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The agribusiness of Samarkand's suburbs as a foundation for the city's sustainable food security

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ABSTRACT
Relevance. Rapid urbanization, declining agricultural lands, and increasing water scarcity make it essential to rethink the spatial organization of agriculture and its integration into urban food policies. In Samarkand, these pressures threaten local food supply stability and highlight the potential of nearby agricultural zones.
Research Objective. This study aims to evaluate the agribusiness potential of Samarkand's suburban districts in ensuring a sustainable food supply for the urban agglomeration.
Data and Methods. The methodology integrates spatial analysis, agroeconomic assessment, and geoinformation technologies. Key data sources include official statistics for 2023–2024, satellite imagery, and calculations of gross agricultural output by district. The study identifies the functional zoning of the Samarkand agro-belt, calculates self-sufficiency coefficients for major agricultural products, and develops scenario models incorporating water availability, urban growth, and changes in production structure.
Results. The analysis reveals pronounced territorial differences in production potential. Under the sustainable development scenario, Akdarya and Pastdargom districts demonstrate the highest self-sufficiency, while the crisis scenario shows substantial declines in vulnerable districts such as Taylak and Jomboy. The study also shows the decisive role of logistical integration and infrastructural accessibility in maintaining a resilient food system.
Conclusions. The study highlights the need for a territorially adapted food security strategy focused on strengthening local production, enhancing spatial integration of agro-zones, and improving institutional coordination between urban and rural areas. The proposed methodological approach is applicable to other cities in Central Asia experiencing similar agrarian and environmental pressures.

KEYWORDS
agribusiness, food security, peri-urban agriculture, spatial analysis, geoinformation modeling, self-sufficiency, City Region Food Systems (CRFS), scenario planning, logistics accessibility, Samarkand region

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Агробизнес пригородов Самарканда как основа устойчивого продовольственного обеспечения города

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АННОТАЦИЯ
Актуальность. Интенсивная урбанизация, деградация сельскохозяйственных угодий и нарастающий дефицит водных ресурсов усиливают необходимость переосмысления пространственной организации сельского хозяйства и его интеграции в городскую продовольственную политику. Для Самарканда данные процессы создают угрозы устойчивости

КЛЮЧЕВЫЕ СЛОВА
агробизнес, продовольственная безопасность, пригородное сельское хозяйство,

локального продовольственного обеспечения и подчеркивают важность оценки потенциала пригородных аграрных зон.
Цель исследования. Целью работы является оценка потенциала агробизнеса пригородных районов Самарканда в обеспечении устойчивого продовольственного снабжения городской агломерации.
Данные и методы. Методологическая основа исследования включает интеграцию методов пространственного анализа, агроэкономической оценки и геоинформационного моделирования. Основные источники данных охватывают официальную статистику за 2023–2024 гг., спутниковые снимки и расчеты валового сельскохозяйственного производства по районам. В исследовании выполнено функциональное зонирование агропояса Самарканда, рассчитаны коэффициенты самообеспеченности по ключевым видам продукции, а также разработаны сценарные модели с учетом водообеспеченности, урбанизационного роста и трансформации производственной структуры.
Результаты. Анализ выявил существенные территориальные различия в производственном потенциале. В устойчивом сценарии развития наиболее высокие показатели самообеспеченности демонстрируют Акдарьинский и Пастдаргомский районы, тогда как кризисный сценарий фиксирует резкое снижение значений в уязвимых районах, включая Тайлакский и Джамбайский. Результаты подчеркивают ключевую роль логистической интеграции и инфраструктурной доступности в поддержании устойчивой городской продовольственной системы.
Выводы. Установлено, что эффективная продовольственная стратегия должна быть территориально адаптированной и включать меры по укреплению локального производства, усилению пространственной интеграции агрозон и улучшению институциональной координации между городскими и сельскими территориями. Предложенный методологический подход может быть применен к другим городам Центральной Азии, испытывающим схожие аграрно-экологические вызовы.

пространственный анализ, геоинформационное моделирование, самообеспеченность, городско-региональные продовольственные системы (CRFS), сценарное планирование, логистическая доступность, Самаркандская область

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撒马尔罕郊区的农业企业作为保障城市可持续粮食供应的基础

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摘要
现实性：快速城市化、农业用地退化以及水资源日益短缺，使得人们越发需要重新思考农业的空间布局及其与城市粮食政策的融合。对撒马尔罕而言，这些进程对当地粮食供应的可持续性构成了威胁，也凸显了评估郊区农业区域潜力的重要性。
研究目标：本研究的目的是评估撒马尔罕郊区农业企业在保障城市集聚区可持续粮食供应方面的潜力。
数据与方法：本研究的方法论基础融合了空间分析、农业经济评估和地理信息建模等方法。主要数据来源包括2023–2024年的官方统计数据、卫星影像以及按地区计算的农业总产出。研究中对撒马尔罕农业带进行了功能区划，计算了关键产品类型的自给率，并结合水资源保障、城市化进程和生产结构转型等因素，构建了情景模型。
研究结果：分析揭示了生产潜力方面显著的地区差异。在可持续发展情景下，阿克达里亚区和帕斯特达尔戈姆区的自给率指标最高；而在危机情景下，包括泰拉克区和占拜区在内的脆弱地区则出现自给率急剧下降的情况。研究结果凸显了物流一体化与基础设施通达性在维持可持续城市粮食系统中的关键作用。
结论：研究结果表明，有效的粮食战略必须因地制宜，并包含强化本地生产、加强农业区域空间整合以及改善城乡地区之间制度协调等措施。所提出的方法论方法可应用于中亚其他面临类似农业生态挑战的城市。

关键词
农业企业、粮食安全、郊区农业、空间分析、地理信息建模、自给率、城市-区域粮食系统、情景规划、物流可达性、撒马尔罕州

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Introduction

Ensuring sustainable food security in rapidly urbanizing regions is a pressing challenge worldwide, as cities face increasing pressure on local agricultural systems and food supply chains. In Samarkand, the peri-urban agricultural areas have traditionally formed a vital "green belt," supported by fertile soils, established irrigation systems, and favorable climatic conditions, providing a steady supply of vegetables, fruits, and dairy products. Today, however, this agrarian potential is steadily eroding. Rapid urban expansion, land fragmentation, the conversion of farmland for construction, water scarcity, and declining profitability of agricultural labor are placing increasing pressure on these areas, increasing the city's dependence on external food supplies and weakening the resilience of its local food system (Olsson, 2018; Ochoa et al., 2020; Avila Sanchez, 2024).

Contemporary challenges to food security mirror broader trends observed in rapidly growing Central Asian cities but are particularly acute in Samarkand. Population growth, shifting consumption patterns, food price volatility, and deteriorating irrigation infrastructure limit agricultural productivity. The absence of a coherent food planning framework further exacerbates the problem: weak coordination between production, logistics, and distribution reduces efficiency, and peri-urban agricultural zones remain insufficiently integrated into the urban economy.

Despite the region's long-standing agricultural traditions, there is no comprehensive framework capturing the functional and spatial organization of Samarkand's agrarian belt or its role in urban food provision. Existing studies are fragmented and predominantly statistical, overlooking spatial heterogeneity in production, logistical linkages, and integration into the urban–regional food system. A range of questions, such as the mechanisms of territorial organization of agribusiness complexes, their adaptability to climatic constraints, and the contribution of individual peri-urban districts to the city's food security, remain insufficiently explored, defining a clear research gap.

This study addresses these gaps by developing a functional and spatial model of agribusiness complexes in Samarkand's peri-urban areas, integrating geoinformation analysis, agroeconomic calculations, and scenario-based modelling. It systematically compares three development scenarios: inertial, adaptive-sustainable, and crisis, taking into account water scarcity, urbanization pressures, and transformations in production structures

An additional contribution lies in assessing the spatial integration of peri-urban agrozones into the city's food logistics system through a transport accessibility index (IL_i). This holistic approach provides insight into the agrarian belt's resilience, highlighting spatial differences in production capacity and adaptive potential.

The aim of this study is to assess the current state, spatial organization, and development potential of agribusiness complexes in Samarkand's peri-urban areas as a key factor in ensuring sustainable food provision for the urban agglomeration.

To achieve the stated aim, the following hypotheses were formulated:

Hypothesis 1. Logistic accessibility and spatial integration of agro-zones determine the resilience of the city's food supply and the scale of regional disparities.

Hypothesis 2. The level of logistic accessibility and the degree of spatial integration of agrozones are key determinants of the city's food supply resilience and shape the magnitude of regional disparities.

Hypothesis 3. A territorially coordinated food policy can enhance the city's ability to maintain a stable and autonomous food supply despite environmental and urban challenges.

Hypothesis 4. Scenario-based modelling can reveal the most vulnerable components of the agrarian belt and measure their adaptive potential under changing environmental and economic conditions.

Theoretical Framework

In this study, the functional-spatial model of the urban–agrarian system is interpreted as an integrative analytical construct designed to capture the multi-layered territorial organization of agricultural production in relation to urban processes, logistical infrastructure, and institutional regimes governing food flows. The model consists of three interrelated sub-systems:

— *Agri-production sub-system*: defined by specialized agro-landscapes, irrigation networks, crop types, and resource resilience;

— *Infrastructural-logistical sub-system*: reflecting road density, accessibility (isochrones), and the spatial distribution of markets and processing facilities;

— *Urban-consumer sub-system*: characterized by population size, urban demand patterns, and institutional mechanisms linking rural products to the city's food system.

The notion of an "urban–agrarian system" has no single origin but reflects the transdisciplinary development of City Region Food Systems (CRFS) research since the early 2000s. CRFS frameworks draw on urban foodscape theory (Morgan & Sonnino, 2010), peri-urban agriculture integration (Zasada, 2011), spatial food resilience (Sonnino, 2009), and analytical CRFS models (Dubbeling et al., 2017).

Food self-sufficiency refers to the capacity of a territory to meet the population's needs for essential food products through its own production, thereby minimizing dependence on external supplies–a definition widely adopted in research on food resilience and regional planning (Tleuberdinova et al., 2025).

The use of a 35-km radius as the outer boundary of Samarkand's agrarian belt is grounded in a combination of three criteria:

(a) *Agglomeration–morphological criterion:* Regional planning documents (2023) show that Samarkand's historical intensive agricultural zone developed within 30–35 km of the urban fringe, shaped by irrigated lands along the Zarafshan Valley;

(b) *Logistical–temporal criterion* (isochrone modeling): Spatial-temporal analysis indicates that this 35-km zone corresponds to a stable logistical isochrone (30–50 minutes), allowing regular delivery of perishable products to the urban core;

(c) *Historical–functional role*: Pastdargom, Akdarya, Jomboy, and Taylak districts have traditionally served as Samarkand's main agricultural supply base, as reflected in agrarian programs, supply structures, and state procurement mechanisms.

Thus, the 35-km radius is not an arbitrary construct but an empirically validated boundary of the territorial–logistical connectivity of the agrarian belt.

Previous research has addressed selected components of the agri-food system of the Samarkand region, yet it has remained fragmented. Studies of territorial agricultural specialization (Ibragimov et al., 2021) document district-level disparities but do not examine their linkages to the urban food system. Spatial studies of the agrarian belt (Boboyev, 2024) identify statistical and institutional limitations but do not propose an integrated urban–agrarian framework. Research on storage and logistics of agricultural products (Boboyev, 2025; Usmanov et al., 2024) highlights infrastructural vulnerabilities that affect the resilience of food supply chains. However, none of these strands of work has put forward a functional–spatial model of Samarkand's urban–agrarian system.

The transformation of agribusiness in Samarkand must consider post-Soviet institutional constraints. Systemic barriers, including inefficient land use, limited decentralization, weak farmers' cooperatives, and restricted market access, persist in Uzbekistan (Djanibekov et al., 2012) and are confirmed by later regional studies highlighting a lack of international technological and agricultural cooperation in the Samarkand region (Danshin & Bogdanchikova, 2006; Daminov, 2021).

Several researchers highlight the crucial role of the institutional environment in shaping the sustainability of CRFS (Berkhout et al., 2023; Rudenko & Nahirna, 2021). They note that, under conditions of urban expansion, agribusiness structures in suburban areas lose resilience, often experiencing displacement and changes in land use.

This study introduces a new approach for analyzing home gardening as a social practice in suburban areas of major urban agglomerations. Peri-urban gardening is considered not only as a source of food but also as a socially differentiated activity influenced by housing type, income level, and access to land (Darly et al., 2021; Marinelli et al., 2023). In the context of Samarkand, this approach allows for the analysis of spatial inequalities in access to agribusiness resources among suburban residents. In districts with a high proportion of private households, the potential for informal vegetable and fruit production is greater, whereas in denser, rented residential areas, such opportunities are limited. These observations underscore the importance of socio-territorial analysis of agribusiness practices, particularly for the development of sustainable food planning policies.

Studies in Italy emphasize shifting from sustainable to "sufficient" city-region food systems, focusing on local production, short supply chains, optimized food flows, and changes in policy and consumer behavior (Krähmer et al., 2024). A comprehensive approach includes spatial analysis of production-consumption balance, support for farmers' cooperatives and local markets, and involvement of vulnerable groups in food initiatives.

For Samarkand, these insights are particularly relevant given the imbalance between high demand and limited local production. Districts with developed agribusiness potential, such as Pastdargom and Akdarya, could serve as cores of the agri-food network, integrated into urban distribution channels such as markets, fairs, and school feeding programs.

In the post-Soviet space, there is an increasing spatial polarization of agricultural territories, where productive areas are enhancing their potential while peripheral zones are degrading (Nefedova, 2019). This is also characteristic of the Samarkand region, where differences between irrigated valleys and arid areas form an uneven structure of agribusiness.

To analyze these differences, economic-geographical profiling can be used to classify territories according to their levels of agricultural and demographic development (Danshin & Radikevich, 2022). This provides a foundation for territorially targeted agricultural policies and the sustainable planning of the agricultural belt.

Suburban areas play a key role in ensuring sustainable food supply, acting as a strategic link in the formation of a sustainable agri-food architecture. According to the concept outlined in FAO policy documents, sustainable development of the agro-industrial complex in peripheral areas requires their spatial and functional integration into agglomeration structures and food logistics systems (Armendáriz et al., 2016; Guibrunet & Arnés, 2021).

Spatial connectivity between suburban production zones and urban consumption centers helps optimize food flows and reduce supply vulnerability. Prudnikov et al. (2025) highlight the importance of linking price segments, particularly for seasonal products, underscoring the need for flexible, regionally adapted food policies. Sabirova et al. (2019) show that fostering competition among local producers enhances regional food resilience, especially in concentrated sectors.

Recent trends indicate that diversifying agricultural functions, including agritourism, strengthens the resilience of agri-food belts. Experiences from Kazakhstan highlight the potential of suburban farms as tourist destinations integrated into agri-food systems (Ospanova et al., 2022; Sergeyeva et al., 2024). Agriculture is increasingly recognized as a resource for agritourism development. In culturally and historically significant regions such as Samarkand, agricultural landscapes can be incorporated into tourism infrastructure (Danshin et al., 2024), supporting economic diversification and the sustainable development of rural areas. This model can be adapted to the Samarkand region, leveraging its rich cultural heritage and resilient landscapes.

Galeano-Barrera et al. (2022) developed a conceptual model of territorial agro-industrial development that emphasizes cross-sectoral synergy and multi-focus analytics and supports collaboration between agriculture, tourism, logistics, and education. This model shows particular promise for Samarkand.

The environmental dimensions of sustainable agribusiness include maintaining soil fertility, preserving biodiversity and pollination, and reducing conflicts between urbanization and agricultural land use (Potter & LeBuhn, 2015). Social sustainability involves ensuring food justice, providing vulnerable groups with access to fresh products, and supporting local employment (Haysom, 2015; Jensen & Orfila, 2021).

Despite growing interest in suburban agribusiness and food security, spatial assessments of agro-potential within Samarkand's agglomeration belt remain limited. Existing studies focus either on macro-level statistical data or on individual micro-cases, without connecting these insights to urban food provision strategies. This study addresses this gap by offering a comprehensive assessment of Samarkand's agribusiness system through geoinformation methods, functional zoning, and spatial efficiency analysis.

Methods and Data

The agribusiness system of Samarkand's suburbs was studied using an interdisciplinary approach combining agricultural geography, spatial analysis, agroeconomic balance, and geoinformation modeling. The goal was to evaluate the production potential of surrounding districts and their contribution to the city's sustainable food supply.

ArcGIS was employed for precise mapping of production zones, modeling logistical isochrones,

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and integrating diverse data sources, including statistics, satellite imagery, and infrastructure layers. Scenario-based modeling assessed the resilience of the agrarian belt under uncertainties such as water scarcity, urbanization, and shifts in production structure, enabling forecasts under varying external constraints in line with FAO and UNEP methodological guidelines.

Balance equations are applied as the most rigorous tool for the quantitative assessment of food self-sufficiency.

Taken together, these methods ensure a comprehensive analysis of the spatial distribution, resilience, and quantitative parameters of Samarkand's food supply system.

The boundaries of the study were defined according to a functional-spatial model of the urban-agricultural system, covering both administrative territories — Samarkand, Pastdargom, Akdarya, Taylak, and Jomboy districts — and agricultural lands located within an average radius of 35 km from the central urban zone of the city of Samarkand.

The analysis used official agricultural statistics of the Samarkand region for the year 2023, obtained from SamStat reports. The statistical data analysis was carried out at the level of administrative districts, followed by aggregation into the main categories of agricultural products, including: grain crops, vegetable crops, fruits and berries, dairy products, as well as meat in live weight (in tons).

For each district, indicators of gross agricultural production for 2023 were calculated. The primary statistical data were preliminarily cleaned of textual attributes, standardized into a uniform numerical format, and aggregated into a consolidated analytical table intended for subsequent quantitative analysis and spatial comparison.

Spatial data were processed using ArcGIS 10.8, which enabled multi-level zoning of the suburban areas of Samarkand.

Since the reports already provide the gross production volumes P_i for each district, the calculation was carried out without detailing by area and yield. The production potential was aggregated:

$$P_i = \sum_{k=1}^{n} P_{ik}, \tag{1}$$

where P_i is the total production volume in district i; P_{ik} is the volume of a specific type of product k (grain, vegetables, etc.)

The volume of product consumption was calculated based on demographic and physiological norms, using the population size of the city of Samarkand (N ≈ 600,000 people, SamStat, 2024) and the standards of annual product consumption:

$$C_k = N \cdot R_k, \tag{2}$$

where C_k is total demand for the product k; R_k is the annual per capita consumption rate (in kg/person/year).

In the calculations, annual per capita food consumption norms approved at the national level in the Republic of Uzbekistan were used and adapted in accordance with FAO recommendations and UzStat data. The specific values were as follows: grain crops — 180 kg/person/year; vegetable crops — 170 kg/person/year; fruits and berries — 100 kg/person/year; dairy products — 260 kg/person/year; meat products — 45 kg/person/year (UzStat, 2024).

To assess the balance of the system, a net balance calculation model was applied:

$$B_k = P_k\,(1 - \delta_k) - C_k, \tag{3}$$

where B_k is the balance of product k taking into account losses; δ_k is the coefficient of logistical and post-harvest losses (assumed in the range of 0,10–0,15).

Thus, the self-sufficiency coefficient was calculated as follows:

$$S_k = \frac{P_k(1-\delta_k)}{C_k}. \tag{4}$$

For the forecast analysis, a modified scenario model was applied, taking into account demographic dynamics, soil degradation, urbanization pressure, and the resilience of the production cycle. Three scenarios were developed: inertial (I) — continuation of current trends; adaptive-sustainable (U) — implementation of agroecological practices (agroforestry, organic farming, drip irrigation); crisis (K) — increased urbanization pressure, water scarcity, and reduction of suitable land.

Using GIS-based isochrone modeling, the study analyzed the accessibility of agricultural areas around Samarkand, identifying which zones are well connected to the city's food logistics system and which are less accessible.

To quantify the spatial integration of agricultural zones, spatial-temporal accessibility analysis was applied, based on isochrone modeling of the transport network using GIS.

The access time (T_i) from each agro-zone to the nearest logistics hub was calculated along the shortest route, taking into account network topology. Then, access time was normalized within the range [0–1] to obtain the logistics inclusion index (IL_i):

$$IL_i = 1 - \left(\frac{T_i}{T_{\max}} \right), \quad (5)$$

where T_i is the access time from agro-zone i to the nearest logistics hub; $T_{\max}$ is teh maximum recorded access time within the entire study area.

The IL_i values were used for the cartographic classification of the agro-zone transport integration index. Using this methodology, we quantified the suburban agro-sector's contribution to Samarkand's food supply and evaluated its development risks and opportunities in the context of sustainable territorial planning.

We selected these methods to combine a quantitative assessment of agribusiness potential with a qualitative analysis of the spatial organization of the food system. This approach aligns with contemporary food geography research, which emphasizes territorial interconnectedness and institutional factors as key determinants of sustainability (Renting et al., 2012).

The reliability of statistical data was verified through cross-validation using independent sources, including FAOstat reports and data from local NGOs. The study is, however, limited by the lack of microdata on household subsistence farming, which would provide a more precise view of food flows at the household level.

The modeling results align with the indicators outlined in Uzbekistan's Food Security Strategy through 2030, particularly regarding food chain localization, the expansion of local production, and sustainable resource management. This makes the findings a valuable tool for evidence-based regional planning and monitoring.

Results

The agrarian belt of Samarkand represents a complexly organized and territorially differentiated system, consisting of various functional zones, each of which plays a specific role in the city's sustainable food provision. Its structure has been shaped by a combination of natural-climatic, socio-economic, and infrastructural factors, along with historically rooted land-use practices and agricultural traditions.

The functional structure of the agrarian belt of Samarkand is characterized by pronounced multilayeredness and internal heterogeneity. It combines zones of high-intensity and commercially oriented production with areas of increased ecological and logistical vulnerability. The effective development and integration of all components of this system into a unified urban — regional food structure require systematic spatial planning, infrastructural modernization, and institutional support.

Assessment of Gross Production and Food Provision

Using territorial agricultural statistics for 2023, an integrated assessment of gross production was carried out for key agricultural products — grain, vegetables, fruits, milk, and meat — across Samarkand's agrarian belt (Samarkand, Pastdargom, Akdarya, Taylak, and Jomboy districts). The analysis aimed to evaluate the actual contribution of suburban zones to the city's fresh food supply and to assess their potential in supporting a sustainable local food system.

However, the analysis of the consolidated SamStat database, which is used in the practice of territorial and sectoral planning at the national and regional levels, revealed the absence of gross values of agricultural production for key types of products (grain, vegetables, fruits, milk, meat) for the five main suburban districts of Samarkand. In some cases, the corresponding cells contain zero values; in others, there is a lack of detail. Meanwhile, the aggregation of primary statistical tables at the district level indicates significant volumes of gross output: over 748 thousand tons of vegetables, 399 thousand tons of grain, 453 thousand tons of milk, and more than 313 thousand tons of fruits and melons (SamStat, 2023). This discrepancy between the primary and aggregated levels of statistical accounting indicates the presence of a systemic information deficit caused by institutional, methodological, and technological limitations in the current monitoring system of the agricultural sector. In particular, the weak integration of dehkan and small commodity farms into state reporting, insufficient digitalization, and the fragmented nature of data aggregation methods lead to a distorted picture of the production potential of agrarian territories.

Table 1

Calculation of Gross Production, Normative Demand, and Self-Sufficiency Coefficient for Key Types of Products in the Agrarian Belt of Samarkand (2023)

Product	Gross Output (t)	Demand (t)	Balance (t)	Self-Sufficiency Coefficient
Grain Crops	399 398,43	108 000	+291 398,43	3,70
Vegetable Crops	748 207,01	102 000	+646 207,01	7,34
Fruits and Melon Crops	313 348,99	60 000	+253 348,99	5,22
Milk	453 537,70	156 000	+297 537,70	2,91
Meat	115 625,00	27 000	+88 625,00	4,28

Source: authors' calculations based on SamStat (2023), FAO/UzStat consumption standards[1], and spatial aggregation within the defined 35-km agro-belt.

The absence of agribusiness data in certain SamStat entries reflects institutional and methodological constraints rather than the underlying economic reality. To fill the information gap, an independent aggregation of district-level SamStat statistical reports for 2023 was carried out, containing numerical values of gross agricultural production by administrative units. The primary statistical data, standardized through cleaning, normalization, and aggregation procedures, served as the empirical basis for the calculation of gross agribusiness indicators presented in Table 1.

Positive balance values show that local production surpasses the normative urban demand, highlighting surplus agricultural capacity. Such surplus may be allocated to exports, reserve formation, or the provision of food to vulnerable populations during periods of instability. However, its effective utilization depends on adequate logistical and infrastructural support.

In parallel, the normative food consumption of Samarkand's urban population (approximately 600,000 people) was estimated using per capita physiological standards approved in the Republic of Uzbekistan and aligned with FAO recommendations. The resulting demand estimates for each category were then analyzed alongside total production figures.

Spatial Analysis and Scenario Assessment of Agribusiness Potential

The results of the spatial analysis of the agribusiness system in the suburbs of Samarkand revealed a clearly defined functional differentiation within a 30-kilometer zone from the city limits. Based on the interpretation of satellite imagery, the spatial structure of the agribusiness belt was identified. Collectively, these territories form the core of Samarkand's urban-agricultural system, supplying the city with locally produced goods.

The spatial analysis enabled the functional zoning of Samarkand's agrarian belt, which primarily encompasses the districts of Samarkand, Pastdargom, Akdarya, Taylak, and Jomboy (Figure 1).

Approximately 43 % of the total area of the analyzed zone is occupied by irrigated agricultural lands, a significant portion of which is concentrated in the Pastdargom (53,6 thousand ha) and Akdarya (27,6 thousand ha) districts. These areas are dominated by highly productive arable lands used for vegetable, melon, and grain crops. The average long-term yield on fields located along the Zarafshan Canal reaches 250–280 centners per hectare, confirming the high potential of these plots.

Jomboy district is characterized by the predominance of perennial plantations — orchards and vineyards (more than 4,7 thousand ha) — as well as a well-developed system of individual farming. Samarkand district, despite a comparatively smaller area of irrigated land, performs an important logistical and processing function due to its proximity to the urban core and the concentration of agro-industrial hubs. Taylak district, in turn, represents a mixed-use zone: it combines small irrigated fields, fruit orchards, and areas designated for pasture use.

The summary land use data reflect the diversity of agroecological conditions and confirm the existence of significant resources for sustainable intensified production.

The results of spatial modeling revealed a clear differentiation of agro-zones within the

[1] UzStat. (2023). *Agriculture of Uzbekistan: Statistical yearbook for 2023.* State Committee of the Republic of Uzbekistan on Statistics. Retrieved from: https://stat.uz (date of access 11.11.2025).

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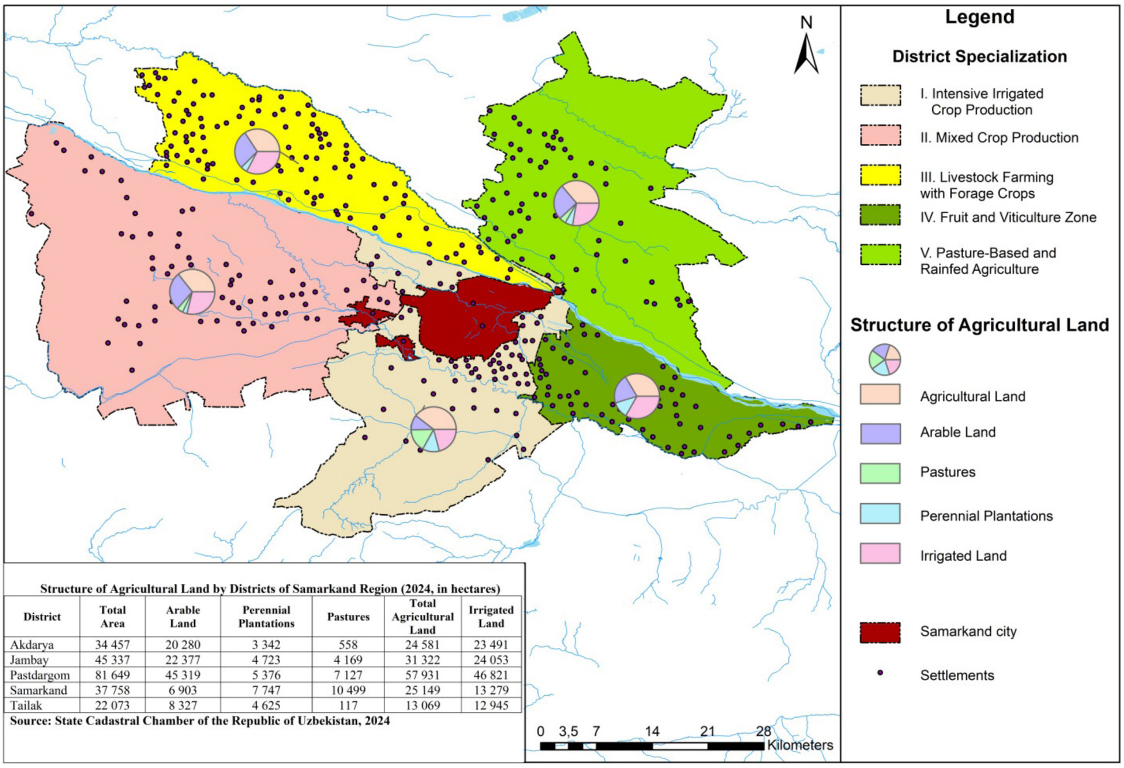

Structure of Agricultural Land by Districts of Samarkand Region (2024, in hectares)

District	Total Area	Arable Land	Perennial Plantations	Pastures	Total Agricultural Land	Irrigated Land
Akdarya	34 457	20 280	3 342	558	24 581	23 491
Jambay	45 337	22 377	4 723	4 169	31 322	24 053
Pastdargom	81 649	45 319	5 376	7 127	57 931	46 821
Samarkand	37 758	6 903	7 747	10 499	25 149	13 279
Tailak	22 073	8 327	4 625	117	13 069	12 945

Source: State Cadastral Chamber of the Republic of Uzbekistan, 2024

Figure 1. *Spatial Organization of the Agribusiness System in the Suburbs of Samarkand*

Source: elaborated by the authors in ArcGIS using district-level land-use statistics (State Cadastral Chamber of the Republic of Uzbekistan, 2024) and GIS-based spatial classification.

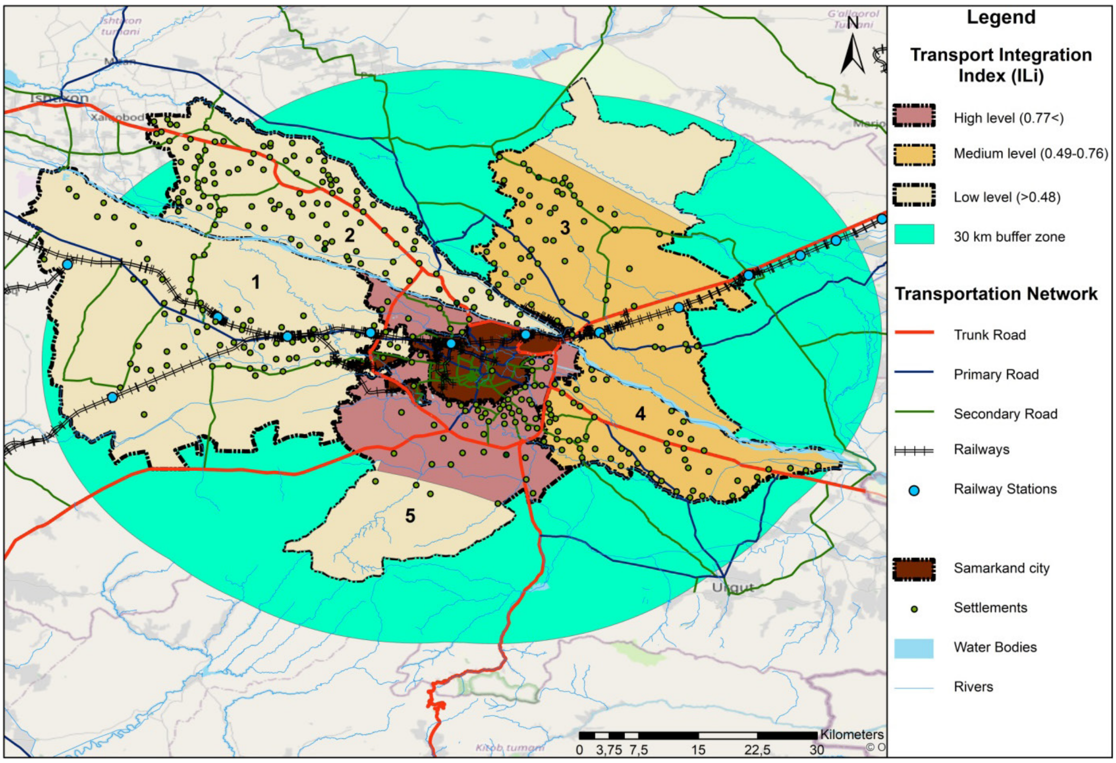

Figure 2. *Logistics Integration Index of Agro-Zones of Samarkand (IL_i) within the 30-km Belt. 1 — Pastdargom, 2 — Akdarya, 3 — Jomboy, 4 — Taylak, 5 — Samarkand*

Source: elaborated by the authors in ArcGIS using road network data, transport accessibility modelling, and district-level spatial datasets (State Cadastral Chamber of the Republic of Uzbekistan, 2024).

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agrarian belt of Samarkand in terms of their inclusion in the city's food logistics system. The values of the agro-zone transport integration index (IL_i) ranged from 0,84 to 0,16, indicating substantial differences in the spatial location and transport accessibility of agricultural areas (Figure 2).

The highest IL_i values (> 0,77) were recorded for agro-zones located near major wholesale markets in the Samarkand district. These areas are characterized by a high density of road networks, minimal access time (up to 25–30 minutes), and direct connection to processing infrastructure.

A medium level (IL_i = 0,49–0,76) was observed in the Taylak and Jomboy districts, where agro-zones have access to logistics hubs within 40–50 minutes. However, infrastructural constraints (road quality, seasonal accessibility) reduce the actual efficiency of market interaction.

A low level (IL_i < 0,48) was recorded on the periphery of the Pastdargom and Akdarya districts. These zones are characterized by fragmented infrastructure, remoteness from wholesale bases, and access times exceeding 50 minutes. The low IL_i here indicates logistical isolation, which limits farmers' participation in sustainable supply chains and highlights the need for territorial redistribution of logistics hubs.

Scenario-Based Forecast of Self-Sufficiency in Samarkand's Suburban Districts

Scenario modeling of Samarkand's suburban agribusiness system through 2030 allowed us to assess how local production can respond to key challenges, including water scarcity, population growth, land-use changes, and institutional constraints. The analysis considered three scenarios — Inertial (I), Adaptive-Sustainable (U), and Crisis (K)— with results broken down by the main suburban districts.

In the inertial scenario (I), which assumes that current conditions persist, self-sufficiency declines across all product categories. Taylak and Jomboy districts are particularly vulnerable, as limited infrastructure and fragmented land use hinder effective agribusiness operations. Even traditionally productive districts such as Akdarya and Pastdargom show low self-sufficiency levels: 33–35 % for dairy products and 49–52 % for fruits.

The adaptive-sustainable scenario (U) assumes the implementation of a set of institutional and technological measures: modernization of irrigation networks, development of cooperation and processing, and spatial integration of agro-zones with urban markets. In this case, Pastdargom and Akdarya districts become key zones for vegetable and dairy production, while Jomboy becomes the core of horticulture. Samarkand district strengthens its logistical and processing functions. The result is the achievement of self-sufficiency coefficients ranging from 75–92 % for vegetables, 68–80 % for fruits, and 50–58 % for milk, depending on the district.

In the crisis scenario (K), the forecast includes the loss of part of the irrigated lands due to urban development, intensification of water scarcity, and a reduction in the number of small producers. The indicators decline especially sharply in Taylak and Jomboy districts (down to 19–22 % for milk and 28–36 % for fruits). Even under the best conditions (Akdarya), the self-sufficiency level does not exceed 45 % for vegetables. This situation indicates the high vulnerability of the suburban food system in the absence of a targeted sustainability policy.

Table 2 below presents the self-sufficiency coefficients by district and scenario, highlighting spatial differences in agrarian productivity and identifying priority zones for targeted interventions.

Discussion

The results of scenario modeling of food self-sufficiency in the agrarian belt of Samarkand demonstrate pronounced territorial and scenario-based differentiation, confirming the high sensitivity of the system to changes in resource base, institutional environment, and logistical structure. The obtained self-sufficiency coefficient values allow for a number of substantive conclusions relevant both for scientific understanding and applied planning.

Firstly, the adaptive-sustainable scenario (U) demonstrates the highest potential for ensuring the food independence of Samarkand. The increase in self-sufficiency to 75–92 % for vegetables, 68–80 % for fruits, and 50–58 % for dairy products is achieved through targeted institutional and technological interventions: irrigation modernization, promotion of cooperation, and expansion of processing. Particularly significant positive shifts are recorded in the Akdarya and Pastdargom districts — areas with favorable agroecological configurations, a high share of irrigated lands, and potential for cluster-based devel-

Table 2

Projected Self-Sufficiency Values for Key Types of Products in the Suburban Districts of Samarkand by 2030 (%)

District	Product	Inertial (I)	Adaptive-Sustainable (U)	Crisis (K)
Akdarya	Vegetables	65 %	92 %	45 %
	Fruits	52 %	80 %	42 %
	Milk	33 %	58 %	27 %
Pastdargom	Vegetables	67 %	91 %	43 %
	Fruits	49 %	76 %	41 %
	Milk	35 %	55 %	29 %
Jomboy	Vegetables	54 %	81 %	38 %
	Fruits	47 %	78 %	36 %
	Milk	28 %	49 %	22 %
Samarkand	Vegetables	48 %	75 %	40 %
	Fruits	40 %	68 %	35 %
	Milk	30 %	50 %	23 %
Taylak	Vegetables	45 %	65 %	32 %
	Fruits	36 %	60 %	28 %
	Milk	22 %	38 %	19 %

Source: calculated by the authors using SamStat agricultural data (2023–2024), FAO/UzStat consumption norms, and scenario-based modeling of production dynamics[2].

opment. These districts can be transformed into cores of sustainable agribusiness integrated into the urban food logistics system.

Secondly, the inertial scenario (I) indicates a trend toward declining food sustainability in the absence of corrective measures. The decrease in self-sufficiency for milk to 22–35 % and for fruits to 36–52 % in some districts signals a gradual decline in productivity and the loss of agricultural function. Taylak and Samarkand districts are particularly at risk, given limited land resources, urbanization pressure, and a low level of water availability. In the long term, such dynamics may lead to the erosion of the city's food sovereignty and increased dependence on unstable external supplies.

Thirdly, the crisis scenario (K) demonstrates the most vulnerable configuration. The drop in self-sufficiency for key types of products to critical levels (down to 19–23 % for milk and 28–36 % for fruits) reflects the cumulative effect of land degradation, water resource scarcity, institutional disorganization, and logistical isolation of certain agrozones. This scenario is especially dangerous in the context of global food and climate shocks and requires the development of mechanisms for strategic stockpiling and emergency support for agricultural producers in vulnerable areas.

It should be emphasized that the territorial heterogeneity of agribusiness potential requires a differentiated sustainability policy. Universal measures applied without taking into account district-specific features may prove ineffective. Instead, a zonal strategy is needed, in which:

Pastdargom and Akdarya districts serve as zones of intensive sustainable production, requiring support in the form of investment incentives and infrastructure modernization;

Jomboy district is considered a horticultural base in need of institutional integration (cooperation, subsidization);

Samarkand and Taylak districts function as logistics-processing and buffer zones, where the priority becomes the preservation of remaining productive areas and the prevention of uncontrolled urbanization.

Scenario analysis shows that food sustainability is not just an agricultural challenge. It is a multi-level system that relies on coordinated policies in urban planning, water management, logistics, cooperation, and social support. The implementation of the sustainable scenario requires the establishment of an institutional coordination mechanism between agricultural districts and the

[2] UzStat. (2024). *Agriculture of Uzbekistan: Statistical yearbook for 2023.* State Committee of the Republic of Uzbekistan on Statistics. Retrieved from: https://stat.uz (date of access 11.11.2025).

city administration of Samarkand, including the development of an urban food strategy with components of spatial planning.

The study is limited by the absence of micro-level farm data, which does not allow capturing intra-district variability in agricultural production. The spatial results reflect the specific natural, climatic, and institutional conditions of the Samarkand region and therefore cannot be directly extrapolated to other areas. The scenario assessments rely on several assumptions regarding water availability, logistical accessibility, and consumption patterns, which may affect the accuracy of the projections.

Conclusions

The study of Samarkand's suburban agribusiness system demonstrates that sustainable urban food provision requires targeted spatial planning and the systemic integration of suburban agrozones into the city's overall food architecture.

Spatial and scenario analyses revealed pronounced territorial disparities in production potential. High-activity zones, such as Akdarya and Pastdargom districts, contrast sharply with resource- and institutionally vulnerable districts like Taylak and Jomboy. These differences underscore the need to move from a universal food policy toward a differentiated approach tailored to the agroecological and logistical conditions of each territory.

Scenario modeling through 2030 indicates that coordinated agricultural policy, infrastructure modernization, and support for local production could achieve high self-sufficiency levels — up to 92% for vegetables and 80% for fruits. Conversely, a crisis scenario predicts severe declines in food provision, highlighting risks to food sovereignty.

The study confirms the value of a scenario-based approach for diagnosing and planning food sustainability. Effective food security depends less on expanding production volumes than on enhancing spatial coherence between production, processing, and consumption zones.

Recommendations include developing agro-industrial cooperation, modernizing logistics hubs, implementing systems to monitor transport accessibility of agro-zones, and designing an urban food strategy grounded in sustainability principles.

The agribusiness potential of Samarkand's suburban belt has significant transformative capacity. With institutional consolidation, investment support, and political commitment, it can serve as both a foundation for increasing urban self-sufficiency and a model for sustainable food planning in other Central Asian cities facing similar challenges.

References

Armendáriz, V., Armenia, S. & Atzori, A. (2016). Systemic Analysis of Food Supply and Distribution Systems in City-Region Systems — An Examination of FAO's Policy Guidelines towards Sustainable Agri-Food Systems. *Agriculture*, 6, 1–19. Retrieved from: https://doi.org/10.3390/AGRICULTURE6040065 (date of access: 11.05.2025).

Avila Sanchez, H. (2024). Food production in proximity peri-urban spaces. Phenomena, processes and socio-territorial expressions in the formation of agri-food systems. *Investigaciones geográficas*, 113. Retrieved from: https://doi.org/10.14350/rig.60806 (date of access: 11.05.2025).

Berkhout, E., Sovová, L. & Sonneveld, A. (2023). The Role of Urban–Rural Connections in Building Food System Resilience. *Sustainability*, *15* (3), 1818. Retrieved from: https://doi.org/10.3390/su15031818 (date of access: 11.05.2025).

Boboyev, Sh. (2024). Territorial Distribution and Specialization of Agro-Industrial Clusters in the Samarkand Region. *FAN va Jamiyat Ilmiy-uslubiy jurnal*, 4/1, 34–36.

Boboyev, Sh. (2025). Evaluation of the economic efficiency of agroindustrial clusters in Samarkand region. *Scientific Journal of the Fergana State University*, 1 (31), 179–188. Retrieved from: https://doi.org/10.56292/SJFSU/vol31_iss1/a131

Daminov, N. A. (2021). International cooperation of the Republic of Uzbekistan in the field of agriculture on the example of the Samarkand region (1991–2016). *Sociasphera*, 2, 11–18.

Danshin A. I. & Bogdanchikova A. V. (2006). Agrarian policy in Central Asia countries. *Regional Research,* 4, 98–106.

Danshin, A. I. & Radikevich, A. V. (2022). The method of economic-geographic profiling of agriculture for territories with contrasting indicators of development. *Vestnik of Saint Petersburg Uni-*

versity Earth Sciences, 67, 106. Retrieved from: https://doi.org/10.21638/spbu07.2022.106 (date of access: 11.05.2025).

Danshin, A. I., Mavlonov, A. M. & Shabalina, N. V. (2024). Agriculture as an element of new tourist destinations in the Bukhara region. *Geographical Environment and Living Systems*, 3, 107–122. Retrieved from: https://doi.org/10.18384/2712–7621–2024–3-107-122 (date of access: 11.05.2025).

Darly, S., Feuillet, T. & Laforêt, C. (2021). Home Gardening and the Social Divide of Suburban Space: Methodological Proposal for the Spatial Analysis of a Social Practice in the Greater Paris Urban Area. *Sustainability*, 13 (6), 3243. Retrieved from: https://doi.org/10.3390/su13063243 (date of access: 11.05.2025).

Djanibekov, N., Van Assche, K., Bobojonov, I. & Lamers, J. P. (2012). Farm restructuring and land consolidation in Uzbekistan: New farms with old barriers. *Europe-Asia Studies*, 64 (6), 1101–1126. Retrieved from: https://doi.org/10.1080/09668136.2012.691720 (date of access: 11.05.2025).

Dubbeling, M., Santini, G., Renting, H., Taguchi, M., Lançon, L., Zuluaga, J., De Paoli, L., Rodriguez, A. & Andino, V. (2017). Assessing and Planning Sustainable City Region Food Systems: Insights from Two Latin American Cities. *Sustainability*, 9 (8), Retrieved from: 1455. https://doi.org/10.3390/su9081455 (date of access: 11.05.2025).

Galeano-Barrera, C., Mendoza-García, E., Martínez-Amariz, A. & Romero-Riaño, E. (2022). Theoretical model of territorial agro-industrial development through multi-focus research analytics. *Journal of Rural Studies*. Retrieved from: https://doi.org/10.1016/j.jrurstud.2022.06.014 (date of access: 11.05.2025).

Guibrunet, L. & Arnés, E. (2021). Calculating Mexico City's Food Supply: Methodological Insights for Regionalizing Food Data at the Urban Scale. *Papers in Applied Geography*, 8, 282–296. Retrieved from: https://doi.org/10.1080/23754931.2021.2006758 (date of access: 11.05.2025).

Haysom, G. (2015). Food and the City: Urban Scale Food System Governance. *Urban Forum*, 26, 263–281. Retrieved from: https://doi.org/10.1007/s12132–015–9255–7 (date of access: 11.05.2025).

Ibragimov, L., Boboyev, Sh., Berdikulov, F., Makhmudova, G. (2021). Specialization of agriculture of Samarkand region. *Journal of Geography and Natural Resources*, 1, 38–49. Retrieved from: https://doi.org/10.37547/supsci-jgnr-04-01-08 (date of access: 11.05.2025).

Jensen, P. & Orfila, C. (2021). Mapping the production-consumption gap of an urban food system: an empirical case study of food security and resilience. *Food Security*, 13, 551–570. Retrieved from: https://doi.org/10.1007/s12571–021–01142–2 (date of access: 11.05.2025).

Krähmer, K., Battisti, L., Berti, G., Bruno, R. G. & Dansero, E. (2024). Towards Sustainable and Sufficient City Region Food Systems: Reflections from the Case Study of Turin, Italy. *Sustainability*, *16* (19), 8569. Retrieved from: https://doi.org/10.3390/su16198569 (date of access: 11.05.2025).

Marinelli, M. V., Argüello Caro, E. B., Petrosillo, I., Kurina, F. G., Giobellina, B. L., Scavuzzo, C. M. & Valente, D. (2023). Sustainable Food Supply by Peri-Urban Diversified Farms of the Agri-Food Region of Central Córdoba, Argentina. *Land*, *12* (1), 101. Retrieved from: https://doi.org/10.3390/land12010101 (date of access: 11.05.2025).

Morgan, K. & Sonnino, R. (2010). The urban foodscape: world cities and the new food equation. *Cambridge journal of regions, economy and society*, 3 (2), 209–224. Retrieved from: https://doi.org/10.1093/cjres/rsq007 (date of access: 11.05.2025).

Nefedova, T. G. (2019). Development of the Post-Soviet Agricultural Sector and Rural Spatial Polarization in European Russia. *Prostranstvennaya Ekonomika = Spatial Economics*, 15 (4), 36–56. Retrieved from: https://dx.doi.org/10.14530/se.2019.4.036-056 (date of access: 11.05.2025).

Ochoa, C., Ruiz, A., Olmo, R., Figueroa, Á. & Rodríguez, A. (2020). Peri-Urban Organic Agriculture and Short Food Supply Chains as Drivers for Strengthening City/Region Food Systems — Two Case Studies in Andalucía, Spain. *Land*, 9, 177. Retrieved from: https://doi.org/10.3390/land9060177 (date of access: 11.05.2025).

Olsson, G. (2018). Urban food systems as vehicles for sustainability transitions. *Bulletin of Geography. Socio-economic Series*, 40, 133–144. Retrieved from: https://doi.org/10.2478/bog-2018–0019 (date of access: 11.05.2025).

Online ISSN 2412-0731

Ospanova G.S., Saipov A.A., Sergeyeva A.M., Saparov K.T., Omirzakova M. Zh. & Nurymova R.D. (2022). Potential for the Development of Agritourism in the Food Supply Zone of the Republic of Kazakhstan, Nur-Sultan City. *Geo Journal of Tourism and Geosites*, 44, 4, 1253–1259. Retrieved from: https://doi.org/10.30892/gtg.44409-941 (date of access: 11.05.2025).

Potter, A., & LeBuhn, G. (2015). Pollination service to urban agriculture in San Francisco, CA. *Urban Ecosystems*, 18 (3), 885–893. Retrieved from: https://doi.org/10.1007/s11252-015-0435-y (date of access: 11.05.2025).

Prudnikov, V.B., Timiryanova, V.M., Rossinskaya, G.M., Krasnoselskaya, D. Kh. (2025). Spatial dependence of prices for seasonally demanded products across price segments in Russian regions. *R-Economy*, 11 (1), 5–21. Retrieved from: https://doi: 10.15826/recon.2025.11.1.001 (date of access: 11.05.2025).

Renting, H., Schermer, M. & Rossi, A. (2012). Building food democracy: Exploring civic food networks and newly emerging forms of food citizenship. *International Journal of Sociology of Agriculture and Food*, 19 (3), 289–307. Retrieved from: https://doi.org/10.48416/ijsaf.v19i3.206 (date of access: 11.05.2025).

Rudenko, L.H. & Nahirna, V.P. (2021). Countryside in the area of influence of the Kyiv metropolis (strengthening of agro-food function under conditions of social transformations). *Ukrainian Geographical Journal*, 2021 (3), 12–18. Retrieved from: https://doi.org/10.15407/ugz (date of access: 11.05.2025).

Sabirova, A.I., Nizamutdinov, M.M., Safiullin, A.R. & Kharisova, F.I. (2019). The impact of competition on regional food security (the case of the milk and dairy market in the Republic of Tatarstan). *R-economy*, 5 (3), 137–143. Retrieved from: https://doi: 10.15826/recon.2019.5.3.014 (date of access: 11.05.2025).

Sergeyeva, A.M., Omirzakova, M.Z. & Saparov, K.T. (2024). Rural tourism in the framework of agricultural diversification in Aktobe Region, Republic of Kazakhstan. *Human Geographies*, 18 (1), 1–13. Retrieved from: https://doi.org/10.5719/hgeo.2024.181.4 (date of access: 11.05.2025).

Sonnino, R. (2009). Feeding the city: Towards a new research and planning agenda. *International Planning Studies*, 14 (4), 425–435. Retrieved from: https://doi.org/10.1080/13563471003642764 (date of access: 11.05.2025).

Tleuberdinova, A., Nurlanova, N., Alzhanova, F. & Salibekova, P. (2025). Food security and self-sufficiency as a factor of country's sustainable development: assessment methods and solutions. *Discover Sustainability*, 6 (1), 50. Retrieved from: https://doi.org/10.1007/s43621-025-00849-y (date of access: 11.05.2025).

Usmonov, M. (2024). Improving Storage Services for Agricultural Products in the Samarkand Region. Central Asian *journal of multidisciplinary research and management studies*, 1 (17), 111–114. Retrieved from: https://doi.org/10.5281/zenodo.14363308 (date of access: 11.05.2025).

Zasada, I. (2011). Multifunctional peri-urban agriculture — A review of societal demands and the provision of goods and services by farming. *Land use policy*, 28 (4), 639–648. Retrieved from: https://doi.org/10.1016/j.landusepol.2011.01.008 (date of access: 11.05.2025).

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