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Strategic Spatial Planning of Territorial Communities to achieve the Sustainable Development Goals

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ABSTRACT

Problem Statement. Strategic spatial planning in Ukraine focuses mainly on economic aspects and takes less into account the environmental consequences of planned activities, which may be threatening to natural and cultural heritage. This is explained, in particular, by the insufficient number of trained specialists for planning sustainable spatial development. It is especially important to integrate scientific natural research into educational programs for training specialists in spatial planning, which include the study of geodiversity, the evolution of natural and cultural landscapes, methods of creating nature conservation areas, the formation of eco-networks, as well as the introduction of innovative technologies in land use and various branches of the national economy. Such research is the basis for developing community strategy and achieving the Sustainable Development Goals (SDGs), effective territorial management and successful spatial planning practices.

The purpose of the article is to consider strategic spatial planning as a modern interdisciplinary field that integrating social, economic, and ecological aspects of sustainable spatial development.

Research methodology proposes an interdisciplinary approach to strategic planning, which takes into account the geodiversity of the territory, the evolution of natural and cultural landscapes, as well as natural and anthropogenic risks. This approach makes it possible to predict optimal scenarios of spatial development, adapted to specific geographical conditions. Special attention is paid to the training of highly qualified specialists at the bachelor's and master's levels, emphasizing their important role in the development of strategic plans, which are the basis of comprehensive plans for the spatial development of territorial communities.

The results. The article presents scientific approaches to strategic planning based on an interdisciplinary study of territories. This study highlights the international experience of strategic planning and similar successful practices in Ukraine territorial communities.

Scientific novelty. The study provides a theoretical basis for the mandatory integration of natural science research into strategic spatial planning. This includes data on geodiversity, natural settings and resources, cultural and natural landscapes, nature reserves and ecological networks. The combination of this information with the data of the land and urban cadasters creates a comprehensive basis for determining the optimal scenarios of spatial development.

Practical significance. The results of this study can be applied to improve the methodology of strategic spatial planning at the local level. Generalized international experience is a valuable guide for setting long-term spatial development goals and implementing specific measures to achieve them. Practical aspects of spatial planning, such as innovative land use systems, implementation of renewable energy sources, inclusive residential and public spaces, protection and preservation of natural and cultural heritage, are illustrated by specific examples discussed in the article. This study is useful for professionals in spatial planning and community management, as well as for researchers, teachers, and students who focus on integrating natural science research into the practice of spatial development.

***Keywords**: strategic spatial planning, geodiversity, eco-network, natural and cultural heritage, international experience, territorial communities of Ukraine.*

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Statement of the problem. The development strategy is an important stage of spatial planning of each territorial community, region, and state. According to experts, such a consistent approach to

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spatial planning with constant coordination of local, regional, and national spatial development programs and projects is one of the advantages of decentralization processes, particularly in the field of land management. However, the results of decentralization in Ukraine indicate certain challenges in the development of the strategies, which should become the basis of the Comprehensive Plans for the Spatial Development of the Territories of Territorial Communities.

Even the most economically active communities need a comprehensive assessment of the natural potential of their territories to choose the optimal scenario of spatial development. The analysis of strategies developed by territorial communities indicates the need for more careful planning of the environmental component. The main reason for this is the insufficient awareness of local authorities and the public about the natural aspects of spatial planning, especially about the need for careful and safe use of natural conditions and resources, as well as about the possibilities of preserving and multiplying natural and cultural heritage. In this context, the use of international spatial planning experience to achieve the Sustainable Development Goals is essential.

Analysis of Recent Studies and Publications. According to the researchers, spatial planning is essential in achieving the Sustainable Development Goals [28], particularly in land management, socio-economic development, and solving environmental problems, such as climate change, biodiversity conservation, and food and energy security.

A focus on the problems of cities dominates the theory and practice of spatial planning. Until recently, rural areas were considered purely agricultural or picturesque landscapes that served as buffers against anthropogenic pressure. Less attention was paid to the village's social problems. Spatial planning must promote rural spatial development, emphasizing that well-being and quality of life should be public policy objectives. Nick Gallent et al. (2015) underlines the composite nature of rural planning, which combines land-use and spatial planning elements with community action, countryside management, and the projects and programs of national and supranational agencies and organizations [22]. These scholars stress the need for governance mechanisms to implement integrated solutions for urban and rural areas and argue that there is a direct connection between ecosystem service consumption and global challenges such as habitat degradation, climate change, and resource scarcity.

Future progress in achieving the Sustainable Development Goals is linked to scientific research, technology, and innovation [28]. A significant role in this process is attributed to Earth observation (EO) and geolocation data provided by Global Navigation Satellite Systems (GNSS). Earth observation involves the collection of information about the physical, chemical, and biological characteristics of our planet, enabling the monitoring and assessment of changes in both natural and anthropogenic environments. This is accomplished through remote sensing technologies, such as meteorological satellite data [15]. Satellites equipped with specialized sensors provide data on the atmosphere, Earth's surface, oceans, ice coverage, and ecosystem health.

Geolocation, particularly GNSS, is utilized in various fields, including transportation, telecommunications, geodesy, mining, precision agriculture, finance, high-accuracy applications, and scientific research. Such applications include measuring the effects of space weather on Earth, monitoring earthquakes, and studying climate change. Satellite telecommunications (SatCom) also contribute to several SDGs (e.g., 4, 15, and 16). Some fields, such as precision agriculture, benefit from using EO, GNSS, and SatCom technologies.

In a study titled Space for the Sustainable Development Goals (2021), 506 projects were analyzed, identifying 1,542 connections to various SDGs and targets, demonstrating that each project contributes to an average of more than three SDGs or targets. The project with the most connections to various SDGs was the SatCom initiative "Every Child Online" (ECO). This initiative supports SDG 4 (Quality Education) by enabling access to high-speed Internet, specialized educational online content, and opportunities for remote learning and lifelong education. Such benefits are especially relevant for remote and isolated communities [5].

The 2030 Agenda for Sustainable Development emphasizes that organizations engaged in space research should align their activities with international frameworks to achieve the SDGs.

Unresolved Aspects of the General Problem. In Ukraine, spatial planning is undergoing a new phase, marked by the development of a Comprehensive Plan for the spatial development of territories of Territorial Communities, which has already been initiated in at least one-third of territorial communities (TCs). This process must be preceded by a Spatial Development Strategy based on an in-depth interdisciplinary analysis of natural, social, economic, technological, and environmental factors. Integrating such interdisciplinary research into practice substantially enhances the potential for achieving the SDGs.

In Ukraine, state institutions and public organizations are actively addressing issues of spatial planning. Among them are the Ministry for Communities and Territories Development of Ukraine [6], the All-Ukrainian Association of Communities

[2], and the Association of Ukrainian Cities [3]. Numerous international organizations also play a significant role in advancing spatial planning in the country. Notably, the United States Agency for International Development (USAID) Agriculture and Rural Development Program (AGRO) [29] has developed a range of educational materials and practical guidelines for preparing comprehensive spatial development plans for communities These resources were created based on the outcomes of pilot projects conducted in the Pisochynska and Rohanska territorial communities in the Kharkiv region. Additionally, the AGRO program collaborates with territorial communities and higher education institutions across Ukraine, integrating its spatial planning methodology into educational processes aimed at preparing future specialists in this field [18, 19].

Unresolved issues include the justification of strategic planning methodology, the development of guidelines for forecasting balanced growth, and the creation of local-level geoportals to serve as reference tools for government officials and professionals. Additionally, there is a need to establish a unified list of mandatory thematic cartographic materials to visualize data on the status of territorial communities and regions in the country [1]. For example, precision farming requires detailed topography, soil mapping, and crop yield indicators.

Main Content. Strategic spatial planning serves as a reliable instrument for achieving the Sustainable Development Goals, encompassing numerous interconnected themes that demand interdisciplinary analysis. A thematic overview of international projects provides valuable insights into the implementation of SDGs through the application of strategic spatial planning. These themes include improving land use systems, fostering economic sustainability and technological innovation, optimizing resources and enhancing energy efficiency, promoting social inclusiveness, protecting cultural heritage and the identity of territorial communities, developing green infrastructure and ecological networks, and advancing participatory governance. The following sections explore the experience of strategic planning in the European Union and the potential for adapting similar practices in Ukraine.

Improvement of Land Use Systems. Strategic spatial planning aims to ensure a balanced allocation of land resources, addressing the dual priorities of urbanization and the preservation of natural ecosystems. This is one of the challenges of our time and aligns with numerous SDGs, including Goals1-3, 6, 11, 12, and 15. These goals focus on eradicating poverty and hunger, ensuring food security, promoting sustainable agricultural development, creating sustainable cities and settlements, preserving terrestrial ecosystems, protecting biodiversity, and reducing habitat loss. Preservation of geodiversity is important not only for the purpose of protecting biodiversity but also as a foundation for sustainable natural resource management. Geodiversity directly determines the natural potential of each territory and the possibilities for its sustainable spatial development.

The first two Goals aim to eradicate poverty and hunger, which are interrelated in many ways. Above all, this requires ensuring that everyone has access to safe, nutritious and sufficient food. The July 2024 High-Level Political Forum on Sustainable Development noted that Goal 2 faces multiple challenges and reflects worrying trends: 600 million people are expected to still be hungry by 2030, and the prevalence of malnutrition has increased by 10%. Many countries are now struggling with the twin problems of undernutrition and obesity. Global obesity rates have increased from 9% in 2005 to 16% in 2022. None of the 193 UN member states have achieved SDG 2 (Sustainable Development Report, 2024) [26].

Land use practices play a crucial role in the stability of geosystems and achievement the Goal 2. Agriculture accounts for more than half of the Earth's land use and 70% of freshwater consumption. This is closely related to worsening climate change and increasing water scarcity. At least one-third of global human-caused greenhouse gas emissions are related to land-use practices.

By 2030, the plan is to double the agricultural productivity and the incomes of small-scale food producers by ensuring secure and equitable access to land, productive resources, knowledge, financial services, markets, value-added opportunities and employment in the non-agricultural sector. SDG 2.4 calls for sustainable food production systems and the implementation of sustainable agricultural practices [28].

These methods aim to support ecosystem functions, increase adaptability to climate change and extreme weather events, and improve soil quality. In addition, it promotes increased investment, including through enhanced international cooperation, in rural infrastructure, agricultural research, technology development, and related advisory services. Achieving these goals largely depends on the strategy for the development of agricultural production and the spatial development of rural areas.

The European Union has established a Common Agricultural Policy (CAP) as a framework for the spatial development of rural areas. The CAP includes initiatives such as the Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) project, which provides a platform for sharing knowledge and expertise on agriculture. This initiative brings together national CAP net-

works, organizations, administrations, researchers, entrepreneurs, and practitioners to exchange best practices.

Key themes for the spatial development of rural areas include supporting agricultural production, efficient natural resource use, market regulation, the provision of social services, preservation of cultural landscapes, environmental protection, biodiversity conservation, climate change mitigation, the use of renewable energy sources, animal welfare, and balanced economic, ecological, and social development.

Each country implements national strategic plans based on CAP. For example, Germany's 2023 National Strategic Plan includes initiatives such as EIP-AGRI, assistance for young farmers, individual investments in agricultural businesses, and public water budgeting.

In 2023-2024, 20 experts from the EU CAP Network Focus Group on "Regenerative Agriculture for Soil Health" worked on issues related to regenerative farming practices. These practices restore, protect, and improve soil health and productivity. Regenerative agriculture involves implementing land-use systems tailored to local conditions. By restoring soil health, regenerative agriculture also seeks to address biodiversity loss, restore water cycles, adapt to climate change, mitigate its effects, and improve economic profitability.

Soil degradation, including wind and water erosion and the loss of organic matter, underscores the need for diverse methods such as managed grazing, compost application, agroforestry, minimal tillage, crop diversification, and biostimulation. These methods are selected based on specific local conditions, which must be thoroughly studied.

The focus group identified several research needs, including developing practical soil health indicators aligned with management practices and productivity metrics across different contexts. Proposed initiatives also include assessing the impact of regenerative farming on climate, integrating microclimate and small water cycle effects, managing plant health through soil health practices, optimizing cover crop practices, and evaluating co-cultivation systems under varying conditions. Innovative ideas for regenerative agriculture include creating minimal or zero-tillage systems that perform well without herbicides, developing farm-level tools for monitoring soil health, designing efficient co-cultivation systems, and integrating pastures into crop farming systems (EU CAP Network Focus Group) [13].

The transformation of land use systems is based on the concept of "Smart Villages", which aims to modernize rural infrastructure through innovative technologies, improve quality of life and education, engage most residents in spatial planning projects, preserve natural resources, and ensure sustainable spatial development. The European Commission (DG AGRI) supports the Smart Villages initiative to help villages develop strategies and methods for their implementation, as well as to inform future policies regarding "Smart Villages" (The Smart Rural 21 project) [25]. As part of the EU's Smart Rural 21 project, 21 applications were selected from over 740 proposals for "Smart Villages" across Europe. Due to the high quality of submissions, leading experts chose 16 villages – rather than the initially planned 12 – to join 5 pre-selected villages in the "Pathway to Smart Villages". The Directorate-General for Agriculture and Rural Development reviewed the development strategies of all participating villages and provided advice on achieving their goals.

To facilitate information exchange, "Knowledge clusters" of smart rural communities were created. These clusters aim to connect local communities with shared thematic interests.

Case Study. From the perspective of elaborating a Spatial Development Strategy, the experience of one of the smallest villages participating in the project – Tomaszyn, a rural settlement in Poland located in the Warmian-Masurian Voivodeship – is particularly noteworthy. The village comprises only ten households and one cooperative. It has the lowest population density in the country. The region is classified as the "Green Lungs of Poland" and is often referred to as the "Land of a Thousand Lakes". The voivodeship is home to eight landscape parks, protecting natural landmarks of European significance. Historical records first mention Tomaszyn in 1410, and the village experienced gradual development over centuries until World War II, during which most buildings were destroyed, and the population dramatically decreased. In 2021 the cooperative "Ostoja Natury" together with the local community participated in the "Smart Village" competition organized by the Polish Academy of Sciences (PAN) and received an award for the concept "Ostoja Natury Wioska 3.0."

Tomaszyn's development strategy incorporates several concepts of farm development (fig. 1) that could be considered as models for the spatial development of territorial communities.

The community development strategy aligns with the principles of permaculture) [21] and incorporates the design of effective ecosystems characterized by diversity, stability, and natural regeneration (Innovation Farm). It emphasizes a harmonious integration of human activity with the natural landscape to ensure the sustainable provision of food (Healthy Food Farm), energy, and housing (Green Energy Farm), supports a healthy lifestyle (Health Farm), and fosters the self-sufficient development of

Fig. 1. "Five farms" of "Ostoja Natury" [23].

artistic, cultural, and spiritual needs (Culture Farm). These "Five Farms," forming a cooperative, are both innovative and compatible with traditional practices. At the same time, they are ecologically sustainable, collectively contributing to the creation of a waste-free, highly efficient ecosystem

The strategy states: "We believe that only effective business models can motivate people to change their attitudes and take a cost-effective path that is friendly to our planet and its inhabitants. Our main task is to create a program for farms with an area of fewer than 100 hectares (in Poland there are more than 700,000 of them), which will allow us to transform production from traditional to ecological, characterized by high-quality products and minimize the negative impact on the natural environment".

Coordinating spatial development plans is critical in planning. Ostoja Natury's spatial development strategy aligns with the Development Strategy of the Olsztynek municipality, adopted by the municipal council. Planned activities correspond to the strategic objective of improving the quality of life in the Olsztynek municipality while achieving individual operational goals.

The nature reserve strategy supports the strategic goal of protecting and enhancing the quality of the natural environment, including the operational goal of safeguarding natural heritage and its effective utilization for economic purposes. The village's strategy emphasizes:

"Focusing on projects aimed at protecting and restoring biodiversity while preserving or gaining a competitive advantage over other regions based on the existing ecological potential and its use in socio-economic growth processes".

In Poland, local (municipal) self-governance was restored in 1990. On January 1, 1999, a three-tier administrative division was introduced, comprising three levels of self-governance: municipalities (gminas), counties (powiats), and voivodeships. Currently, Poland has sixteen voivodeships, 314 counties, and 66 cities with county status, as well as 2,478 municipalities. The municipality is the primary unit of local governance, a core element of state organization. Local self-governance is a key principle in public administration, with municipalities, counties, and voivodeships tasked with performing state functions.

However, each region has unique approaches to rural development – ranging from preserving historical appearances to adopting modern technologies.

Economic sustainability and technological innovation. Spatial planning supports economic development by optimizing the natural potential of the territory, improving infrastructure, and creating jobs. This principle is consistent with SDG 8 – decent work and economic growth and SDG 9 – industry, innovation, and infrastructure, which contribute to economic productivity and innovative approaches to spatial development.

Economic sustainability directly or indirectly affects the achievement of all other goals. Each settlement can be considered as a socially constructed system of practices and organizations.

For example, the "Ostoja Natury's innovation farm" in Tomaszyn is developing precision agriculture, automation (cleaning, processing and packaging lines) and robotics (e.g. Farm Bot, Turtle Robotics), that increase the demand for specialists in IT, robotics and machine operation, creating employment opportunities in rural areas and narrows the technology gap between rural and urban communi-

ties. The farm cooperates with many enterprises for the introduction of grain, vegetable and fruit growing technologies.

Thanks to passive solar greenhouses and innovative technologies, organic plants may grow all year round. The construction of such greenhouses is described in detail in scientific literature (Solar Greenhouse, 2019) [24].

"Ostoja Natury" create a model of a self-sufficient agricultural environment where processes, machines and fertilizers support the cultivation of natural crops in accordance with all environmental standards. A team of experienced professionals develops standard solutions for organic farming in Poland and around the world.

Optimization of resources and energy efficiency. Spatial planning focuses on rational resource use, consistent with SDG 12 – responsible consumption and production, which reduces pressure on the environment and ensures sustainable development. "Ostoja Natury' green energy farm" use of renewable energy sources (sun, wind, hydropower, biogas) increases the energy efficiency, independence, profitability and sustainability of the farm, while reducing the impact of agriculture on the environment.

Energy-efficient building technologies (passive greenhouses, thermal insulation, innovative heating systems), optimized energy consumption at the industrial and domestic levels, energy management and audits, waste management, including sorting, recycling, and disposal.

Achieving synergy through the interconnectedness and complementarity of waste minimization processes creates added value for each strategy by significantly reducing operating costs (e.g. packaging made from waste mass, waste management, mechanical ventilation with heat recovery and energy production). The implementation of this strategy makes it possible to expand the area of organic production, volumes, and value, as well as to make organic food products more accessible to consumers. This, in turn, creates new jobs and improves the level and quality of life of residents.

Residential infrastructure in "smart villages" is envisioned as a waste-free, self-sufficient living environment. The goal is to create a universal design for rural farms based on the Wood100 technology introduced by Tom Holtz [30]. When combined with renewable energy sources (solar, wind, water) and infrastructure such as heat pumps and domestic wastewater treatment systems, such buildings become fully autonomous – often completely autonomous. They are self-sufficient in heat, energy and water and can recycle waste without harming the natural environment. A family house built using Wood100 technology can be assembled in record time – in just one day.

Social inclusiveness. The goal of spatial planning is to create an accessible and comfortable living environment that meets the needs of different population groups, especially children and the elderly. This is consistent with SDG 3, aimed at improving the quality of life of the community, goal 4 - education, goals 5 and 10, which are aimed at reducing inequality, including gender inequality, and goal 11, which emphasizes the development of inclusive urban and rural spaces with access to essential services for all.

For example, "Health Farm" in Tomaszyn focuses on creating a space for a healthy lifestyle and physical, mental, and emotional well-being.

The main components of Health Farm include:

- organic farming: no chemical fertilizers or pesticides;
- healthy produce: growing vegetables, fruits, greens, and other nutritious foods (Healthy food farm);
- wellness programs: sports, tourism, breathing exercises, etc;
- natural healing methods: herbal medicine, water treatments, and more;
- education: hosting lectures, workshops, and masterclasses on healthy living, sustainable farming, and balanced nutrition;
- courses on growing plants, care for the environment and energy saving;
- use of renewable energy sources (solar batteries, wind turbines, etc.);
- environmentally friendly building materials, energy-efficient construction design;
- eco-friendly environment away from city noise;
- healing effect of nature through walks, gardening, contact with animals;
- integration of agriculture and medicine, for example, the cultivation of medicinal plants or the creation of products to support health.

"Health Farm" corresponds to this concept and is an example of the formation of a modern space for a healthy lifestyle. Currently, there are more than 30 banks operating in Poland, which support the nutrition of both the elderly and adults, as well as children, for which they organize meetings, as well as social campaigns, during which Poles are encouraged to use food sparingly. The main goal is to create a completely waste-free model of food production and distribution.

Protection of cultural heritage and identity of territorial communities. The spatial development of cultural landscapes and the preservation of local identity are reflected in SDGs 4, 11 and 16, which are aimed at the study and protection of cultural objects and historical monuments, strengthening efforts to protect and preserve world cultural and

natural heritage, preserving them for future generations.

Rural landscapes are the most widespread and long-lasting forms of cultural landscapes, covering a wide range of cultures and traditions throughout the world. These landscapes are vital components of human heritage, providing multiple economic and social benefits, cultural value, and ecosystem services.

The Principles for the Conservation of Rural Landscapes as Cultural Heritage were adopted at the 19th ICOMOS General Assembly in New Delhi, India on 15 December 2017 [16].

"Ostoja Natury's culture farm" is aimed the restoration and popularization of traditional handmade products – symbols of high quality and knowledge passed down from generation to generation. There is a tendency to return to local crafts, revival of traditional products, services and ancient professions, such as beekeeper, blacksmith, brewer, miller, carpenter. It is planned to build a nature trail with an educational purpose – as an interesting way of spending time for different age groups and an attractive source of knowledge about nature and culture. Such eco-trails or routes can be arranged in each community to study the territory, its natural potential and opportunities for spatial development.

Green Infrastructure and Ecological Networks. Spatial planning is designed to regulate the interaction between society and the environment, the same tasks are faced by the SDGs, particularly 3, 6–9, 13, 15 and 17. Without considering environmental factors, it is impossible to ensure a healthy lifestyle, build a safe infrastructure, ensure energy availability, etc. For example, the organization of green infrastructure in settlements and nature conservation areas improves local conditions while contributing to global adaptation to climate change and protection of natural resources.

Special attention should be paid to SDG 6, which aims to achieve integrated management of water resources at all levels by 2030, including transboundary cooperation. This goal also includes protecting and restoring ecosystems such as mountains, forests, wetlands, rivers, aquifers, and lakes.

In the European Union, considerable emphasis is placed on the spatial development of transnational nature conservation areas and the connection of ecological networks of individual countries into a pan-European ecological network.

Case Study. The Danube River Protection Convention (DRPC) serves as the main legal framework for cooperation and management of transboundary waters in the Danube River Basin.

The International Commission for the Protection of the Danube River (ICPDR) was also established under this convention. In 2010, the European Commission, alongside Danube region countries and stakeholders, adopted the EU Strategy for the Danube Region (EUSDR) – one of the EU's four macro-regional strategies, approved by the European Council in 2011 [11]. The strategy involves 14 countries and develops 12 thematic priority areas, each coordinated by two member states.

In 2014, a nonprofit association, DANUBEPARKS (Danube Parks) was founded to promote partnerships among protected areas in the Danube region. This association provides a platform for coordinated, transnational collaboration and joint initiatives among protected area administrations along the Danube. Its mission is to conserve, develop, and restore the Danube River and its main tributaries, as well as surrounding wetlands. The organization focuses on five areas: Danube valley *morphology, habitat preservation, biodiversity conservation, monitoring, and tourism* (DANUBEPARKS Association) [4].

Morphology of the Danube Valley. The natural dynamics of rivers serve as a crucial factor in maintaining biodiversity and landscape diversity, encompassing habitats and species. Significant hydrological events, such as large floods and periods of low water levels, continuously reshape the morphology of the valley, leaving imprints in the form of steep banks, gravel islands, and sandy shores. The floodplain zone is highly dynamic; the force of water can drastically alter its structure in mere days. As a functioning system, the river provides natural flow numerous services to both nature and human communities, including fertile soils and appealing recreational sites. However, over the past 150 years, the natural flow of the river has undergone substantial transformations. Hydropower plants disrupt natural connectivity, embankments, and straightened channels disconnect floodplain zones from the river. The necessity to restore these altered sections has become evident to preserve the unique ecosystems of the floodplains and wetlands along the river's course.

Habitats. The interconnection between natural systems and the species that inhabit them is dynamic and essential for their migration and survival. Uninterrupted links between similar habitats, free from anthropogenic infrastructure, are critical. Given that the Danube Valley's ecosystems span multiple countries, fostering international cooperation in conservation is imperative to safeguard not only aquatic and semi-aquatic habitats but also river-associated forests, meadows, and even dry habitats. Riparian forests represent vital habitats that perform numerous functions for both flora and fauna as well as for human communities.

Over the past century, around 90% of the Danube's original wetlands have been lost due to human

activities. Today, most remaining floodplain forest complexes are designated as protected areas. To combat the isolation of wildlife populations, measures are required to create a continuous ecological network. Monitoring the state of riparian forests along the Danube, using Geographic Information System (GIS) data and remote sensing, forms the foundation for strategic documents focused on protecting the riparian forest corridor. Approximately 5,000 animal species and 2,000 plant species inhabit the Danube Basin.

The development of conservation strategies employs the concept of "umbrella species" – those most sensitive to habitat conditions. By addressing the needs of these species, the habitats of numerous other species are simultaneously preserved.

Monitoring. The primary goal of monitoring is to gather information and build databases to inform conservation and habitat restoration efforts. Coordinated data collection is necessary to evaluate the state of the entire river ecosystem, which is a core function of the ecological network. This approach helps assess the overall effectiveness of conservation measures for the Danube River.

Tourism. Protected areas along the Danube River feature unique natural landmarks that attract nature enthusiasts. The region's rich natural heritage allows conservation areas to serve educational purposes, raising awareness among visitors and local populations about the value and functions of biodiversity-rich habitats. Eco-tourism in protected areas is inherently educational, promoting sustainable development. It can also enhance local economies (particularly in rural areas) by creating income-generating opportunities while safeguarding valuable recreational zones for local residents.

A critical task for conservation management involves regulating visitor flows to balance access to the area's attractions with environmental protection. Visitor management strategies, such as providing information, maps, rules, and marked trails, achieve this. The DANUBEPARKS network plays a dual role: it enables members to exchange best practices through workshops and training programs while collaborating on developing tourism products and marketing, especially for international visitors and tour operators.

In 1970, the Danube Delta National Institute for Research and Development (DDNI) was established to conduct fundamental and applied research [12]. Its primary aim is to support scientific management of the biosphere reserve and other wetlands of national and international significance, with a particular focus on preserving geo-diversity and biodiversity while promoting sustainable resource use.

The Ukrainian section of the Danube Delta is also an integral element of the Vylkovo Territorial Community's spatial planning framework.

Restoration of Geodiversity. Among spatial planners, debates often arise regarding the potential for restoring geo-diversity. It is widely acknowledged that once lost or severely degraded, natural landscapes cannot be fully restored to their original state. However, there is evidence of successful restoration of regulated river channels by reconstructing man-made structures to allow for natural water flow (Darby S., Sear D., 2008) [12]. Over time, rivers have been shown to reclaim natural forms in artificially created meanders. River restoration benefits both geo-diversity and biodiversity, as demonstrated in the case of Swindale Beck in Cumbria, England, where salmon and trout have returned to spawn in redeposited gravel beds in re-meandered sections of the river, where the flow has slowed.

Participation and governance. The involvement of local communities in strategic planning is an important tool for achieving all the goals of sustainable development. Participation and governance are important aspects of sustainable development, which involve the active participation of citizens in decision-making processes at all levels, from local to national. This approach allows for effective management that meets the needs of all segments of the population and considers the interests of various social groups. Participatory governance ensures transparency, accountability and inclusiveness in political, economic, environmental and social processes. Inclusiveness in decision-making involves the involvement of citizens in the discussion and decision-making related to the development of their communities, society and the country in general. This may include public hearings, consultations, surveys, and participation in local and national advisory bodies. In this way, the community can actively influence the formation of policies in such areas as ecology, economy, health care and education. Providing citizens with access to the necessary information is an important element of participatory management. The use of modern digital technologies, such as online platforms for gathering public opinion and electronic petitions, allows to simplify the process of interaction with authorities and contributes to more transparent management. It also helps to increase the level of awareness among citizens regarding various aspects of public policy and management decisions. Participatory is closely related to decentralization, which allows more authority to be transferred to the local level, creating conditions for a more flexible response to community needs. Local authorities have a better understanding of local problems and needs, which stimulates the development of public responsibility and activates participation in spatial planning. In addition, participatory governance is important in the field of natu-

ral resource management, such as water resources, forests, agricultural land, where the community actively participates in the implementation of sustainable development goals.

It is important to involve children in the planning activities of children and youth. This allows organizing public spaces that meet their needs. Engaging children in dialogue can take many forms, from interactive design sessions to surveys and field observations. Schools can also integrate spatial planning into the curriculum by encouraging students to participate in local projects. This approach not only empowers children, but also fosters a sense of responsibility for the environment, and the future development of cities will reflect their needs and aspirations. Thus, the process of creating child-friendly settlements is complex and involves considering the child's needs at every stage of the urban planning process. Living environments should prioritize the health and well-being of the youngest residents, from play and learning to mobility and safety, with an emphasis on public spaces, schools and housing that meet the needs of children. Spatial planning that considers the needs of children is not only morally necessary, but also strategically justified, as it promotes social cohesion and sustainable growth. (Designing Child Friendly Cities, 2024) [10].

Public participation in Environmental Impact Assessment and Strategic Environmental Assessment is important to identify the environmental impact of plans and projects at an early stage. Participatory planning uses modern digital tools and technologies for community engagement, interactive modeling and virtual meetings that promote transparency and openness and motivate citizens to collaborate in the spatial planning process.

Results. Every country has its structure and organization of spatial planning systems and a national spatial strategy for sustainable development. Strategic spatial planning focuses on medium- and long-term development goals, including the development of plans, programs, and projects for shaping land-use policies, spatial organization, zoning, measures for engineering protection, prevention of natural or anthropogenic disasters and risks, implementation of local spatial plans for residential and urban development, urban regeneration programs, and the preservation of natural and cultural heritage.

Regulatory spatial planning addresses the general use of land in urban and rural areas, aligning sustainable development with social, economic, and environmental objectives. Its goal is to ensure sustainable economic growth, increase employment, enhance territorial and social cohesion, protect landscapes and biodiversity, and ensure efficient use of natural resources.

In Ukraine, spatial planning has become particularly relevant in the context of decentralization. This is not only due to the transfer of powers to local governments and the development of spatial development strategies but also because communities can choose their way and create various types of communities (urban, rural, or settlement). Consequently, each rural council had the opportunity to become a hub for a territorial community or choose a new center for spatial development, whether a city, town, or village.

The roles of these new centers have also evolved. They are now responsible for ensuring the balanced spatial development of the entire community's territory, which varies significantly in scale. For instance, the Yemilchynska Territorial Community in Zhytomyr region encompasses 72 settlements with a population exceeding 21,000, whereas one of the smallest rural communities, Matusivska in Cherkasy Region, consists of just two villages.

Such uneven distribution of territory, population, levels of economic development, and natural capital among newly created administrative units raises numerous methodological questions about optimal planning decisions and the feasibility of implementing local development projects. Additionally, new urban-rural connections have emerged, emphasizing joint spatial development plans.

Based on the results of the already passed stage, it becomes clear that no government strategy or policy can influence the real development of territories in the same way as the active and responsible position of local communities.

Initiative, the use of innovative technologies, the professionalism of local authorities and the general education of citizens are the tools that can quickly distinguish a community and make it competitive.

Among the modern challenges of territorial communities are demographic changes (population aging, negative natural growth, migration), economic challenges (decline in agricultural production, unemployment), environmental problems (pollution, loss of natural resources, climate change).

The purpose and task of strategic spatial planning is to ensure balanced spatial development through the support of agricultural activity and economic development, functional zoning of the territory, development of infrastructure, in particular transport, social, tourist, information, preservation of natural and cultural heritage, improvement of the quality of services, etc.

Currently, strategic planning of smart rural areas is gradually being implemented in Ukraine, especially this applies to practices of precision agriculture, the purpose of which is sustainable agriculture, preservation of soil fertility, increase in yield, preservation of ecosystems, biodiversity, prevention

of adverse climate changes, development of export potential, opening of sales markets in the EU. The main principles are the use of cover crops, expansion of crop rotation, minimization of tillage, and optimization of costs. For this purpose, measures such as analysis of the soil, the state of the field, the presence of unfavorable processes, revision and expansion of crop rotations, calculations of crop sowing rates, optimization of resources, and innovative methods of field cultivation are carried out. As a result, in the 3rd year, the profit increases by 20%, the amount of biomass increases by half, and resource costs decrease by 15%. For example, great water savings when watering with agricultural drones: for watering a field of 1000 hectares, agricultural drones use 5-7 cubic meters of water per irrigation cycle, which saves 93-97% of water compared to self-propelled sprayers that use 100-200 cubic meters of water. With the help of agricultural drones, desiccation is also carried out – the process of removing excess moisture from the soil to prevent the spread of diseases. Some farms are planting plant seeds with the help of drones, creating maps for differentiated applications of fertilizers and spraying of fields. Mapping land resources, monitoring and evaluating the productivity of different types of soils, considering their chemical composition, structure, moisture level and other factors, allow GIS analysis to predict the yield of various crops under certain conditions. Long-term observations of changes in temperature, precipitation and soil moisture help to develop adaptation strategies for farmers and rural communities, to adapt agricultural crops to climate change. Spatial models of climate change, created based on GIS data, help to predict the potential impact of climate on different regions, which prevent adverse processes.

In the summer of 2024, independent consultants and experts from the USA, Germany and New Zealand visited several farms in Ukraine. In the format of an agro-consilium, scientists studied soils, discussed agronomic problems and developed strategies for their control and management. A detailed survey of soil layers, biota, underground and aboveground parts of plants was conducted. Foreign consultants shared the experience of advanced Western technologies, methods of adapting them to modern Ukrainian conditions, and offered practical recommendations for improving technological maps in farms. Over-compaction of the soil due to the use of heavy machinery, uncontrolled use of herbicides and other plant protection products, cultivation of monocultures, which destroys the biota of the soil and affects the yield, are among the shortcomings identified in agricultural farms. Therefore, it is recommended to switch to permaculture and organic farming, growing organic products that meet European eco-standards. For example, "Poltava-sad" LLC confirmed the certificate of the international standard IFS FoodVersion 6, and also received the certificate of the international standard Global GAP, which shows that the products are not only of high quality, but also safe for use. The main difference from other Global GAP standards is that it assesses not only the safety of the grown products themselves, but also the safety of the entire production cycle, starting with the seed material and ending with the finished product.

The Role of Education in Spatial Planning. A critical component of sustainable community development is the training of specialists in spatial planning. In Ukraine, several higher education institutions offer programs in territorial planning, including traditional universities, specialized institutions, and even pedagogical universities, which are not traditionally associated with spatial development.

The preparation of specialists in such a complex field should be based on three fundamental pillars: natural sciences (geography and ecology), law, and technology. These interdisciplinary approaches are exemplified at institutions such as Taras Shevchenko National University of Kyiv, V.N. Karazin Kharkiv National University, and Kyiv National University of Construction and Architecture.

The Department of Earth Science and Geomorphology at Taras Shevchenko National University of Kyiv, within the framework educational program “Soil Science, Land Resource Management, and Territorial Planning” undergraduate students acquire interdisciplinary knowledge necessary for strategic planning. Special attention is paid to the study of topics related to geodiversity (Gray, 2024) [14]. The geodiversity of natural objects, processes and phenomena determines the natural potential of each territory, and its effective use involves an integrated study of morphostructure, (relief and geological structure), composition rocks, soils, underground and surface waters, as well as processes that affect their formation in the form of typical and individual landscapes It is precisely the morphological structure of the landscape that largely determines the planning structure of settlements, the combination of various functional zones and the construction of infrastructure, the need for engineering protection of the territory and many other possibilities of spatial development. Therefore, detailed landscape research with the construction of a landscape plan is a mandatory prerequisite for successful spatial planning.

Geodiversity is important for the spatial development of communities, in particular, ecological – as it is the basis for the existence of ecosystems and biodiversity (Lausch et al., 2022) [17], economic – as a georesources (building materials, minerals, water), educational, cultural and scientific – geodi-

versity is a source of knowledge about the Earth's history and natural processes, contributes to the development of geotourism and the preservation of natural heritage. The study of geodiversity is necessary for spatial planning, natural resource management and the implementation of the next Sustainable Development Goals: 9 – innovation and infrastructure, 11 – sustainable development of cities and communities, 12 – responsible consumption, 13 – adaptation to climate change, 15 – preservation of ecosystems. The implementation of these goals will allow us to comprehensively solve social problems, in particular, overcoming hunger and poverty, ensuring a healthy lifestyle (Goals 1-3).

The study of geodiversity at the Department involves a quantitative assessment of natural conditions, resources and opportunities for consumption of geosystem services. Several eco-projects have been initiated, including assessment of natural conditions, functional zoning of the territory, protection of small rivers, formation of an eco-network, development of schemes of nature routes, etc. All these topics are relevant for the sustainable spatial development of communities. For example, geotourism is an important tool of local and regional development, which directly depends on geodiversity, as it allows tourists to visit and learn about different natural and cultural landscapes. It is necessary to be able to create a high-quality tourist product in territorial communities, which will include the laying of nature routes, the formation of tourist infrastructure, the organization of various events - cultural, artistic, tourist, sports, educational, scientific, etc., which are based on the geographical diversity of the territory and contribute to its sustainable development. By creating such destinations, each community can influence regional development.

The training of specialists in the field of territorial, in particular landscape, planning has begun at the Department of Physical Geography and Cartography of V. N. Karazin Kharkiv National University. The main emphasis in the preparation of masters under this program is made on the problems of nature management and restoration of territories, which apparently will be relevant for the eastern and southern regions of our country for a long time.

The program has been developed by integrating advanced European experience, primarily from Germany, in landscape planning, along with the research conducted by specialists from the Institute of Geography of the National Academy of Sciences of Ukraine. These experts developed and visualized landscape plans for regional and district levels, as well as for community: the Cherkasy Oblast, Kaniv District, and Stepanetska Territorial Community (Landscape Planning in Ukraine, 2014) [20].

This educational program aims to train highly qualified specialists equipped with comprehensive knowledge for creating strategic development documents for territories. Its effectiveness is demonstrated through the development of comprehensive spatial development plans for the Rohanska and Pisochynska territorial communities in the Kharkiv region (Figures 2 and 3).

The method of identifying nature conservation objects and providing them with legal protection is important. Combining nature conservation areas into a single ecological network is a component of spatial planning and land resource management. Unfortunately, spatial conflicts often arise when the law is ignored, or economic factors are given priority over environmental ones. For example, for several years in a row, a conflict situation has been going on in Ukraine related to the construction project of the ski

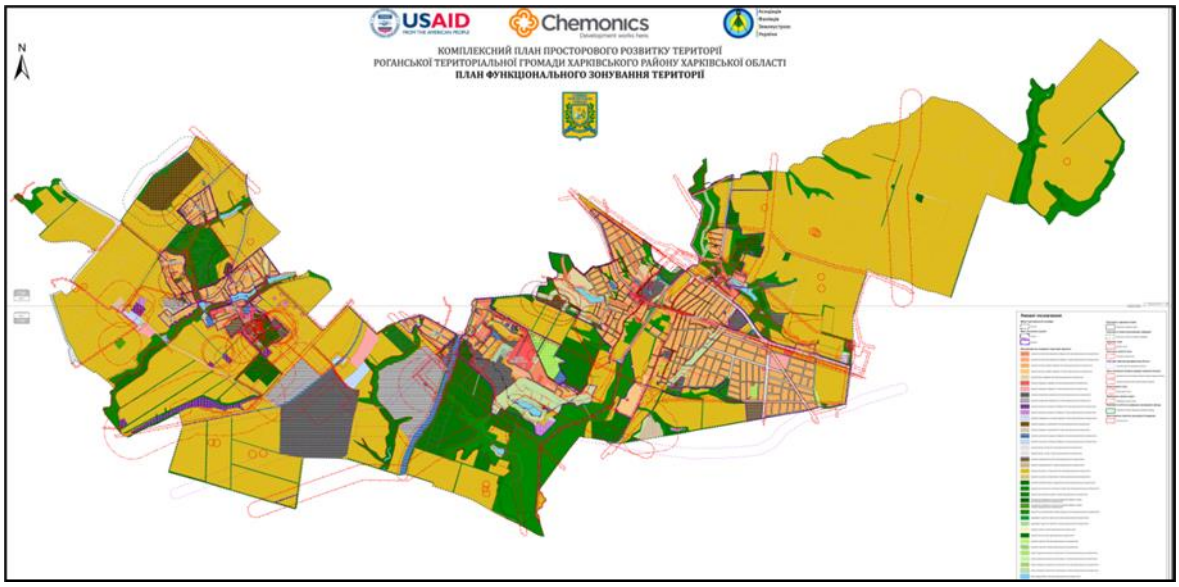

Fig. 2. “Plan of functional zoning of the territory”, the fragment of “The Comprehensive Plan of the Spatial Development of Territory of the Rohan Territorial Community of Kharkiv region”

Fig. 3. Methods of map series production for a local social-economic development strategy (a case study of Pisochyn urban village) [24]

resort “Svydovets”, the construction of which threatens the unique protected landscapes of the Ukrainian Carpathians, including the primeval forests of the Svydovets massif, which is a UNESCO World Heritage Site. Such objects should be included in the national/regional system of spatial planning and protected by the norms of environmental law. Another problematic aspect of nature management in Ukraine is the issue of irregular ownership of land. Thus, there are hundreds of cases of illegal expropriation of nature reserve fund lands for industrial, agricultural, and private sector objects being implemented in the regional prosecutor's offices of Ukraine. As the experience of the cooperation of regional prosecutors with Kharkiv cartographers, who annually conduct dozens of examinations of the illegal alienation of PZF lands, shows that this is often not the result of criminal conspiracy or corruption schemes, it is the result of unsystematic land use, lack of coordination of economic sectors, irresponsibility of local authorities in the distribution of land, and in general - lack of long-term, strategic

plans for the territorial development of territories at the level of communities, and then - of districts, regions and the country as a whole.

In 2023, the Ukrainian government proposed adding 16 more cultural and natural sites to the list of World Heritage sites, and in the future this list may be expanded at the initiative of territorial communities, which in this way can popularize their natural and cultural heritage, while receiving sustainable economic benefit.

Conclusions. Strategic spatial planning is an important tool for achieving the Sustainable Development Goals, covering numerous interrelated topics that require interdisciplinary analysis. Key among these topics are: improving land use systems, promoting economic sustainability and technological innovation, optimizing resources and increasing energy efficiency, promoting social inclusion, preserving the cultural heritage and identity of territorial communities, developing green infrastructure and ecological networks, involving the public in planning and management processes.

International projects such as "smart cities" and "smart villages" demonstrate how a new nature of the relationship between urban and rural areas is being formed, influenced by numerous factors, including the introduction of a scientific approach to spatial planning and innovative technologies, which not only create alternative employment opportunities, but also significantly improve social living conditions, provide a quality environment, mobility and communication, promote recreation and provide access to diverse and healthy food systems. The example of Tomasin's "smart village" illustrates how sustainable development can be achieved if the right strategy is chosen, which is based on natural potential, innovative technologies and high public activity. The idea of forming rural "socio-cultural spaces" that increasingly compete with overpopulated urban areas deserves special attention.

To develop a strategy for the spatial development of territorial communities, it is important to apply the main tools and methods of spatial planning and, first of all, scientific studies of the natural potential of the territory and an objective assessment of its ecological state, in particular, the study of natural risks, extreme weather phenomena (landslides, floods, etc.), which must be taken into account when developing spatial planning strategies. The determination of priorities for the spatial development of territories is based on the data of integrated natural science studies.

GIS is an integral tool for analyzing and visualizing spatial data, mapping resources and assessing their condition. The planning structure, functional zoning, determination of the optimal combination of residential, industrial and landscape-recreational zones, planning of green infrastructure and econetworks and many other tasks in spatial planning are performed with the help of GIS tools. Currently, a national infrastructure of geospatial data is being formed in Ukraine, aimed at meeting the needs of society in all types of geographic information and for integration into the global and European infrastructure of geospatial data. Land and urban planning cadastres provide collection, systematization and analysis of data on land management and urban planning activities, infrastructure, etc. These data are necessary for the development of comprehensive plans for the spatial development of territorial communities and their coordination at the regional level.

Geospatial modeling and forecasting are tools that allow you to compare different scenarios of territorial development based on databases and trends.

Strategic environmental assessment allows to determine environmental priorities. Each of the local development projects must be evaluated from the point of view of its impact on the environment - from individual initiatives to the development of a Comprehensive Plan for the Spatial Development of the Territorial Community.

Digital platforms and smart technologies expand the possibilities of managing territories in real time, for example, monitoring and controlling the condition of agricultural lands, tracking climate changes and their impact on ecosystems.

The successful integration of these tools will allow balancing the economic, ecological and social aspects of territorial development and contribute to the achievement of the Sustainable Development Goals, and the training of spatial planning specialists will contribute to increasing the level of awareness and skills in this area.

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Стратегічне просторове планування територіальних громад для досягнення Цілей сталого розвитку

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Стратегічне просторове планування в Україні здебільшого орієнтоване на економічні аспекти, тоді як екологічні наслідки запланованої діяльності часто залишаються непрогнозованими та можуть бути загрозливими для природної та культурної спадщини. Це пояснюється, зокрема, недостатньою кількістю підготовлених спеціалістів для планування сталого просторового розвитку. Особливо важливо інтегрувати наукові природничі дослідження в освітні програми підготовки фахівців з просторового планування, які включають вивчення георізноманіття, еволюції природних і культурних ландшафтів, методику створення природоохоронних територій, формування екомереж, а також впровадження інноваційних технологій у землекористування та різні галузі народного господарства. Такі дослідження є основою для розробки стратегії розвитку громади та досягнення Цілей сталого розвитку (ЦСР), ефективного управління територіями та успішних практик просторового планування. Метою статті є розглянути стратегічне просторове планування як сучасну міждисциплінарну галузь, яка інтегрує соціальні, економічні та екологічні аспекти сталого просторового розвитку. Особливу увагу приділено підготовці фахівців у галузі просторового планування на бакалаврському і магістерському рівнях та інтеграції природничих наукових досліджень у практику просторового розвитку та розроблення стратегії і комплексних планів просторового розвитку громад. Проаналізовано міжнародні проєкти, зокрема Спільну аграрну політику ЄС, ініціативу Smart Village та транскордонне управління басейном Дунаю. Досліджено практичні аспекти українського досвіду, зокрема впровадження точного землеробства, створення нових природоохоронних об'єктів та екомережі, розвиток ландшафтно-рекреаційних зон та геотуризму. Результати дослідження можуть бути використані для вдосконалення методології стратегічного просторового планування на місцевому рівні. Узагальнений міжнародний досвід стане цінним для формулювання довгострокових цілей розвитку громад та реалізації конкретних заходів, таких як інноваційні системи землекористування, впровадження відновлюваних джерел енергії, створення інклюзивних громадських просторів, охорона природної й культурної спадщини, міжнародне природоохоронне співробітництво.

Ключові слова*: стратегічне просторове планування, георізноманіття, екомережа, природна й культурна спадщина, міжнародний досвід, територіальні громади України.*

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