Urban agriculture models and their effectiveness in supporting farm-to-table supply chain

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Abstract

As urbanization continues to accelerate globally, the need for innovative food production solutions within cities has become more pressing. By 2050, nearly 70% of the world's population is expected to live in urban areas, placing immense pressure on traditional food supply chains that rely on rural agriculture (United Nations, 2018). In the Philippines, urban agriculture has gained attention as a response to the increasing challenges of food security, poverty, and environmental sustainability in rapidly urbanizing areas. With more than 47% of Filipinos living in urban areas, the country faces growing pressure on its food supply chains, particularly in densely populated regions like Metro Manila (Philippine Statistics Authority, 2020). Makati City, a key commercial district in Metro Manila, faces significant urban challenges, including high population density and limited green spaces. These conditions have heightened the need for innovative solutions to improve food security and sustainability within the city. Urban agriculture has emerged as a strategic response to these challenges, offering opportunities to enhance local food systems, reduce carbon footprints, and engage communities in sustainable practices. The study aims to identify which models best support local food systems, enhance food security, and provide a sustainable approach to urban food production. Data gathering will be applicable with 7 respondents, a worker from urban green, one of its consumer restaurants, the restaurant's customer. Each respondent represents a key that will conclude the result of this study. The study used Narrative research design is a qualitative approach that centers on exploring and understanding personal stories and experiences. The qualitative insights from the informants reveal the dynamic relationships

between urban farms, local businesses, and end consumers, highlighting the key themes of farm-to-table experiences, local food systems, and sustainability. In conclusion, the urban agriculture practices in Makati City are multifaceted and innovative, addressing both environmental and social needs. Hydroponics, vertical farming, and community gardens all contribute to creating a more sustainable and resilient urban food system. Moving forward, these practices can serve as models for other densely populated cities, demonstrating the potential for urban agriculture to thrive even in the heart of highly developed metropolitan areas.

Keywords: urban agriculture, supply chain, farm to table, agricultural models

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1. Introduction

As urbanization continues to accelerate globally, the need for innovative food production solutions within cities has become more pressing. By 2050, nearly 70% of the world's population is expected to live in urban areas, placing immense pressure on traditional food supply chains that rely on rural agriculture (United Nations, 2018). These supply chains, often long and resource-intensive, face challenges such as food loss during transportation, increased carbon emissions, and fluctuating food availability due to climate change (FAO, 2020). In response, urban agriculture has emerged as a solution that can localize food production, reduce transportation distances, and improve access to fresh produce for urban populations. Urban agriculture models have been implemented across various global cities, each tailored to local needs and conditions. Vertical farming, for example, has gained momentum in densely populated cities like Singapore and Tokyo, where limited land space and high demand for fresh produce have spurred the adoption of high-tech solutions.

The integration of urban agriculture into city planning offers numerous benefits. Despite its potential, the effectiveness of urban agriculture models varies across different regions due to factors such as regulatory frameworks, access to technology, and socio-economic conditions. In the Philippines, urban agriculture has gained attention as a response to the increasing challenges of food security, poverty, and environmental sustainability in rapidly urbanizing areas. With more than 47% of Filipinos living in urban areas, the country faces growing pressure on its food supply chains, particularly in densely populated regions like Metro Manila (Philippine Statistics Authority, 2020). The COVID-19 pandemic further exposed vulnerabilities in the food system, leading to disruptions in supply chains, price fluctuations, and limited access to fresh produce, particularly for low-income households (Asian Development Bank, 2021).

These challenges have intensified the need for sustainable food production solutions, making urban agriculture an increasingly relevant strategy in addressing local food security. Urban agriculture in the Philippines is not a new concept but has evolved into a more formalized practice with support from government initiatives, non-government organizations (NGOs), and community-based movements. Programs such as the Gulayan sa Barangay and Gulayan sa Paaralan have encouraged the establishment of community and school-based gardens, helping local communities grow their own food and reducing reliance on external supply chains (Department of Agriculture, 2019). These initiatives aim to empower communities to cultivate vegetables and herbs, contributing to both household food security and local food markets. Furthermore, cities like Quezon City and Makati have integrated urban agriculture into their development plans, promoting the use of vacant lots, rooftops, and community spaces for food production. Quezon City's urban farming initiative, for instance, has created hundreds of urban gardens, transforming idle land into productive spaces that supply local markets with fresh, organic produce (Quezon City Government, 2020).

This not only reduces the distance between food producers and consumers but also creates employment opportunities and enhances local economies. The farm-to-table supply chain in urban agriculture is increasingly vital in these urban centers. By growing food within cities, transportation costs are reduced, and the carbon footprint of food production is minimized. However, the success of these models is often contingent on factors such as land access, technological support, and local government policies. Rooftop and vertical farming models, while promising, often require substantial investment and technological knowledge, which can limit accessibility for smaller-scale farmers or low-income communities. The effectiveness of urban agriculture in supporting the farm-to-table supply chain also depends on the level of community engagement and the ability to integrate these practices into local food systems. Makati City, a key commercial district in Metro Manila, faces significant urban challenges, including high population density and limited green spaces. These conditions have heightened the

need for innovative solutions to improve food security and sustainability within the city.

There is limited research on how urban agriculture affects the efficiency and effectiveness of the supply chain, including the reduction of transportation distances, food waste, and costs, and the enhancement of freshness and reliability. Existing studies often focus on isolated benefits of urban agriculture, such as local food production or community engagement, without providing a holistic assessment of its impact on the entire supply chain. There is a need for comprehensive evaluation methods that consider all aspects of the farm-to-table supply chain, including economic, logistical, and environmental factors. The main purpose of the study titled "Urban Agriculture Models & Their Effectiveness in Supporting Farm-to-Table Supply Chain" is to evaluate different urban agriculture models and assess how effectively they contribute to the farm-to-table supply chain. The study aims to identify which models best support local food systems, enhance food security, and provide a sustainable approach to urban food production.

Additionally, it will explore the impact of these models on reducing the distance food travels from production to consumption, thus promoting fresher produce and reducing carbon footprints. These researchers aim to evaluate the effectiveness of Urban Greens and similar urban agriculture models in Makati City, focusing on their impact on the farm-to-table supply chain. By analyzing these models, the study will provide insights into their role in enhancing local food systems and addressing urban sustainability challenges.

2. Background

Benis and Ferrão (2018) discussed that these techniques are collectively referred to as controlled environment agriculture (CEA). CEA is used in a variety of urban farming systems, with rooftop greenhouses and vertical farms being the most well-known examples. Vertical farms can reduce water usage by up to 90% and eliminate the need for pesticides, while also significantly cutting transportation costs by growing food directly within the city (Benke & Tomkins, 2017). Conversely, in wealthier cities, high-tech urban farming models, while efficient, often require substantial investment and advanced infrastructure that may not be scalable in less developed areas (Clarke et al., 2020). Furthermore, because vertical farms can be set up almost anywhere, including underground, they could enable hyper-localized production, reducing food supply chains and supplying fresh and healthy local foods all year (Eldridge et al., 2020; Shamshiri et al., 2018).

Hydroponics, on the other hand, can address this issue by allowing plants to grow in a water-based nutrient solution, eliminating the requirement for soil and providing greater flexibility in location and space usage (Rash, 2013). Rufí-Salís et al. (2020) stated that vegetable production in urban gardens, buildings, roofs, and hydroponic systems is the most common agricultural food production model in cities. During the early phases of the COVID-19 epidemic, gardening seemed to provide a secure and beneficial environment for individuals to socialize, learn, and be creative (Kingsley et al., 2022).

Urban agriculture (UA) is frequently touted to mitigate these problems while also providing multi-functional health and well-being advantages (Gomez Villarino et al. 2021; Newell et al. 2022). Farming within or on the fringes of cities has emerged as a new notion for improving the city's sustainability while fulfilling economic, social, and environmental objectives (Fanfani et al., 2022; Feola et al., 2020). Urban agriculture offers numerous social and environmental benefits for city dwellers, countering negative externalities associated with urban production and consumption patterns (Menconi et al., 2020; UN General Assembly, 2016). Moosavi-Nezhad et al., (2022) stated that the UPF uses a variety of approaches to enhance space usage and resource efficiency, including vertical farming, hydroponics, aquaponics, and rooftop gardens.

Recent studies have highlighted that urban agriculture can also contribute to waste reduction. For instance, composting organic waste from urban areas can be integrated into urban farming systems, thereby closing the waste loop and reducing landfill use (Martinez, Cooper, & White, 2022). One of the most significant economic benefits of urban agriculture is its ability to promote local economies by providing jobs and supporting local companies. Urban farms and community gardens frequently create jobs in agriculture, food processing, and

distribution, boosting local economic resilience (McCarthy et al., 2021). Community gardens provide chances for social engagement and collaborative action, which strengthens community bonds and increases social capital (Smith et al., 2022).

Urban agriculture initiatives, such as community gardens and urban farms, create jobs in a variety of industries, including production, food processing, and distribution. These initiatives support local economies by creating direct job possibilities and stimulating related sectors like retail and hospitality (McCarthy et al., 2021). Johnson et al, (2022) explained that the initial investment for modern technology such as hydroponics and vertical farming systems can be significant, and ongoing operational costs for energy, water, and maintenance add to the financial burden. Smith et al., (2022) stated that while urban agriculture can help with environmental sustainability, high-tech systems such as vertical farms frequently require significant energy for lighting and climate management, which can negate some of their environmental benefits if not managed properly.

3. Findings

Based from the analysis and narratives of the study, what recommendation may be proposed on future direction and strategic plan for urban agriculture model for farm-to-table supply chain in Makati?

PARTICIPANTS	KEY THEMES	KEY QUOTES	ANALYSIS	SUMMARIZED COMPARATIVE RELATIONSHIP
Informant 1	Hydroponic cabinets for freshness	"Our goal is to provide a hydroponic cabinet for the farm-to-table supply. So that they also have the experience of eating fresh hydroponic greens."	Focuses on the use of Innovative technology to enhance the freshness of produce for consumers.	All responses align in promoting innovative and sustainable solutions for urban agriculture's farm-to-table model. Informant 1 focuses on accessibility and consumer experience through hydroponic cabinets, Informant 2 emphasizes the integration of renewable energy for sustainability, and Informant 3 highlights collaboration as a strategy to improve efficiency and access. Collectively, they provide a holistic approach to advancing urban agriculture in Makati.
Informant 2	Renewable energy for sustainability	"Isama sa mga future plans ang paggamit ng renewable energy sources sa mga hydroponic farms para mas maging sustainable at cost-efficient ang farm-to-table supply chain."	Highlights the need for Sustainability and cost-efficiency by integrating renewable energy into hydroponic systems.	
Informant 3	Collaboration between farmers and restaurants	"I-encourage ang collaboration between local farmers and restaurants sa Makati para magtulungan silang mag-provide ng fresh produce directly sa mga consumers."	Advocates for partnership-building between farmers and restaurants to improve direct consumer access to fresh produce.	

4. Discussions

The study gathered qualitative data from three informants to propose future directions and a strategic plan for an urban agriculture model for a farm-to-table supply chain in Makati City. Key themes that emerged were hydroponic innovation, sustainability through renewable energy, and collaboration among stakeholders. Informant 1 highlighted the goal of "providing a hydroponic cabinet for the farm-to-table supply" to offer consumers the experience of eating fresh hydroponic greens. Informant 2 emphasized incorporating renewable energy sources to make hydroponic farms more sustainable and cost-efficient. Informant 3 advocated for fostering collaboration between local farmers and restaurants to provide fresh produce directly to consumers.

Informant 1's suggestion of hydroponic cabinets aligns with the global trend of integrating advanced hydroponic systems into urban agriculture. Hydroponic technologies are proven to enhance productivity while minimizing land and water use (Al-Kodmany, 2018). Such innovations cater to consumer demands for freshness and support the concept of localized food systems. Informant 2's recommendation of renewable energy integration addresses critical challenges in urban agriculture, such as high operational costs and environmental impact. Solar panels, wind turbines, or bioenergy can reduce the carbon footprint of hydroponic farms, aligning with the United Nations' Sustainable Development Goals (SDGs), particularly Goal 12 (Responsible Consumption and Production) and Goal 13 (Climate Action) (UN, 2024). Informant 3 highlighted collaboration between farmers and restaurants, which resonates with studies emphasizing community-based food systems. Such partnerships reduce reliance on intermediaries, enhancing supply chain efficiency and consumer satisfaction (Feenstra, 2002). Collaboration also fosters economic opportunities for local farmers, strengthening the overall agricultural ecosystem.

The data collectively indicate that a holistic approach combining innovation, sustainability, and collaboration can significantly enhance the farm-to-table supply chain in urban settings like Makati City. Informant 1's emphasis on hydroponic cabinets provides a practical solution for increasing accessibility and promoting local food consumption. Informant 2's call for renewable energy integration underscores the importance of aligning urban agriculture with environmental sustainability goals. Informant 3's focus on collaboration highlights the socio-economic benefits of engaging multiple stakeholders

5. References

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