

REVIEW ARTICLE

## Prerequisites and peculiarities of conservation and restoration of ecosystem stability of the concept of sustainable development

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The article deals with defining of the term 'ecosystem' through the study of its essence and on the basis of the existing definitions. The state and ecological problems of Ukraine's ecosystems from the point of view of the concept of sustainable development are considered. The principles of rational and careful attitude to ecosystems, which ensure their stability in a long-term perspective are identified. The functions of the regional policy on rational and careful attitude to national ecosystems are found out taking into account measures aimed at preventing losses in ecosystems. The directions of rational and careful attitude to national ecosystems which require implementation in all spheres of life are suggested. The measures that are supposed to allow to preserve, restore and use natural resources effectively as well as to ensure ecosystem stability and future development of Ukraine are structured.

**Keywords:** Ecosystem; sustainable development; natural resources; environmental problems; agricultural production

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### Introduction

It is well known that an irresponsible and consumer attitude of mankind to the environment is the main reason for its deterioration, also it reduces the reserve of non-renewable natural resources and, in general, threatens the survival of mankind. Current environmental problems require not only the introduction of resource-saving technologies in all branches of production, the use of alternative energy sources, but also the restoration of the already disturbed ecosystem stability and their further preservation.

Thus, Ukraine belongs to a group of countries with complex environmental problems, which are related to the transitional state of the economy: an unbalanced use of natural resources like in developing countries; environmental pollution by the industrial activity like in industrialized countries. Also, the specific problem of the transformation period is the waste management, since the volume of generated waste is increasing, and the proportion of those that are being processed is negligible. The modern domestic practice of depositing newly created waste on overfull landfills is a threat to the environment and increases risks to public health (Goals of the sustainable, 2017).

It is necessary to add that the existing practice of agricultural production causes the depletion of fertile Ukrainian black soils, the industrial pollution of soils and the intensive development of virgin lands, the widespread use of monocultures, the application of nitrogen and nitrate mineral fertilizers. Also, the exhausting use of land, forest and water resources leads to irreversible losses of ecosystem and biological diversity. The share of nature reserved areas (6.6% of the country's total area) is insufficient to prevent such losses.

Consequently, the existing ecological problems, the crisis ecological situations indicate that the current level of production and use of natural resources in Ukraine is not rational and worsens the ecology of ecosystems. It results in negative consequences: the deterioration of the ecological state of the environment, the depletion of natural resources, the loss of soil fertility, the increased morbidity rate of population, the deterioration of a general standard of living, first of all, of rural residents, the deterioration of food quality, the growth of social tension, the increase of expenses for overcoming of consequences of ecological disasters, the decrease of volumes of agricultural production and, accordingly, food supply of population, the reduction of all economic indicators at micro- and macro-levels.

The theoretical foundations of stability were substantiated in the classical works of Poincare, Liapunov, Lagrange, Svirizhev and Logofet, which are based on the estimates of the assimilation and transformation of energy and information, that is, the laws of thermodynamics of functioning of ecosystems, synergetics, entropy indicators applied to open systems (Glensdorf, 1973), (Prigozhyn, 1985), (Nicolis, 1990), (Svetlosanov, 2006). Among contemporary scientists, the issues of ecosystem stability

have been investigated by V.V. Gorshkov (Gorshkov, 2008), Ya.P. Didukh (Didukh, 2011), A.B. Kachynskiy (Kachynskiy, 2001), A.M. Molchanov (Molchanov, 1976), V.A. Svetlosanov (Svetlosanov, 2006), B.F. Tantsiura, Yu.S. Urliuk, V.Yu. Yukhnovskiy (Tantsiura, 2014) and others. However, some issues regarding the conservation and restoration of ecosystem stability through a rational resource use in Ukraine have not been paid sufficient attention yet.

The purpose of our study is to determine the prerequisites and peculiarities of conservation and restoration of ecosystem stability in Ukraine, taking into account existing ecological problems and opportunities.

## Results and discussion

Ecosystems are functional units of the biosphere, just as cells are functional units of an organism. The term "ecosystem" (from Greek oikos-a place of living, a house and a system-the whole, composed of parts, a combination) was proposed by the English botanist Arthur George Tensley (1871-1955) in 1935. Today, there is a significant number of definitions of the term "ecosystem" (Table 1).

**Table 1.** Definitions of the term "ecosystem".

Author	Definition
A.Tensley	An ecosystem is a unit of nature on the earth surface, which covers biota with a complex of environmental factors.
E. Odum	Any unity that includes all organisms on a given site and interacts with the physical medium so that the energy flow creates a clearly defined trophic structure, species diversity and the cycle of matter (the exchange of substances and energy between the biotic and abiotic parts) within the system is an ecological system or an ecosystem.
V.N. Sukachov	Biogeocoenosis is an interdependent complex of living and inorganic components interrelated by the exchange of substances and energy.
D.F. Owen	The community of living organisms along with the inanimate part of the environment, in which it is located, and all various interactions, is called an ecosystem.
V.V. Denysov	The complex of organisms and inorganic components of their environment, in which the cycle of matter can take place, is called an ecological system or an ecosystem.
V.S. Dzhyhyrei	An ecosystem is a spatial system that includes the historically formed complex of living beings interrelated by trophic bonds and inanimate components of their habitat, which are involved in the process of the exchange of substances and energy.
S.I. Dorohuntsov, K.F. Kotsenko, M.A. Khvesyk	An ecosystem is a complicated natural complex of living creatures that interact with the inorganic environment and are in the material and energy dependence on it.
Ya.B. Oliinyk, P.H. Shyshchenko, O.P. Havrylenko	An ecosystem is a group of different species of plants, animals and microorganisms that interact with each other and the environment so that all this complex can exist for indeterminate amount of time.

The source: developed by the author.

Thus, in our opinion, an ecosystem is a complicated complex of living organisms and the environment representing the dialectical unity of all ecological components with the conditional interdependence and cause-and-effect relationships associated with the cycle of matter and energy metabolic processes and are in the state of self-organization, self-regulation and self-development.

An ecosystem is characterized by permeability and includes relatively closed, stable in space and time flows of matter and energy between the biotic and abiotic parts of ecosystem. The basis of the existence of almost any ecosystem is the flow of sunlight energy, which is the result of the thermonuclear reaction – in the direct (photosynthesis) or indirect (decomposition of organic matter) form with the exception of deep-water ecosystems, the source of energy in which is internal heat of the earth and the energy of chemical reactions (Goals of the sustainable, 2017).

It is worthwhile noting that Ukraine has a strong potential for ecosystem, landscape and species diversity. The relief of the country is formed by mountain groups (5% of the territory), highlands (25% of the territory), plains and lowlands (70%), which are the habitat of living organisms and areas of human economic activity. The plain part of the country includes the steppe zone, the forest steppe and the zone of conifer-broad-leaved forests. Mountain groups are mainly covered with forests and are characterized by vertical zoning. The extensive river net, lakes and reservoirs as well as the Black Sea and the Azov Sea waters are a medium of water ecosystems and a factor in climate formation. The biota of Ukraine comprises more than 25 thousand species of plants and 45 thousand species of animals that accounts for about 35% of species and population diversity of Europe. Two main world routes of bird migration pass through the territory of the country. Places of nesting of migratory bird species, in particular in the south of the country, are of international importance.

However, the human economic activity has a significant impact on the state of the environment. Thus, in the early last century 40% of the territory of Ukraine was covered with steppes, and today most of these lands are used for agricultural activities (more than 70%), and the territory of the remains of natural steppe ecosystems comprises only 3.0-3.5% of the country's territory. 30% of all threatened flora and fauna that are red-listed are concentrated in these territories.

As of January 1, 2015, the land fund of Ukraine was 603.5 thousand square kilometers, more than half of which has already been cultivated (arable land reaches 54%), and another 13% is used as hayfields and pastures. Ukraine also has rich soil resources, which are represented by fertile black soils, but the land cover is suffering from pollution and erosion. At the same time, water and wind erosion causes up to 15 t/ha of average annual soil losses. Losses of humus and nutrients are observed on 43% of the total area. Large territories are polluted due to an economic activity. More than 57% of the territory is defined as eroded.

At present, in Ukraine, the industrial development, agriculture and water management, urbanization, mining, and other types of farming are steadily causing pollution and physical transformation of the habitat of living organisms. The hydroelectric development and creation of reservoirs, the drainage work in Polissya and the irrigation of steppe areas in South Ukraine have caused significant changes in the hydrological regime of the territories. There is a reduction in populations, and at the moment some species have faced danger of extinction. That is why the number of species listed in the Red Data Book of Ukraine is increasing (Goals of the sustainable, 2017).

Consequently, in order to protect ecosystems in the economic activity and everyday life, humanity must follow the principles of rational use of resources and natural management, which allow to ensure life worth living and development of the modern society, simultaneously preserving a high quality of the human environment and protect future generations. It is achieved through the economical and rational exploitation of natural resources and conditions as well as the most effective regimes for their reproduction, the use of energy-efficient technologies and alternative energy sources taking into account perspective interests of the development of the economy and the preservation of human health.

Due to the limited self-recovering and compensatory functions of the biosphere, the processes of human activity must take place exactly in accordance with the laws of the development of society and nature and the laws of interaction between them. These laws must deliberately be carried out to keep the process of nature management under strict control and regulated by the state. These laws are implemented through observance of the principles of rational nature management (Table 2), which refer to certain economically conditioned rules of human and society behaviour in the natural environment. Observance of the principles of rational nature management will allow to develop environmental protection measures, to restore disturbed relations in ecosystems as well as to prevent the environmental downfall (Dorohuntsov, 2005).

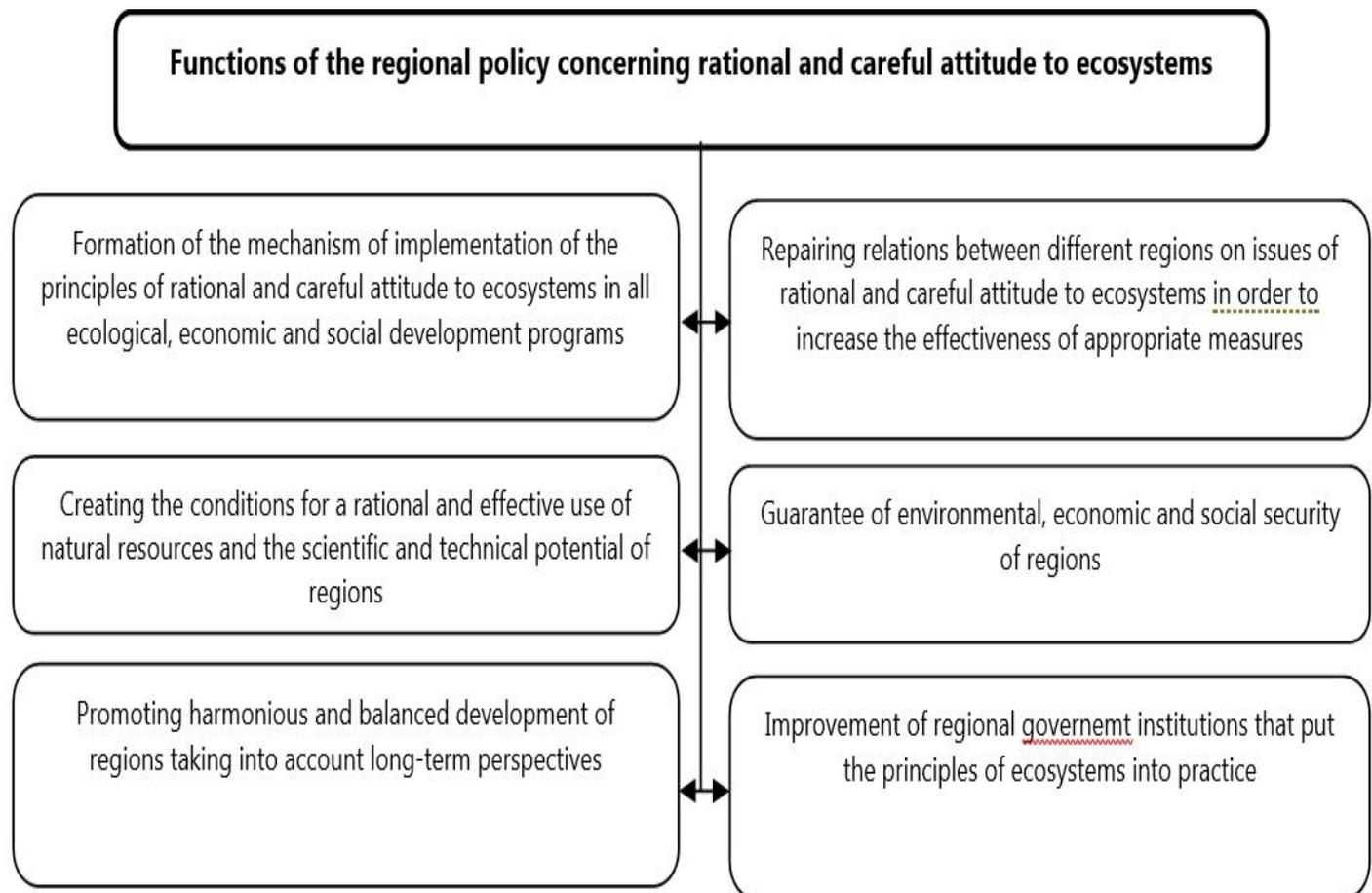
**Table 2.** Principles of rational and careful attitude to ecosystems.

<b>Principle</b>	<b>Essence</b>
1. "Zero level" of natural resources consumption	Zero level is considered as a level of consumption of primary resources by the business entity in the previous period, and in the next one - the excess of this level is limited at the state level in range of 2-7% by types of resources. Exceeding the standard results in financial sanctions, which may be greater than the profit of the business entity.
2. Correspondence of anthropogenic loading with the natural - resources potential of the region	Aimed at maintenance of natural equilibrium by balancing of cycles of the use and restoration. Violations occur in the following cases: - excess of the level of anthropogenic loading due to excessive concentration of production within the region; - inconformity of specialization of production to the specificity of natural-resources potential (for example, the development of heavy industry in recreational regions).
3. Preservation of spatial integrity of natural systems in the process of their economic use	Preservation of components of the natural ecosystem, as the change of one component leads to changes in others and may generally change its quality.
4. Preservation of the nature-related cycle of matter in the process of human activity	Used natural resources, passing the cycle «resource – production – consumption», should return to the ecosystem in the form of waste within the limits of the nature cycle, that will allow to assimilate the natural substance gradually. In this case, the technological processes of specific industries should be limited by cyclicity; cyclic processes, in turn, represent a series of stages of production, which are interrelated or concerned with complex processing of raw materials, or their stage use.
5. Coordination of production and natural rhythms	Any ecosystem and each of its components follow their time rhythm according to the principles of the Universe. Therefore, in order to maintain the equilibrium of the ecosystem, the overall speed of its internal processes should be guided by its slowest link, since any anthropogenic impact, which makes some part of the cycle work faster than the entire ecosystem works, will disrupt the stability of the ecosystem. A cyclic rhythm of natural processes leads to their repetition, that allows to take into account a lot of processes in perspective planning, bringing the activity of economic units into step.
6. Priority of ecological optimality for a long-term perspective	Natural processes are influenced by factors of short-term and long-term effects. The priority of environmental optimality for a long-term perspective must overwhelm the economic efficiency of the current natural management, since all negative environmental effects of an economic activity are irreversible.

The source: developed by the author.

Thus, all the principles of rational and careful attitude to ecosystems are based on the fact that correcting the negative effects of anthropogenic loading in the long-term perspective is a particularly difficult task. Even F. Engels warned, '... we will not ... be too tempted with our victories over nature. It retaliates us for each such a victory. Each of these victories has, firstly, the consequences that we have been counting on, but secondly and thirdly, there are quite different, unpredictable consequences that very often eliminate the value of the first ones...' (Marx, 1996).

In Ukraine, they have started to take measures aimed at preventing losses in ecosystems. A powerful legislative framework has been developed, which, despite some gaps, provides sufficient opportunities for nature conservation activities. Appropriate state and local programs are approved and implemented (Goals of the sustainable, 2017). However, this is not enough due to the scale of environmental problems and a low overall level of environmental consciousness of the population, that requires to intensify the functions of regional policy in this direction (Figure 1).



**Figure 1.** Functions of the regional policy concerning rational and careful attitude to ecosystems. The source: developed by the author.

One of the most effective measures for conservation of biodiversity is the formation of an ecological network, the creation of territories and objects of nature reserve fund (natural and biosphere reserves, national natural parks, etc.) and nature protection areas of international importance. As of January 1, 2017, the nature reserve network of Ukraine comprised 8,246 such territories and objects located on 6.6% of the state's territory. It is planned to increase the area occupied by natural complexes (now about 29% of the country's territory) and forested areas (about 16%).

More than 40% of Ukraine's area belongs to the territory of the ecological network. At present, the measures of the National Program for the formation of the national ecological network are not fully implemented and remain relevant. In addition, in Ukraine, it is necessary to perform the tasks identified by the Parties of the Convention on Biological Diversity (Nagoya, Japan, 2010) in the Biodiversity Strategic Plan for 2011-2020, including the abolition of losses of biological and landscape diversity through further territorial expansion of nature reserve fund and development of the ecological network, creation and maintenance of effective functioning of a representative effectively managed system of nature protection territories, first of all, across boundary nature protection areas of international importance on land and offshore.

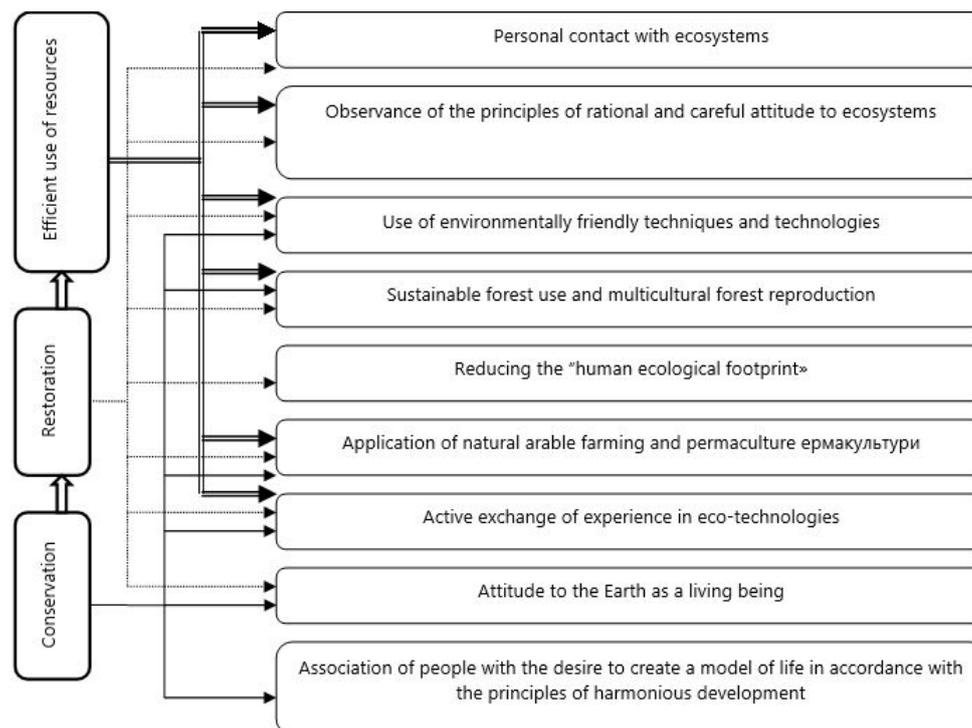
The critical condition of soils makes take measures to build up soils. As processes of lands degradation arise and develop in

different places, their building up should be aimed at maintaining a neutral general condition of lands and preventing further deterioration. Reaching a neutral level of land degradation is supposed to be the basis of the land policy promoted by the Desertification Convention. The land policy in Ukraine should be balanced and rational. An urgent need is the introduction of such sustainable practices of land use at which soils are not depleted and not polluted, but on the other hand, at which degraded and eroded lands are recovered (Yasnołob, 2017). The achievement of a neutral state of lands is supposed to be one of the priorities of fulfilling the obligations of the Desertification Convention. It is advisable to strengthen the national biosecurity system. In this context, it is important to ratify the Nagoya Protocol to the Convention on Biological Diversity in terms of regulation of an access to genetic resources, which will ensure sharing of the benefits of their application on an equitable basis.

In the direction of rational and careful attitude to national ecosystems it is recommended:

- to create networks of area conservancy which cover the most important endangered territories, all types of habitats including remains of steppe ecosystems, open shallow waters, islands, etc.
- to develop a representative effectively managed system of nature protection areas on land and offshore;
- to intensify measures for the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems including steppe and wetland ones;
- to expand forest areas and ensure a sustainable use of forest resources;
- to ensure protection and a sustainable use of lands, to prevent desertification of the country's territory and reduction of soil fertility;
- conservation of exotic and red-listed species of animals and plants including the development and implementation of conservation measures for certain species;
- to ensure conservation and a sustainable use of mountain ecosystems.

These directions should be realized in all spheres of human life: daily life, education, production, scientific activities, cultural and recreational activities, etc. To solve ecological problems there is no need to wait for help from the state, since every citizen is a state, and everyone must start with myself, personal consciousness, and personal lifestyle. This particular approach will allow to conserve, restore and use natural resources effectively, to ensure ecosystem stability and the future development of Ukraine (Figure 2).



**Figure 2.** Prerequisites and peculiarities of conservation and restoration of ecosystem stability. The source: developed by the author.

## Conclusions

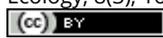
Thus, conservation and restoration of ecosystem stability are possible only by observing the relevant principles and rational nature management in all regions regardless of the hierarchical level. Preservation of a common ecological balance is possible only if the balance of natural systems of certain regions is preserved and vice versa. In addition, the problem of ecosystem stability cannot be solved only in regional and even national boundaries, because it is a global problem that is inherent in the whole planet. And only if humanity realize inability to continue destroying the environment and are sensible of responsibility for their activities for future generations, then it will be possible to preserve and restore ecosystem stability with the aim of harmonious development of humanity.

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