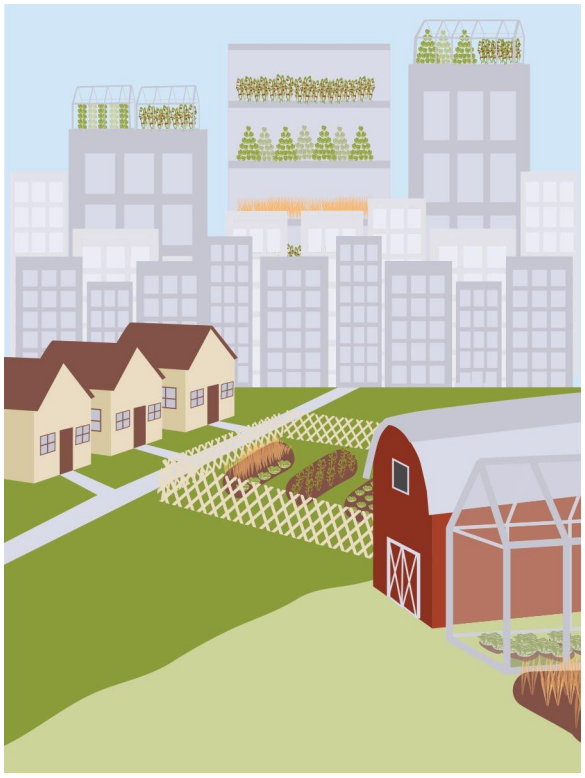

PLANTING THE SEED

How Urban Agriculture Grows Stronger Communities

ABSTRACT

Urbanization, food miles, and food deserts are all factors that call for a reconstruction of the way we think about food. This report examines three potential methods of urban agriculture that can be used to create a more dynamic food system. This is done first through a literature review that examines three main concerns of urban agriculture: the benefits to the community, lack of space, and need for government involvement. Each method is then explored through a case study. Peri-urban agriculture is looked at in the Greater Melbourne area. Traditional agriculture is examined through Seattle's P- Patch system of community gardens. Finally, innovative urban agriculture is seen in New York's collection of controlled environment farms.

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Introduction

There is a trend of people moving into urban areas. By 2050 sixty-six percent of the world's population is predicted to live in cities (Newbold, 2017). These urban areas provide hope for jobs, homes, and connections. However, the commute between all of these places is becoming a challenge due to urban sprawl. Urban sprawl is a term used to describe the expansion of urban areas, usually designed so one must drive in order to get to important places (Newbold, 2017). Additionally, cities often have zoning that segregates land usage, spreading out residential, commercial, and industrial areas. This separation means that people often have to go long distances to go to work or get groceries. These areas are referred to as food deserts, where one must walk over a mile to access fresh, healthy, affordable, and culturally appropriate foods (Sage, 2013). In addition to consumers having to go long distances to purchase food, produce travels an average of 1,500 miles before arriving at supermarkets (Duram, 2010). This distance between farmers and consumers has led to a significant disconnect in how people view food. Many urban planners and scholars have turned to urban agriculture for a solution to these problems. Although it cannot provide the same volume of food as industrial agriculture, urban agriculture can contribute to healthier communities and a more sustainable food system. Therefore, appropriate urban agriculture methods should be invested in by public and private groups across the world.

Industrial farming was born out of the green revolution in the 1960s (Newbold, 2017). They were able to intensify the farming process through machinery, pesticides, and fertilizers (Newbold, 2017). This intensification meant a greater yield of crops, but with the added costs of polluting the environment with chemicals and greenhouse gases. Additional damage is done by irrigated watering systems that produce a large water footprint and monoculture, a limited selection of crops, that harms biodiversity (Duram, 2010). These industrial farms can harm the local economy in addition to the environment. More machines are used in industrial farming, meaning there are fewer chances for employment. Whatever jobs are available from production are far from where the goods are consumed. Goods made through this process are sent to supermarkets, which takes business away from local shops and farmers (Santandreu, 2018).

Urban agriculture, on the other hand, is broadly defined as food produced in or around the local area. Currently, these methods are not as efficient at producing large amounts of food as industrial farming (Duram, 2010). In addition, Santandreu did not find conclusive evidence that urban agriculture can provide large-scale food to cities (Santandreu, 2018). While urban agriculture may not be the solution for providing large volumes of food in urban areas, implementing different urban agriculture elements into a food system will reduce food miles, promote biodiversity, improve the local economy, and connect people within the community to one another and nature.

This paper will compare three main types of urban agriculture to determine the most appropriate circumstances for each method. The first is traditional methods of urban

agriculture, such as home gardens, school gardens, and community gardens (Armanda, 2019). The next category is peri-urban agriculture, which is defined as agriculture done on the fringe of an urban metropolis (Santandreu, 2018). The final category is innovative urban agriculture, including Aero farming, aquaponics, hydroponics, and vertical farming (Armanda, 2019). Each of these different methods have different advantages and disadvantages.

Methodology

This report is conducted through a case study literature review focused on the three types of urban agriculture. The sources range from more theoretical journals that examine the relationship between the urban environment and food systems to the more practical applications of urban garden systems. While searching "urban agriculture" on the academic search engines, there are plenty of articles and journals (94 search results). However, there are not nearly as many as there are for "food production" (525,405 search results) or "urban planning" (324,711 search results). There is a limited amount of information on urban agriculture for two reasons. The first of which is because aside from the Garden City movement, urban planning and food systems were not thought about in conjunction until the 2000s (Cabannes, 2018). Even with urbanization, food production was seen as a rural concern; however, there has recently been an uptake in interest. The other reason for the lack of literature on urban agriculture is that the studies take a long time to see results, sometimes even taking decades (Cabannes, 2018).

The literature review is broken down into three sections exploring common elements of the different resources. The first section examines the community benefits of urban agriculture. The second section discusses the apparent lack of space in cities for urban agriculture and possible solutions to this problem. The third is the apparent need for government involvement in the urban agriculture process. Together these sections reveal how the different urban agriculture methods can play a different role in a sustainable local food system. Further research will include case studies for each of the three different methods of urban agriculture discussed.

Literature Review

Community Benefits

The first way that urban agriculture can benefit the community is by fulfilling its goal of providing healthy, affordable, and convenient foods (Ventura, 2017). Garden produce stands and farmers' markets must understand the community to know if the produce offered is culturally appropriate and offered at a reasonable price point (Ventura, 2017). In addition to the obvious goal of providing food, community garden programs can make people feel connected socially and gives people something to be proud of (Ventura, 2017). A sense of place can be created within these food networks, connecting the community to their location through local food production (Duram, 2010). Other social goals of urban agriculture include employment opportunities, training programs, and youth education and after-school programs

(Ventura, 2017). Programs for children and youth can provide them with the opportunity to connect with nature, something that may be missing from many of their lives (Ventura, 2017).

Many cities have realized the lack of nature in their urban environments, and they have begun a process of "renaturing" (Morgan, 2015). Aside from providing food, renaturing comes with many practical benefits. Holloway's (2003) work found that roof and façade gardens can create microclimates that influence the surrounding temperature offsetting the urban heat island effect. They can increase biodiversity, sequester pollution, and provide stormwater and greywater management systems (Holloway, 2003). Urban agriculture can double as neighborhood beautification, all while providing food and connection to nature.

Lack of Space

One of the biggest concerns that urban agriculture faces is limited access to potential sites to grow food. These challenges stem from high land prices, competition with real estate development, contamination within soil preventing growth, and potential pollution from gardening practices (Armanda, 2019). Peri-urban agriculture has to fight for space with the ever-sprawling urban metropolis (Santandreu, 2018). Traditional forms of urban agriculture may face land being unavailable due to ownership issues. In Toronto, Canada, most of the open land has been purchased by private entities and cannot be used for community gardens despite great interest (Bailey,1993).

A potential solution to this problem is rooftop and vertical farming. Bailey (1993) found rooftop gardens are becoming more popular, especially for those in apartments. Taking advantage of rooftop spaces means that more land does not have to be purchased from private owners to provide renters with a space to grow food. Rooftop gardens are planned systems, and therefore they do not have to worry about contaminated soil on-site (Holloway, 2003). Rooftop gardens enclosed by a greenhouse and vertical farms have the additional benefit of being a controlled environment (Armanda, 2019). This means that they are less dependent on the weather and can grow crops independent of local weather and climate (Armanda, 2019). While rooftop gardens have a large upfront cost for building owners, they can have long-term payoffs. In the report done by Wilson (1999), they found that a rooftop garden with an area of 750 square meters could produce $500,000 worth of fresh produce. In this case, the rooftop garden was on a retail building and used food scraps from the same restaurant it sold the produce to create fertile growing material (Wilson, 1999).

Rooftop gardens on various building types can provide city renters with their outdoor space and retail areas with fresh produce. Having an apartment building with a garden on top would resemble a more traditional community garden; therefore, the garden users would get the added social benefits of connectedness. The garden on the retail building would stimulate the local economy through the use of innovative urban agriculture. They could potentially provide jobs and help create a more circular economy.

Need for Government Involvement

The first case that shows the importance of government involvement in urban agriculture is in Toronto, Canada. After Ecology Park community garden found great success, many residents of Toronto wanted to get involved in urban gardening. However, as discussed, all of the undeveloped land is now privately owned. Toronto sold a lot of land to private developers in the past, so even though there is open land, it is not city controlled and unusable. The city is doing all they can to raise money to buy back land from the developers, though they have not found success in securing funding. Even if the city cannot secure the land to create their own community garden, they could offer developers incentives to develop at least a portion of their site for urban agriculture (Bailey, 1993). Tax breaks or additional funding for developers who include green roofs or open space on their site for a garden could generate more urban agriculture spaces, at least for residents of their buildings. Alternatively, the city and developers could negotiate a land trust that allows the development of community gardens.

Another case study demonstrating the need for government support is described in *Urban agriculture in Lima metropolitan area: One (short) step forward, two steps backwards* by Santandreu. This report goes in-depth on how important government support is for urban agriculture programs. In the early 2000s until 2010, Lima city officials were allocating funds for several urban agriculture programs, including peri-urban farms and community gardens located under power lines in neighborhoods (otherwise unused space). However, since then, the government has changed hands, and all of these programs have ceased running (Santandreu, 2018).

Case studies

The following section focuses on three cases studies: peri-urban farming using the Greater Melbourne Area, traditional urban agriculture using Seattle, Washington's P-Patch community gardens, and innovative agriculture using New York's recent rise of controlled environment agriculture farms. Each case study will discuss the benefits and issues of the approach through the lens of their specific city's food system demands.

Peri-Urban Agriculture

Spataru defines peri-urban agriculture as rural areas experiencing amplified changes to their community such as succession, price fluctuations, productivity, and aging farmers due to their proximity to an urban metropolis (2019). As rural residents see it, the metropolitan urban area is invading the countryside while the country is there to fulfill the urban demand from the urban perspective. In Australian cities, peri-urban agriculture contributes less than one percent to local economies (Spataru, 2019). However, Spataru cites many economic and non-economic benefits to peri-urban agriculture (2019). Local employment and agribusiness, multiplier effects, and lower transportation costs are all potential economic benefits. Ecosystem functions such as water management, soil and air quality, and biodiversity are all non-economic benefits,

in addition to recreation and heritage, community unity, tourism, quality of life, and education and health opportunities (Spataru, 2019).

There have been several policy changes throughout the years that have attempted to create harmony between Melbourne's metropolitan and rural areas. In the 1970s, there was an initiative to create a green belt consisting of green spaces set aside between growth corridors (Buxton, 2016). In 2002 the city implemented *Melbourne 2030,* which included new rural planning zones and a new growth boundary for the green belt. Later, in 2012, the city reduced regulation on the rural zoning plans and allowed subsidies for non-farming commercial uses (Buxton, 2016). The current planning model of Australian metropolitan areas favors continuous urban growth and disregards the benefits of agriculture (Spataru, 2019). However, there are some policies in place to protect the farmland. Things like zoning, "Right to Farm" ordinances, agricultural buffers, and acquisitions of farmland using trusts, incentives, and taxation all help keep the land from being urbanized (Spataru, 2019). The core of the issue, in this case, is how the land is valued. For those who favor urban growth, the land is more valuable when developed and the contributions that the farmland makes is not as important. If the farmland will be protected long term, the city will have to work with the agriculture workers and farm owners to optimize the land to show it can offer more to the community as farmland (Spataru, 2019).

One farm study found that much of the produce may not be able to be imported from other areas, and what can be brought in from other areas would come at the cost of the consumers (Buxton, 2016). Business models currently do not consider sustainable food production, food security, climate change, or land and resource management. Including these issues in how farmland is valued shows how vital it is to protect agricultural land (Spataru, 2019). Urban sprawl has the potential to reduce Melbourne's peri-urban food production from 41 to 18 percent by 2050 (Hynninen, 2020).

While sustainable food production is a key aspect in maintaining the farmlands long term, not all of these peri-urban farms are using sustainable farming methods. Within the last forty years, the agriculture sector has shifted to competitive productivism, which has led to wide use of monocultures, industrial-scale production, and expansion of world food trade (Spataru, 2019). Farmers are pressured to either keep up with these unreasonable demands or get out of the business. In order to keep up, farmers have turned to using more fertilizers, insecticides, equipment powered by fossil fuels, and animal pharmaceuticals (Spataru, 2019). In addition, irrigation has allowed farmers to expand to areas that would not naturally get enough water to sustain agricultural practices. This intensification of agriculture allows farmers to keep up in economic competition, at the expense of the environment. These methods ignore traditional knowledge and practices, rely on commercial seed and chemical inputs, and favor economic development over systems that support the natural environment (Spataru, 2019). Some of the environmental impacts of these practices are soil erosion and salinization, pest and plant intrusion, and damage to native vegetation. The local government had previously

supported these practices to aid farmers in maintaining their farmers; however, many now critique these methods as only short-term solutions that will have long-lasting effects on the environment (Spataru, 2019).

Competitive productivism in Australia was amplified by the belief in the agriculture sector that farmers should manage all of the risks, markets, and uncertainty without any governmental subsidies. This has decreased the number of operating farms throughout Australia from 145,000 to 85,000 since 2000 (Spataru, 2019). At the same time, farms with revenues of $1 million or more increased from three to sixteen percent and their occupancy has grown from forty-five percent to sixty-three percent (Spataru, 2019). Four issues are affecting the peri-urban area of Greater Melbourne: loss, dilution, transition, and transference. Loss refers to the decreasing amount of farmland as it gets converted to commercial or urban use. Dilution suggests the hazy delineation of urban and rural land has led to farmers competing for land with commercial and residential buildings. Transition refers to the decrease in agricultural businesses, which has led to a decrease in support in other aspects of the supply chain. Finally, transference discusses the relocation from peri-urban areas due to limited financial practicality or growth opportunities (Spataru, 2019). Farmers such as Andrew Thompson, whose family has farmed their land for fifty-three years, are becoming less common. He said to Hynninen he sees signs of these changes every day as the land around him is divided or sold to non-farmers wanting to convert to a rural lifestyle (2020).

As a response to competitive productivism, planners have been looking at a "post-productivist" model, multifunctional agriculture. This is a holistic approach to re-evaluate agriculture activity, emphasizing food security, environmental, socio-cultural, and economic functions (Spataru, 2019). Internationally, the World Trade Organization claims that multifunctional agriculture supports rural development and environmental sustainability. According to the Food and Agriculture Organization, multifunctional agriculture is meant to address food security, environment, economy, and socio-cultural functions (Spataru, 2019). The Organization for Economic Co-operation claims there are two different interpretations for multifunctional agriculture: positive concept of multifunctionality and normative concept of multifunctionality. In the first interpretation, the agriculture effects or outputs are many and interrelated. This is an economic approach framing the outputs so that their value is based on market factors (Spataru, 2019). The second perspective, the normative concept of multifunctionality has three parts: expanding to multiple markets, building farms a wider economic framework for alternative income, and encouraging unconventional farming innovations for their process and products (Spataru, 2019).

Spataru identifies six principles that are relative to the scale of the area being examined. The first principle, flexibility, refers to the ability of government agencies, farmers, and associates to reach a fair agreement. Collaboration, the second principle, is another that is in demand in Greater Melbourne. There is a clear need for cooperation between the local government and farmers to maintain the agriculture sector. The third principle, "smaller-can-

be-better" describes the move from farming agriculture as economies of scale to economies of scope (Spataru, 2019). Promoting smaller farmers gets rid of the mentality in the area that only big farms can survive. Smaller farms have shown to be more flexible and adaptable as well. The fourth principle is long-term strategies, which creates a vision for all stakeholders while maintaining environmental constraints, rural development, and climate change (Spataru, 2019). The fifth principle, use of technology, refers to farmers adopting the technology that would best suit their practices and make production more efficient. Finally, the last principle is circular resource use, calling for farming systems to reduce emissions and waste, prioritize circular economy, while minimizing their impact on the environment (Spataru, 2019).

If these principles were applied to Greater Melbourne, or any peri-urban area, they would create a stronger food system. Support from the local government and prospective alternatives for income in times of need would allow more small farms to stay open. These smaller farms cannot currently compete with large-scale commercial farms and these subsidies and support could mean the difference of staying afloat. Smaller businesses have a lot of potential, they have more flexibility with what they can grow, have the ability to adapt and cater to niche markets in the food system (Spataru, 2019). If these peri-urban farms are lost it will not only affect the farmers or those in rural areas, but those in the city that depend on having fresh produce, eggs, chicken, etc. (Hynninen, 2020). Promoting multifunctional agriculture prioritizes more than just the economic aspects, benefiting the environment and socio-cultural factors (Spataru, 2019).

Traditional Urban agriculture

The City of Seattle has done a lot to promote a diverse and inclusive local food system. In 1973 they began the P-Patch community garden after buying the Picardo Family Farm. Since then, the city has expanded the P-Patch program to include over 60 gardens with more than 1,900 plots occupying 12 acres of land (Cipalla, 2018). While buying the farm was the first city-run community garden, the area's interest in urban agriculture began a few years prior. In 1970 the Boeing Bust caused many residents to be out of work, money, and food, leading to a "back to the land" movement. It was then that University of Washington student Darlyn Rundberg Del Boca devised a plan to teach children how to grow food and provide neighborhoods with fresh, healthy produce. She worked with Wedgewood Elementary school to create a large plot of produce for the community on a portion of the Picardo Farm. Families were given an 8' by 8' plot on the site for their gardens (Cipalla, 2018). After this first farm was developed and the city saw how successful it was in providing food and bringing people together, they purchased the Picardo Farm, and ten more garden sites by the following year. In 1974 the Mayor, Wes Uhlman, a P-Patch gardener himself, began a community garden program to promote open space and recreation (Cipalla, 2018).

While this movement benefited many community members, the gardens were seen as temporary, and many were lost to development. By the early '80s, the city faced budget cuts that threatened the garden program; many did not think it would survive. Glenda Cassutt, the

Figure : Picardo Farm "P-Patch" Shed (Cipalla)

manager at the time, said the first thing that saved the program from being cut was forming an advisory council for community support and aid in lobbying and fundraising. The second thing that helped was similar organizations across the country reaching out for moral support (Cipalla, 2018).

In the late 1980s, the program gained recognition when four different P-Patch sites won national community gardening awards. After this, Seattle hosted a conference for the American Community Gardening Association; attendees went on to spread the word (Cipalla, 2018). By 1993 P-Patch was the largest community gardening network in the nation, having 30 gardens and a waitlist of 600. By 2017 these numbers have expanded to 90 gardens with 2,000 people waitlisted. Anyone can apply for a space in the garden, with three different plot sizes ranging in price and financial assistance available for those who cannot afford the fees. The smallest plot is 10 feet by 10 feet for $43, the medium plot is available for $57, and the largest plot is 10 feet by 40 feet for $85. The fees are used to maintain the rest of the garden and for the garden employees. Although the gardens have been expanding, the program has the same number of employees, putting a strain on their workforce. In addition to the P-Patch program employees, all gardeners must volunteer at least 8 hours to sustain the public areas of their garden (Cipalla, 2018). While the program is not profitable for the city, they are dedicated to working with their partners to continue providing everyone who wants to participate in gardening a chance to do so. The social benefits the program brings to the community outweigh the need for fundraising (Cipalla, 2018).

The City of Seattle has created a powerful asset in its food system through its community gardens network. They are devoted to providing the community members with fresh, healthy foods and a connection to the community and nature. P-Patch gardeners are passionate about land stewardship and have fought hard to maintain their garden space. While the program is the largest in the country, some neighborhoods are not currently benefiting from them. Neighborhoods such as downtown, Capitol Hill, and south lake lack open space meaning there is nowhere for the city to create new gardens for the residents in these areas (Cipalla, 2018). However, this logistics will not stop the city from implementing community garden programs for everyone who wants to be involved. They are looking into creative ways to create urban agriculture spaces, such as collective gardens without individual plots, giving gardens, and food forests (About the P-Patch Program).

The P-Patch Program has several partnerships that come together in support of market gardening, youth gardening, and community food security programs. They emphasize providing

food to the City's immigrant, youth, and lower-income residents (About the P-Patch Program). According to the program's 2020 end of year report, their mission statement was defined by two principles: putting race and equity at the center of all decisions and actions and investing in the power of community-generated solutions (2020). The program is working to achieve racial equity and dismantle the barriers that have previously kept people of color from participating in the program (Seattle Department of Neighborhoods, 2020). In 2021 the P-Patch program has three priorities. The first is to continue increasing the number of Black, Indigenous, and people of color (BIPOC) participating in gardening and improving the gardeners' experience. Priority two is to enhance engagement and outreach in BIPOC communities. Their final priority for 2021 is to develop partnerships and collaboration within and serve target communities (Seattle Department of Neighborhoods, 2020).

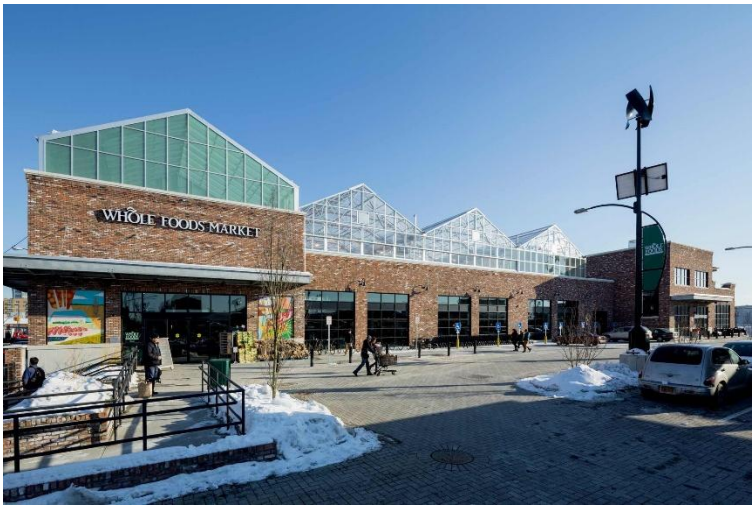
Innovative Urban Agriculture

While there have been accounts of soilless and vertical gardening for hundreds of years, controlled environment agriculture has gained more popularity in the last few decades due to improvements in lighting and plastic for greenhouses (Goodman, 2018). One place that has been taking advantage of these advancements in New York City. While there have been community gardens throughout the city for years, larger and commercial farms have become more prominent (Cather, 2018). In order to support this growing industry, the New York City Council passed the city's first urban agriculture policy bill in 2017. As a part of this bill, they created a digital network to collect data on urban agriculture across the city, all compiled onto one website. A related bill proposed by the council calls for updating the language in the zoning codes to include terms such as "urban farming," "rooftop farm," "vertical farm," "hydroponics," etc. (Cather, 2018). However, the final version of the bill does not include these updates to the zoning regulations. This has not stopped the residents from becoming increasingly interested and involved in urban agriculture (Cather, 2018).

Due to the city's climate, most of the growing has to be done in controlled environments. Most of these controlled environment farms grow their food through soilless methods, such as hydro and aquaponics (Goodman, 2018). These methods maximize the yield for the small spaces, allow year-round production, reduce water use, eliminate pesticides, and reduce pollution from water runoff. However, there are some concerns with controlled environment agriculture setups. There is usually a large start-up cost associated with creating the controlled space and a high energy demand to provide enough heat and light for the plants year-round, and there is still a chance for disease and infestation within the controlled systems (Goodman, 2018).

Goodman looks at three farm typologies: commercial farms, institutional gardens, and community gardens. Seven commercial farms use these techniques within the city, five companies that make controlled environment agriculture technology and products, and two restaurants that have controlled growing environments as key features. In addition, controlled

environment agriculture is used by six social service agencies to grow food for low-income families, five youth-focused non-profits, and 133 public schools (Goodman, 2018).



The commercial farms have the primary goal of attaining profitability with secondary targets aligned with urban agriculture's social expectations. In New York, there are ten commercial farms, overseen by seven companies, that use controlled environment agriculture (Goodman, 2018). These companies have a variety of methods for reaching their consumers. Gotham Greens distributes to the largest network, including online orders, wholesales to mid-and high-price supermarkets and grocers, and highly rated restaurants. Edenworks works with Whole Foods and other mid-priced grocers. Square Roots' microgreens can be found at twenty-four different grocers across the city, while Eli Zabar's produce can only be found at his store, the Vinegar Factory. Sky Vegetables have online shopping for their grocery stores and vends to a restaurant in Connecticut, and Farm.One has direct sales to restaurants.

The next category of controlled environment agriculture addressed by Goodman is institutional farms. These farms are affiliated with hospitals, schools, prisons, or public housing developments (2018). Across the city's five boroughs, there are over one hundred and thirty controlled environment agriculture farms. These farms function as more than just food production centers- they often offer education on how to grow produce to the community associated with it. Most of the produce grown in schools is given to the students, with any surplus being donated to food banks or homeless shelters. Controlled environment agriculture setups can be found at four percent of the city's public elementary and middle schools and at eleven percent of the public high schools (Goodman, 2018).

The smallest category of controlled environment agriculture in New York is community farms. Six out of the seven of these farms are run by non-profits and function to engage the local community in food production (Goodman, 2018). The other farm, project Farmhouse, functions as an example of indoor farming with a public-centered education center. These farms were started by a non-profit and are maintained by independent agencies and are at risk of closure in the future due to lack of planning after staff turnover (Goodman, 2018). Goodman was unable to find any community gardens within the city that function as a controlled environment system; however, Oko Farms has a hybrid model that sells produce and offers aquaponics training to adults and low-cost or free youth education programs (2018).

Overall, Goodman had difficulty finding exactly how much food was produced by the controlled environment farms (2018). The data that was found came from a mix of surveys from the controlled environment farms and Agrilyst, a technology firm that does data monitoring and analysis of New York's indoor farming sector (Goodman, 2018). The most common produce within the commercial sector was lettuce greens and herbs, with farms that deliver to chefs having a wider range of produce. Two of the farms, Edenworks and Oko Farms, have fish or seafood in addition to the produce they grow. They found that the produce grown within these controlled environment farms is priced at a premium and is more expensive than similar items grown conventionally or locally that can be found at the same stores. This makes the produce grown by these commercial-controlled environment farms unaffordable to low and even middle-income shoppers (Goodman, 2018).

As of now, commercial controlled environment agriculture makes up 0.0015 percent of New York City's land. Five of these farms are located on rooftops, three are inside of buildings or shipping containers, one is both on top of a roof and indoors, and only one is located at ground level (Goodman, 2018). In an interview with a broker, Goodman found that the average lease rate for an indoor farm would run $32 to $40 per square foot (2018). However, there have been cases investors are willing to give better deals or even free spaces to promising businesses. Since land and real estate are so valuable, many farmers look to use either unused or underused space, such as rooftops.

Before 2012, this was difficult to do in the city, as the roof was counted as a part of the floor-to-area ratio and therefore prohibited for buildings at or near this ratio. However, after 2012 this rule was changed, opening the door for several new rooftop farms. If the farm is being built on a rooftop that was not intended to be a growing space, the farm should find a building constructed between 1900 and 1970 when codes demanded greater roof loads, to ensure structural stability (Goodman, 2018). The New York City council has a number of members devoted to creating a modern food policy and includes space for the industry to grow efficiently in the era of technology (Cather, 2018). The council is navigating the balance between these large tech-driven commercial farms and existing small-scale farmers in the communities. While indoor and vertical farms advocate zoning and code changes for their production, community farms are fighting for the right to their land against real estate development. The council is working on legislation that will protect the rights of these different parties (Cather, 2018).

Another typical concern with controlled environment growing systems is the energy demand. Only four New York indoor farms rely on sole-sourced light or LEDs. Seven of the commercial controlled environment farms rely on sunlight to grow their produce, only using lighting to supplement the remaining demand. In addition to being one of the companies that primarily use natural sunlight, Gotham greens has an array of solar panels that generate fifty-five kW of energy (Goodman, 2018). In addition, they have an automated system that monitors the weather, humidity, temperature, and lighting for their farm spaces. Gotham Greens utilizes

the latest technology that constantly monitors and collects data to create the most efficient production. Monitoring the plants with this technology allows them to keep up to date with the crops' progress and health (Gotham Greens). Gotham Greens and many other controlled environment farms are not certifiably organic, but they use an integrated pest management system that uses natural pesticides like beneficial insects (Goodman, 2018).

While there are many different commercial farms in New York utilizing controlled environment agriculture, Gotham Greens may have had the largest impact in the industry. In 2011 they became the first commercial-scale rooftop greenhouse in the United States and two year later, they became the first commercial-scale greenhouse farm integrated with a supermarket in the world. As of 2015, they held the world record for the largest greenhouse and New York's third and largest greenhouse (Gotham Greens). They have since extended their facilities across the United States, with locations in Chicago, Baltimore, and Denver, and distribution to more than 40 states. Across all of their locations, they employ over 400 full-time employees (Gotham Greens).

In New York, an estimated one hundred and fifty people are employed by the six commercial controlled environment farms, with sixty-six percent of the workers being employed by Gotham Farms (Goodmen, 2018). Eleven percent of the jobs are high-paying stem jobs, eleven percent of the jobs are non-greenhouse agriculture work, but the majority, sixty-six percent, of the jobs are greenhouse work that pays around minimum wage and require little agricultural skills (Goodman, 2018). Commercial controlled environment farms do provide a small quantity of green-sector jobs to the community. However, most of these jobs do not pay very well and at the price point of the produce many of the workers would not even be able to afford what they grew if they were to buy it from a grocery store.

According to Cather, even if all potential land were converted into gardening or farm space, they could only produce enough to provide between 103,000 and 160,000 out of the 8.4 million residents with produce (2018). Goodman found that controlled environment agriculture contributed very little to New York's overall produce consumption. Even though most farms are focused on low-income neighborhoods, it cannot be proved that they help substantially (2018). The produce available from these farms is limited in selection and generally is not the most nutritious (i.e., lettuce, herbs). However, there is still great potential for controlled environment farms within the city. There is a lot of available space on roofs and potential for affordable space within underutilized industrial areas. On the other end of the spectrum, the commercial farms opt to be within the city to provide their high-end customers produce in hours instead of days (Goodman, 2018).

Controlled environment agriculture is a big investment for farmers that may not pay off in every scenario. In New York, the city has the infrastructure, demand from consumers, and a short traditional growing season. This means that their start-up cost was not as much as in a city that does not have expansive roof space for agriculture use and if their investment was made, they might not have the customer base who are willing to pay the premium of produce

grown under these circumstances. In addition, areas with longer growing seasons might find it more beneficial to just grow their produce using outdoor soil methods. Overall, each form of urban agriculture has its time and place where it can greatly benefit the community, environment, and economy but is most effective when tailored to a specific city.

Conclusion

An increase in urbanization coupled with the disconnect between the urban environment and food production makes it clear that changes must be made to our modern-day food system. Bringing in food made through industrial agriculture is unsustainable due to farming techniques and transportation and can harm local economies by taking money away from local farmers. Urban agriculture, on the other hand, can provide freshly grown foods within the community. This can have positive impacts on both the people involved in the food system and the environment. While there are challenges faced by urban agriculture, such as lack of available land and dependency on funding, overcoming these adversaries can pay off for the community in the long run. Peri-urban agriculture, traditional agriculture, and innovative agriculture systems all can change how people interact with the food system. While these techniques might not all be appropriate for all locations, a combination of methods should be invested in by public and private entities to make a dynamic, resilient food system.

Traditional Urban Agriculture, such as community gardens, provides the most social benefits for a community. These spaces provide education on growing food and land stewardship, strengthening the community with a space to connect with others and nature. For many urban residents, this connection to nature is missing due to a lack of green space. However, outdoor gardens may not be a viable option in every climate. Without having greenhouses, the plants are entirely dependent on moderate temperatures, and variation within weather patterns or seasons can lead to the loss of crops leading to decreased interest among participants. On the other hand, if participants live in a moderate climate and are provided a space with good soil conditions for growing, they will see great success with their produce. Once a few residents have successful harvests, other community members may want to participate in the gardening. While there is some potential revenue for the community, traditional urban agriculture does not produce much produce to sell back to community members. In most cases, the revenue is only enough to maintain the garden maintenance.

Peri-Urban agriculture is an essential asset for communities. While community members may not get to work on the farm and garden, they are still provided with fresh, healthy, local foods. Like traditional urban agriculture, peri-urban farms have to either use greenhouses to protect their crops or rely on the weather for enough lighting and growing temperatures that might not be as consistent in some areas. While they still do not produce as much as industrial agriculture methods, peri-urban farms can often produce more than community or home gardens. The agriculture methods used on peri-urban farms are generally more sustainable than the methods used on industrial farms. Peri-Urban farms need to be supported to save

them from being taken over by the sprawl of urban areas. Many farms are now being threatened by this sprawl, lack of interest and workers, and imported produce. For consumers, buying from local farms might not be as affordable as buying from supermarkets. However, if the city could find a way to make up the farmers' price through incentives like tax reductions, it is more likely these farms will keep serving their communities.

Innovative Urban Agriculture has the most hurdles to overcome as a potential growing method. The upfront costs are often high, deterring developers from investing in these projects. The operation of vertical farms can be expensive and energy-intensive due to the amount of light needed by the produce. While there are some emerging techniques to use natural sunlight reflected through the building, innovation is needed in this sector before it will be the most sustainable method of growing produce. Though innovative urban agriculture has its downsides, it is still an important part of creating strong urban food systems. Indoor gardens and vertical farms can be built everywhere regardless of the weather due to their independent internal temperature and lighting controls. They can also be made at a large scale that can produce more fresh foods than the other two methods. The amount of produce that these farms can grow means that there is potential to become profitable.

Limitations and Future Research

When it comes to implementing these ideas, they must be considered in the context of the given city rather than at face value. Every city can benefit from urban agriculture as it can bring people together, support the local economy, and help alleviate food deserts. However, a plan of how to best strengthen a city's food system should be analyzed based on the community's needs and conditions. As discussed, not every form of urban agriculture is appropriate for every city; traditional gardens might not have the right weather conditions, or there might not be enough investors for innovative technologies.

Future research should be done looking at a specific city and its current system to determine where improvement is needed. Eliminating food deserts should be a priority for urban agriculture to ensure everyone has access to fresh, healthy, and affordable foods. These communities might not have any open space to create gardens. In these cases, solutions such as a rooftop or indoor gardens should be considered. In cold areas, greenhouses and innovative growing techniques will be more appropriate than outdoor gardens as the growing season would not be long enough to provide an adequate amount of food. Overall, every city can benefit from some or all of these growing methods. All methods should be considered in order to find what best serves the community. Once the methods are determined, investment from the city and private entities is needed to implement a stronger food system. With these urban agriculture techniques cities can provide residents access to fresh produce, bring people together over food, and create a resilient community.

Works Cited

About the p-patch program. (n.d.). Retrieved March 15, 2021, from https://www.seattle.gov/neighborhoods/programs-and-services/p-patch-community-gardening/about-the-p-patch-program

Armanda, D. T., Guinée, J. B., & Tukker, A. (2019). The second green revolution: Innovative urban agriculture's contribution to food security and sustainability – A review. Global Food Security, 22, 13-24.

Bailey, S. (1993). Lack of space frustrates urban gardeners. Alternatives, 19(3), 10-11

Buxton, M., & Phelan, K. (n.d.). The Role of Peri-Urban Land Use Planning in Resilient Urban Agriculture: A Case Study of Melbourne, Australia. Balanced Urban Development: Options and Strategies for Liveable Cities, Water Science and Technology.

Cabannes, Y., & Marocchino, C. (2018). Food and urban planning: The missing link. In Cabannes Y. & Marocchino C. (Eds.), Integrating Food into Urban Planning (pp. 18-59). London: UCL Press.

Cather, A. (2018, January 3). The politics of NYC'S urban Farming: The City Notices urban agriculture. Retrieved from https://www.nycfoodpolicy.org/the-politics-of-nycs-urban-farming-the-city-notices-urban-agriculture/

Cipalla, R. (2018, November 08). P-Patch program (Seattle). Retrieved March 15, 2021, from https://www.historylink.org/File/20662

Duram, L., & Oberholtzer, L. (2010). A geographic approach to place and natural resource use in local food systems. Renewable Agriculture and Food Systems, 25(2), 99-108.

Gotham Greens. (2020, December 29). Our story. Retrieved from https://www.gothamgreens.com/our-story/

Holloway, D., Ho, P., & Boxshall, B. (2003). ROOF AND FACADE GARDENS. Environment Design Guide, 1-11.

Hynninen, E. (2020, May 09). Will Melbourne's growing urban SPRAWL impact Food security? Retrieved from https://www.abc.net.au/news/rural/2020-05-09/growing-urban-sprawl-impacting-future-food-security/12224830

K. Bruce Newbold. (2017). Population Geography: Tools and Issues: Vol. Third edition. Rowman & Littlefield Publishers.

Morgan, K. (2015). Nourishing the city: The rise of the urban food question in the Global North. Urban Studies, 52(8), 1379-1394.

New York City, Land Use Policy, Volume 83,2019, Pages 160-173, ISSN 0264-8377, https://doi.org/10.1016/j.landusepol.2018.12.038.

Sage, J., McCracken, V., & Sage, R. (2013). Bridging the Gap: Do Farmers' Markets Help Alleviate Impacts of Food Deserts? American Journal of Agricultural Economics, 95(5), 1273-1279.

Santandreu, A. (2018). Urban agriculture in Lima metropolitan area: One (short) step forward, two steps backwards – the limits of urban food planning. In Cabannes Y. & Marocchino C. (Eds.), Integrating Food into Urban Planning (pp. 117-133). London: UCL Press.

Seattle Department of Neighborhoods. (2020). P-Patch Gardening 2020 Year End Review (Rep.).

Spataru, A., Faggian, F., Docking, A. Principles of multifunctional agriculture for supporting agriculture in metropolitan peri-urban areas: The case of Greater Melbourne, Australia, Journal of Rural Studies, Volume 74, 2020, Pages 34-44, ISSN 0743-0167, https://doi.org/10.1016/j.jrurstud.2019.11.009.

Venture, S., & Bailkey, M. (Eds.). (2017). Good Food, Strong Communities: Promoting Social Justice through Local and Regional Food Systems. Iowa City: University of Iowa Press.

Wilson, G. (1999). Farming on city rooftops. ReNew: Technology for a Sustainable Future, (67), 52-55.