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Revitalization as a component of monitoring studies of disturbed ecosystems

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SUMMARY

The article considers the importance of revitalization in the context of modern environmental challenges of Ukraine. The new legislative framework has been analyzed, in particular the Law of Ukraine on the State Environmental Monitoring System, which creates the basis for improving monitoring. The problems of mining regions, where dangerous natural and anthropogenic processes are activated, as well as approaches to the optimization of natural and economic systems have been considered.

Despite military operations, Ukraine is modernizing the environmental monitoring system, updating equipment and legislation. Revitalization goes beyond technical renewal and contributes to solving social, economic and environmental problems on the basis of sustainable development. The use of the determining method of damage caused to natural resources will contribute to the fixation of ecocide and ensure compensation and restoration of the environment.

Introduction

The relevance of solving the problems of revitalization of damaged ecosystems from the standpoint of monitoring studies is that although currently in Ukraine there are a number of departmental systems for monitoring the state of the natural environment, they are not combined into a single complex. This does not allow for the effective implementation of the generalizing function of assessing the state and level of use of natural resources in Ukraine and ensuring an adequate post-war level of revitalization of territories. The issue of studying revitalization processes from the standpoint of restoring damaged ecosystems is important.

The term "revitalization" is new and is gradually entering scientific use. Today, revitalization is characterized as a multifaceted process that includes reassessment, restoration, reconstruction, modernization and other actions aimed at the revival of the territory. Revitalization is a process characterized by complexity and duration, the main goal of which is restoration in combination with basic measures to solve environmental and socio-economic problems of the territory. This process is complicated by the fact that the results of revitalization projects mainly create a change in qualitative indicators, rather than quantitative ones.

Results

Revitalization is an important element of regional development policy aimed at preventing degradation of urbanized territories, crisis phenomena, and observing the principles of balanced development. The policy of the European Union plays an important role in supporting revitalization processes in the light of the implementation of sustainable development goals, based on territorial development programs (Territorial Agenda), taking into account the Leipzig Charter on Sustainable European Cities (Leipzig Charter).

Factors influencing the assessment of revitalization of disturbed territories: 1) taking into account physical-geographical and climatic features; 2) assessment of physical and chemical properties of the soil; 3) vegetation cover of the territory and the influence of excitation conditions; 4) the area of disturbed territories; 5) national economic significance of lands in the process of their disturbance; 6) social-economic and environmental efficiency of capital investments in revitalization processes; 7) long-term plans for sustainable development of disturbed territories.

Table 1 *The main problems of environmental monitoring in Ukraine*

Problem	Reasons
The regulatory and legislative framework is out of date	Lack of modern monitoring standards
Lack of a unified system of observations	Difference of departmental observations
Low level of automation	Limited technical resources
Environmental information is closed	Lack of public databases

For the purpose of rational land management, ensuring the preservation and restoration of lands, regional methods of land cadastre and land assessment are being developed, spatial analysis of land resources of regions is carried out. It is important to note that the basis of the planning and cartographic documentation is the cadastral map of the lands of Ukraine. Thus, since January 1, 2013, an electronic land cadastre has been introduced in Ukraine as a geoinformation system of information on lands. In addition, environmental information is currently provided in a fragmented form, there is a weak level of its analysis and interpretation, and due to military actions in Ukraine, the situation with communication has become more complicated.

Currently, the environmental situation in Ukraine remains extremely difficult, the burden on the environment is constantly growing, military actions threaten the integrity of ecosystems and national environmental security. The Law of Ukraine "On the Basic Principles (Strategy) of the State Environmental Policy of Ukraine for the Period up to 2030" notes that the state of the state environmental monitoring system is unsatisfactory, which is a disappointing factor (Law of Ukraine, 2019). There is also no law that would systematically regulate the implementation of environmental supervision in Ukraine. Currently, there is the implementation of the European approach to environmental monitoring in Ukraine. This path requires the improvement of the material and technical base of environmental monitoring entities in Ukraine, the introduction of automated monitoring tools and the provision of timely information, which requires updating the existing regulatory framework on environmental monitoring (Leta et. al., 2022).

In March 2023, the Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine Regarding the State Environmental Monitoring System, Information on the State of the Environment (Environmental Information) and Information Support for Environmental Management" was adopted (Law of Ukraine, 2023). It lays the foundation for the system of improvement of the state monitoring system, based on a systematic approach to its implementation using modern information technologies.

The Resolution of the Cabinet of Ministers of Ukraine "Some issues of the operation of the service for recording facts of damage to the surrounding natural environment as a result of emergency situations, events, armed aggression of the Russian Federation "EkoThreat" was approved (Decree of the CMU, 2023-b). Also in July 2023, the Concept of the State Targeted Ecological Program of Environmental Monitoring was approved, the purpose of which is to solve the following problems: 1) obsolescence of regulatory, legislative, technical and organizational support of the environmental monitoring system; 2) lack of a coherent network of environmental observations; 3) unsatisfactory methodological support for observations, selection and analysis of the environmental system; 4) lack of uniform requirements for the collection, processing, and storage of environmental data regarding the state of the environment; 5) the need to ensure openness of information about the state of the natural environment (Decree of the CMU, 2023-a).

Scientists note that the methodological foundations for the restoration of anthropogenically disturbed territories and revitalization should be based primarily on expert findings from a systematic survey of the soil cover of disturbed areas. We note that with s*lightly changed conditions of growth sites* (minor change in edatope), it is important to carry out only nature conservation measures. *With moderately changed conditions of growth sites*, it is necessary to carry out phytomelioration in two stages. *At the first (design) stage*, the target use of the territory, work methods and the necessary material and technical support, the choice of plant species composition and, if necessary, agrotechnical care for them are assessed. Continuous, partial or terraced surface planning is carried out. *At the second (biological) stage*, the natural species composition of plants is restored or, if necessary, new phytocenoses are formed with agrotechnical measures for plant care. Restoration of disturbed territories with *very strongly changed conditions of growth sites* is possible only with the implementation of a set of reclamation measures. They are carried out in three stages: design, technical, biological. *At the first stage*, the target use of lands is determined taking into account long-term plans for sustainable development of the territory. *At the second stage*, when phytocenoses are created on toxic and highly acidic and highly saline rocks, the screening layer of rocks is reclaimed. At the third stage, in order to form more productive biogeocenoses, increased doses of organic and mineral fertilizers are introduced, and longer agrotechnical and economic measures are carried out (Panas, 2005).

Figure 1 *Block diagram of the process of revitalization of disturbed areas (in stages).*

Revitalization of landscape objects involves the processing and transforming natural environments, the purpose of which is to create a more attractive environment for human life. It includes providing access to water, ensuring sanitary and hygienic conditions, reconstructing or creating parks and gardens, modernizing roads and paths, restoring and modernizing small architectural forms, changing the land for agricultural purposes, etc.

The principles of architectural and landscape revitalization include: 1) ensuring the preservation of the natural diversity of the revitalization area; 2) ensuring optimal integration of natural and architectural elements, 3) ensuring environmental sustainability of the revitalization area to protect natural resources; 4) ensuring resource efficiency (water, energy, chemical resources, land and plant resources); 5) ensuring correct revitalization planning, taking into account local conditions, the limits of the revitalization project and the purpose of its implementation.

River revitalization involves activities that support the restoration of an ecosystem that has been degraded, damaged, or destroyed. Currently, the formation of an attractive river network during revitalization processes is possible under the following conditions: 1) with the possibility of maximum preservation of river valleys; 2) partial refusal to straighten riverbeds and unjustified concreting of banks; 3) preserving the continuity of the river network; 4) with the possibility of maximum preservation of water quality and species diversity. Compliance with the specified conditions contributes to the self-regulation of natural complexes, as well as preserves their recreational appeal. River revitalization projects also include the reconstruction of ancient hydrotechnical structures.

Currently, 44% of surface water bodies in Ukraine are at risk of hydromorphological changes. These loads include physical changes in the riverbed, coastal zones or banks, dams, weirs and locks. The State Water Agency of Ukraine has defined a list of rivers on which revitalization is required with a total length of 324.58 km. Revitalization activities are already ongoing in the Dniester and Vistula river basins. The concept of free-flowing rivers should be achieved by removing barriers and restoring floodplains and wetlands, while assuming a complete absence of artificial barriers and restoration of the natural multidimensional communication of the river. On the eve of the "Dnieper Day" in 2024, a presentation of a large-scale project "Integrated Vision of the Dnieper River" took place, organized by the NGO "Urban Coalition Ro3kvit" and Greenpeace with the participation of representatives of the State Water Agency. The presented project contains an in-depth analysis and offers a comprehensive vision of scenarios for the economic and environmental potential of the Dnieper.

Currently, the relevance of the issues of optimization natural and economic systems (NES) of the mining regions of Ukraine is growing. This is due to insufficient attention to the issues of monitoring, land cadastre, reclamation and revitalization of geosystems. Such dangerous natural and anthropogenic processes as subsidence, flooding, karst, linear erosion are activated on the sites. Optimization measures based on the conducted revitalization processes need to be implemented. An important issue for revitalization is the assessment of the state of mining geosystems (MGT), their anthropogenic modifications, environmental conditions of stay, threatening situations. The basis for geoecological mapping of MGT for revitalization is a field survey aimed at assessing their landscape structure, anthropogenic impacts, threatening environmental conditions. When revitalizing MGT, it is necessary to take into account the following areas of work: lithogenic, geomorphological, geobotanical and landscape proper. The main results of MGT state optimization are: 1) improvement of their ecological state; 2) regulation of hazardous natural and anthropogenic processes; 3) reclamation of waste heaps, sumps, industrial sites, etc.; 4) revitalization of anthropogenically transformed geosystems; 5) implementation of a geoecological monitoring system; 6) improvement of the land use structure and creation of nature conservation facilities (Ivanov, 2009).

Currently, two main approaches to optimization of the MGT are used. The reclamation approach involves the construction of complex technical structures on the site of liquidated quarries, waste

heaps or sumps, and the implementation of comprehensive mining and phytomeliorative works. The revitalization approach involves the systematic use of the potential of natural self-restoration of geosystems. It is the implementation of phytomeliorative measures on the territory that involves the preservation of the existing landscape structure of waste heaps, will weaken the manifestation of exogenous processes and create the prerequisites for the formation of cultural landscapes.

Despite the military actions in Ukraine, there is an active process of introducing a new approach to the functioning of the state environmental monitoring system, namely: 1) updating the regulatory framework, 2) bringing the environmental monitoring system closer to European principles of organization and implementation, 3) modernizing the environmental monitoring system equipment. This is the key to updating all subsystems of the state environmental monitoring system, which must comply with the legislation and approaches of the EU, determine the information needs of environmental management, ensure the integration of information and analytical systems of each subsystem of environmental monitoring into the Unified ecological platform "EcoSystem".

Conclusions

Thus, the relevance of revitalization processes is growing, as today it has gone beyond the meaning of "technical or technological renewal". This term is comprehensive and helps to solve a number of social-economic and environmental problems of territories that have undergone the phenomena of degradation on the basis of sustainable development. The use of the methodology for determining the amount of damage caused to the natural resources of Ukraine as a result of Russia's military actions will contribute to the fixation of ecocide, which will in the future ensure compensation and restoration of the natural environment.

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