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Urban Agriculture: Sowing Seeds of Sustainability in New York City

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Abstract

This paper critically examines urban agriculture as a vital strategy for addressing the interconnected challenges of food insecurity and climate resilience in New York City. Chapter 1 employs quantitative data to illuminate the complex interplay between climate change and food injustice in New York City, highlighting reciprocal impacts and underscoring the urgency of intervention. Chapter 2 traces the historical trajectory of urban agriculture in New York City, emphasizing its anticipated contributions to the city's food security and climate resilience. This section also explores the diverse forms urban agriculture takes and assesses their suitability for the contexts of New York City. Chapter 3 delves into the economic dimensions of urban agriculture, exploring its feasibility and sustainability while drawing on successful business models. By analyzing the costs and benefits of urban agriculture initiatives, this chapter provides insights into the economic implications of investing in urban farming. Expanding on these themes, Chapter 4 employs an environmental justice framework to evaluate urban agriculture's impact on fostering a more equitable urban landscape. It sheds light on the grassroots origins of urban agriculture in New York City, emphasizing the pivotal role of residents in shaping its trajectory, while also illuminating persistent power imbalances within the movement. Finally, Chapter 5 presents a set of targeted policy recommendations aimed at advancing urban agriculture in ways that prioritize equity and resilience. These recommendations seek to amplify the positive impacts of urban agriculture while mitigating the risk of exacerbating existing injustices, thereby fostering a more inclusive and sustainable urban future for all New Yorkers.

Keywords: climate resiliency, food insecurity, new york city, urban agriculture, environmental economics, environmental justice

Table of Contents

Introduction. Sprouting Sustainability—NYC's Urban Agriculture Revolution

Chapter 1. Confronting Climate Change and Food Insecurity in New York
- a. Problem 1: NYC's Climate Crossroad
- b. Exploring Ecosystem Services
- c. Problem 2: NYC's Food Injustice
- d. Urban Agriculture as the Answer

Chapter 2. The Roots of NYC's Urban Agriculture
- b. Concrete Growth: Development in NYC
- c. Nourishing NYC Through Urban Agriculture
- d. Cultivating Climate Resiliency
- a. Urban Agriculture Approaches

Chapter 3. From Seed to Sale: Economics in Urban Agriculture
- a. The Ground Price
- b. Sowing Success
- c. Behind the Bottom Line

Chapter 4. Cultivating Change: Unearthing Environmental Injustice in NYC
- a. From the Ground Up
- b. The Collision of Two Movements
- c. Power, Privilege, and Pictures

Chapter 5. Feeding the Future: Policy Recommendations
- a. Land Acquisition
- b. Incentivizing Rooftop Agriculture
- c. Financial Support
- d. Fair Food Access

References

Introduction. Sprouting Sustainability—NYC's Urban Agriculture Revolution

In New York City, like many other urban centers around the world, two intertwined challenges persistently loom over the city's residents: the escalating impacts of climate change and the enduring issue of food insecurity. With a population exceeding eight million and widespread food deserts in many neighborhoods, the city confronts significant barriers to food access and equity. As temperatures rise and extreme weather events become more frequent, the essence of urban life in NYC is increasingly threatened. Yet, it's not just infrastructure and lifestyle that face jeopardy; food production itself is under threat. This inseparable link between food production and climate change underscores the need to address both challenges in concert.

Amidst this urban tumult, a green revolution is quietly taking root – urban agriculture. By reclaiming city spaces for food production, urban agriculture offers a dual promise: to mitigate the effects of climate change and alleviate food insecurity. Moreover, it serves as a catalyst for social cohesion while reconnecting city dwellers to nature and offering a beacon of hope for a more sustainable and equitable future.

This movement represents more than just a shift of agricultural practices; it embodies a paradigm shift in the way we conceptualize food production, distribution, and consumption within urban spaces. From rooftop gardens to community-run farms, these initiatives reimagine the cityscape as a fertile ground for cultivation, fostering biodiversity, promoting local food systems, and reducing carbon footprints. By decentralizing food production and empowering communities to reclaim control over their food sources, urban agriculture offers a path towards greater resilience and self-sufficiency.

As a transplant from the vibrant landscapes of Hawaii to the cityscapes of New York, my journey into urban agriculture began as a quest for connection to nature and community. To my

surprise, I found a community garden in my neighborhood in West Harlem that would become my sanctuary within the urban chaos. Yet, it was not just a refuge from the city; it was a microcosm of resilience in the face of adversity. In this small patch of green, I witnessed first-hand the transformative power of urban agriculture to address the twin crisis of food insecurity and climate change, while fostering social cohesion and community empowerment.

Throughout my experiences, I encountered a diverse array of individuals whose lives were touched by urban agriculture. From children unfamiliar with shovels and worms to grandparents who had never watched something grow, from stressed students seeking an outlet to individuals in need of a meal, urban agriculture served as a common ground for connection, learning, and empowerment.

This paper aims to investigate the multifaceted impact of urban agriculture on climate resilience, sustainable development, food security, and community wellbeing. By delving into the intersectionality of urban agriculture with sustainability, social equity, and economic resilience, these chapters will offer insights into the transformative power of urban agriculture as a catalyst for positive change in New York City's urban ecosystem. Chapter 1 provides quantitative data on the challenges posed by climate change and food insecurity. Chapters 2-4 explore the historic, economic, and ethical dimensions of urban agriculture, providing a comprehensive understanding of its evolution and significance. In Chapter 5, I present policy recommendations deeply rooted in principles of equity and community-driven approaches, ensuring a pathway to success.

Chapter 1. Confronting Climate Change and Food Insecurity in NYC. Climate change poses significant challenges to urban centers worldwide, and New York City is no exception. In recent

decades, the city has experienced firsthand the impacts of a changing climate, from rising sea levels to extreme weather events. These environmental changes exacerbate existing challenges, including food insecurity, which affects many urban residents. This chapter will use quantitative data to contextualize the issue of climate change and food insecurity in New York City. Furthermore, it will explore urban agriculture as a solution to these interwoven challenges.

A) Problem 1: NYC's Climate Crossroad. Climate change refers to the long-term alternation of Earth's climate patterns, including shifts in temperature and weather events. This phenomenon is primarily driven by human activities, particularly the emission of greenhouse gases such as carbon monoxide and methane (IPCC 2023, 8). Since the Industrial Revolution, human activities such as burning fossil fuels, deforestation, and industrial processes have significantly increased the concentration of these gases in the atmosphere, trapping heat and leading to approximately 1.1°C of warming (IPCC 2023, 7). The consequences of climate change are extensive and varied, impacting ecosystems, weather patterns, sea level rise, and human societies.

Urban areas worldwide face multifaceted challenges due to climate change, spanning from threats to infrastructure and public health to the exacerbation of social inequalities. The planning, design, and maintenance of settlements and key infrastructure play a crucial role in determining patterns of exposure, social and physical vulnerability, and capacity for resilience. Urban infrastructure, which concentrates and interconnects populations, assets, and energy use, serves to amplify these risks. Moreover, the concentration of people and resources in urban areas intensifies the impact of extreme weather events and environmental degradation. Evidence from both urban and rural settlements unequivocally demonstrates that climate impacts are felt

disproportionately in urban communities, particularly affecting the most economically and socially marginalized groups (IPCC 2023, 14).

Climate change disproportionately impacts certain communities, ethnic groups, and economic classes as the result of underlying historical disparities and inequities. These vulnerable groups often reside in higher-risk areas such as flood zones and lack access to resources and services necessary to prepare for, recover from, and adapt to the impacts of climate change (more discussion in Chapter 4) (Gamble et al., 2016, 252). Hurricane Sandy vividly demonstrated this in New York City, where populations in coastal and low-lying areas, as well as the elderly, young, and lower-income neighborhoods, faced heightened vulnerability. The storm tragically claimed the lives of 44 city residents and inflicted an estimated $19 billion in damages and lost economic activity across NYC.[1] The health impacts of Hurricane Sandy varied considerably throughout the city, influenced by localized storm and tidal surges, variations in housing types, disruptions to energy, water, and transportation infrastructure, and underlying health and resilience factors among the affected population (Huang 2012).

As a major urban center, New York City faces significant challenges in adapting to and mitigating the impacts of climate change on its residents, infrastructure, and environment. The climate of the New York City is undergoing noticeable shifts—annual temperatures are rising, heavy downpours are becoming more common, and sea levels are rising. Given its coastal location, New York City faces heightened threats from sea level rise and storm surges induced by climate change. Since 1900, sea levels in New York City have risen by an average of

[1] NYC Mayor's Office of Climate and Environmental Justice 2024

1.2 inches per decade, nearly double the observed global rate of 0.5 to 0.7 inches per decade over a similar period.[2] Projections indicate that sea level rise in New York City will continue to outpace the global average.[3] Consequently, it is virtually certain that sea level rise alone will result in more frequent and severe coastal flooding throughout the century.[4] These forecasts highlight just one aspect of the challenges that climate change poses to New York City.

B) Exploring Ecosystem Services. The concept of ecosystem services has been developed to articulate the diverse benefits provided by the environment to humanity. Climate change poses a significant threat to these essential ecosystem services, with far-reaching consequences for human welfare. The Millennium Ecosystem Assessment, which assessed the consequences of ecosystem change for human well-being, identified four major categories of ecosystem services: regulating, provisioning, cultural, and supporting services.[5]

Regulating services encompass the vital functions performed by ecosystems to regulate the natural environment, ensuring its stability and resilience.[6] These services include a range of processes that contribute to environmental balance and support life on Earth. Among these functions are water retention, erosion control, temperature regulation, carbon sequestration, and pollination.[7] In New York City, regulating services are crucial for maintaining the city's environmental health and resilience in the face of climate change.

Water retention is a critical regulating service provided by ecosystems, particularly in mitigating the impacts of flooding and drought. Water retention refers to the ability of ecosystems to capture, store, and slowly release water over time. It is a critical regulating service

[2] New York Academy of Sciences, 2015, 11
[3] Ibid.
[4] Ibid.
[5] Millennium Ecosystem Assessment 2005, 49
[6] Millennium Ecosystem Assessment 2005, 57
[7] Ibid.

provided by natural environments, including forests, wetlands, and soil systems. Water retention helps to mitigate the impacts of flooding by absorbing excess water during heavy rainfall events. However, climate change can disrupt water retention processes by altering precipitation patterns and increasing the frequency of extreme weather events, leading to more frequent and severe floods and droughts (IPCC 2019, 12). In New York City, this issue takes on added significance due to its pronounced vulnerability to flooding. With its extensive coastal areas, low-lying terrain, and densely populated neighborhoods, New York City is exceptionally susceptible to the ravages of flooding.

Temperature regulation is another vital service for maintaining climatic stability and supporting ecosystem health and biodiversity. Ecosystems such as forests, wetlands, and coastal habitats help regulate local and regional temperatures by providing shade, evapotranspiration, and cooling effects. These ecosystems act as natural air conditioners, moderating temperature extremes. However, climate change poses a significant threat to temperature regulation services by disrupting vegetation patterns, reducing vegetation cover, and intensifying heatwaves and extreme temperatures. Consequently, this disruption can lead to heat stress, habitat loss, and the further degradation of ecosystem services.

While temperatures are increasing globally, urban areas face even greater heat challenges due to the urban heat island effect. Urban landscapes, characterized by concentrated structures such as buildings and roads with limited greenery, trap and re-emit solar heat, resulting in higher temperatures compared to surrounding areas. These localized pockets of elevated temperatures, known as "heat islands," exacerbate heat-related risks for urban residents. Research indicates that the heat island effect can elevate daytime temperatures in urban areas by 1–7°F and nighttime temperatures by 2–5°F compared to outlying regions (Hibbard et al. 2017, 6).

In the context of New York City, the effects of climate change on temperature regulation are particularly noteworthy. Every summer, roughly 350 premature deaths linked to hot weather in New York City (Madrigano et al. 2018). Central Park, a focal point for climate data in New York City, has experienced a consistent increase in mean annual temperature over the past century. From 1900 to 2013, Central Park witnessed a rise in mean annual temperature at a rate of 0.3°F per decade, resulting in a total increase of 3.4°F.[8] Projections for the future indicate a continuation of this trend, with temperatures expected to further rise. By the 2050s, estimates suggest increases ranging from 4.1 to 5.7°F, and by the 2080s, projections indicate even higher increases, ranging from 5.3 to 8.8°F.[9] Moreover, the frequency of heatwaves in NYC is projected to triple by the 2080.[10] This poses significant challenges for the future of NYC's residents, infrastructure, and overall resilience.

Supporting services are fundamental processes provided by an ecosystem that are necessary to produce all other ecosystem services.[11] These services are essential for maintaining the conditions of life on Earth and play a critical role in supporting human well-being and livelihood. Supporting services encompass a range of ecological processes, including the production of atmospheric oxygen through photosynthesis, soil formation, nutrient cycling, water cycling, and the provisioning of habitat for animal species. However, climate change is exerting significant pressure on supporting services, disrupting these essential processes, and impacting ecosystems worldwide.

Water cycling, which involves the movement of water through the atmosphere, land, and oceans, is a critical supporting service provided by ecosystems. Climate change is intensifying

[8] New York Academy of Sciences 2015, 10
[9] Ibid.
[10] Ibid.
[11] Millennium Ecosystem Assessment 2005, 59

the water cycle, leading to more frequent and intense rainfall events, as well as more prolonged and severe droughts in many regions (IPCC 2023, 24). These changes can disrupt water availability, alter hydrological processes, and exacerbate water scarcity and flooding, affecting ecosystems, agriculture, and human communities. The New York City Panel on Climate Change anticipates that by the end of the century, the city could experience as much as 25 percent more annual rainfall, and 1.5 times as many days with more than one inch of rain.[12] This surge in heavy precipitation presents formidable challenges for urban infrastructure and services throughout NYC.

Recent history attests to the growing frequency and severity of these deluges. When Hurricane Ida struck on September 1, 2021, unprecedented downpours overwhelmed the city's sewer system, triggering catastrophic flooding in subways, streets, and basements, tragically claiming the lives of 13 individuals (City of New York 2010). Two years later, Tropical Storm Ophelia unleashed another downpour on September 29, 2023, shutting down subway lines, inflicting damage on homes and hospitals, and flooding streets (Bocanegra et al. 2023). In response, Governor Hochul and Mayor Adams declared a state of emergency and issued a travel advisory (Bocanegra et al. 2023). During this 24-hour onslaught, a staggering 8.65 inches of rainfall fell in the city (City of New York 2023). Fortunately, no fatalities were reported from this storm, but its impact serves as a stark reminder of the growing threat posed by extreme precipitation events in New York City.

As climate change continues to exert pressure on supporting services, disrupting vital ecological processes and ecosystems worldwide, the stability and reliability of provisioning services are also increasingly threatened. Provisioning services are the material or energy outputs

[12] New York Academy of Sciences 2015, 10

from an ecosystem that directly benefit humans.[13] These services include essential resources such as food, fiber, and water, which are fundamental for sustaining human life and supporting economic activities. However, the stability and reliability of provisioning services are increasingly threatened by climate change, posing significant challenges to global food security and resource availability. Climate change exacerbates the vulnerability of the global food supply by increasing the frequency and severity of extreme weather events, such as floods, storms, droughts, and heatwaves (IPCC 2019, 15). These events can disrupt agricultural production, damage crops and infrastructure, and compromise food distribution networks, leading to food shortages, price volatility, and food insecurity (IPCC 2019, 41). Moreover, climate-related shifts in temperature and precipitation patterns can affect the suitability of land for agriculture, alter crop growing seasons, and impact the productivity of agricultural systems worldwide (IPCC 2019, 21). Consequently, New York City is at risk of experiencing food shortages, price volatility, and increased food insecurity due to climate-related shifts in temperature and precipitation patterns that affect the suitability of land for agriculture and alter crop growing seasons. This concern is amplified by the city's ongoing struggle with food insecurity, underscoring the urgency of addressing climate-related threats to food systems.

Finally, cultural services are the non-material benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, moments of reflection, recreational pursuits, and aesthetic pleasures.[14] Cultural services are tightly bound to human values, behavior, and the institutions that shape our society. They play a significant role in enhancing individual and collective well-being, fostering a sense of connection to nature, and shaping the cultural

[13] Millennium Ecosystem Assessment 2005, 56
[14] Millennium Ecosystem Assessment 2005, 58

identity of communities. Climate change is increasingly impacting cultural services by altering the availability, accessibility, and quality of natural environments. Rising temperatures, extreme weather events, and habitat loss are disrupting the scenic beauty and biodiversity of ecosystems, diminishing opportunities for spiritual enrichment, recreational activities, and aesthetic enjoyment.

Urban centers like New York City are both contributors to and victims of climate change, making them pivotal in addressing our global climate crisis. Urban areas are significant sources of greenhouse gas emissions, stemming from various human activities such as transportation, energy production, and industrial processes. However, cities are also on the front lines of climate change impacts, facing heightened risks from rising temperatures, extreme weather events, and sea-level rise. As such, cities are key stakeholders in the trajectory of climate change and wield considerable influence in either exacerbating or ameliorating its impacts.

C) Problem 2: NYC's Food Injustice. Food security remains a pressing issue in New York City. Over the past year, food costs surged by 10.1 percent[15] while housing costs have reached historic heights (Bocanegra 2023). Compounding this challenge, the average meal cost in New York County stands at $6.31, nearly double the national average of $3.25, placing additional strain on budgets for food-insecure families (Dewey et al. 2023, 9).

Food insecurity, which is characterized by inconsistent access to nutritionally adequate food required for a healthy lifestyle (Rabbit et al. 2023), remains a prevalent concern among New York City residents. Families grappling with food insecurity may worry that food will run out before they have enough money to buy more, eat less than they should, or be unable to afford to eat balanced meals. The latest data reveals that approximately 14.6% of New York City

[15] MacLachlan and Sweitzer, 2023

residents, accounting for over 1.2 million people, are affected by food insecurity (Dewey et al. 2023, 44).

The geographical distribution of food resources within the city exacerbates food insecurity, with certain neighborhoods lacking adequate access to affordable, nutritious food options. These areas, known as food deserts, are characterized by a scarcity of supermarkets and grocery stores offering fresh produce and healthy staples (Dutko et al. 2012, 5). Instead, residents turn to smaller stores, bodegas, or fast-food restaurants, which may have a restricted selection of healthy items and tend to charge higher prices for groceries compared to stores in wealthier neighborhoods (Herforth and Ahmed 2015, 510). Foods available in these locations are typically processed, pre-packaged, and high in calories, fat, sugar, sodium, and preservatives (Herforth and Ahmed 2015, 510).

The lack of access to fresh, nutritious foods fosters unhealthy eating habits, and therefore has the potential to increase the risk of obesity, diabetes, and other diet-related diseases such as hypertension and high cholesterol (Morland et al. 2006, 336). As of 2021, the obesity and diabetes rates in New York City were 29.1% and 10.1% (Black et al. 2010, 491). However, these rates can vary based on demographic factors and socioeconomic conditions within the city.

In New York City, like in many other urban settings, there are stark disparities in health outcomes between low-income minority neighborhoods and more affluent, predominantly white areas. In 2006, the obesity rates in New York City demonstrated stark differences between neighborhoods. While the affluent Upper East Side had an obesity prevalence of only 9%, areas like East and Central Harlem and North and Central Brooklyn, which have lower income levels, showed much higher rates ranging from 21% to 30% (Black et al. 2010, 19). Likewise, there were significant variations in diabetes prevalence rates, with only 5% of adults in the Upper East

Side reporting a diabetes diagnosis compared to 10–15% in East and Central Harlem and North and Central Brooklyn (Black et al., 2010, 19). These health disparities align with areas that have long been considered food deserts, such as Bedford-Stuyvesant and Brownsville in Brooklyn, the South Bronx, and parts of Harlem (Gordon et al. 2011, 698).

The impact of food insecurity is felt across various demographics, but marginalized communities, including people of color and immigrant populations, bear a disproportionate burden (Dewey et al. 2023, 5). For instance, statistics from 2019 reveal a stark contrast in food insecurity rates, with Black households being twice as likely as White families to experience food insecurity. Specifically, 19.1% of Black households and 15.6% of Latinx households were affected, in contrast to 7.9% for White families (Silva 2020). Structural inequalities rooted in historical injustices, such as racism, redlining, and housing discrimination, have created systemic barriers to food access and economic opportunities for these communities.

These disparities are deeply entrenched in historical injustices, including systemic racism, redlining, and housing discrimination, which have erected formidable barriers to food access and economic opportunities for marginalized communities. Research consistently demonstrates that areas with higher levels of poverty are more likely to lack adequate access to nutritious food options (Dutko et al. 2012, 11). This disparity is evident in the median household incomes across New York City's boroughs, with the Bronx having the lowest median income at $43,011, followed by Brooklyn at $67,569, Manhattan at $84,435, Queens at $73,262, and Staten Island at $86,054 (NYCC 2021). These economic disparities are closely linked to rates of food insecurity in each borough, with the Bronx experiencing the highest rate at 19.1%, followed by Brooklyn at 15.5%, Manhattan at 13.6%, Queens at 12.1%, and Staten Island at 10.1% (Office of Food Policy

2022). The correlation between poverty levels and food insecurity underscores the systemic challenges faced by communities with limited access to affordable and nutritious food options.

Moreover, the historical context of urban development and discriminatory policies has perpetuated these disparities. Neighborhoods with higher poverty rates are often marginalized, lacking investment and infrastructure, including supermarkets and grocery stores. Research indicates that majority-Black neighborhoods are more than twice as likely as majority-White neighborhoods not to have a supermarket (Meyersohn 2020). This can be attributed to practices like redlining, which systematically denied financial services and investment to predominantly Black neighborhoods, effectively segregating these communities and restricting access to essential amenities (Shaker et al. 2022, 103). These communities also lack purchasing power which can hinder efforts to attract supermarkets and grocery stores. Retailers may be deterred from investing in these areas due to perceptions of lower consumer demand and profitability (Shaker et al. 2022, 108). As a result, residents are left with limited options, relying on convenience stores and fast-food outlets that offer predominantly processed and unhealthy food choices.

The convergence of rising food costs, housing disparities, and limited access to nutritious food emphasizes the critical need for comprehensive action to address food insecurity in New York City. As discussed in the previous section, climate change threatens to intensify the severity of food insecurity by disrupting agricultural production and increasing extreme weather events. Marginalized communities will continue to bear the brunt of these inequalities, highlighting the imperative for targeted interventions that address systemic barriers to access and economic opportunities. In the face of these challenges, proactive measures must be undertaken

to bolster resilience within the food system, mitigate the impacts of climate change, and safeguard the food security of all New York City residents.

D) Urban Agriculture as the Answer. Urban agriculture refers to the practice of cultivating, processing, and distributing food in or around urban areas. It encompasses various forms of agricultural activities that employ diverse techniques, including rooftop farming, community gardens, and vertical farms, among others (refer to chapter 2). Unlike traditional agriculture, urban agriculture contributes to the functioning of all ecosystem services and provides a means for cities to address both food insecurity and climate change.

One of the most obvious contributions of urban agriculture is with the provisioning of food in proximity to consumers. In some cases, the food is directly consumed by the garden volunteers, improving food security for households (refer to chapter 2). In other cases, much of the food is distributed through local markets, providing disposable income sources for individual residents and economic vitality for the community (refer to chapter 3).

This plays a significant role in reducing the distance that food travels from farm to table. Food miles refer to the distance food travels from the place of production to the consumer's plate and is used to help conceptualize the environmental impacts of our food system. The transportation of food over long distances contributes to carbon emissions, air pollution, and energy consumption, thus impacting climate change and environmental degradation. Researchers estimate that carbon emissions from transporting food account for about 6% of the global total, with fruit and vegetables the largest contributor (Li et al. 2022, 540). By shortening the supply chain and eliminating the need for long-distance shipping, urban agriculture provides the opportunity to minimize the carbon footprint of food production and contribute environmental sustainability. This reduction in food miles not only benefits the environment but also enhances

the freshness and nutritional value of the food, as it is harvested closer to the point of consumption.

In terms of regulating ecosystem services, urban agriculture contributes significantly to temperature regulation, stormwater management, carbon sequestration, and air quality improvement. Rooftop gardens, community green spaces, and urban farms act as green infrastructure, helping to reduce the urban heat island effect, absorb carbon dioxide, and mitigate extreme heat events (see refer to chapter 2). These practices also aid in managing stormwater runoff, reducing the risk of urban flooding and erosion, while promoting groundwater recharge and maintaining local water cycles (refer to chapter 2).

Urban agriculture also contributes to supporting ecosystem services through soil formation and biodiversity. Through the cultivation of plants and crops within urban areas, it enhances soil health and structure, facilitating the development of fertile soils capable of sustaining a diverse array of plant life. Furthermore, urban agriculture offers an alternative to larger-scale food systems, which often degrade soil quality through intensive agricultural practices. Additionally, urban agriculture spaces provide habitats for various species of plants and animals, thereby enhancing biodiversity within urban environments. This biodiversity not only contributes to the resilience of urban ecosystems but also provides important ecological benefits, such as pollination, pest control, and nutrient cycling.

Furthermore, urban agriculture plays a crucial role in fostering social cohesion and promoting community engagement, thereby significantly contributing to cultural services. Community gardens serve as vital spaces where neighbors can gather to not only cultivate food, relationships, and a sense of community (as discussed in chapter 4). These gardens offer

invaluable opportunities for education, skill-building, and cultural exchange, allowing residents to learn from one another and share their diverse knowledge and experiences.

Beyond fostering community cohesion and the exchange of knowledge, urban agriculture spaces serve as platforms for residents to express and celebrate their cultural heritage. These spaces are often created and maintained by communities themselves, tailored to their specific needs and preferences. Immigrants often cultivate plants in these areas that are integral to their culinary traditions and cultural practices, which may not be readily available in stores. Whether it's growing culturally relevant crops, practicing traditional farming techniques, or hosting cultural events and celebrations, these community-driven initiatives reflect the unique aspirations and values of the people who inhabit them.

Overall, urban agriculture plays a vital role in enhancing the ecological sustainability and resilience of urban landscapes. The remaining chapters will explore urban agriculture as a solution to both climate change and food insecurity in New York City. These chapters will provide a comprehensive examination of the various dimensions of urban agriculture, highlighting its potential to mitigate the adverse impacts of climate change while simultaneously bolstering food security measures in New York City.

Chapter 2. The Roots of NYC's Urban Agriculture. Environmental history seeks to understand the relationship between humans and the environment across time (Hughs 2016, 19). This is done with the goal of improving our management of the natural world. This chapter seeks to comprehend the historical evolution and impact of urban agriculture in New York City to inform future endeavors. To do this we will explore the development of urban agriculture in New York City, its contributions to food security and climate resiliency, and the diverse forms it takes.

A) Concrete Growth: Development in NYC. The earliest forms of urban agriculture in NYC can be traced back to the early 19th century where it was common for residents to keep livestock and home gardens for subsistence. During this time, most areas were covered by agriculture, except for the heavily urbanized Lower Manhattan (Angotti 2015, 339). In the 1890's, New York's Municipal Government supported public gardening programs to address food insecurity among poor residents during economic crises (Lawson 2005, 170). However, as economic conditions improved in New York, these gardening programs gave way to development.

During World War I, the US Government launched programs such as the US School Garden Army and the Liberty Garden Program which framed gardening as a patriotic activity. The government's goal was to increase the available food for troops and free up wartime shipping capacity by reducing food transport while building support for the war by engaging civilians (Lawson 2005, 210). These initiatives lead to substantial increases in urban agriculture production. For instance, in 1918, Liberty Gardens were estimated to have provided $520 million worth of food nationally (Hynes 2004, 172). New York City based organizations supported these federal efforts by sponsoring demonstration gardens in prominent locations such as Bryant Park and Union Square (Lawson 2005, 131). Although many garden sites were developed into real estate after World War I (Hynes 2004, 176), the onset of World War II launched the second national gardening initiative. The Victory Garden Campaign promoted gardening as a civic duty and encouraged Americans to grow their own food to support the war (Lawson 2005, 172). This initiative led to the establishment of four hundred thousand Victory Gardens in NYC by 1943 (Jenkins 1944). However, during the 1950s, as wartime gardening programs closed and the US

economy grew, urban agriculture waned. Food production in the city was seen as an emergency measure during economic crisis instead of a means of long-term sustenance.

Since the 1960s, urban agriculture re-emerged as a grassroots effort in response to broad economic, political, and social changes (Lawson 2005, 247). In New York City, community gardening emerged to revitalize communities facing disinvestment (Reynolds et al. 2006, 31). Through community organizing and cleanup efforts, residents reclaimed vacant lots, transforming them into vibrant gardens (refer to chapter 4) (Reynolds et al. 2006, 31). Recognizing that gardeners were revitalizing vacant parcels and enhancing community cohesion at minimal cost to the city, City Hall stepped into the realm of urban agriculture. In 1978, the NYC government began supporting these grassroots initiatives by launching Operation GreenThumb which provided technical assistance to gardeners and facilitated the management of city-owned garden sites (Reynolds et al. 2006, 32). This initiative supported hundreds of urban agriculture projects throughout the city's low-income communities, as required by the funding (Lawson 2005, 258). Unlike previous programs, such as those during wartime and the Great Depression, Operation GreenThumb did not solely focus on increasing production. Instead, NYC launched the program to engage residents as caretakers of city-owned land until development opportunities arose (Reynolds et al. 2006, 32). Additionally, there was an aspiration for gardens to attract investment by enhancing the appeal of surrounding neighborhoods to higher-income individuals and real estate developers (Reynolds et al. 2006, 32).

During this period, other government initiatives supporting urban agriculture in NYC included the Garden and Greening program of the New York City Housing Authority (NYCHA). Originating from a citywide resident garden competition in 1963, this program evolved to include vegetable gardening contests and expanded to encompass tree plantings and

environmental education (New York City Housing Authority 2014a). Motivated by the aim to provide wholesome activities for low-income public housing residents and utilize the vast landscapes of the city's housing projects, the Garden and Greening program contributed to the proliferation of urban agriculture initiatives.

By 1980, as real estate development gained momentum in Manhattan and other boroughs, displacement of lower-income residents surged in neighborhoods adjacent to central business districts (Sites 1997, 545). City agencies and private developers sought to capitalize on housing demand, leading to the adoption of policies aimed at creating more housing units. With the economy rebounding, sites previously viewed as valuable for development began to attract attention, with gardeners seen as obstacles to progress. This dynamic, particularly evident in neighborhoods like the Lower East Side, where gentrification had taken hold, led to conflicts over garden displacement. The demolition of the Garden of Eden in 1986 and the subsequent riot in Tompkins Square Park in 1988 (Zukin 2011) exemplified these tensions. The conflict between housing production and community gardens continued through the 1990s as the local and national economies grew (more discussion in chapter 4). Increasing land values in communities with gardens and news of plans to convert sites into housing raised concerns among all community gardeners about their tenure on city-owned parcels (Howe 1994).

Overall, the period that began in the late 1990s galvanized a strand of activist-oriented urban agriculture in New York, which remains a vital part of the system today. The experience of fighting to save community gardens strengthened advocacy groups supporting urban agriculture, framing gardens as integral to the city’s landscape. One enduring outcome of this battle was the establishment of a group of community gardens with permanent land tenure and management staff, including those operated by New York Restoration Project, various land trusts, and larger

nonprofit organizations (Reynolds et al. 2015, 37). These privately held gardens are recognized as productive spaces providing instrumental value to the city, helping to legitimize food production as a legitimate urban land use.

By 2010, as urban agriculture gained popularity nationwide and concerns about diet-related public health disparities became politically salient, the city implemented new rules granting licenses for gardens in the GreenThumb program to operate on city property. These rules include provisions for automatic renewal, provided gardens comply with the license terms and conditions, with mandatory public review if the city intends to evict gardeners and develop a site (City Record 2010). Despite these procedures, the city retains the ability to develop garden sites for housing or any other public purpose (refer to chapter 4).

Contemporary urban agriculture in New York City constitutes a diverse network that both builds on historical legacies and embraces innovations such as aquaponics and rooftop farming, all while engaging with present-day social and political concerns. Presently, New York City boasts over 700 urban agriculture sites, including approximately 500 community gardens, ten urban farms, and four indoor farms (Reynolds et al. 2006). Despite facing various challenges, particularly regarding property rights, these sites have remained integral parts of the city's landscape, serving as valuable community spaces.

In September 2022, New York City established the Office of Urban Agriculture, signaling its commitment to enhancing locally grown produce, bolstering climate resilience, and stimulating economic growth (Sheldon 2023). Through initiatives supporting urban farming, community gardens, and green infrastructure, the office aims to increase access to fresh food, mitigate the impacts of climate change, and create new opportunities for entrepreneurship. By promoting sustainable urban development, the city seeks to foster a more resilient and inclusive

urban environment that benefits both residents and the planet. The establishment of this office represents a pivotal step towards building a greener, more equitable future for New Yorkers.

B) Nourishing NYC Through Urban Agriculture. Urban agriculture is already contributing to improved food security in New York City and has the potential to significantly increase access to fresh, healthy food. As discussed in chapter one, food security is used to signify both a lack of hunger and an adequate access to affordable and healthy foods (Rabbit et al., 2023). By cultivating fruits, vegetables, and herbs within the urban landscape, urban agriculture initiatives are actively addressing food deserts and improving the availability of wholesome food choices for residents across diverse socioeconomic backgrounds.

Given what many assume to be an inhospitable climate, a surprising variety of crops are being cultivated in New York City's community gardens and farms. That said, there is a limit to what can be grown, and ideal crops for NYC include products that are climate suitable, high yield, high value, can be harvested multiple times during the season, can do well in marginal soils. Many urban farmers focus production on vegetables not only because they are well suited to urban conditions, but also because they wish to contribute to increased access to fresh, healthy foods (particularly vegetables) which are critical to addressing many of the public health problems that are affecting low-income urban communities (Ackerman et al. 2011, 19).

Community gardens are working to fill the food supply gap through provisioning food to both volunteers and neighboring residents. Urban agriculture groups often donate to local organizations and food banks (Ackerman 2011, 54). These efforts extend food access beyond garden volunteers and foster community engagement and empowerment through local partnerships. Some community gardens also sell their produce at farmers markets (refer to chapter 3) (Ackerman et al., 2011, 12). These community farmers markets are often in areas

where conventional grocery stores are reluctant to locate due to neighborhood demographics (refer to Chapter 1).

Assessing the potential of urban agriculture to sustain urban populations requires estimating the amount of food that can be cultivated within a given area. However, estimating potential yields is inherently challenging due to numerous variables such as environmental conditions (soil quality, water availability, sunlight exposure) and cultivation methods, as well as the types of crops considered. As such, determining the amount of land area required to feed a specific population lacks a simple answer and relies heavily on assumptions.

However, if existing urban food production is already impacting food access in New York City, there is great potential for urban agriculture to enhance the overall picture of food security. However, it's crucial to recognize that increasing food insecurity involves more than simply ramping up local food production (refer to chapter 4). Food insecurity is rooted in complex and unequal power dynamics that extend beyond the realm of agricultural production (refer Chapter 1). Urban agriculture stands as one tool among many to improve access to food while also providing additional benefits such as enhancing ecosystem services (refer to Chapter 1), improving health (refer to Chapter 3), and serve as spaces for community gathering (refer to Chapter 4).

C) Cultivating Climate Resiliency. As discussed in chapter 1, cities are at high-risk for hazards caused by climate change. Recognizing this, New York City has introduced Adapt NYC, a comprehensive plan aimed at adapting to the challenges posed by climate change.[16] Among the identified hazards are extreme heat, heavy rainfall, and flooding, all of which pose significant risks to the city's residents and infrastructure. Adaptation involves preparing New York City's

[16] NYC's Mayors Office of Climate Justice 2023

communities, infrastructure, buildings, land, critical infrastructure, and natural systems for the impacts of climate change, both now and in the future. Fortunately, urban agriculture offers a versatile set of solutions with wide-ranging benefits for climate adaption and resiliency.

Urban agriculture can have a drastic impact on temperature regulation in cities, especially with the urban heat island effect. As discussed in chapter 1, the urban heat island effect is a serious threat for the future of New York City. One way of addressing the urban heat island effect is through the creation of more green spaces. Comprehensive green infrastructure solutions have the potential to reduce the urban heat island effect by 22-44%, with on the ground planting accounting for 13-15% (Rosenzweig et al. 2006). Simulations have also shown that greening rooftops by 50% in NYC could reduce average temperatures by 1.4 degrees Fahrenheit (Ackerman et al. 2011, 68). By integrating urban agriculture as a form of green infrastructure, New York City can effectively combat extreme temperatures while simultaneously addressing food insecurity and fostering social cohesion.

Another major environmental challenge facing New York City, especially in the wake of increased rainfall, is the issue of storm water run-off and combined sewage overflow (refer to chapter 1). Green infrastructure encompasses a variety of practices that leverage or imitate natural systems to effectively manage stormwater runoff, namely through water retention and detention.[17] Retention occurs as rainwater is absorbed by soil and eventually evaporates into the air. Retained water never enters the sewage system. Detention occurs as rainwater is absorbed by soil and eventually released once it reaches its maximum saturation point. The delay between rainfall and the eventual release of water offers the advantage of alleviating the burden on sewage treatment systems.[18]

[17] New York Department of Environmental Protection 2020
[18] Ibid.

Urban agriculture provides both benefits by increasing the amount of permeable surface area in New York City. These benefits are significantly enhanced when urban agriculture groups engage in rainwater harvesting practices. This collected water helps minimize the stress on New York City's infrastructure during heavy rains and serves as a valuable resource throughout the growing season. There are more than 140 rainwater harvesting systems in New York City community gardens, collecting over 1.5 million gallons of rainwater a year from nearby roofs or shade structures, making water collection convenient for gardeners, and reducing demand on the public water supply system (Hu, 2022).

Urban agriculture provides a variety of approaches that can be used to support NYC's climate adaption and mitigation plan. Its adaptability to various neighborhoods, cost-effectiveness, and multifaceted benefits spanning climate resilience, food security, and community development make it an ideal choice for the city.

D) Urban Agriculture Approaches. Urban agriculture refers widely to the growing of food within cities and surrounding (peri-urban) areas. Urban agriculture encompasses a wide range of food production methods, including ground-level farming, rooftop farming, and suburban farming. These methods vary from small-scale, community-based endeavors like community gardening to high-tech, capital-intensive projects such as vertical farming cooperatives. Each approach can prioritize different goals, making urban agriculture well-suited to address the diverse environmental, social, and economic conditions of New York City.

The first broad category of urban agriculture is soil-based, not-for-profit food production. Community gardens are the most prevalent manifestation of this in urban agriculture. Often rooted in grassroots activism and community stewardship (refer to chapter 4), these gardens go

beyond mere food production, often emphasizing education, empowerment, and economic opportunity.

In New York City, community gardens serve as multifunctional spaces where residents come together to grow fresh produce, learn about sustainable agriculture practices, and build social connections (refer to chapter 1). These gardens remain true to their grassroots origins (see chapter 4), employing a bottom-up approach where gardeners collaborate to customize their gardens according to the needs and preferences of their communities. These gardens also serve as vital green spaces where residents can connect and exchange knowledge (refer to chapter 1).

While these gardens may yield smaller annual harvests compared to commercial farms, they play a vital role in enhancing food access and food sovereignty in underserved neighborhoods. Many community gardens distribute their produce through farmers markets, community-supported agriculture programs, and local, community-run markets, thereby directly connecting residents with locally grown, nutritious food options (refer to Chapter 3).

Some gardens have incorporated into larger non-profit organizations such as Added Value Farm in Brooklyn and the Battery Urban Farm in Manhattan. These urban farms operate on a much smaller scale than rural farms and are often intended as community spaces (Ackerman et al. 2011, 8) Urban farms remain more business and technologically oriented, with the primary goal of maximizing yields and selling produce. However, many urban farms still take a strong educational role and are directly involved in the development of school gardens (Ackerman et al. 2011, 8). Urban farms often prioritize sustainable farming practices, innovation in urban agriculture, and economic viability.

Another form of urban agriculture that is soil-based and not-for-profit is rooftop gardening. Rooftop gardening can produce food, improve building aesthetics, and provide

recreational space with environmental benefits. The scale of rooftop agriculture can also vary from localized efforts to large-scale farms. This versatility allows rooftop gardens to adapt to the unique characteristics of each urban environment, catering to the diverse needs and preferences of local communities.

Rooftop farming is particularly appealing in urban areas like New York City due to the challenge of land tenure. With limited available land at ground level, rooftops offer a valuable opportunity to utilize vertical space for agricultural purposes, effectively maximizing the use of urban real estate. The manufacturing district in New York City is highly suited for rooftop agriculture given its number of large, flat rooftops combined with high property values and population density (Ackerman et al. 2011, 42).

Rooftop agriculture indeed presents its own array of challenges. The structural integrity of rooftops imposes limitations on soil depth, often resulting in lower yields compared to ground-based agriculture (Ackerman et al. 2011, p. 23). Additionally, rooftop soil lacks regenerative capacity, necessitating frequent replenishment of nutrients (Ackerman et al. 2011). Moreover, environmental conditions at elevated levels can be harsher, with crops exposed to stronger winds and increased sunlight. These factors underscore the need for a more technologically advanced and capital-intensive approach to ensure the success and sustainability of rooftop agriculture.

Controlled Environment Agriculture (CEA) is another broad category of urban agriculture that includes soil-less, for-profit farms. This method allows for year-round production of high-quality crops regardless of external weather conditions. CEA systems typically include indoor facilities such as greenhouses, vertical farms, and hydroponic or aeroponic systems. Examples of this in New York City include Gotham Greens, Square Roots, and AeroFarms.

These farms are focused on technologically innovative and adaptive farming. In CEA, growers can optimize growing conditions to maximize plant growth and yield while minimizing resource use. This includes regulating factors like temperature and humidity to create an ideal climate for plant growth, providing artificial lighting to supplement or replace natural sunlight, and using hydroponic or aeroponic systems to deliver water and nutrients directly to plant roots without soil.

This can be incredibly helpful in ensuring a year-round food supply with consistent yields. However, CEA products are currently sold at a premium, which limits their ability to effectively address the problem of food insecurity in New York City (refer to Chapter 1). Nonetheless, they play a vital role in popularizing local, sustainable, and healthful foods, serving as a representation of the economic potential of urban farming (refer to Chapter 3) (Adams 2021, 7).

The peri-urban is the transition zone between urban areas and their rural counterparts. They have lower population densities and a lack of infrastructure compared to cities and are therefore not considered urban (Piorr et al. 2011). However, they are also not considered rural as they have a limited amount of agricultural land (Piorr et al. 2011). Peri-urban agriculture occurs in this transition zone. This form of agriculture is often managed by professionals and is focused on producing food for market profit (Opitz et al. 2015). When compared to other approaches to urban agriculture, peri-urban agriculture can be expected to produce higher yields per season due to the availability of space, the application of technology, and the level of professionalism (Opitz et al. 2015). As such, it plays a crucial role in localizing food production and reducing greenhouse gas emissions associated with transportation (refer to Chapter 1).

Through fostering community engagement, promoting environmental stewardship, and enhancing food security, urban agriculture plays an indispensable role in building resilient and equitable cities for the future. With a diverse manifestation of forms, it represents a dynamic and multifaceted approach to sustainable food production and climate resiliency, offering solutions tailored to the unique needs and opportunities of urban environments like New York City.

Chapter 3. From Seed to Sale: Economics in Urban Agriculture. In urban areas, agriculture is gaining recognition as a burgeoning business opportunity. Environmental economics explores the cost-effective allocation, utilization, and preservation of the world's natural resources. As discussed in chapter 2, the variety of approaches to urban agriculture entail different scales and goals, presenting significant variations in economic viability. This chapter uses the discipline of environmental economics to analyze and understand these dynamics.

A) The Ground Price. Soil-based farming, like community gardens, tend to be not-for-profit with equal focus on food production and social empowerment. One of the largest barriers to urban agriculture is the cost and availability of land, especially in areas with high real estate values (refer to Chapter 4). However, community gardens often occupy underused or abandoned urban spaces, transforming these places into productive plots of land yielding social, economic, and environmental returns. Community gardens have been recognized as effective means to transform vacant lands into productive spaces, often at little or no cost to the government (Norhdal 2009). This is partially attributable to municipal governments ability to avoid substantial costs where vacant lots are converted to community gardens and their maintenance work absorbed by gardeners (refer to Chapter 4). Beyond the initial start-up costs, community gardens require minimal additional inputs as labor is often minimally compensated or free. Once

established, gardens most quantifiable economic benefit is in garden harvests and food budget savings. However, research on yield and harvest values have been limited.

The Department of Parks and Recreation has proven to be supportive of urban agriculture on its underused land. It's GreenThumb Program, is the largest urban agriculture project in the country and supports over 550 community gardens with over 20,000 volunteers. In the fiscal year 2022, the New York Department of Parks and Recreation's budget was $532.7 million (DiNapoli 2023). The GreenThumb department was allocated $3.9 million, less than 0.1% of the parks department's budget (DiNapoli 2023). Despite this minimal budget allocation, the GreenThumb program was able to distribute over 3,000 yards of soil and compost, 70,000 vegetables and native species starts and seeds, and 4,500 gardening tools (NYC Parks and Recreation 2022).

Surpluses generated from community gardens are often channeled into farmers market or community supported agriculture. Such programs offer famers direct access to consumers, which increases profits for the farmers, provides more fresh food retail options for residents, and encourages greater food system awareness by providing opportunities for direct connection between producers and consumers (Brown and Miller, 2008). Notable examples in New York City include Just Food, which operates a neighborhood-based community-supported agriculture network spanning over 80 locations, and GrowNYC's Greenmarkets program, managing 54 farmers' markets across the city (GrowNYC 2020).

Supporting the local economy is a central tenet of urban agriculture initiatives, offering a multitude of benefits that extend beyond food production. By promoting the sale of locally grown produce through farmers' markets, community-supported agriculture programs, and other direct-to-consumer channels, urban agriculture helps to circulate money within the local

community. This keeps economic resources within the neighborhood, supporting local businesses, creating jobs, and fostering economic resilience.

Soil-based agriculture serves as a catalyst for job creation, particularly at the entry level. As community gardens, urban farms, and similar initiatives proliferate, they generate a demand for various roles essential to their operation. Entry-level positions in soil-based agriculture encompass a wide range of responsibilities, including but not limited to soil preparation, planting, watering, weeding, harvesting, and general maintenance of garden or farm infrastructure. These roles often require minimal prior experience or specialized skills, making them accessible to individuals seeking entry into the workforce. Soil-based agriculture initiatives also frequently prioritize community engagement and education, creating opportunities for roles such as community outreach coordinators, educators, and workshop facilitators. These positions contribute to the social and educational aspects of urban agriculture while providing avenues for individuals to develop valuable skills in communication, leadership, and community organizing.

B) Sowing Success. Soil-less approaches such as vertical farming, hydroponics, and aquaponics are collectively referred to as controlled environment agriculture (CEA). This approach operates much differently than soil-based programs and rely on business models to sustain production. CEAs are often for-profit, larger in scale, and more technologically advanced. This means that they require higher levels of capital and funding, however, they are also able to produce larger, more reliable yields. Due to high start-up costs, CEA produce is often sold at a premium as farms focus on recouping their investment (Goodman and Minner 2019, 170). Overtime, especially with increased investments in urban agriculture, it is likely that these prices will lower. However, it presents challenges in addressing food insecurity, as the higher costs limit accessibility for vulnerable populations.

Despite these limitations, CEA serves as a tangible demonstration of the economic potential within the sector. Successful business models employed by local New York City producers such as Brooklyn Grange, Square Roots, Gotham Greens, and many others have demonstrated market resilience and proven performance in profitability and employment capacity. Several local New York City producers, including ventures like Brooklyn Grange, Square Roots, Gotham Greens, have implemented business models that not only showcase market resiliency but also exemplify notable profitability and job creation.

For instance, Gotham Greens inaugurated its first rooftop greenhouse in Brooklyn in 2011 and has since expanded its footprint, establishing eight locations across major US cities by 2022 (Quakenbush 2022). This growth not only underscores the viability of their business model but also highlights their ability to navigate the diverse urban market, contributing to both economic and employment resiliency in the industry.

Extrapolating the success of these urban farming models to broader acreage numbers reveals the immense growth potential within this sector. As we continue to expand and scale these successful models, it is evident that urban agriculture not only addresses pressing environmental and social challenges but also offers promising economic opportunities.

C) Beyond the Bottom Line. The benefits of urban agriculture extend beyond its immediate outputs, providing externalities that often escape conventional economic assessments. Urban agriculture, whether soil-based or soil-less engages with and impacts the surrounding environment in multifaceted ways.

While the primary focus of urban agriculture may be on food production and economic viability, the sector delivers a range of ecosystem services which provides an important contribution to human welfare on the planet (refer to Chapter 1). It’s been estimated that the

annual value of ecosystem services is over $33 trillion (Costanza et al. 1997). Urban agriculture has been argued to improve air-quality, stormwater management, temperature regulation, and biodiversity. Despite the challenges of quantifying environmental outcomes of urban agriculture, efforts to tackle the monetary evaluation of ecosystem services offers a promising picture of urban agriculture's economic potential.

Urban agriculture serves as a strategic ally in the quest for reduced energy consumption. Through innovative practices such as vertical farming, hydroponics, and rooftop gardens. urban agriculture optimizes spatial efficiency and minimizes the need for extensive transportation of produce from distant areas. By bringing the food closer to urban centers, the energy intensive processes associated with long-distance transportation, refrigeration, and storage are significantly diminished. Additionally, green roofs act as natural insulators, reducing the energy required for both heating and cooling within buildings. Because of this, urban agriculture reduces energy usage, fossil fuel consumption, and greenhouse gas emissions, contributing to a more sustainable urban landscape.

One of New York City's most inextricable environmental problems is stormwater runoff and combined sewer overflow (CSO) into the city's waterways. Given the prohibitive expense of establishing treatment capacity through gray infrastructure, the NYC Department of Environmental Protection is proposing a green infrastructure approach to increasing rainwater capture and increasing permeable surface area (Ackerman et al. 2011, 23). Another point to consider is that decreasing stormwater runoff from rooftops has benefits beyond reducing CSO incidents as contaminants from roofscapes make their way into the city's waterways. There are indications that conventional green roofs can reduce pollutant runoff in water through filtration and the biological uptake of nutrients (Ackerman et al 2011, 25). Urban agriculture could

provide all these services through rooftop rainwater harvesting and increasing urban green space (refer to chapter 2).

Green infrastructure solutions are not only cost effective in comparison to gray infrastructure approaches but have the added benefits of reducing energy consumption, increasing property values, and cleaning the air. If urban agriculture were to be considered a form of green infrastructure, food security and health outcomes could be added to that list.

Several studies have shown significant health benefits and cost savings stemming from community garden interventions. For instance, vegetation in urban areas helps absorb air pollutants such as particulate matter and harmful gases, leading to cleaner air and fewer respiratory illnesses among city residents (Junior et al. 2022, 1106). Moreover, participating in community gardens positively influences participants to engage in increased consumption of fruits and vegetables, reduced fast and processed food intake, and improved nutritional knowledge, which also has an impact on dietary habits (Malburg Dyg et al. 2019, 794). These changes in dietary habits are particularly impactful when targeting youth populations.

In a randomized controlled trial involving metropolitan middle-school students, those exposed to a health intervention aimed at increasing fruit and vegetable intake demonstrated a cost-effectiveness ratio of $4,305 per quality-adjusted life year (QALY) saved.[19] For a population of 310 students, this translated to predicted savings of $15,887 in medical care costs and $25,104 in loss of productivity costs.[20] While there is no universally accepted threshold, a cost-effectiveness ratio of less than $30,000/QALY is often considered favorable, indicating the promising nature of this promotion strategy.[21]

[19] Wang et al. 2003, 1135
[20] Ibid.
[21] Ibid.

City greening, along with improved educational, health, and social outcomes of participants in urban farming, are financially sound investments in our city's future. To ensure that urban farming benefits all New Yorkers, it is necessary to invest in both hyper-profitable, soil-less farming opportunities and soil-based urban farming ventures, which generate more entry level jobs and offer greater long-term carbon footprint offset. Together, soil-based, and soil-less farming operations attract development and investment, while increasing community enrichment, education, training, and employment opportunities, food sovereignty, and improved health outcomes.

Chapter 4. Cultivating Change: Unearthing Environmental Injustice in NYC. This chapter seeks to delve into the dynamic interplay between environmental justice and urban agriculture within the unique context of New York City. Environmental justice addresses the fair and equitable distribution of environmental benefits and burdens, particularly among different social groups (Newton 1996). Through an examination of both the strengths and weaknesses inherent in this relationship, our aim is to offer a nuanced understanding of how urban agriculture initiatives intersect with environmental justice principles in the urban landscape of the city.

A) From the Ground Up. As discussed in chapter 2, urban agriculture re-emerged in NYC as a grassroots effort. One of its most prominent expressions was the proliferation of community gardens initiated by residents on vacant lots. This resurgence was catalyzed by a combination of economic, political, and social factors. In 1975, the city of New York faced imminent bankruptcy, necessitating austerity measures to trim its operating budget (Fuchs 2010). Consequently, essential services funded by tax revenue, including garbage collection, firefighting, policing, schools, hospitals, and libraries, suffered significant cuts (Fuchs 2010).

Among the cutbacks in municipal services during the city's financial crisis in 1980, the decision to consolidate fire companies in low-income areas had profoundly detrimental effects. Dozens of fire companies were closed or merged, predominantly in low-income communities of color in the Bronx and Brooklyn, despite these areas being densely populated with older housing (Cohen and Reynolds, 2016, p. 28). As a result, fires led to widespread displacement of low-income residents within and between neighborhoods (Smith et al., 2003). The blazes also ravaged housing units, prompting landlords to abandon properties, which accelerated the migration of middle-class residents to other neighborhoods (Cohen and Reynolds, 2016, p. 28). Many of the city's gardens and farms now occupy the vacant lots created during this era of government neglect and property-owner disregard for low-income communities of color.

In the wake of the city's financial crisis in 1980, the city adopted neoliberal growth strategies reliant on public-private partnership to stimulate economic growth (Smith et al. 2003). However, this approach excluded low-income communities of color, which lacked favorable investment conditions, from the recovery plan. These communities also lacked personal wealth to substitute diminished city functions like education, healthcare, and sanitation with private services.

Community gardening, the dominant form of urban agriculture in New York City, emerged as a response to intertwined economic and political trends, although gardeners were driven by various motivations. For residents reluctant or unable to leave their neighborhoods, transforming a rubble-strewn lot into a garden often served as a survival strategy, with residents' sweat equity filling in for diminished municipal services. Additionally, for activists engaged in civil rights, feminist, and mainstream environmental movements, urban gardens served as both spaces for community organizing and platforms to address issues such as crime, environmental

injustice, and the need for enhanced educational opportunities for youth (Hynes and Howe 2004). Unlike gardening programs led by progressive reformers in the late nineteenth and early twentieth centuries, or those sponsored by federal government programs during wartime and the Depression, urban agriculture in this period evolved from grassroots organizing (Lawson 2005, 237).

The Green Guerillas, founded in 1973 by Liz Christy, were the first group to advocate for community gardens in New York City (Lawson 2005, 258). Christy mobilized neighborhood residents to scatter seeds over fences and plant flowers in median strips to reclaim abandoned lots, eventually becoming the first person to receive a lease for a community garden (Lawson 2005, 214). Christy's vision and efforts to reclaim abandoned lots and transform them into community gardens were undoubtedly driven by a desire to improve living conditions for existing residents and advocate for community control over land use. However, the long-term consequences of these efforts were mixed.

On one hand, the community gardens created by the Green Guerillas and similar initiatives contributed to the beautification and revitalization of neighborhoods like the Lower East Side. However, this process of revitalization often led to the displacement of long-standing residents, particularly low-income communities, and people of color (Reynolds et al. 2006, 32). As property values increased, so did rents, making it difficult for many residents to afford to remain in their neighborhoods. This phenomenon, known as gentrification, has been a persistent issue in urban areas across the United States, including New York City. In gentrifying communities, however, people of color and new residents did often work together to create gardens, focusing on the immediate benefits of lot cleanups and safer green spaces and not the secondary effects of these gardens on real estate values and how a real estate boom induced by

neighborhood greening might make the gardens vulnerable to development pressures (Reynolds et al. 2006, 31).

In addition to its pivotal role in addressing food insecurity, fostering community engagement, and advocating for environmental justice, urban agriculture stands as a grassroots movement. This grassroots nature underscores the power of local communities to initiate and sustain agricultural initiatives, empowering residents to reclaim control over their food systems and environments. However, the intersection of urban agriculture with gentrification introduces complexities and contradictions into the urban landscape. While urban agriculture offers numerous benefits, including economic opportunities and improved access to fresh produce, it can also inadvertently contribute to displacement and inequity, particularly in rapidly gentrifying neighborhoods. Striking a balance between the positive impacts of urban agriculture and the imperative to address issues of displacement and inequity presents a central challenge for policymakers, activists, and residents in New York City and beyond.

The Collision of Two Movements. The historical challenges faced by urban agriculture, as highlighted in Chapter Two, stem largely from competing land use priorities. These priorities are particularly evident in the context of New York City, where housing insecurity looms large for many residents. The pressing need for adequate and affordable housing options often clashes with efforts to preserve and promote urban green spaces, which are essential for community well-being. Tight restrictions on available land, especially in Manhattan, can lead to a push and pull between providing housing and access to green spaces, which are vital to creating healthy and livable neighborhoods.

This tension was starkly illustrated during Mayor Giuliani's tenure in 1994 when the city's decision to halt the approval of new GreenThumb community gardens and sell of vacant land ignited fierce debate and raised questions about the future of urban green spaces (Elder 2005, 776). This situation escalated in 1998 when the city ceased renewing existing GreenThumb licenses and prepared to auction off 114 garden sites (Elder 2005, 777). Mayor Giuliani framed the issue as a need for land to construct new housing, prioritizing the creation of apartments to accommodate lower-income residents over maintaining gardens. He argued that housing, rather than food production, was a fundamental right for city residents, and that property owners of newly constructed market-rate housing would stabilize "impoverished" neighborhoods and benefit residents of all income levels.

However, activists from various movements, including community gardening, environmental justice, parks and open space, and affordable housing, countered these arguments. They contended that the administration's focus was on cultivating the support of the white middle class, real estate, and development interests, rather than addressing the needs of all residents. For activists, the battle was about preserving community gardens in areas lacking open space and fostering community building in marginalized communities. Beyond providing much needed green space and a means for food production, these gardens served as spaces where communities could unite in pursuit of shared goals and develop a collective voice. They argued that these gardens benefited the entire urban landscape, extending beyond the individual advantage of apartment units (refer to Chapter 1) (Staeheli et al. 2002, 200).

Additionally, they highlighted the availability of other vacant land for housing and suggested that the administration feared the garden sites as potential hubs for mobilizing opposition to its policies (Cohen and Reynolds 2016, 45). The common refrain was that while

these were city owned spaced, they were overlooked until gardeners transformed them into spaces for community mobilization (Cohen and Reynolds 2016, 45). These gardens were created in spaces that were abandoned and ignored by the city and, as such, spaces with relative freedom where people could gather and mobilize. This allowed activists to gain visibility and ultimately preserve their gardens.

The ensuing struggle involved legal fillings and public protests (Smith and Kurtz 2003). These lawsuits were filled based on claims that the proposed sale violated city environmental law reviews and disproportionately harmed people of color (Elder 2005, 788). The courts initially dismissed these claims; however, activists convinced the New York attorney general, Eliot Spitzer to file a lawsuit. This halted the administrations auction and allowed the New York Restoration Project (NYRP) and the Trust for Public Land (TPL) to purchase the 114 plots. In the wake of the Spitzer lawsuit, the purchases by NYRP and TPL, and the emergence of an energized urban agriculture activist movement that extended beyond gardeners into environmental justice, the Giuliani administration relented (refer to chapter 2). As a result of this battle, most existing garden sites were saved from development, though, land tenure remains a major issue.

Today, the tension between housing needs and green space accessibility is exemplified at the Elizabeth Street Garden in Little Italy, Manhattan. Little Italy and Soho has an open space ratio of 0.07 acre per 1,000 residents (3 square feet per resident), leaving the district with one of the lowest ratios of public open space in the city (Booth et al. 2022). In the crammed neighborhoods of Little Italy & SoHo, this garden stands as the sole public green space that provides an open, tranquil environment for locals of all ages.

Originally, the garden emerged from a neglected lot, leased to artist Allan Reiver, who made a commitment to transform the space.[22] Through his dedicated efforts, Reiver cleared the debris, cultivated lush greenery, and adorned the area with an eclectic array of outdoor structures, shaping the garden into the unique sanctuary it is today. Over time, the garden became a cherished oasis within the bustling urban landscape, frequented by locals seeking respite from the city's hustle and bustle.

However, the garden faces an uncertain future as plans emerge to replace it with senior affordable housing and commercial developments (Zaveri 2023). Despite assurances of affordability, this designation is temporary, with a mandated minimum of 30 to 60 years before potential conversion to market-rate housing.[23] Additionally, alternative sites for housing development exist, rendering the sacrifice of Elizabeth Street Garden unnecessary. These alternative locations, identified through thorough urban planning and land use evaluations, offer viable options for housing projects without compromising valuable green spaces like Elizabeth Street Garden. By exploring these alternatives and prioritizing sustainable urban development, policymakers can address the city's housing needs while safeguarding essential community resources.

In response to the looming threat, the garden has taken proactive steps to advocate for its preservation. Establishing a 501(c)(3) nonprofit corporation with an independent board of residents and business owners, the garden has rallied nearly 400 volunteers to beautify the space and maintain it for public enjoyment year-round.[24] Open for over 40 hours per week seasonally and boasting a diverse program of over 150 free public events, the garden has evolved into a

[22] Elizabeth Street Garden 2024
[23] Ibid.
[24] Elizabeth Street Garden 2024

beloved community hub and a tangible example of grassroots activism in action.[25] However, despite a clear community voice, the future of the garden depends on ongoing negotiations and decisions made by city officials regarding its fate.

In this complex interplay between housing and green space, the fate of Elizabeth Street Garden serves as a poignant reminder of the ongoing struggle to balance the competing demands of urban living. As the city grapples with the challenge of accommodating its growing population while preserving its cultural and environmental interests, the fate of Elizabeth Street Garden and its activists remains emblematic of larger debates surrounding equitable urban development. It also serves as a poignant reminder of the residents who stand behind the movement, embodying the spirit of grassroots activism and community resilience.

Power, Privilege, and Pictures. While urban agriculture can help promote social justice, it also exists within broader systems with uneven power dynamics that present additional challenges to less-powerful groups. As urban agriculture continues to grow and activists are engaging more deeply with the question of social justice in the food system, it is increasingly important to understand ways that race and class-based disparities and white dominance surface within these movements. To successfully use urban agriculture to advance social justice on multiple scales it is also important to address ways that social patterns can be re-enacted within the movement.

Urban agriculture faces challenges from land tenure, accessing resources, and finding sufficient funding. However, within NYC's urban agriculture system, individuals and organizations often experience these challenges differently according to their race, gender, and class (Reynolds et al 2014, 28). For example, accessing clean soil and compost for raised beds is

[25] Ibid.

important in many urban environments, since urban soils tend to be low in nutrients and high in contaminants (McClintock 2010, 199). However, contaminated soil is particularly common in areas with mixed industrial and residential land, and these areas often are communities of color and/or neighborhoods with predominantly low-income residents (McClintock 2010, 200). As a result, these farm and garden organizations must take additional precautions (often requiring financial and material resources and technical help) merely to ensure the safety of the food they produce. Soil quality is just one example of how general challenges to urban agriculture may be different from community to community, often with disproportionate burdens placed on gardeners situated in historically low-income communities and communities of color in New York City.

For activists in communities that have been marginalized by economic and political systems, status quo power arrangements present additional, and more formidable, roadblocks to achieving their social justice goals. Access to private funding, government resources, and city services often results from being part of influential networks (Reynolds et al. 2014, 97). Frequently, being part of those networks is connected to social and economic privilege that often comes from higher socioeconomic status. Furthermore, residents of low-income communities of color often lack the funds or time to contribute to political campaigns or participate in meetings. This provides another barrier to building social and political capita which limits the group's ability to strengthen its financial viability or political influence.

Time constraints are a pervasive challenge for community-based organizations, but they are particularly acute for gardeners and farmers who not only cultivate food but also contend with financial struggles. While recruiting volunteers is relatively feasible in some communities, especially given the burgeoning popularity of urban agriculture in cities like New York, it proves

more challenging in lower-income areas where residents face longer commutes and often juggle multiple jobs, including shifts during nights and weekends.

Assembling a core group of participants poses a significant hurdle, affecting not only the availability of labor for planting, tending, and harvesting food or advocating for political change, but also the allocation of resources from agencies and donors. Donors and public agencies typically fund groups that demonstrate active community involvement, which usually is measured by the number of volunteers and the amount of time people commit to a garden or farm project or related activities (Lawson 2005, 259). Keeping track of the number of people involved in a group's activities requires at least some degree of record-keeping skills and can be a challenge considering limited volunteer time. As a result, it can be difficult to convince supporters to invest money and other resources.

Funding is also highly uneven, and projects led by better connected groups have easier access to capital and operating funds than those in low-income communities of color. Staff members, volunteers, and community members involved in urban agriculture programs in underserved communities may lack connections to financial support sources available to more privileged counterparts. Consequently, securing necessary grants, donations, and contracts becomes more challenging without strong social and professional ties with affluent and politically influential groups. Beyond network affiliation, navigating the system requires a nuanced understanding of the philanthropic landscape. Identifying the opportunity to apply for relevant grants requires some degree of familiarity and knowledge of the philanthropic world that comes with the social capital of race (Reynolds et al. 100). This becomes particularly concerning as these groups also lack personal capital to offset limited external funding.

Moreover, the ability of groups to raise funds and donations from residents and business owners is constrained when potential donors themselves face significant financial constraints.

These power inequalities within our existing social and economic systems prevent underserved communities from accessing and scaling up urban agriculture facilities. This is further enforced by inaccurate media representation of the urban agriculture movement and who is involved.

Despite the current popularity of urban agriculture in New York City being attributable to the grassroots efforts of low-income communities of color, media often inaccurately situates the leadership of the NYC urban agriculture movement among mostly young, white entrepreneurs. This exclusion perpetuates the erasure of their contributions and reinforces existing power dynamics within the movement.

While urban agriculture is not explicitly labeled as an exclusive pursuit for white, middle-class individuals, the prevalent depiction of predominantly young white individuals in news articles and online forums implies a dominance of whiteness within this realm (Reynolds et al. 2014, 8). This observation is especially pertinent as media representation serves as a significant political and cultural tool that can reinforce the power dynamics of dominant groups (Curran, 2002). Additionally, there is a tendency for media to showcase trendy or high-tech urban agriculture projects, shifting the attention away from traditional or community-oriented methods. These projects may be unaffordable or inappropriate for many urban agriculture groups, particularly those in low-income communities of color.

This misrepresentation not only hinders the efforts of activists seeking support for their work but also overlooks the rich history of urban agriculture, which has deep roots in marginalized communities and their struggles for food sovereignty and justice. Without attention

to these oppressive structures, urban agriculture may perpetuate or even reinforce the injustices supporters aim to address. As food scholars have pointed out, there is a distinction between alleviating symptoms of injustice (such as access to food) and disrupting the social and political structures that underlie them.[26] Thus, while urban agriculture is important for many reasons and should remain in cities, it is necessary to critically evaluate uneven dynamics of power, privilege, and representation to ensure equitable support and advancement.

Chapter 5. Feeding the Future: Policy Recommendations. Within New York City, urban agriculture emerges as a transformative force with the potential to address pressing challenges and unlock newfound opportunities at the core of our urban landscape. This chapter is dedicated to exploring a comprehensive set of policy recommendations that prioritize equity and resilience to nurture and sustain the growth of urban agriculture. These policies are grounded in the insights from previous chapters, recognizing urban agriculture not only as a means of local food production but also as a dynamic contributor to environmental, economic, and social well-being. By formulating actionable policy solutions focused on mitigating the risk of exacerbating existing injustices, this section propels the discourse forward, fostering a more inclusive and sustainable urban future for all New Yorkers.

A) Land Acquisition. As highlighted in preceding chapters, gaining access to appropriate locations for urban agriculture poses a significant challenge in New York City. The proposed policies aim to unlock vacant land, while also aligning with broader objectives of fostering social cohesion, promoting environmental sustainability, and stimulating economic development.

[26] Alkon and Agyeman 2011, 18

Despite this substantial inventory of vacant public land, the abundance of vacant private land far surpasses it. Approximately 8,465 acres of vacant land exist in NYC, with 3,641 acres being public land (New York City Department of Planning 2011). Vacant land presents the city's greatest opportunity for conversion to urban agriculture, particularly public land held by municipal agencies such as the Department of Parks and Recreation, Department of Transportation, and the Department of Education.

To harness the untapped potential of unused private areas for urban agriculture, governmental bodies could explore the option of imposing supplementary property taxes on lots deemed vacant for extended durations. The generated tax revenue could then be earmarked to offer incentives to property owners willing to facilitate urban agriculture initiatives on their land.

To promote collaboration and maintain a balanced approach, property owners who agree to allocate a specified portion of their land to gardening over an extended period could be eligible for tax exemptions or credits. This incentivizes property owners to actively participate in urban agriculture efforts while ensuring equitable benefits for their contributions.

Additionally, urban agriculture offers a valuable opportunity to enhance urban sustainability and should be integrated into the planning process as a form of green infrastructure. Currently, interventions targeting water, energy, air quality, climate resilience, and public health are often assessed separately, leading to narrow analyses in policymaking. By embracing urban agriculture within broader sustainability plans, cities can adopt a more holistic approach to address multifaceted challenges and promote long-term resilience.

B) Incentivizing Rooftop Agriculture. New York City is one of the most advantageous places to establish rooftop agriculture due primarily to density, but also public interest, access to infrastructure, and consumer demand (refer to chapter 2). However, existing green roof incentive

programs have not been designed to support rooftop agriculture. For instance, The NYC Green Roof Tax Abatement offers a one-time property tax credit of $4.50/square ft. for up to $100,000 for the construction of green roofs on 50% or more of the buildings surface area (Liu 2019). Unfortunately, this credit mandates that more than 80% of the green roofs area be covered in drought resistant plants which is inconducive to food production (Liu 2019).

To promote rooftop agriculture, the government should revise the NYC green roof tax credit to incentivize food-producing green roofs. Expanding this tax credit is warranted given the significant economic, food security, and climate mitigation benefits associated with rooftop farming. In terms of stormwater management, rooftop farming may provide comparable or even superior benefits to conventional green roofs (refer to Chapter 2) (Ackerman et al., 2011, 24).

The engagement of private landowners is crucial for the success and scalability of large-scale rooftop farming initiatives within the urban agriculture movement. Given that many rooftop spaces in New York City are owned privately, the participation of these landowners is essential to unlock the potential of rooftops for agricultural purposes. Without their involvement, it would be challenging to access the necessary infrastructure and resources to establish and maintain rooftop farms on a significant scale.

C) Financial Support. Communities investing in urban agriculture encounter numerous challenges, and maximizing the impact of these initiatives necessitates substantial financial backing. While maintaining funding for programs such as GreenThumb is essential, the government's responsibility goes beyond mere sustenance; it involves establishing proactive funding mechanisms.

To tackle the financial obstacles, the government should launch inclusive grant programs and subsidies specifically earmarked for urban agriculture. These initiatives would empower

farmers to surmount initial costs and procure vital infrastructure, thereby alleviating accessibility barriers, particularly for soil-less urban agriculture approaches, which frequently entail significant upfront investments (as detailed in Chapter 3). By furnishing CEA groups with greater upfront funding, it may be feasible to mitigate the price hikes linked to covering startup costs.

It's crucial to meticulously calibrate the allocation of funds to ensure their equitable distribution and to prevent the replication of oppressive power structures (as discussed in Chapter 4). Simplifying and streamlining the grant and subsidy application processes are essential steps to ensure fair access for a group of varying demographics, fostering inclusivity, and averting financial disparities.

To diversify funding sources, the government can incentivize private investment in urban agriculture through targeted tax incentives. Offering tax credits to individuals and businesses supporting urban agriculture initiatives not only attracts a diverse range of investors but also encourages community engagement and corporate social responsibility. Beyond financial gains, this approach allows urban agriculture groups to scale up their operations, promoting growth and sustainability. Collaborating with the private sector can foster innovative partnerships, creating a dynamic ecosystem that bolsters the long-term success of urban agriculture initiatives.

D) *Fair Food Access*. Expanding access to fresh and healthy foods in underserved neighborhoods is pivotal for fostering food security and public health. Legislation should be tailored to actively support agriculture in these areas, employing a strategic approach through the establishment of urban agriculture incentive zones. These zones carefully identified based on criteria such as limited access to healthy food retail, high rates of obesity and diabetes, low-

income demographics, and elevated levels of vacant land, can serve as focal points for targeted intervention.

Designated urban agriculture incentive zones would receive additional resources and support from key government agencies, including GreenThumb, the Department of Education, and the Department of Health. Concentrating efforts in these areas from multiple angles enables policymakers to effectively address the root causes of food insecurity and health disparities, enhancing the availability of nutritious food options and improving overall well-being within underserved communities.

Collaborating with established programs in both the public and private sectors is essential for mounting an efficient, multipronged approach. This will allow policymakers to leverage existing resources and infrastructure to further promote urban agriculture. This alignment of efforts and resources enables stakeholders to amplify the impact of urban agriculture, leading to enhanced food security, public health, and community well-being.

An example of successful collaboration is between the NYC Department of Health and GrowNYC's community markets. This alliance has facilitated the integration of EBT card usage at farmers' markets, making fresh produce more accessible to a broader demographic. Additionally, the Health Bucks program, provides incentives for SNAP recipients to purchase fresh fruits and vegetables at farmers' markets by offering additional coupons for every dollar spent.[27] By incentivizing healthier food choices, this initiative promotes public health while strengthening the local food economy. Through this collaborative effort, these organizations can amplify the impact of their interventions.

[27] New York Department of Health 2021

Overall, the creation of urban agriculture incentive zones represents a comprehensive and proactive strategy for addressing food insecurity, acknowledging the interconnectedness of social, economic, and environmental factors that contribute to this pressing issue. By fostering partnerships and collaboration, policymakers can work towards creating more resilient and equitable food systems that benefit all members of society.

As New York City confronts the interconnected challenges of climate change and food insecurity, urban agriculture offers a way to cultivate a greener, healthier, and more resilient future. By reclaiming underutilized spaces and repurposing them for cultivation, urban agriculture not only increases access to fresh produce but also nurtures biodiversity, revitalizes ecosystems, and fosters a deeper connection between city dwellers and their food sources. However, to fully harness urban agriculture's potential and realize its transformative impact, a comprehensive and collaborative approach is essential. As outlined in the policy recommendations presented above, it is imperative to engage a diverse array of stakeholders, promote equitable access to resources, and ease barriers to access. By prioritizing the well-being of both New Yorkers and the city's environment, urban agriculture can emerge as a powerful force for building a resilient, sustainable, and equitable city for generations to come.

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