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Review

Leveraging and combining resources for sustainable urban agriculture development in major Vietnamese cities

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Abstract: Cities serve as principal economic hubs within the nation, characterized by unique socio-economic conditions and potential that present advantages as well as challenges for future economic advancement. The swift urbanization process is associated with the increasing demand for safety and sustainable development, especially in major cities like Ho Chi Minh City in Vietnam. Notably, sustainable urban agriculture, which is an integral component of the increasing movements towards locally sourced food, is a significant concern and is prioritized in the city's comprehensive planning. This review paper presents models of agricultural development, emphasizing the synthesis, analysis, and evaluation of diverse resources—both their individual effects and their collaborative interactions with urban development—alongside the principal benefits and challenges in optimizing and utilizing these resources for optimal effectiveness. Additionally, this paper also suggests strategies to optimize resource utilization and foster the establishment of a sustainable, adaptable, and efficient urban agricultural system.

Keywords: clean agriculture; pre-urban agriculture; smart cities; sustainable development; urban agriculture

1. Introduction

Globalization is advancing rapidly, and urbanization has significantly augmented urban populations, which has raised global food consumption in the face of intricate climate change challenges. This context necessitates stronger global commitment and new, innovative solutions to achieve sustainable development for every country, particularly in food production. Therefore, urban agriculture has long been discussed in various forms. However, since the 19th century, it has increasingly [1] become a vital component of urban development [2,3]. Today, sustainable urban agriculture has emerged as an attractive alternative to traditional agriculture, enhancing food accessibility, promoting healthier lifestyles, and improving urban living conditions. In this article, urban agriculture was considered from the perspective of organizing agricultural production activities within urban areas and peri-urban regions. The study aims to increase food production, enhance income, improve health and the environment, and contribute to the sustainable development of urban areas. In North America, sustainable urban agriculture has gained popularity through hydroponics and greenhouses, artificial growth rooms in the city home, especially on rooftops [4,5]. In Asia [6], digital and information technologies are being applied widely to agricultural practices [7,8]. Expanding urban agriculture poses economic challenges due to the low profitability, but its high standards and enhanced socio-economic benefits are

undeniable, which effectively integrates concerns connected to technology, socio-economics, and policy [9,10].

Vietnam, one of the developing countries, is experiencing dramatic urbanization recently in both large cities and sem-urban area. By 2022, the country's urban population reached 37.4 million [11]. Major cities, including Hanoi, Ho Chi Minh, Da Nang, and Can Tho, as well as Type I urban centers, have been expanding their boundaries from urban cores to peripheral areas from 2010 to 2020. Urban economic sectors have contributed about 70% of the GDP, acting as economic growth drivers for various regions [6,12]. The wave of migration to large cities has increased pressures and other problems, such as on population, employment, housing, and other social welfare issues. Migration has also introduced challenges for both the country as a whole and its largest cities: Food insecurity, environmental pollution, and uneven resource distribution [13]. Among these challenges, ensuring food security has become increasingly important for urban residents and in the overarching urban development strategy. In Vietnam's urban planning, large cities such as Hanoi, Ho Chi Minh City and other large cities directly become dynamic cities [14,15], leading to the creation of spillover effects, linking urban areas and regions, and being an important part of the urban network of Southeast Asia and Asia. Type 1 and 2 cities play the role of satellite cities to reduce the load on central cities. Of which, there are 42 type 1 cities and 50 type 2 cities; these are also important links in the network of sustainable urban system development, contributing to reducing pressure on large cities [16,17]. Pressure on agriculture for all cities is a common problem in the urbanization process. However, we want to emphasize more on the central role, economic expectations and typical models of sustainable urban agriculture in large cities to contribute to promoting sustainable development based on endogenous resources, firmly consolidating its position in the overall planning of the whole country.

The Vietnamese government has implemented various programs related to agriculture. One of these initiatives includes Prime Ministerial Decision No. 150/QD-TTg, which approved the Strategy for Sustainable Agricultural and Rural Development for 2021–2030, with a mission to 2050. This strategy focuses on restructuring agriculture toward sustainable development, aligning it with advancements in science and technology, which the target base on innovation and commerce, and fostering the creation of "green cities" and "eco-urban areas" [12]. The national urban development strategy emphasizes intelligent and sustainable urban development aligned with global conditions. It seeks to fulfill citizens' demands for fresh and safe food while simultaneously tackling pressing concerns regarding sustainable, clean environments and the development of livable areas in both the present and future. Sustainable urban agriculture development has emerged as an essential trend in Vietnam. In this article, the author examines urban agriculture from the perspective of organizing agricultural production activities within urban areas and peri-urban regions. The study aims to increase food production, enhance income, improve health and the environment, and contribute to the sustainable development of urban areas.

Numerous sustainable urban agriculture strategies are being implemented worldwide. Vietnam, leveraging its agricultural capabilities, must implement a modernized agricultural approach in major metropolitan centers, guided by a roadmap

that aligns with practical conditions [2,18]. However, in defining urban agricultural spaces, the author observes that studies on urban agriculture abroad are highly diverse in type, particularly from the perspective of urban agricultural practice spaces. In Vietnam, research on urban agriculture remains limited, primarily focusing on reconciling planning requirements and the role of agriculture in the urban economy. Published results in this field are mainly journal articles and scientific conference proceedings concentrated in a few urban areas. Moreover, each centrally governed city in Vietnam has an economic scale that significantly impacts the national economy while possessing unique strengths in agricultural potential, primarily concentrated in peri-urban areas [4]. Therefore, the author's research focuses mainly on these peri-urban regions, proposing solutions for developing models based on integrated ecological and high-tech scientific approaches [6].

The novelty of this research lies in analyzing and synthesizing both endogenous and exogenous resource conditions of major cities in Vietnam that can be utilized to develop sustainable urban agriculture models. This aspect has not yet been comprehensively studied in Vietnam. Furthermore, the research examines theories of sustainable urban agriculture and specific models from other countries to propose strategies for optimizing resources to advance sustainable urban agriculture in major urban areas of Vietnam [19]. In addition, this study examines theories of sustainable urban agriculture and specific models from other countries to propose resource optimization strategies for developing sustainable urban agriculture in major urban areas of Vietnam.

2. Research methodology

The research employs a method of synthesis and analysis of published research findings from both domestic and international sources, relevant policies, and data (including information, documents, national and local datasets, as well as data collected by scientists). This method involves comparing, selecting, classifying, and synthesizing data and documents that align with the research objectives. Through this approach, the author endeavors to demonstrate that, given the unique characteristics of each major urban area in Vietnam, especially the current challenges they face, developing sustainable urban agriculture while effectively utilizing local resources is essential. Based on these findings, the author proposes solutions for optimizing the use of these resource conditions in Vietnam's major urban centers.

3. Urban agriculture and its impact on socio-economic development

After more than 40 years of economic changes, Vietnam continues to be a country grounded in agricultural traditions [12], with agricultural growth central to its national socio-economic and regional development purposes. Sustainable urban agriculture is an appropriate answer; however, it poses a considerable challenge for Vietnam's main cities. The construction of urban infrastructure to accommodate industrialization in Vietnam will diminish arable land, while rural-to-urban migration intensifies strain on employment, food resources [20], and environmental alterations. Urban agriculture, alongside rural agriculture [21], fosters a diverse food network that satisfies the local demands of urban regions.

A variety of researchers have offered diverse definitions of urban agriculture. Achieving a comprehensive definition is challenging due to the influences of diverse academic disciplines and variations in historical and geographical characteristics. In 1990, Jac Smit [22] defined urban agriculture as the production, processing, and distribution of food and fuel primarily to satisfy the daily requirements of urban consumers, utilizing land allocated across urban and peri-urban areas, employing specialized production techniques, natural resource usage, and the recycling of urban waste to cultivate diverse crops and diversify livestock [23].

The Food and Agriculture Organization (FAO) defines urban agriculture as any production activity carried out at residences or on sections of land within urban areas in 2003 [24]. Urban agriculture encompasses the cultivation of vegetables and fruit trees, as well as cultivation of specialist trees (such as medicinal and ornamental plants), timber production, small-scale livestock farming, beekeeping, and aquaculture (integrated fish farming and crop cultivation) [5].

In a broader sense, urban agriculture is an industry that substantially influences several economic, social, and environmental issues. This is a viable solution to fulfill the food requirement of urban dwellers and serves as a critical factor affecting numerous socioeconomic dimensions (**Figure 1**). Urban agriculture research encompasses more than mere food production; it examines the multifaceted roles of urban agriculture, including the production, processing, and distribution of food within an urban setting. Otherwise, it impacts cities' natural resources and environment. Its role in economic development and evaluated contribution to food security, fostering social interaction, and educating the public [25].

The advancement of conventional agriculture predominantly emphasizes development and productivity enhancement, while neglecting the vertical integration of influencing elements, so affecting the industry's character and future prospects. Agriculture globally and in Vietnam currently confronts environmental degradation and factors that jeopardize sustainability in agricultural production. Sustainable development has increasingly emerged as an objective and a collective worldwide aim. Since its inception by the World Commission on Environment and Development in 1987, the notion of sustainable development has been extensively used and described as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [26]. The sustainability in urban agriculture, especially concerning the water-energy-food nexus [27], digital transformation solutions, and factors related to resilience, sustainability, and flexibility, is a primary focus of contemporary scientific research [28].

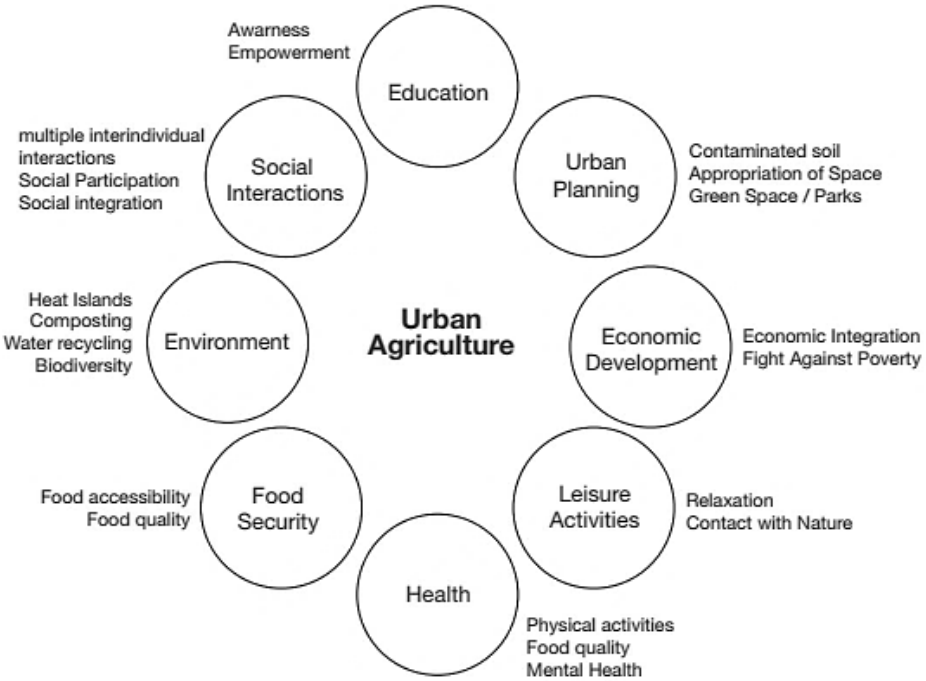

Figure 1. Different areas of activity and assessment on urban agriculture in relation to economic, social and environmental development [29].

The urban food system is progressing in which urban agriculture plays an essential role in creating a sustainable, eco-friendly urban ecosystem [30]. This goal is crucial as it facilitates the integration of urban resources involving water, garbage, and energy. To fully realize these connections, urban agriculture can enhance food production in cities by implementing solutions like green agriculture, circular agriculture, indoor farming, and vertical farming, thereby promoting the circulation of materials and resources within the city.

According to the United Nations Food and Agriculture Organization in 1992, sustainable agricultural development entails the management and preservation of organizational, technical, and institutional modifications to agriculture, ensuring an increasing provision of food and services to satisfy human requirements while also addressing future demand. Sustainable agricultural development is a multifaceted process encompassing, first of all, the sustainability of the food chain from production to consumption; second, the sustainable utilization of land and water resources in both spatial and temporal contexts; and third, the ability for commercial interaction in agricultural and rural development to guarantee livelihoods and food security [31]. As a result, sustainable agricultural growth presents considerable problems for urban areas, necessitating the maximization of human and biological resources, minimization and integration of external inputs, as well as the efficient and optimal utilization of internal resources. Sustainable urban agriculture fosters a circular economy by applying innovative technologies and repurposing by-products or waste from the economic segment as inputs for another.

In light of numerous challenges arising from rapid urbanization, urban agriculture has emerged as a pivotal element in development, significantly contributing to sustainable urban planning. As urban areas evolve, urban agriculture is crucial in

facilitating this progress. Firstly, it can provide a source of fresh, safe and locally sourced food [32], significantly addressing the consumption requirements of urban inhabitants in reality [33]. The urban population is increasing dramatically; peri-urban households are losing their primary means of production, which diminishes their income and limits their livelihoods, hence exacerbating the difficulties faced by low-income households and complicating their management [34]. The risk of dietary and nutrition deficiencies for urban inhabitants is significantly higher than for those in rural areas. Encourage the establishment of local production models and minimize the supply chain from production to consumption (from rural to urban areas), so generating a source of fresh food locally and lowering product costs for consumers. In addition, urban agriculture diminishes the disparity in access to healthy food sources [8]. Local cultivation of fresh produce will reduce product costs, improving the living situations of impoverished and low-income individuals adversely affected by elevated food prices. Numerous studies have shown that the relationship between food and food-related concerns can exert multifaceted effects on the spatial context and orientation of cities (**Figure 2**).

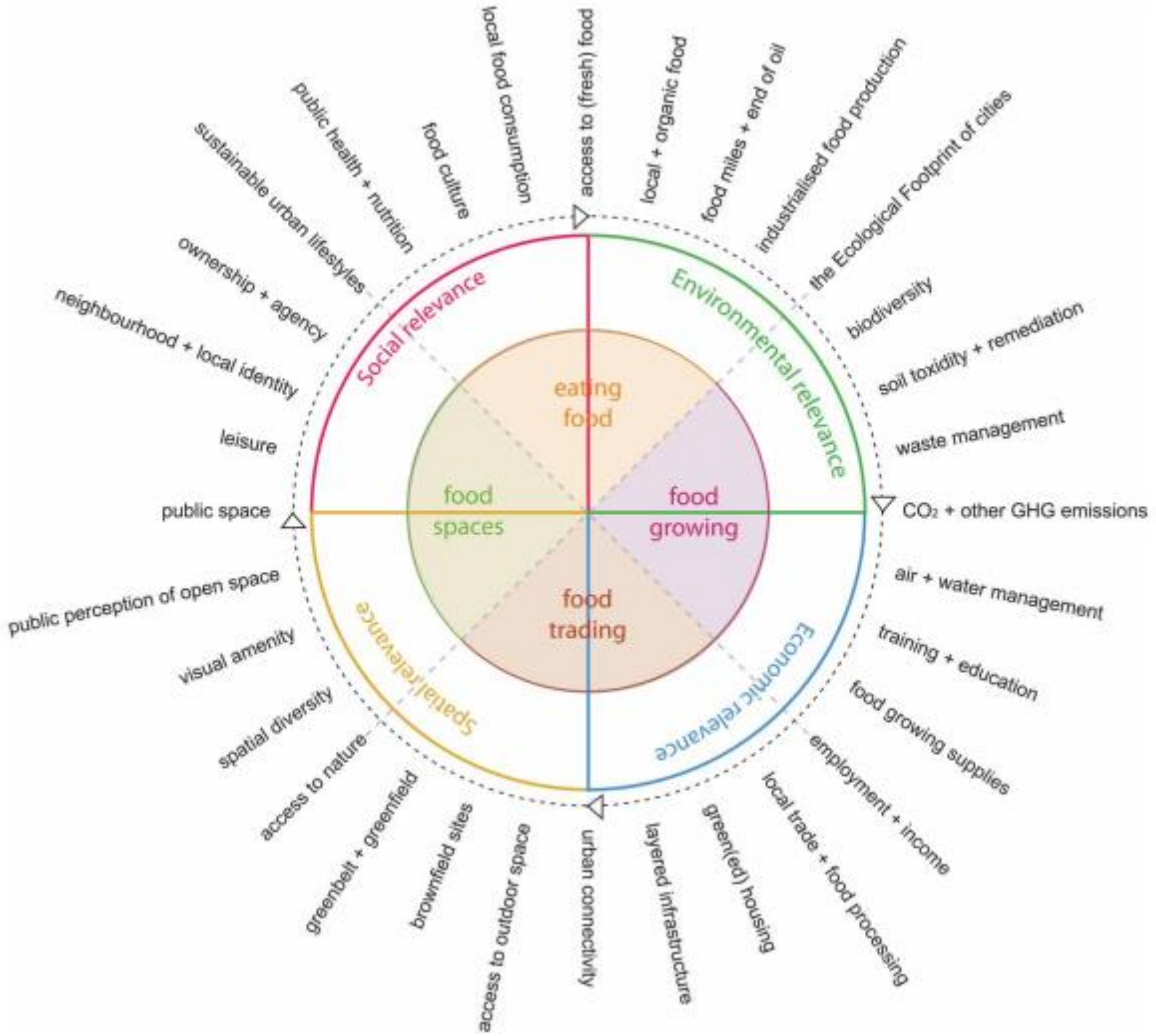

Figure 2. The various connections between food and many facets of urban life highlight urban food's spatial features, particularly urban agriculture [35].

Secondly, urban agriculture contributes to the sustainable management of natural resources and reduces environmental pollution. Urban garbage is a challenge to cityscapes and contributes to environmental spoilage. As Vietnamese cities execute strategies to create smart cities adhering to sustainable urban development criteria [3,8], local authorities may leverage segments of urban waste for clean, safe, and efficient agricultural production. Urban agriculture improves urban air quality by diminishing fossil fuel consumption, attributable to reduced transit distances for harvested products [36]. Multiple studies indicate that the conventional food system utilizes 4–17 times more fuel, with CO_2 emissions being 5–17 times more than those from on-site production. Urban agriculture will reduce the carbon level in numerous cities, hence regulating the air quality in urban environments [7].

Thirdly, urban agriculture improves urban landscapes and promotes public health. The goal of creating ecological and green urban regions is to design and construct urban spaces that are harmonious with nature, hence ensuring optimal public health standards. Integrating agricultural activities inside urban areas, including rooftop gardens and vertical farms, promotes environment aesthetics, enhances biodiversity, fosters ecological health, and elevates the quality of life [37]. In addition, participation in urban agricultural activities results in positive physical health effects, such as decreased body mass index, less obesity risk, reduced stress levels, and improved mental well-being [38].

Fourthly, urban agriculture offers jobs and income for the urban population. The rapid urbanization development presents considerable obstacles for workers. The expansion of urban areas and population growth frequently leads to the diminishment of agricultural land in suburban areas [39], adversely impacting the livelihoods of inhabitants. Many individuals forfeit their primary means of production, forcing them to alter their professions and adjust to low-skilled employment [40] and an industrialized lifestyle. Furthermore, the increasing migration to metropolitan centers exacerbates job rivalry, rendering employment difficulties more pressing. Consequently, a long-term strategy for planning and development that leverages available land resources can enable urban agriculture to mitigate surplus labor, improve productivity, and raise income for workers affected by urbanization.

4. Resources for urban agricultural development in prominent Vietnamese cities

In developing countries like Vietnam, urban agriculture plays a crucial role in improving the livelihoods of city residents, ensuring food security, and generating income. Urban agriculture is increasing dramatically in urban planning and global and national strategic development agendas ass a crucial component of sustainable green cities. Urban agriculture addresses the food requirements of urban areas, particularly major urban centers in Vietnam, as illustrated in **Figure 3**.

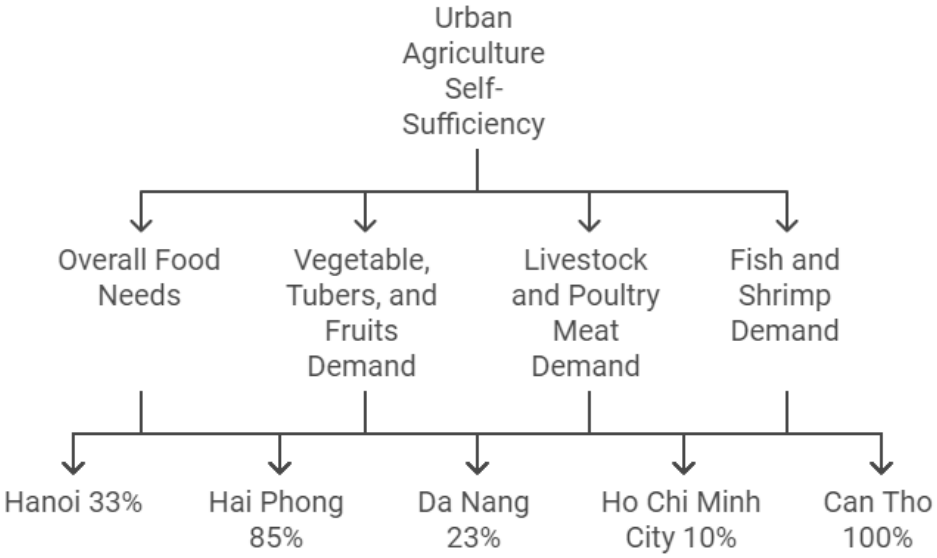

Figure 3. Level of meeting food demand of urban agriculture in big cities in Vietnam [17].

Urban agriculture in Vietnam must contend with competing other urban activities. Three key resources integral to urban planning are human resources, environmental resources, and policy-financial resources. Centrally administered cities like Hanoi, Ho Chi Minh City, Da Nang, Hai Phong, and Can Tho had a tendency to increase their urban limits and space during the period 2010–2020. The efficient combination and coordinated planning of these resources within the GDP sector ratios are crucial for achieving sustainable development.

4.1. Human resources

People are an important element in shaping development, and improving human capital is regarded as a primary policy priority for the Vietnamese government. The urbanization rate in Vietnam surged from 19.6% in 629 urban areas in 2009 to approximately 39.3% in 833 urban areas in 2020. The urban population is expanding swiftly due to high immigration rates. In 2020, the migrant population aged 15 and older totaled 877,800, with women comprising 5% of this group. Most of these migrants relocated to urban areas (69%). The ratio of migrants within the entire total urban population remains 3.6 times higher than in rural areas (2.2% versus 0.6%) [10]. Ho Chi Minh City constituted 31.8% of the overall migrants, totaling 279,100 people. Vietnam's urban population density is notably high, especially in cities such as Hanoi with a density of 2398 people/km^2, Ho Chi Minh City with 4292 people/km^2, and Da Nang with 800.73 people/km^2 [10].

In addition, the periphery of large urban areas in Vietnam still lacks appropriate orientations and management tools in the transformation from rural to urban areas. Urbanization of rural peri-urban areas will create many pressures on demographics, rural structural transformation, urban infrastructure overload, environmental, housing, social and technical problems. Implementing the country's renovation policy, together with the multi-dimensional impact of industrialization, modernization, and the Fourth Industrial Revolution, has profound framework. This has resulted in the emergence of new occupations and placed considerable pressure on traditional ones, requiring a

workforce equipped with the skills and qualifications to satisfy increasing demands. The percentage of agricultural labor decreased from 48.7% in 2010 to 27.6% in 2022, resulting in a decline of 10.369 million workers in the industry (from 24.469 million to 14.1 million in 2022). However, the transition from exclusively agricultural work has progressively augmented the number of households involved in industry, trade, and services. Agricultural, forestry, and fishery operations in urban areas have employed 17.89% of the urban population aged 15 and older [17].

Consequently, the urbanization process increases population pressure, leading to a swift increase in the labor force in large cities such as Ho Chi Minh City, Hanoi, and Da Nang. This consequently results in a decrease in the agricultural workforce. Additionally, large cities possess advantageous conditions for labor resources, significantly impacting the development of urban agriculture, especially in the context of the transition from traditional agriculture to modern, green, and circular agriculture. Such conditions encompass ample, high-quality labor resources. Large cities in Vietnam serve as focal points for universities, vocational training institutions, research centers, and high-tech zones. Statistics indicate that universities are primarily concentrated in developed economic regions, notably the Red River Delta (44.3%) and the Southeast (18.4%), which encompass the two largest cities, Hanoi and Ho Chi Minh City. The concentration of educational institutions offers a significant source of highly skilled labor, particularly in management, engineering, finance, and technology applications. As of 2022, the country had planned 34 high-tech agricultural zones throughout 19 provinces and cities, including Hanoi, Ho Chi Minh City, Binh Duong, and Thanh Hoa. These zones, typically situated in urban or peri-urban areas, offer opportunities for modern agricultural practices and technological innovation.

With a large population and a high urbanization rate, cities have a substantial labor supply of young, dynamic workers who can meet the demands of diverse industries. This young workforce is capable of quickly adapting to new technologies, enabling the adoption of modern agricultural techniques to boost productivity and efficiency in urban agriculture. The next condition is the ability to access and innovate: The rapidly evolving economic and social environment in large cities provides workers with early access to the latest technological trends and advanced farming methods. This enables them to meet the demands of businesses, improve production efficiency, and protect the environment. The strong development of technology and service industries, coupled with advancements in technologies like sensors, photovoltaic cells, IoT, and new materials, has created favorable conditions for urban labor to easily adopt and apply these innovations in urban agriculture, leading to automated farming systems. On the other hand, improving product quality and diversifying products is an important condition because the large cities boast a diverse workforce with expertise in various fields, ranging from engineering and science to economics and entrepreneurship. This skilled labor force contributes to enhancing the quality of agricultural products, meeting the growing demands of consumers. Finally, the urban market: The urban market, with its large population, proximity to consumers, and diverse needs, presents numerous business opportunities for urban agricultural products [41]. This favorable environment empowers small and medium-sized processing enterprises to intensify production, create value-added food products, reduce storage costs, and maximize market reach.

However, several challenges hinder the development of urban agriculture in large cities. These include uneven distribution of labor, a lack of agricultural experience among the urban workforce, a tendency towards the service industry, and intense competition from other agricultural regions.

4.2. Natural resources

In order to optimize the utilization of urban natural resources, researchers have investigated factors influencing the efficiency of urban agriculture, including culture, tradition, market access, water availability, rainfall, soil type, plot size, land accessibility, and financial access [42].

Vietnam, situated in a tropical monsoon climate zone, benefits from abundant rainfall and high humidity, fostering diverse agricultural products. However, Vietnamese agriculture faces increasing pressure from demographic, economic, and market factors. Additionally, climate change, characterized by temperature fluctuations, sea-level rise, altered rainfall patterns, and extreme weather events, poses significant challenges to agriculture, especially land use options. In large urban areas, air pollution, which reduces sunlight and increases ground radiation due to pollutants and aerosols, poses a significant risk to agricultural development [35].

According to statistics released by the Ministry of Natural Resources and Environment in December 2022, compared to the 2021 land area statistics, the agricultural land area increased by 8255 hectares in 2022. Nationally, the land area increased by 5579 hectares, with urban land increasing by nearly 5900 hectares and rural land decreasing by nearly 320 hectares. Hanoi currently possesses approximately 188.6 hectares of agricultural land, accounting for about 56.34% of its natural land area [11]. With a population of about 10 million, including 4 million rural residents (55.6% of the city's population), the city has a significant demand for agricultural products. Moreover, agriculture continues to play a crucial role in the economic structure and labor settlement of many suburban districts. One of the six key solutions for agricultural production in Hanoi is the development of high-tech and urban agriculture in an ecological and modern manner. The Nhan Dan newspaper has published the data, indicating that Ho Chi Minh City currently has 113,634 hectares of agricultural land, constituting 54.23% of its natural land area [43]. The city's daily food and foodstuff consumption averages approximately 10,962 tons. According to the city's Department of Agriculture and Rural Development, agricultural, forestry, and fishery production in the first six months of 2023 reached over VND 9089 billion, a 2.15% increase compared to the same period in 2022. However, the city's agricultural sector can only supply around 28% of the population's demand for fresh vegetables. Ho Chi Minh City's agricultural economic structure is shifting toward urban agriculture, incorporating high technology and biotechnology.

Other major cities also maximize their agricultural strengths. For instance, Da Nang, a coastal province, leverages its advantages in agriculture, forestry, and fisheries, with agricultural land comprising 69,970 hectares, or 54.46% of the total provincial area. Binh Duong, a key province connecting the regional economy, has a smaller agricultural sector, with agricultural land covering 207,464 hectares, or 77.03% of its total area. Can Tho, located in the mid-lower Mekong Delta, specializes

in rice, aquatic products, fruit trees, livestock, and poultry, with an agricultural land area of 114,256 hectares, accounting for 80% of its natural area]. Socio-economics and urban agricultural development will integrate suburban and inner-city agriculture, resulting in the creation of concentrated, specialized production zones and modern production areas. By gradually adopting high-tech and organic agricultural practices, these zones can produce high-quality products tailored to urban market demands. This approach contributes to increasing agricultural productivity, output, and value while also enabling a rational restructuring of the agricultural sector and the efficient utilization of urban land and labor.

4.3. Policy and financial resources

Over the years, Vietnam's agricultural sector has achieved significant milestones, contributing to food security and national development. Government policies and regulations can provide financial support for urban agriculture initiatives, such as rooftop gardens and community farming, promoting social and environmental sustainability while generating profits. Sustainable finance can play a crucial role in supporting urban agriculture, particularly for microenterprises, by providing access to funding, technical assistance, and resources to promote sustainable production and distribution [9].

Estimates indicate that the entire agricultural sector will grow by 3.83% in 2023, marking the highest growth rate in a decade. The agricultural sector plays a pivotal role in socio-economic development and improving people's quality of life. However, traditional production methods remain prevalent, leading to negative environmental impacts such as resource depletion, biodiversity loss, soil degradation, and water pollution. To address these issues, the 13th Party Congress Resolution outlines a development strategy for the 2021–2025 period [44], emphasizing infrastructure development, urban development, and rural economic development, with a particular focus on ecological agriculture, modern farmers, and smart farming. The resolution underscores the crucial role of science and technology in driving breakthroughs in agricultural productivity, quality, and efficiency. In line with this, the Prime Minister issued Decision No. 150/QD-TTg, approving the strategy for sustainable agricultural and rural development for the 2021–2030 period, with a vision extending to 2050 [17,45]. This strategy prioritizes the regeneration of the agricultural sector, sustainable development based on science and technology, innovation, and market expansion.

The Ministry of Agriculture and Rural Development has integrated climate change mitigation and adaptation solutions into its plans and strategies, including the Climate Change Response Framework for the Post-2008–2020 period, the Climate Change Action Plan for Agriculture and Rural Areas for the 2016–2020 period, and the implementation plan for the Paris Agreement on Climate Change for the 2021–2030 period. To create more favorable mechanisms and policies to support agricultural investment in the context of new factors and requirements, the Ministry of Planning and Investment issued Decree 57/2018/ND-CP, which refines mechanisms and offers preferential policies on land tax exemptions and reductions, as well as investment credit support for agricultural, forestry, and fishery production in rural areas.

In response to government policies and orientations for agricultural and urban agricultural development, provinces and cities have implemented various programs and plans tailored to their specific strengths. A key focus has been on developing high-tech agriculture and mechanization in urban agricultural development strategies. Typical models include Ho Chi Minh City, Ha Noi, Can Tho, Da Nang, and Binh Duong [6,13,44].

Ho Chi Minh City focuses on developing high-tech agriculture, biotechnology, and high-value crops and livestock [46]. The city aims to reduce rice and cassava cultivation and establish itself as a leading center for research, production, and supply of high-quality plant, animal, and aquatic varieties for the southern region and the entire country. Leveraging its strong scientific and technological capabilities and high-quality human resources, the city has implemented a program for developing plant, animal, and high-tech agricultural varieties for the 2020–2030 period. By 2030, the city aims to increase the contribution of high-tech agricultural production to 75%–85% of the total agricultural production value. Additionally, over 70% of farming households, 80% of enterprises, and 30% of cooperatives are expected to adopt high–tech agricultural practices.

Hanoi, which is known as the capital city of Vietnam with its unique natural conditions, landscapes, and cultural heritage, has experienced significant growth. On 24 December 2015, the Hanoi People's Committee approved the "Program for Developing High-Tech Agriculture in Hanoi City (2016–2020)" (**Figure 4**) and the "Plan for Restructuring the Agricultural Sector of Hanoi City towards Increasing Added Value and Sustainable Development (2016–2020)". In line with these plans, the city's agricultural development is oriented towards modernization and ecological urban agriculture (**Figure 5**). This approach contributes to creating a favorable urban environment and promoting the development of both urban and rural agricultural tourism.

Figure 4. High-tech vegetable growing model at Smart Green Agriculture Company Limited [46].

Figure 5. Ecotourism model in Thuong Tin district, Hanoi [45].

Meanwhile, cities like Binh Duong, Da Nang, and Can Tho have implemented groundbreaking strategies to concretize Resolution 26-NQ/TW of the 10th Party Central Committee on "Agriculture, Farmers, and Rural Areas". For instance, Binh Duong approved Decision No. 1013/QD-UBND on 15 February 2007, outlining a high-tech agricultural project for the 2007–2010 period and planning high-tech agricultural zones to promote technological advancements in production [15]. Furthermore, Binh Duong has adopted other orientations and strategies to develop high-tech, urban, and ecological agriculture, leveraging the province's potential and strengths to boost agricultural production and processing.

Can Tho City prioritizes the development of safe urban agriculture as an inevitable path forward. In April 2017, the Can Tho City Party Committee issued Resolution No. 10-NQ/TU on "Building Can Tho City into a Smart City (2016–2025)". The Department of Agriculture and Rural Development is currently submitting a plan to the City People's Committee for approval, outlining a pilot urban agriculture model to be implemented in four districts of Can Tho City from 2018 to 2020 [12]. This plan involves 72 production models, including mushroom cultivation, leafy vegetable production, fruit and vegetable greenhouse cultivation, and flower cultivation, with a total budget of 10.4 billion VND. These models will be implemented in Phu Thu Ward (Cai Rang District), Thot Not Ward (Thot Not District), Chau Van Liem Ward (O Mon District), and An Khanh Ward (Ninh Kieu District).

Da Nang City has promoted urban agriculture with an emphasis on ecological practices, focusing on models such as sprout cultivation, mushroom production, flower cultivation, and the development of green trees and ornamental plants. The goal is to ensure food safety and economic efficiency [47]. The urban agricultural planning in Da Nang aims to industrialize and modernize agriculture and rural areas, developing diverse, sustainable, high-quality, and competitive agricultural products. The city strives to become a regional marine economic center, achieving high growth rates while prioritizing environmental protection and sustainable development [16].

In summary, government and local policies are increasingly focused on modernizing the agricultural sector to meet practical needs and promote flexibility and creativity. These policies aim for sustainable development tailored to the specific capacities of each region and area [15]. The government, ministries, sectors, and localities are prioritizing policy reform, fostering public-private partnerships, promoting food industry trade, building competitive value chains, and implementing financial liberalization to incentivize investment in urban agriculture [48]. These efforts are considered crucial for the future advancement of urban agriculture. However, urban authorities are still limited in promoting and introducing urban agricultural products. Many urban agricultural products have not yet built a brand, causing difficulties in consuming the products. Many models, high-tech applications, organic agriculture, ecological agriculture have been successfully piloted in urban areas but have not been widely replicated and developed comprehensively throughout the area. Coordination policies between ministries, departments and different sectors to jointly solve the problems of groundwater pollution, soil pollution due to pesticide residues; untreated livestock wastewater and burning of agricultural by-products are still not consistent.

5. Experience in developing sustainable urban agriculture in some countries in the world

5.1. Cuba's organic agriculture model

Since 1994, a national urban agriculture program has been implemented under the research of the Alejandro Humboldt Institute for Basic Research in Tropical Agriculture. Due to energy, fertilizer, and pesticide shortages, the Cuban government encouraged a shift towards animal traction, natural composts, and the use of natural pesticides and beneficial insects [49]. As a result, organic agriculture flourished throughout the country, yielding impressive results. Numerous farms, both large and small, emerged to supply a significant portion of Cuba's vegetable needs [50]. Notably, 70% of vegetables are now grown organically, and these farms have created approximately 300,000 jobs with competitive salaries. By 1998, Havana alone boasted over 8000 urban farms, producing nearly half of the nation's vegetables. What began as a grassroots initiative has evolved into one of the largest sustainable agriculture endeavors globally, positioning Cuba as a world leader in urban agriculture.

Currently, Cuba's urban organic agriculture model focuses on cultivating key agricultural crops and maintaining stable production on farms smaller than 40 hectares [51]. Additionally, over 200 centers specialize in producing microorganisms like fungi, bacteria, and beneficial insects to support organic vegetable and fruit gardens in urban areas. Thanks to the strong development of this urban agricultural model, Havana has achieved self-sufficiency in 90% of its fresh food needs. In 2008, over 200,000 urban Cubans were employed in the urban agricultural sector. From a nation once facing agricultural shortages, Cuba has transformed into a self-sufficient country, providing for its essential food needs [51].

While Cuba's organic farming model may not be the most efficient for large-scale production, it offers a viable solution to the challenges of urban agriculture in

Cuba's specific context. This model addresses the country's domestic food needs and presents opportunities for exporting agricultural products to foreign markets.

5.2. Urban agriculture model in Malaysia

Malaysia, a Southeast Asian country smaller than Vietnam, boasts a significantly higher level of urbanization. The country's urban agriculture model primarily relies on small-scale agriculture, particularly community gardens. These gardens foster community interaction, resilience, and local food production [52]. To maximize productivity and space utilization, urban agricultural practices in Malaysia include aeroponics, hydroponics, rooftop vegetable gardening, vertical farming, and aquaponics systems on parking lot roofs and in unused buildings (**Table 1**).

Table 1. Urban farming systems.

Farming system deseription	Expected products	Place location/technique
Aquaculture	Vegetables, fish, seafood, and fodder	Ponds, cages, streams, lagoons and wetlands
Horticulture	Fruits, vegetables, and com-post	Homesteads, wetlands, parks, containers, rooftops, hydroponics, and greenhouses
Livestock farming	Milk, eggs, meat, hides and manure	Hillsides, zero grazing, peri-urban areas
Agro-forestry	Fruits, wood fuel, building posts and fodder	Street trees, home-steads, forest parks, steep slopes, wetlands and orchards
Other systems	Household plants, flowers, and medicinal herbs	Ornamental horticulture, roof tops and container farming

Source: Ngahdiman, i. n. b. Intention to practice agriculture among urban dwellers in the Klang valley Malaysia. Thesis, 2017.

These methods employed by urban Malaysians demonstrate the technological advancements in food production, making them suitable for urban environments. As of 2021, Malaysia had 11,000 urban farming communities, and the government aims to increase this number to 20,000 by 2030 [6]. Malaysia's urban farming policies have significantly boosted agricultural production, meeting 78.4%, 44.6%, and 22.9% of the population's demand for fruits, vegetables, and meat products, respectively. The program has also reduced vegetable and fruit consumption costs for Malaysians by at least 45.56% [13]. To address labor shortages and attract young, skilled individuals to the agricultural sector, the Malaysian government is implementing initiatives to make agriculture a profitable profession.

5.3. Urban agriculture model in Israel

Israel, a country renowned for its achievements in science, technology, and innovative solutions, is recognized as one of the most modern agricultural nations in the world. Despite facing challenges such as an arid climate and limited natural resources, Israel has developed a sustainable urban agriculture model that integrates advanced technology, effective water management, and sustainable development practices.

In agricultural production, Israel is known for several distinctive models, with two prominent examples being the Moshav and Kibbutz systems. The Moshav model emphasizes the role of the family, linking nuclear families together to establish large agricultural centers. In contrast, the Kibbutz is a rural community with unique

characteristics: A micro-society that serves as a significant source of agricultural products for Israel and contributes to economic growth through various industries and services [14,53]. This model also embodies independent cultural and social values, fostering a connected and progressive society where people live and work in an equal and peaceful environment.

The kibbutz is organized by village, where the sole form of ownership is public ownership of all means of production and consumption. This model is closely linked to scientific and technological advancements from researchers and universities, serving as the starting point or application site for many scientific achievements [54]. A common feature of Israeli agricultural models is the application of advanced technology in production. The use of greenhouse technology is regarded as a key solution in agricultural development. This greenhouse model employs modern and Industry 4.0 technologies to create an ideal ecological environment for the growth and development of crops and livestock while also supporting intensive farming practices that optimize productivity and enhance the quality of agricultural products.

5.4. Brazil's sustainable agricultural model

Brazil is a developing country in South America, but like many other nations, it faces significant environmental challenges. As one of the largest global emitters of greenhouse gases, Brazil has not yet fully harnessed its world-leading biodiversity for sustainable development [55]. Through well-directed policies and the application of numerous technological advances in agriculture, Brazilian farmers have propelled the country into the top 10 agricultural exporters globally. Among the most important crops in terms of volume are soybeans, corn, sugarcane, wheat, beans, and rice.

Brazil's urban agriculture integrates large agribusinesses producing export commodities with family farming, which accounts for the majority of food consumed. The ecological urban agriculture model is a distinctive feature of Brazil's approach to sustainable agriculture. Sustainable technologies under study include the use of multifunctional microorganisms, also known as efficient and beneficial microorganisms, as well as direct planting systems, cover crops, and crop rotations [56]. This model emphasizes diversifying production, reducing reliance on external inputs such as chemical fertilizers and pesticides, and preserving natural resources [57]. This model integrates various farming methods, including: Crop rotation to enhance soil fertility and reduce pest risks; livestock grazing on natural pastures or cultivated pastures grown as livestock feed [58]; agroforestry systems that provide environmental benefits, water conservation, and biodiversity preservation; organic farming practices, and the use of local plant varieties.

Agricultural development in Brazil must incorporate a sustainable production chain strategy that links all stakeholders in the production chain, including producers, suppliers, distributors, and retailers. Each part of the chain must adhere to robust supply chain standards. Notably, the sustainable distribution of beef and pork supply chains features core innovations such as enhanced cooperation, information sharing, and government involvement throughout the supply chain. Establishing and monitoring environmental and social standards from inputs to final product consumption and distribution ensures product legitimacy and demonstrates

responsibility to consumers. By establishing and monitoring rigorous environmental and social standards from input to final product consumption and distribution, the model ensures product legitimacy and demonstrates a commitment to consumer welfare [59].

5.5. Insights gained for sustainable urban agriculture development in large cities in Vietnam

Through studying sustainable urban agriculture models in other countries and considering Vietnam's specific conditions, we can derive some key lessons for sustainable urban agriculture development in Vietnam as follows:

Firstly, it is essential to continue researching, reviewing, and refining the legal framework and development strategies to support the long-term growth of urban agriculture. This includes focusing on tax exemption and reduction policies for individuals and small and medium enterprises investing in the agricultural sector, providing loan support policies for agricultural production investment, and establishing policies to inspect and monitor environmental impacts and violations in agriculture. Adjusting long-term urban planning to maximize urban space for agricultural production can also contribute by both generating agricultural products and fostering a green living environment in cities [6].

Secondly, promoting the development of scientific and technological services is crucial to building and advancing modern urban agriculture through the application of high technology. Urban management should be transformed to facilitate cooperative partnerships between stakeholders (such as the government, citizens, communities, and businesses) [49]. Broad application of high and smart technologies across the entire value chain, with coordinated connections to various industries and sectors, can help develop smart agriculture, optimize natural resource use, reduce labor demands, and improve productivity.

Thirdly, agricultural development should be closely linked to environmental protection and green growth [60]. This includes developing village and household agricultural models suited to urban conditions, implementing policies that promote regional products, creating distinctive symbols for each urban area, raising consumer awareness of the health benefits of organic products, and advancing green agriculture [49].

This model integrates various farming methods, including: Fourth, urban agriculture should focus on models that provide clean, safe food for urban residents while contributing to environmental protection. Urban agriculture models in other countries emphasize the role of community involvement and product diversification. In contrast, major urban areas in Vietnam predominantly adopt small-scale household models, primarily focusing on growing green vegetables, which do not fully meet market consumption demands. Large urban centers should prioritize building communities that produce and consume clean products, encouraging product diversification beyond vegetables, fruits, and roots to include other products such as mushrooms and aquaculture. Additionally, urban governments should establish mechanisms to provide technical support, develop markets—particularly for clean

agricultural products—and organize forums and workshops to connect businesses and individuals within urban areas.

6. Proposing solutions for sustainable urban agriculture development in major cities of Vietnam

Firstly, establishing a legal framework and standardizing basic standards for urban agriculture is essential. This includes developing urban agriculture models compatible with urban infrastructure and optimizing the efficient use of natural resources (e.g., land, climate) while protecting the environment and ecosystems [61,62]. As urbanization is rapidly progressing in major Vietnamese cities, with complex socio-economic dynamics, the issues of food security and urban environmental quality are more pressing than ever. Recently, numerous strategies for rural and urban agricultural development have been issued and studied by the government and urban authorities. To foster sustainable urban agriculture development, long-term urban infrastructure planning is necessary, along with policies that support urban agriculture, such as agricultural insurance, financial support, farming techniques, and training for human resources in agriculture. Urban authorities should conduct comprehensive urban space planning by sector and region, ensuring strong links to the development of urban environmental planning criteria [63]. Additionally, urban authorities need to develop supplementary policies to support organic and circular agriculture, with contributions from both the government and the community, and to establish agricultural product quality standards that align with international standards. Strengthening the attraction of domestic and foreign direct investment should be based on a list of key programs, projects, and regional flagship products. It is essential to avoid scattered investments and instead select and prioritize projects that focus on high technology, ecological agriculture, and organic agriculture.

Secondly, enhancing the application of advanced technology in agricultural production and developing the agricultural processing industry are crucial [19]. Although there has been a significant shift in strategic vision and supportive policies for high-tech applications in agricultural production, challenges remain due to limited capital, fragmented land, and small-scale urban plots, especially in suburban areas. These factors restrict the development of high-tech agriculture in Vietnam. Urban agriculture should be managed by enterprises or cooperatives, employing technologies in smart agriculture [64], such as automated livestock and crop farms, data analysis and processing using artificial intelligence, the Internet of Things, and microcontroller applications, as well as vertical farming and organic agriculture in greenhouses. These approaches enhance labor productivity, product quality, and resilience to climate conditions. Additionally, urban agriculture must prioritize waste treatment processes, the regeneration of new materials, and the expansion of organic production models and clean agriculture [20]. Automation technologies combined with digital technology and product traceability platforms are also essential areas that require prioritized attention.

Third, training, fostering, and developing agricultural human resources, especially experts in agricultural research, is essential. It is important to strengthen training programs and improve skills in using and operating vehicles and technological

equipment in agricultural production. Information and knowledge about products and technological applications should be regularly updated and disseminated to technical staff, human resources for enterprises, high-tech zones, and farmers. Short-term training courses should be organized for enterprises and farmers to provide knowledge about high-tech applications, sustainable agricultural criteria, and product consumption and branding tailored to the characteristics of each region. Additionally, strengthening cooperation with domestic and foreign experts and scientists who understand the conditions for agricultural development in urban areas is crucial.

Fourth, the focus should be on creating a seamless link between the stages of production, processing, and consumption of agricultural products. Policies must be synchronized to ensure connectivity and collaboration between producers and enterprises, providing stable consumption channels for agricultural products and helping enterprises control product quality. Enterprises should be encouraged to invest in and collaborate with cooperatives, forming production and supply chains for local green agricultural products, replacing uncontrolled external sources of income. Sustainable urban agriculture is a developmental process that begins with raising awareness and leads to action on methods, conditions, and the scope of space for transitioning from traditional agricultural production to modern agriculture. Urban authorities should encourage and organize farmers into associations and cooperatives, attract farmers to participate, and create a foundation to stimulate large-scale regional production.

Finally, strengthen policies to support capital sourcing, technology transfer, and the application of biotechnology in production. Implementing urban agriculture requires significant investment in modern equipment and machinery. The government should create favorable conditions for individuals, businesses, and cooperatives to access capital through appropriate policies and programs, facilitating structural transformation and value-added growth. Leveraging available resources at institutes and agricultural research centers in cities, collaboration and technology transfer can be promoted. By applying biotechnology, advanced equipment, and machinery to urban agricultural production, it is possible to develop crop and livestock breeds adapted to local soil and climate conditions. Additionally, the introduction of natural pest control methods, such as beneficial insects, can help improve crop and livestock productivity and quality.

7. Conclusion

Vietnam, similar to numerous other nations globally, is experiencing an urbanization process that entails both challenges and opportunities. Although global models demonstrate the efficacy of urban agriculture, most major Vietnamese cities prioritize expansion rather than the simultaneous development of economic, social, cultural, and urban management factors, which are crucial for sustainability. With inherent resources such as natural conditions, a skilled labor force, open policies, and a comprehensive reform mindset from the central to local levels, it is evident that urban agriculture in major urban areas of Vietnam has received attention but has yet to be developed and expanded appropriately. Sustainable urban agriculture offers a solution to address common challenges in urban development. Vietnam’s major cities possess

significant potential for urban agriculture, which is being leveraged to provide a novel approach to sustainable food production in developing countries like Vietnam. Agricultural models from other nations offer valuable lessons, ranging from the development of organic, clean, and ecological agriculture to the application of advanced science and technology in agricultural production. These approaches can enhance efficiency, save time, and accelerate the research and application process in Vietnam's urban areas.

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References

1. Delgado-Baquerizo M, Eldridge DJ, Liu YR, et al. Global homogenization of the structure and function in the soil microbiome of urban greenspaces. Science Advances. 2021; 7(28). doi: 10.1126/sciadv.abg5809
2. Chi VD. Urban agriculture—theory and applicability in using abandoned land in urban areas (Vietnamese). Journal of Social Sciences. 2017; 12(232): 9–12
3. de Wit MM. A Lighthouse for Urban Agriculture. Gastronomica. 2014; 14(1): 9–22. doi: 10.1525/gfc.2014.14.1.9
4. Engels JL, Watson S, Dulai H, et al. Collaborative research to support urban agriculture in the face of change: The case of the Sumida watercress farm on O'ahu. PLOS ONE. 2020; 15(7): e0235661. doi: 10.1371/journal.pone.0235661
5. Orsini F, Kahane R, Nono-Womdim R, et al. Urban agriculture in the developing world: A review. Agronomy for Sustainable Development. 2013; 33(4): 695–720. doi: 10.1007/s13593-013-0143-z
6. Nhuần NU, Huyền NTT, Lý NT. Overview of international experience in urban agricultural development and lessons for Vietnam (Vietnamese). Vietnam J. Agri. Sci. 2023; 21(6): 695–705.
7. Yan Z, Zhou D, Li Y, Zhang L. An integrated assessment on the warming effects of urbanization and agriculture in highly developed urban agglomerations of China. Science of The Total Environment. 2022; 804: 150119. doi: 10.1016/j.scitotenv.2021.150119
8. Piso Z, Goralnik L, Libarkin JC, Lopez MC. Types of urban agricultural stakeholders and their understandings of governance. Ecology and Society. 2019; 24(2). doi: 10.5751/es-10650-240218
9. Yuan GN, Marquez GPB, Deng H, et al. A review on urban agriculture: Technology, socio-economy, and policy. Heliyon. 2022; 8(11): e11583. doi: 10.1016/j.heliyon.2022.e11583
10. Tổng cục thông kê. Report on results of labor and occupation survey 2020 (Vietnamese). Gen. Stat. Off. 2020.
11. T. cục thống Kê. Population data published by urban and rural areas, General Statistics Office (Vietnamese). Available online: https://www.gso.gov.vn/px-web-2/?pxid=V0221-23&theme=Dân số và lao động (accessed on 20 August 2024).
12. Phủ TC. Strategy for sustainable agricultural and rural development for the period 2021–2030, Prime Minister (2022) 2003–2005 (Vietnamese). Available online: https://dataindonesia.id/sektor-riil/detail/angka-konsumsi-ikan-ri-naik-jadi-5648-kgkapita-pada-2022 (accessed on 20 August 2024).
13. Hoa HT. Urban agricultural development in some countries in the world and suggestions for Vietnam, Economic and Forecast Magazine (2022) (Vietnamese). Available online: https://kinhtevadubao.vn/phat-trien-nong-nghiep-do-thi-o-mot-so-quoc-gia-tren-the-gioi-va-goi-y-cho-viet-nam-21233.html (accessed on 20 August 2024).
14. Bhat C, Paschapur A. Urban Agriculture: The Saviour of Rapid Urbanization. Indian Farmer. 2020; 7: 01–09.
15. Hân DT, Hương NTM. Attracting investment capital for agricultural and rural development in Vietnam today (Vietnamese). Journal of Forestry Science and Technology. 2019; 1: 113–121.
16. Anh DT, Trường HX, Mai NN. Sustainable peri-urban agricultural development in Vietnam (Vietnamese). Agricultural Publishing House; 2019.
17. Trưởng LV. Identifying vietnamese urban agriculture (Vietnamese). Available online: https://repository.vnu.edu.vn/bitstream/VNU_123/94/1/Le Van Truong.pdf (accessed on 20 August 2024).
18. U. ban nhân dân T. phố H.C. Minh, Decision on approving the urban agricultural development program in Ho Chi Minh City for the period 2021–2030, vision to 2050 (Vietnamese). Ho Chi Minh City People's Committee; 2024.
19. Nath P. Urban and Peri-Urban Agriculture. The Basics of Human Civilization. 2021; 465–475. doi: 10.1201/9781003246237-35

20. Aparicio-Martínez P, Martinez-Jimenez MP, Perea-Moreno AJ. Health Environment and Sustainable Development. International Journal of Environmental Research and Public Health. 2022; 19(13): 8175. doi: 10.3390/ijerph19138175
21. Nowysz A, Mazur Ł, Vaverková MD, et al. Urban Agriculture as an Alternative Source of Food and Water Security in Today's Sustainable Cities. International Journal of Environmental Research and Public Health. 2022; 19(23): 15597. doi: 10.3390/ijerph192315597
22. Niedermeyer E, Freund G, Krumholz A. Subacute Encephalopathy with Seizures in Alcoholics: A Clinical-Electroencephalographic Study. Clinical Electroencephalography. 1981; 12(3): 113–129. doi: 10.1177/155005948101200304
23. Smit J, Nasr J, Ratta A. Who Are the Urban Farmers? Urban Agric. Food, Jobs Sustain Cities. 2001; 22.
24. Azunre GA, Amponsah O, Peprah C, et al. A review of the role of urban agriculture in the sustainable city discourse. Cities. 2019; 93: 104–119. doi: 10.1016/j.cities.2019.04.006
25. Kayasü S. Assessing the sustainabiliy of urban agriculture the case of cankaya municipality. Uygulamali Etik Arastirma Merk. Appl. Ethics Reseach Cent. 2020; 2003–2005.
26. Tuan BV. Sustainable Urban Agriculture Development: Theory and Practice (Vietnamese). Sustainable Agricultural Development Theory and Practice. 2010.
27. dos Santos LCR, Junior OC, Sampaio CAC. Reflections on the productive chain of sustainability: Oriented product. Revista Brasileira de Planejamento e Desenvolvimento. 2020; 9(2): 214. doi: 10.3895/rbpd.v9n2.11931
28. Shindelar R. The Ecological Sustainability of Local Food Systems. RCC Perspectives. 2015; 1: 19–24.
29. Koscica M. Agropolis: The Role of Urban Agriculture in Addressing Food Insecurity in Developing Cities. Journal of International Affairs. 2014; 67(2): 177–186.
30. Duchemin E, Wegmuller F, Legault AM. Urban agriculture: Multi-dimensional tools for social development in poor neibourghoods. Field Actions Science Reports. 2009; 2(1): 1–8. doi: 10.5194/facts-2-1-2009
31. FAO. Fao library. Food and Agriculture Organization of the United Nations. 1992.
32. Pretty JN, Thompson J, Hinchcliffe F. Sustainable Agriculture: Impacts on Food Production and Challenges for Food Security. Int. Inst. Environ. Dev. 1996.
33. Renting H, van VJ, Halliday R. Enabling Multiple Benefits of Urban Agriculture. Urban Agriculture Magazine. 2023.
34. Brüssow F, Bruessow F, Brüssow H. The role of the plant microbiome for forestry, agriculture and urban greenspace in times of environmental change. Microbial Biotechnology. 2024; 17(6). doi: 10.1111/1751-7915.14482
35. Skar SLG, Pineda-Martos R, Timpe A, et al. Urban agriculture as a keystone contribution towards securing sustainable and healthy development for cities in the future. Blue-Green Systems. 2020; 2(1): 1–27. doi: 10.2166/bgs.2019.931
36. De Zeeuw H, Van Veenhuizen R, Dubbeling M. The role of urban agriculture in building resilient cities in developing countries. The Journal of Agricultural Science. 2011; 149(S1): 153–163. doi: 10.1017/s0021859610001279
37. Kiamba A. The Sustainability of Urban Development in Developing Economies. Cons. J. Sustain. Dev. 2012; 8: 20–25.
38. Audate PP, Fernandez MA, Cloutier G, et al. Scoping review of the impacts of urban agriculture on the determinants of health. BMC Public Health. 2019; 19(1). doi: 10.1186/s12889-019-6885-z
39. Dorr E, Hawes JK, Goldstein B, et al. Food production and resource use of urban farms and gardens: A five-country study. Agronomy for Sustainable Development. 2023; 43(1). doi: 10.1007/s13593-022-00859-4
40. Drechsel P, Cofie O, Keraita B, et al. Recovery and reuse of resources: Enhancing urban resilience in low-income countries. Urban Agric. Mag. 2011; 66–69.
41. Open Development Vietnam. Urbanization in Vietnam (Vietnamese). Available online: https://vietnam.opendevelopmentmekong.net/vi/topics/urbanization-in-vietnam/ (accessed on 20 August 2024).
42. Desalegn G, Tangl A, Fekete-Farkas M, et al. Linking policies and regulations to sustainable finance for the promotion of urban agriculture: Evidence from micro and small businesses. Heliyon. 2024; 10(11): e31938. doi: 10.1016/j.heliyon.2024.e31938
43. World Bank. Transforming Vietnam Agriculture: Adding Value, Reducing Inputs (Vietnamese). Vietnam Development Report. 2016.
44. Da Nang City, Da Nang City Statistics Bureau (Vietnamese). Available online: https://cucthongke.danang.gov.vn/so-lieu (accessed on 20 August 2024).
45. Hương NM. Rural tourism development in Hanoi: Potential and challenges (Vietnamese). Available online: https://www.tapchicongsan.org.vn/web/guest/nghien-cu/-/2018/827693/phat-trien-du-lich-nong-thon-o-ha-noi--tiem-nang-va-thach-thuc.aspx (accessed on 20 August 2024).

46. Anh P. Developing urban agriculture based on high technology application (Vietnamese). Available online: https://dangcongsan.vn/khoa-hoc-va-cong-nghe-voi-su-nghiep-cong-nghiep-hoa-hien-dai-hoa-dat-nuoc/diem-nhan-khoa-hoc-va-cong-nghe/phat-trien-nong-nghiep-do-thi-tren-co-so-ung-dung-cong-nghe-cao-624176.html (accessed on 20 August 2024).
47. Phương ML. Multifunctional Agriculture in Urban Areas: Theoretical and Practical Issues (Vietnamese). Development Economics. 2015; 222: 82.
48. Em NVN. Proposing a sustainable urban agriculture model in Soc Trang city, Soc Trang province (Vietnamese). Can Tho University Journal of Science. 2021; 57(3): 138–146. doi: 10.22144/ctu.jvn.2021.095
49. Gonzalez CG. Seasons of Resistance: Sustainable Agriculture and Food Security in Cuba. Tulane Environ. Law J. 2003; 16: 685–732.
50. Hevia WJ, Olexa MT, Ankersen TT, et al. Seizing the "Organic" Moment: Cuba's Agricultural Crossroads and Certified Organic Export Potential. Florida Journal of International Law. 2017; 29(1): 16–32.
51. Funes-Monzote FR. Farming like we're here to stay: The mixed farming alternative for Cuba. Wageningen Univ. 2008; 211.
52. Nafisi N, Tahir OM, Nafisi S, et al. Effectiveness of Urban Farming Program in Providing Multiple Benefits to the Urban Community in Malaysia. Journal of Architectural Environment & Structural Engineering Research. 2020; 3(3): 4–9. doi: 10.30564/jaeser.v3i3.2138
53. Zabala FJV, Zapata V, Martina M, et al. Urban agriculture: As a transformation strategy for social construction and improvement of the quality of life in vulnerable communities in the urban area. WSEAS Trans. Environ. Dev. 2018; 14: 674–687.
54. Việt TX, Sung TV. Research on the experience of developing smart agriculture in Israel and lessons learned for Lam Dong province (Vietnamese). Yersin Science Journal. 2023; 4: 2–19.
55. da Silva ME, Nascimento LF. Emphasizing Social Issues Toward Sustainable Supply Chain: A Brazilian Perspective. Independent Journal of Management & Production. 2015; 6(2). doi: 10.14807/ijmp.v6i2.288
56. da C Monteiro NO, Cruz DRC, Ferreira IVL, et al. Sustainable practices in brazilian and global agriculture in the 21st century. Contribuciones A Las Ciencias Sociales. 2024; 17(8): e9520. doi: 10.55905/revconv.17n.8–238
57. McKay B, Nehring R. Sustainable agriculture: An assessment of Brazil's family farm programmes in scaling up agroecological food production. IPC-UNDP Work. Pap. 2014.
58. Molossi L, Hoshide AK, de Abreu DC, et al. Agricultural Support and Public Policies Improving Sustainability in Brazil's Beef Industry. Sustainability. 2023; 15(6): 4801. doi: 10.3390/su15064801
59. Ikematsu P, Maurin C. Progress towards a more sustainable and equitable food system in Brazil? Segurança Alimentar e Nutricional. 2024; 30: e023032. doi: 10.20396/san.v30i00.8675118
60. Sridhar A, Balakrishnan A, Jacob MM, et al. Global impact of COVID-19 on agriculture: Role of sustainable agriculture and digital farming. Environmental Science and Pollution Research. 2022; 30(15): 42509–42525. doi: 10.1007/s11356-022-19358-w
61. Bennedetti LV, de Almeida Sinisgalli PA, Ferreira ML, et al. Challenges to Promote Sustainability in Urban Agriculture Models: A Review. International Journal of Environmental Research and Public Health. 2023; 20(3): 2110. doi: 10.3390/ijerph20032110
62. Zimmerer KS, Bell MG, Chirisa I, et al. Grand Challenges in Urban Agriculture: Ecological and Social Approaches to Transformative Sustainability. Frontiers in Sustainable Food Systems. 2021; 5. doi: 10.3389/fsufs.2021.668561
63. Nguyen PL, Nguyen TT, Nguyen MD. An analysis of factors affecting residents' perception of peri-urban agriculture in Hanoi, Vietnam. Management Science Letters. 2020; 3469–3476. doi: 10.5267/j.msl.2020.7.002
64. Adesipo A, Fadeyi O, Kuca K, et al. Smart and Climate-Smart Agricultural Trends as Core Aspects of Smart Village Functions. Sensors. 2020; 20(21): 5977. doi: 10.3390/s20215977