SUSTAINABLE URBAN PLANNING MODELS TO INTEGRATE RURAL ECONOMIES IN UKRAINE DURING MARTIAL LAW

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Abstract
Sustainable urban planning to integrate rural economies in Ukraine during martial law presents unique challenges due to disrupted infrastructure, population displacement, and resource constraints. In such circumstances, there is a need to form economic resilience in urban-rural systems through optimisation of resource allocation models for agricultural production and distribution, reintegration of urban-rural populations and redistribution of labour, use of decentralised governance between urban and rural areas, digital integrated governance. The aim of the study is to explore and apply sustainable urban planning for ensure resilience, adaptability and maintaining rural economic activity to support both urban and rural populations during martial law. The study is based on the analysis of agricultural production, supply chain security and urban market access; the investigation into the impact of martial law on rural productivity and urban market demand; and the examination of the employment of displaced urban and rural populations in economic activities, including agriculture and resource processing. The paper identifies the role of decentralised administrations in maintaining essential functions between urban and rural areas, assesses the system of rural resource management in Ukraine during martial law, and examines the level of integration of digital systems to maintain governance continuity in rural areas. The research results suggest the creation of a national urban-rural resilience framework focusing on integration rural economies with urban centers in Ukraine during martial law. In terms of long-term development goals, directions for further integration of the urban-rural economy are proposed through the creation of innovation hubs that integrate agriculture, technology, and renewable energy sources.
Keywords: urban areas, rural areas, populations, decentralised governance, innovation hubs.

Introduction

Ukraine's agricultural sector plays a vital role in national and global food markets. The integration of rural economies into sustainable urban planning has never been more critical for Ukraine, particularly under the constraints of martial law. Russia's military aggression in Ukraine created unprecedented challenges for both urban and rural areas, disrupting economic activities, displacing populations, and straining infrastructure. In this context, sustainable urban planning models that integrate rural economies are not only essential for recovery but also for building resilience and ensuring long-term development. Martial law has further emphasized the need for innovative approaches that bridge the gap between urban and rural regions, fostering economic interdependence, resource optimization, and social cohesion.

Sustainable urban planning models aim to create synergies between cities and rural areas, ensuring that both benefit from shared resources, infrastructure, and economic opportunities. These models are particularly relevant in Ukraine, where rural areas play a critical role in agriculture, energy production, and natural resource management, while urban centers serve as hubs for innovation, governance, and services. By integrating rural economies into urban planning frameworks, Ukraine can address key challenges such as food security, energy independence, and equitable development, even in the face of wartime disruptions.

This approach involves leveraging digital technologies, decentralized governance, and green infrastructure to create a cohesive system that supports both urban and rural populations. For instance, digital platforms can facilitate supply chain management for agricultural products, while decentralized energy systems can provide reliable power to remote areas. Additionally, sustainable urban planning can promote the development of rural-urban clusters, where cities and surrounding villages collaborate on economic projects, infrastructure development, and social services.

During martial law, the integration of rural economies into urban planning becomes even more critical. Rural areas often serve as safe havens for displaced populations, requiring enhanced infrastructure and services to accommodate increased demand. At the same time, urban centers must adapt to support rural economies by providing access to markets, technology, and financial resources. By adopting sustainable urban planning models, Ukraine can ensure that both urban and rural regions contribute to and benefit from the nation's recovery and growth.

The scientific literature contains studies on sustainable urban planning models to integrate rural economies. The integration aspects of urban and rural areas are considered in the context of social development, using the methodological tools of dynamic series to study the impact on integration from the point of view of the flow of rural population and the city's steam-power structure, temporal and spatial differences, and government intervention development (Xu et al., 2019). It is proposed to apply an innovative approach to stimulate rural development and spatial structure by providing urban services for its residents and residents of neighbouring villages to overcome rural problems at the social, economic and environmental levels (Allawi & Al-Jazaeri, 2023). The 'life quality theory' is used to study the interaction between the space of rural settlements and the quality of life of their

inhabitants; optimisation of the spatial organisation of rural settlements should be achieved through support for rural livelihoods and concentration of agricultural and industrial spaces, distribution of various types of resources and infrastructure development (Tang et al., 2018). In the context of sustainable development of territories, the authors propose mechanisms for bridging the gap between urban and rural areas using a regression model and indicators of rural demography and urbanization (Wei et al., 2021). The authors propose a model of sustainable urban-rural cooperation for poverty alleviation in rural areas based on the analysis of benefits and costs, especially for the environment through the growth of industrial production (Ji et al., 2019). The authors investigate landscape models, their consequences and sustainability on the impact of urban-rural integration, taking into account socio-economic and environmental indicators and innovations (He et al., 2024).

A review of the scientific literature has shown that there is a substantial body of research in the field of urban-rural integration for spatial planning and ensure sustainable development. However, there are no studies of these aspects in wartime conditions, and further generalisation of existing approaches is needed, taking into account the limited functioning of agricultural entities in rural areas, ensuring spatial planning and inclusion of rural-urban associations.

Materials and Methods

The methodological basis of the study is a monographic review and identification of factors that influence the integration of urban and rural areas in Ukraine, as well as social, economic, environmental and spatial processes that occur there during the period of martial law. The sources of information are the statistical data of the State Statistics Service of Ukraine on the agricultural sector. The results of the implementation of decentralisation and community development reforms in Ukraine were used to study practical cases of successful use of decentralised governance and digital integrated governance between urban and rural areas by territorial communities of Ukraine. A sequence structure is used to build an algorithm for the formation of sustainable urban planning models to integrate rural economies in Ukraine during martial law.

Results and Discussion

The ongoing war in Ukraine since 2022 has had a significant impact on the production, processing and distribution of agricultural products, causing physical destruction, logistical difficulties and changes in agricultural policy.

According to the State Statistics Service of Ukraine, in 2022, agricultural production decreased by 25% compared to 2021. In particular, production at agricultural enterprises decreased by 28% and at private farms by 18.6%. In crop production, the decline was 28%, and in livestock production – 12%. In 2023, production recovered. Agrarians harvested 79.2 million tonnes of products, including 58.4 million tonnes of grains and pulses and 20.8 million tonnes of oilseeds. Sugar beet production increased by 29% compared to 2022 (SSCU, 2024).

Changes in volumes of agricultural production were caused by the occupation of part of Ukraine's territories and the loss of agricultural land; problems with the supply of fertilisers, fuel and seeds, which led to a decrease in yields; and a reduction in the workforce due to mobilisation and migration. The distribution of agricultural products in Ukraine was affected by logistical challenges – the blockade of seaports in 2022-2023 made export more difficult, and disruption of domestic transport routes and infrastructure.

It is also worth noting that the hostilities have led to large-scale internal displacement and external migration, which has significantly affected the ratio of urban to rural population in Ukraine. In 2024, the share of the rural population in the total structure was 21%, and in 2022 – 30% (SSCU, 2024).

We have studied the main models of agricultural production and distribution used by actors during martial law in Ukraine (Table 1). The studied and identified models are based on the mechanisms of adaptation of agricultural producers to wartime conditions, introduction of innovations in production and distribution, state and international support.

As a result of the hostilities and the losses incurred by agricultural producers, the problem of ensuring the security of agricultural supply chains and access to urban markets has arisen.

To this end, a number of activities were organised by stakeholders, including the development of alternative logistics routes (increasing the use of road and rail), strengthening local agri-food systems (development of productive small and medium-sized farming, processing and development of regional agro-industrial clusters). This, in turn, has strengthened the capacity of local agri-food systems, made them less vulnerable and ensured that agricultural raw materials (for processing companies) and products (for urban and rural populations) are supplied.

The hostilities in Ukraine have caused significant changes in the demographic situation and the labour market, affecting the reintegration of urban and rural populations and the redistribution of labour.

As a result of the hostilities, many territorial communities in Ukraine are under occupation or in the area of active hostilities, which has led to the displacement of people both within and outside the country. In this regard, Ukraine has created a digital platform (Clarity Hromada) to track the current status of territorial communities, which helps to coordinate efforts to reintegrate the population.

Table 1
Models of agricultural production and distribution used by entities during martial law in Ukraine

Models	***Characteristics***
Diversification of production and processing	Development of agricultural raw materials processing at the local level (urban and rural areas) in relatively safe areas.
Implementation of innovations and technological solutions in production	Active use of innovative technologies, such as precision farming, drones for crop monitoring and optimisation of fertiliser and pesticide use.
Support for small farmers	Introduce a state programme of financial assistance to farmers to ensure sustainable agricultural production in the frontline regions of Ukraine and facilitate access to markets.
Alternative transport routes and sales logistics	Developing transport infrastructure, including railways and roads, to ensure uninterrupted supply of agricultural products to domestic and foreign markets.
Cooperation with international partners in the production and marketing of agricultural products	Implementation of support programmes for the agricultural sector, including financial assistance, tax breaks and grants for infrastructure development, humanitarian and technical assistance to stabilise agricultural production and ensure food security.

Source: authors' research.

In addition, the government is implementing a policy in the de-occupied territories aimed at restoring state authority and reintegration, including the restoration of social and economic infrastructure, and ensuring security and justice in urban and rural areas. In the regions of Ukraine most affected by the military aggression, the number of jobs has decreased and competition for available vacancies has increased. This resulted in an imbalance between labour supply and demand, as many enterprises were forced to reduce production, especially in rural areas. The burden on the rural population, in particular on the cultivation of raw materials and food production, increased.

There is a shortage of labour due to the mobilisation of men, women, children and the elderly often work in agriculture, and the level of mechanisation is declining due to the lack of fuel or spare parts, forcing a return to manual labour. Unemployment tends to increase in urban areas due to the closure of enterprises, while in rural areas there is a shortage of labour. Women often take on roles previously held by men, leading to changes in the social structure of the population in both urban and rural areas. Rural people often migrate to cities in search of work or security, which can lead to urban overcrowding.

The martial law in Ukraine has had a significant impact on agricultural productivity and urban market demand. The main reasons are a reduction in planted areas and changes in production technologies that lead to lower yields. The total harvest of grains and oilseeds decreased from 107 million tonnes in 2021 to a projected 77 million tonnes in 2024 (SSCU, 2024). In addition, export restrictions, declining agricultural production and supply chain disruptions have led to shortages of certain foods in urban areas. This, in turn, led to an increase in food prices, which affected the purchasing power of the urban population. At the same time, urban markets have faced the need to adapt to the new conditions by seeking alternative sources of supply and implementing new logistics solutions to ensure food security. In western Ukraine, this problem was partially solved by importing agricultural products, concentrating production and developing wholesale trade. This process was actively promoted by local governments and the international community, which provided financial support to farmers, developed internal logistics and implemented programmes to encourage local production.

The economic sustainability of urban and rural systems in Ukraine during martial law is achieved through the financial autonomy of territorial communities. This involves, in particular, reducing the dependence of local budgets on state subventions and grants by increasing the share of own revenues, seeking additional sources of funding (such us grants and donations), and adapting the budget process to ensure the continuous execution of local budgets and prompt response to the needs of urban and rural communities.

During martial law, territorial communities used forms of decentralised governance and digital integrated governance between urban and rural areas to ensure resilience and territorial development. Under decentralised governance, local authorities have a better understanding of the needs of their communities and can respond more quickly to challenges, optimise the use of budget funds by directing them to the most important projects, and stimulate rural development through the transfer of powers to the local level to promote infrastructure, education, healthcare and other areas in rural areas. Digital technologies play a key role in ensuring effective management of urban and rural areas. They allow for data integration, process optimisation and transparency in decision-making. Digital integrated governance between urban and rural areas ensures effective coordination of resource allocation in times of war, allows for real-time analysis

of the state of infrastructure, resources and needs of the territories, provides transparency in the use of budget funds and decision-making, and helps decision-makers make informed decisions. During martial law, urban and rural communities in Ukraine use existing and create new digital platforms to manage production resources, monitor infrastructure and communicate between communities, use the IoT to monitor the condition of roads, energy systems, water supply, etc., and use electronic services for citizens to provide access to public services, which is especially important for remote rural areas.

The above-mentioned aspects have led to increased integration of urban and rural areas in Ukraine during martial law. This has found practical expression in several key areas:

- the development of transport infrastructure: This includes – improving the road network between cities and villages to ensure the mobility of people and food.
- Creation of economic clusters: This involves – uniting urban and rural enterprises for joint production and sales of agricultural products.
- Development of social infrastructure: – This means ensuring equal access to education, healthcare and other services for urban and rural populations.
- Support for small and medium-sized businesses: – This entails creating conditions for the development of farms in rural areas, which helped reduce migration to cities.

We have summarized examples of successful use of decentralized governance and digital integrated governance between urban and rural areas by territorial communities of Ukraine, which significantly contributes to the effective creation of sustainable urban planning models to integrate rural economies in Ukraine during martial law (Table 2). Also it identified directions for urban-rural integration and the implementation of innovative projects by territorial communities of Ukraine (Table 3).

The tables shows that decentralized administrations play a key role in preserving the basic functions between urban and rural areas. They ensure effective resource management, infrastructure, social services, environmental and economic development, which contributes to the balanced development of both types of territories.

Table 2

Cases of successful use of decentralised governance and digital integrated governance between urban and rural areas by territorial communities of Ukraine

Direction of implementation	***Case description***
Decentralized governance	The Berehove territorial community (Zakarpattia region) united the city of Berehove and the surrounding villages. Due to decentralization, the community has received funds for infrastructure development: roads have been repaired, new schools and medical facilities have been established. It actively attracts international assistance to implement projects such as restoring the street network and developing tourism.
	The Pokrovsk territorial community (Dnipropetrovsk region) united the city of Pokrovsk and rural settlements. The community focused on developing social infrastructure: new kindergartens were built and administrative service centers were opened. Funds were raised from international donors to implement energy efficiency projects.
	Zolochiv territorial community (Lviv region): united the city of Zolochiv and surrounding villages. The community is actively developing tourism infrastructure, restoring historical monuments and creating new routes for tourists. Transparent budget management mechanisms have been introduced, allowing citizens to control expenditures.
Digital integrated governance	The Diia platform is a national platform that provides electronic services for citizens, including the rural population. Through Diia, you can get a driver's license, register a business, apply for social benefits, and more. This greatly simplifies access to public services for residents of remote villages.
	The Electronic Construction Cadastre system allows for online construction permits, which simplifies the process for local communities and businesses. It is especially useful for rural areas where obtaining permits used to be difficult.
	Digital platforms for farmers – platforms such as AgriChain, Kernel, AgriEye help farmers manage supply chains, analyze market prices, and obtain financing. This allows agriculture to operate more efficiently and integrate into the national and international economy.
	Electronic auctions for local budgets – many territorial communities use electronic systems to conduct tenders for the purchase of goods and services. This ensures transparency and reduces corruption risks.

Source: summarised by authors based on Decentralization, 2024.

Table 3
Cases of successful urban-rural integration and the implementation of innovative projects by territorial communities of Ukraine

Direction of implementation	***Case description***
Integration of urban and rural areas	Development of transport infrastructure – in many regions, new public transport routes have been created to connect cities and villages. For example, in Lviv region, a Smart Bus system has been introduced that allows rural residents to easily get to the city.
	Creation of economic clusters – in Kharkiv region, urban enterprises cooperate with rural farmers to produce and sell products. This helps to ensure a stable income for the farmers.
	Development of tourism clusters – in the Carpathian region, urban tourism operators are working with rural communities to create eco-trails and develop rural tourism.
Innovation projects	Smart Villages – a smart village project was implemented in the village of Stari Petlivtsi (Kyiv region), which includes solar power plants, energy-efficient lighting, and a water quality monitoring system.
	Digital education hubs – many rural schools have created digital classrooms where students can receive education through online platforms such as All-Ukrainian School Online.
	Electronic healthcare services – telemedicine consultations are being introduced in rural communities, allowing residents to receive qualified care without having to travel to the city.

Source: summarised by authors based on Decentralization, 2024.

Taking into account the above-mentioned aspects of the state of the resource potential and the volume of activities of agricultural enterprises, models of production and distribution of agricultural products, demographic changes in the labor market and migration processes, mechanisms of interaction and integration of urban and rural territorial communities, development of decentralized governance and digital integrated governance aimed at economic sustainability, social equality and environmental sustainability, we propose an algorithm for the formation of sustainable urban planning models to integrate rural economies in Ukraine during martial law (Table 4).

The algorithm for applying sustainable urban planning to ensure resilience, adaptability and support for rural economic activity during martial law includes a number of steps aimed at integrating urban and rural areas, optimizing resources and ensuring sustainable and inclusive territorial development.

Taking into account the current military situation in Ukraine, we propose specific directions for the further integration of urban and rural economies. Our approach is based on the algorithm for the forming sustainable urban planning models, designed to integrate the rural economy. This involves creating innovation hubs that combine agriculture, technology and renewable energy sources. Such hubs will ensure the sustainability of agri-food systems and food security, increase the overall integration, and foster the sustainable and inclusive development of these territories. In view of the creation of innovation hubs, it is proposed to actively introduce technical-technological solutions for agriculture, such as precision farming, IoT for monitoring soil and crop conditions, drones for field processing; create technology transfer centers where farmers can access the latest developments and learn how to use them. It is recommended to develop digital platforms for data exchange, market price analysis, supply chain management and financing, and provide access to electronic markets for product sales. An important structural unit of the innovation hub should be an energy department for the development of renewable energy sources, including the creation of solar, wind and biogas power plants in rural areas. This will ensure energy independence and reduce greenhouse gas emissions by focusing on sever key areas: the introduction of microgeneration for individual farms and rural communities: the development of energy saving projects for agricultural enterprises and residential buildings, and the use of energy efficient technologies in the production and processing of agricultural products.

Training centers and research laboratories should function effectively at the innovation hub. Training centers should organize training programs for farmers, entrepreneurs and youth on the use of innovative technologies in agriculture and energy, cooperate with universities and research institutions to conduct research, and develop new technologies for restoring damaged soil, infrastructure, etc. The activities of research laboratories should be aimed at testing new plant varieties, soil cultivation methods and energy solutions; developing environmentally friendly technologies for agriculture and energy; introducing waste sorting and recycling systems in rural areas; using organic waste for biogas and organic fertilizers; developing projects for soil restoration, forest and water protection; and implementing environmental standards for agriculture.

Table 4

Algorithm for the formation of sustainable urban planning models to integrate rural economies in Ukraine during martial law

Stage 1. Analysis of the current state			
assessment of infrastructure: a study of the state of transport networks, energy systems, water supply and other key infrastructure elements	assessment of economic potential: analysis of the agricultural, industrial and tourism potential of rural areas	social analysis: assessment of population needs, including education, health and social protection	environmental assessment: identifying environmental issues and resources for sustainable development
Stage 2. Developing an integration model			
setting goals: set specific goals for urban-rural integration, such as increased economic activity, improved infrastructure and social equity		create an action plan: developing a detailed plan that includes implementation steps, resources and responsible parties	
Stage 3. Implementation of digital technologies			
digital platforms: creating platforms for resource management, infrastructure monitoring and e-services	telemedicine and distance education: ensuring access to medical consultations and educational programmes for the rural population		electronic markets: development of platforms for the sale of agricultural products and other goods
Stage 4. Infrastructure development			
transport infrastructure: improving the road network, building bridges and organising public transport	energy infrastructure: introduction of renewable energy sources such as solar panels and biogas plants		water supply and sewerage: building water supply and wastewater treatment systems
Stage 5. Supporting economic development			
support for small and medium-sized businesses: provision of grants, consultations and preferential terms for entrepreneurs in rural areas		development of the agricultural sector: providing farmers with machinery, seeds and access to markets	tourism: development of rural tourism, creation of tourism clusters that unite urban and rural areas
Stage 6. Social development			
education: establishing hub schools in rural areas where children receive quality education and introducing distance learning	healthcare: opening outpatient clinics, primary healthcare centres and introducing telemedicine for rural residents		social protection: providing assistance to vulnerable groups, including pensioners, the disabled and large families
Stage 7. Environmental sustainability			
waste management: establishing waste sorting and recycling systems that reduce the burden on the environment	conservation of natural resources: protecting forests, rivers and soils through the implementation of environmental standards		energy efficiency: implementation of energy saving projects in communities, such as insulation of schools, hospitals and other public buildings
Stage 8. Crisis management			
evacuation and resettlement: organising the movement of people from war zones to safe regions	humanitarian aid: providing the population with food, medicine and other essentials		restoration of infrastructure: repair of destroyed facilities such as schools, hospitals and residential buildings
Stage 9. Monitoring and evaluation			
permanent monitoring: continuous collection of data on infrastructure, economic activity and social indicators		performance evaluation: analysing the results of plan implementation and making necessary adjustments	
Stage 10. Public engagement and international support			
public initiatives: involving local communities in project planning and implementation		international support: attracting financial and technical assistance from international organisations	

Source: authors' proposal.

The development of the infrastructure component of the innovation hub should help improve the road network between cities and villages to ensure fast transportation of agricultural products; develop logistics centers for storage and distribution of agricultural products; ensure stable Internet connection in rural areas for the use of digital technologies; and create data centers for resource analysis and management.

Conclusions

1. The integration of rural economies into sustainable urban planning models is not only a strategic necessity for Ukraine during martial law but also a pathway to long-term resilience, economic stability, and social cohesion. The challenges posed by the ongoing war have underscored the importance of creating interconnected systems that leverage the strengths of both urban and rural areas. Sustainable urban planning models offer a framework for achieving this integration, ensuring that rural economies are supported, urban centers are strengthened, and the nation as a whole moves toward recovery and growth.
2. Despite the destruction of agricultural land, equipment and facilities, and environmental hazards, the agricultural sector in Ukraine demonstrated extraordinary resilience during martial law. Agricultural enterprises in Ukraine adapted to modern challenges, accumulated their own efforts and resource potential, and introduced innovations. The stability of agriculture in Ukraine has received continuous support from the government, international partners, and the private sector.
3. The martial law disrupted the structure of agricultural production and the supply chain of agricultural products and their access to urban markets. Agricultural enterprises used diversification of logistics routes and mechanisms to strengthen local food systems through the integration of urban and rural producers. Identifies and characterizes the models of production and distribution of agricultural products used by entities during martial law in Ukraine. The structure of urban and rural population in the regions of Ukraine has been disrupted. Due to internal and external migration processes, the number of residents in cities and villages has changed. Demand for labor in villages has increased as the number of men leaving the workforce due to mobilization has decreased. Women, young people, and the elderly began to perform most agricultural work.
4. Decentralized governance and digital integrated governance are key tools for ensuring the balanced development of urban and rural areas. In the context of martial law, these approaches allow for the efficient use of resources, transparency of governance, and improvement of the quality of life of urban and rural populations, as well as sustainable and inclusive development of urban and rural areas. Successful cases of decentralized governance and digital integrated governance between urban and rural territorial communities of Ukraine are considered.
5. The development of sustainable urban planning models to integrate rural economies in Ukraine during martial law is a necessary step to ensure economic resilience, social equality, and environmental sustainability. These models allow to optimize the use of resources, provide access to services for citizens of urban and rural areas. The proposed algorithm for applying sustainable urban planning to ensure resilience, adaptability and support for rural economic activity during martial law includes a comprehensive approach that includes analysis of the current situation, model development, introduction of digital technologies, infrastructure development, support for economic and social development, environmental sustainability, crisis management, monitoring and evaluation, as well as public engagement and international support. This approach allows for sustainable and inclusive development of both urban and rural areas in Ukraine, promoting their integration and enhancing resilience during martial law.
6. The creation of innovation hubs that integrate agriculture, technology, science and research, renewable energy, and infrastructure are key areas for further integration of the urban and rural economies in Ukraine. Such hubs will contribute to economic development, increase resource efficiency, and ensure sustainable and inclusive development. Successful implementation of these areas requires support from the government, international partners and active participation of territorial communities.

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