

Developing Urban Agricultural Spaces: Opportunities and Challenges in Mekong Delta Cities

Nguyen Thi Hong Cuc^{1,*}

¹ Vinh Long Provincial Committee of the Ho Chi Minh Communist Youth Union;

*Corresponding author: hongcuctdv15697@gmail.com

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ABSTRACT

Urban agriculture (UA) is emerging as a key approach for developing sustainable, climate-resilient cities. The Mekong Delta, Vietnam's largest agricultural hub, offers favorable natural, cultural, and policy conditions for integrating agricultural spaces into urban areas. This study analyzes the theoretical foundations, examines representative UA models, and assesses their applicability in cities across the Mekong Delta. Results indicate the region benefits from land availability, favorable agroecological conditions, a workforce rooted in agricultural traditions, and a distinctive cultural identity. However, it faces significant challenges, including climate-change impacts, urbanization pressures, a shortage of skilled personnel, and fragmented policy frameworks. These findings provide an evidence base to guide the design and selection of context-appropriate strategies for developing urban agricultural spaces in the Mekong Delta.

Keywords: Cultural identity, climate change, Mekong Delta (Vietnam), urban agricultural spaces, urban agriculture, sustainable development.

1. INTRODUCTION

In the context of accelerating global challenges, including climate change, rapid urbanization, and increasing threats to food security, the development of urban agricultural spaces has increasingly emerged as an inevitable trend. UA not only provides localized food sources but also contributes to microclimate improvement, enhances the natural self-purification of the atmosphere, supports green ecosystem functions, and offers spaces that foster community cohesion toward sustainable urban development.

However, urban areas in Vietnam are undergoing significant transformations in their socio-economic structures. Major cities, in particular, are facing increasing pressure from rapid population growth and rising demands for urban infrastructure development, which has led to a continuous reduction in land available for agriculture within urban settings. The recent Covid-19 pandemic further exposed critical vulnerabilities in urban food supply chains, revealing the fragility of food

and resource distribution systems in cities.

Restrictions on mobility and disruptions in the transportation of goods have caused many cities to experience temporary shortages of food supplies, thereby affecting social welfare. For urban areas in the Mekong Delta, in addition to these common challenges, cities in the region also face other major threats, including saltwater intrusion, sea level rise, and increasingly extreme and unpredictable weather conditions.

From this reality, the development of agricultural spaces within Mekong Delta cities is not only a culturally distinctive option but also a practical necessity and a long-term strategic orientation. This article aims to clarify the theoretical foundations of UA, examine prevalent UA models, and assess their applicability under the specific conditions of the Mekong Delta. It also analyzes the existing challenges associated with integrating agricultural spaces as an essential component of a sustainable urban structure in the region.

2. OVERVIEW OF URBAN AGRICULTURAL SPACES

2.1. Concept of Urban Agricultural Space

* Concept of Urban Agriculture:

According to Jac Smit, who introduced the concept of UA in 1990, UA is defined as a sector engaged in the production, processing, and marketing of food and fuel primarily to meet the daily needs of consumers within a town, city, or metropolitan area. It relies on the land and water resources available throughout urban and peri-urban areas, applies intensive production methods, and utilizes as well as recycles natural resources and urban waste to support multi-crop cultivation and diversified livestock production [1].

According to Mougeot, the integration of UA with urban ecological and economic systems is a distinctive feature that differentiates it from rural agriculture. These spaces are not limited to vacant land but also include areas that have been renovated or newly designed to incorporate agricultural production within the urban environment [2].

According to the definition of the Food and Agriculture Organization of the United Nations (FAO), UA refers to the cultivation, livestock production, and processing of food within and around urban areas to directly meet the needs of urban residents [3]. This is a comprehensive concept that covers both activities and spatial dimensions, in which urban agricultural space represents the tangible physical component.

In the context of developing cities in general and the Mekong Delta in particular, *“UA can therefore be understood as a new form of agricultural activity shaped by urban characteristics. It engages directly in the urban development process, meets the demand for locally produced agricultural goods, and contributes to a form of urban development that harmonizes built and natural elements while maintaining strong local identity”*. [4, page10].

* Concept of Urban Agricultural Space:

Urban agricultural space: *“This refers to*

urban space that encompasses all activities related to UA, functioning as a multifunctional domain within the practice of UA. Urban space that incorporates UA can be understood as a spatial environment consisting of architectural structures, green areas, water surfaces, and forms of cultivation and livestock activities suitable for urban conditions, all of which exert direct influence on the urban landscape. Accordingly, urban agricultural spaces can be viewed as comprising both traditional urban landscapes and derivative productive urban landscapes.” [4, page10].

2.2. The Role of Agricultural Space in Urban Areas

Urban agricultural space plays an increasingly important role in strategies for sustainable urban development. Its significance extends beyond the provision of food to include contributions in environmental, economic, cultural, and community dimensions. Recent studies indicate that UA contributes in multiple ways to enhancing the resilience and adaptability of modern cities. These contributions can be observed through the following roles:

- *Contributing to food security and enhancing urban self-sufficiency:* Urban agricultural space helps supply a portion of fresh, locally produced food, thereby reducing dependence on external supply chains. It is regarded as *“a special productive sector of critical significance to the socio-economic development of a nation, as it constitutes the initial stage of material production in human society”* [5]. The development of agriculture within urban areas strengthens the self-sufficiency of the urban food system, supports social welfare, and improves the city's capacity to cope with unexpected shocks.

- *Contributing to environmental improvement and urban ecosystem enhancement:* When agricultural spaces are integrated with urban green systems, vegetation, and water surfaces, they help improve the microclimate, reduce surface temperatures, and mitigate urban heat island

effects. Agricultural areas also contribute to capturing a portion of stormwater, increasing infiltration capacity, and reducing pressure on urban drainage systems. In addition, UA plays a role in enhancing the living environment for urban communities and promoting the development of “*ecological cities*” and “*green cities*” [6].

- *Contributing to the urban economy and creating livelihoods for residents:* The development of UA generates employment opportunities for urban dwellers, particularly for low-income groups and the elderly. In practice, several UA models associated with tourism, services, and organic production have created added value and contributed to diversifying the urban economic structure.

- *Playing a role in education, culture, and community cohesion:* Urban agricultural spaces also serve as places where residents participate in collective activities, learn cultivation skills, and enhance their awareness of environmental protection and sustainable consumption. Community gardens, school gardens, and urban farms have demonstrated their effectiveness in fostering social cohesion, preserving cultural identity, and promoting nature-oriented lifestyles.

3. MODELS OF URBAN AGRICULTURAL SPACES

Over the past several decades, UA has evolved in a variety of forms, reflecting the diversity of natural conditions, economic contexts, and cultural characteristics across different localities. The development of urban agricultural spaces can be categorized into three main groups based on organizational form and spatial configuration: horizontally oriented models, vertically oriented models, and models that incorporate advanced technologies.

3.1. Horizontally Oriented Urban Agricultural Space Models

This is the most fundamental and long-standing type of UA, typically established on ground surfaces or water bodies within inner-

city and peri-urban areas. It often makes use of vacant interstitial land, underutilized public spaces, or open areas. In urban planning, this form of space can be integrated as part of open space systems, green corridors, or mixed-use functional zones. Horizontally oriented urban agricultural spaces are generally characterized by flexibility and ease of functional adaptation, with a strong community dimension. They are commonly associated with community gardens, school gardens, urban or peri-urban farms that can provide partial self-sufficiency in food production, while enhancing the landscape and improving environmental quality.

3.1.1. Community Gardens

Community gardens are established on public land or vacant plots within urban areas and are managed by resident groups, social organizations, or local authorities. Community members participate directly in cultivation, maintenance, and benefit sharing, with produce sometimes allocated to individual households or used collectively for social purposes. These gardens serve not only as production spaces but also as sociocultural environments that strengthen community cohesion, enhance the sense of ownership, and foster responsibility toward urban space.

In New York (United States), more than 600 community gardens operate under the “*GreenThumb*” program, which has revitalized abandoned spaces and generated social value for residential neighborhoods. In Havana (Cuba), community gardens supply a substantial portion of fresh vegetables to inner-city residents, particularly during periods of food crisis (Figure 1) [7]. In Vietnam, several pilot community gardens have been established in Ha Noi and Ho Chi Minh City (Figure 2) through collaborations between volunteer groups and local authorities, aiming to develop models of agriculture linked to education and community engagement. These gardens not only provide sources of safe vegetables but also function as shared communal spaces where residents participate in cultivation activities and strengthen community bonds.



Figure 1. Community garden in Havana (Cuba)
Source: <https://ashui.com/havana-cam-hung-ve-mot-nen-nong-nghiep-do-thi-dich-thuc/>



Figure 2. Community garden at 152 Nam Ky Khoi Nghia Street, Saigon Ward, District 1, Ho Chi Minh City

Source: <https://thanhvien.vn/doc-dao-vuon-cong-dong-o-tphcm-ai-cung-co-the-den-trong-cay-hai-rau-185230415172201535.htm>

3.1.2. School Gardens

School gardens are located within the premises of educational institutions and primarily serve experiential learning purposes by connecting students with cultivation activities. They are not only small-scale production spaces but also environmental education tools that enable students to engage with knowledge related to biology, ecology, and sustainable lifestyles (Figure 3).



Figure 3. School Garden Models in Urban Areas
Source: <https://educationforthegreatturning.weebly.com/the-learning-environment.html>

3.1.3. Peri-Urban Farms and Agricultural Estates

Peri-urban farms or agricultural estates represent large-scale forms of UA, primarily located in green belts, on the outskirts of cities, or along ecological corridors. This model exemplifies the linkage between urban areas and adjacent agricultural production zones, thereby fostering a reciprocal relationship between urban development and ecological balance. These areas are typically used for the specialized cultivation of vegetables, tubers, fruits, ornamental plants, or medium- to large-scale livestock production, supplying substantial volumes of fresh produce to urban markets. They function as ecological lungs, contributing to climate regulation, biodiversity conservation, and the reduction of environmental pressure on inner-city areas.

Currently, many effective peri-urban farm models exist around the world. For example, a peri-urban farm in Detroit (United States) provides free food to approximately 2,000 households (Figure 4).[8]; The London Green Belt, maintained since the twentieth century, encompasses thousands of hectares of peri-urban agricultural land that provide food supplies while preserving the natural landscape. In Beijing (China), large-scale vegetable and flower farms are organized to supply agricultural products to the capital while also serving as popular weekend destinations for urban residents. In Vietnam, peri-urban farms have gradually emerged, although at relatively modest scales and with limited connectivity. In Ha Noi, for instance, safe vegetable production areas have been developed in Gia Lam, Dong Anh, and Soc Son districts (Figure 5); these peri-urban farms play an important role in supplying fresh vegetables to inner-city markets. Similarly, Ho Chi Minh City has developed peri-urban zones for dairy farming, vegetable cultivation, and ornamental plant production in districts such as Cu Chi, Hoc Mon, and Binh Chanh, ...



Figure 4. Peri-urban farm in Detroit

Source: <https://viettimes.vn/6-trang-trai-do-thi-lon-nhat-the-gioi-post64377.html>



Figure 5. Organic vegetable farm in the peri-urban area of Hanoi

Source: <https://vnexpress.net/thoi-su/mo-hinh-trong-rau-huu-co-cho-nang-suat-400-tan-moi-nam-tai-soc-son-ha-noi-3520293.html>

3.2. Vertically Oriented Urban Agricultural Space Models

In the context of major cities increasingly facing pressures from rapid population growth, high building density, and limited land availability, vertically oriented UA has emerged as a solution for optimizing production space within the urban fabric. This model makes use of architectural surfaces and structural components, including rooftops, balconies, terraces, vertical walls, and specialized facilities such as vertical farms, to accommodate agricultural production. It harmoniously integrates architectural, ecological, and economic functions within the urban environment.

Vertically oriented urban agricultural spaces possess several notable characteristics. They optimize the use of urban space by

enabling the expansion of cultivation areas in the vertical dimension at a time when available land is increasingly limited. They are also well suited to advanced technologies, typically including hydroponic and aeroponic techniques combined with smart control systems. These spaces help regulate the microclimate, improve air quality, and play an important role in shaping urban landscape values, thereby contributing to the development of green infrastructure and green mobility within cities. A representative example is the Sky Greens model in Singapore, which is known as the first commercial vertical farm in the world. It features nine-meter-tall rotating steel frames operated by energy-efficient hydraulic systems and produces hundreds of kilograms of fresh vegetables daily for the inner-city market (Figure 6).



Figure 6. Sky Greens agricultural system

Source: <https://bambuup.com/news/1592/Nong-nghiep-xanh-tai-Singapore>

In Vietnam, major cities such as Ho Chi Minh City and Ha Noi are witnessing increasing popularity of rooftop gardens and hydroponic balcony gardens established by households and community groups to meet the demand for safe and fresh vegetables. In addition to traditional small-scale cultivation methods, many households and enterprises have begun adopting vertically oriented agricultural solutions, including multi-tier hydroponic systems, vertical growing racks, and modular units installed in smart greenhouses. This trend not only optimizes limited urban land resources but also enables larger-scale production with better control over quality, food safety, and weather-related risks.

Vertically oriented agriculture is therefore emerging as a promising direction that is reshaping the landscape of urban agriculture in Vietnam, meeting local food needs while opening new prospects for sustainable development in the future (Figure 7).



Figure 7. Vertical aeroponic vegetable garden
<https://nongsanviet.nongnghiepmoitruong.vn/trong-rau-tren-troi-thu-tien-duoi-dat-d370783.html>

3.3. Urban Agricultural Space Models Based on High-Technology Applications

This type of model applies an integrated set of advanced technologies, including biotechnology, automation, artificial intelligence (AI), the Internet of Things (IoT), environmental sensors, renewable energy systems, and big data management, to produce high-quality, high-yield, and safe agricultural products within urban conditions. Its key characteristics include:

- *Advanced production technologies:* The use of smart greenhouses and hydroponic, aeroponic, and aquaponic systems with closed-loop cycles that minimize the use of land, water, and chemical inputs.

- *Automated control systems:* Cultivation environments are tightly regulated in terms of light, temperature, humidity, and nutrient levels, enabling continuous production with minimal dependence on climate variability.

- *Resource efficiency:* This model can save up to 70 – 90 percent of water compared with traditional farming, significantly reduce land use requirements, and lower greenhouse gas emissions.

- *Urban multifunctionality:* In addition to food production, high-tech agriculture can be integrated into the urban system as

a technological ecological infrastructure associated with research, education, and experiential tourism.

The Netherlands is a global leader in the development of high-tech agriculture, particularly through its automated greenhouse systems in Westland, which cover more than 10,000 hectares and employ IoT and AI for environmental control. These innovations have helped transform the Netherlands into one of the world's largest agricultural exporters (Figure 8). In Singapore, where land availability is extremely limited, the government strongly promotes high-tech agriculture. Notable examples include the Sustenir Agriculture project, which produces leafy greens in controlled environments with AI applications. Singapore has set the “30 by 30” target, aiming to meet 30 percent of its food demand by 2030.

In Vietnam, Da Lat is regarded as the country's largest hub for high-tech greenhouse agriculture, encompassing thousands of hectares of hydroponic and aeroponic vegetable and flower production equipped with artificial lighting and automated irrigation systems. In Ha Noi, several start-ups have introduced smart urban agriculture models, such as Hachi, which provides intelligent hydroponic systems installed on rooftops, balconies, and urban greenhouses. Can Tho and other Mekong Delta cities are also piloting high-tech agricultural models adapted to climate change, focusing on hydroponic vegetables, salinity-resistant net houses, and circular water treatment technologies.



Figure 8. High-technology urban agriculture in the Netherlands

Source: <https://edulinks.vn/nen-nong-nghiep-cong-nghe-cao-tai-ha-lan/>

4. ASSESSING THE POTENTIAL FOR DEVELOPING URBAN AGRICULTURAL SPACES IN MEKONG DELTA CITIES

As a key economic and agricultural region of the country, the study of developing UA spaces in the urban areas of the Mekong Delta represents a strategic and sustainable direction that aligns well with local conditions. However, a substantive assessment of the potential for implementing these models in Mekong Delta cities must take into account a range of dual factors. Alongside clear advantages, there remain fundamental challenges that require targeted solutions to overcome.

4.1. Advantages

- *Favorable natural conditions:* The Mekong Delta is the country's largest hub for rice, fruit, and aquaculture production, endowed with fertile alluvial soil, a dense network of rivers and canals, and abundant irrigation water. These characteristics provide an important foundation for developing urban agricultural spaces along rivers and canals as well as peri-urban farms. In addition, the region's warm tropical climate, with year-round sunshine and limited exposure to major storms, allows for continuous multi-season production. This creates particularly favorable conditions for short-cycle vegetable and fruit models, hydroponic and aeroponic systems, and other forms of UA within urban areas.

- *Relatively abundant land available for urban agriculture:* Unlike major cities such as Ha Noi or Ho Chi Minh City, where peri-urban agricultural land has been significantly reduced, many urban areas in the Mekong Delta such as Vinh Long, Dong Thap, and An Giang still maintain substantial peri-urban agricultural zones. This provides favorable conditions for establishing and developing urban agricultural spaces integrated into the urban green belt, functioning both as ecological buffer zones and as landscapes that preserve the region's characteristic riverside identity. In addition, the utilization of vacant or interstitial land parcels within inner-city areas offers viable opportunities for implementing urban gardens, community gardens, and small-scale ecological spaces, thereby contributing to

improved living environments and enhancing the overall sustainability of the urban structure.

- *Diligent and adaptive human resources in the Mekong Delta:* In addition to favorable natural conditions, human capital in the Mekong Delta is a significant advantage for the development of urban agricultural spaces. First, local residents have a long-standing agricultural tradition, characterized by diligence, industriousness, and a deep attachment to land, orchards, and agricultural production. This background enables them to readily adapt when transitioning to new models such as community gardens, urban farms, or peri-urban cultivation. Second, in the context of urbanization and increasing demand for clean production, many households, cooperatives, and rural youth have demonstrated a strong willingness to learn and proactively adopt scientific and technological innovations, including hydroponics, aeroponics, and automated irrigation systems. This adaptability is a key factor enabling UA in the Mekong Delta to move beyond traditional practices and evolve toward high-tech, modern, and sustainable directions.

- *Distinctive cultural identity as an additional advantage for developing UA spaces:* The Mekong Delta's garden culture, floating markets, and its network of communal houses, pagodas, churches, and historical temples have shaped culturally and spiritually rich landscapes. When integrated with UA development, these cultural assets can be leveraged to form eco-cultural and spiritual tourism models. Examples include visits to fruit orchards combined with participation in traditional festivals, or tours of craft villages connected to local cultural practices. This integration enables UA spaces to function not only as production areas but also as socio-cultural environments that preserve regional identity and create distinctive highlights for Mekong Delta cities in their pursuit of sustainable development and broader integration.

- *Mechanisms, policies, and development orientations:* In recent years, several localities in the Mekong Delta have begun to pay greater attention to UA as a component of their

strategies for building ecological and climate-adaptive cities. Urban governments in the region have issued programs that encourage high-tech agricultural production, provide support for green credit, and promote start-up initiatives in the field of clean agriculture. In addition, the national orientation toward green transition, the development of a circular economy, and the call for enterprise investment in high-tech agriculture have created new opportunities for the structured and sustainable development of UA in the Mekong Delta. These policies not only establish a favorable legal framework but also serve as important enabling mechanisms that support the transition of UA from small-scale and fragmented practices to larger, modern, and market-oriented production systems capable of connecting with domestic and international markets.

4.2. Challenges

- *Climate change and environmental risks in urban areas:* The Mekong Delta is one of the regions most severely affected by climate change in Vietnam. Saltwater intrusion, urban flooding, localized drought, and increasing land subsidence all heighten the vulnerability of agricultural models located along rivers and canals. Furthermore, pollution of water sources caused by domestic and industrial waste poses major challenges for clean and safe urban agricultural production.

- *Urbanization pressure leading to the reduction of agricultural land:* Although some Mekong Delta cities still retain peri-urban agricultural land, the rapid pace of urbanization is placing significant pressure on these areas. Agricultural land is easily converted to industrial zones, housing, or infrastructure projects, resulting in instability for UA models. Vacant plots within urban areas are also difficult to utilize over the long term due to the absence of clear planning frameworks and frequent changes in land-use functions.

- *Limited high-quality human resources for urban agriculture:* Although residents of the Mekong Delta are known for their diligence and strong attachment to agriculture, the adoption and operation of modern

technologies such as hydroponics, aeroponics, greenhouses, and automated systems remain challenging. A portion of the younger workforce is shifting away from agriculture toward industry and services, resulting in a shortage of successors capable of engaging in high-tech UA. As noted, “Although agriculture has experienced continuous growth at a relatively high rate in recent years, it has generally been characterized by quantitative rather than qualitative expansion, with breadth emphasized more than depth” [9]. Meanwhile, the initial investment required for modern UA models exceeds the financial capacity of many households and cooperatives.

- *Risk of cultural commercialization and unsustainable agricultural tourism:* The use of riverside culture, garden-based traditions, and historical heritage in association with UA-related tourism still faces many shortcomings. Several models have developed spontaneously without coherent planning, which can lead to excessive commercialization, diminish the authenticity of cultural values, and increase environmental pressures. If not managed carefully, UA may lose its dual role of both production and preservation of regional cultural identity.

- *Fragmented support policies and lack of region-specific mechanisms:* Although local governments have introduced certain policies to encourage high-tech agriculture, these policies remain fragmented, lack systematic coordination, and do not provide region-specific incentives tailored to the Mekong Delta. Many pilot programs lack sufficient scale to be replicated, while urban planning frameworks have yet to clearly integrate UA. The lack of coordination in policies, credit access, land-use mechanisms, and market development make it difficult for UA models to transition from small-scale operations to sustainable commercial systems.

5. CONCLUSION

The development of urban agricultural spaces in Mekong Delta cities is not only a solution for ensuring food security and improving urban living conditions but also an important pathway for building green,

climate-adaptive cities while preserving the region's distinctive riverside cultural identity. The advantages in natural conditions, land availability, human resources, rich socio-cultural foundations, and supportive policy orientations have created significant opportunities for these models to expand.

However, under the pressures of climate change, rapid urbanization, limited high-quality human resources, and fragmented policy frameworks, urban agriculture in the Mekong Delta continues to face considerable challenges. This situation calls for an integrated approach that both leverages existing strengths and addresses limitations through long-term planning, technological innovation, effective governance, and coherent policy systems.

Based on the analysis of opportunities and challenges, this study proposes several policy orientations to promote sustainable urban agriculture in the Mekong Delta. First, urban agricultural spaces should be integrated into comprehensive urban development and land-use planning, aligned with green, smart, and climate-adaptive objectives. At the same time, incentive mechanisms should be established through financial support, green credit, and preferential policies for production models that apply high technology, circular approaches, and environmentally friendly practices.

In addition, the development of markets and branding for urban agricultural products, the training of high-quality human resources, the acceleration of technology transfer, and the enhancement of community awareness regarding the value of urban agriculture are essential solutions. These recommendations not only help address existing limitations and capitalize on available opportunities but also lay the foundation for Mekong Delta cities to develop urban agriculture in a more efficient, adaptive, and sustainable manner in the future.

SCIENTIFIC CONTRIBUTION

This study clarifies the theoretical foundations of urban agricultural space (UA) and identifies representative UA models in the context of urbanization and climate change. It systematizes three groups of UA

spatial models horizontal, vertical, and high-technology applications providing a basis for assessing their suitability within Mekong Delta cities. The research also highlights the region's specific advantages and challenges, thereby proposing feasible policy orientations to promote sustainable, adaptive, and culturally distinctive UA development.

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