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Original paper

A systematic justification of the decision-making scheme in planning the rational use of disturbed lands in Ukraine

Maria Malanchuk[1]*, Alena Palamar[2], Natalia Muzyka[1], Andriy Vovk[1]

[1]Lviv Polytechnic National University, Lviv, Ukraine
e-mail: malanchuk.mari@gmail.com; ORCID: http://orcid.org/0000-0003-0819-6573
e-mail: myzuka69@ukr.net; ORCID: http://orcid.org/0000-0002-6019-7795
e-mail: andrii.i.vovk@lpnu.ua; ORCID: http://orcid.org/0000-0001-5457-135X

[2]Kryvyi Rih National University, Kryvyi Rih, Ukraine
e-mail: palamar1alena@gmail.com; ORCID: http://orcid.org/0000-0003-2682-6786

*Corresponding author: Maria Malanchuk, e-mail: malanchuk.mari@gmail.com

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Abstract: The purpose of this work is to justify the need to develop a set of solutions for the organization of the step-by-step planning of rational use of disturbed lands. Currently, environmental problems have worsened due to the closure of mining enterprises, which has led to an urgent need for a scientific approach to the environmental remediation of mining regions and their future rational use and evaluation. The implementation of such approaches can be largely achieved through the creation of improved natural and anthropogenic landscapes on disturbed lands. As a result of the research, the procedure and sequence for the development of rational use of technologically disturbed lands have been formed. This procedure and stages of work performance will provide an opportunity for their reuse, as well as systematize the activities of local government bodies. The criteria for choosing the direction of the technogenic landscape transformation in Ukraine, which are based on the prevention of undesirable, uncontrollable processes of natural and technogenic origin have been formed. The process of the technogenic landscape transformation should be based on the use of potential opportunities and trends inherent in nature itself. The studies on the rational use of disturbed lands in order to adapt them to reuse and prospective use has shown that lands formed as a result of mining can be used for both recreation and industrial development. Complex schemes of sequential actions in the organization of works on the rational use of lands have been develope.

Keywords: technogenic landscape, disturbed lands, technogenic territories, land pollution, rational use of disturbed lands

1. Introduction

In the conditions of scientific and technological progress, a human affects the environment like never before. Significant environmental changes have occurred in open-pit mining. As a result, the soil cover, which is the main component of a productive natural landscape, was disturbed.

At present, environmental problems have escalated due to the closure of mining enterprises. As a result, there is an urgent need for a scientific approach to the environmental remediation of mining regions and their future rational use. The implementation of such methods can be carried out by creating improved natural and human-made landscapes on disturbed lands through rational use.

Many Ukrainian scientists studied the territories that were disturbed as a result of mining, the industrially transformed landscape, and the state of the soil cover. However, the unresolved part of the problem remains the improvement of the ecological condition, the improvement of disturbed territories, the development of scientifically based recommendations and proposals for the efficient use of disturbed lands.

The consequences of disturbing the earth's surface and environmental pollution have become apparent and are currently at the centre of public attention. New approaches to the rational use of disturbed lands are needed. Today, with social development and precise economic calculations, there is an urgent issue of the landscaping of disturbed areas with the adaptation of human-made terrain in the modern environment for various types of production or services, which in today's conditions is just beginning.

The article provides for research and improvement of methodological objectives for planning the rational use of disturbed lands. For this goal, it is necessary to determine the impact of disturbed lands environment, develop a system of rational use of disturbed lands, draw up a scheme for implementing an innovative strategy for the rational use of disturbed areas. The incorrect and irrational use of land resources by humankind has led to negative phenomena, such as disturbance of soil cover, soil degradation, pollution of land and fertile layer (Malanchuk, 2011).

Disturbed lands are lands that have lost their economic and ecological value due to disturbance of the soil cover as a result of human production activities or the action of natural phenomena (Verkhovna Rada of Ukraine, 2003). According to statistics, the area of disturbed lands of Ukraine is 163.1 thousand hectares (State Statistics Service of Ukraine, 2019). Such disturbed lands include (degraded lands 1%, unproductive 1%, technogenic disturbed 98%.

Degraded lands include:

- land plots, the surface of which is disturbed due to earthquakes, landslides, karst formation, floods, mining, etc;
- land plots with eroded, waterlogged, high acidity or salinity, soils contaminated with chemicals, etc.

Low-productive lands include agricultural lands, the soils of which are characterized by negative natural properties, low fertility, and their economic use for its intended purpose is economically inefficient. Technologically disturbed lands are lands polluted as a result of human economic activity.

The main reason for this is the mining industry, and the work performed thoughtlessly. The consequences of this activity are the disturbance and pollution of the land, which is felt more and more often. In particular, there is a large number of imprudent actions in geological exploration.

It is well known that the area of land resources on the planet is limited. Moreover, they cannot be replaced by any other resources. From year to year, more and more land is used for other purposes (Vaganov et al., 2009). Especially it concerns the agricultural land because the loss of each hectare of fertile land reduces the ability of humankind to solve food, resource, social and other global problems.

Ukraine is one of the countries that significantly affect the global ecological situation: insufficient forest cover of the territory (14.3%), a high level of plowing of lands (70%), a decrease in their fertility due to losses of humus, insufficient protection of areas, depletion of ecosystems due to an increase in the number of endangered and rare species. Negative anthropogenic factors have led to the extinction of a large number of biological species and the threat of existence for many of the existing species. About 540 species and 380 species of animals are listed in the Red Book of Ukraine, 127 rare and endangered typical plant groups are included in the Green Book of Ukraine (Verkhovna Rada of Ukraine, 2000). The number of almost all species of prey and waterfowl birds, chickens, cranes, mammals, fish, insects is decreasing. There is a tendency to the rapid spread of viral infections in the biocenoses of Ukraine. The problem of rational use of land, as well as other natural resources, is essential and relevant. Establishing the order of rational land use is the prerogative of the state and its authorized bodies. The organization of rational use of land as a natural resource, a means of production in agriculture and forestry and a spatial basis, an operating base for the implementation of any activity are impossible without the proper execution by the state of such administrative functions as land management, land cadastre, control over land use, etc. The competence of the relevant state bodies in this area is enshrined in the norms of the current Land Code of Ukraine (Dobryak, 2010).

Rational use of land is a historical category, which was also known in the previous legislation. So, according to the Land Code of the Ukrainian SSR (1970), ensuring rational land use was recognized as the responsibility of land users.

The problem of rational land use in current conditions is enriched with elements of qualitatively new content, in particular, environmental factors. Today, the widespread understanding of the rational use of land as "achieving the maximum effect (result) in realizing the goal for which the land was provided" is already imperfect (Panas, 1986). In current conditions, the rationality of land use can no longer be associated only with the achievement of economic effect. The rapid acquisition of economic and financial impact by the owner today can not only be an indicator of rational land use but in some cases can create a particular environmental risk.

In current conditions, anthropogenic factors and human influence on all-natural processes are increasing (Koltun and Kovalchuk, 2012). Such issue also applies to land resources. In situations when the economical use of lands is expanding, but not the protected regime, then their protection in the process of industrial use forms the main content of the problem of rational land use.

Rational use of land also involves its efficient use (Verkhovna Rada of Ukraine, 1991) This means that the land should be used most appropriately and with the greatest return. With rational land use, its quality should not deteriorate, but, on the contrary, should improve, that is, the environmental factor must be taken into account. Landowners and land users are obliged by law to increase soil fertility and preserve the useful properties of land. (Verkhovna Rada of Ukraine, 2002). The land exploitation, which does not provide for the recreation of its useful properties or contributes to the development of processes that worsen the condition of the land, is a predatory use of land. Such use of land leads to its damage and entails negative legal consequences (Verkhovna Rada of Ukraine, 2001).

2. Materials and methods

In the course of the study, it was revealed that the disturbed lands are not used effectively. Therefore, we have identified a number of scientifically based measures for land protection, and recovery, such as the creation of territory for recreation (the creation of reservoirs and the placement of buildings for recreation at the site of quarry excavations), an ornithological reserve at the sites of hydraulic dumps, industrial production, placement of waste processing plants. Such steps require funding. We offer to attract investors by providing land for rent on a preferential basis. The creation of reserves should be based on the state budget with the involvement of international grants. Combining all these measures requires an appropriate model for the implementation of successive actions (Fig. 1). The implementation mechanism here aims to form and combine a certain set of actions in order to restore and reuse the disturbed areas.

An analysis of the current state of land management as one of the basic components in the land use management system confirms the need of expanding the powers of state authorities on the optimization and correct use of disturbing territories. This is one of the first steps that will enable local authorities to make decisions on the use of disturbed lands as soon as possible. However, such decisions must be made based on environmental research and complete information about the site. Following this, we have developed a procedure for the formation of the rational use of disturbed territories, based on the phased passage of all components of the related project, as a set of regulatory, economic, technological measures for the improvement and justification of the process of rational use, protection and restoration of land (Fig. 2).

The application of this algorithm will make it possible to avoid many shortcomings of the existing mechanism of enterprise formation based on former industrial facilities due to a comprehensive approach (Cabinet of Ministers of Ukraine, 1998). The basis of the proposed algorithm for the formation of rational use should be a combination of three components:

– ecological safety;
– market requirements;
– funding opportunities.

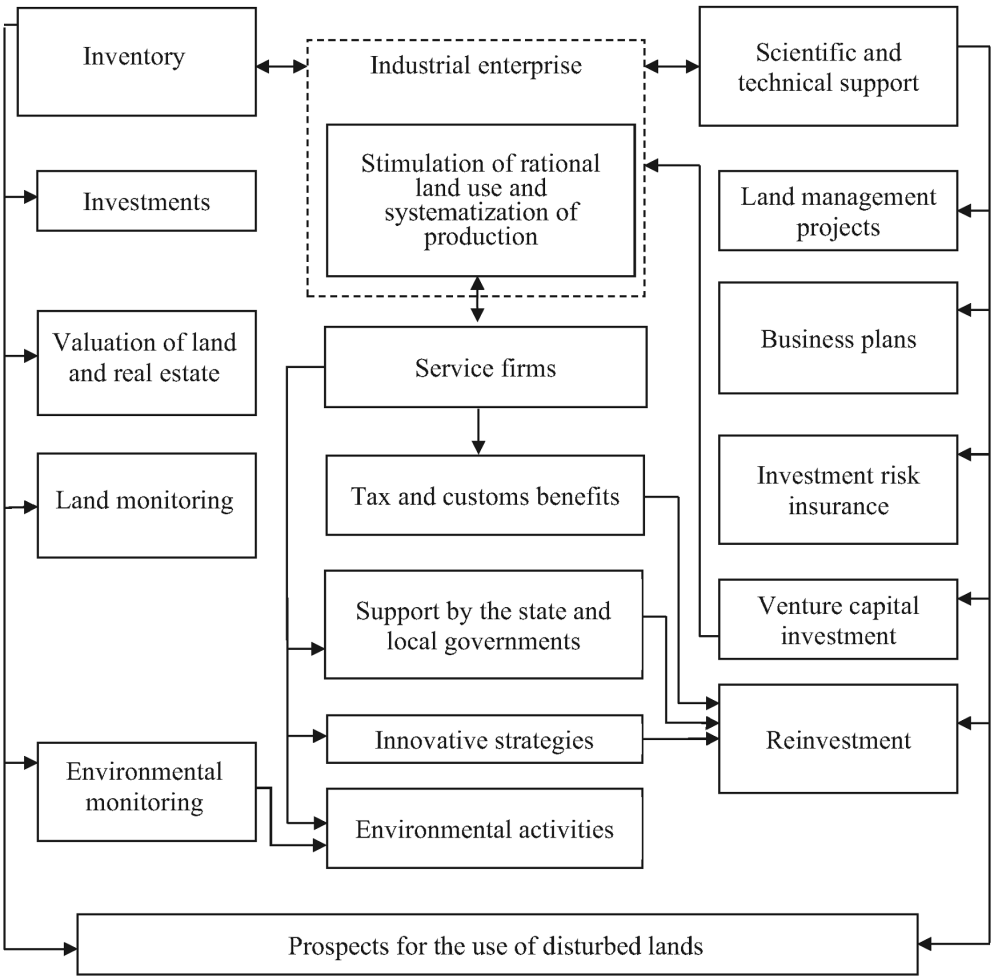

Fig. 1. Scheme of implementation of innovative strategy of rational use of disturbed territories

The application of innovations in the design of rational land use will positively affect the quality of development and justification of methods to achieve the expected effect. Taking into account the requirements of the market environment will allow us to acquire high functional suitability of the project. The availability of material and technical support and other elements of the resource potential is one of the main factors limiting the volume of project solutions, which are related to the main estimated characteristics of rational resource use in general.

A decisive factor in the reuse of disturbed lands is investment activity, which provides state support to stimulate priority areas of innovation. The necessary conditions for this are created by effective government regulation and planning of the use of land resources through financing, providing loans, a balanced pricing policy, subsidies, etc.

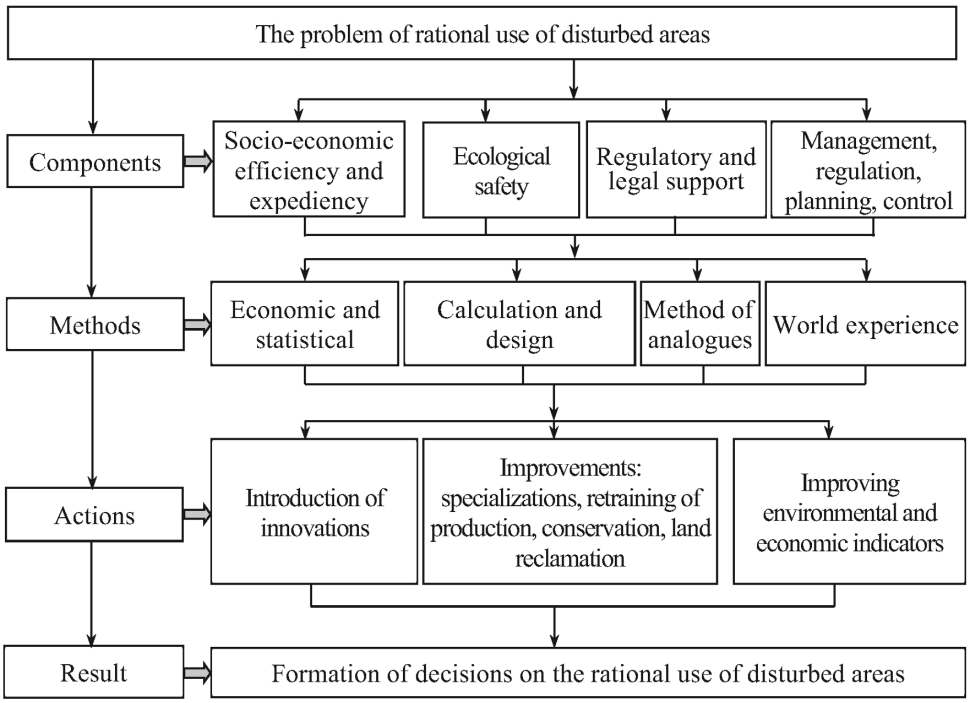

Fig. 2. The procedure for the rational use of disturbed areas

Achievement of a specific goal predetermines the need to fulfil particular policy objectives:

- development of the concept of an innovative land-use model focused on environmentally friendly development;
- normative-legal and program-methodological support of structural transformations in land use based on the innovative basis;
- formation of state orders for research in the field of use of disturbed lands;
- promoting the formation of innovative initiatives of business entities based on the development of their environmental awareness.

In Ukraine, the territories are left for self-recovery after the end of mining. As a result, large industrial areas with infrastructure are not functioning. These territories have not been restored or used for years (OJSC "GIRKHIMPROM" DGRP, 2004).

Therefore, it is important to develop theoretical recommendations for the rational use of disturbed lands. These recommendations are based on actual data on the state of the territories (qualitative and quantitative indicators).

The reason for the decline and deterioration of the ecological situation in these territories is the lack of funding and failure to follow the sequence of decision-making. For correct and consistent decision-making, a diagram that shows the stages in planning the use of disturbed lands is proposed (Fig. 3).

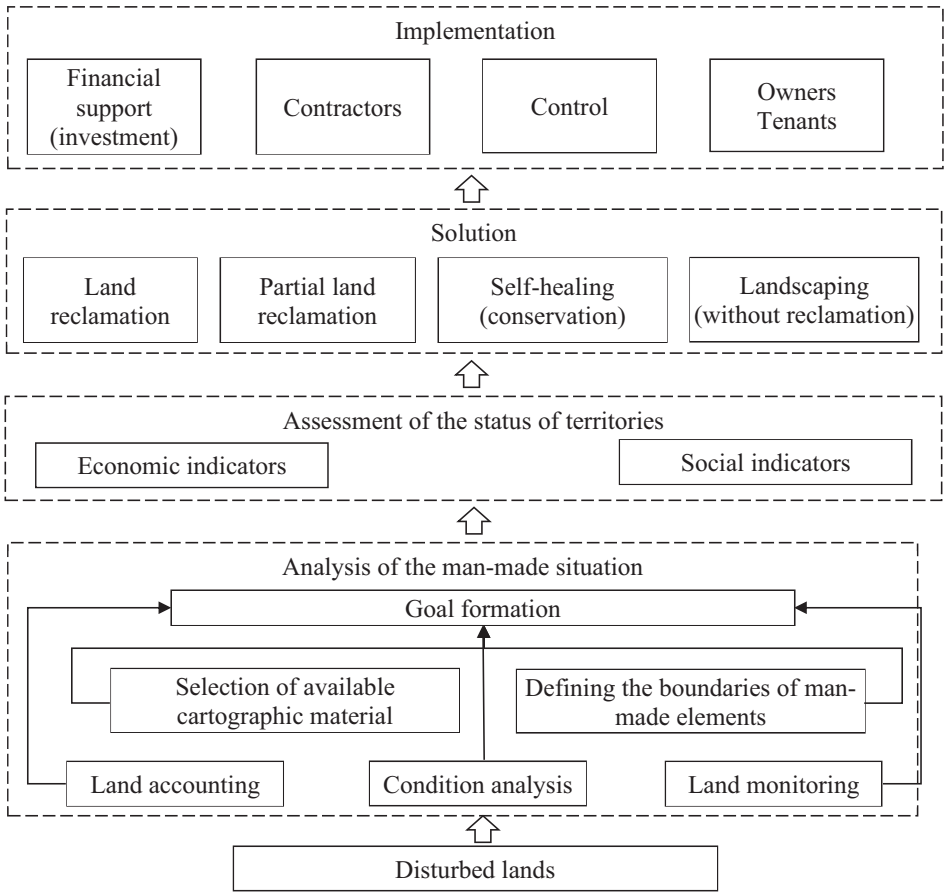

Fig. 3. Stages of planning the rational use of disturbed lands

3. Results

To solve this problem, we have proposed a systematic justification of the decision-making scheme in planning the rational use of disturbed lands (Fig. 3).

According to the presented scheme, the rational use of disturbed lands is a complicated and rather lengthy process as a detailed study of the ecological, socio-economic situation in the research areas is required. An important role is played by the collection of relevant (archival) information about the disturbed lands and the activities of a particular enterprise. The situation is more complicated for the territory in which enterprises have already ceased to operate (no monitoring is conducted, data from previous years have not been preserved). If you do not know the past, it is challenging to build the right future for the disturbed lands. In such situations, the territory remains for self-restoration.

Mostly disturbed territories occupy a significant part of administrative units or create an unattractive investment climate. (Mandryk, 2005). Also, an essential component is obtaining monitoring data or conducting it in these territories. This will make it pos-

sible to assess whether the situation is stable or worsens and outline the main directions for future actions. However, monitoring is long term and costly. But for these areas, monitoring is the basis for rational use decisions.

After systematization and processing of all necessary data, the assessment of a condition of territories is carried out. Most attention is paid to environmental, economic and social indicators. Because of this data, a decision about future use is formed. A number of issues are being resolved:

– is it advisable to carry out industrial activities on this territory?
– will such activities ensure the social development of administrative units?
– will it do more harm to the environment?

Many questions arise, which are answered by the validity of the state of the territories and the decision on their use.

According to the proposed scheme in Figure 3, the decision on the rational use of disturbed lands may be based on the reclamation or partial reclamation in more problematic areas. But such a solution is possible only if a reclamation is economically viable.

In the current state of the economy, the most profitable use is self-restoration or conservation (Shapar et al., 2007). This is primarily because the budget does not have the funds to implement a particular project. And there is no socio-economic interest of sponsors.

An urgent solution is the arrangement of disturbed areas without reclamation, i.e. adaptation of the use to the human-made landscape and ecological situation. An example is the hydro dump of Yavorivsky State mining and chemical enterprise "Sirka". Today it is the territory of the Cholhynsky ornithological reserve (820 hectares) (OJSC "GIRKHIMPROM" DGRP, 2004), as well as the former quarry – today it is a lake. That is, the purpose of rational land use is to turn disturbed lands into recreation areas.

4. Conclusions

As a result of mining activities, areas appear that are unbalanced in terms of material and energy flows, which are not orderly material and energy set. These areas have lost the features of natural landscapes. For a biological system to emerge in this area, it is necessary to use it rationally, in compliance with clear planning. Before obtaining the desired effect from such lands, we get:

– human-made landscape, which will affect (not always favourably) the adjacent areas before it becomes a natural system;
– the transformation of the landscape will be carried out over a long period;
– the new natural system formed as a result of self-development may not meet the current needs of the population living in the area. In this regard, the idea of controlled transformation of the disturbed landscape as a result of technological activity from "disturbed" to "normal" arises.

The concept of "better" or "worse" does not exist in nature, just as there are no bad or good landscapes. Therefore, the criteria for choosing the direction of the transformation

of the human-made landscape for Ukraine should be determined by social needs, which can be formulated in the following ways:

- prevention of undesirable, uncontrolled processes of natural and human-made origin (soil erosion, erosion, waterlogging, pollution of water, air and soil, etc.);
- ensuring maximum productivity of renewable natural resources, as well as increasing biodiversity;
- providing the best natural conditions for education, recreation and cultural development of people;
- high demand in the transformed landscape, its "efficiency", including environmental;
- the process of transformation of the industrially transformed landscape should be based on the use of potential opportunities and trends inherent in nature itself.

It is impossible to isolate the geosystem from external influences. Therefore, to obtain new and stable changes in the structure of the geosystem, it is necessary either to transform its external environment (which is impossible) or to rebuild the system of internal connections, but in such a way that the new system of relations is in stable equilibrium with the environment.

No matter how much the landscape is changed, it remains a part of nature and obeys its laws. In the process of mining activities, people did not create new components of the landscape. People only introduced new elements into it: dumps, residual quarries, hydraulic dumps, sludge storage, etc. Any new elements of the landscape act as analogues of natural objects. Both operate in a system of natural bonds, performing similar functions as physicomechanical and geochemical agents. On the other hand, they are equally exposed to natural processes. Various human-made structures are subject to weathering, like rocks, abandoned canals, waste heaps are destroyed by erosion, reservoirs evaporate water, fill with sediments, and they all receive intense pressure from the natural flora and fauna.

Author contributions

Conceptualization: M.M.; Methodology development: A.P.; Writing – original draft: N.M.; Writing – review and editing: A.V.

Data availability statement

The raw/processed data required to reproduce these findings cannot be shared at this time as the data also forms part of an ongoing study.

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