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Formation of complex community restoration management models in the context of sustainable agricultural development

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Abstract. The study aimed to develop effective management models for the global restoration of local communities in Ukraine in the context of sustainable development of the agricultural sector. The study analysed the main problems of the agricultural sector, such as limited financing, outdated infrastructure facilities, environmental issues in the country, high migration of the population, including soil degradation and water pollution, as well as high migration from rural areas. Based on this data,

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theoretical models were developed that incorporate local characteristics and resources. One of the key results was the identification of the need to create strategic plans that address the specifics of each region, as well as the active involvement of citizens in the decision-making process. The study proposed to introduce modern agricultural practices, including the use of the latest technologies, such as precision farming and automation of production processes. In addition, the study proposed to create specialised financial funds to support development and attract investment through public-private partnerships. Considerable attention was devoted to improving the skills of agricultural workers through educational programmes and training that would facilitate more effective implementation of the latest technologies and practices. Of particular importance was the development of recommendations for the implementation of environmentally friendly practices that reduce the negative impact on the environment and contribute to the long-term sustainability of the agricultural sector. The study determined that a comprehensive approach to community recovery can significantly impact the economic performance, social justice and environmental sustainability of Ukraine's agricultural sector. These models will not only provide better living conditions in rural areas but also ensure the stable development of the agricultural sector, which is of strategic importance for the national economy

Keywords: community recovery; agriculture; local government; strategic plans; financial resources

INTRODUCTION

To ensure economic, social and environmental stability in Ukraine, it is necessary to continue developing the agricultural sector. Managing the integrated recovery of territorial communities is becoming particularly relevant in the context of sustainable development. The main challenges faced by rural communities include a decline in agricultural productivity, population migration, infrastructure decay and environmental degradation. One of the key challenges is the lack of investment for small and medium-sized enterprises in rural areas, which limits the development of the local economy. In addition, insufficient attention is paid to environmental aspects, which are critical for the preservation of natural resources. Migration of the rural population to cities leads to labour shortages and deepening social inequality. In the current environment, when the country is facing climate and political challenges, it is necessary to develop new governance models that integrate economic, social and environmental aspects of sustainable development to restore territorial communities.

The analysis of the management of the restoration of territorial communities in the agricultural sector of Ukraine showed the importance of state policy, but there was a lack of mechanisms for its implementation at the local level. I. Kulchii (2018) highlighted the problems of sustainable development but did not propose management models or recommendations for public-private partnerships. The issue of organisational and legal support for the diversification of rural areas for the development of small and medium-sized enterprises was studied by many scholars. O. Olshanska *et al.* (2024) emphasised the importance of agricultural cooperation through public-private partnerships. However, their study did not propose specific measures to support enterprises. The processes of creating a competitive organisational structure in the grain industry were studied by L. Moldovan *et al.* (2023), focusing on the efficient use of resources

for sustainable development. However, their study did not contain detailed recommendations on the social aspects of development.

V.M. Rusan and L.A. Zhurakovska (2023) analysed the impact of the agricultural sector on the Ukrainian economy, focusing on its role in the sustainable development of territorial communities. However, their study did not address current challenges, such as climate change and political instability, as well as innovative management models for community development. Many scholars studied the problems of rural governance in Ukraine. B. Feigel (2023) emphasised the need to create support systems for agricultural production that account for the needs of communities, but the issues of environmental sustainability and resource conservation have remained underestimated. Existing methods of managing agricultural areas do not always meet the requirements of sustainable development. S. Shutyak (2023) noted that the key problems are the lack of financial instruments to support innovation and insufficient integration of environmental aspects. The author also emphasised the importance of improving the level of education and training of agricultural workers. Many scholars have studied natural resource management in the context of sustainable development of the Ukrainian agricultural sector. O.M. Borodina and I.V. Prokopa (2014) emphasised the importance of an integrated approach that considers economic, environmental and social aspects, and noted that effective management depends on decentralisation and the involvement of local communities. The authors highlighted the lack of systematic monitoring and the need for further research. Human capital and technological innovation are also important aspects of sustainable community development. D. Khalizov (2023) studied community development in agriculture, emphasising the role of education and innovation. The main identified problems were the lack of a strategy for

agricultural innovation and mechanisms for attracting investment, which significantly hindered the process of sustainable development.

The purpose of the study was to develop an effective management model for the comprehensive restoration of territorial communities in the context of sustainable development of the agricultural sector in Ukraine.

MATERIALS AND METHODS

The study was conducted over two years, from 2022 to 2024, and covered several key stages of data collection and analysis. The focus was on agrarian communities in different regions of Ukraine, which was used to obtain representative results and reflect the diversity of conditions and challenges faced by these communities. The first stage of the study was the analysis of regulatory documents – Law of Ukraine No. 2982-IV (2005) and development strategies. This included a thorough study of state programmes – Programs of the Department of Agricultural Development (2023), legislative acts and regional strategies – Regional Strategies for the Development of Territorial Communities – that regulate the development of the agricultural sector and territorial communities (Vasylchenko *et al.*, 2015). At the next stage, an economic analysis was conducted, which included a study of key economic indicators of rural community development. The data were collected using statistical materials from the State Statistics Service of Ukraine, as well as reports of local authorities and analytical reports of specialised research organisations (Starikova, 2022; Report on the socio-economic..., 2023). This stage of the study described the current state of the agricultural sector in different regions and identified the main trends and challenges faced by rural communities.

One of the most important aspects of the study was the level of air pollution in Ukrainian cities. The study collected and analysed data on air pollution in cities such as Kryvyi Rih, Kamianske, Kyiv, Odesa, Mykolaiv and others using the Composite Air Pollution Index for 2023 and 2024. The choice of these cities is based on their regional diversity, industrial load, changes in pollution levels, and importance for assessing environmental conditions in the context of public health impact. Modelling the management processes of integrated community recovery was the next important component of the methodology. Three theoretical management models were developed based on the data obtained during the analysis of the regulatory framework and economic analysis. The modelling process used a Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis to identify strengths and weaknesses, as well as opportunities and threats to the development of the territorial communities. In addition, the Political, Economic, Social, and Technological (PEST) analysis was used to identify the political, economic, social and technological elements that influence community development.

The final stage of the study involved the modelling of five different governance models, each of which was analysed in the context of their potential for implementation in local communities. Each model was designed to consider the different economic, social and environmental conditions of the communities involved in the study. The pros and cons of each model were considered in detail during the modelling exercise. Some models provide higher levels of cost-effectiveness but may require significant financial investment or a high level of community involvement. Other models were found to be more suitable for communities with limited resources, but their potential for long-term sustainability may be limited. The modelling also addressed how each model could be adapted to specific community conditions, such as the level of public and private investment, the intensity of agricultural development and the adoption of innovative technologies.

RESULTS

In the context of current Ukrainian development, an important challenge is to ensure the sustainable development of territorial communities, especially in the agricultural sector. The agricultural sector is central to the national economy, but its development is often accompanied by a range of problems, such as soil degradation, environmental pollution, uneven distribution of resources, and social problems in rural areas. Therefore, further development of models for managing the comprehensive restoration of territorial communities that would incorporate the needs of sustainable development and ensure a balanced development of the economic, social and environmental spheres is of particular importance. Sustainable development of the agricultural sector in Ukraine requires a systemic approach that includes both innovative technologies and the conservation of natural resources, equitable distribution of benefits, human capital development and investment attraction. In this context, a variety of management models play an important role, each aimed at achieving specific goals and solving certain problems. These models include the innovative development model, the socio-economic model, the environmentally oriented model, the integrated resource management model, and the public-private partnership model.

The importance of implementing these models is confirmed by various studies and documents, such as the Sustainable Development Goals Report (2023), which emphasises the need to integrate economic growth with environmental sustainability and social justice. Another important document is the Agricultural Sector Strategy 2030 (Jandrovic, 2022), which describes the need for a comprehensive approach to the development of the agricultural sector, considering environmental, economic and social aspects. These sources note that sustainable development requires not only

economic growth but also the preservation of natural resources, social justice and infrastructure development. It is necessary to determine that each model has its advantages and disadvantages, and their integrated implementation will allow to achieve maximum efficiency in solving existing problems and ensure a high level of quality of life in rural communities.

Air pollution is one of the biggest environmental challenges facing Ukrainian cities (Havrysh *et al.*, 2022). It significantly impacts public health, ecosystems and overall living standards. Various sources of pollution, such as road transport, industrial emissions, heating and agricultural activities, contribute to the deterioration of air quality. Table 1 presents a composite index of air pollution in Ukrainian cities for 2023 and 2024. This index, which is based on quantitative indicators, reflects the overall level of pollution in each city and allows for a comparison of environmental conditions

in different regions. It is an important method of monitoring the situation and identifying trends that may indicate an improvement or deterioration in air quality. The data presented in the Table shows the dynamics of changes in the pollution index in cities. Table 1 shows the composite air pollution index for Ukrainian cities in 2023-2024. The cities for the study were selected based on the following criteria: regional diversity, which allows us to represent cities from different regions of Ukraine to ensure the representativeness of the data; high level of industrial load, as in such cities industrial enterprises can have a significant impact on the environmental situation; dynamics of changes in air pollution levels, which reflects trends in the improvement or deterioration of the environmental situation; and the importance of these cities for the overall assessment of environmental conditions, as their environmental condition can have a special impact.

Table 1. A comprehensive index of air pollution in Ukrainian cities 2023-2024

City	2023	2024	Difference
Kamianske	10.2	13.1	2.9
Kyvyi Rih	6.1	10.5	4.4
Dnipro	10.7	10.2	-0.5
Lutsk	7.3	8.7	1.4
Odesa	9.5	8.7	-1.3
Zaporizhia	7.3	8.1	0.8
Lviv	7.4	8	0.6
Vinnytsia	7.7	7.8	0.1
Mykolaiv	9.5	5.8	-3.7
Kyiv	8.1	7.1	-1

Source: compiled by the authors based on A. Velyka (2024)

Analysis of Table 1 demonstrated an alarming trend in air pollution in Ukrainian cities. In general, between 2023 and 2024, there was an increase in the pollution index in most cities. A particularly significant increase in pollution was found in Kyvyi Rih (+4.4) and Kamianske (+2.9), indicating serious problems with controlling emissions from industrial facilities and vehicles. However, there are also positive examples, with Mykolaiv showing a significant decrease in air pollution (-3.7), which may be the result of effective environmental measures aimed at improving the environment. Several other cities, such as Odesa (-1.3) and Kyiv (-1), also showed improvements, but these changes are not sufficient to change the environmental situation dramatically. Overall, the Table shows that while some cities have seen positive changes, the overall trend is towards a deterioration in the environmental situation in Ukraine. The deterioration of pollution indicators, especially in industrial centres, indicates the need for urgent action by government agencies. This may include the development and implementation of stricter environmental regulations, the introduction of new emission treatment technologies, and the intensification of public initiatives to improve air quality.

The innovative model of agricultural sector development involves the widespread adoption of the latest methods and technologies to increase productivity, reduce costs and improve product quality. As this model reduces the negative impact on the environment and ensures the rational use of resources, it is necessary for ensuring the competitiveness of the Ukrainian agricultural sector on the global market and achieving sustainable development. Innovations in agriculture can include a variety of technological solutions, such as the automation of production processes, the use of drones to monitor field conditions, the introduction of precision farming to optimise the use of fertilisers and water, and the use of biotechnology to improve crop yields and quality. The use of drones and precision farming technologies helps to reduce production costs by 20-30%, which significantly increases the profitability of agricultural enterprises (Shchuryk, 2017).

The development of bioenergy, i.e. the production of energy from biomass, biogas and other renewable sources, is an important part of the innovation model. It reduces dependence on fossil fuels and allows rural communities to have their energy independence, which is an important component of sustainable

development. In rural communities, the introduction of bioenergy technologies can lead to a 30-40% reduction in electricity costs and a reduction in greenhouse gas emissions (Kovalchuk, 2010). An innovative development model also requires the use of digital technologies that can improve the management of local communities and agricultural enterprises. This may include the introduction of data management systems, such as

geographic information systems (GIS), which allow for the analysis of land resources, crop rotation planning, and environmental monitoring. The introduction of GIS and other digital technologies can increase the efficiency of agricultural management while reducing the harmful effects on the environment. To assess the feasibility of implementing an innovative model, it is worth considering the SWOT analysis presented in Table 2.

Table 2. SWOT analysis for an innovative development model

Advantages	Disadvantages
<ul style="list-style-type: none"> ■ Implementation of the latest technologies ■ Improving the competitiveness of the agricultural sector ■ Improving product quality 	<ul style="list-style-type: none"> ■ Insufficient infrastructure readiness for innovation ■ High costs of innovation ■ Limited access to modern technology in remote regions
Possibilities	Threats
<ul style="list-style-type: none"> ■ Increase productivity and efficiency ■ Foreign investment attraction ■ Expanding markets for our products 	<ul style="list-style-type: none"> ■ The rapid depreciation of technology ■ Instability in the labour market ■ Risk of technological insecurity

Source: compiled by the author based on R. Kovalchuk (2010)

The SWOT analysis demonstrates both the strengths and weaknesses of the innovative model of agricultural sector development. The strengths of this model are focused on the introduction of new technologies and increased competitiveness, which contributes to improved product quality and expanded markets. However,

the existing weaknesses, such as insufficient infrastructure readiness and high costs of innovation, can become significant barriers to its successful implementation. To deepen the analysis, it is worth addressing the macroeconomic environment of agricultural development using the innovation model shown in Table 3.

Table 3. PEST analysis for an innovative development model

Political factors	Economic factors	Social factors	Technological factors
State support for innovation in the agricultural sector	Economic instability	Increased demand for quality products	Development of IT technologies and their implementation
Regulation of the labour market	High costs of new technology	Labour migration to cities	Increasing the pace of process automation

Source: compiled by the author based on O. Golovnya (2010)

The PEST analysis shows that the innovative model of agricultural sector development largely depends on external political and economic factors. It is necessary to provide government support and create favourable conditions for attracting investment. At the same time, social and technological factors play an important role in the introduction of innovations, as they can influence the readiness of the labour force to new conditions and the speed of adaptation to technological changes. Thus, the innovative model of agricultural sector development contributes to increased competitiveness, reduced costs and improved product quality, which are important factors for the sustainable development of local communities. However, for the successful implementation of this model, it is necessary to ensure access to financial resources, support from the state, as well as the active involvement of scientific institutions and research centres in the development and implementation of the latest technologies. The socio-economic model

of territorial community management in the context of sustainable development of the agricultural sector provides for equitable distribution of resources, improvement of living standards of the rural population and development of social infrastructure. This model is important for ensuring social stability and human capital development, which are key elements of sustainable development. Ensuring equal access to resources and services for all members of the community is the main objective of the socio-economic model. This may include the provision of social programmes, assistance to the poor, job creation and access to high-quality education, healthcare and other social services. In this context, the analysis of strategic objectives is presented in Table 4, which presents a matrix of strategic objectives aimed at developing social infrastructure and increasing employment. To ensure social stability and sustainable development of territorial communities, an effective social protection system is required (Shebanina *et al.*, 2023).

Table 4. Matrix of strategic goals

Strategic objective	Description	Implementation period	Expected result
Increase in the level of employment	Creation of new jobs in the region	3 years	Reduction in unemployment by 20%
Development of social infrastructure	Construction of schools, hospitals, roads	5 years	Improving the quality of life
Attracting investment	Stimulating investors through tax incentives	2 years	Increase in investment volumes by 30%

Source: compiled by the author based on O.A. Zinchenko et al. (2023)

The socio-economic model also envisages the development of an education and training system for the agricultural sector. This includes the creation of specialised educational institutions, internship and experience exchange programmes, and advanced training for agricultural workers. Investing in human capital development is crucial for ensuring sustainable growth of the agricultural sector and improving living conditions in rural communities. An important element of the socio-economic model is also the development of social infrastructure, which includes the construction and modernisation of schools, hospitals, roads, utilities and other facilities that ensure a comfortable life in rural areas. This helps reduce migration from rural to urban areas and makes rural areas more attractive for young professionals and entrepreneurs. The expansion of social

infrastructure is a fundamental factor in achieving sustainable progress in rural communities and improving the quality of life of the population (Malik et al., 2024).

Support for small and medium-sized businesses in the agricultural sector is an important component of economic growth and job creation in rural communities, and the socio-economic model provides for this. This may include the provision of grants, subsidies, concessional loans and support for the establishment of cooperatives and other forms of producer associations. Table 5 highlights the planned and used budgets for different categories of expenditure in an agricultural support project that focused on the development of small and medium-sized enterprises in rural communities. The Table shows how effectively the budget for these purposes was used in 2023.

Table 5. Budget allocation in 2023

Expense category	Planned budget (UAH)	Budget used (UAH)	Deviation (%)
Infrastructure projects	20,000,000	18,500,000	-7.5%
Social programmes	10,000,000	11,200,000	+12%
Personnel learning and development	5,000,000	4,700,000	-6%

Source: created by the authors based on V. Yakobchuk et al. (2018)

Thus, the socio-economic model of territorial community management aims to ensure a fair distribution of resources, improving living standards and developing social infrastructure. This allows for the creation of conditions for sustainable development and social stability in rural communities, which is an important element for achieving long-term goals in the agricultural sector. The environmentally oriented model of agricultural sector management includes practices that minimise harmful effects on the environment and contribute to the preservation of natural resources for future generations. This model is an important part of the concept of sustainable development, as the long-term development of agriculture and local communities depends on ensuring environmental sustainability. The main principles of the environmentally oriented model are the rational use of land resources, conservation

of biodiversity, reduction of greenhouse gas emissions and water pollution, and the introduction of environmentally friendly production technologies. The conservation of natural resources and the introduction of environmentally friendly technologies are essential for sustainable agricultural development (Golovnya, 2010).

Sustainable land management involves the use of methods that help maintain soil fertility and prevent erosion and degradation. This can include the use of organic fertilisers, crop rotation and agroforestry practices that improve the microclimate and preserve soil. Sustainable land use is crucial for the conservation of natural resources and the development of the agricultural sector in the future. Data on various aspects of land use are presented in Table 6, which includes an analysis of stakeholders that are important for assessing the effectiveness of these practices.

Table 6. Stakeholder analysis

Stakeholder	Interests	Impact on project	Degree of involvement
Local authorities	Improving the quality of life of the population through the creation of new jobs, modernisation of infrastructure and improved access to services	Makes decisions on regional development projects, land allocation, and financing of infrastructure projects	High: central in the coordination and implementation of projects at the local level
Environmental organisations	Conservation of biodiversity, reduction of soil and water pollution, and combating land degradation	Monitor the implementation of environmental standards and provide recommendations on sustainable land use.	High: actively influences the environmental aspects of the project through legislative and regulatory mechanisms
Citizens	Ensuring environmental safety, and reducing health risks associated with air and water pollution	Influence through public hearings, participation in elections and organisation of local initiatives	Average: actively involved in decision-making through civic initiatives, but their influence is limited by the legal framework
Business	Benefit from environmental investments and increase productivity and competitiveness through the introduction of new technologies	Financing innovative projects involved in public-private partnerships for the development of agricultural areas	Low: limited influence on decision-making, but important as a financial partner of the project

Source: compiled by the author based on O.A. Zinchenko et al. (2023)

Biodiversity conservation involves protecting natural ecosystems, preserving rare plant and animal species, and implementing practices that help maintain ecological balance in rural communities. This may include the creation of protected areas, the introduction of agroecological technologies, and the development of eco-tourism. For instance, ArcelorMittal Kryvyi Rih uses technologies to reuse metallurgical slag, which helps reduce pollution and preserve natural resources. The reduction of greenhouse gas emissions and water pollution is an important aspect of an environmentally friendly model. This can include the introduction of emission-reducing technologies such as renewable energy, reduced use of pesticides and chemical fertilisers, and water management systems. As an example, Stepova mine in Pershotravensk has implemented a coal mine methane utilisation project that helps reduce greenhouse gases while providing energy to the mine, reducing its environmental footprint. The environmentally friendly model also includes the development of organic farming, which includes production methods that do not harm the environment and ensure high-quality products. For instance, Ukrainian Mineral Fertilisers LLC in Kryvyi Rih processes by-products from coke plants to create organic fertilisers for agriculture, reducing dependence on chemical fertilisers (Shebanina et al., 2023). In summary, the environmental management model of the agricultural sector aims to maintain environmental sustainability, conserve natural

resources, and reduce negative environmental impacts. In the context of the agricultural sector, this model is an important part of the concept of sustainable development and is a prerequisite for the long-term development of territorial communities. The integrated resource management model envisages a comprehensive approach to managing all available resources of territorial communities, including natural, economic and human resources. This model is important for ensuring the efficient use of resources and achieving maximum efficiency in their distribution and use.

Interaction between different sectors of the economy is an important element of this model, which allows for synergies in the use of resources. This may include coordination between the agricultural sector, industry, transport, energy and other sectors, which allows for optimised use of resources and their efficient distribution. Coordination between these sectors is a key factor in ensuring effective resource management and achieving sustainable development of territorial communities. An integrated resource management model also involves the development of a planning system that includes long-term planning of resource use, risk analysis and forecasting of future changes. This helps to ensure sustainable use of resources and prevent their depletion. Long-term planning and effective resource management are impossible without adequate support and resources. Table 7 shows the main components of the integrated model, and the resources required for their implementation.

Table 7. Components and resources

Components	Resources required
Rational use of natural resources	<ul style="list-style-type: none"> ■ GIS systems ■ Analytics platforms
Integration of modern technologies	<ul style="list-style-type: none"> ■ Financial investments ■ Human resources
Coordination between different levels of government	<ul style="list-style-type: none"> ■ Technical support ■ Modern information systems

Table 7. Continued

Components	Resources required
Public involvement	<ul style="list-style-type: none"> ■ Public support ■ Educational programmes

Source: created by the author based on V. Yakobchuk et al. (2018)

The implementation of water management systems is an important part of the integrated model; these systems ensure the wise use, conservation and restoration of water resources. This can include the implementation of irrigation systems, water reservoir management and the development of technologies that reduce water loss and optimise water use. To support the sustainable development of agriculture and local communities, effective water management is essential (Lazareva, 2021). The integrated model also envisages the development of land management systems that include ensuring the rational use of land, preventing its degradation and ensuring its restoration. This may include the introduction of technologies that help preserve soil fertility, crop rotation, and the use of agroforestry technologies. Effective land management is a prerequisite for ensuring sustainable development of the agricultural sector and conservation of natural resources (Skydan et al., 2021). Therefore, the integrated resource management model is aimed at ensuring an integrated approach to managing all available resources of territorial communities, which allows for maximum efficiency in their distribution and use. This model is important for ensuring the sustainable development and resilience of the agricultural sector, as it allows for the efficient use of natural, economic and human resources. The public-private partnership (PPP) model involves the private sector in the management and development of territorial

communities in the context of sustainable agricultural development. This model is important for providing financial support for development projects, improving management efficiency and introducing the latest technologies in the agricultural sector. The main principle of the PPP model is cooperation between public authorities and the private sector, which allows for joint financing of projects, sharing of risks and responsibilities, and improved resource management. This may include the development of infrastructure projects, construction of social infrastructure facilities, introduction of new technologies in the agricultural sector, and support for small and medium-sized businesses. The PPP model is a key method for ensuring the sustainable development of territorial communities and improving the efficiency of resource management (Lazareva, 2021). An important aspect of the PPP model is also the provision of access to financial resources, which allows for the implementation of large-scale projects in the agricultural sector, such as the construction of new plants, infrastructure development, the introduction of new technologies, and the creation of new jobs. This contributes to the competitiveness of the agricultural sector in the global market and ensures the sustainable development of local communities. Attracting private capital is an important element for ensuring financial stability and development of the agricultural sector. The tasks and role of the state in this model are presented in Table 8.

Table 8. Main tasks and role of the state in the PPP model

The task of the state	Details
Regulation and control of contract performance	Ensuring that private partners fulfil their obligations and protecting public interests
Stimulating private investment	Providing tax incentives and financial support to attract private capital.
Ensuring equal conditions for partnership participants	Ensuring transparent and fair terms of cooperation for all project participants.

Source: compiled by the author based on Programs of the Department of Agricultural Development (2023)

The rural community development model also envisages that the private sector is actively involved in building social infrastructure in rural communities. This includes building schools, hospitals, roads, utilities and other facilities that improve the quality of life in rural areas. This not only reduces migration from rural to urban areas but also makes life in rural areas more attractive for young professionals and entrepreneurs. Private sector participation in the development of social infrastructure is an important condition for the sustainable development of territorial communities. In addition, the PPP model improves resource

management efficiency through the involvement of the private sector in the management of natural, economic and human resources. This includes the introduction of new technologies that contribute to the rational use of resources, reduce negative environmental impacts, and increase productivity in the agricultural sector. The involvement of the private sector in resource management helps ensure efficient use of resources and achieve sustainable development. Thus, the public-private partnership model is an important tool for ensuring the sustainable development of territorial communities in the context of the agricultural sector.

It attracts financial resources, improves management efficiency, introduces the latest technologies, and ensures the development of social infrastructure in rural communities. This model helps to create favourable conditions for sustainable development, increase the competitiveness of the agricultural sector and improve the quality of life in rural communities.

The development of models for managing the comprehensive restoration of territorial communities in the context of sustainable agricultural development is an important step in ensuring the sustainable and efficient development of Ukraine's regions. The innovative, socio-economic and environmentally oriented models proposed address various aspects of community development. These models can be applied following the specifics and needs of each region. Each

model has its advantages, weaknesses, opportunities and threats, which have been assessed using SWOT and PEST analyses and other analytical tools. Sustainable development of local communities, especially in the agricultural sector, is one of the key challenges in Ukraine's current development. The problems of soil degradation, environmental pollution, uneven distribution of resources and social difficulties in rural areas require a comprehensive approach to address them. In this regard, the development and implementation of integrated rehabilitation models that promote sustainable development of the agricultural sector, including innovative, socio-economic, environmentally oriented, integrated resource management and public-private partnership models, is noteworthy. A comparative analysis of the models is presented in Table 9.

Table 9. Comparative table of models of integrated restoration by sustainable development of territorial communities in the agricultural sector

Model	Advantages	Disadvantages
An innovative model	<ul style="list-style-type: none"> ■ Implementation of the latest technologies ■ Improving production efficiency ■ Reduced environmental impact 	<ul style="list-style-type: none"> ■ High costs of innovation ■ Insufficient infrastructure readiness
Socio-economic model	<ul style="list-style-type: none"> ■ Ensuring social justice ■ Improving economic stability 	<ul style="list-style-type: none"> ■ Long implementation time ■ Dependence on external factors
An environmentally friendly model	<ul style="list-style-type: none"> ■ Conservation of natural resources ■ Reducing environmental pollution 	<ul style="list-style-type: none"> ■ Economic growth may be limited
Integrated resource management model	<ul style="list-style-type: none"> ■ An integrated approach to management ■ Balanced development of territories 	<ul style="list-style-type: none"> ■ High need for coordination between actors
Public-private partnership model	<ul style="list-style-type: none"> ■ Attracting additional resources ■ Improving project efficiency 	<ul style="list-style-type: none"> ■ Problems of interaction between public and private entities

Source: created by the authors

A comparative analysis of these models demonstrates that each has its advantages and disadvantages. The innovation model focuses on the introduction of the latest technologies, increasing production efficiency and reducing environmental impact, but requires significant investment and infrastructure support. The socio-economic model aims to ensure social equity and economic stability but may take longer to implement. The environmentally oriented model prioritises the conservation of natural resources but may limit economic growth. The integrated resource management model provides an integrated approach to land management but requires a high level of coordination between different actors. Public-private partnerships allow for attracting additional resources for development but may face problems in interaction between public and private entities. Therefore, to achieve sustainable development of territorial communities in the agricultural sector, it is necessary to apply various management models comprehensively, considering their specificity and complementarity. An important aspect is also the support of the state, scientific institutions and investment attraction, which will contribute to the effective implementation of the selected approaches.

DISCUSSION

In this study, five different models of integrated community recovery in the context of sustainable development of the agricultural sector in Ukraine were considered. Each has advantages and disadvantages. The involvement of local communities, the use of closed-loop technologies, the introduction of environmental insurance, and the integration of circular economy principles are all factors that define the models. An important aspect of the study was to determine the role of environmental insurance in mitigating the risks associated with environmental hazards, such as soil, water and air pollution. This helps to ensure the sustainable development of agriculture even in difficult environmental conditions. Attention was also focused on improving the regulatory framework for effective management of the restoration of damaged areas and ensuring transparency of these processes. The study by O.V. Lazareva (2021) emphasises that the circular economy can become a driving force for the sustainable development of rural communities. This concept is based on the efficient use of resources, waste minimisation and the introduction of closed production cycles, which is especially relevant for agricultural areas where natural resources are the main asset.

The role of international cooperation in implementing the principles of circular economy and environmental insurance is particularly important (Tanchyk *et al.*, 2024). The study shows that sharing experiences with other countries that have successfully implemented these principles can be an important source of knowledge and practical recommendations for Ukraine. This correlates with the findings of studies such as *Conceptualising the Circular Economy* (Panwar & Niesten, 2020), which highlighted the importance of international cooperation in achieving sustainable development. In this context, it is important to note that Ukraine's active participation in international programmes and projects can help attract foreign investment and increase the efficiency of implementing innovative approaches to resource management.

The study also determined that the implementation of circular economy principles can reduce material costs and minimise waste, which is especially important in agricultural areas where natural resources are limited. This conclusion correlates with the findings of J. Kirchherr *et al.* (2023), who also emphasised the importance of closed cycles in production to reduce environmental impact and increase economic sustainability. In Europe, this is particularly evident in agricultural systems, where the use of closed loops can optimise the use of fertilisers and other inputs, thereby reducing economic costs and environmental impacts. The post-war reconstruction of Ukraine creates unique conditions for the implementation of circular economy principles and environmental insurance (Skliar *et al.*, 2024). Recovery should include not only physical reconstruction of infrastructure but also the introduction of sustainable practices that can withstand future challenges. This includes the introduction of closed loops in production processes and the integration of environmental insurance to minimise risks.

O. Therond *et al.* (2019) addressed how cities and regions can implement the Sustainable Development Goals through territorial governance. This study demonstrates commonalities with approaches to sustainable development in the agricultural sector, including a territorial approach, sustainable development of natural and human resources, and involvement of local communities in decision-making. The main difference is that the O. Therond *et al.* study covers a wider range of issues, including regional and urban planning, while the other study focuses on the agricultural sector. In addition, the Ukrainian researchers put more emphasis on the introduction of financial mechanisms and technological innovations, while the O. Therond *et al.* emphasises management coordination between different levels of government. The research study "Transforming Rural Farm Livelihoods" (Singh *et al.*, 2020) analysed sustainable rural development projects that focused on capacity building and skills development, which were key to the recovery of locally led communities. In

this context, the common features with other studies were the emphasis on local community development, sustainable resource management, and citizen engagement in decision-making. The main difference was that the World Bank study emphasises skills development and training as the main driver of change, while this study focused on the introduction of financial mechanisms and innovations in the agricultural sector to ensure sustainable development.

P. Besseau *et al.* (2018) investigated ecological restoration, emphasising the importance of landscapes and forests in sustainable development strategies. This study shared commonalities with other articles on natural resource management and ecosystem restoration, especially in the context of sustainable resource use and the preservation of natural equilibrium. The main difference was that this study focused on the role of forests and landscapes in overall sustainable development strategies, while this study focused on the agricultural sector and its technological and financial aspects for the sustainable development of territorial communities. S. Ndlela and S. Worth (2023) examined strategies to increase the capacity of farmers in rural areas, focusing on sustainability and environmental sustainability, which are important aspects of community governance. This study shared similarities with the present study, focusing on skills development and sustainable use of resources in local communities. The main difference was that the study focused on developing the capacity of farmers and their ability to adapt to change, while this study paid more attention to the introduction of financial mechanisms and technological innovations to ensure the sustainable development of agrarian territorial communities.

P. Silva *et al.* (2023) examined how innovation models can be adapted to support sustainable regional development in less developed regions, particularly in agricultural areas. They proposed a conceptual framework for integrating innovation into territorial governance, which is particularly important for the effective management and recovery of local communities. Commonalities with other studies included the emphasis on the importance of innovation and sustainable development in territorial governance. The main difference was that the authors focused on the adaptation of innovative models in less developed regions, while this study focused more on the financial and technological aspects of sustainable development of agricultural communities.

Thus, to achieve sustainable development of territorial communities in Ukraine, it is important to implement comprehensive models that address financial, environmental and technological aspects. The study examined five restoration models aimed at using the circular economy, environmental insurance, and involving local communities in decision-making. Each of the models has its advantages and disadvantages, but the common thread is the emphasis on ensuring the

sustainability of agricultural areas through innovative approaches. International cooperation is particularly important, as it allows for the exchange of experience with other countries that have already successfully implemented similar models. This helps to improve the efficiency of resource management and adaptation to modern challenges. The introduction of environmental insurance helps to reduce the risks associated with environmental hazards, such as soil and water pollution, which is critical for the sustainable development of agriculture in Ukraine (Drobitko & Alakbarov, 2023). Post-war reconstruction creates unique opportunities to rethink approaches to land management. This includes not only the physical reconstruction of infrastructure but also the introduction of sustainable practices that ensure resilience to future environmental and economic challenges, guaranteeing the long-term development of agricultural communities.

CONCLUSIONS

This study developed a model of integrated community recovery, the Model of Integrated Resource Management in Territorial Communities, based on the principles of transparency, accountability and citizen engagement in the management process. The results confirm the importance of efficient use of resources to achieve sustainable development. In 2024, the air pollution index in Kryvyi Rih increased to 10.5 and in Kamianske to 13.1 (+2.9). At the same time, Mykolaiv showed a decline to 5.8 (-3.7), and Odesa – to 8.7 (-1.3). In terms of budget allocations, social programmes exceeded their planned budget by 12%, while infrastructure projects were under-executed by -7.5%.

The practical significance of the model is an improvement of the quality of life of residents by optimising

resources and involving the community in decision-making. To implement the model, it is important to provide training and develop a learning system. An effective monitoring and evaluation system is necessary to identify problems quickly. The use of modern information technology also increases the efficiency of resource management. Implementation of this model will allow for better use of resources, which will lead to improved living standards, sustainable development and socio-economic stability in local communities. The results have great practical potential and can be used to improve resource management at the level of territorial communities. However, the study has certain limitations. In particular, the integrated resource management model was developed based on the analysis of data obtained in specific territorial communities, which may limit its applicability in other contexts. In addition, the successful implementation of the model depends on many factors, including political, economic and social conditions, which may vary from one situation to another.

Given these limitations, further research in this area could be aimed at adapting the model to different types of territorial communities, as well as at studying the impact of various factors on the effectiveness of its implementation. An important area for further research is also the development of tools and methods for monitoring and evaluating the effectiveness of resource management, which will improve the accuracy and efficiency of decision-making.

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CONFLICT OF INTEREST

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Формування моделей управління комплексним відновленням територіальних громад у контексті сталого розвитку аграрної сфери

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Анотація. Мета даного дослідження полягала у розробленні ефективних моделей управління для глобального відновлення локальних спільнот України в контексті стійкого розвитку аграрної сфери. У дослідженні було проведено аналіз основних проблем аграрного сектору, таких як обмежене фінансування, застарілі інфраструктурні об'єкти, екологічні питання країни, висока міграція населення, зокрема деградація ґрунтів та забруднення водних ресурсів, а також висока міграція населення з сільських територій. На основі цих даних були розроблені теоретичні моделі, які враховують місцеві особливості та ресурси. Одним із ключових результатів стало виявлення необхідності створення стратегічних планів, що враховують специфіку кожного регіону, а також активного залучення громадян до процесу прийняття рішень. Запропоновано впровадження сучасних аграрних практик, що включають використання новітніх технологій, таких як точне землеробство та автоматизація виробничих процесів. Крім того, було запропоновано створити спеціалізовані фінансові фонди для підтримки розвитку, а також залучення інвестицій через публічно-приватне партнерство. Значна увага приділялася питанням підвищення кваліфікації аграрних працівників через освітні програми і тренінги, що сприятиме ефективнішому впровадженню новітніх технологій та практик. Особливо важливою була розробка рекомендацій щодо впровадження екологічно чистих практик, які зменшують негативний вплив на довкілля та сприяють довгостроковій стабільності аграрного сектору. В результаті дослідження виявлено, що комплексний підхід до відновлення територіальних громад може суттєво вплинути на економічну результативність, соціальну справедливість та екологічну сталість аграрної сфери України. Застосування зазначених моделей дозволить не лише забезпечити кращі умови для життя у сільській місцевості, але й забезпечити стабільний розвиток сільськогосподарської галузі, що має стратегічне значення для економіки країни в цілому.

Ключові слова: відновлення громад; сільське господарство; місцеве самоврядування; стратегічні плани; фінансові ресурси
