

# STRATEGIC, ECONOMIC AND LEGAL DIMENSIONS OF AGRIBUSINESS DEVELOPMENT IN THE EUROPEAN UNION AND UKRAINE: PERSPECTIVES, CHALLENGES, AND OPPORTUNITIES

ANETA BEŁDYCKA-BÓRAWSKA  
IRENEUSZ ŻUCHOWSKI



**OSTROŁĘCKIE  
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**STRATEGIC, ECONOMIC AND LEGAL  
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## **Abbreviation Meaning**

€	Euro (currency)
EC	European Commission
EITI	Extractives Industries Transparency Initiative
EPA	Economic Partnership Agreement
EU	European Union
FTA	Free Trade Agreement
G8	Group of Eight
GATT	General Agreement on Tariffs and Trade
GSP	Generalized System of Preferences
HS	Harmonized System
IR	International Relations
KPCS	Kimberly Process Certification Scheme
MFN	Most-Favoured Nation
NAMA	Non-Agricultural Market Access
OECD	Organization for Economic Co-operation and Development
RMI	Raw Materials Initiative
RTA	Regional Trade Agreement
SITC	Standard International Trade Classification
TDCA	Agreement on Trade, Development and Cooperation
TFEU	Treaty on the Functioning of the European Union
UNCTAD	United Nations Conference on Trade and Development
UK	United Kingdom
US	United States
VAT	Value-Added Tax
WTO	World Trade Organization
WWII	World War II



## INTRODUCTION

The significance of agribusiness as a strategic economic sector has grown notably in recent decades, transcending the traditional perception of agriculture merely as food production. Today, agribusiness encompasses a comprehensive system that integrates agricultural production, input supply, food processing, and distribution channels, thereby playing a pivotal role in contemporary global economic dynamics. The evolving nature of international trade policies, shifts in market demands, and challenges associated with sustainable agricultural practices highlight the sector's strategic, economic, and legal complexities. This monograph, provides a critical and timely analysis of these multifaceted challenges in a European context, focusing in particular on the European Union (EU) and Ukraine.

The relationship between the EU and Ukraine in the agricultural sector presents an intriguing case for investigation due to Ukraine's geopolitical position, rich agricultural resources, and recent steps towards European integration. Given Ukraine's ongoing journey towards potential EU membership, exploring the strategic, economic, and legal interactions in agribusiness between Ukraine and the EU provides crucial insights. The presented analyses take into consideration existing trade regulations, policy frameworks, and institutional arrangements necessary to enhance effective collaboration, market integration, and sustainable agribusiness development.

The structure of the monograph is meticulously organized into three parts, each addressing specific dimensions relevant to agribusiness development. The first part investigates strategic approaches to trade policies within the EU, emphasizing key issues such as the export restrictions of industrial raw materials and their implications on global trade. This section also explores the evolution and dynamics of grain trade within Poland, the EU, and broader global markets, illuminating the interdependence and strategic positioning of these entities in the international agricultural economy.

The second part of the monograph delineates the diverse factors shaping the development of agribusiness, with a particular emphasis on Ukraine and Poland. This segment provides a thorough exploration of contemporary challenges and opportunities, including the role of organic agriculture in promoting sustainable practices amid economic and political instability in Ukraine. It also

delves into specialized topics such as niche crops, rural development models aligned with European integration strategies, the emergent sector of wine tourism, financial accounting complexities, urban agricultural systems, and the critical issue of legal liabilities faced by farmers concerning environmental protection. Collectively, these discussions underline the dynamic interplay between agribusiness, policy frameworks, and market demands in facilitating sustainable economic growth.

The final part of the monograph addresses the critical aspect of agricultural extension services, particularly within the Ukrainian context. Recognizing the importance of advisory services for enhancing agricultural productivity and sustainability, this section evaluates the current state, challenges, and future prospects of agricultural extension systems. It further integrates discussions of digitalization impacts and highlights the essential role of these services in fostering economic security for small-scale agricultural enterprises.

Methodologically, the contributions in this monograph combine theoretical frameworks with empirical analyses, drawing insights from various interdisciplinary perspectives, including economics, trade policy, rural sociology, environmental science, and law. This integrative approach facilitates a comprehensive understanding of agribusiness complexities and highlights pragmatic policy recommendations aimed at enhancing sectoral efficiency, resilience, and sustainability.

The monograph aims not only to enrich academic discourse but also to serve as a resource for policymakers, practitioners, and stakeholders engaged in agribusiness. By addressing the strategic, economic, and legal dimensions of agribusiness development, the authors collectively underscore the sector's significance in fostering economic integration, sustainability, and resilience amidst changing global economic conditions and emerging geopolitical scenarios.

This comprehensive analysis provided by the contributing authors underscores the necessity of ongoing dialogue and strategic cooperation between the EU and Ukraine. Such collaboration will undoubtedly contribute significantly to advancing agribusiness development, promoting sustainable agricultural practices, and enhancing economic prosperity for both regions in the context of a rapidly evolving global economic landscape.

Aneta Będycka-Bórawska  
Ireneusz Żuchowski

# URBAN AGRICULTURAL SYSTEMS AS A COMPONENT OF SUSTAINABLE ECONOMIC DEVELOPMENT OF TERRITORIAL COMMUNITIES

*Iryna Barulina*

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## 7.1. Introduction

Modern urbanized areas, given the dynamic growth of the population and the growth of climatic anomalies, face several critical challenges. First, the growth of the anthropogenic load on the environment requires the introduction of highly efficient and environmentally balanced forms of management. In particular, in the context of rapid urbanization, when the number of urban populations exceeds the capabilities of existing infrastructure systems, there is an urgent need to optimize spatial planning, diversify food supply sources, and form added value within urban agglomerations. Second, the impact of climate change (sharp temperature fluctuations, droughts, rising sea levels, decline in biodiversity, etc.) requires the application of adaptation strategies that can support the economic resilience and food security of communities.

In this context, urban agricultural systems act as an effective mechanism not only for providing urban residents with fresh agricultural products but also for providing some important environmental and economic functions: reducing logistics costs, stimulating the development of small and medium-sized businesses, reducing the carbon footprint, and optimizing the use of water and land resources. At the same time, there is a need for a scientific justification of the economic feasibility of such systems because only thanks to clearly developed financial, organizational, and legal mechanisms is it possible to ensure their

long-term payback and integration into urban sustainable development strategies.

The relevance of the study is due to the need to develop scientifically grounded methods for assessing the economic efficiency of urban agricultural systems, which will not only determine their competitiveness but will also contribute to the formation of a favorable economic environment for their development. In the context of transformational changes in land relations, changes in the paradigm of land use in cities, and growing demand for local food initiatives, the task of determining the potential of urban agricultural systems as a driver of economic growth of territorial communities. In addition, their development is directly related to employment problems, the formation of local value chains, and the diversification of sources of income in the urban environment. The topic is of particular importance in the context of the reconstruction of the infrastructure and economy of Ukrainian cities after military destruction. The introduction of urban agricultural systems that meet the principles of economic profitability, social cohesion, and environmental safety can become a catalyst for accelerated recovery. These include new jobs, stimulation of domestic investment, and the introduction of innovative technologies with zero or minimal negative impact on the environment. At the same time, there is a growing need to develop a methodologically clear approach to assessing and comparatively analyzing the effectiveness of various forms of urban agricultural production, in particular for the formation of sound management decisions and areas of state or municipal support.

The purpose of the study is to scientifically and methodologically substantiate the economic efficiency of urban agricultural systems and develop recommendations for their integration into the spatial and economic structure of cities, considering the principles of sustainable development.

To achieve this goal, the following tasks have been formulated:

- Analysis of the prerequisites for the development of urban agricultural systems in the context of global economic, environmental and urbanization trends.
- Substantiation of the concept, classification and role of urban agricultural systems in the modern economy, their place in agri-food systems and spatial development of cities.

- Substantiation of the effectiveness of the methodology for assessing the efficiency of urban agricultural systems "Index of Sustainability of Urban Agricultural Systems" considering three key components: economic, environmental and social impact.
- Study of challenges and opportunities for the development of urban agricultural systems in Ukraine, analysis of financial, economic, environmental and organizational barriers that hinder the development of urban agricultural production.
- Formation of recommendations for the integration of urban agricultural systems into spatial planning, development of financial support mechanisms and promotion of investment in urban agricultural systems.

The scientific novelty of the study lies in the development of approaches to ensuring the financial and economic stability of urban agricultural systems through the adaptation of business models that consider social activity, environmental responsibility and diversification of funding sources. Strategies for supporting urban agricultural systems in the restoration of Ukrainian cities through attracting investments, financial incentive mechanisms and innovative approaches to management have been further developed.

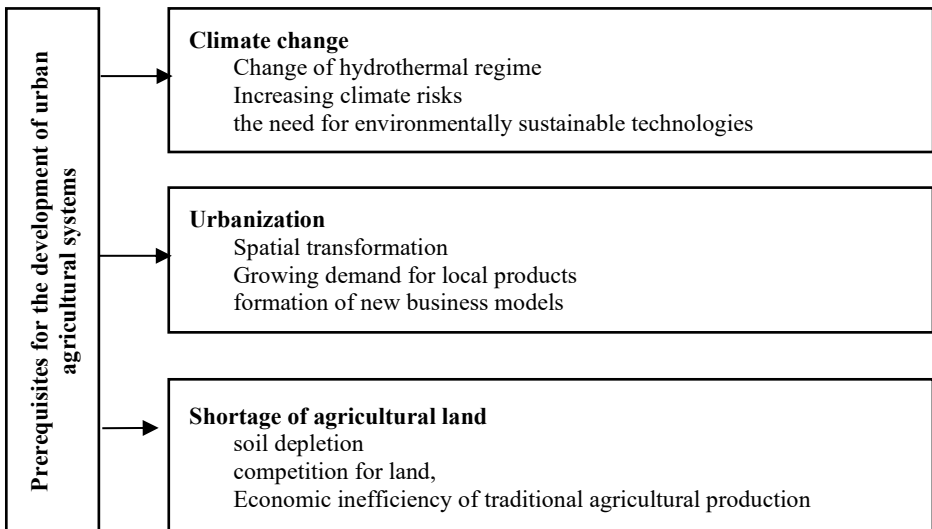
The significance of the study lies in its practical orientation and the possibility of applying the results obtained in various areas of economic management and spatial development of cities. The developed approaches can be used by state authorities and local governments to form strategies to support urban agricultural production, develop financial and institutional incentive mechanisms, and integrate urban agricultural systems into the spatial planning of territorial communities. For enterprises and investors, the results of the study serve as an analytical basis for assessing the investment attractiveness of agribusiness in urban conditions, determining the level of profitability of production, assessing the financial stability of agricultural systems and forecasting their long-term impact on the economy of urban areas. NGOs and social initiatives can use the developed recommendations to expand the socio-economic role of urban agricultural systems in ensuring food security, creating new employment opportunities, stimulating social entrepreneurship and increasing the level of social cohesion of communities.

The results obtained will contribute to the improvement of economic approaches to the development of urban agricultural systems, increasing their efficiency and sustainability in the face of modern urban challenges. The research

also has the potential for further integration into international scientific discussions on urban agricultural production and its role in shaping new economic models for sustainable urban development.

## 7.2. Prerequisites for the development of urban agricultural systems

Climate change and urbanization processes are two key global trends that are radically transforming the economic, social and environmental systems of modern cities. They not only create new challenges for urban areas but also determine the prerequisites for adapting the urban environment to changing conditions, in particular through the introduction of urban agricultural systems. If climate change creates the need for environmentally sustainable models of food production and rational use of resources, then urbanization causes spatial and economic transformation, which requires innovative approaches to the integration of agricultural systems into the urban environment. Thus, the interaction of these two processes significantly affects the development of urban agricultural systems, determining their structural features, economic efficiency and spatial organization.



**Figure 1. Prerequisites for the development of urban agricultural systems**

Source: generated by the author

Climate change is a determining factor in the transformation of spatial planning, economic strategies and agricultural practices in urban areas. Rising average annual temperatures, precipitation instability, increased frequency of extreme weather events and degradation of natural resources create new challenges for the urban environment, in particular in the field of food security, water resources management and urban climate regulation. In the context of urban development, accompanied by an increase in building density, fragmentation of green spaces and an increase in anthropogenic load on the environment, urban agricultural systems are becoming an important element of adaptation to climate change and a tool for ensuring sustainable development of urban areas.

One of the key aspects of the impact of climate change on the prerequisites for the formation of urban agricultural systems is a change in the hydrothermal regime of urbanized areas. An increase in the average annual temperature in cities is accompanied by the effect of an urban heat island, characterized by abnormally high temperatures within urban areas compared to the surrounding rural areas. Decrease in the albedo coefficient and insufficient level of natural ventilation. The intensification of this process in the context of global warming causes an additional burden on urban infrastructure systems, increases the need for energy-efficient technologies and actualizes the need for the development of urban agroecosystems, which contribute to reducing overheating of territories, increasing air humidity and improving microclimatic conditions (Dudiak et al., 2024).

In addition, hydrological instability is essential, manifested in changes in the distribution of precipitation, the frequency of droughts and an increase in the level of evaporation from open surfaces. Urbanized areas are characterized by a high degree of impermeability of soils, which limits the possibilities of natural moisture absorption and causes rapid drainage of precipitation into drainage systems (Kernasiuk, 2021). As a result, the risks of urban floods are formed, causing significant economic losses and destabilizing the water balance of urban areas. The use of urban agricultural systems as an element of the green infrastructure framework of cities helps to reduce flood risks, improve water infiltration into the soil and create local mechanisms for the accumulation of precipitation for further use in agricultural needs.

The adaptive potential of urban agricultural systems is also due to their ecological function, which includes the regulation of the cycle of biogenic elements, the restoration of disturbed ecosystems and the increase in the level of biodiversity. Soil degradation and an increase in the level of atmospheric air

pollution in cities limit the possibilities of traditional agricultural production, which stimulates the development of innovative agricultural technologies, such as aeroponics, hydroponics and aquaponics. Agricultural systems allow for optimizing water consumption, reducing the use of pesticides and chemical fertilizers, and increasing the efficiency of food production in the face of growing climate risks (Langemeyer et al., 2021).

The increase in the frequency and intensity of extreme climatic events also affects the prerequisites for the development of urban agricultural systems. An increase in the number of days with extremely high temperatures, periods of prolonged droughts, severe hurricanes and hailstorms negatively affect the yield of traditional crops, which necessitates the use of adapted plant varieties that have increased resistance to climatic stresses. In addition, the development of vertical agricultural systems and closed ecosystems (greenhouses, urban farms based on artificial lighting) minimizes the risks of crop losses due to adverse climatic conditions and ensures the stability of agricultural production within cities.

In the context of food security, urban agricultural systems play a strategic role in creating local food supply chains, which reduces the dependence of urban areas on centralized imports of agricultural products. Climate change leads to the reduction of agricultural land due to soil degradation, land salinization and rising water scarcity, which stimulates the search for alternative models of food production. Compensating for the loss of agricultural production in traditional rural regions contributes to the diversification of food flows and increases the resilience of urban food systems to global climate risks (Skar et al., 2019).

In addition, climate change affects the socio-economic aspects of the development of urban agricultural systems, in particular, the structure of employment. Growing climate risks are creating a demand for new professions in the field of adaptive agriculture, environmental management, water resources management and innovative agricultural production, which contributes to the creation of jobs in the urban environment.

The current stage of global socio-economic development is accompanied by a rapid increase in the level of urbanization, which causes fundamental transformations in the spatial organization of cities, their resource base and economic structure. Urbanization, as a multifaceted process of concentration of population, capital and infrastructure in urban agglomerations, is a key factor influencing territorial food systems, the availability of natural resources, the configuration of land use and environmental Balance. The formation of meg-

acities, the expansion of suburban areas and the active development of industrial clusters create significant challenges for the agricultural sector, requiring the adaptation of food production models to the conditions of a limited urban spatial structure. In this context, urban agricultural systems are becoming a strategic tool for ensuring the food autonomy of cities, increasing the efficiency of the use of urban land resources and reducing the ecological footprint of urban agglomerations (Sonnino & Hanmer, 2023).

One of the defining aspects of the impact of urbanization on the development of urban agricultural systems is the transformation of spatial planning and land use. The growth of building density and the expansion of transport infrastructure and commercial zones contribute to the reduction of traditional agricultural land, which stimulates the need to rationalize the use of vacant land in the urban environment. The high level of competition for land resources between industrial, residential and recreational facilities forms the need for innovative forms of agricultural production that can be effectively integrated into urban development. In this context, vertical farms, hydroponic and aeroponic systems, rooftop greenhouses, agroparks and multifunctional green spaces play a key role in shaping sustainable urban land use patterns.

In addition, urbanization significantly affects the structure of food consumption and changes in consumer priorities of the population. The demographic growth of urban agglomerations is accompanied by a change in the structure of demand for food products, in particular, an increase in the consumption of ecologically clean, locally grown, organic products, which stimulates the development of urban agricultural production (Satterthwaite et al., 2020). In megacities, the concept of short food supply chains is being formed, which provides for minimizing logistics costs, reducing the carbon footprint of transporting products and ensuring the economic availability of fresh food for the urban population. This contributes to the active development of farmers' cooperatives, urban community gardens, local food initiatives and urban farming programs that ensure the sustainability of urban food systems in the face of global economic and environmental challenges.

Of particular importance in the process of urbanization is the economic aspect of the development of urban agricultural systems, which is determined by the high concentration of capital, innovative technologies and financial instruments in urban centers. The creation of agro-industrial clusters within urban areas contributes to the formation of new business models of urban farming, the development of startups in the field of agricultural technologies, the attraction of venture capital to sustainable farming projects and the introduction of digital

technologies in urban areas' agricultural production. The use of artificial intelligence, IoT solutions, automated climate control systems, biotechnology, and robotic mechanisms for growing plants increases the productivity of agricultural systems, minimizes production losses, and creates new economic opportunities for urban agricultural enterprises (Van Gerrewey et al., 2022).

Another significant consequence of urbanization is the increase in the energy burden on urban areas and the need to develop energy-efficient models of agricultural production. Traditional agricultural technologies are resource-intensive, which makes it impossible for them to be widely used in urban environments due to limited access to energy, water and land resources. In this context, urban agricultural systems focus on the use of renewable energy sources, the use of closed production cycles, the recycling of water resources and the integration of energy-saving technologies. This allows not only to reduce the environmental burden on the urban environment, but also to ensure the long-term economic efficiency of urban agricultural production.

Urbanization also causes significant social changes that directly affect the structure of employment and the formation of human capital in the field of urban agricultural production. Industrialization, automation, and digitalization of urban economies are accompanied by the displacement of traditional agricultural practices from the labor market, which creates a need for new professional competencies and specializations. The development of urban agricultural systems stimulates the creation of jobs in the field of ecological farming, agrotechnological engineering, food systems management and urban planning, which contributes to increasing the level of social stability in cities and ensures the sustainability of local economic systems.

In addition, urbanization processes stimulate the expansion of institutional mechanisms to support urban agricultural systems, including state subsidy programs, investment funds, tax incentives for ecological farming, grant initiatives, and financial mechanisms for sustainable development. The involvement of public and private capital in the development of urban agricultural production contributes to the formation of inclusive food policies, the strengthening of urban agricultural cooperatives and the development of multifunctional ecosystems of urban farming.

The global trend of agricultural land reduction is a critical factor that necessitates the transformation of agri-food systems, in particular through the integration of urban agricultural systems into the spatial structure of cities. The depletion of soil resources, the growth of urbanized areas, industrial expansion

and changes in land use cause a structural shortage of land suitable for agricultural activities, which, in turn, threatens food security and the sustainability of agricultural production. In conditions when agricultural landscapes are increasingly giving way to residential and industrial development, the development of urban agricultural systems is becoming a strategic direction for ensuring the food autonomy of cities, rationalizing the use of land resources and minimizing the negative impact of anthropogenic factors on ecosystems.

Separately, it should be noted that one of the determining factors in the reduction of agricultural land is the accelerated expansion of urbanized areas, which is accompanied by the intensive development of peripheral zones of cities. The economic attractiveness of urban lands, due to the high level of capitalization of real estate and the dynamic development of infrastructure, leads to competition between agricultural and non-agricultural use of land resources, which leads to their mass withdrawal from agricultural production. International organizations estimate that the annual loss of productive agricultural land due to urbanization is about 3.3 million hectares in the world, which is equivalent to the area of an average European country (FAO, 2023). In Ukraine, this problem is also becoming alarming, as intensive urbanization, expansion of transport routes, logistics hubs and industrial facilities cause a rapid reduction in agricultural land, especially in the suburbs of large agglomerations.

In addition to the urbanization factor, land degradation is another key factor in the formation of agricultural land shortages. Unfavorable climatic changes, soil erosion, desertification, salinization and depletion of agricultural landscapes cause a decrease in the productivity of traditional agricultural production, which increases the need to search for alternative models of agriculture. Soil depletion is especially relevant in countries with a high level of anthropogenic load, where intensive use of fertilizers, monoculture farming and irrational agricultural technologies lead to a decrease in organic matter in soils, which makes it impossible for them to be further used in traditional agriculture. In this context, urban agricultural systems based on soilless cultivation technologies, closed ecosystems and innovative methods of resource management make it possible to compensate for the loss of traditional agricultural land and ensure efficient food production within the urbanized space.

The shortage of agricultural land is also a consequence of the economic inefficiency of traditional agricultural production in regions with high capitalization of land resources. In cities and suburban areas, where the market value of land is extremely high, the use of land for traditional agriculture becomes unprofitable compared to other economic activities. This causes agricultural

production to be displaced from areas with a high level of urbanization, which in turn increases logistics costs, rising food prices and increasing dependence of urban food systems on foreign markets. The formation of urban agricultural systems allows for minimizing transport costs, ensuring the stability of food supplies and optimizing the use of urbanized space, which is critically important in the context of ensuring the economic efficiency of the urban food sector.

Another important factor is the growing role of ecological farming, which involves the limited use of chemical fertilizers, rational management of water resources and the reduction of greenhouse gas emissions. In the context of a shortage of agricultural land, traditional methods of extensive production become less effective, while urban agricultural systems offer closed production cycles, the use of alternative energy sources, the minimization of resource losses and adaptation to environmental challenges. This contributes to the development of "smart agriculture", digital management of agricultural production, automation of production processes and the use of precision farming technologies, which allows you to obtain stable yields under conditions of limited land resources.

Thus, climate change, urbanization and shortage of agricultural land are key prerequisites for the development of urban agricultural systems, forming the need to adapt food systems to modern global challenges. Increasing climate threats, including rising average annual temperatures, water imbalances and increasing frequency of extreme weather events, pose risks to traditional agriculture, which stimulates the search for innovative approaches to food cultivation. At the same time, urbanization processes entail spatial transformation, which is accompanied by a high level of competition for land resources, fragmentation of agricultural landscapes and an increase in demand for locally produced products. The shortage of agricultural land caused by urbanization, soil degradation and the economic unprofitability of traditional agricultural production in cities and suburbs requires a rethinking of land use models and the introduction of alternative cultivation methods. The interconnection of these factors forms an objective need for the development of urban agricultural systems that ensure the efficient use of urban space, the reduction of food supply chains, the reduction of the environmental burden and the increase of the sustainability of urban food systems. In this paradigm, urban agricultural systems act not only as a response to threats but also as a strategic tool to ensure the sustainable development of urbanized areas in the context of modern global transformations.

### **7.3. Concept, classification and role of urban agricultural systems**

Urban agricultural systems are one of the key elements of modern urban transformation, combining economic, social and environmental aspects of the development of urban areas. Their concept was formed under the influence of global challenges, in particular climate change, growing urbanization, shortage of agricultural land and the need to ensure a sustainable food supply in conditions of limited natural resources. At the same time, urban agricultural systems should be considered not only as a means of food supply but also as a strategic tool of spatial planning that contributes to the creation of self-sufficient, environmentally sustainable and cost-effective urban environments.

In modern scientific research, urban agricultural systems are viewed through the prism of three main dimensions: environmental, economic, and social (Kumar & Yadav, 2023). In the context of environmental sustainability, they contribute to reducing the carbon footprint, optimizing the use of water and land resources, managing organic waste and reducing the negative impact of urbanization on the environment. The economic role of urban agricultural systems is manifested in the formation of local food chains, the creation of new jobs, the diversification of economic activities of cities and the stimulation of entrepreneurship in the field of urban farming. The social dimension includes the development of urban communities, ensuring food security, increasing the level of social cohesion and improving the quality of life of the urban population (Fanfani & Duží, 2022).

The growing interest in urban agricultural systems is explained by their institutional integration into urban development strategies. At the political level, they are seen as a tool for sustainable development, which allows reducing the dependence of cities on external food supplies, supporting local production and strengthening the ecosystem functions of urban spaces (Wesseler & von Braun, 2017). In many countries, including the Netherlands, the United States and Canada, urban agricultural systems are already part of strategic urban planning, which is confirmed by the provision of state subsidies, tax benefits and the creation of legal mechanisms for their integration into the spatial structure of urbanized areas.

Information support for urban agricultural systems also plays an important role in their development. The media popularize the concept of urban farming through the coverage of successful cases of urban farms, environmental initiatives and social projects, which contributes to the formation of a posi-

tive public attitude towards this practice. On the other hand, society increasingly considers urban agricultural systems not only as a food initiative but as a comprehensive mechanism for cities to adapt to global challenges, including the food crisis, climate change and social disintegration.

In international scientific practice, urban agricultural systems are defined through a wide range of terms, including "urban agriculture", "urban farming", "community gardening", "rooftop farming", each of which has a certain specificity depending on the territorial context, the level of integration into the urban environment and the target functionality. Despite the diversity of approaches to definition, the key characteristic of urban agricultural systems remains their integration into the urban environment to produce food, increase the resilience of cities and preserve the ecological balance.

Urban agricultural systems, as a complex phenomenon of modern urban development, form new paradigms of integration of agricultural activity into the urban environment, which necessitates their regulation. However, the domestic legal framework does not contain clearly defined mechanisms for promoting or regulating these activities, which creates numerous administrative and economic barriers to their development. One of the key problems is the lack of a coordinated terminological apparatus, which complicates the institutional integration of urban agricultural systems into spatial planning, agricultural policy and environmental strategies of the state.

The analysis of Ukrainian regulations shows that none of the current legislative documents contain a clear definition of urban agricultural systems or provisions regulating their activities (Barulina, 2024). The main legislative barriers are related to restrictions on the use of land resources within urban areas. In particular, the Land Code of Ukraine does not provide for a special legal regime for agricultural production in cities, which complicates the implementation of urban farming initiatives due to the need to change the purpose of land (Land Code of Ukraine, 2025). This significantly narrows the opportunities for attracting investment in this area, reduces the flexibility of legal regulation and hinders the institutional development of urban agricultural systems.

Also, the Law of Ukraine "On Farming" does not contain provisions that would take into account the specifics of urban farming (On Farming, 2024). The support mechanisms and legal conditions for the activities of farms defined in the law are not adapted to the specifics of urban agricultural systems, which complicates their access to financial instruments, subsidies and agribusiness support programs. A similar situation is observed in the Law of Ukraine "On Personal Farming", which regulates the activities of agricultural producers

only within agricultural land, not covering urban agricultural systems (On Personal Farming, 2024).

A separate problem is that urban planning legislation does not contain mechanisms for taking urban agricultural systems into account in spatial planning. Master plans of cities, as a rule, are focused on other land use priorities, while the Law of Ukraine "On Regulation of Urban Planning Activities" does not provide for regulatory provisions on the development of urban agricultural initiatives (On Regulation of Urban Planning Activities, 2025). The lack of integration of urban agricultural systems into urban planning documents leads to the fragmentation of their development and complicates the process of their legalization.

Instead, environmental legislation, in particular the Law of Ukraine "On Environmental Protection", contains provisions that can potentially contribute to the development of urban agricultural systems in the context of sustainable use of natural resources and rational management of organic waste (On Environmental Protection, 2024). However, these provisions are not directly related to the development of urban farming as a separate area of activity, which creates additional legal uncertainties.

In addition to legislative barriers, significant challenges are the imperfection of the terminological apparatus used in the Ukrainian scientific and legal field. In addition, there is terminological uncertainty, which greatly complicates the coherence between different regulations and scientific research. In the Ukrainian scientific discourse, different terms are used to refer to urban agricultural systems – "urban agriculture", "urban farming", "urban farming", "urban agriculture", "city farming" - which complicates their interpretation and implementation in the legal plane. At the same time, certain terms cause lexical contradictions since they combine concepts that are opposite in the classical sense ("urban" and "agriculture"), which can affect the perception of this phenomenon both in scientific circles and among practitioners.

A detailed analysis of foreign definitions of urban agricultural systems, in particular those proposed by FAO (n.d.), McEldowney (2017), Mougeot (2001), and Smit (1996), demonstrates their significant variability depending on conceptual approaches to the study of this phenomenon. In the international scientific environment, they are defined either as a branch of urban spatial planning and environmental regulation, as economic activities aimed at creating sustainable food systems within the cities, or as a multifunctional system that integrates food production, social cohesion and environmental sustainability of urban areas. Despite the wide range of approaches, most definitions emphasize

that urban agricultural systems should not be limited exclusively to food cultivation, as they also perform ecosystem, social and economic functions, which is a key difference from traditional agriculture.

An important aspect of the development of urban agricultural systems is their integration into the spatial planning of cities, which in world practice is implemented through the expansion of green space zones, the creation of special zones for urban agriculture, institutional support for agricultural initiatives and the introduction of legal mechanisms for their incorporation into urban development strategies. The absence of such mechanisms in Ukraine indicates the need to form a comprehensive policy in the field of urban agricultural systems, which will include modification of legislative norms, adaptation of spatial planning, introduction of financial incentives and support for socio-economic initiatives within cities.

Therefore, the presence of legal barriers, terminological inconsistencies and the lack of a strategic vision for the development of urban agricultural systems in Ukraine create significant challenges for their implementation in the urban space. To ensure their effective development, it is necessary to conceptually define this phenomenon, adapt legal regulation and introduce institutional mechanisms to support urban agricultural production. This will not only eliminate existing regulatory restrictions but also contribute to expanding opportunities for the implementation of urban agricultural initiatives, which play a key role in ensuring food security, ecological balance and socio-economic sustainability of urbanized areas.

The analysis indicates the need to form a unified definition that would reflect the specifics of urban agricultural systems in a broad socioeconomic and environmental context. The existing definitions proposed by foreign researchers have a significant level of detail and consider the economic, environmental and social aspects of urban agricultural production. However, they do not consider the specifics of the Ukrainian legal and spatial context, which necessitates the development of an adapted definition.

The analysis of the existing definitions of urban agricultural systems allows us to identify several important aspects that need to be clarified within the framework of this study. Firstly, most scientific approaches focus on the technological and environmental aspects of urban farming without fully considering its economic component and role in the structural development of urban areas. Second, the definitions of urban agricultural systems are often limited to traditional agricultural production methods, not considering innovative agricultural

technologies, including vertical farming, closed cultivation systems, and intelligent agricultural platforms. Thirdly, in many cases, the concept of urban agricultural systems is considered only in the context of small-scale production, although modern practice demonstrates the growth of large commercial agricultural enterprises integrating into urban infrastructure.

Based on the analysis, the author's definition of urban agricultural systems can be formulated as follows:

"Urban agricultural systems are systems located in urban communities that are engaged in the production, processing and distribution of various food and non-food products of crop and livestock production, using intensive and innovative methods based on the principles of circular economy and sustainable development, to meet the daily demand of urban consumers, contribute to the preservation of the environment and support the socio-economic development of local communities."

This definition allows integrating the environmental, economic and social functions of urban agricultural systems into a single conceptual framework, which contributes to a more comprehensive understanding of their role in the development of modern cities. In particular, urban agricultural systems can act not only as an alternative to traditional agriculture but also become a key element of urban ecosystems that ensure the circularity of resources, reduce the environmental burden and increase the self-sufficiency of urban areas.

Thus, the development of urban agricultural systems is a natural process due to global challenges related to sustainable food supply, spatial planning and environmental safety of cities. Their integration into the urban environment allows solving complex problems of optimizing land use, forming a circular urban economy and ensuring the sustainability of urban systems in the long term.

Urban agricultural systems play a significant role in the development of food systems of cities, ensuring ecological balance and the formation of social cohesion, but their diversity and multifunctionality complicate the process of their classification. The lack of a single typology creates conceptual uncertainty, which complicates the formation of effective policies for their support, assessment of economic and environmental effects, and integration into sustainable urban development strategies (Barulina, 2024).

At the international level, there are already typologies developed within the framework of European and global studies, such as COST Action Urban Agriculture Europe (Lohrberg et al., 2016, p. 38), the European Forum on Urban Agriculture (2022) and FAO, Rikolto and RUAF (2022, p. 156), which make it possible to consider urban agricultural systems in various aspects –

from social initiatives to high-tech agro-industrial production. However, the analysis of these typologies and their comparative characteristics (See Table 1.) demonstrates significant differences in approaches to the classification of urban agricultural systems, which is due to different research focuses and priorities.

In particular, COST Action Urban Agriculture Europe pays more attention to traditional forms of urban agriculture, such as community gardens and educational and therapeutic gardens, which focus on social inclusion and environmental sustainability. Instead, EFUA focuses on high-tech systems, including vertical farms and commercial urban agribusinesses, aimed at maximizing the use of urban resources. In turn, the FAO, Rikolto and RUAF typology systematizes urban agricultural systems according to the degree of commercial orientation, outlining the difference between food initiatives for self-consumption and market-oriented models.

The importance of developing a clear typology of urban agricultural systems is due to the need to unify approaches to their analysis, the development of support policies and the formation of regulation. A structured typology allows not only to systematize urban agricultural systems according to the main characteristics, such as production methods, forms of ownership, level of commercialization, location and environmental aspects, but also to determine the strategic directions of their development in the conditions of a specific urban environment.

**Table 1. Comparative analysis of typologies of urban agricultural systems**

<b>Comparison aspects</b>	<b>COST Action Urban Agriculture Europe</b>	<b>EFUA (European Forum on Urban Agriculture)</b>	<b>FAO, Rikolto and RUAF</b>
Social integration	Community gardens and garden associations promote social cohesion	Community parks and social farms integrate communities through agriculture	Community and collective gardens strengthen social bonds
Food security	Urban farms and garden associations contribute to food security	Urban farms provide products for both consumption and sale	Home gardens and commercial farms provide products for consumption and sale
Environmental sustainability	Permaculture gardens contribute to environmental sustainability	Vertical farms and innovative projects focused on reducing resources	Using organic methods and permaculture to minimize impact

Commercial Component	Urban farms are focused on commercial production	Some farms are sales-oriented, but many initiatives have social goals	Clear distinction between commercial and social agricultural systems
Technological Innovation	Less emphasis on technology, more traditional forms	Vertical trusses and hydroponics play a key role	Use of technology for commercial production and institutions
Scope of activity	Covers different scales – from gardens to farms	Covers a wider range from public to large farms	Households and commercial households of various sizes

Source: generated by the author

One of the key aspects of the problem is that most of the existing typologies are developed considering the socio-economic context of developed countries, where urban agricultural systems are already integrated into spatial planning, receive state support and are considered as part of the food strategy. At the same time, in Ukraine, urban agricultural systems do not yet have a clear regulatory definition, which complicates their development. The lack of formal legal status for many types of urban agricultural systems, such as community gardens, social farms or vertical farms, creates institutional barriers to their implementation, limiting the possibilities of obtaining financial support and assistance from municipalities.

In addition, the problem lies in the terminological ambiguity since different research and policy institutions use different concepts to refer to urban agricultural systems, which complicates their implementation in state programs. In the scientific literature, you can find such terms as "urban agriculture", "urban farming", "city farming", and "urban agriculture", which, despite their similarity, can have different contexts of application.

Thus, the lack of a generally accepted classification of urban agricultural systems hinders their integrated development and integration into the spatial, economic and social strategies of cities. To eliminate this problem, it is necessary to adapt the existing typologies to the specific features of the Ukrainian urban environment, which will allow:

- To create a clear classification system for urban agricultural systems by their functional characteristics and level of integration into the urban environment.

- To identify potential directions for the development of urban agricultural systems that best meet the challenges of urbanized territories of Ukraine.
- Develop effective support policies for certain types of agricultural systems, considering their socio-economic and environmental functions.
- To contribute to the formation of the legal status of urban agricultural systems and the definition of mechanisms for their regulation.

Thus, the systematization of urban agricultural systems according to clear criteria is an important step for their effective development and integration into the urban environment. Considering the specifics of urban space and the ecological, social and economic aspects of their functioning, it is advisable to form a coordinated typology that will reflect the key characteristics and differences between different forms of urban agricultural production.

With this in mind, this study proposes the author's typology of urban agricultural systems, which considers international experience and adapts to Ukrainian realities.

Typology of urban agricultural systems for Ukraine:

1. Urban farm – agricultural enterprises located within urban territorial communities and specializing in the cultivation of various types of agricultural products, such as vegetables, fruits, herbs, as well as animal husbandry, poultry farming and aquaculture. These farms operate within an urban or suburban area and play an important role in providing citizens with fresh, local products. In addition to the main activity of growing products for sale, urban farms offer a wide range of additional services that combine agricultural activities with recreational and educational activities. Such farms organize agritourism, public tastings, and master classes and can also provide space for cultural events, festivals and photo shoots. This helps to strengthen the ties between producers and consumers, as well as create a sustainable economic model.
2. A public garden is a shared urban space where locals collectively grow vegetables, fruits, and other plants for their consumption or sharing. These gardens are often located in adjoining areas, municipal lands, or areas specifically designated by local authorities. Public gardens not only have a food function but also fulfil a social and ecological role, contributing to community cohesion and greening the city.
3. Home gardens are private household plots where owners grow vegetables, fruits, berries, and other plants and also engage in animal husbandry for their consumption and sometimes to sell surpluses in local markets.

This system is the most common in Ukraine, especially in the suburbs. Home gardens play a key role in ensuring food security at the household level, enabling people to reduce food costs and get fresh produce throughout the year.

4. A social farm is an enterprise that combines the cultivation of agricultural products with a social mission aimed at supporting vulnerable segments of the population. These can be people with disabilities, war veterans, children, or other groups in need of rehabilitation and social integration. In the context of the war in Ukraine, the importance of such farms increases significantly, as many veterans who have been injured or become disabled need physical and psychological rehabilitation. Social farms offer them the opportunity to recover through work on the land, communication with nature and socialization in communities.
5. Educational farms are special agricultural initiatives created to teach children, youth and adults the basics of agriculture, sustainable development and environmental awareness. Such farms are often organized at schools, educational institutions or communities and provide the opportunity for interactive learning through direct participation in agricultural activities. In Ukraine, educational farms are of particular importance, as agricultural skills can be important for self-sufficiency and economic support of communities, especially in difficult times.
6. Vertical farms are high-tech agricultural systems that use vertical planes to grow plants in urban environments. Through the use of technologies such as hydroponics, aeroponics, and artificial lighting, these farms allow greens, vegetables, and even mushrooms to be grown in a limited area. The main advantage of vertical farms is the possibility of intensifying agricultural production in densely populated urban areas or even in rooms where conventional farming methods are not possible.

The development of a systematic typology of urban agricultural systems is an important element of ensuring the sustainable development of urbanized territories of Ukraine. It allows not only to structure approaches to urban agricultural production but also to create an effective basis for assessing their economic efficiency, environmental sustainability and social impact. In the context of growing food risks caused by hostilities, economic instability and climate change, urban agricultural systems act not just as an element of alternative production but as a strategic tool for the formation of an autonomous, adaptive and efficient food system of urban communities. In Ukraine, where a significant

part of agri-food chains has been disrupted due to the destruction of infrastructure and logistical constraints, the development of urban agricultural systems allows for minimizing dependence on imported products, reducing transportation costs, reducing transportation losses and providing citizens with affordable and high-quality food products.

The proposed typology considers various forms and models of functioning of urban agricultural systems, which makes it possible to distinguish them according to the main criteria: economic orientation, social functionality, level of technological support and scale of production. In particular, urban farms act as important actors in the formation of local food markets, as they provide a commercial component focused on profitable production and sale of products, which contributes to the development of small and medium-sized businesses. At the same time, public gardens and social farms form alternative models aimed at social integration, increasing food security among vulnerable segments of the population and activating civil society by involving citizens in joint work. Home gardens, which traditionally occupy an important niche in the Ukrainian economy of households, reduce the level of dependence on external sources of supply, ensure self-employment and contribute to the rational use of urban space.

The development of educational farms plays a significant role in the formation of human resources of the agro-industrial complex, as it contributes to the involvement of young people in agricultural production and the popularization of agribusiness as a promising field of activity. Vertical farms focused on high-tech production provide innovative solutions for intensifying agricultural processes within an urbanized environment. They allow optimizing the use of urban resources, reducing the cost of transportation, water and energy resources, which is critical for the formation of a circular economy in the face of a shortage of natural resources.

The interaction between different types of urban agricultural systems is a key aspect of their effective functioning. Urban farms can act not only as production units but also as educational and social hubs, providing training and rehabilitation for socially vulnerable groups, including war veterans and internally displaced persons. Public gardens can be integrated into municipal development programs aimed at improving the ecological quality of urban spaces, contributing to reducing the level of thermal pollution, the formation of natural recreational areas and the formation of an ecologically sustainable environment. Educational farms can expand their activities through cooperation with

urban farm enterprises, providing young people with practical skills in agricultural business, which will contribute to the creation of new jobs and the development of agricultural innovations in urban communities.

Particular attention should be paid to commercial models of interaction, in particular the formation of cooperative associations, which allow optimizing costs and ensuring joint sales of products. Collaboration between vertical farms and urban farmers can contribute to the creation of high-performance production clusters that apply economies of scale, ensuring the competitiveness of urban agribusiness at the national level. Institutional support from municipalities, including the provision of tax incentives, incentives for investment in high-tech agricultural systems and the development of strategic programs for the development of urban agriculture, can significantly improve the conditions for the functioning of these systems.

Thus, the typology of urban agricultural systems allows us to form a systematic vision of the role of urban agricultural production in the socioeconomic development of urbanized areas. It contributes to the identification of strategic priorities for the development of this area, allows you to identify potential risks and barriers to its spread, and also serves as a basis for the development of effective support mechanisms at the level of public policy. The integration of urban agricultural systems into the overall economic model of the city will contribute to increasing the level of food security, economic diversification, social cohesion and environmental sustainability, which is critically important in the current conditions of urbanization and global transformations.

#### **7.4. Methodology for assessing the efficiency of urban agricultural systems: "Index of sustainability of urban agricultural systems"**

Despite the significant potential of urban agricultural systems, their impact is still not clear and easily understood due to the lack of unified approaches to assessment. This makes it difficult for communities, city planners, and investors to determine their real value and effectiveness. To maximize the benefits of urban agricultural systems and promote sustainable development, it is necessary to develop a methodology that will allow assessing their economic, environmental and social impact in a complex.

Today, there are many generally accepted and authoritative methods for assessing certain aspects of the effectiveness of enterprises, projects and initia-

tives – economic, environmental and social – which foreign and domestic scientists successfully apply to study the effectiveness of urban agricultural systems. Among these tools, the following can be distinguished.

To assess economic efficiency, methods are used to determine how successfully the agricultural system functions from a financial point of view:

1. Cost-Benefit Analysis (CBA), which compares all costs associated with the implementation of a project (e.g. initial investment, operating and accompanying costs) with the potential benefits it can bring (revenues, cost reductions, positive externalities).

Thus, in a study (Hosseinpour et al., 2022). The authors used CBA to assess the feasibility of introducing urban agriculture in park design. The resulting cost index of 4.08 indicated the cost-effectiveness and low risks of such a solution, which confirmed the effectiveness of this method for assessing the effectiveness of urban agricultural systems. At the same time, CBA may not fully consider environmental and social aspects, so it is often combined with other methods for a more comprehensive assessment of sustainable projects, such as urban agricultural systems.

2. Net Present Value (NPV) is a financial instrument used to assess the long-term profitability of a project, considering the time value of money. Its essence is to compare the present (discounted) value of future cash receipts from the project with the present cost of its implementation. If the NPV is positive, it indicates the financial feasibility of the project (the benefits outweigh the costs), while the negative NPV value indicates the unprofitability of the investment.

As indicated in the study (Avgoustaki & Xydis, 2020). The method is widely used in the field of investment decision-making, as it allows you to consider key factors such as risk and inflation, which can have a significant impact on the sustainability of the project in the long term.

To assess environmental efficiency, the following methods are used to measure the impact of activities on the environment:

1. Life Cycle Assessment (LCA) is a technique that allows you to comprehensively assess the environmental impact of a product, service or process at all stages of its life cycle: from the extraction of raw materials and production to use and disposal. LCA makes it possible to estimate the number of resources used, energy consumed, and the amount of pollution generated at each stage. This allows you to determine the environmental sustainability of the project and ways to minimize the negative impact.

As indicated in the study (Langemeyer et al., 2021), this method is particularly useful for evaluating urban agricultural systems focused on increasing the sustainability of the urban environment and reducing the carbon footprint and energy load. LCA helps identify "hot spots" – the stages that consume the most resources or create the most pollution, which is critical to achieving environmental sustainability. However, this method is quite time-consuming and requires significant resources and detailed data, which can be an obstacle to its application by small businesses or communities.

2. The Ecological Footprint is an indicator that measures the number of natural resources needed to support a particular activity, consumption or lifestyle compared to the planet's ability to renew these resources. It is expressed in hectares and considers the area of land and water resources necessary for the production of consumed goods, the absorption of emissions (such as CO<sub>2</sub>) and the disposal of waste.

As indicated in the study (Taylor & Lovell, 2021), The ecological footprint is an effective tool for assessing the environmental sustainability of urban agricultural systems and their compliance with the environmental standards of the urbanized environment. Cities and even countries. At the same time, its use has certain limitations, in particular, the underestimation of local environmental features and complex ecosystem relationships.

The following methods are used to assess social efficiency:

1. The Social Impact Assessment (SIA) is a methodology that analyses the potential impact of a project on the social aspects of the population's life, including employment, well-being, social inclusion, and quality of life. SIA investigates how the implementation of the project can affect different populations, with a particular focus on vulnerable categories, and determines whether these changes will contribute to improving social conditions and community cohesion.

The main goal of SIA is to identify both positive and negative social impacts, which allows project managers to prevent risks and adapt the project to the interests of the community. This contributes to the formation of a more sustainable foundation for the project, ensuring the integration of the needs and opinions of stakeholders. As noted by Bailkey and Nasr (2021) Urban agricultural systems can significantly influence social aspects, increasing food security, strengthening social cohesion and creating new economic opportunities for local communities. The use

of SIA in such projects allows not only the assessment of these benefits but also the consideration of all the factors that affect the sustainability of the project, providing an integrated approach to social assessment in the urban environment.

However, the SIA method has certain limitations: it is often based on qualitative data and respondents' opinions, which can lead to subjectivity, making it difficult to quantify and compare the results with other projects.

2. Stakeholder Analysis is a method that allows you to identify the interests, needs and influences of different groups or individuals involved in the implementation of a project for a deeper understanding of their expectations and possible reactions. It includes identifying key stakeholders (e.g. local communities, investors, government authorities, partners), analysing their impact on the project and assessing their level of interest or support.

The application of this method allows you to adapt communication and interaction strategies to different groups, contributing to increasing social cohesion and reducing the risks of conflicts. Considering the interests of all stakeholders ensures transparency, openness and building trust in the project. Urban agricultural systems can significantly contribute to the creation of sustainable cities, and the integration of the stakeholder analysis approach allows not only to meet the needs of communities but also to promote social inclusion. Such an integrated approach to considering the interests of different groups increases the efficiency of the implementation of urban agricultural system projects and contributes to their sustainable development.

However, the assessment of urban agricultural systems solely by individual components does not allow a complete and objective picture of their impact and potential. In modern conditions, there is a growing need to apply integrated approaches that combine economic, environmental and social aspects in a single assessment system. This approach allows you to conduct a comprehensive analysis of the effectiveness of agricultural systems and make informed decisions on their implementation and development.

To ensure a comprehensive approach to assessing the effectiveness of urban agricultural systems, it is important to apply integrated methods that consider all dimensions – economic, environmental and social. One such approach

is the Triple Bottom Line (TBL) concept, which focuses not only on financial performance but also on sustainability aspects.

The TBL concept evaluates the effectiveness of an organization or project through three main dimensions: economic, environmental and social. Its goal is to help organizations and communities make decisions aimed at sustainable development and not be limited by financial indicators.

TBL is an effective tool for assessing the sustainability of urban agricultural systems, as it considers all key aspects important for sustainable development in an urbanized environment. As the article by (Li et al. 2022) demonstrates, TBL has been successfully applied to assess urban agriculture in Shanghai, which confirms its ability to provide a comprehensive assessment of sustainability, highlighting the importance of each of the dimensions for the development of urban agricultural systems.

Based on the analysis, the author's methodology "Index of Sustainability of Urban Agricultural Systems" was developed, which considers the specifics of the economic, environmental and social impact of urban agricultural systems, adapted to the conditions of urban development of Ukraine (Barulina, 2024).

This index allows you to systematically assess the effectiveness of agricultural systems in three main areas – economic, environmental and social – and determine their impact on the community, the environment and the local economy.

The Urban Agricultural Systems Sustainability Index provides an integrated approach to assessing the efficiency of urban agricultural systems. It is focused on determining the level of sustainability, analysing the impact on social cohesion and environmental stability, and assessing the ability of agricultural systems to ensure long-term economic efficiency.

The methodology considers three main areas: economic, environmental and social. Within each direction, 10 indicators cover the key components of the sustainable development of urban agricultural systems, allowing for a comprehensive assessment of their effectiveness and potential.

The economic direction assesses financial efficiency and contribution to the local economy.

List of indicators:

1. Increase in tax revenues
2. Number of jobs created
3. Profitability of production
4. Investment return

5. External funds raised
6. Return on investment
7. Unit Area Maintenance Costs
8. Volume of products produced per unit area
9. Gross income per unit area
10. Diversification

The environmental direction assesses the impact of urban agricultural systems on the environment, in particular the efficiency of resource use, reduction of pollution and the promotion of environmental sustainability.

List of indicators:

1. Improving air quality
2. Organic waste management efficiency
3. Energy consumption per unit of production
4. Water consumption per unit of production
5. Energy efficiency and use of renewable energy
6. Environmental Efficiency of Transport Logistics
7. Maintaining the natural nutrient cycle
8. The level of environmental responsibility of the agricultural system
9. Water efficiency
10. Biodiversity

The social direction assesses the impact of urban agricultural systems on the community, in particular their contribution to improving the quality of life, social cohesion and support for vulnerable groups.

List of indicators:

1. Community Activity and Engagement
2. Educational activities of the agricultural system
3. Development of entrepreneurial initiatives in the field of urban agricultural systems
4. Involvement of young people in agricultural projects
5. Social cohesion and quality of life
6. Inclusion and support for vulnerable groups
7. Cooperation and partnership in the community
8. Number of social jobs created
9. Level of gender equality and women's involvement
10. Ensuring local food security

For each indicator, a 10-point assessment scale has been developed (see Appendix G), which allows you to consider the features of each direction and provides quantitative indicators for a comprehensive analysis. The scale is

structured in such a way that 1 point means the minimum level of influence or achievement, and 10 points means the maximum.

Data for each indicator is collected by surveying the owners of the agricultural system and monitoring their activity on social networks.

Questionnaires are one of the key methods of collecting information in the methodology for assessing the effectiveness of urban agricultural systems, as they provide accuracy, standardization and wide coverage of data necessary for in-depth analysis.

The questionnaires cover indicators of economic, environmental and social efficiency, which allows you to get a holistic view of the activities of the agricultural system. This is important for a comprehensive assessment of the impact that the agricultural system has on the community and the environment.

All questions in the questionnaires are formulated in such a way as to obtain information in a unified form. This provides convenience for further analysis, comparison between agricultural systems and identification of trends. Each question in the questionnaire provides not only the variability of answers but also the possibility of your expression. This helps to consider the uniqueness of each agricultural system and ensures accuracy in collecting data for indicators. Free answers allow respondents to provide detailed explanations that can expand the possibilities of evaluating and adapting the methodology, as urban agricultural systems are constantly evolving, and approaches to their activities are changing with them.

The questionnaire was chosen as the main method of data collection due to its flexibility, accessibility and the possibility of obtaining internal information. This method allows:

- Systematize the process of collecting data for a wide range of indicators.
- to ensure high accuracy of data collection through the direct participation of agricultural system owners.
- to increase the reliability of assessments, providing respondents with the opportunity to independently inform about the specifics of their activities.

Another method of obtaining information was the monitoring of activity in social networks, which is a flexible and effective tool that allows you to obtain additional data to assess both social, environmental, and economic indicators of the agricultural system. In addition to tracking community engagement, this method of gathering information allows you to gain important insights into products, services, active seasons, and customer feedback.

An economic assessment based on social media monitoring allows you to analyse in detail the activity of the agricultural system through the study of the content on its pages. Firstly, the analysis of publications makes it possible to trace the range of products, including both seasonal and permanent goods, as well as additional services such as workshops or excursions, which is important because the complete list of products and services reflects the ability of the agricultural system to adapt to the needs of the market. Secondly, monitoring marketing activity, frequency, and nature of promotional posts allows you to determine the level of economic activity, the popularity of products and consumer reviews, which are important indicators of demand and market stability of the agricultural system. Finally, permanent or seasonal collaborations with local businesses, as well as participation in market events covered on social networks, allow you to assess the level of partnership with local enterprises and the breadth of markets, which significantly affects the economic development of the agricultural system.

Social assessment based on social media monitoring allows you to assess the social impact of the agricultural system according to several important criteria. Feedback and comments from consumers and visitors reflect the general attitude towards the agricultural system and the level of satisfaction with its products and services, which serves as an indicator of social cohesion and reputation. Community engagement is expressed through likes, comments, reposts and participation in events reflected in social networks, which is a direct indicator of active interaction of the community with the agricultural system and an important element for evaluating indicators. The transparency and openness of the agricultural system are manifested in the constant informing of the public about environmental practices, measures and innovations, which indicates the desire for social responsibility and openness in communications (Ding & Shi, 2020).

The analysis of social networks provides an opportunity to assess the environmental performance of the agricultural system since most urban agricultural systems seek to demonstrate their environmental responsibility in the public space. This allows you to obtain information about the different environmental aspects of the activity. For example, environmental practices and initiatives of the agricultural system, such as waste sorting and disposal, the use of organic fertilizers, the rejection of pesticides and herbicides, and the conservation of biodiversity are often covered in publications. This approach allows you to assess how much the agricultural system adheres to the principles of envi-

ronmental sustainability. If an agricultural system uses innovative environmental technologies, such as drip irrigation or water recycling, it usually shares this information on social media, which helps to assess the effectiveness of resource management, in particular water and energy, and understand the level of innovation of the agricultural system. Social media also provides information on activities to raise environmental awareness of the community, such as environmental workshops, tree planting campaigns, creation of "green barriers", etc., which contributes to the assessment of environmental awareness indicators and community involvement in environmental conservation. The transparency of environmental activities is manifested in constant information about the implementation of environmental innovations and practices, which increases community confidence and indicates the desire of the agricultural system for environmental responsibility.

Thus, the analysis of social networks is an auxiliary method of collecting information that allows you to obtain relevant, versatile and reliable data on the activities of the agricultural system. Since most agricultural systems actively use social networks to communicate with the community and promote their products and services, these platforms become a valuable additional source of information for evaluating performance on economic, social, and environmental indicators.

The proposed methodology allows not only to objectively assess the efficiency of the functioning of urban agricultural systems, but also to form scientifically grounded recommendations for their integration into the urban environment. The use of the "Index of Sustainability of Urban Agricultural Systems" provides a comprehensive assessment of the impact of these initiatives on the local economy, environmental situation and social cohesion, which is critically important in the current conditions of urban development in Ukraine. The results of the study can serve as a basis for strategic decision-making to support urban agricultural systems at the municipal and state levels, which will contribute to increasing food security, expanding the socio-economic opportunities of communities and strengthening the environmental sustainability of urban areas.

The study of urban agricultural systems within the framework of the "Urban Agrosystems Sustainability Index" methodology provided a comprehensive assessment of their impact on local economic development, social inclusion and environmental sustainability. The use of an integrated approach made it possible to identify key patterns in the functioning of different types of agricultural systems, as well as to develop recommendations for improving their

efficiency. The analysis of six types of urban agricultural systems, including vertical farms, urban farms, community orchards, social farms, educational farms, and home orchards, made it possible to assess their contribution to the local economy, their impact on communities, and the environmental situation in cities.

The results of the study demonstrate significant differences like the economic, social and environmental impact of different types of urban agricultural systems. In particular, vertical farms have proven to be the most efficient in terms of economic indicators since they are characterized by high profitability, quick return on investment and efficient use of urban space. However, their social and environmental contributions are relatively limited, as they function indoors and do not contribute to direct interaction with the community or the greening of the city. At the same time, such agricultural systems demonstrate high results in the field of resource efficiency, in particular in terms of water and energy consumption, which emphasizes their important role in the development of sustainable urban food systems.

Urban farms demonstrated the most balanced distribution of impact across all assessment categories. They are economically sustainable, ensure stable production of products for local markets and create jobs, which has a positive impact on local economic development. In addition, such farms play an important social role by interacting with local consumers and participating in the development of urban food systems. With the introduction of modern technologies, urban farms can also contribute to increasing environmental sustainability by reducing the carbon footprint of agricultural production and optimizing the use of natural resources.

While vertical and urban farms focus on cost-effectiveness, community gardens place a primary emphasis on social and environmental impact. They perform a critical function in the field of social cohesion, contributing to the interaction of city residents, increasing the level of environmental awareness and creating recreational green areas. At the same time, such agricultural systems do not have a significant economic effect since their activities are mainly financed by membership fees, charitable support or grants. They are a tool to restore the lost ties between urban communities and food production, contributing to the promotion of sustainable consumption principles.

Social farms have an important impact in the context of integrating vulnerable populations and promoting their economic self-sufficiency. In Ukraine, where the number of war veterans and people with disabilities is growing, so-

cial farms can become an effective rehabilitation mechanism, providing physical and psychological support. They also contribute to the development of self-employment skills and the creation of inclusive labour opportunities, which can have a positive impact on the employment rate of socially sensitive groups. However, the economic sustainability of such agricultural systems largely depends on grant support and charitable funding, which limits the possibilities of their long-term development without additional state or municipal support programs.

Educational farms have significant social and environmental potential as they combine the educational process with direct agricultural activities. They create opportunities for the development of entrepreneurial thinking, provide practical training for young people and contribute to the promotion of sustainable agricultural production. In addition, such farms can integrate elements of social entrepreneurship, which allows them to partially ensure financial independence. The analysis demonstrated that their greatest potential is revealed in cooperation with local communities, which allows them not only to perform an educational function but also to promote social cohesion.

Home gardens, as the most common form of urban agricultural systems in Ukraine, play an important role in ensuring the food security of households. They reduce food costs, increase the level of food self-sufficiency of citizens and form a culture of responsible consumption. Although these agricultural systems do not have a significant direct impact on the local economy, their mass nature creates the potential for the development of local food markets and support economic activity through informal distribution channels.

The overall analysis proved that the effectiveness of urban agricultural systems cannot be evaluated solely from an economic point of view since they perform a significant social and environmental role in the urban environment. At the same time, to ensure their sustainability, a balanced approach is needed, combining economic feasibility, social utility and environmental responsibility.

The methodology "Index of Sustainability of Urban Agricultural Systems" used in the study allows you to obtain a comprehensive assessment of the effectiveness of these initiatives and is an effective tool for decision-making to support urban agricultural systems at the municipal level. In addition, the results can be useful for investors considering financing urban agricultural projects, as the methodology allows you to assess risks, development potential, and profitability.

Thus, the study confirms the need to integrate urban agricultural systems into the spatial planning of cities, in particular through state support mechanisms and their inclusion in sustainable urban development strategies. The use of the "Urban Agricultural Systems Sustainability Index" methodology allows not only the assessment of the effectiveness of existing agricultural systems but also the determination of ways to optimize them, which is a key factor in building sustainable, environmentally responsible and cost-effective urban food systems.

### **7.5. Challenges and opportunities for urban agricultural systems in Ukraine**

Urban agricultural systems play an increasingly important role in ensuring food security, improving environmental sustainability, and promoting the socio-economic development of urban communities. However, their effective functioning faces several challenges that require a thorough analysis and development of strategic solutions to overcome them. The study showed that the main barriers to the development of urban agricultural systems in Ukraine are due to environmental, economic and social factors that significantly affect the level of productivity, competitiveness and overall sustainability of these systems.

One of the key environmental challenges is the degradation of urban soils, which is associated with pollution by heavy metals, industrial waste and pesticide residues. The high level of anthropogenic load on urbanized areas leads to the accumulation of toxic elements in the soil, which creates risks to public health and limits the potential for growing safe products (Lu et al., 2015). Restoring the fertility of urban soils requires significant financial investments in bioremediation technologies and the introduction of green manure and organic fertilizers, which significantly increase the cost of agricultural production. At the same time, the effective integration of ecological farming methods, including vermicomposting, the use of biological products and precision farming technologies can contribute to reducing pollution and increasing the economic sustainability of urban agricultural systems.

The second important factor limiting the development of urban agriculture is air pollution due to the high level of urban load. Emissions of particulate matter (PM<sub>2.5</sub>, PM<sub>10</sub>), nitrogen oxides, sulphur, volatile organic compounds and heavy metals negatively affect the quality of products, as pollutants settle

on the leaf surface of plants and can penetrate tissues (Medvedeva et al., 2021). This creates additional challenges for urban farmers, who are forced to implement protective measures, including placing production areas indoors or using special agricultural technologies such as hydroponics and aeroponics. In the future, active cooperation of urban agricultural systems with municipal authorities to improve the quality of the urban environment, in particular through the creation of green spaces, parks and phytofiltration barriers that reduce the level of air pollution, is a strategically important area of development.

Another significant limitation is the poor quality of water resources used for the irrigation of urban agricultural systems. Water coming from centralized water supply systems often contains traces of chlorine, heavy metals and organic pollutants, which reduces its suitability for use in high-tech plant growing systems. Alternative sources, such as rainwater or well water, may also contain impurities, which requires the introduction of additional filtration systems and treatment technologies (Teston et al., 2022). This creates additional financial costs for urban agricultural systems, which require the development of innovative approaches to water management, including water recycling systems, bio-filtration and the use of water-saving technologies.

In addition to environmental challenges, considerable attention should be paid to economic constraints, among which the high resource intensity of urban agricultural systems is key. Growing agricultural products in an urbanized environment requires significant investments in technological equipment, energy-efficient systems, packaging materials and logistics. In particular, vertical farms and hydroponic systems are completely dependent on artificial lighting and microclimate control, which significantly increases their operating costs. An analysis of the resource consumption of urban agricultural systems showed that one of the key strategies to increase their economic efficiency is the introduction of circular management models, in particular the use of renewable energy sources, the use of organic fertilizers from local sources, and the minimization of water and nutrient losses (Ghisellini et al., 2016).

Social constraints also play an important role in the development of urban agricultural systems. One of the key challenges is the low social acceptability of some types of agricultural systems, in particular, high-tech vertical farms, which often operate in isolation from urban communities. The lack of direct social ties between producers and consumers can reduce the level of trust in products, which, in turn, limits the potential for the development of local food markets. At the same time, socially oriented types of urban agricultural systems, such as community gardens and social farms, demonstrate a high level

of integration into local communities, contributing to the development of urban initiatives, increasing the level of social cohesion and promoting environmentally responsible consumption.

An important aspect is also the financial availability of urban agricultural products. The high cost of products grown in an urbanized environment can create barriers to their widespread distribution among the population, especially among socially vulnerable groups. This may threaten market segmentation when urban agricultural systems serve only a premium segment of consumers without significantly affecting the overall level of food security. Thus, a prerequisite for the development of urban agriculture is the development of mechanisms of financial support and state incentives, which may include grant programs, tax breaks and subsidies for small farms.

The analysis showed that urban agricultural systems, despite the presence of significant challenges, have a high potential for sustainable development if comprehensive strategic decisions are implemented. The integration of environmental, economic and social approaches to the development of urban agriculture will contribute to the creation of efficient production models that ensure high productivity, environmental responsibility and social inclusion. The key areas of further development are the introduction of precision farming technologies, the use of renewable resources, the creation of financial support mechanisms and the strengthening of interaction between urban agricultural producers and communities. This will allow urban agriculture to become a full-fledged element of urban food systems, contributing to the formation of sustainable urban food networks and increasing the overall food security of the country.

To maximize the potential of urban agricultural systems in Ukrainian cities, it is important to ensure their effective integration into all aspects of the urban environment. Below are the main recommendations and practical steps that will contribute to the comprehensive implementation of urban agricultural systems in the urban environment of Ukraine.

### 1. Amendments to the legislation

To ensure the sustainable development of urban agricultural systems in Ukraine, it is proposed to introduce comprehensive measures aimed at legitimizing and supporting agricultural activities in urban areas through legal and regulatory changes. One of the key steps is the official inclusion of the term "urban agricultural systems" and its definition in the legal system of Ukraine, as well as in the main regulatory legal documents, such as the Land Code of

Ukraine, the laws "On Farming", "On Personal Peasant Farming", and "On the Regulation of Urban Planning Activities". This will create the necessary legal framework for the development of agricultural activities in urban communities and legalize the use of urban spaces – undeveloped land plots, roofs of buildings, parks – for agricultural purposes.

It is also necessary to simplify the procedures for changing the purpose of land for urban farming. In this context, it is proposed to develop special mechanisms that will allow the temporary use of undeveloped urban areas for agricultural activities. This will allow for faster use of available land resources and reduce legal barriers that currently complicate the development of urban farming. For example, the introduction of simplified procedures for obtaining permits for the temporary use of roofs of buildings or undeveloped land plots can significantly contribute to the expansion of agricultural systems in cities.

The integration of the term "urban agricultural systems" into legislation should also include the definition of agricultural activities that can be considered as part of these systems. These can be various forms of plant cultivation, aquaculture, and raising animals for local consumption. The definition of specific activities will allow the standardization of urban farming practices and ensure that they comply with environmental and economic requirements.

The integration of the concept of "urban agricultural systems" into the legislative framework of Ukraine is aimed at creating a stable legal foundation for their development. This includes the regulation of land issues, the determination of the rights of agricultural entities, the establishment of environmental standards and the support of urban farming as a tool for ensuring food security, environmental sustainability and socio-economic development of local communities.

## 2. Integration of urban agricultural systems into comprehensive plans for the spatial development of the territory of territorial communities

The integration of urban agricultural systems into comprehensive spatial development plans of territorial communities and city master plans is a key step to ensure their stable functioning and optimal use of urban space. The introduction of zoning, which provides for the allocation of special plots for various types of agricultural systems – public gardens, urban and vertical farms, as well as other forms of agricultural activity – allows you to effectively organize urban space, making the most of the available territories. This approach contributes to the integration of agricultural systems into residential and public areas of the

city, providing them with access to the necessary infrastructure, including water resources, transport networks and power grids.

The integration of agricultural systems into urban planning allows them to be combined with green areas, recreational areas and other functional areas of the city, contributing to the development of integrated green infrastructure. This not only increases the ecological quality of the urban environment but also creates favorable conditions for social integration, involving residents in agricultural activities and increasing their environmental awareness. The designation of public plots for agricultural systems stimulates community participation in production processes, contributes to the strengthening of social ties and supports environmental responsibility among residents.

Clear zoning of agricultural systems in urban plans creates the necessary legal and economic prerequisites for attracting investment and state support. This opens up new opportunities for the development of both private and public initiatives in the field of urban farming. Thanks to such measures, urban farming can develop more efficiently, increasing the environmental, social and economic sustainability of urban communities.

In addition, the integration of urban agricultural systems into spatial planning contributes to the introduction of innovative technologies and ecological cultivation methods that meet modern standards of sustainable development. This allows cities to adapt to climate change, ensure food security and increase the resilience of communities to environmental and economic challenges. Thus, a systematic approach to the planning and development of urban agricultural systems not only optimizes the use of urban space but also contributes to the creation of more sustainable, healthy and prosperous urban environments that meet the needs of modern society.

**3. Development of standards and instructions for environmentally friendly agricultural technologies.** The development of environmental standards for urban agricultural systems should be aimed at optimal use of resources, preservation of the urban environment and minimization of negative impacts on the ecosystem. These standards should become the basis for ensuring the sustainable development of urban agricultural projects, regulating their activities by environmental priorities. In particular, such standards should cover several key aspects:

- Effective water resources management. Water is one of the most important resources for agricultural production, especially in urban environments. Environmental standards should regulate methods for the eco-

nomical use of water and promote the introduction of modern technologies such as rainwater harvesting, recirculation for reuse, as well as drip irrigation, hydroponic and aeroponic systems. For example, the use of automated irrigation systems will avoid overconsumption of water, reduce the load on the city water supply and ensure stable moisture of plants even during periods of drought. In addition, such approaches will contribute to the conservation of water resources for other urban needs while reducing the costs of agricultural systems for irrigation.

- Support for organic farming. Organic methods of growing products are an important component for maintaining the ecological balance of urban ecosystems. Environmental standards should recommend the abandonment of chemical fertilizers and synthetic pesticides, replacing them with organic alternatives such as compost, biological products and green manure. This approach not only improves soil quality and prevents soil depletion but also minimizes water and air pollution, providing a healthy environment for residents. Organic farming also contributes to the preservation of local biocenoses and allows you to maintain high-quality products, which is a key factor for consumers.
- Reducing carbon footprint and improving energy efficiency. Urban agricultural systems should strive to minimize greenhouse gas emissions and reduce energy consumption. This can be achieved through the introduction of energy-efficient equipment, the use of modern LED lighting, and renewable energy sources such as solar panels or windmills. Environmental standards should also provide for measures to optimize the energy infrastructure of agricultural systems. For example, the use of such technologies not only reduces energy costs but also helps to reduce the carbon footprint, which has a positive effect on the overall environmental condition of the city.
- Integration into existing urban ecosystems. The choice of crops for urban agricultural systems should consider local climatic conditions and ecological balance. The standards should regulate the cultivation of plant species adapted to local conditions, which reduces the need for additional resources such as water, fertilizers or protective equipment. For example, the introduction of local varieties will not only increase the sustainability of agricultural systems but also contribute to the preservation of local

biodiversity. This approach will allow the harmonious integration of agricultural systems into the urban environment, ensuring their environmental sustainability.

The introduction of environmental standards will create uniform rules for agricultural projects that will ensure their effective integration into urban spaces. This will contribute to the development of environmentally friendly technologies, raise awareness of urban communities about sustainable development, and help reduce the negative impact on the ecosystem. At the same time, such standards will ensure the rational use of urban resources, create conditions for improving the quality of life of residents and be an important step towards preserving the natural environment in the urban context.

**4. Formation of effective financing and partnership mechanisms.** Attracting funding from various sources, such as international grants, government support programs, private investors, as well as active cooperation with local communities, non-governmental organizations and businesses, creates a solid financial basis for the launch and development of urban agricultural projects. This approach allows you to ensure the stability of agricultural systems, minimize financial risks and effectively manage resources.

**International grants and investments.** International grants, in particular from environmental, social and innovation funds, are an important source of funding for agricultural systems seeking to implement projects that meet the Sustainable Development Goals. The funds direct financial support to the implementation of innovations such as vertical farms, social agricultural platforms, training programs and environmental initiatives. This not only helps to increase environmental awareness among citizens but also helps to modernize the infrastructure of agricultural systems.

**International investments,** in turn, can become a source of long-term financing for the expansion of agricultural systems and the modernization of equipment and technologies. For example, investments in automated irrigation systems, energy-efficient lighting or water recycling systems reduce operating costs and increase productivity and environmental sustainability.

**Government support programs.** The role of the state in stimulating the development of urban agricultural systems cannot be overestimated. Subsidies, tax breaks, and grant-funding programs focused on supporting small and medium-sized businesses will create favorable conditions for the launch and development of agricultural projects. In particular, state support may cover:

- Granting subsidies for the launch of social farms that promote the employment of vulnerable groups.
- Allocation of funds for the development of innovative agricultural projects.
- Preferential terms of land lease for socially significant initiatives.

Private Investors and Business Partnerships. The private sector plays an important role in supporting urban agricultural systems, especially in terms of implementing innovative and profitable solutions. Companies can invest in environmental initiatives through sponsorship, participation in joint projects, or funding for the development of community gardens, training programs, and social farms. For example, cooperation with corporate partners may include financing the installation of solar panels, supporting training courses for the community, or organizing educational activities.

For businesses, such participation is beneficial not only from the point of view of social responsibility, but also as a way to improve their image, expand the affiliate network and attract new customers.

Cooperation with local communities and NGOs. Interaction with local communities increases the level of social cohesion, responsibility, and citizen involvement in urban agricultural system projects. Citizens who participate in such initiatives become more interested in their development and preservation.

Non-governmental organizations can play the role of coordinators, providing support through the organization of educational events, the attraction of external financial resources and the implementation of social programs.

Local governments can also contribute to the development of agricultural systems by introducing municipal support programs, allocating land plots, or providing grants for the development of environmental projects. Preferential rental conditions or simplification of registration procedures are additional incentive tools.

These approaches create a sustainable basis for the development of urban agricultural systems, minimizing financial risks and providing the possibility of scaling. Thanks to the interaction of international, public and private sources of funding, agricultural systems will be able to implement large-scale projects aimed at achieving sustainable development goals.

Also, the involvement of local communities in cooperation will contribute to the formation of a positive social image, strengthening the social responsibility of business and creating conditions for the long-term integration of agricultural systems into the spatial planning of Ukrainian cities.

5. Monitoring and evaluation of the effectiveness of agricultural systems. The monitoring system is an important component of the management of urban agricultural systems, which allows for a comprehensive analysis of their impact on the economy, ecology and social processes. This approach not only contributes to the improvement of agricultural projects but also creates preconditions for attracting external funding, including investments, grants, and municipal support.

Key aspects of the monitoring system:

- Economic indicators. The system should include an analysis of such parameters as the number of jobs created, the volume of local products produced, the level of tax revenues and the economic efficiency of the agricultural system. Tracking these indicators allows you to assess the economic contribution of agricultural systems to the development of the community and demonstrate their financial stability to investors.
- Environmental indicators. The environmental component includes monitoring of air, water, and soil quality, as well as assessment of carbon footprint reduction and resource management efficiency. Such data will help assess the environmental sustainability of the agricultural system, its impact on the local environment and the effectiveness of the implemented eco-technologies.
- Social indicators. Social aspects include the analysis of the level of community involvement in the activities of agricultural systems, the availability of educational programs, the level of social cohesion and the impact on the quality of life of residents. Monitoring of social indicators will help determine the extent to which agricultural systems contribute to the formation of an integrated and cohesive society, as well as their role in solving social problems.

Regular data collection and analysis will allow timely adjustment of strategies for the development of agricultural systems, increasing their efficiency. This is especially important for identifying weaknesses and introducing innovations that meet modern challenges.

The monitoring data will be a convincing argument for attracting international grants, investments from private businesses and support from local authorities. A clear demonstration of economic, environmental and social results will strengthen the confidence of investors and sponsors, contributing to the further expansion of agricultural initiatives.

Public coverage of the monitoring results will help increase the level of trust on the part of the community and local authorities. This will provide support for residents, more active involvement in volunteer and educational programs, and increase loyalty to the project.

The monitoring system will become the basis for expanding the activities of agricultural systems, allowing successful practices to be adapted to other urban spaces. This will contribute to the creation of a national network of urban agricultural projects that are harmoniously integrated into the spatial planning of cities.

**6. Conducting an information campaign as a key tool for popularizing urban agricultural systems in Ukraine.** The popularization of urban agricultural systems requires a comprehensive information campaign that will contribute to their successful implementation and integration into urban spaces. Such a campaign should cover all stakeholders: urban communities, businesses, local governments, educational institutions and non-governmental organizations. The main goal is to raise awareness of the economic, environmental and social benefits of agricultural systems, as well as ways to overcome the challenges associated with their implementation. Thanks to this, it is possible to achieve public support, attract new participants and partners, and create a favourable environment for the development of urban agricultural systems.

The main directions of the information campaign:

- Educational and outreach activities for communities. The campaign should inform citizens about the benefits of urban agricultural systems, in particular their contribution to reducing food dependence, improving the environment and creating new opportunities for public interaction. Information seminars, workshops, excursions to existing agricultural systems, as well as the distribution of educational materials will allow residents to better understand the value of such projects. The involvement of citizens will contribute to the formation of a positive attitude towards urban agricultural systems and stimulate their participation in relevant initiatives.
- Information support for business. The business community is a key partner in the development of urban agricultural systems. The information campaign should highlight the economic opportunities created by agricultural systems, provide practical examples of business models and demonstrate the return on investment in this area. The organization of presentations, workshops and consultations on funding opportunities, in

particular through grants, government programs or private investments, will allow businesses to consider urban agricultural systems as a promising and profitable direction. In addition, the information campaign should contribute to the formation of partnerships between agricultural systems and businesses, for example, in the supply of fresh products to restaurants, cafes or supermarkets.

- Seminars and consultations for local authorities. The integration of urban agricultural systems into spatial planning requires the active participation of local authorities. They should organize seminars on the economic and environmental benefits of agricultural systems, as well as their role in the socio-economic development of communities. Providing recommendations for the development of support policies, the allocation of land plots, and the provision of subsidies and benefits for agricultural projects will help create a favourable environment for the development of this area. The participation of local authorities will contribute to the effective implementation of agricultural systems and their integration into local development strategies.
- Spreading success stories. Success stories are a powerful tool for forming a positive image of urban agricultural systems. The publication of real-world examples of projects that have already demonstrated successful economic, environmental and social impact will inspire other communities, businesses and authorities to implement similar initiatives. Such stories can be shared through social media, public events, or information platforms. They strengthen trust in urban agricultural systems and contribute to the formation of public consensus on their importance.

The information campaign will increase the level of public awareness of the benefits of urban agricultural systems and contribute to the formation of a positive attitude towards such projects. For business, this will be an opportunity to find new areas of development, and for local authorities, it will be a tool for implementing policies aimed at sustainable development. The campaign will help attract investments, expand partnerships and form active support from communities. In the long term, this will ensure the effective integration of urban agricultural systems into the spatial planning of cities, make them part of the urban environment and contribute to the sustainable development of Ukrainian communities.

## 7.6. Conclusions

Thus, urban agricultural systems are an important element of the spatial development of modern cities, capable of ensuring sustainable socio-economic development of territorial communities. In the course of the study, it was determined that the integration of urban agricultural production into the urbanized environment contributes not only to reducing food dependence on external supplies but also to creating additional economic opportunities for local entrepreneurs and households. The aspects of the development of urban agricultural systems considered in the monograph allow us to make several generalizations about their role in the sustainable development of territorial communities, economic efficiency and challenges facing their integration into the spatial planning of cities.

The prerequisites for the development of urban agricultural systems are formed under the influence of complex global transformation processes, in particular, anthropogenically caused climate change, rapid growth in the level of urbanization and the growing shortage of productive agricultural land. Changes in average annual temperatures, instability of the hydrothermal regime and extreme weather events pose threats to the agricultural sector and the ecological balance of urban areas, which necessitates the introduction of sustainable agricultural models, effective resource management and water-saving technologies. At the same time, urbanization causes spatial transformations, increasing competition for land resources and reducing the area of traditional agricultural land. The high capitalization of urban land complicates agricultural production, which requires the introduction of innovative approaches to food supply. It has been proven that the integration of urban agricultural systems into spatial planning contributes to increasing the food autonomy of cities, reducing transport costs, minimizing the carbon footprint and efficient use of urban land. In addition, the growing shortage of agricultural land, caused by the complex action of climatic, economic and social factors, actualizes the need to introduce alternative models of food production. In this context, urban agricultural systems act as a tool for ensuring food security, localization of production, implementation of circular models of resource management and adaptation of food strategies to the challenges of the modern urban environment.

The analysis of the conceptual apparatus, classification and role of urban agricultural systems made it possible to establish their multifunctionality and strategic importance for ensuring the sustainability of urban areas. It is deter-

mined that urban agricultural systems are complex socio-economic and environmental formations that integrate the processes of production, distribution and consumption of food within the urbanized space. Their development contributes to the formation of adaptive food systems, reducing the food vulnerability of the urban population and optimizing the use of natural resources according to the principles of a circular economy.

The author's definition and typology of urban agricultural systems proposed in the study are adapted to the national socio-economic, environmental and spatial conditions of Ukraine. It considers the variety of organizational and economic models and technological approaches used in urban agricultural production, which makes it possible to classify agricultural systems by functional purpose, level of technological development, organizational structure and spatial integration. It has been determined that different types of urban agricultural systems play a specific role in the socio-economic development of cities.

It has been proved that the integration of urban agricultural systems into the economic space of cities contributes to the formation of sustainable models of urban land use that combine industrial, social and environmental functions. It is determined that the development of such agricultural systems is an important tool for diversifying urban economies, as they create new opportunities for entrepreneurial activity, innovative development and attracting investments.

An important conclusion is that the functional efficiency of urban agricultural systems largely depends on the level of their integration into municipal spatial development policies. The introduction of appropriate regulatory and support mechanisms will contribute to the optimization of land use, increasing the economic profitability of urban agricultural production and the formation of an ecologically balanced environment. It has been determined that the promising directions for the development of urban agricultural systems are the institutionalization of their status in the urban planning system, the creation of specialized food clusters, the improvement of financial support mechanisms and the introduction of environmental standards of production.

The developed methodology "Index of Sustainability of Urban Agricultural Systems" is a tool for a comprehensive analysis of their economic, environmental and social impact. It contributes to the assessment of food security, land-use efficiency, investment attractiveness, social cohesion and environmental sustainability.

The methodology is based on 30 indicators distributed among three dimensions of sustainable development. The economic block assesses profitabil-

ity, profitability and investment attractiveness. The ecological dimension considers the efficiency of resource use, the impact on the microclimate, biodiversity and eco-technologies. The social component analyses employment, community engagement, social inclusion and food accessibility.

The use of the index as a management tool allows you to optimize decision-making at the municipal and state levels and contributes to the financing of urban agricultural production and the integration of agricultural systems into spatial development plans. The adaptability of the methodology ensures its application for monitoring the development of agricultural systems, which is critically important for the strategic management of urban agricultural production.

Further improvement involves expanding indicators, considering regional characteristics and introducing digital analytical technologies to predict the development of urban agricultural systems.

The study showed that urban agricultural systems, despite the challenges, have significant potential to ensure food security, social cohesion and environmental sustainability of urban areas. Their sustainable development is possible if economic, environmental and social aspects are integrated. The key factors in the development of urban agricultural systems in Ukraine are the introduction of innovative agricultural technologies, the use of renewable resources, the improvement of the regulatory framework and the strengthening of cooperation between communities, government and business.

The need for legislative changes to legitimize urban agricultural production and simplify the procedures for the use of urban land for agricultural systems is substantiated. The integration of urban agricultural systems into spatial planning will contribute to their effective functioning and optimal use of urban resources. The development of environmental standards to regulate the rational use of water resources, organic production and reduction of the carbon footprint is proposed.

The financial sustainability of urban agricultural systems requires the creation of effective support mechanisms, including the attraction of government programs, international grants, and private investment. A system for monitoring the efficiency of agricultural systems has been proposed, which will allow analysing economic, social and environmental indicators to optimize management decisions.

The importance of the information campaign, which will contribute to the popularization of urban agricultural systems, the involvement of citizens and investors, and the integration of urban agricultural production into sustainable urban development strategies, was emphasized.

Thus, urban agricultural systems are an important tool for adapting urban areas to global challenges, integrating the principles of sustainable development and increasing the economic self-sufficiency of urban communities. Further research should be aimed at improving the mechanisms of their implementation, adapting efficiency assessment methods to local conditions and developing strategic models for the development of urban agricultural production in Ukraine.

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