesticides.

As for social sustainability, urban farming can improve community engagement, health, and development, as well as promote cultural inclusion, relaxation, outdoor recreation, democratic values, and social connection. It creates a common space for urban dwellers to interact and participate in various activities, building stronger and more sustainable communities that can better address common social challenges in highly populated urban areas. Additionally, urban farming can enhance the availability of fresh and nutritious food, tackle food deserts, advance public health, and increase food accessibility for low-income families. Furthermore, urban farming can offer different educational activities for people to learn about various subjects, including

environmental issues, food science, and biology and raise public awareness about food security and environmental protection.

Regarding economic sustainability, urban farming can optimize growing conditions and increase constant yields via innovative technologies like hydroponics, aquaponics, and vertical farming, together with monitoring systems. Urban farming is also resilient to extreme weather conditions, and it can reduce food deficits by producing fresh food locally, lowering transportation costs and dependence on imports. Urban farming products can be produced and sold year-round through various channels, such as farmers' markets and online, which supports local economies and promotes sustainable economic development.

In addition, urban farming can create job opportunities ranging from farmers to distribution and marketing positions. It also provides opportunities for entrepreneurship and small business startups, particularly in low-income communities. Additionally, urban farming can address the needs of people with disabilities and mental illnesses by employing them through specific channels. Apart from that, urban farming can also promote community economic growth by creating job opportunities, stimulating local economic activity, increasing property values, and providing a sustainable source of income for local farmers. It can also save municipal agencies money by utilizing vacant lots and increasing access to fresh, healthy food for residents, especially in low-income areas.

While urban farming does face challenges, such as limited access to urban farming-related information, public awareness, financial resources, regulatory barriers, limited space, and high investment requirements, these obstacles should not overshadow the potential impact of urban farming on sustainability in highly populated cities. Despite the challenges, the research findings underscore the promising urban farming opportunities supported by government initiatives, technological advancements, investor interest, and the multifaceted benefits that urban farming brings to society, the environment, and the economy.

As urban areas continue to expand with the complex issues posed by rapid population growth and human activities, urban farming emerges as a viable and sustainable solution that can mitigate these issues. By recognizing and harnessing its benefits, policymakers, urban planners, and other stakeholders can work together to create an enabling environment that fosters the growth of urban farming and maximizes its positive impact. This requires targeted efforts to address the identified challenges, such as improving access to urban farming-related information, raising public awareness,

securing funding sources, streamlining regulatory processes, and optimizing land and space utilization.

In conclusion, this paper contributes to the existing research by providing a thorough analysis of how urban farming affects social, economic, and environmental sustainability, as well as the challenges and opportunities it presents. It takes into account the impact of urban farming in highly populated cities, which has not been well-studied before. As cities continue to grow and more people move into urban areas, understanding the effects of urban farming becomes crucial. This paper further contributes to the existing body of literature by adding the perspectives of urban farming organizations in various highly populated cities worldwide, enhancing our understanding and offering valuable insights on urban farming and sustainability.

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Appendix

A Interview Questions

Environmental Sustainability

1. Where is the food delivered?
2. How is the food packaged?
3. How many varieties of vegetation do you have?
4. How is the farm watered and fertilized?
5. What kind of waste does the farm produce?

Economic Sustainability

6. What is the difference in price between the food produced in your farm and the same kind of food in the market?
7. How many harvests can you have each year?
8. How much food does the farm produce each year?
9. Do you receive any financial support from the government?

Social Sustainability

10. How does the farm interact with the community?
11. What changes has the farm brought to the community?
12. Are the employees hired locally?
13. Are there any educational activities on your farm?

Challenges and Opportunities

14. What are the initial challenges for constructing the farm?
15. What are the challenges of maintaining the farm?
16. Where do you get general and expert information on urban farming?
17. What is the future outlook of urban farming?

B Interview Transcripts

Interview with ComCrop

Kai Zhang 0:04

I think it's recording. Thank you so much. And Darren, thank you for the opportunity, you know, taking your time to do this interview. And I really appreciate. So for the questions I did went through the your website, and also the interview that you guys did on YouTube. I cross out some questions. And you, but if you do realize that some of the questions that I'm going to ask you, like, if they don't apply it to your organization, or it has been answered, it's totally okay, if you don't answer them.

Interview respondent 1 0:42

Okay.

Kai Zhang 0:43

So um, yeah, well, I won't not waste, you know, more of your time. So let's just get started. Let's talk about environmental aspects. So because I realized that, that there are some like new farms open in your organization. So how many varieties of vegetation do you have at this moment?

Interview respondent 1 1:05

So with the new greenhouses, we actually now produce about five or six varieties, I think, if I can just list them down. We are growing lattices. So it's one variety of lattices. We are growing two varieties of kale, Tuscan kale and curly kale. We also do a very limited variety of, limited quantity of Komatsuna is a Japanese variety of the Titan. We do basil, mint, sweet basil, mint, and rosemary. So that actually brings it up to seven.

Kai Zhang 1:51

Okay, thank you so much. How is the how is the farm watered and fertilized.

Interview respondent 1 1:57

So we're hydroponic farm. So we primarily rely on, you know, water and nutrients to keep the plants growing. And all these obviously controlled by us. And we use a

mixture of rainwater as well as the tap water. And nutrients wise, we obviously will have to buy our own, and then we will mix it according to our own certification.

Kai Zhang 2:25

Okay, What kind of waste does the farm produce?

Interview respondent 1 2:30

Well, definitely, I don't think there's any, any production that doesn't produce waste. But, of course, we try and limit it as much as possible. A lot of the waste would, I suppose, be in the form of maybe some plastic waste and some maybe paper waste and stuff like that, we actually ship out our vegetables together with a root and a growing medium. So we reduce the wastage on that end, because that actually goes to the consumers. And when consumers are done with consuming the vegetables, they can actually take that grow medium, which is made on cocoa pea, and together with the roots that are already there, they can just break it up and actually put it into the potted plant for the then compose. Or they can, you know, throw it onto the soil and let it break down naturally. So there's our way of trying to reduce the waste that we throw away because in Singapore, it's important to remember that we don't really we don't, we don't do landfills. So a lot of it is incinerated. And as much as possible, we also try to reduce the waste that's going to incineration with regard to water and nutrients because we circulate the water and the nutrients as much as we can. And most of it gets taken up by the plants. So there is actually very little waste over there. You know, day to day I think a lot more of the so called waste with the maybe cosmetic filtering of the vegetable where certain vegetables maybe like the leaves are not as green as the supermarket one tip or you know certain things don't look so nice you pluck it off by what we do also is that we either you know donate that to some food rescuers or sometimes there are certain organizations that do one compost for their soil base growing so we then pass it over to them.

Kai Zhang 4:31

Okay, thank you very much.

Interview respondent 1 4:32

Yeah.

Kai Zhang 4:33

Now, it's the are the questions for the economic aspect. And I saw the video that you guys have a new farm and the guy said it produces 65,000 packages per month. But if if added the order together with the original farm, how much food does all the farm produce? Like each?

Interview respondent 1 4:58

I don't know which I'm not ready for Whenever which video you actually watched, but the last one, I mean, the most recent update is that we actually have one main site, which is at Woodlands. And that one site has five greenhouses. So that's the only one location that we're producing at the moment, and that location will produce about 220 tonnes a year.

Kai Zhang 5:25

Okay. It's the one where the culture and environmental minister was was there to cut the for the opening ceremony?

Interview respondent 1 5:35

Yeah, I believe so. Correct. That was that would have been the one in October last year. Yeah. Okay. Okay.

Kai Zhang 5:41

alright. So, all right. Um, and obviously, do you receive any financial support from the government.

Interview respondent 1 5:50

So financial support from the government usually comes in the form of grants. And these grants are typically meant to offset the kind of capital investments that we have. And we required to build such a large farm. So we do have some grants that that we had to help us to build this new expansion. But of course, a lot of the grants, not all of them come up upfront, there is a small percentage that comes up, comes to the farm upfront, but then we also have to get the rest of it ourselves. And then we have to work on a reimbursement basis most of the time. But that's the only one where they sort of offset a little bit capital and everything is down to us. They don't, Singapore doesn't subsidize business and Raela.

Kai Zhang 6:40

Okay, thank you. And let's talk about social wise, how does the farm interact with the community?

Interview respondent 1 6:48

Well, we try very much to you know, engage the community where we can, and this comes in multiple forms, we try to work with social service organizations to potentially look at how maybe people with disabilities could work on the farm. So we are working with an organization called Apex harmony Lodge, and they deal with elderly with dementia. And we will get them onto the farm and they will do the work that we assign, and then based on the amount of work that they complete, then we will pay them accordingly. So that's one way. We also work with another school called Great Auto school where they deal with kids with mental disabilities, and we train them with the idea that eventually when they graduate, they could potentially do work on the farm for some of the more simple or repetitive tasks. And at the same time, we also then engage a lot with schools and corporates to try and, you know, share the, the way they were growing the reasons behind the way that we're growing, while we're doing and, and also a lot about like food security, environmental sustainability, and even like, the context of production in Singapore. So those are some of the things that we try very much to engage the community in. We used to do a lot more of the free public tours, but now because of the way that we're growing, and because we do sort of like a controlled environment, greenhouse, so it becomes quite difficult to have such large public tours all the time. So now we only do sheduled guided tours. For schools, and for corporates as well. Yeah. smaller groups,

Kai Zhang 8:37

You mentioned schools. So are there any educational activities? On your farm?

Interview respondent 1 8:44

Well yeah, of course. Yeah, we do. We do. Cover like the topic that I mentioned. So involved, sometimes giving talks at schools. And so they're getting the school kids themselves to come over to the farm and see how the operations are like. And of course, we will then tailor that according to what the school is looking to do, you know, for different programs, and all that sort of thing.

Kai Zhang 9:12

But they're like, mainly elementary school or high school, or

Interview respondent 1 9:16

We typically engage a lot more with what we call the secondary schools, which are probably your high school. Yeah, so about 14 to 1213 to 16, or 13 to 17. And we deal a lot with the tertiary education and as well, so junior colleges, polytechnics, and even universities, primary schools, we are open but of course, then the content doesn't go as deep. It doesn't become a technical. Yeah

Kai Zhang 9:48

Yeah, so um, well, let's talk about the challenges and opportunities. What are the initial challenges for constructing the farm in the beginning

Interview respondent 1 9:59

for I mean, definitely one of the challenges was in getting the regulatory approvals for all of that, because it was something new that in Singapore. The other thing was also how to then you know, speak to the building owner. And, and get them to understand what this is really about. Because it is a in attendance, a new sort of business model, where, you know, roof tops used to be either you have, you have a covered and have shopped there and stuff like that, or you have it open and maybe put on a car park or, you know, leave it, leave it empty. Or even perhaps put solar panels, right, that's something that's been going on nowadays. But now then we're talking about, you know, using the land for activity where you have actually some production and you have people moving in and out. So that obviously was not easy to get people to understand and recognize, but I think over time, we've started to show that there is a lot more than just, you know, commercial activity, there's a lot is actually really activating the space, in a sense, getting people to come to the building, exploring the rooftop. Seeing that it's actually a very productive piece of land. Yeah, right. And then, of course, you know, because we are building on the rooftop. So certain structural limitations have to be taken into account. We need to make sure that everything is safe, everything is good for, you know, people to be working around. And also, you know, just thinking about the way that operations work, considering how the water is channeled up, how we use electricity efficiently, at the same time or so how do we then make sure that we don't, you know, call it any of these amenities to the rest of the occupants in the building? Right.

Kai Zhang 12:02

Okay. And what are the challenges of maintaining the farm?

Interview respondent 1 12:09

Well, I think it's the challenges of maintaining the farm are no different than any of the other farms in a sense, where a lot of it is about operations, making sure that, you know, your production is consistent, making sure that your produce is good. Know, making sure your plants are healthy, you reduce the incidences of pests and things like that. And, of course, then downstream is about getting people to understand and recognize the product, you know, to sort of support one local farms and also to support local farms that are meant to be in a sense, hyper local, right, very, very close to and productive producing within the community.

Kai Zhang 12:56

Okay, so where do you get general? We're just expert information on urban farming like yours.

Interview respondent 1 13:04

Sorry, we're doing what?

Kai Zhang 13:05

Where do you get general and expert information, on running a farm like yours in the city center.

Interview respondent 1 13:13

I would say all over, there's no one specific place that we would get them from we we do get some support from the local educational institutions, we get support from the Singapore food agency as well. They provide expertise. And there's another one called the National Environment Agency, they also do with plant health. And, you know, I think the local community is small enough that there are experts here who are always willing to lend a hand. And then we also have visitors from overseas and expertise, some of the suppliers, some of the partners that we work with, they also have their own expertise that they share. So we we tend to get information from everywhere.

Kai Zhang 13:58

Right. And one of the if I was not mistaken, one of them is from the government, right?

Interview respondent 1 14:04

Yep.

Kai Zhang 14:05

Okay, thank you. And the final question, what is, in your opinion, the future outlook of urban farming?

Interview respondent 1 14:14

Well, that's really hard to say because everyone is trying different things at the moment. So you have people who are trying things indoors, there are people trying things underground, you have people trying things on rooftops. And then of course, you have different ways of traditional farming, where you do the you know, the broad acre based kind of crop farming and you have a slow shift towards maybe organic and permaculture I think it's going to be a balance of everything where we're going to find we're going to have to find the most efficient and least impactful kind of farming method while trying to maximize the production and also there will be a lot of, I think concerted attempts to preserve a lot of the primary forests and wildlife that we have here. So it's going to be a bit of a struggle, and there's going to be some form of tension. But I think it's good because then it forces people to find the right solution. I wouldn't say the right solution, but maybe the best solution for the limitations that we have. And, you know, it's giving people that understanding that whatever that we do, whatever actions that are taken, whatever technology that we adopt, we do have to think about the longer term impact of feeding a growing population, and how might we then, you know, reduce the wastage and the kind of impact that we have traditionally done to the environment, all the while, you know, that your world population is continuing to grow? And how do we then also manage that? So that's how I see it going.

Kai Zhang 16:04

Right, exactly. Well, thank you so much for your insights there. And I really appreciate this opportunity. I'm going to process all the information on my own and later on. And so thank you, Darren, I wish you and best of your business and thank you.

Interview respondent 1 16:24

All right. Thank you so much. Take care. All right, bye.

Kai Zhang 16:26

Thank you.

Interview with De stadsgroenteboer

Kai Zhang 0:00

Thank you. All right. So get the questions. You also saw the questions beforehand, right?

Interview respondent 2 0:08

I did not. I just because I saw it only now that you sent an email yesterday evening. So I don't know if this is convenient or not because

Kai Zhang 0:20

No, no, no, it's fine. All the questions are not like technical. They're like, basically facts about the farm. So. And of course, if one of the questions does not apply to your farm, it is totally okay. You can, we can just skip it. So it's fine. So the questions are actually about four aspects. The first one is environmental, sustainability, economic sustainability and social sustainability. And we'll also talk about the challenges and opportunities for for urban farm like the one you have. So let's talk about the environmental aspect. So where is your food delivered?

Interview Respondent 2 1:06

And so we are a CSA. I don't know if you're familiar with the concept.

Kai Zhang 1:15

Community Supported farm, right?

Interview Respondent 2 1:17

Exactly. Yeah. So our food is delivered to Amsterdam. We are located just like just outside Amsterdam. We deliver 123 kinds of vegetation by bike by cargo bikes. And it's delivered to different neighborhoods where people then pick up their weekly subscription. And I would say about 85% of all the food we produce goes to the boxes, the weekly boxes that enter the private people, families, whoever is interested, buys it. And then we have a small percentage that goes to a few restaurants that we work together with. Yeah, like we will this year start with one small shop to see how that goes. But yeah, the bulk is really there. The CSA,

Kai Zhang 2:10

okay. And how is the food packaged?

Interview Respondent 2 2:14

So basically, we put the vegetables in one of those foldable plastic crates that are quite sturdy and reusable. Some of the things that are like loose leaves, we put in paper bags. And otherwise often things are just bunched with a rubber band. It comes washed, reasonably washed, we ask people to wash it again. And then people then will come to the pickup point. And we ask them to put it in their own bag and leave the crate there. So we can kind of collect it the following week. And there is like an exchange of crates. Yeah, we'll also ask the people to actually collect the bags and give them back to us. If they're, you know, okay, states, like if they're not really greasy or wrecked. We can.

Kai Zhang 3:06

Yeah, so plastic is hardly used, right?

Interview Respondent 2 3:11

Yes. So the only way we use plastic in the actual packaging of the food is when we deliver flowers to restaurants. We usually use those kind of take away food containers. That then we also ask them to return us and then we wash it and we reuse it. But the flowers are really kind of stay much pressure if they can be in a sealed container.

Kai Zhang 3:42

Okay, and how is the farm watered and fertilized.

Interview Respondent 2 3:48

And so the water well, we live in the Netherlands and we are on the sea level. And there's water everywhere. But we are kind of we are surrounded by a ditch a little Canal where we take the water out for irrigation. And we use that to irrigate our greenhouse and also to irrigate outside. We don't use it all the time because often it's rain fed and we have installed a sprinkler system. And the third the fertilization. It's kind of it's a mix of we buy in compost which is our main source of fertility that is made like the bulk of the composite ribeye is made from Green clippings and leaves and branches that is then composite. And then we have a small amount of compost that we make ourselves and that also has more diverse ingredients. We have some chickens and we kind of re recycle and compost their poop for extra. For certain crops, they really like it, but we're not gonna add it everywhere. We have also a neighbor that has horses, and we can if we pay for the delivery or like for the truck that picks it up and brings it to us, we can also

take off their manure, but that comes fresh. It's when you were mixed with straw. So we let it decompose on our farm for like about a year, and then we use it later on the more hungry plants. Okay,

Kai Zhang 5:30

So what kind of waste does the farm produce

Interview Respondent 2 5:35

Um, well, kind of normal wastes that you would have in a household because we also have a little kitchen that we use things like food, and then that comes in packaging, and that packaging is waste. The farm itself, we have, since we are a CSA, we have very little food waste in in that sense. And if there is something either gets thrown out of compost, or it goes through the chickens, stuff that is too ugly to sell or has gone over there, their primetime. And yeah, I mean, besides that, I mean, we do have always some construction project or like if we have to renew something, maybe we have to throw something all the way. But that's kind of the infrastructure of the farm, the farm itself. Well, we have very little waste in that sense. Don't know if it's a good answer.

Kai Zhang 6:33

Yeah, that's That's true. So the unwanted part of the farm kind of goes to the fertilization part, right? Yeah, yeah, we used okay. Yeah. So that's about the environmental aspect. Now, the economic aspect. So what is the difference in price between the food produced in your farm in your farm and the exact same food in the market?

Interview Respondent 2 7:01

Um, I think it really depends. Because I would say it's more expensive, right? It depends. If you go, for example, to if we compare ourselves to an organic supermarket, or an organic farmers market, or a farmers market that has an organic producer, I think it's around the same price, maybe a little bit more pricey, but really, like, when you go, for example, to the market, or the supermarket, actually, the vegetables that vary a lot over the year, when things are not quite in season, they sell it for much more expensive. But when it's like really kind of there is much more produce around and also the price drops. And then we kind of stay the same throughout the season, whatever we have with pricing. But since we are CSA, it's, it's kind of the prices are more for our internal understanding on how much we want to put into the vegetable box to understand a little bit from the value. But in the end, we try not to be too much guided by Oh, we have to put like one more carrots or we reached the right value in the box. But it's more to make

it really complete subscription or a service that people pay for. And since they also pay not in a fixed way, but there is like a flexible price scheme. It makes it even more difficult to say this is our price. Because it depends on so many things.

Kai Zhang 8:34

But yeah, I saw that on your website. Yeah

Interview Respondent 2 8:35

Yeah, we don't I mean, I would say yes, we expensive. Yeah, for sure. Yeah. I

Kai Zhang 8:43

mean, it's kind of worth it for for like you actually see what is growing and the process and everything. I think yeah.

Interview Respondent 2 8:52

Yeah, I mean, many people think it's worth it. I understand loads of people that say it's too expensive because maybe they have other or didn't have not so much like spare money in the month, they can also have really nice food. And the end of the day, like if we want the to have farms like we have that are very, like labor intensive and remote domain input is labor. Just gonna cost because we like we also have to eat and we also have to pay rent so like from our labor. That cannot be endlessly cheap, right? So Right. Oh, yeah. Yeah.

Kai Zhang 9:29

So how much food does the farm produce each year?

Interview Respondent 2 9:34

Um, I can tell you in tongues if you're interested. I can look it up.

Kai Zhang 9:39

Yeah, that would be great. Thank you.

Interview Respondent 2 9:43

It depends a little bit on the year, I would say. We have been this is we did four seasons already. Yeah. for seasons with dates, and in the beginning, we produce way less we had also half of the land and kind of in the meantime, we after two years we managed to get a better more or less. So these things of course, standard harvest increases here

Interview Respondent 2 10:38

okay have to real quick. Yep

Kai Zhang 10:40

No problem. Take your time.

Interview Respondent 2 10:42

I'm not quite sure if that works, but from the top of my head 35,533 So 35 turns

Kai Zhang 10:56

35,000 pounds, right? Sounds johnstones Yeah. 35,000 tons.

Unknown Speaker 2 11:04

Oh, I don't know in pounds. I'm really bad.

Kai Zhang 11:07

Oh, no, I'm not saying pounds. No, I mean, can t

Unknown Speaker 2 11:14

35 turns. So 35

Kai Zhang 11:19

Are we seeing the same word because it's t o n, right? So yeah, yeah. So 35,000 town. Yeah.

Interview Respondent 2 11:28

But not 1000s. Oh, wait. 35,000 kilos. Ah, so once, but in pounds. I don't know if you said pounds, but that will be 70,000 pounds. Two pounds or one kilo?

Kai Zhang 11:46

Yes. Yes. Okay. Yeah, I got that. Right. Okay, thank you. So I assume

Interview Respondent 2 11:53

This is very surprising this amount. So I could also be a bit less. Okay. Let's take it like it was something like less, but it can really be that we had really good harvests. And of course, things that way a lot. They kind of seem a lot like zucchini. They're very easy to grow. And then they're maybe not huge in calories, of course. And then we have letters, which 100 kilos of letters is like huge. Like, if you see it in front of you. It's impressive. But 100 kilos of zucchini is not so impressive. but yeah.

Kai Zhang 12:29

Yeah so about the harvests. You can harvest all year round, right?

Interview Respondent 2 12:36

Yes, no, yeah. Well, our season, our main season goes from May to December. So that's seven months, but don't mistake yet. But then the rest, it's kind of, we harvest a little bit, but not enough to supply the whole CSA group, because that's 180 families or 180 members. But then we usually we can harvest a little bit, mainly for ourselves, and sometimes make a very small subscription in the winter. But like now, right now, March and April are kind of the months where we have almost nothing to harvest. And because it's kind of everything from the winter is used up. But the spring stuff is not ready yet. So we're waiting patiently. We have like, a little bit of lettuce somewhere, but then that's it. Right.

Kai Zhang 13:27

So the last question from the economic part, do you receive any financial support from the government?

Interview Respondent 2 13:37

Um, Not on a regular basis. No, sometimes we do, but that is you to that we look up and kind of participate in a program or subsidy, but you have to kind of come up with a proposal, a project proposal, and then you have to accept you, and then you get like, some some money for it. And we got that already, like two three times, I think, one quite big subsidy. And then some smaller ones, but they're always going to be very, very directly related to a specific project and you have to be quite cool that you have to make a report and you have to like click Keep all your all your exact expenses and you

have to like justify everything. So it's also a lot of work, but we kind of do it on a regular basis.

Kai Zhang 14:25

Okay, but there is a channel for the for applying for the financial support.

Interview Respondent 2 14:32

Yes, or let's say there is a lot of money around so you have to know how to access it, what to like also, to kind of be on time and not miss the deadline and it has like your idea your project really has to fit in in those people's mind like what they have money set aside for and if you don't kind of speak exactly their language or you don't really speak to their vision then you might Don't get it even though it's a nice product. Yeah.

Kai Zhang 15:03

Okay so now it's the social aspect. How does the farm interact with the community? I mean, this is a very obvious one. But yeah, just for the sake of the research.

Interview Respondent 2 15:15

Um, it's really it's, I mean, we have multiple channels, of course of communication, and one that is more. For the electorate, what we do for our CSA and for our community of the CSA is that we, during the season, we send them a newsletter every week, I guess, a bit more than half read it. There, we also kind of let them know what's going on in the garden. We have regular days where people can come and help out at the farm to kind of feel invited, they can come and volunteer for a little bit. And twice a year, we do kind of like a spring and fall or like, we call it a harvest party in the spring party. So it's more like an event that we do. And we will invite members of the CSA, but also their friends and their families and the kids, just like people who are interested, and then we give them tours, or we maybe make a small activity with them. And besides that, yeah, we have also on social media, but I think that's not so special, I think, yeah, the thing with the newsletter, what makes it maybe it's very, really specific to the garden and specific to the vegetables defined. So we also try to have an educational moment. People, often they don't even recognize the vegetable. And then we, we made this part on our on our website, where they can also look up all sorts of kind of recipes and things related to the specific vegetable. And that's more like the educational part. That is not only it's not only for the members, because anyone could go on the website and read it. For them. It's

Kai Zhang 17:08

yeah. Well, you kind of answered the next question. Because, yeah, I was gonna ask you, are there any educational activities on your farm?

Interview Respondent 2 17:17

Yeah, yeah, I mean, that's. And then sometimes we get approached by companies, or also schools, not like on a regular basis. Now, last year, we started working together with the culinary school in Amsterdam. Hopefully, they will also come this year. And it was quite nice, because the young people, they can kind of really see what's growing where and get a bit more connection to what they're actually cooking. And then also able to talk a little bit like a small meal from the stuff that was already in the garden. So that was quite nice, because they were really, they had no idea. And besides that, we we also collaborate with the university that we all studied, at least in Italy. And we kind of not all the time and not extremely regularly, but we stay close contact and we kind of take part of their activities, or like we even go for guest lecturer something that is kind of approaching us and not us reaching out. Very nice position to be in the approach and be like, an interesting thing for people. So people that approach, which is nice. Yeah.

Kai Zhang 18:42

So as for the challenges and opportunities of the first question is what are the initial challenges for constructing the farm?

Interview Respondent 2 18:59

Money? Yeah. money and time. Of course, it's always a problem, or it's always a challenge. It's always if you if you want to start a farm from scratch, what you don't really have is probably money and a lot of time. Yeah, these things are very useful. On top of that comes maybe it's good. Like, I wish we had a bit more knowledge, or of course, now we're much more smart, and we would do things differently. So you learn a lot by kind of making mistakes and learning from them. And I think it's just when there's many challenges, but I guess it's really a job that you really grow onto. Yeah, and it's not. It's not like you went to school and then you know it, but it's also not like, you know, like you Oh, Let's learn and you always kind of every, every season is different, and there's so much that you cannot control or that it's like beyond your control, and you just have to kind of adapt to it and deal with it. So it takes that kind of mindset that you cannot have ever the perfect garden or like, that job is never done. So kind of that mindset has to be clear, in order to, to kind of manage through through a season. Yeah. Okay,

Kai Zhang 20:31

so apart from the experience, you accumulated throughout the years, a warehouse, do you get general or expert information on urban farming?

Interview Respondent 2 20:43

Um, let's see, well, the internet is a very good resource. Yeah, find anything really. Even if you not subscribe to like, professional magazine or something, you can always find lots of information, lots of research on specific things. But what I really like to do is listen to podcasts. Podcasts, is also something I do while commuting. And that's like, I used to try to use my time wisely. And then kind of listen to lots of interviews. Also, from farmers that interview farmers that do similar things, yeah. Maybe in a similar environment, or size, or just concept wise, because you get kind of an idea what other people do. Yeah, and that is, I think, very valuable, because it's really related to the practicalities. And also at the farm ourselves. We kind of try to make a study trip every year.

Kai Zhang 21:49

To where?

Interview Respondent 2 21:51

It depends, we can make any temporary for maybe two, two days, maybe three, maybe one depends on how much time we have to visit other farms and actually talk to them. And maybe, yeah, kind of exchange like that. And that is very valuable. Because besides like, kind of building a lot of network, it's also just, it's different. Of course listening to a podcast and, and seeing things with your own eyes. Yeah, I think that is the least you can learn so much from kind of fellow farmers, even if they do not exactly the same thing, or even if they're not organic, or it kind of just kind of broadens your understanding about the difficulties and the topics and yeah, what other people do, and then it can help a lot.

Kai Zhang 22:39

So what are the challenges of maintaining the farm as like a day to day basis?

Interview Respondent 2 22:47

Hmm. Well, since like, we have quite a big team. Now, this year, we are six people, we all work part time. So I think teamwork and communication is just key. Yeah, to kind of

make it run smoothly. When if that part is done really well, of course, then there's other challenges. Like when things break, and you have to fix them, and they break again, and you don't know how to fix it on you. You lose like a day running after things that are broken. Are things that are not delivered or suppliers that are not reliable. That is like always, of course, headache. But I think it's like it's tough. Number one thing is kind of communicating with a team in a in a good way. If that works well, all the other things that can also not work so well. You can still kind of master through the challenges, but if right? Yeah, I think that's something. Okay. All right.

Kai Zhang 23:49

So the final question, what is the future outlook, your opinion of urban farming in general?

Interview Respondent 2 24:01

I don't really know about other places than the Netherlands. But here I can see that. It's actually more farms that are urban farms are kind of similar size farms that do similar things they keep on popping up. Mm hmm. It seems like a very trendy thing to do, or very, quite popular or more popular than it used to be. Yeah. And I see it may be that more and more farmers that are like, let's say first generation, farmers get interested in it, and then they kind of innovate farming that way. Like because so many like I wasn't born into a farming familiar, I didn't go to like agricultural school or you know, it was kind of a you come from besides and we're you know, like do the traditional farming background and the knowledge that can really help to do things a little bit differently or think outside the box? And I think that's just really nice if young people from different backgrounds join into farming, because in my opinion, farming in general is pretty fucked up. In many ways. Yeah. But there is also kind of hope. And it needs this young people that think differently about it or are not very, like put, don't think don't put things in a box necessarily already from the beginning to also explore things that maybe are like, unconventional or Yeah. So I think it will grow. Definitely. And I hope that people also the city will, kind of longing for this kind of connection to farming. And there's always, I think, if ever if someone has an office job, that kind of long for having also a balance and getting maybe outside and doing something with your hands. So it's nice if we can take advantage of it and have some extra people that will lend helping Yeah. Interesting. Okay.

Kai Zhang 26:10

Well, that's basically all the questions that I have for this interview. Thank you very much, Laura.

Interview Respondent 2 26:17

Nice. Of course, you're welcome. Sorry for being a little bit late. But no,

Kai Zhang 26:21

no, that's, that's totally fine. Like I said, I'm pretty much free myself as well. And yeah, very interesting. I actually went through the although, you know, like information on your website. I think it's, yeah, it's very, very interesting. I'm very positive about the future of urban farming. That's why I'm actually doing my master thesis on this. I'm personally very interested in farming. I don't know why, like I grew up in a big city. I live in a big sea, but I just, I just love farming.

Interview Respondent 2 26:52

I think it's also something like human or like, kind of very deep down in humanity. People want to have that connection somehow.

Kai Zhang 27:01

Yeah, yeah. We live in a very big city. But we have a rooftop, like my dad. Well, my family runs and yeah, we just constantly get vegetables. We don't really we hardly buy vegetables in a supermarket. So it's like self sustained. Yeah.

Interview Respondent 2 27:18

Congrats.

Kai Zhang 27:20

Thank you. Yeah, very interesting.

Interview Respondent 2 27:22

Guy. If you have any more questions, or if something is unclear, you can also just send me an email and then yeah, thank you something. Yeah. Later on Morris. Yeah.

Kai Zhang 27:31

I think I got all the questions answered. So thank you very much, Laura. And I will not waste more of your time. I wish you as long. Yeah.

Interview Respondent 2 27:40

Thank you. You too.

Kai Zhang 27:42

Thank you. Bye. Bye, you too. Bye. Bye.

Interview with BIGH

Interview Respondent 3 0:00

Just ask you like, if you can briefly explain what you are expecting and what you would like to know, actually, because I read the email, I remember what you would like to, to have as information, but just to get to know you a bit. What what are you doing exactly, and what you would like us to provide you as the information.

Kai Zhang 0:20

Yeah, so I am a master student, and K 11. Master. My program is Public Sector Innovation and E governance. And currently, it's my last semester and I am writing a thesis about sustainability, specifically about urban farming. And for the questions I have sent you the list. I don't know if you saw the questions. But

Interview Respondent 3 0:51

check again, because we have several email addresses. Not only the time working on the one that you're contacting,

Kai Zhang 0:59

yeah, it's fine. I mean, all the questions are not technical. They're basically about general facts about the farm. So yeah, yeah. Okay.

Interview Respondent 3 1:18

Wait a second.

Kai Zhang 1:19

Yeah. And if you cannot see it, I can also like,

Interview Respondent 3 1:24

the question. I have the question.

Kai Zhang 1:26

Okay. Yeah. So, well, I'm not going to waste more of your time. So are you ready? We can get started.

Interview Respondent 3 1:32

And ready, let's go.

Kai Zhang 1:35

So yeah, so the questions are mainly about environmental, sustainable sustainability, and also economical and social. And we'll also talk about challenges and opportunities for urban farming. So let's go to environmental sustainability. Where is the food delivered?

Interview Respondent 3 1:55

Okay, so actually, we are a local producer in the region of results, so we only deliver the food to local restaurants and local supermarkets. Okay, is we really mainly where customers come from, we only deliver the food directly to the to the super to the clients that are located in Brussels. And also regarding our partners, we only worked closely we only work closely with local partners also, when I say local partner, this catering or commercial partners,

Kai Zhang 2:34

Ah, okay, I see. And how is the food packaged.

Interview Respondent 3 2:40

So actually, all the food is packaged at the farm, there is only one intermediary that we have. It's an organization a company called utopia that is located also close to Brussels. This is a company which is being asked to remove the spines from the sandwich roots actually, because we are practicing sediment roots at the farm. And, but everything is prepared at the farm. So once we start once the products are ready to be commercialized, we prepare the packaging directly at the farm and we deliver it to the customers directly

Kai Zhang 3:18

Do you use plastic or

Interview Respondent 3 3:21

like, actually, so actually the only plastics that we use in the parts of the aromatic herbs, but we plan to change those parts. So actually, it's a recyclable plastic. But we would like to find another solution. The main issue that we have with a hermetic herbs is that the plants are just for the hermetic herbs I'm talking about the plants are receiving the water on the table. So it's really complex to change this kind of material to something more organic because we if we use something organic, it might deteriorate the detail of it in the in the water. So we use only for the moment, plastic parts, but we plan to change it to something more organic and eco responsible

Kai Zhang 4:15

Okay, and I know that you have many different farms. So add all that together. How many varieties of vegetations Do you have?

Interview Respondent 3 4:25

Okay, just to correct you so for the month we have one pilot farm in Brussels so the first aquaponic farm from big that has been built is in Brussels, but we have a second pilot farm, which won't be exactly the same. And it's not really a pilot farm. It's something it's a bigger aquaponic farm in Neil in France. And actually this farm is odd to say all the experiments that we are doing at birth in Brussels, it So can have knowledge for the upcoming farms that are going to be built. So, for the moment as I told you we have two forms with the second one is not yet finalized and for the moment what we are producing in Brussels, so, we have different kinds of vegetables. So, as I say we have a verity of aromatic herbs for the mind we are producing six types of aromatic herbs and we plan to extend to new kinds of aromatic herbs such as diabetes heal, Basil, basil and also other kinds of herbs Shizuo two we are testing the shizzle and for the vegetables we for the moment doing some work in one of our greenhouse and in this greenhouse, we will still producing to meet Sherry tomatoes, heck plants, so, white and Tiger plants and also she papers we also produce produce, we produce all socially papers at the farm. And in this greenhouse, they will be the new variety of aromatic herbs. We have in the plan to also produce some cucumbers but it's not 100% yet confirm Okay, for the aquaculture system for the moment we are only producing Salman truth, but we might in the future. So when I say in the future is in a few months, we make in the future also produce a blind the word in English but I will translate it now. Produce crayfish in symbiosis also with salman tools.

Kai Zhang 6:46

Ah, okay.

Interview Respondent 3 6:48

So this is what we print. Sorry.

Kai Zhang 6:50

Yes, yeah. So fish, vegetables and herbs.

Interview Respondent 3 6:54

Exactly. Okay, so for the moment, that's what we produce in our greenhouses. So just to give you an overview about the farm, the space that we have actually, we are located on a rooftop of a building called Food net, which is located in a very famous place in Brussels called the abattoir and actually we use for 4000 square meters of of space and there is 2000 square meters where we have the greenhouses so where we produce the fish and the other vegetables, and 2000 square meters of external garden the products are harvested and produced in the external garden is not a commercialized by big is another company, actually a nonprofit association with maintaining the external garden and picking up the vegetables to sell it faster. Okay, so we have a kind of cloud where we are a private company or a private producer. But we also have a value which is also to open to have a more educative and also social value behind the project.

Kai Zhang 8:08

All right. Okay, thank you so much. So about the forest question, how is the farm watered and fertilized?

Interview Respondent 3 8:17

So, regarding the water, we we use three we have three ways we using the water because that big we try as much as possible to reuse all the resources that we have, and also to be as much as possible sustainable. So for the water, we have a connection so down the building of the food myth building, actually where we are located, there is a groundwater six system where we are connected. So actually the City of Brussels allowed us to we have an agreement with them and who has to to have a connection with this groundwater system. And to use a certain quantity not a lot of water a certain quantity of this water for fish farm. Why we're using only this water for the fish farm is because this water is more stable for the salmon shoot. Just to let you know, send

maturities are very sensitive fish. So this is a fish that needs water that is not too acid has not a big pH level. So we use this water for the fish farm. And this water also is we have a common so in the building with other Metcons we have also heating term system. So come on eating type system that allows us to warm up the weather for the greenhouses. So this is the way we warm up the greenhouses, it's with hot water and to call them to cool the water for the fish farm. So this is the first way we are using water. And the second way is the rainwater. So we have a uterus that allows us also to recollect collect the rainwater and also this water is filtered and we use it for our irrigation system. The third way so, we call in the, in the aquaponic slang, we call it the return water. So, it's water that has not been absorbed by the plants. For instance, once we launch an irrigation system, so, visually you have to see a bit maybe, but I will try to visualize it for you. So, for instance, in the greenhouses, in our hermetic herbs, we water the plants on tables. So there is a kind of drain system that brings the water and fill in the tables with water and this water that has not been absorbed by the glands goes back to the drain system and goes back to our irrigation system actually. So once we have to reactivate an irrigation system, we reuse again this water that has not been used. And so this return water is the mix of the water from the from the rain. So that as I said is all the time filtered we have filters system that allow us to filter the water a mix of this rainwater a mix of the return water and the water from the fish actually, so I don't know if you're familiar with aquaponics eco Oh does it work

Kai Zhang 11:24

a little bit yeah a little

Interview Respondent 3 11:27

bit. So actually it works is because we are using the water from the fish and oh to say that direction so the difference of the fish so literally the shit of the fish and we use it as fertilizer for the plants. And the water also is used for the for the vegetables so it's a kind of closed system of usually we do not reuse the water from the irrigation system and from the plants to the fish farm because there is a kind of biosecurity is first biosecurity reasons we don't do that. We haven't found the solution to reuse this water also in the fish farm. So the fish farm is a closed system the weather only goes out for the for the plants but the rest of the do not go inside. So we have all this system that filter all the time the water and the water stayed in the fish farm only just to irrigate the plants and for the fertilizer as they said we use the influence of the fish as nutrients for the plants and we have also a way of we reuse the waste from the projects that we have. So for instance the plants that are not commercialized or not given away we will use the

plants for as compost so there is a mixture that we produce and we use that for the excellent garden.

Kai Zhang 12:55

Okay, thank you very much. The fifth one I read on your website it says you basically produce almost zero waste right? But what kind of waste does the farm produce?

Interview Respondent 3 13:11

I'm trying to give you an example. So we are almost zero. Not to say we do not produce a lot of waste but it's I'm lying to you if I say that we are not producing some waste. So the only ways that we have and we try to find a solution for that and we have an alternative that is coming up. For instance when we are preparing the fish when you are getting the fish there are some waste that for instance to say this we say in French we should slowly shoot is when you are cutting the meat of the fish. There are some parts not use or they are not well cut. And this is kind of ways that we would like to say to valorize and we found a way in the future we might ask to a cook very famous cook in Brussels to transform this fish waste as as a new product transform so we say in French so it's a game of fish in I don't know if you know what is the kind of pate is a kind of fish mousse that you can put on some toast or something like this. So this is the plan that we have for the fish waste okay and for the fish waste that we cannot transform as a food product. We use it in also in the external garden to bring minerals to the ground soil. For the waste it happens for instance in summer especially that we have a lot of tomatoes. This is typical from all the tomatoes producers in the region. In summer as it is very hot. We every producer tomato producer has a lot of another production. So it happens sometimes that we have to cut the price to send it to sell it to our customers. And for the tomatoes, the rest of the tomatoes that we have, we try to give it away for instance to a local partner that is located also in the abattoir side and which is called Future game. And future game, actually they are. It's a nonprofit association where they do activities with the use of the municipality. And also they organize private cook lessons. And the purpose is also to make wellness against food waste. So we give one power to them. But obviously, sometimes we have too much. So we give it away to internally for the colleagues that we have in the team. We tried as much as possible to give it away. But for the food waste, sometimes it happened that we have a little we reuse it in the compost. Okay,

Kai Zhang 16:02

thank you very much.

Interview Respondent 3 16:04

Maybe I'm thinking something else regarding food, we were getting waste. We do not have a lot of ways this is the main two ways that we have at the farm. For instance, we don't you are familiar with secret economy, but I think so because you mentioned it at the beginning. But there is an approach called cuddle to cuddle.

Kai Zhang 16:30

Or I read on your website about Cradle to Cradle.

Interview Respondent 3 16:34

Okay, so it's quite common in especially in urban farming and architecture, urban architecture is to reuse is a way of reusing material until they are not usable. So to give life to material that might will be used and wasted or throw it away. At the farm, we try as much as possible to reuse all the materials. So when I say material is organic material, for instance, as I said, like the ways that we have, for instance, we reconnect old wooden boxes to two plants are, for instance, or red fruits are really used some nets also that have not been used for from other, I don't know Metcons or other producers. So we really try to give a second life to some material. For instance, to give you an example, our offices are hauled containers, there has been a remain that has been to say, prepare to be usable as an office. So it's the way we try as much as possible to not have any organic of material. Waste.

Kai Zhang 17:46

Okay, well, that's a lot. Thank you for the information.

Interview Respondent 3 17:50

Yeah, that's me, you can ask me a question. If you don't understand or if there is something that is not really well explained, we would like to have more information to know.

Kai Zhang 17:59

Yeah, I understand everything. And thank you so much. It's just a lot of information. It's very useful to me, but

Interview Respondent 3 18:04

I think it's better for you. So you have a lot. Yeah.

Kai Zhang 18:08

Exactly. This is so useful. Like I was just trying to tell you that it's very useful for my research. Thank you.

Interview Respondent 3 18:15

You're welcome. Any case, if there is something that you would like to highlight, after the interview, like you have another other question, you can still ask us.

Kai Zhang 18:25

Yeah, yeah, absolutely. Okay. So let's talk about the question. Yeah, economic sustainability. So what about the price difference between the product produced in your farm and the same kind of product in the market?

Interview Respondent 3 18:40

Okay, just to give you a bit of a view, so the WHERE TO THE abattoir is the place to the site where we are located is one of the biggest food market in the region of results. And from Friday to Sunday, you have the this food market that is happening. And actually, it's a bit complicated to compete with this food market. So that's why we are not selling the product in this market. Because the price of the oldest products are really cheap. Most of the products are imported, and they come directly from the entry bowl. So it's something to to sell the products at this food market. One day we would like to but it's a bit complicated. So the pricing of our products are a bit more expensive than the pricing that you can find. For instance, in this kind of food market or so in some supermarket to the reasons why it's a bit more expensive. I'm not saying it's really expensive is a bit more expensive, because we want as much as possible so to obviously to gain from the selling of the products but also to be as much as possible to democratize price. So something that is also at accessible for the local consumers. So, for the moment, for instance, to give you an example, one kilo of an entire fish a fish that is not good, it's 32 euros a kilo. Okay. And for instance, a slice of 200 grams of fish, it's around six euros. So it's something it's a bit more expensive, but it's not also to compare with the price of the market. So expensive. So, how can I, for instance, explain to you the cost of some of the products is because there is a lot of handwork that is, is done behind. So as I said to the beginning, the packaging is prepared here or the

products are produced at the farm and maintained on the farm and collected the farm. And also like, we do not have the only one, as I say to you, at the beginning, we have only one intermediary, it's for the fish, but all the rest everything is prepared the farm, and we use a lot of technologies through. So for instance, for the fish farm, we have we can control the oxygen levels, the pH level and so on. With some application on our phones, everything, we have a mythological system, we have we use a lot of electricity, we have a lot of automatic system that also has a cost behind so to cover these those costs, we have to also propose a price that is a bit more higher than the price that is proposed in the market. But to just define it a bit like we are not so much expensive, it's still affordable. Most of the products start to be you can find most of the product also now in some big chains such as Cafu, Koha, farms and so on. So it's still affordable, but we are a bit more expensive.

Kai Zhang 22:06

Yeah. That's understandable. I mean, everything is produced with the such organic way. And yeah,

Interview Respondent 3 22:13

exactly. So this is why I say to you like the we would like to democratize more price but we have to cover all the costs that we have behind also and there is a lot as I said hand word there is the product that we are using also for the fish as the cost. We are also making some systems summer tests that cost also some money for instance, like we would like in the future to change the feeding of the fish, for instance, not use fish sown and fish efficiently. Fish oil and fish floor, we like to change it for instance, the fish floor to insect floor, but it's something that is quite expensive, still expensive in the market for the moment. Because it's not the there are a lot of producers who start to use those products, but it's still very expensive. So this kind of things has also cost so we have to cover all the expenses and but we hope in the future also to democratize the price and also to decrease a bit the price. But regarding also the current situation with the price of the energy, the increasing of the price of the food is something that we have also to be aligned with it.

Kai Zhang 23:28

Yep. Okay, so how how many harvests Can you have each year

Interview Respondent 3 23:35

for the harvest for the external gather, and I do not have the exact data so I won't advance to this question. But for instance, for the fish, and the and for the vegetables, we can produce in the capacity. So for the fishery incapacity we can produce 20 tons. It never happened due to the fact that we, for the fish we channel for the production a few years ago to Simon truths, and it's something that we had to do a lot of, of work behind, such as marketing and communication and, and testing also to see the fish was also in has a good flavor. So last year, just to give you an example, in 2022, we produce 10 tons of fish.

Kai Zhang 24:23

So it's a year right one year 10 tons

Interview Respondent 3 24:28

So in 2022 we produced in terms of fish. So as I said to you, I cannot give you too many details. For instance, like the salmon shoot, we started producing it in 2021. So I don't have enough data to give you to compare with the other years. And for the fish that was produced in the past. I don't know the exact quantity so but I know that in our fish farm, the capacity, the capacity that we have allowed us to produce 20 tonnes a year. Okay, it hasn't been reached. yet but we tried we will see to also from the demand and what we can produce in the fish farm to reach maybe these amounts in the next coming years. But last year we produced 10 tons of sandwich routes to give you the data for the greenhouses so I know from from my knowledge from the home attic herbs last year we produce in average one hand we sell sorry, we sell in average 170 170,000 Of note is 170,000 of our material herbs. I think the capacity can be much more higher than this. This setting because our hermetic herbs is something that we produce the entire year, such as the fish but for the greenhouses, I know we put some data on no current because we're working on the website we are doing a new website but let me check for the

Interview Respondent 3 26:14

sorry after the garden doing some gardening outside so that's when you hear the noise
It's okay

Kai Zhang 26:20

It's fine I don't hear anything perfect great.

Interview Respondent 3 26:24

So for the data's tomatoes I know that we produced last year five comma five tons but I think the capacity also there is much more higher but I do not have exactly the exact number so do not hesitate to to resend me an email with this question because it's something I think I need to ask to my colleagues I've just checked maybe find the data so.

Interview Respondent 3 27:02

Okay, so let's you are producing strawberries through in a vertical way but we will stop it but I can give you the data. So we produce 204 kilos of strawberries last year. And this was a bit failed because it was not good in taste. It's a bit complicated to reproduce strawberries with the aquaponic system and a eggplants we produce 2,005th Now 2054 kilos and the spicy papers we produce 169 kilos a year. So in 2022 This all these data are from 2020 to

Kai Zhang 27:45

162 right 169 or 69 kilos, okay. Spicy papers

Interview Respondent 3 27:53

and HACCP plans is 2054

Kai Zhang 27:58

Okay, thank you. So, do you receive any financial support from the Belgium government?

Interview Respondent 3 28:08

Actually, from this year, we are not receiving anything but we are applying to cool off tenders to get some firms from the on the to get some subsidies from the research region, such as the good food good food is a strategy that has been launched by the article that again, the Environmental Public Service of the region. And so we the way that we are getting some subsidies is true call of tenders that we are applying to. But most of the funds that are invested in the farm comes from private investors. We do have some EU funds in the past. But it was not directly given to big it was the abattoir who receive these funds to reinforce the rooftop of where we are located. But most of the investment comes from private companies, private investors.

Kai Zhang 29:05

Okay. Yeah, thank you. So for the social aspect, how does the farm interact with the local community?

Interview Respondent 3 29:17

So we have the second just to let you know to do the second activities of the farm. So the first one is food producing and the second one is we we have we organize visits, so public and private visits. And also we organized some events at the farm. So this is a way of showing the farm and trying to encourage it to connect with the citizens of so to show those that the elders and aquaponic system work. The second way of connecting with the community. So on the abattoir side there are other companies startups focusing on food, pet food industry and And we try as much as possible to create some synergies and partnerships with them. And we also for instance, with I'm just giving an example with future again, what we do is we we let them the access to come for to them. So, they can come with schools commercial with the other organization to visit the external gathering of the farm. And also regarding the social aspects, for instance, as I said, at the beginning, the external gathering is all the products that are listed and produce is not big with maintaining the external gathering is necessary navigation call actually holds a lens, which is also located not too far from the abattoir and actually called a nine actually what they do is they help people who do not have jobs, or for instance, people who do not have the citizenship, the belgian citizenship or who have also mental health issue to, to learn how to adjust, and to learn a bit about the agri agriculture sector. And they teach them out to others and they come in the oxen and gather and when those people are so and not only in the vegan, they do that in several places also in the region. They teach them also and they help them to to have an activity and to get access easier to the work market. So this is also the point that we wanted to emphasize is to not only privatize all the space that we have, because just to let you know we are renting the space also. So the rooftop of there, but the footman is not from big, we have to pay a rent to the abattoir. Okay. And so for food for three co tenants is the point that we wanted also, to emphasize is also to not privatize all the space, but to let other organization also to have the access to the farm. Obviously, we organize with them, they don't come whenever they want. But this is the kind of thing that we try as much as possible to create with the local community is by creating new partnerships, especially partnerships from the people that are located from the companies and organization that are located on the abattoir. and are located on the abattoir. And also for the for the rest. As I said to you like we organize public visits, obviously with pricing that are those visits are paid. But what we do also we implemented the pricing that I'd say that were decided also by the government, for instance, like the pricing for students, pricing from people who do not have a job, or an employed and so on, we really want to make as

much as possible the farm accessible through through events and also through partnerships.

Kai Zhang 33:00

Okay, so are all your employees hired locally? Are they all from Brussels?

Interview Respondent 3 33:08

Not actually, we have a multinational team, okay. Most of the people that are working out at the farm of French speaking so from Belgium and from France. But we have a lot of sort of international students that are coming. And we have also one of our colleagues with British. So it depends a bit but in general, we have several workers or several law students also that are doing the internship that comes from other countries. For instance, last year we had Lana was coming from Russia, we had we had also Spanish students, so it's quite different. It's quite open in the fix, for instance, the fixed contract. So when I say the fixed contract is the long term contract, we have one colleague who is coming from retail, we would like we are open to other other people to join the team. So we are really quite open at the farm and we speak must other the time, French but English to, to also to help those who do not speak French. So it's quite multinational environments.

Kai Zhang 34:18

Just just a different question, though. You mentioned that you hired a non EU Right?

Interview Respondent 3 34:27

Exactly. Yeah. But is, is a living in Brussels is a while? So I think Joe for Joe is the name of the colleagues. I think has an own kind of agreement contract. And I need to ask him because I don't know. But I think he has to call that. Design and you have to find the word in English. This kind of conscience again. He's again, a visa that he has also to work in, in the invasion.

Kai Zhang 35:06

So the government has been okay,

Interview Respondent 3 35:10

exactly. He has been living here for more than five years now. So. Okay, this is the kind of he has the kind of visa to I think so.

Kai Zhang 35:17

Yeah. Okay. I see. Well, that's just a site question. That's not important. Okay, that's for social. Yeah, we're down here. So finally, the challenges and opportunities. So what are the initial challenges for constructing the farm in the beginning.

Interview Respondent 3 35:38

So in the beginning, as I said, it's the farm is located on a rooftop, which was, which is not really common to there, there are some urban farms on the rooftop, it's not really common to, to do that, and specifically within an aquaponic system, because as we have a fish farm, the tanks to the days where the fish are quite heavy, so it's something that's why the abattoir and the main founders of the project, so Steven Baker's who is an architect, and the others investors, I had to find a way to reinforce the rooftop. And so this is the main challenge is that, for instance, we cannot install more greenhouses, but we do have the space. There is one space in the in the farm where we are not putting anything because it's not well, we can work on it, but we cannot put bigger infrastructure on it because it's not well maintained. So it's the main issue at the beginning was the space. Oh 202 Instead of farming in a space that was not really well maintained, which is a rooftop, and especially when you're producing fish, and you you have to have the tanks that are quite easy. So this was the main challenge. The main challenge and also the main challenge, too is that aquaponic was not well and still not well known by the citizen. So when you are approaching, for instance, the clients at the beginning they were like what is that will Oh, can you produce fish in the city? It's not in an environmental. Obviously, it's not in the environmental ways in the tanks. They were quite not concerned with a bit. Do putative a bit like they were not really open to that. So this was the two main challenges, actually.

Kai Zhang 37:32

Yeah, then what are the main stories? Yeah, go ahead. Sorry.

Interview Respondent 3 37:38

No, no, I'm just saying this was those two main challenges was to make a company's place also into the food market in Brussels. And to get to, to to attract also the visitors to the visitors or the customers to show them what is it and that is also very sustainable way of producing food. But people were not really done with this. So it was there were

a lot of, of communication work behind a lot of changes to make it work. The first one that I said was the maintenance and the structure also on the phone, on the on the rooftop of a building.

Kai Zhang 38:19

Okay, so what what are the daily challenges of maintaining the farm?

Interview Respondent 3 38:26

The daily challenges, the daily challenges, for instance, for the one point because as I'm working in the events and communication department, I know it's working. But as we are located on an abattoir, on the abattoir side, which is a very big place. There are several main entrances so people get lost when they come to the front. So the one the first challenge that we had, but to come to come back to the functional of the functional challenges of the form. Mainly it's can I find it, for instance, is the energy use, for instance, the electricity and so on, but we do not have any issue but the price is having an impact also on our activity. And for maintaining the farm. But obviously, it'll come back to the fact that we're in the city center, on the big site. And especially on the site where there is a food market and meat and fish market, there are a lot of birds. So for external gathering is something where we have to pay attention with the birds because they are picking up the fruit. And the rest also is for the excellent gatherer. For more, let's say production side, as we are on a rooftop, we have to pay attention for instance, we are not using conventional soil. On the excellent garden is a mix is used different kinds of strike. For instance, we have a we use compost, we have volcanic stones or so because it's not so heavy. And it's a very good draining the stones for the plant, which is maintained better the humidity. And we have another substrate that we use is the perlite. And it's something that's on the roof that is a big challenge, we had to find a way to not put too many weight, especially in one part of the farm. So that's what I said at the beginning. This is a bit the challenge because it's not a conventional so so we have two two men maintain the excellent garden in different way to compare with the greenhouses. With the food, the main challenge that we have, for instance, for the hermetic herbs, is regarding the demands of the clients. Yeah. So especially the hermetic herbs. It happens, for instance, in the greenhouses, that it might happen that we have a meal, you can have some illnesses on the plant. So you don't have to the word in English, but it's something that we have to pay attention to it. Because it can go really fast, and it can contaminate the rest of the plants. So we have old techniques that helped us to maintain the greenhouses to avoid the illnesses, but there is a lot of work behind to maintain the fight against invasive insects or to fight against illnesses. Yeah, so as we do not use it happens sometimes where it is really rare and we avoid to do that. We do

rarely use pesticide. So pesticides that are recognized by the EU, but the EU, but a daily way to fight it's with natural mechanism. For instance for the illnesses and invasive insects we use other insects, so use biomimetics mechanism that the nature use also, for instance, we use ladybugs, bumblebees, mites. We have also other mechanism, a natural mechanism to fight against those illnesses. But this is one of the main challenge that we have to pay attention especially in vegetable greenhouses is The control and the risk of illnesses regarding the clients is the demand. So we have a big demand of classic basil. And it's something where we have to produce more than the rest of the hormetic herbs. And it's not all the time easy to overproduce, basically because it goes really fast. So in terms of selling, this is one of the issues that we have. And the last issue that daily challenge that we have to pay attention is in the fish farm is the water quality, quality for different reasons is that an aquaponic system just to let you know, it's the main challenge of an aquaponic system is the risk of when you say that again, the risk of parents like lack of some nutrients in the in the water of the fish that are the really important for the development of the plants of the vegetables. So we have to really control the water quality. First of all for the fish to see if the water is clean and also it's a good temperature for the fish as it is a cold fish. So, we have to pay attention to the temperature that is not too cold or too high or too too hot. Also to check in the nutrients from the increments in the effluence of the fish, we find the three main nutrients so the calcium ion and potassium if there is a carriage account sorry of those three nutrients we do it manually being created manually. But it's something that all aquaponic system are facing is the risk of having a lack of some of the to do stream and nutrients that are really important for the for the How to say that they are really important for the development of the plants okay. So, this daily challenge that we have that we have to take care and pay attention all the time.

Kai Zhang 44:22

So, where do you get general and expert information on urban farming like how do you know how to do that.

Interview Respondent 3 44:30

So actually just the main founders of the farm, so, when the project was launched at the beginning, most of the people were specialized in urban farming or there will be no engineering or architecture of such as such as Steven Baker's was the main founder of the firm actually, and they do have to they do ask to external consultants also to get the expertise and they called also other organization where they had to pay at the beginning to get the knowledge or so. And just to give you an example for another firm for instance the people that are managing each department or specialize in all in the those

topics for instance articulator the two main managers of the executor, basic, the the main students are teacher, or they are engineers in the fish farm also is the same they are specialized in marine biology or they're specialized in the in aquaculture. And for the rest of the team is the same. But regarding the systems. Our main investors are specialized on those. Let's say for instance, one of the domain investor is really specialized in water reuse, and technology. And so we get the knowledge from them too. And also it's for them, it's really important that it works. So they have to to help it with this. But once we do a lot of studies to So, we have interns that are doing also studies on several topics linked with the production that we have. So this is also how we get the knowledge so this is the third way of getting the knowledge so first of all, it's from external consultants that they get the big deal and we still ask for some some questions. So then one is from the team and the third one's comes from the investors

Kai Zhang 46:30

here and you don't get those information from the government right.

Interview Respondent 3 46:34

Not especially the only maybe information that we get is regarding the recommendations okay, we think for the food control, there is this organization public organization that school apscs If you want I can read it as care is the public organization that control all food producers. So they control to check the quality the IGN also of the food producing. So this is from them also where we get some knowledge regarding the maintenance of the of the of the food production.

Kai Zhang 47:10

All right, so the fine

Interview Respondent 3 47:12

there is another name for us. gainbridge But I don't have it. It's okay,

Kai Zhang 47:18

I'll look Get up later. Thank you very much. Yeah. So the final question is, what is the future outlook, your opinion of urban farming?

Interview Respondent 3 47:25

In general, regarding urban farming,

Kai Zhang 47:29

in general, on this topic, like what do you think about urban farming in the future

Interview Respondent 3 47:35

it's something that is attracting the interest of a lot of people, but it's quite complex to implement, especially from from all sides. And just thinking to talking about the point of view of being, as we for instance, us we do use a lot of technologies and so on. It's something that is still quite new, actually. I mean, there are a lot of innovation around it, but especially like about vertical farming or aquaponic, systems and so on. But it's still something that is quite recent, and where the there is a lot of knowledge that there is a still to say an improvement that has to be done. And so to globalize everything with urban farming in the future, from my point of view, in general, the thing is that you'll be see more and more urban farmers that are that have facing some big challenges, especially regarding resources, especially regarding water resource, whether energy resources, due to the fact that there is this impact from economical and environmental impact. And so this, there is an optimist side from all I mean, people who are working in the field, but found that there are a lot of innovation that put into into it, there are a lot of interest coming from investors coming from citizens coming from, from also universities, that that we noticed that is really important. But there are big challenges also coming that are already here, and that our will be coming up. And so this is why urban farming, I think, from my point of view in the future, should make a combination of traditional and innovation, the innovation side, so I mean, like technologies is really important, but it's not also all the time the solution. It's something that should be complementary to help urban farming, especially in the city. So it's something that has to be complementary, and that I think will in the future help also old urban farmers and also all people who are interested in developing combat famines, there are a lot of sort of spaces that are not used in the cities that might be used also, for urban farming is something really important, especially for the region of Brussels, where there is a plan, which is called the Good Food strategy, which is mainly to squash optimist optimistic, but I think something important to avoid importing food from external, externally, so like to produce in average 30% of the vegetables and fruit in the city. I think there is a lot of insurance, there is a lot of knowledge behind there's a lot of, of plans. But there are some challenges, especially socio economic, and also environmental challenges that will put some I'd say some barriers to production. But as I say to you, I think it's something like that still evolving. And that still getting more and more interest. Yeah, yeah.

Kai Zhang 50:59

Well, that's all the questions. Thank you so much for your time. Yeah, you really give me a lot information. And I think it's going to be very useful for my paper. And I really appreciate your time.

Interview Respondent 3 51:14

You're welcome. Thank you, to you. It was a pleasure also to be meeting you. And in any case, you have some questions, you can still send me some questions or some points that you would like to emphasize. Yes. Obviously, regarding the data for the capacity of the greenhouses production, I need to ask to my colleagues, especially for the vegetables, greenhouse.

Kai Zhang 51:35

Yes, yes, yes. for that. I think it's okay. I just need to like a general like, like, what kind of amount do you produce? I think the data that you gave me is sufficient. So thank you so much,

Interview Respondent 3 51:47

but in case not really you have other question, Don? Is it is Kate, we say kya.

Kai Zhang 51:52

Yeah, Kate? Yes.

Interview Respondent 3 51:55

i Okay. To contact us and ask you. So, just wanted to say yes, as I said, if you need it, you have questions or remarks on it, don't hesitate. I might not be there the rest of the week, so I won't work. But if, if you have question you can ask me that last week. Yeah, next week. Sorry.

Kai Zhang 52:18

You have to be no problem thank you so much Thank you

Interview Respondent 3 52:22

You're welcome very good day and talk to you soon

Kai Zhang 52:24

yeah bye bye bye

Written Interview Answers with Urban Growers Collective

1. What was the inspiration behind establishing this organization, and how has it transformed since its inception?

While farming is the foundation upon which we grow, helping people thrive is our emphasis and the motivation for our work. Since our inception in 2018, Urban Growers Collective has worked towards building stronger, healthier communities through a variety of programming centered around Food Access, Job Training & Education, and Community Engagement. Through our programs, we provide training and education on urban agriculture and food systems; offer skill building experiences, jobs, and economic opportunities to youth; identify and lift up community priorities and needs; and use evidence-based practices to create safe and beautiful places for communities to convene, create, heal, and transform. Our core values honor shared leadership and collective decision making; racial, economic, gender, and LGBTQ+ equity; and employee well-being. We have witnessed how these values lead to thoughtful, holistic programming and yield environments that create and nourish prosperity.

2. How do you determine the needs and priorities of the communities you serve, and how do you incorporate them into your programs?

Working closely with community partners, our approach is to demonstrate the development of community-based food systems and to support communities in developing systems of their own where food is grown, prepared, and distributed within the community itself. We operate 8 urban farms on 11 acres of land, predominantly located on Chicago's South Side. These farms are production-oriented but also offer opportunities for staff-led education, training, leadership development, and food distribution. Each farm utilizes intensive growing practices and year-round production strategies to best maximize growing space.

Urban Growers Collective is familiar with the needs of the urban communities that we serve, and we meet community members through grassroots outreach and frontline service. Additionally, for new projects, we use an inclusive approach to development through charettes and surveys to help gauge community needs. This becomes the stepping stone for our programs because being a grassroots agricultural collective requires needs-based commitment. As such, our programs are able to change with the circumstances our community partners face.

3. How do you address issues of equity related to race, gender, sexual orientation, and economic status in your work?

Racism affects all aspects of our society, including our food system. At the turn of the 20th century, formerly enslaved Black people and their heirs owned 15 million acres of land, primarily in the South, mostly used for farming. Now, Black people are only 1 percent of rural landowners in the U.S., and under 2 percent of farmers. Rates of food insecurity are substantially higher for BIPOC-headed households than for White-headed households.

Our aim is to provide jobs while working to mitigate food insecurity and limited access to affordable, culturally affirming, and nutritionally-dense food. Through the symbiotic work we do, we are able to address issues of equity related to race, gender, sexual orientation, and economic status. The nature of our cooperative allows for an ongoing exchange of skills, knowledge, and resources that are intersectional to these issues among our participants. Our work serves as a model for what's possible when being a community-based collective.

4. Why is it important that UGC's training and education programs on urban agriculture and food systems are grounded in evidence-based practices?

Urban Growers Collective provides hands-on job training and creates economic opportunities for youth and beginner BIPOC farmers. Our approach is to build economic opportunity for BIPOC urban growers and makers; mitigate food insecurity; and increase access to high quality, affordable, culturally affirming, and nutritionally-dense food on Chicago's South and West Sides.

From our experience, we know that training and education programs on urban agriculture and food systems are pathways for young people and adults to build a healthy lifestyle and transferable job-skills. This work is important because not only are we engaging with the basic human right to have access to healthy food, but we are also able to work toward an alternative future in urban agriculture. Our Theory of Change helps guide our work and provides the metric from which we measure success.

5. What impact does your work have on the communities you serve, and how do you evaluate it?

Helping people thrive is the motivation for all our work. Through our programs, we provide training and education on urban agriculture and food systems; offer skill building experiences, jobs, and economic opportunities to youth; identify and lift up

community priorities and needs; and use evidence-based practices to create safe and beautiful places for communities to convene, create, heal, and transform.

We create food access pathways for the Southside and Westside of Chicago by helping folks gain access to grow in urban settings through community gardens and growers' apprenticeships and our food access programs, such as the Fresh Moves Mobile Market. When our community members reach out to us and share how grateful they are to have found one of our community plots or to have received high-quality produce, we know we're making an impact.

6. How do you engage and provide skill-building opportunities and jobs to young people as part of your programs?

In partnership with After School Matters, our Youth Corps teen job training program engages over 180 youth annually. Across our farms, which serve as safe spaces, teens explore their interests, work collectively, share their talents, learn from one another, and develop skills that they can apply to school, work, and life. During their time spent on our farms, our Youth Corps ambassadors expand their understanding of urban farming, community food systems, and business development through a STEAM (science, technology, engineering, art, and math) curriculum.

The Youth Corps program aims to serve as both a job training experience and to encourage leadership development. It's our goal that teens graduate with a comprehensive understanding of sustainable food system development and the ability to connect and communicate how the skills they've gained at the farm translate to any career path they may follow.

7. What are the main challenges you face in mitigating food insecurity, and how do you overcome them?

It's not a matter of "if" community members want access to fresh fruits and vegetables, it is a matter of purchasing power. Once we began giving out free \$10 voucher coupons with Covid Relief Emergency Funds, the number of folks being served on the Fresh Moves Mobile Market skyrocketed from 5,000 customers annually to over 36,000 in 2022.

Another challenge some community members experience is the learning curve in preparing and cooking nutritional food that isn't processed. We overcome this through education, cooking workshops, and recipes attached to crops like okra and heirloom squash, for example.

8. How do you ensure that the food you offer is both culturally appropriate and nutritionally dense?

UGC's farm sites are crucial community spaces for so many reasons, and we are excited to be able to grow the impact of our farm programming as we move into 5 years since UGC's founding. Our farm sites allow our team to grow delicious and nutritionally dense foods so that we can increase access to healthy foods for our communities, improving food insecurity and health, and advancing food justice for all.

At UGC, we love compost. When making our own, we only use food and garden waste—not manure. This prevents pathogens like e-coli and listeria. In addition to organic materials from our farms, we source brewery mesh from Marz Brewing to use in our compost. Our mushroom compost is sourced from a farm outside of the city. We are very particular about who we buy from. Through controlling our soil, we can assure that the food we grow is nutritionally dense.

We ensure that the food is culturally appropriate through representation in our agricultural methods. We are grounded in Black and Indigenous traditions in agriculture, and this understanding guides our food-growing practices.

9. What role can technology play in improving access to healthy food in urban areas, and how can we ensure that these tools are accessible to low-income residents who may lack reliable internet access?

Technology helps with logistics, tracing, and tracking data on the farm and serves our day-to-day needs within our cooperative work. There are several programs in the City of Chicago that give low-income residents access to technology like phones, tablets and discounts on internet. We often use social media to post updates and trainings, but for customers that have limited access, we also make it a priority to call them and let them know of changes.

10. What kind of economic opportunities do you create for BIPOC urban growers and makers?

Our Growers and Herbalism Apprenticeship program is a hands-on training program designed to lead up-and-coming BIPOC urban growers and makers to a pathway in cooperative economics. The apprenticeship includes workshops, mentoring, and repeated practice to build basic hands-on skills and understand the fast pace needed to meet commercial demands. UGC works with participants to create a pathway for future procurement and larger-scale commercial distribution. It also provides scaffolded

opportunities for participants to refine core values; build business aptitude; and work toward financially, environmentally, and socially sustainable farming operations.

11. What are your long-term goals and plans for growth, and how do you envision the future of your organization?

We prioritize people, and we plan to expand our reach within the communities we serve. We are working to build a place where our communities are increasingly able to engage with the distribution of compost and develop the skills it takes to grow food in the urban environment. Our long-term goals are to increase food access by enabling participants, once trained and educated, to continue making compost and growing food themselves outside of our program as we continue to bring more new people into the program.

12. In many ways your work feels like a celebration of Chicago. One of the most exciting developments on the horizon is the Green Era Campus. What is your vision there?

Green Era's mission is to create more sustainable communities by supporting local food production through better management of biodegradable waste and access to soil.

We're transforming a 9-acre vacant brownfield on the South Side of Chicago into a renewable energy facility and green oasis for economic empowerment, clean energy, fresh produce, and vibrant communities.

The vision for our Green Era Campus is to have a place that helps folks grow healthy food and healthy soil. It is exciting to know that this project will be able to create green jobs that support Black and Brown communities, which in itself addresses many issues all at once. Chicago is in the midst of a hunger crisis, with more than half a million Cook County residents experiencing food insecurity. Auburn Gresham has one of the highest food insecurity rates in all of Chicago.

Green Era will provide the compost created by the digester at low cost to farmers throughout Chicago, and use it on the project's seven-acre urban farm, which is expected to grow 26,000+ pounds of produce. The farm will provide ongoing benefits to neighboring residents by producing farm-fresh and culturally-responsive food year-round. The Green Era Campus farm is expected to grow:

10,000 bunches of collards

3,500 pints of strawberries

4,000 tomatoes

70+ varieties of medicinal and culinary herbs

Green Era Stats/Facts:

55M POUNDS: Chicago's total monthly food waste that Green Era Campus will begin to divert

300 NEW JOBS created for the community, including construction jobs and permanent positions

42,500 TONS Carbon dioxide offset by Green Era technology each year

125+ varieties of fresh produce and medicinal herbs grown and distributed per year

20,000+ square feet of community outdoor space

According to the US Environmental Protection Agency, food waste is the largest solid waste stream reaching landfills in the United States, with Chicago alone producing 55 million pounds of food waste per month. Green Era has developed an anaerobic digester that will recycle organic waste — inedible food waste — to produce renewable natural gas (RNG) and nutrient-rich compost.

13. Tell us about the anaerobic digester.

Anaerobic digestion is a safe and proven technology widely used to manage organic waste and to produce energy. Using natural, biological processes, anaerobic digestion breaks down organic matter without oxygen, resulting in two by-products: biogas and nutrient-rich compost.

The biogas can be converted into clean, high-quality Renewable Natural Gas (RNG). This provides communities and businesses with a green and local supply of gas to meet growing energy needs—all without building new pipelines.

Using food waste sourced from mission-aligned partnerships (including Urban Growers Collective) with local municipal agencies, local restaurants, food companies and manufacturers, and residents, we can begin to divert some of this food waste away from the landfills and give it a second life.

The large volumes of organic, nutrient-rich compost produced by Green Era's process will be provided at low-cost to farmers throughout the city and used on our seven-acre urban farm, which is expected to grow 26,000+ pounds of food annually.

14. In what ways can public-private partnerships be utilized to increase access to healthy and affordable food in urban areas, and what role can local businesses and community organizations play in supporting these efforts?

Green Era provides businesses, organizations and communities an easy and cost-effective alternative to landfilling your organic waste, while also helping to meet zero-waste, recycling goals and creating a thriving green community.

The project is part of the Auburn Gresham - Quality of Life plan that was

completed in 2017 and is based on 20 years of trailblazing work to solve the

issue of healthy soil to grow food and remediate the toxins prevalent in Black and

Brown, and low-income communities. UGC and Green Era held over two dozen meetings and visioning sessions with residents of the 21st ward and with our partner Greater Auburn Gresham Development Corporation, another 501c3 who has opened a full-service Health Hub. Additionally, Urban Growers Collective worked with students from Simeon Career Academy and our Youth Corps - After School Programs to design the community education, retail food and agriculture production facets of the campus (7 acres). We partnered with Taylor Staten, Principal of TNStudio to lead the design process. We also worked with Rudd Communications to share the outcomes and process with the community at large.

This project has been worked on for 13 years with our teams and collaborators, consultants and advisors. We have a dynamic and diverse group of engaged community-based owners. UGC would not have a project without community involvement and support.

Interview with Eco Green Gardens

Kai Zhang 0:00

There we go. Okay. All right. Thank you so much. So I just because the project that me and my supervisor and doing right now is talking about is researching urban farming in highly populated cities. So what I did is I looked for cities with huge population, usually more than 5 million population. And I just, I just type urban farming Google map in Chicago, in Los Angeles in New York. And then I just go through one by one and yours was like, Wow, I'm often in LA. So yeah. Cool.

Respondent 5 0:39

Cool, because I do have a friend who I dabbled on a project with down in Belgium. They live in Belgium. His wife is Chinese. She has a production company in China still. Wow. So I've been, you know, and I know their son goes to the university in Antwerp. And now somewhere in Brussels, in there, probably

Kai Zhang 1:06

my school then is the University of London.

Respondent 5 1:11

Maybe I should email so so and he, his son is very much involved in you know, the protection of the of the Earth as well. I think more with plastic reductions, something like that. But also environment. So I was like, oh, maybe that's that's a connection that happened because TMI spoke or?

Kai Zhang 1:38

Yeah, well, thank you very much for your time.

Respondent 5 1:41

Husband and wife and I spoke so. Yeah, yeah.

Kai Zhang 1:46

Yeah. Um, your name is Marianna, or Marianne.

Respondent 5 1:52

Marianne zoek.

Kai Zhang 1:54

Marian. Okay. So yeah, thank you so much for your time. And for this opportunity. Your organization is really like, really what we're looking for, especially towards how you engage with the community in Los Angeles. So I don't want to waste further, you know, like your time, so maybe we can get started with the questions.

Respondent 5 2:18

Sure, go for it. Yeah. So

Kai Zhang 2:20

maybe you can start with the social perspective. Perspective first. So how does the community interact with your farm?

Respondent 5 2:33

That's a good question. Um, our community is a very poor community in Los Angeles County. It's one of the poorest areas in social equitable area for for our area in more or less Southern California. So we intended we are going through the school districts. So by teaching children how to change their habits, whether it's food habits, also environmental habits, health habits, it's all together. So we, we went that route, because we believe that if we change a child's life, then most likely they will take that into higher education. And eventually, when they have kids, they will change that with their kids as well. But more so food is a community experience. It's a communal experience. So we all eat. And we all when we gather around the table, information is exchanged. Kids who go to school, coming home to mom and dad, or grandpa, number one, we bridge we gap the the, you know, we close the gap between generations, there is a conversation going on at home, why this teacher was talking about at the farm lab about this or that or the author, and therefore the kids are bringing a new way back home. So that's how we chose to help this community and in time, hopefully change the culture. And when I say the culture is the eating habits. Okay, so going from processed food to organic food.

Kai Zhang 4:52

Right. So you mentioned schools, right? What activities do you guys do specifically with the school

Respondent 5 5:00

was they they learn how to grow food, cultivate the land, learn Plant Science, Nature science. And we also are connected to health organizations. So they come in with their teacher talking to them about nutrition.

Kai Zhang 5:27

Gotcha. So the educational activities about the farm, usually you because I saw that on your website, you basically work with the schools and you build a like a farmland, like a piece of like, a farmland, and then you take the students who I guess educate them on site? Is that what you're doing?

Respondent 5 5:52

Yeah, so it's a farm lab, as in laboratory, or outdoor classroom. Okay, it's an outdoor classroom. So I'll go back. And in our very short history, the pandemic, nobody could be in a school room. So we saw our schools were shut down. But by standing and having an outdoor classroom, you could still connect outdoor with six feet apart, or seven feet apart. So the idea is really bad. And there is science behind it, that children who learn and who are in an environment that has trees and grasses and pollinators, and, you know, produce just green environment actually learned better than kids who are in a concrete school with maybe even bars on their windows, and they hardly see the blue sky. So there is scientific studies there that children's do better being involved having activities having learning outside as well. Um, so what it means is that we design we farm and we educate and in the entire process, children are involved. So it is children with the one that you see most Arroyo High School, which our is our hub. Basically a showcase. It is the children who went to the principal and said, We need to go green. Wow, we need to turn this plot on this campus into a farm. Wow. And then we as an nonprofit, we connected to them, we became their partners. And therefore we're able to also find monies for this project, to create a farm lab on their site, everything goes through the school board, and goes through the principle, of course, but it is the child who says I want to know how to grow organic food. And I want to go I want us to go green, I want to be environmentally more savvy.

Kai Zhang 8:43

Right? That's very impressive.

Respondent 5 8:46

How are they this is these these, and this bin? This initiative is about eight years old. Then they went to the principal. So back in 20 1314. And it took a minute to get things going, you know, because I mean, in Belgium probably doesn't take as long as here. But you have to go through various, when you are working with the school board, you know the school district,

Kai Zhang 9:26

right. Um, so let's talk about the economic aspect because you do mention that you get various different kinds of monies. But one question I have is Do you receive any financial support from the government?

Respondent 5 9:41

I'm trying right now. Yes, I do. Every so often. I get some money. Definitely during COVID I got some money from our governor Newsom. I am working with the school district to to do, it's easier if would be, it's easier for connect with the school district as well, and get the money through the school district. And then the school districts, you know, signs of some money to us because we're their partner. So when you do a model like ours, it is very important that the nonprofit, the community nonprofit, is in very good standing with the district, or the city, or the county, or the state, so that you are working something like that as a hub with multiple partners. You can't do things just by yourself. That's for profit mentality. Yeah.

Kai Zhang 10:53

So, um, because you also have a on the website, because you have like three projects. The other one is Farm to Table market. So I assume the farm you have for this project is different than the farm for the school. Right?

Respondent 5 11:11

Right. So with the with the Farm to School, it's exclusively on the school property, where we design a space, we design, then we build the space, and then we we do the curriculum for the space for the kids. So it becomes a capital investment. That turns into programs programmatic. Right.

Kai Zhang 11:42

Yeah, go ahead.

Respondent 5 11:44

So with the farm to table idea of growing your food on a farm, whether it's on a school farm, or whether it's at the Community Farm, and then you take that produce, and you feed the the community with it. So you you create, you know, you take that produce, you go to the farmers market, you create, you build harvest that produce you go and do CSA programs. CSA is the boxes? I'm sure you have those in your in Europe, in Belgium. Yeah. People can pick up. Yes, they are. So on our end, and I hope somebody hears this, this recording. My intent is now to find money that will pay for the food boxes. So we can give them for free to our low and income people. Because like you said, the very expensive and somebody was very, you know, has has a has a low income cannot afford that.

Kai Zhang 13:03

Yeah. Some farms here that, that I worked with, they give specific proportion of their harvest, to like for free to those low income communities. Like one farm, they give 30% of their produce to like for free for charity. So that's one way they do it. But you're absolutely right. The reason the only reason why they can do it is they receive financial support from the government or from other organizations. Because they need this kind of money to keep the farm running. Exactly. So how much food does the farm produce each year?

Respondent 5 13:52

Well, right now it produces about seven or 8000 pounds

Kai Zhang 14:01

seven and 8000 between two schools.

Respondent 5 14:04

Yeah, about three to 4000 kilos, so not that much. But we are. We are our our school. We are breaking grounds for an aquaponics and this Aquaponics is 1200 square feet big. And that will issue 30,000 pounds of food. That's 15,000 pounds of food a year.

Kai Zhang 14:38

Wow. And you're working on the project, right?

Respondent 5 14:41

Yes. That is what we're working on and what we're doing to greenhouses. So that means our community can potentially get 30,000 kilos of food, which is amazing. If we can feed the whole community, there is no such thing that a kid, a kid will go hungry with this kind of model.

Kai Zhang 15:08

Yeah. But I assumed that there are I'm not 100% Sure. But are there a lot of like, initiatives where like programs that help help help nonprofit nonprofit organization like yours in America?

Respondent 5 15:24

That there are Yes. What's specifically the question?

Kai Zhang 15:30

Because I was just wondering, if you have such amazing programs, usually government will have specific bound that will support you to to build this program. Right.

Respondent 5 15:42

Right. Right. We do. We do. We're doing quite well. Okay. That's usually my job is money, and systems, and numbers. And that's what the IDI does. And I usually have funding for three, two years. Moving forward. So it's, it's, um, yeah, and I'm actually just hiring a grant writer, as we speak. Okay. He just likes that. So I'm just hiring her, because I'm going specifically after LA county money. Okay. All right. I'm pretty, pretty strong in in that field. Okay, that's good. Thank you for asking. Those are good. Questions.

Kai Zhang 16:36

Yeah, those are my, my, that the wasn't that I have to ask that that's for the academic part. But now it's for the environmental sustainability. So about the products you have, how many varieties of vegetations Do you have? Roughly?

Respondent 5 17:00

Oh, my goodness, I can't count them probably 200 different species. So I don't know what, you know, I'm European myself, but I never know how much an acre of land is. Arroyo farmlab is an acre of land, but it's not an acreage, like in Europe, it's a different acreage. Right. And, yeah, we have about 200 species there. They're specifically installed to teach kids how a rain garden is. So we're focusing on the rain gardens, we're focusing on bioswale, which is essentially a rain garden. You know, if you go into I'm from Switzerland, we have the Alps, you have a lot of rocks going down a stream. That's like a rocky stream, a dry dry creek. So we built those here. First of all, it looks pretty second, when we do have water like we have this year, then it actually fills the Greek and, you know, the vegetation can grow around it. And because we're in California, we only grow California native, non invasive species.

Kai Zhang 18:27

So when you take these products to the farmers market, or the packaged?

Respondent 5 18:36

Um, we don't, so yes and no. Um, okay. What goes to the farmers market, of course, what we focus on is farm fresh food. So it's the fresh vegetables, the carrots, the basil, cilantro, chili, chili peppers, you know, squashes all the farm fresh food. With California natives, they're also edible, and we have a lot of edible foods there. Because our community is also South American and Asian. So we bring in a lot of Asian food to grow, and we bring in the South American Central American food with that, California, and it's cross cultural. If you look at recipes. People use similar foods in in Asia as they use in let's say, Guatemala. So you know, it's just you. It's just made differently. different spices are being used. So when it comes to the California native plants that we use The rules we use for food, we usually dry them and use them for a syrup piece rubs for for spices, so we teach kids how to dry white sage or how to dry Moringa. That's, that's a tree plan. It actually is is very helpful to combat diabetes or high blood pressure. So we we harvest the, the flower or the kernel, and we teach them how to dry it or the leafs how to dry it, chop it up and then we put you know, teas together. Right.

Kai Zhang 20:51

Okay, so how is the farm fertilized and watered?

Respondent 5 20:57

Oh, my goodness, well, water, just water we wander. We love our stuff. Two to three times a week, you know, for like a half an hour. Some in the summer a lot more. We harvest water with the basin meadow and the dry swale. You know, dry rock swell that harvests the water when it rains. And a lot of these California natives once they're established after two first year, second year, the first year, they need quite a bit of water. But after that they don't need a lot of water. Sometimes they only need water every two weeks, maybe three weeks. Wow. Yeah, yeah. So so in the winter, once a month, maybe in the summer, every two weeks, and our summers are getting hotter and hotter. So we do pay attention to that. And then the third part is it's all organically fertilize. So we use the compost, we have a program where we allow people to bring their food scraps things, and our farmer knows exactly how to create compost. It's part of somebody in the environmental studies, I think they need to know how to make soil. Yeah, that's that's my idea. Yeah, definitely. It's the rainwater, you know, you go to the out, the rainwater just flushes down your soil. So somebody needs to rebuild this soil, and the best way is compost.

Kai Zhang 22:42

Yeah. So I assume all your products goes to La only right? Not outside of California?

Respondent 5 22:52

Oh, yeah. It's actually not even like local to LA County, or local to where the school is located. Okay, that's good. That would be the best. And because you want to reduce the co2, but also when you say that it's local to the school. And what we also do is that some of our produce is part of the school cafeteria.

Kai Zhang 23:23

Okay, so the last aspect, which is challenges and opportunities, I guess I'll just with the new to two questions. So what are the challenges for initially constructing and setting up the farm?

Respondent 5 23:40

getting everybody on board? Yeah, yeah. Creating policy in this world, you know, creating policy in our world, whether your side or my side, it's very difficult. You have to have a lot of patience. But they can be done. So yeah, we've done it. So.

Kai Zhang 24:07

So it's really about the policies specifically for your farm, like for urban farming.

Respondent 5 24:15

Now, the policy I mean, to can, that's the wrong word, but it's essentially to convince the school board to do this program, and why it's beneficial for the school, and then the community at large. So that you have to create policies there. And if one school district does it, and they do it successfully, this policy will then go all the way up to the State Department. And eventually it will be a policy that is going to be embedded for every school. And then once that's happening Then cities will create more like parks with community farms. And I think Holland this they're good at that. Sweden and Holland, I think.

Kai Zhang 25:13

Yeah. So where do you get general?

Respondent 5 25:16

Even Belton? I don't know. I've never been to Belgium.

Kai Zhang 25:20

Yeah. Where do you usually get general and expert information on urban farming?

Respondent 5 25:29

Oh, from the university. So our organization is, is connected to the, to the university. So I'm okay. I'm alignment. I do numbers. So I do want to be connected to the university who does urban agriculture. But I also want to be connected to very old people who know how to farm that treasures, their gold. Yeah. They're amazing.

Kai Zhang 26:03

So University, and then you also talk to the people with experience

Respondent 5 26:07

with experience. Usually elders. Yeah. Okay. Yeah, right.

Kai Zhang 26:13

All right. Final question. In your opinion, what is the future outlook of urban farming?

Respondent 5 26:25

This is a movement. And I think it's gonna stay. I believe this movement, you know, has taken a hold here in Los Angeles. The Los Angeles Unified School District I also work with is the largest, the largest Third, the second largest school district in in the United States. And they're greening their schools. This is a movement. So and, you know, I, I will retire sometime soon, sure, five, five years from now, 10 years from now, I do believe that the young people, people of your age, they will take this and run with it even faster. So it's just like, you know, we're in the we're no longer in the first gear. We're in the second gear. But there are numerous more gears coming. So it's a good thing. It's a good time.

Kai Zhang 27:28

Yeah, thank you. Maybe it's maybe because I am working on this project. I mean, this area, this field, it is really like a trend. In various countries, urban farming is getting very huge. And, yeah, they're getting a lot of attention. That's probably one of the reasons why we're doing this research. So yeah. And also the other farms that I

interviewed, they also have similar opinion as you they think it's a movement to think it's going to go huge, they think it's going to have a very important role to play in the future. So yeah, very good.

Respondent 5 28:09

With that said, with that said, we, we are being strangled. With that, keeping people healthy, you know, the cost of diabetes, the cost of hypertension, the cost of cancer is huge. We now know that eating healthfully will change your your health. Yeah. So right there. Finances. You know, it's all it's yes, it's a trend. But on the bigger picture, when you do the bigger picture of research, there is that financial benefit if constituents are healthy,

Kai Zhang 28:56

right. Absolutely. Yeah. Well, that's all my questions. Thank you very, very much for your time.

Respondent 5 29:04

It was a very welcome. That was a fantastic, fantastic questions that you had, it was really nice to talk to you over the pond.

Kai Zhang 29:16

Do ya realize I'm not going to waste any of your time and if you would like to see my research in the end, I can also sit my paper to you.

Respondent 5 29:28

So so yeah.

Kai Zhang 29:31

And we also have like, we also do like a lot of research on those scientific papers about urban farming about like rooftop and also in dry areas. So if you have some specific questions, you can also shoot us an email and we can see if we can help find any information for you.

Respondent 5 29:50

I would like that I definitely would like to