



Borys **BURKYNSKYI** • Natalya **ANDRYEYeva** • Hanna **TIUTIUNNYK**

STRATEGIC MANAGEMENT OF INVESTMENT AND INNOVATION ACTIVITIES IN THE FIELD OF ENVIRONMENTALLY SAFE LAND MANAGEMENT

Borys **Burkynskyi**, Academician, DSc, Prof. (ORCID: 0000-0001-9303-0898)

Natalya **Andryeyeva**, DSc, Prof. (ORCID: 0000-0002-9960-559X)

Hanna **Tiutiunnyk**, PhD (ORCID: 0000-0003-4864-6129)

– *Institute of Market and Economic and Ecological Research of the National Academy of Sciences of Ukraine*

Correspondence address:

French boulevard, 29, 65044, Odesa, Ukraine

e-mail: ecoregnatures@ukr.net

ABSTRACT: The purpose of the study is to form a methodology for strategic management of investment and innovation activities in environmentally safe nature management based on the analysis of world experience. The study's methodological approach is based on the step-by-step SMART-research, economical-ecological analysis, systematic investment and innovation activities assessment, PESTLE-, SWOT-analyzes, and definition of ecologically safe strategies.

The proposed study formulates the author's vision of combining methods of foresight methodology in the field of environmentally safe land management, SMART-method and Quintuple Helix (5 helix) for sustainable development of methodology for strategic management of investment and innovation activities in the field of environmentally safe land management. Furthermore, the proposed methodological approach will promote the development of applied tooling to develop systems of strategic management of investment and innovation activities of environmentally safe land management.

In contrast to the existing methodological approaches in land relations, the developed methodology of strategic management of investment and innovation activities in ecologically safe land management is based on a comprehensive combination and use of foresight tooling.

KEYWORDS: Foresight, SMART, Quintuple Helix (5 helix), PESTLE, strategic management, environmentally safe land management

Introduction

According to the scientific works of domestic and foreign scientists, the study was developed the author's concept of strategic management of investment and innovation activities in the field of environmentally safe land management – this is an effective process with regard to strategy formation, which provides the realisation of the mission, goals, objectives focused on the long-term results and future development of environmentally safe land management and took into account the variability and correlation with the internal and external environment through the development/implementation of environmentally safe innovations and their investment in order to create competitive advantages.

The methodology of the work is based on a modern approach to foresight research, which involves the complex use of modern economic and management methods. Regarding the problems of nature management, the authors recommended using a group of methods: Smart research, economic and environmental analysis, systematic assessment of investment and innovation activities, PESTLE, SWOT analyses.

Problems of the regulation of land relations have recently become especially actual when the best practices in the functioning of the land resource sphere have undergone large-scale changes both in Ukraine and throughout the world.

Models of ecologically safe lands as organic lands, green zones (environmental top low emission zone), green spaces (land that is partly or completely covered with grass, trees, shrubs, or other vegetation includes parks, community gardens, and cemeteries) are fixed in electronic databases of EUROSTAT (figure 1-4, table 1, 2).

According to technical reports, scientific papers and Eurostat data, statistics on ecologically safe lands of other types, namely green urban areas, are presented in table 1, figure 1. The largest number and highest rate of green area per capita are in Croatia, Poland and Italy.

Table 1. Green urban zones in the cities of Ukraine and the EU countries

No.	Administrative formations		Green urban areas, ha	Population	Green area per capita, m ²
1	Croatia	Zadar	3696.8	71471	517.24
2	Poland	Krakow	20121.1	761873	264.1
3	Italy	Padua	2167.1	210401	103.00
4	Germany	Hamburg	6800.0	1541823	44.10
5	Poland	Poznan	2004.2	550742	36.39
6	Sweden	Malmo	1077.5	307758	35.01
7	Hungary	Szeged	541.4	162183	33.38
9	Denmark	Archus	1000.0	319094	31.34
10	Slovenia	Maribor	690.9	240555	28.72
12	Austria	Linz	515.4	189889	27.14
13	Ukraine	Odessa	2678.3	1013159	26.43
14	Finland	Helsinki	1518.8	595384	25.51
15	Germany	Halle	588.0	233705	25.16
16	Netherlands	Utrecht	665.4	316275	21.04
17	Netherlands	Amsterdam	1511.3	857713	17.62
18	Germany	Berlin	5890.1	3501872	16.82
19	Ukraine	Belgorod-Dniester	82.1	48967	16.77
20	Ukraine	Izmail	101.8	73500	13.85
21	Poland	Lodz	849.1	718960	11.81
22	Slovenia	Ljubljana	260.7	280607	9.29
23	Italy	Milan	1133.4	1262101	8.98
24	Italy	Bari	174.5	313213	5.57
25	Ukraine	Yuzhne	13.6	32679	4.16
26	Romania	Oradea	87.6	196367	4.46
27	Ukraine	Chornormorsk	31.58	59261	5.33
28	Spain	Barcelona	53.1	179405	2.96

Source: author's work on the basis of data from EUROSTAT and the State Service of Ukraine for Geodesy, Cartography and Cadastre of Ukraine as of January 01, 2016 and [13-16].

Table 2. Percentage of public green spaces (parks and gardens) in cities

City	Percentage	Year	Source
Oslo	68.0%	2018	Bymiljøetaten, commune of Oslo
Singapore	47.0%	2011	Council of National Parks
Sydney	46.0%	2010	New South Wales Planning Department
Vienna	45.5%	2014	Vienna Annual Statistics 2014
Chengdu	42.3%	2017	Bureau of Statistics Chengdu
Zurich	41.0%	2018	Green city of Zurich
Shenzhen	40.9%	2016	Shenzhen Statistical Yearbook
Nanjing	40.7%	2018	Nanjing Statistical Bureau
Helsinki	40.0%	2018	City of Helsinki
Hong Kong	40.0%	2018	Department of Agriculture, Fisheries and Protection; Department of Surveying and Mapping, Department of Lands
Stockholm	40.0%	2015	Stockholm city
Rome	38.9%	2017	Roma Capitale
Los Angeles	34.7%	2016	Assess the needs of Los Angeles County parks and recreation
London	33.0%	2015	Information about Greenspace for Greater London
Seoul	27.8%	2016	Seoul Metropolitan Government
New York	27.0%	2010	New York City Department of Urban Development
Dublin	26.0%	2018	Dublin City Council
Johannesburg	24.0%	2002	State of the Environment Report, Johannesburg 2009
Cape Town	24.0%	2016	The city of Cape Town
Lisbon	22.0%	2018	Camara Municipal de Lisbon
Guangzhou	19.8%	2018	Guangzhou Statistical Yearbook 2019
Edinburgh	19.0%	2016	ESRI
Brussels	18.8%	2015	IBGE
Moscow	18.0%	2017	Department of Natural Resources
Warsaw	17.0%	2015	Main office of geodesy and cartography
Shanghai	16.2%	2017	People's Government of Shanghai
Montreal	14.8%	2013	City of Montreal, Directorate of large parks and dunes
Amsterdam	13.0%	2018	Statistics Netherlands / TNO
Toronto	13.0%	2018	The city of Toronto
Milan	12.9%	2016	Commune of Milan

City	Percentage	Year	Source
Austin	11.0%	2018	The Trust for Public land ParkScore 2018
Barcelona	11.0%	2019	Department of Statistics. Barcelona City Council
Melbourne	10.0%	2016	Victorian Planning Office
Paris	9.5%	2013	IAU de-le-de-France
Buenos Aires	9.4%	2018	Statistics and Censors
Tokyo	7.5%	2015	Bureau of Urban Development
Bogota	4.9%	2017	Administrative Department of the Defensorium del Espasio Publico
Taipei	3.4%	2017	Parks and street lighting office, Taipei city
Istanbul	2.2%	2015	Istanbul Municipal Municipality

Source: (Natura 2000 protected areas. Eurostat, 2021).

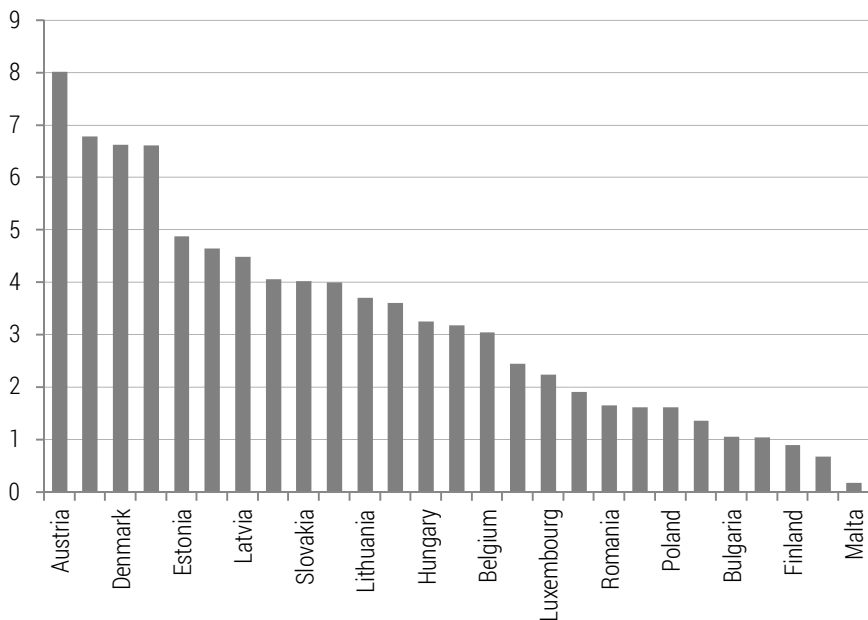


Figure 1. Share of areas of organic territories to the total territory of the country in 2019 in the EU, %

Source: author's work based on EUROSTAT.

The number of cities with a high share of green zones remains low at 0-35%, only in two cities it is 75 percent or more, and in seven cities – 65-75%

of the total area of the studied city. When considering the totality of cities in each country with a large area of green urban zones, the first place is occupied by France (12 cities and almost 80% of green zones in the city); Finland – 4 cities, more than 70% of green recreational zones in Oulu (The EEA workspace, 2021). According to the rating of green areas of the European Union, the first five metropolitan areas are occupied by the cities: Belfast, Nice, Wiesbaden, Ruse, Oulu; the second five: Genoa, Karlovy Vary, Tour, Riga, Barcelona; the third five: Herlen, Porto, Stockholm, Giurgiu, Cork; the fourth five: Linz, Stargard, Tallin, Yuryugge, Panevezys; the fifth five: Budapest, Hair, Banska Bystrica, Odense, Luxemburg (figure 2).

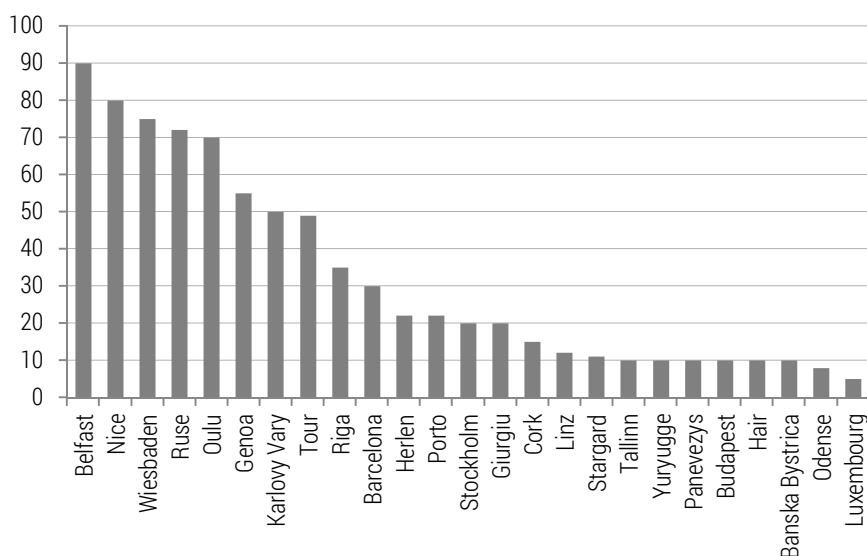


Figure 2. Rating of cities in the EU by share of green zones in 2021

Source: author's work based on (The EEA workspace, 2021).

Figures 3, 4 show ecologically safe lands in Ukraine and EU countries, based on categorical subordination of lands such as organic and recreational.

The largest share of lands of the nature reserve fund is in Austria, Slovenia, Croatia. Ukraine is characterised by the largest zones in the Western (Rivne, Lviv regions) and Southern parts of Ukraine (Kherson, Zaporizhzhia, Dnipropetrovsk, Odesa and Mykolaiv regions).

As of January 01, 2020, the percentage of protected areas in Ukraine is 6.77% of the total area of territories, which is 4085862.37 ha but is much smaller than in most European countries, where the average percentage of protected areas is 21% (Ministry of Environmental Protection and Natural Resources of Ukraine, 2021).

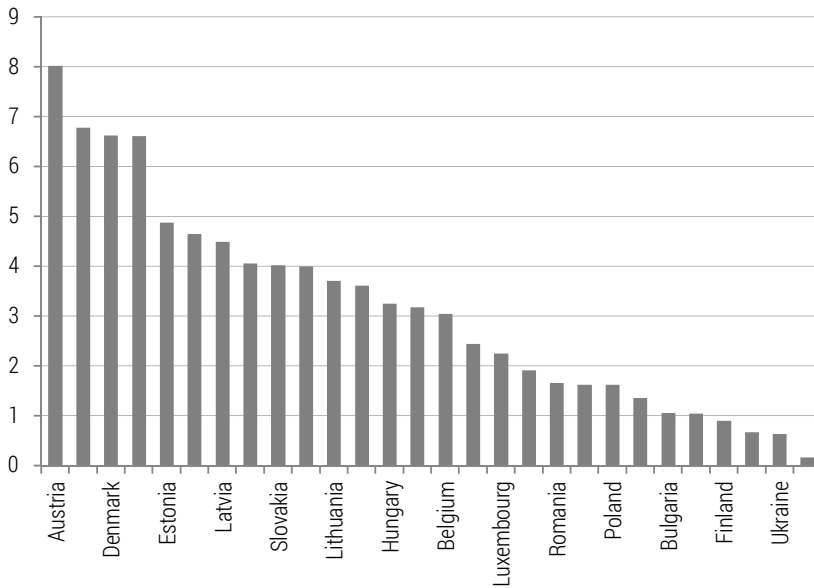


Figure 3. EU and Ukraine organic areas for 2019, ha
 Source: (Federation of organic movement of Ukraine, Eurostat, 2021).

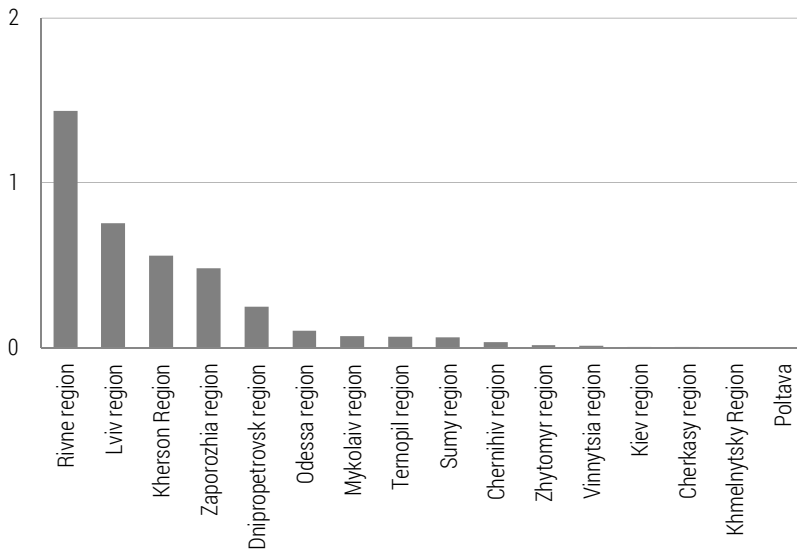


Figure 4. Share of the area of territories and objects of the nature reserve fund by regions of Ukraine in 2019, ha (State cadastre of territories and objects of the nature reserve fund of Ukraine, 2021)

Source: formed by the authors based on (Ministry of Environmental Protection and Natural Resources of Ukraine, 2021).

The share of environmentally safe territories in Ukraine of the total area of the country's territory has critically low scores compared to the EU. For example, Ukraine ranks 27th among the 27 countries surveyed in terms of green urban zone per capita; the percentage of area of the lands of the nature reserve fund of the country's total territory in Ukraine is 3.1 times smaller than in the EU.

According to the abovementioned analytical data, it can be said that statistical information and its components on environmentally safe lands are not characterised by sufficient diversity and content. Qualitative content of databases is absent.

Considering modern approaches to the EU Common Agricultural Policy and Green Deal Policy, measures and tooling for implementing strategic priorities of management of investment and innovation activities of ecologically safe land management, improvement of methodological support of the system of environmental regulation of land relations are especially resonant. Today in Ukraine and some countries of the world, there is a need to form a new system of regulation of land relations, related not only to the development of the land market but also taking into account the dominants of sustainable development and socio-ecological economic aspects of the life of the society. In this context, the methodology and practice of strategising in an ecologically safe land management system will become especially important.

The corresponding development of investment and innovation activities is the development of more technological and innovative economic entities, which primarily causes competitiveness and accelerates innovative development. Encouragement to increase investment in research and development, scientific and technological innovations should be aimed at business entities engaged in environmentally safe land management development. Investing in the creation of various research institutes, innovative resources, and technological reserves will support the transformation of scientific and technological achievements, as well as the development of business incubators, scientific and technical consulting, and other scientific and technical institutions, as well as the transformation of scientific and technological achievements in the direction of ecologically-oriented nature management and natural environment protection. It is appropriate to support business entities in the full use of different platforms for the transfer of technology and technological advances, as well as to accelerate the transformation and technological advances.

Entities of ecological and economic activity are interested in improving the use of modern technologies, increasing the competitiveness of manufacturers of goods. Therefore, households and enterprises need equal state aid. The state, first of all, has an interest in the transition to Industry 4.0 (auto-

mated manufacturing, where all processes are managed in real-time and taking into account changeable external conditions) because it is a way of development without violating international obligations.

Natural resources need uniform and sustainable management, improving the efficiency of their use and introducing innovations by enterprises. Management systems need to be constantly improved through more effective institutions, rules and standards for the management of natural resources, incentive mechanisms, clearly defined property rights, managed relations between the state and business, and management of rent payment (ERD 2011/2012: European Report on Development, 2021).

The use of Foresight forecasting methodology will acquire a specific interest in the context of environmentally safe land management through the adaptation and step-by-step use of many strategic management methods in the system of rational nature management. The article does not cover the whole range of problems in the formation of regulation of the ecologically safe land management in connection with their diversity and systemic heterogeneity; some scientific positions are debatable. At the same time, according to the authors, the proposed methodological approach will promote the development of applied tooling for the development of systems for strategic management of investment and innovation activities of environmentally safe land management.

Analysis of recent studies

Strategic management is the basis for optimising environmentally safe land management, decision-making and the key to the positive development of the relevant economic sphere. The essence of the development of modern strategic management requires mobility, rapid pace and wide coverage by power structures of the definition of clear goals and tasks, which must be correlated with the tasks of sustainability, rational use of natural resources, inclusiveness. Strategic management is a simplification process, balancing, improving the functioning and coordination of strategic and tactical management tasks. Strategic management of the sphere of ecologically safe land management should take into account scientifically-based approaches, creation and implementation of innovative technologies, external and internal factors of the influence over the development, restoration and preservation of environmental quality and sustainability of soils, rational and efficient use of water resources (Borovik and Tanklevska, 2019, p. 122-123).

The directions to increase land resources reproduction efficiency and the modal formation strategy of ecologically balanced measures system for their effective employment are defined by Stepanenko et al. (Stepanenko et al.,

2021). Wang et al. explore the coupling relationship between land use and rural development to improve the environmentally friendly level of land use and attain accelerated rural revitalisation (Wang et al., 2019). Damien et al. review some of the forthcoming challenges that the agricultural sector should address to confirm its significant progress towards land-use sustainability (Damien et al., 2017). De Wrachien describes the main physical, social and economic features of land use planning projects, along with their environmental impact and the constraints of sustainable development. The importance and role of institutional strengthening, sound financial and managerial frameworks and the availability of human resources are analysed, along with research thrust, technology transfer and networking improvement (De Wrachien, 2002). Mishina et al. say that reducing environmental pollution is possible only with the use of clean and environmentally friendly sources of energy. Increasingly renewable energy sources have been mentioned as the most economically advantageous and the most expensive at the initial implementation stage. An important issue is investment and innovation support for the sphere of environmentally friendly land use and the development of its strategic management (Mishina et al., 2020).

A small number of scientific concepts are characterised by the presence of investment and innovation aspects of strategic management.

Development, implementation, and realisation of strategic goals require the formation of alternative strategies, control, regulation, and adjustment of the entire strategic management system in environmentally safe land management (figure 5).

Strategic goals in the field of ecologically safe land management and the general direction of the strategy should be focused on the use of innovative technologies with the help of which it will be possible to monitor the quality of land pollution. However, this is quite an investment-cost technology. Thus, the issue of investment security and attractiveness with the encouragement of participants and stakeholders for further development of this area plays an important role in implementing and promoting strategies.

Such innovative technologies can be sensor equipment with the function of an electromagnetic signal generation that will determine the characteristics of the land area and transfer them to the information database of regulatory bodies for land protection or land survey using GIS technology.

Climate change poses new threats to the health of vegetation and crops. Ensuring their sustainability in such conditions requires measures for better protection of plants from pests and diseases and the introduction of innovations. In its Farm-to-Fork strategy, the EU Commission pays close attention to new innovative methods, including biotechnology and the development of bio-based products. The development of proposals focuses on innovation,

with a special focus on adaptation and mitigation of climate change, agri-environmental issues, sustainable landscape management and land management, conservation and sustainable use of biodiversity.

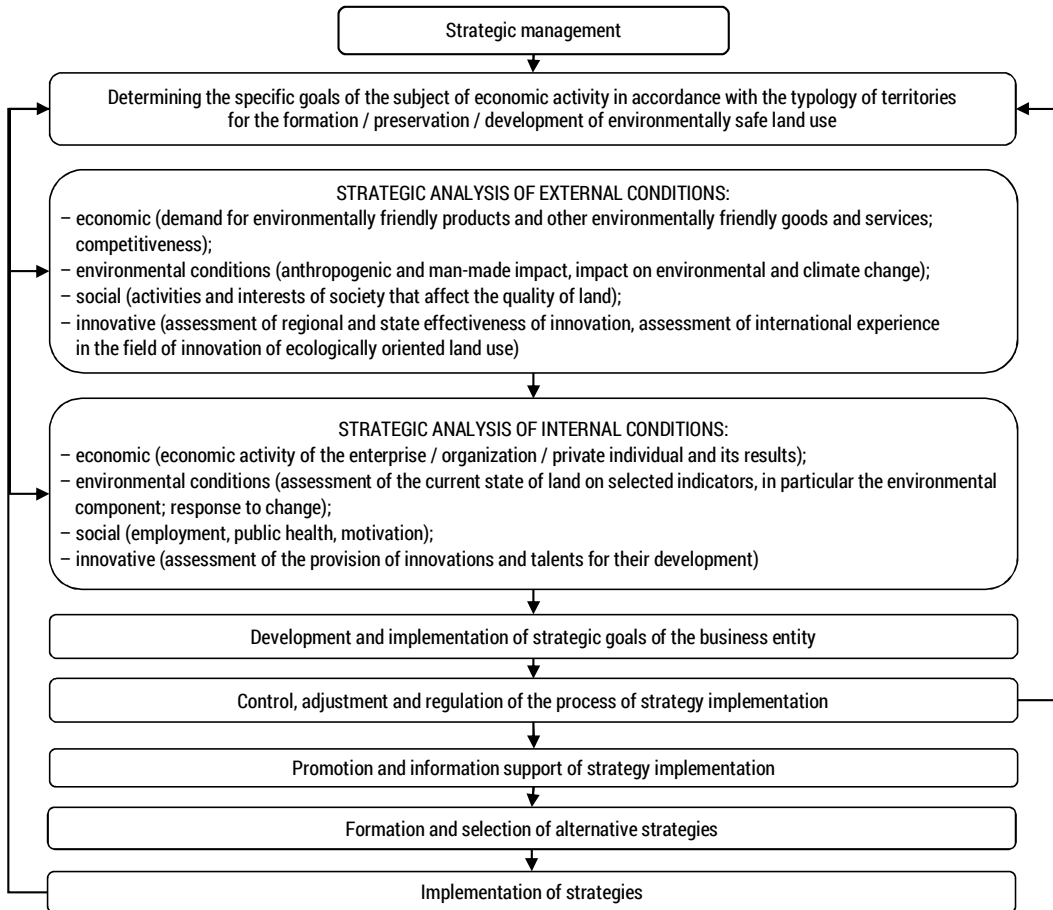


Figure 5. Monitoring and evaluation of the effectiveness of the strategic management system in the field of environmentally safe land management

Source: author's development using (Borteichuk, 2013., p. 2; Paladchenko and Molchanova, 2018; Yermakova, 2019, p. 14-18).

Support for innovative and sustainable solutions concerning packaging using environmentally safe, reusable and secondary materials is essential. The main goal of the Strategy and the EU Green Course priorities is to develop solutions to restore soil health and function.

Innovative development and knowledge transfer is key task of the EU Commission. It takes place through cooperation with member states to

strengthen the role of the European Innovation Partnership “Agricultural Productivity and Sustainability” (EIP-AGRI). Involving farmers and rural areas in cooperation is a key factor in providing employment, business and investment in rural areas, as well as in improving the quality of life. The European Fund is investing in innovation and cooperation in the regional context.

The strategy of sustainable financing mobilises the financial sector to more sustainable investments, in particular in agriculture, promotes investment support to improve the sustainability and accelerate the environmental and digital transformation of farms (A farm to fork Strategy for a fair, healthy and environmentally-friendly food system, 2020, p. 9-17).

The use of innovative technologies allows taking the necessary measures to delineate the boundaries of contaminated areas, leading to the storage of contaminated adjacent areas, including their natural state. In addition, information on land damaged by pollutants will be used to create a database for transforming land into environmentally safe, returning to its natural state or termination of usage.

Particular attention is to be paid to monitoring not only the quality of land resources but also the possible costs of restoring the land. As a result of the effectiveness of the land management system in Ukraine, it will be possible to stop using contaminated areas that are economically inefficient and dangerous.

Concerning investment activities for the management and development of environmentally safe land management, it provides for reimbursement of up to 30% of the cost of certification of organic production and reimbursement of up to 30% of the cost of purchasing the permitted plant protection products and fertilisers, seeds, planting material and feed (On state support of agriculture of Ukraine, 2004). In the desired form, the investment system for the formation, development and preservation of ecologically safe lands should provide for the creation and systematic renewal of regulations, an environmental audit of territories to improve the procedure for assessing the ecological state of the environment comparing environmental safety with economic opportunities.

According to the description of investment and innovation activities in the field of ecologically safe land management, it can be seen a coherent process and intertwining of the properties of both components (figure 6).

Scientific support for the strategy of environmentally safe land management should be based on several principles:

- systematicity, based on the consideration of land management as an interconnected ecological and innovative system;
- environmental friendliness, in particular, land valuation taking into account the ecological condition of natural resources;

- self-reproduction of the land, which causes the lack of use of artificial means of intensification of land management formation;
- voluntary participation of landowners and land users in the processes of the greening of land management;
- priority of local management, namely the emphasis on local conditions, with the subsequent concentration of environmentally safe zones and their appropriate management;
- complexity caused by taking into account economic, environmental, social needs, interests, requirements of business entities;
- openness and transparency of the strategising process and promotion;
- feedback and information support (Tiutiunnyk and Kupinets, 2020, p. 26).

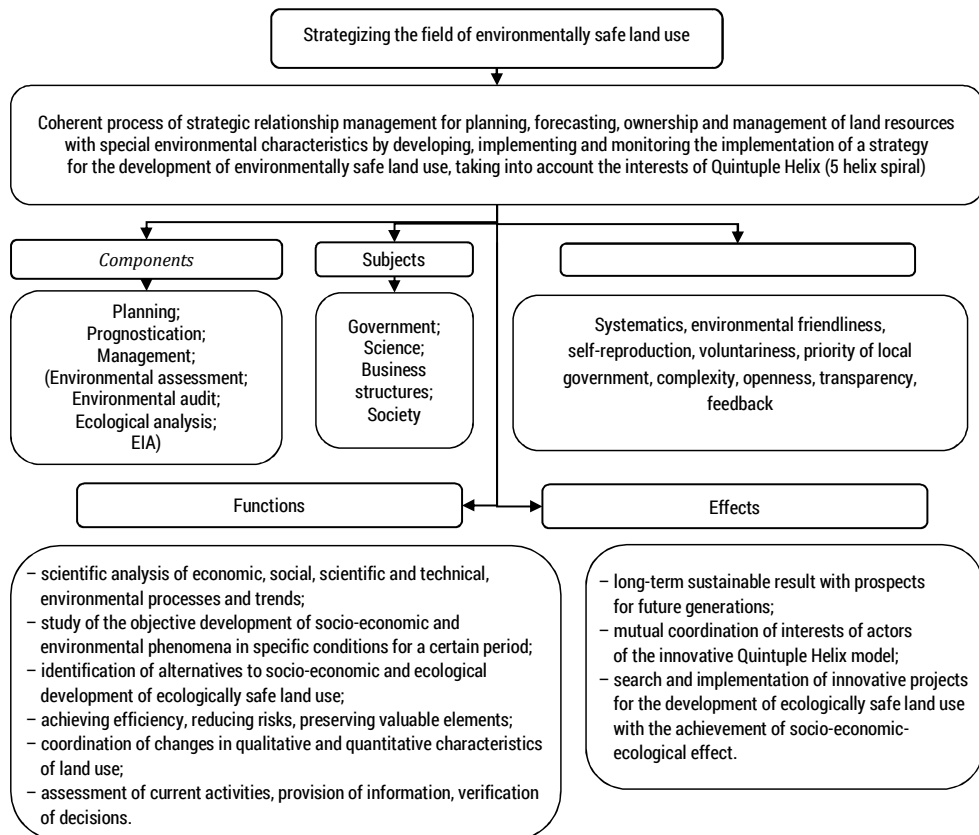


Figure 6. Logical and structural scheme of strategizing the sphere of ecologically safe land management

Source: author's development using (Sierov, 2000, p. 606; Campbell et al., 2015; Svyrydova, 2016, p. 75; Bulysheva and Andryeyeva, 2018, p. 157).

The balance and support of the two (innovative and ecological) components will lead to a comprehensive ecological-economic and innovative effect, the possibility of international cooperation with EU countries and maintaining the necessary pace for the development of environmentally safe land management and climate change mitigation.

Research methods

In his research, the world-famous scientist Popper proposed representing a set of varieties of the Foresight-method in the form of the Foresight-diamond (Popper, 2008). Diamond has about 44 methods. In recent years, the variety of quantitative and qualitative methods used for foresight and forecasting has increased sharply. In addition to the well-known Foresight methods, such as expert groups, scripts and Delphi, more advanced methods have been introduced in Foresight. At the same time, traditional methods have also been improved using new technologies and applications.

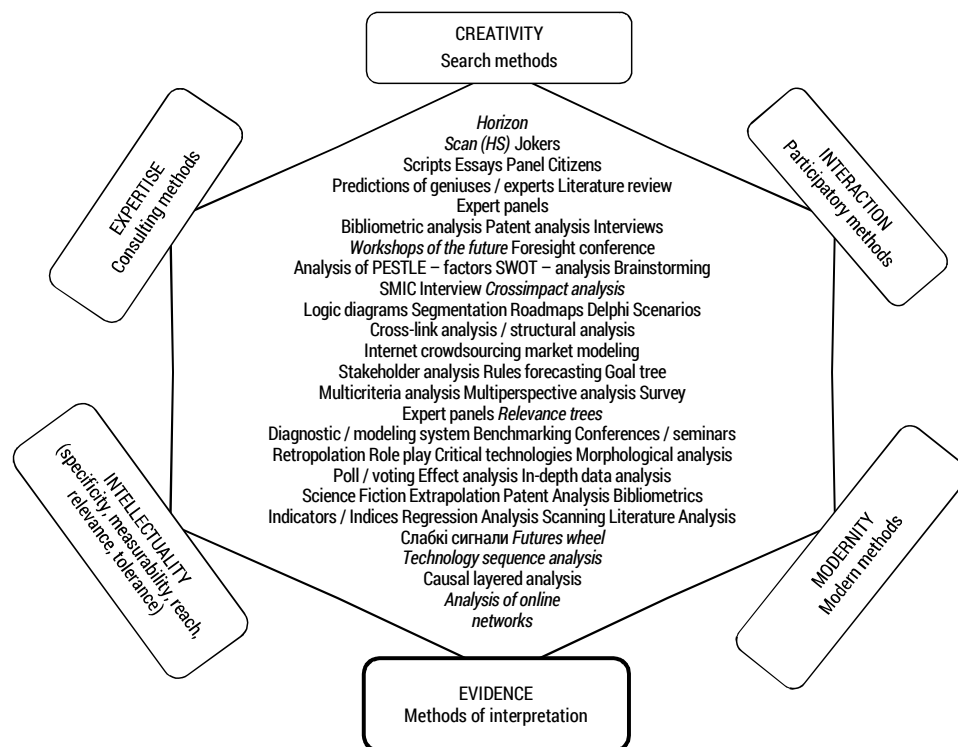


Figure 7. The star (heptagram) of the foresight

Source: author's improvement (italics) using (Bulysheva and Andryeyeva, 2018, p. 156; Zanyzdra, 2020, p. 105; Paladchenko et al., 2010; Saritas and Burmaoğlu, 2015).

These methods can be characterised as modern (up-to-date), particularly the analysis of megatrends, technology forecasting, science and technology policy methods, technological planning, and cross-impact. The total number of methods is more than 68. The star (heptagram) of the foresight is shown in (figure 7).

The foresight method can be described as intelligent (a special place in which takes the SMART method). It provides the study and presentation of many plausible (relevant) and unpredictable ways that can form and develop an uncertain future (reachability).

Forecasting is based on structures (measurability), disciplined and mutually complementary methods (specificity) – verified, repeated and provide different ways of seeing and processing.

Foresight is inherently common and seeks diversity (tolerance) – that is, the systematic involvement of long-term stakeholders to promote mutual learning, collective vision and joint actions to reflect current and future perspectives [Morrison, 2010; Saritas et al., 2015, p. 3]. In addition, foresight raises stakeholder awareness of new trends, events and challenges.

Results of the research

According to the authors, environmentally safe land management should be understood as the process of ensuring the greening of land relations, based on the principles of preserving and improving the qualitative and ecological condition of the environment in the context of the priorities of the Sustainable Development Goals.

The procedure for implementing the foresight methodology in the field of ecologically safe land management in the study is presented at the traditionally separated stages, adapted to the peculiarities of the field of environmentally safe land management, management of its investment and innovation activities (figure 8). As part of the study, the authors proposed a methodological approach to implementing foresight forecasting and strategising of environmentally safe land management, which got the approval on the example of the Odesa Region within the Black Sea Region of Ukraine.

Relevant stages of the methodology of strategic management of environmentally safe land management and foresight forecasting are:

Analysis of existing information using SMART indicators based on the Quintuple Helix methodology (5 helix):

- investment potential of land protection (Government), Economic activity (Entrepreneurship);
- scientific and innovative potential in the field of environmentally safe land management (Science);

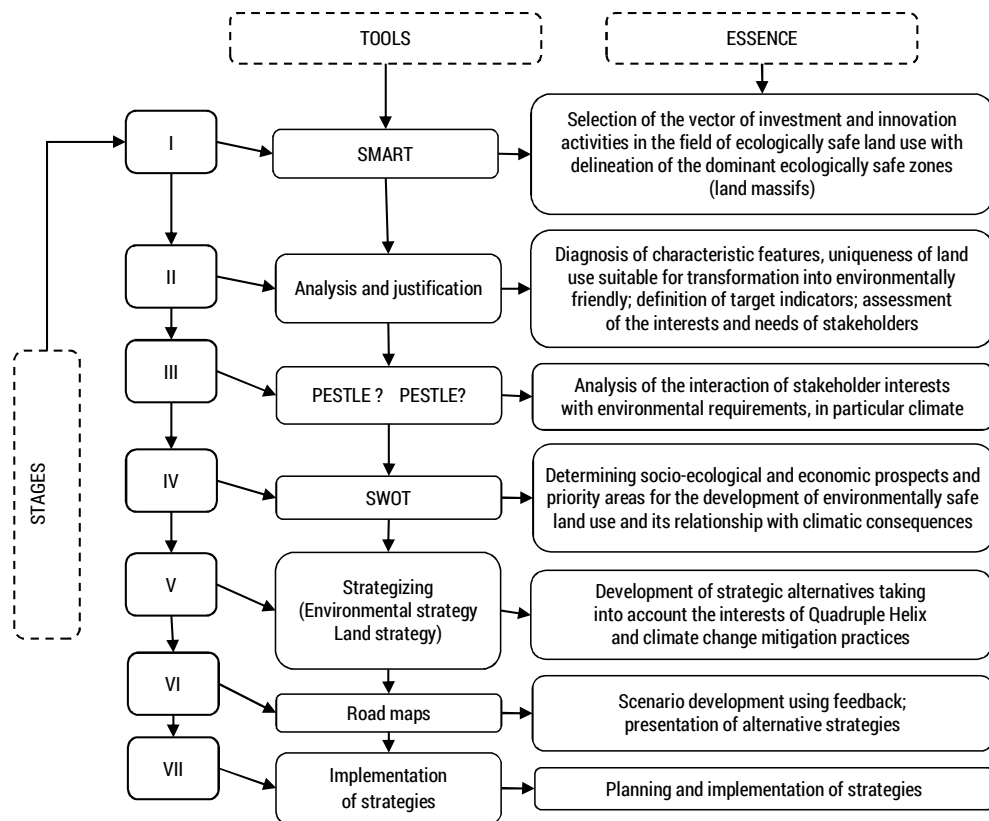


Figure 8. Stages and tooling of foresight methodology in the field of environmentally safe land management

Source: author's development using (Bulysheva and Andryeyeva, 2018, p. 159; Yermakova, 2019 p. 29; Procedure for developing regional development strategies and plans of measures for their implementation, as well as monitoring and assessment of the effectiveness of implementation, 2015).

- agroecological, climatic potential of land management and territories suitable for transformation (Environment);
- degree of anthropogenic impact (Public sphere) on the existing environmentally safe land management and suitable for transformation, the choice of development of the vector of investment and innovation activities. The methodological approach is presented in previous studies (Andryeyeva and Tiutiunnyk, 2020, p. 62);
- Development of a database upon indications for assessing the needs in the field of environmentally safe land management;
- Monitoring the state of the environment in accordance with the interests of stakeholders and climate change mitigation requirements;

- Drawing of perspectives and choice of priority directions concerning optimisation of the development of the sphere of environmentally safe land management;
 - Formation and substantiation of strategic alternatives of the sphere of land management with special environmental characteristics taking into account the interests of Quintuple Helix (5 helix);
 - Presentation of the scenario of formation, development and preservation of environmentally safe land management with the analysis of socio-economic and ecological results from the introduction of the eco-innovative component. Assessment of the impact of the development of environmentally safe land management on climate change.
- Planning and implementation.

Stage I

The synergy of the innovative and ecological components in the field of environmentally safe land management as mutual complementation correlates with the characteristics of the SMART method by scientists Ortega, McCann, Perianes-Forte, Cervantes, Larosse and Sanchez (Ortega et al., 2013). Due to the lack of a cadastral database of ecological qualitative and quantitative characteristics of land management and the irregularity of data, a key element of the SMART process is the use of public opinion, data and technology from social media, online tools (Bakhshi and Mateos-Garcia, 2016). Involvement of beneficiaries and users, public consultations, expert recommendations, submission through web tools are defined as important components of the selected method according to the research of Delaney and Osborne (Delaney and Osborne, 2013).

According to the analysis of information sources, the SMART method was selected as the basic method for foresight forecasting. Calculations were carried out within the framework of the preliminary author's research of the regions of Ukraine "Methodological approaches to determining the dominants of the regional investment and innovation policy of nature management" (Andryeyeva and Tiutiunnyk, 2020, p. 62) (table 3, figure 9).

Table 3. Comprehensive assessment of the dominant position in the context of investment and innovation regional nature management policy of the Black Sea Region (by groups of indicators of Smart Specialization)

Region	Economic activity and investment potential of environmental protection	Scientific and innovative potential in the field of nature management	Environmental performance according to SDG	Natural resource potential
Mykolaiv region	1.5	3.5	2.1	2.6
Odessa region	1.4	5.6	2.0	3.8
Kherson region	0.9	4.4	2.6	3.1

Source: calculated on the basis of (Andryeyeva and Tiutiunyk, 2020).

Note: green zones are strong, yellow are moderate, orange are neutral and red are weak.

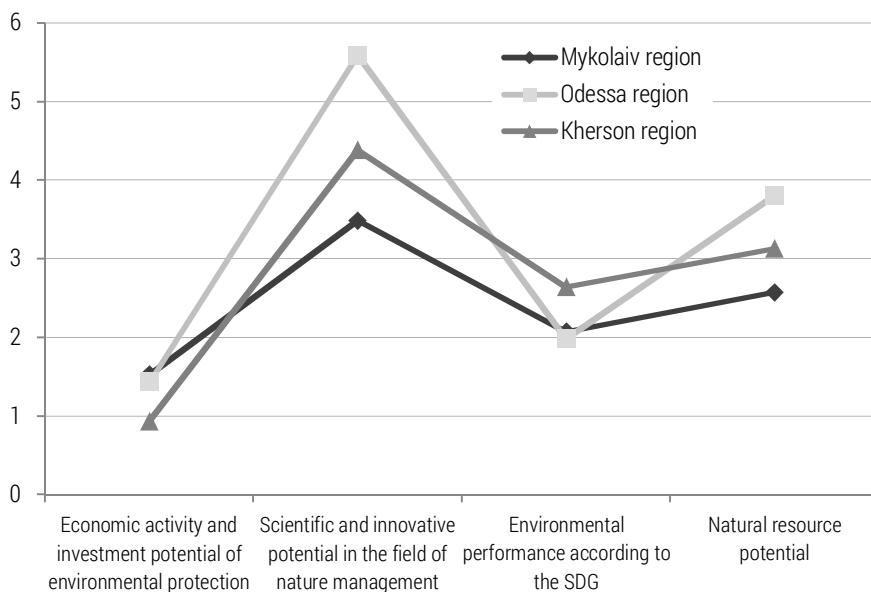


Figure 9. Comprehensive assessment of the priority of implementation of Smart-projects in the field of nature management of the Black Sea Region of Ukraine

Source: developed based on table 7.

Due to the lack of necessary indicators specified in the description of the stages of methodology and the availability of a number of necessary information only on land fertility in the Black Sea regions as a basis for the develop-

ment of environmentally safe land management and based on previous studies, there were made the conclusions (table 4, figure 10).

Table 4. Soil area by humus content for 2020 in the Prymorskyi Region of Ukraine

Soil area by humus content for 2020, %							Weighted average, %
Humus content	very low < 1.1	low 1.1-2.0	medium 2.1-3.0	Elevated 3.1-4.0	high 4.1-5.0	very high > 5.0	
Odessa region	0.0	0.3	15.8	48.3	28.9	6.7	3.77
Kherson region	11.07	26.62	51.72	10.56	0.03	0.0	3.62
Mykolaiv region	7	3.3	34.3	45.5	9.8	0.1	3.0

Source: developed based on (Regional report on the state of the environment in Odesa Region, 2020).

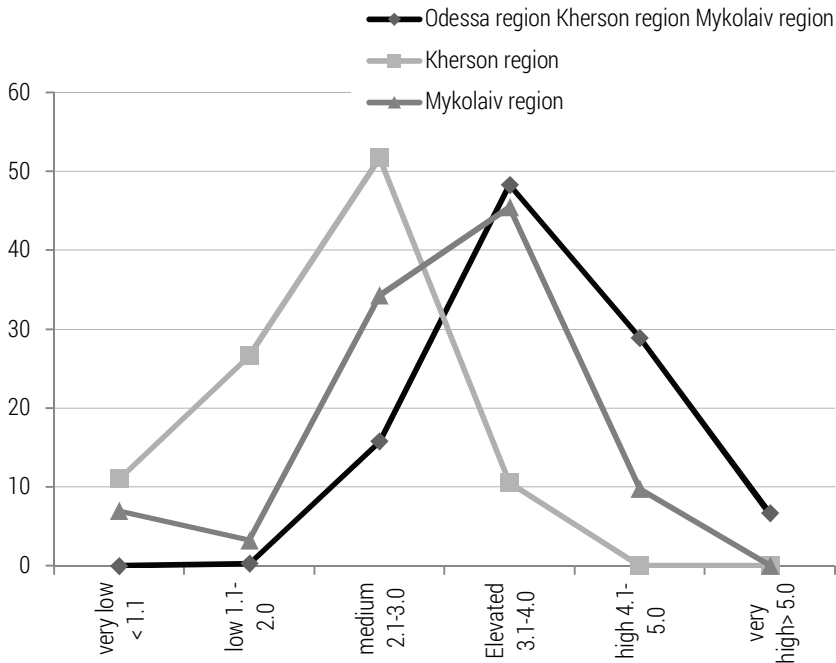


Figure 10. Concentration of humus content for 2020 in the Prymorskyi Region in soils

Source: developed based on table 8.

As a result of approbation of the author's technique on the statistical basis of the Black Sea Region of Ukraine, it was revealed that the dominant region would be Odessa Region, despite a number of problematic issues and necessary tasks to be solved, then Kherson and Mykolaiv regions.

Stage II. The definition of target indicators with the assessment of stakeholder interests

Sustainable Development Goals (SDG) and the optimal state of land management was carried out at the stage of analysis and justification. This stage may comply with the SMART method, as well as it was a separate process. The target indicator (according to the methodology) can be correlated with the indicators of the dominant region, in this case, Odesa Region and/or be determined based on international standards and target indicators of SDG (2 – Overcoming famine, 4 – Quality education, 6 – Clean water and proper sanitation conditions, 7 – Renewable energy, 8 – Decent work and economic growth, 9 – Innovation and infrastructure, 11 – Sustainable urban development and community, 13 – Combating climate change, 14 – Preservation of marine ecosystems, 15 – Preservation of terrestrial ecosystems).

Stage III

Provides for using an adapted matrix of analysis of external strategic factors and an extended version of PEST-analysis – PESTLE-analysis (table 5).

Table 5. PESTLE-analysis of environmentally safe land management

Factor code	Deciphering the factor	Characteristic	Factors of ecologically safe land use
P	Political	Intentions and means of implementation of the development of ecologically safe land use by public authorities	<p>Political factors in the field of environmentally safe land use:</p> <ul style="list-style-type: none"> • System of support (benefits, compensations, compensations) of landowners, land users with ecologically safe lands; • Ecologically oriented policy of land use; • Distribution of powers of authorities and systematisation of the branch directly related to environmentally friendly use and functioning of land; • The level of control and supervision over compliance with the law, the level of corruption, the level of possibility to implement appropriate measures.
E	Economic	Investment attractiveness of ecologically safe land uses as a basis for the production of quality products and ecological safety in relation to environmental degradation	<p>Economic factors of ecologically safe land use:</p> <ul style="list-style-type: none"> • Economic and monetary evaluation of ecologically safe lands with the use of ecological component as a basis for increasing investment attractiveness, rent; • Demand and production of environmentally friendly products; • Income/expenses of landowners and land users from the formation and transformation of environmentally safe land uses; • Settlement of forms of ownership in the land market; • Availability of compensation and other economic incentive mechanisms to reimburse the costs of creating and operating environmentally safe land use.

Factor code	Deciphering the factor	Characteristic	Factors of ecologically safe land use
S	Social	The socio-educational and cultural level of land-owners and land users, reasonable urbanisation	Social factors in the field of environmentally safe land use: <ul style="list-style-type: none"> • The level of educational training of specialists, the provision of the educational base; • Social conditions and protection of employees; • Ecological worldview, awareness, awareness, feedback, ecological culture, traditions; • Inclusiveness as multifunctionality of natural resources and inclusion of all segments of the population; • Directions of anthropogenic impact, nature and form of land management; • Reasonable development of urban processes.
T	Technological	The level of implementation and functioning of the innovation component, its impact on the environment and the development of environmentally friendly land use.	Innovative factors in the field of ecologically safe land use: <ul style="list-style-type: none"> • availability of technological equipment; • compliance with modern trends and best world practices; • inclusiveness in use; • safety and performance for the environment.
L	Legal	Regulatory and legal field of formation, development and functioning of ecologically safe land use and the sphere of use of the respective lands	Legal factors in the field of environmentally safe land use: <ul style="list-style-type: none"> • Development of a regulatory framework that covers both general issues of environmentally safe land use and in accordance with each category of land and their scope; • Improving existing land legislation with a focus on the environmentally safe use of land resources.
E	Ecological	Interaction of the state of the natural environment on ecologically safe land use	Ecological factors of ecologically safe land use: <ul style="list-style-type: none"> • The impact of the development of environmentally safe land use on climate change mitigation; • The impact of green hydrogen production on the state of land use and development of H2 reserves; • The current state of agro-climatic features of the environment for environmentally safe land use;

Source: author's development using (Bulysheva and Andryeyeva, 2018, p. 164).

The analysis of the best practices of the EU and the world community shows the need for a comprehensive review of indicators. Furthermore, it should be noted that the investment and innovation policy closely intersects with the Energy and Hydrogen Development Strategies.

According to the Concept of Green Energy Transition of the Ministry of Energy and Environmental Protection of Ukraine, renewable energy sources and innovativeness in nature management (Decarbonization of the economics, 2021). According to the European Hydrogen Strategy presentation, such sources supply the latest energy resource to the European market, namely green hydrogen. The EU has identified Ukraine as a priority partner in the implementation of the European Hydrogen Strategy. In the summer of 2020, Ukraine and Germany launched an energy partnership, particularly in developing hydrogen energy and its integration into the network.

There are four regions in the south of Ukraine where powerful bases for generating solar and wind energy have been formed, which can already be used to produce and export green hydrogen. In addition, the southern regions of Ukraine are also suitable because there is a demineralised water generator system from which hydrogen will be obtained. These are Odesa, Kherson, Mykolaiv and Zaporizhzhia regions.

The process of obtaining the H_2 molecule from ordinary water by electrolysis is referred to as the transition from conventional carbon fuel to environmentally friendly hydrogen as a new global energy trend and a strategic priority of rational environmental management (Is Ukraine ready to become an exporter of “green” hydrogen to Germany?, 2021). However, hydrogen can be produced not only in the subsoil and through the use of water but also in the soil layer. The presence of hydrogen ions (H-ions) in the soil cover and exchangeable hydrogen and aluminium ions in the absorbing complex causes an acidic reaction in the soil due to their incomplete neutralisation. The root system of plants releases hydrogen ions and organic acids that also acidify the soil. Soil microorganisms can produce and consume H_2 due to metabolic processes, thus actively participating in the molecular hydrogen cycle in nature. Natural hydrogen production depends on environmental conditions, such as humidity, temperature, presence and composition of microorganisms and in different areas, its value will be different.

Production of hydrogen from the soil cover will not only solve the problem of replenishing the necessary energy resources. However, it will also solve a problem for preventing the oxidation of particularly valuable soils (chernozems). Such measures correlate with the transformation of land into environmentally safe. After all, the decrease in the content and qualitative composition of humus is associated with anthropogenic processes of agrogenic soil cultivation, but hydrogen emissions cause a significant impact. Soils affected by hydrogen intensively change their properties: the mobility of many elements changes; humus transforms more mobile. It leads to the removal of humus outside the soil profile (Chakmazian, 2016).

Research of the sphere of environmentally safe land management in such an innovative way and assessment of quality indicators of land management that affect the life of flora/fauna, humans and climate allows to form a zoning system and economically justify the possibility of hydrogen production on the relevant territories and mitigate the impact on climate change (Tiutiunyk, 2021).

Stage IV. The analysis of the interaction of stakeholders' interests with the environmental requirements is characterised by using a SWOT analysis

The implementation of such measures, in particular their plans and mechanisms for developing regional development strategies, in which they are set, is determined in Ukraine in accordance with the "Procedure for developing regional development strategies and action plans for their implementation, as well as monitoring and evaluating the effectiveness of the specified regional strategies and plans of measures".

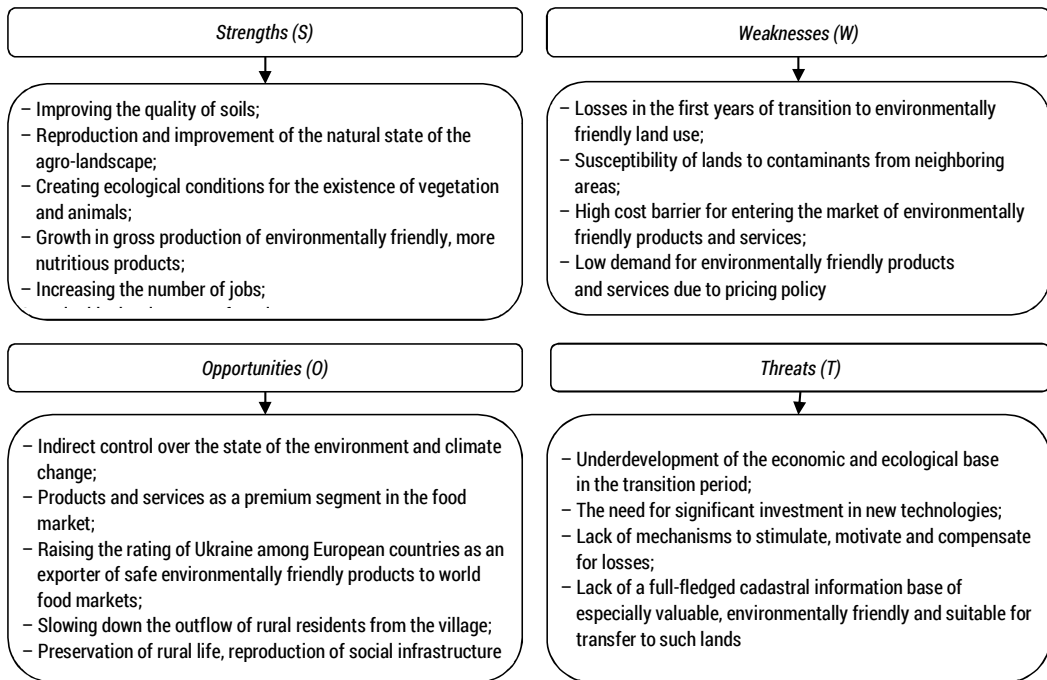


Figure 11. SWOT-analysis of the effectiveness of formation, development and operation of environmentally safe land management

Source: author's development using (Tiutiunyk and Kupinets, 2020, p. 93-94; Procedure for developing regional development strategies and plans of measures for their implementation, as well as monitoring and assessment of the effectiveness of implementation, 2015; Yermakova, 2019. p. 126-127).

The regulatory legal act also indicates the need to monitor and assess the effectiveness of implementing these regional strategies and action plans, particularly based on smart specialisation, through SWOT analysis. It establishes a link between internal (strengths and weaknesses) and external (opportunities and challenges) factors (Procedure for developing regional development

strategies and plans of measures for their implementation, as well as monitoring and assessment of the effectiveness of implementation, 2015). These factors are of strategic importance for the development of the region. The SWOT analysis results are used to identify and select strategic and operational development goals of the region. Trends and main problems of socio-economic development of the region, including the results of SWOT-analysis, were identified based on SMART-specialization (see figure 11).

Stage V

On the example of the Odesa Region, the authors proposed a Strategy for developing environmentally safe land management that can be used (as an example) in other regions of Ukraine and the world.

Note that ecologically safe lands, according to their qualitative characteristics, can be attributed to particularly valuable lands according to Article 19 and Article 150 of the Land Code of Ukraine (Land Code of Ukraine, 2001). However, in the land legislation, there are no criteria for assigning plots to the appropriate categories. The intended purpose of land management is determined with the help of data from the State Land Cadastre, which are currently insufficient and belong to outdated information, land management documentation, statistical data and others. Note that there are no cartographic materials (cadastral plans, maps) of such soils. As a result, there is no possibility of their use in the context of the region. In modern land management practice, there is no zoning of territories. The boundaries of plots suitable for conversion into ecologically safe ones are not delineated, making it impossible to fully preserve them as a framework for the ecological sustainability of territories.

All types of information sources used for land classification and further use can only state the current condition of the land but not be the basis for its intended purpose. It is especially true of ecologically safe lands, as the land area can belong to several categories of land at the same time. Therefore, its formation requires a number of survey works and the creation of a separate information platform. After carrying out organisational measures, it is possible to assign the land plot claiming the role of ecologically safe, to a separate category of especially valuable lands, to give it the corresponding intended purpose, to establish the regulatory order with the definition of the behaviour of subjects of land legal relations.

The cadastral database of ecologically safe lands, which includes indicators of survey works and systematic monitoring by the relevant services and public authorities, should be coordinated with landowners and land users' information and communication tool. Informational data at the beginning of the formation, use of land area requires the introduction of information on

information and communication platforms, along with reports on the agri-environmental condition of the land.

In the context of actualising the issue of climate change and the need to increase its sustainability, protecting the health of citizens and ensuring the interests of business entities, an important task is to monitor the consequences of economic activities, especially on land. After all, non-rational and non-ecological land management generates significant emissions of nitric oxide – the third greenhouse gas in order of importance, with the potential for global warming. An environmentally safe land management system has lower nitrogen emissions per hectare than conventionally treated and contaminated soils.

It means that cadastral databases currently, in addition to ecological-toxicological, soil-agrochemical, agrophysical, physicochemical, agrochemical, economic indicators, need to be filled with information on qualitative climatic characteristics correlated to the relevant land zone/massif (Titiun-nyk and Kupinets, 2020, p. 28).

According to the information of the territorial bodies of the State Service of Ukraine for Geodesy, Cartography and Cadastre of Ukraine, there are more than a million hectares of degraded, unproductive and man-made contaminated lands that require conservation and restoration. In particular, in the Odesa Region, land resources for their economic use are characterised by insufficient environmental and economic sustainability under the definition of the coefficient of ecological stability of the agricultural landscape. Suppose the territories of degraded and man-made contaminated lands have decreased, the areas of unproductive and disturbed lands have significantly increased. It affected the implementation of measures to improve the state of Ukraine's lands. Most attention is paid to improvement and recultivation, but this does not improve the overall situation.

However, Odesa Region is one of the three regions on the territory of Ukraine that are not polluted to dangerous limits. Therefore, the use of environmentally sustainable technologies will be most appropriate. Furthermore, the degree of their contamination with radionuclides, heavy metals and pesticides is lower than the MPC. Therefore, it is easier to grow on them environmentally friendly products for baby, medical and preventive nutrition.

In Odesa Region, there is significant scientific and innovative potential in the field of nature management. Odesa also occupies a dominant position in the context of investment and innovation regional nature management policy of the Black Sea Region (by groups of Smart Specialization indicators), despite a number of problematic issues and necessary tasks to be solved.

Table 6. Strategy for the development of environmentally safe land management

1. Purpose and objectives of the Strategy	
<p>The purpose of the Strategy is to develop economic and organisational support for the formation, development and operation of environmentally safe land use by creating favourable conditions for:</p> <ul style="list-style-type: none"> • Improving the quality and quantity of land with environmentally friendly use; • Changes in the concept of ecological, economic and monetary valuation of land and increasing the value of environmentally friendly land use; • Effective investment and innovation activities in the field of environmentally safe land use. 	<p>Tasks of the Strategy:</p> <ol style="list-style-type: none"> 1. Formation of the basic and improvement of the existing normative-legal field concerning the ecologically safe use of lands, their creation, development and functioning; 2. Development of land quality management system as part of monitoring and zoning, in order to ensure compliance of soil quality with established standards of Ukraine and the EU; 3. Monitoring of ecologically safe lands for classification and zoning (transformation of suitable lands), formation of cadastral database and cartographic representation; 4. Training and raising the educational level, qualification of existing staff in the field of nature management, in particular environmentally safe land use, international cooperation; 5. Carrying out organisational and economic measures to prevent pollution of existing environmentally safe lands and transformation, rehabilitation, regeneration (conservation), improvement of unproductive and degraded lands; 6. Increasing investment attractiveness and introduction of qualitatively new ecologically safe technologies of formation and preservation of ecologically safe land use; 7. Development of regional programs for the protection and restoration of land quality; 8. Development of motivational mechanisms for environmentally safe land use, the transition to an environmentally friendly way of management; 9. Improving the existing system of ecological, economic and monetary valuation of land using the environmental component; 10. Development and support of research on the impact of environmentally safe land use on climate change, making proposals and recommendations to the legal framework, land valuation system, organisation of the management process; 11. Formation of an information and communication platform to improve management in the field of environmentally safe land use.
2. Strategic directions and principles of the Strategy	
<p>The economic vector of development of ecologically safe land use provides economic growth through income from ecologically safe better products and services, prevention of costs for restoration of natural ecosystems, benefits and basis of healthy life of future generations, competitiveness in world markets;</p> <p>The ecological vector of development of the sphere of ecologically safe land use provides preservation and prosperity of a qualitative natural condition of ecosystems, improvement of climatic features;</p>	<p>Principles of Strategy:</p> <ol style="list-style-type: none"> 1. systematic, based on the consideration of ecologically safe land use as a socio-economic-ecological system; 2. voluntary participation of landowners and land users in the process of creating or transforming land-use into environmentally safe; 3. environmental assessment, scientific and technological progress and management, all land requirements need to be environmentally sound, taking into account the environmental status of natural resources; 4. complexity, due to taking into account economic, environmental, social needs, interests, requirements of business entities; 5. openness and transparency of activities in the field of ecologically safe land use; 6. feedback, with the help of innovative communication tools, a combination of internal and external actors in the field of environmentally friendly land use; 7. directed sustainable development, which implies the transition of production of certain agricultural products to the formation of life-saving complexes and taking into account the priorities of the Sustainable Development Goals;

The social vector of development of ecologically safe land use involves the creation of new jobs, healthy and quality food and livelihood in the future.

8. motivation – continuous stimulation of the population's interest in ecological and economically efficient management;
9. economic feasibility – any actions are economically feasible, and rational using the law of demand and forecasting, income, as a result of their implementation, exceeds costs and allows to make a profit at the planned level;
10. scientific validity, which means that all activities carried out on land use in the organisation of agricultural production must be scientifically justified by the degree of modern achievements of scientific and technological progress.

3. Stages of development and implementation of the Strategy

Stages of Strategy development:

- Monitoring, research and systematisation of quantitative and qualitative information of ecologically safe lands and suitable for transformation into such;
- Analysis of modern economic and environmental problems of land use, prerequisites, trends in the dynamics of ecologically safe lands;
- Development, substantiation, coordination of the goals of the Strategy for the development of ecologically safe land use;
- Definition of directions and substantiation of tasks of Strategy with the indication of the corresponding measures of its realisation;
- Promotion, adjustment, adoption of the Strategy;
- Implementation and control.

Stages of Strategy implementation:

Stage 1 (3-5 years): conducting research on the impact of environmentally safe land use on climate change, outlining the value of land as an important component of the overall state of the ecosystem and the well-being of future generations; improving the land valuation system based on the environmental and climatic components; development of the institutional basis in the field of ecologically safe land use; formation of new and improvement of existing regulatory framework, its correlation with EU legislation and standards; coordination of interests of external and internal subjects of ecologically safe land use; increasing the investment attractiveness and innovative equipment of ecologically safe land use.

Stage 2 (5-7 years): development of ecologically safe land use taking into account ecological, economic, social needs, interests, requirements of present and future generations; motivational, state, marketing support; development of educational-scientific, personnel, working potential; development of a quality system of management, control and supervision of ecologically safe land use; development of international cooperation.

4. Tools (means) for implementing the Strategy

Monitoring;
 Certification of lands;
 Information and communication tool;
 Information and communication platform;
 Cadastral database;
 Environmental audit;
 Ecological examination;
 Climate research;
 Zoning;
 Classification of lands;
 Assessment of lands taking into account the ecological and climatic component;
 Motivational mechanisms;
 Foresight methods of development and implementation of the Strategy.

5. Strategic alternatives

The strategy of innovative ecologically safe land use – the strategy is based on improving the quality of land use through the introduction of innovative tools as an information and communication tool and information and communication platform of land relations on the formation, use and operation of environmentally safe land use.

Traditional land-use strategy – fulfilment of the existing state requirements for ecologically oriented land use, expansion of areas of ecologically safe land use, but without taking into account the ecological component in the assessment of lands and possible climatic consequences.

Strategy of intensive ecologically oriented land use – development and implementation of the latest innovative component in the field of environmentally safe land use, improvement of quantitative and qualitative indicators of land condition, implementation of changes in the regulatory framework and land valuation system.

6. Implementation and monitoring of the Strategy implementation

The task of implementing the Strategy should be assigned to the branch of executive power with representatives of the public, business structures, landowners and land users.

The task of monitoring the implementation of the Strategy should be assigned to the State Service of Ukraine for Geodesy, Cartography and Cadastre, territorial bodies of the State Geocadastre, Regional State Fertility, Ministries and agencies in accordance with the purpose of environmentally safe land use.

The results of the Strategy will be highlighted in the relevant reports on the state of the environment at all hierarchical levels.

7. Results

Improving the quality characteristics of soils (bioproductivity, humus formation), improving the state of biodiversity, groundwater;

Reducing the ingress of harmful substances into soils, water, atmosphere;

Mitigation of climate change and improvement of climate indicators;

Improving the quality of food, creating healthy living conditions;

Stabilisation and improvement of the ecological, environmental situation in the countryside, development and landscaping of rural areas;

Stopping the outflow of rural residents from the countryside, the development of self-employment, the preservation of rural settlements and rural lifestyles, the reproduction of social infrastructure, the development of inclusiveness;

Increasing the competitiveness of the country as an exporter of environmentally friendly products and services, generating income, increasing investment attractiveness;

Development of educational, innovative and research spheres in the direction of practical use, introduction of innovative methods of land use organisation and their development.

Source: author's development using (Tiutiunnyk and Kupinets, 2020. p. 28, p. 77; Bulysheva and Andryeyeva, 2018; Yermakova, 2019).

The draft strategy for environmentally safe land management development is given in Table 6 and is based on the concept of sustainable development.

Stage VI. Provides for the development of a Road map for a specific area

The Road map for the development of ecologically safe land management is developed with a *strategic goal* in mind: to improve the quality and quantity of land with ecologically oriented use, change the concept of ecological, economic and monetary valuation of land and increase the value of environmentally safe land management, effective investment and innovation activities in the field of environmentally safe land management.

The Road map reflects the priorities for developing environmentally safe land management, responsible entities, deadlines, sources of funding. The main beneficiaries of ensuring environmentally safe land management

development are the government, science, business structures, and society. Achieving a strategic goal contains the following sub-goals (figure 12).

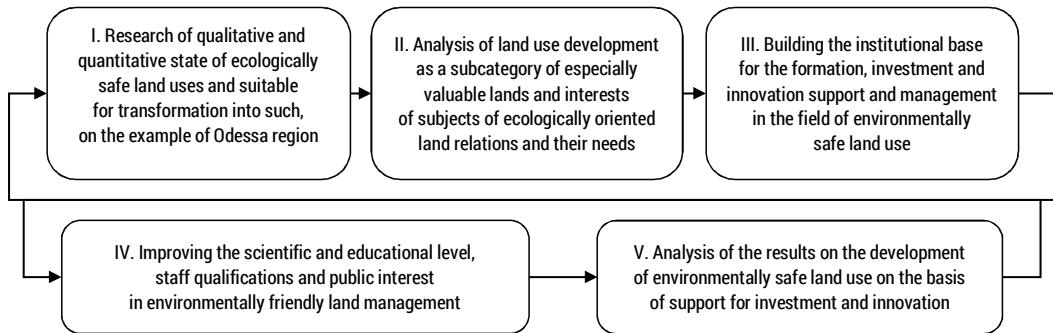


Figure 12. Sub-goals of the strategic goal of development of environmentally safe land management

Source: author's development (italics – monitoring and control of results).

Risks of the Road map implementation may include the following:

- *Environmental risks*: pollution from neighbouring areas, transboundary pollution, seismic phenomena, accelerating climate change, destruction of the general quality of ecosystems, landslides, mudslides, desertification, other extreme environmental and climatic phenomena.
- *Economic risks*: market changes, lack of economic motivational mechanisms, economic crises, low demand for environmentally friendly products and services, insufficient and uncoordinated mechanism of investment and innovation support.
- *Social risks*: rapid urbanisation, reduction of state support for research, education and innovation, insufficient awareness and environmental culture of society.
- *Technology-related risks* are associated with emergencies, man-made disasters.

The authors proposed a Road map for the leadership of the Odesa Region. This initiative is supported by the leadership of the Odesa Regional State Administration of Ukraine.

Conclusions

High-tech development of the modern world and its new opportunities opened by scientific and technical achievements and the development of information networks that allow obtaining immediate information, wide availability of modern technologies and change in the role of human resources

increases the need for greater effectiveness economic and environmental efficiency of management. It encourages the transition to an innovation-oriented path and the importance of the development of its environmentally oriented model of strategic management. However, this decision largely depends on how the implemented innovations are provided with the necessary amount of investment resources.

Statistical information and its components on ecologically safe lands are not characterised by sufficient diversity and completeness. Qualitative completeness of databases is completely absent. According to the available data, it can be determined that the share of ecologically safe territories in Ukraine of the country's total area has critically low indicators compared to the EU. Ukraine ranks 27th out of 27 countries surveyed in terms of green urban zone per capita; the percentage of the land area of the nature reserve fund from the country's total territory in Ukraine is 3.1 times smaller than in the EU. The percentage of protected areas in Ukraine is 6.77% of the territory's total area, which is much smaller than in most European countries, where the average percentage of protected areas is 21%. The reorientation of the economic system to innovation requires the involvement of the necessary amounts of both external and internal investment, different in type and form.

In the context of the current transformation of the world and domestic society on the greening of the economy at the macro-, mezo- and micro levels, the development of theoretical and methodological approaches and principles for strategic management of investment and innovation land management policy will be of particular importance.

At the same time, it should be noted that innovation and investment processes in the field of nature management should be considered comprehensively, based on logically selected and economically sound performance indicators of the entity, with due regard for a synergistic effect.

An objective relationship characterises the innovation and investment components of economic spheres. Innovation cannot achieve its goal without proper cash flow. Environmental investment is the catalyst for eco-innovation. Based on the goals and objectives of the study, the authors obtained the following scientific results:

Methodological developments and their general characteristics regarding the possibility of their use in the innovative process of planning and development of environmentally safe lands are analysed. Recommendations for their improvement are given. The choice of conducting the strategy process based on the foresight method as the main tool for identifying scientific and technical priorities is substantiated. Improving the foresight diamond as a Star (heptagram) of the foresight is proposed.

The system of strategic management in the field of ecologically safe land management is developed. The essence of strategic management of investment and innovation activities in the field of environmentally safe land management is revealed.

The importance of synergetic development of innovation and investment aspects of ecologically safe land management is substantiated. A logical-structural scheme of strategising the sphere of ecologically safe land management has been developed.

The methodological approach to the strategic management of investment and innovation activity in the field of ecologically safe land management is developed. The stages and tooling of the foresight methodology in ecologically safe land management are substantiated with the help of SMART-method indicators based on Quintuple Helix (5 helix).

Acknowledgements

The research was performed within the Research work “Dominants of investment and innovation policy of nature management of the national economy “budget program” Support for the development of priority areas of research” (Code of the budget program 6541230).

The contribution of the authors

Burkynskyi B. V. developed a strategic management system in the field of environmentally safe land management, comparative characteristics of statistical data Ukraine – EU countries.

Andryeyeva N.M. substantiated methodological approach of the study is based on the step-by-step SMART-research, economical-ecological analysis, systematic assessment of investment and innovation activities, PESTLE-, SWOT-analyzes, the definition of ecologically safe strategies.

Tiutiunyk H.O. assessed the potential of countries and regions as a component of investment and innovation policy of land management; developed structure of strategising the sphere of ecologically safe land management, the star (heptagram) of the foresight, etc.

Andryeyeva N.M.&Tiutiunyk H.O. developed a methodological approach of combining methods of foresight methodology in the field of environmentally safe land management, SMART-method and Quintuple Helix (5 helix) for sustainable development of methodology for strategic management of investment and innovation activities in the field of environmentally safe land management.

References

A farm to fork Strategy for a fair, healthy and environmentally-friendly food system, 2020. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. European Commission. Brussels.

- Andryeyeva, N.M., 2020. Methodological approaches to determining the dominants of regional investment and innovation policy of nature management: scientific report In: Andryeyeva N.M., Tiutiunnyk H.O. (Eds.) NAS of Ukraine, Institute of Market Problems and Economic-Ecological Research. Odesa: IMPEER NASU, 2020. 100 p.
- Andryeyeva, N.M., Bulysheva, D.V., 2016. Application of STEPLE – analysis in strategic management of greening the recreational land use of urban agglomerations. *International Scientific – Practical Conference Economic Development Strategy in Terms of European Integration: Conference Proceedings*, May 27, Kaunas: Baltija Publishing, 219-223.
- Bakhshi, H., Mateos-Garcia, J., 2016. New Data for Innovation Policy. Paper presented at the OECD Blue Sky Conference 2016, Ghent, Belgium.
- Borovik, L.V., Tanklevska, N.S., 2019. The impact of investment policy on the formation of environmental investment potential of agriculture. *Intelligence XXI*. No. 3, 121-125.
- Borteichuk, R.Yu., 2013. Optimisation role of strategic management in the activity of public authorities of Ukraine, Democratic governance. Ed. 11, http://nbuv.gov.ua/UJRN/DeVr_2013_11_12.
- Bulysheva, D.V., Andryeyeva, N.M., 2018. Ecologization of economic relations in the system of recreational land management of urban agglomerations: theory and practice. In: NAS of Ukraine, Institute of Market Problems and Economic-Ecological Research. Odesa: IMPEER NASU.
- Campbell, D. F. J., Carayannis, E. G., Rehman, S. S., 2015. Quadruple helix structures of quality of democracy in innovation systems: the USA, OECD countries, and EU member countries in global comparison. *Journal of the Knowledge Economy*, 6(3), 467-493.
- Chakmazian, K. V., 2016. Changes in the structure of microbial biomass of soils under the conditions of deposits and emission of hydrogen. Dissertation Candidate of Sciences (Biology), Lomonosov Moscow State University. Moscow.
- Damien, A., Isabelle, T., Christovam, B., Nicolas, J., Vincent, D., 2017. Land use sustainability on the South-Eastern Amazon agricultural frontier: Recent progress and the challenges ahead. *Applied geography*, Issue 80, 86-97. <https://doi.org/10.1016/j.apgeog.2017.02.003>, <https://www.webofscience.com/wos/woscc/full-record/WOS:000399867600008>.
- De Wrachien, D., 2002. Sustainable land use: The role of agricultural engineering. *Advances in geoecology*. Issue 35, 19-32, <https://www.webofscience.com/wos/woscc/full-record/WOS:000178403800003>.
- Decarbonisation of the economics: The Ministry of Energy presented the Concept of green energy transition, https://glavcom.ua/new_energy/news/dekarbonizaciya-ekonomiki-minekoenergo-prezentuvalo-konceptiyu-zelenogo-energetichnogo-perehodu-658848.html.
- Delaney, K., Osborne, L., 2013. Public sector horizon scanning-stocktake of the Australasian joint agencies scanning network. *Journal of Futures Studies*, 17(4), 55-70.
- ERD 2011/2012: European Report on Development, <https://www.odi.org/projects/2323-erd-20112012-european-report-development> [08.09.2020].
- Eurostat. <https://ec.europa.eu/eurostat/data/database> [08.09.2020].
- Federation of organic movement of Ukraine. <http://organic.com.ua/en/home/> [08.09.2020].

- Information and analytical materials of the Ministry of Energy and Environmental Protection of Ukraine on "Analysis of the areas of the nature reserve fund of Ukraine in terms of administrative-territorial units." Ministry of Environmental Protection and Natural Resources of Ukraine, <https://mepr.gov.ua/>.
- Is Ukraine ready to become an exporter of "green" hydrogen to Germany? <https://ua.korrespondent.net/business/economics/4321515-chy-hotova-ukraina-staty-eksporterom-zelenoho-vodnui-do-nimechchyny> [08.09.2020].
- Land Code of Ukraine dated October 25, 2001 No. 2768-III, Bulletin of the Verkhovna Rada of Ukraine dated January 25, 2002. 2002 No. 3. Article 27.
- Methodological tooling for strategising the innovative development of regions on the basis of glocalisation of economic processes: brochure, O.A. Yermakova (Ed.), 2019. NAS of Ukraine, Institute of Market Problems and Economic-Ecological Research. Odesa: IMPEER NASU.
- Mishina, Z.A., Kozlov, S.N., Kaukova, O.V., Stepanov, A.V., 2020. Sustainable Development of Rational Use of Agricultural Land with Allowance for State Support. 35th International-Business-Information-Management-Association Conference (IBIMA). 1-2 April 2020, Seville, Spain, <https://ibima.org/accepted-paper/sustainable-development-of-rational-use-of-agricultural-land-with-allowance-for-state-support/>.
- Morrison, M., 2010. History of SMART Objectives: Introduction to SMART objectives and SMART Goals, RapidBI.
- On state support of agriculture of Ukraine: Law of Ukraine of June 24, 2004 No. 1877-IV. *Information of the Verkhovna Rada of Ukraine* dated December 03, 2004. 2004, No. 49, Article 527.
- Ortega, A.R., McCann, P., Perianez-Forte, I., Cervantes, M., Larosse, J., Sanchez, L., 2013. Innovation-driven growth in regions: the role of smart specialisation. OECD Science, Technology and Industry Policy Papers; Vol. 12. Paris: OECD/ODCE.
- Paladchenko, O.F., Molchanova, I.V., 2018. Modern approaches and methods of forecasting research: world experience and the possibility of its use in Ukraine, Science, technology, innovation. 2018. No. 2 (6), 23-32.
- Popper, R., 2008. Foresight methodology, In: Georghiou, L., Cassingena, J., Keenan, M., Miles, I. Popper, R. (Eds), *The Handbook of Technology Foresight*, Edward Elgar, Aldershot.
- Procedure for developing regional development strategies and plans of measures for their implementation, as well as monitoring and assessment of the effectiveness of implementation, Resolution of the Cabinet of Ministers of Ukraine of November 11, 2015 No. 932. Official Gazette of Ukraine of November 27, 2015. 2015, No. 92, p. 111, Article 3131, act code 79471/2015.
- Regional report on the state of the environment in Odesa Region. Ministry of Ecology and Natural Resources of Ukraine, <https://ecology.odessa.gov.ua>.
- Saritas, O., Burmaoğlu, S., 2015. The evolution of the use of Foresight methods: a scientometric analysis of global FTA research output. *Scientometrics*, <https://doi.org/10.1007/s11192-015-1671-x>.
- Sierov, H.P., 2000. Environmental audit. Conceptual and organisational-legal bases. M., "Exam. 768 p.
- State cadastre of territories and objects of the nature reserve fund of Ukraine. <https://eurogeographics.org/member/state-service-of-ukraine-for-geodesy-cartography-and-cadastre-stategeocadastre/>.

- Stepanenko, T. O., Khloponina-Gnatenko, O.I., Stankevych, S.V., Sokolov, A.S., 2021. Ecological and economic aspects of agricultural land use in European integration processes. *Ukrainian journal of ecology*. Issue 11, Vol. 1, 181-185, DOI:10.15421/2021_28, <https://www.proquest.com/docview/2503471628> .
- Svyrydova, O.V., 2016. Planning in the system of state management of land resources of the country. State and regions. *Public administration* No.4 (56), 73-77.
- Yermakova O.A. et al., 2019. Strategising of innovative development of regions of Ukraine on the basis of glocalisation. In: Yermakova O.A. (Ed.), *NAS of Ukraine, Institute of Market Problems and Economic-Ecological Research*. Odesa: IMPEER NASU.