DEGRADATION OF NATURAL COMPLEXES UNDER EXPOSURE TO EROSION

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Abstract

Analyzing the theoretical and practical aspects of studying changes in natural territorial complexes, the authors conclude that the anthropocentric paradigm has a negative impact on the use of agricultural landscapes.

It is proposed to consider the interpretation of the term "erosion" not only as a process of destruction, but also as a process of accumulation and transformation of energy in ecosystems. In this regard, recommendations are proposed to change the methodological approaches to the study of the erosion process and its consequences.

Keywords

Natural-territorial complex, agricultural landscape, erosion, geosystem, landscape, degradation, ecosystem

Natural complex is a relatively homogeneous elementary areas of the earth's surface, which develop with the constant interaction of the energy of the Universe and the internal energy of the Earth. According to D. L. Armand's definition, a natural complex is a spatially limited set of components united by a relatively close interaction. In this case, they can be complete, that is,

including all the components available in a given place, or partial, including only part of the components that are most closely related or of interest for research purposes. Since natural complexes do not have clear boundaries and each of their boundary area is associated with any common properties, or the transfer of certain types of matter and energy, with the areas lying outside, the boundaries of natural complexes are carried out along the lines of weakening the bonds, i.e. on the surfaces along which the transfer of matter and energy is the least [1].

In connection with the widespread system approach in science, geosystems have acquired great importance as territorial or aquatic (hereinafter-territorial) complete or partial natural complexes limited only by belonging to the Earth and by relatively close ties

It should be noted that the description of natural phenomena, understanding them as a system, was carried out long before the term “geosystem” which is now familiar to us. So L. S. Berg [2] singled out the system as important for determining the Genesis and understanding and forecasting of natural processes; V. N. Golovanov [10] wrote: "the Content of cognition is a reflection of the essence and form of knowledge is the system», and B. L. Gurevich [11] believes that "without the detection of order, consistency and laws that Express "constant and stable" in changing geographical formations, geography as a science is impossible».

In the words of A. I. Golovanov, E. S. Kozhanov, Yu. I. Suharev [9], the geosystem assumes the special essence of the object, its belonging to the systems, expressed in the universal form of the nature, and its system concept reflects the universal connection and interaction of the nature of objects and phenomena of nature. Because of this, geosystems should be considered as a system of a special class, with a high level of organization, with a complex structure and mutual conditionality of components subject to General laws. Thus, according to V. B. Sochava [22], geosystem is defined as "...the terrestrial space of all dimensions, where the individual components of nature are in a system connection with each other, and how a certain integrity interact with the space environment and human society».

D. L. Armand [1] suggests that the allocation of geosystems, including ecosystems, is very fruitful in theoretical issues, but it is often inconvenient for practical purposes. For them, the division into natural territorial complexes is usually used, since practical purposes require the allocation of territories limited by vertical surfaces, which dissects the geosystems into parts. In other words, the natural territorial complex represents the site of the territory or the water area conditionally allocated by vertical borders by the principle of relative homogeneity, and by horizontal borders-by the principle of disappearance of influence of that factor on the basis of which this complex is allocated.

Many scientists (D. L. Armand, U.K. Yefremov, F. N. Milyukov, V. I. Prokaev, etc.) considered the term "natural territorial (or aquatic complex") very cumbersome and, despite the accuracy, inconvenient with frequent use, and instead recommended to use the short term "landscape", which has already become habitual in use.

Thus, the landscape is a synonym of the natural territorial complex. This implies the concept of the type of landscape, which is understood as a set of natural territorial complexes, although fragmented, but with a set of the same components, though in the same composition and condition [4]. Being the basic unit in the hierarchy of natural territorial complexes, the landscape in accordance with the regional interpretation is understood as a specific individual and unique natural-territorial complex, which has a geographical name and exact position on the

map. In the theoretical concept of landscape science landscape is a specific territorial unit consisting of several elementary geographical units.

The decrease in the energy balance of the territory, which occurs with the participation of organic and inorganic matter and human activities, as well as with the active participation of Outer space, cause the development and degradation of natural complexes. The degradation processes include hydrological erosion, chemical, radiological, mechanical, and the main types of degradation of natural complexes are: desertification; wind and water erosion; soil aridization; hydromorphism; compaction with heavy machinery; heavy metal pollution, which leads to disruption of biocenoses; chemical degradation, accompanied by the accumulation of soluble salts on the soil surface, increased mineralization of surface and groundwater, and others, detrimental to the energy balance of the planet.

According to A. N. Kashtanov, at the end of the XX-the first half of the XXI century, formed natural complexes with unpredictable elements began to appear failures in the genetic information of living systems and irreversible changes in agricultural landscapes. Adopted in 1982, the World Soil Charter, and later in Rio de Janeiro at the UN world conference on environment and development, the Program of action of all States to correct the dramatic situation on the planet called on humanity to change the consumer and destroying nature of the anthropocentric paradigm to the ecological and environmental one. However, these documents and appeals did not find the proper response from the governments of most States, as a result of which we have a large-scale degradation of natural complexes-soil, water resources, flora and fauna, the atmosphere, that creating a threat to life on the planet [16].

The transformation of natural complexes is observed in time and space, but in the presence of common features, they are specific for each zone. In the historical aspect, each natural complex in its development goes through the stages of emergence, development, perfection, flowering, degradation and revival at each new energy level. In the historical aspect, each natural complex in its development goes through the stages of emergence, development, perfection, flowering, degradation and revival at each new energy level [17].

Degradation is usually understood as gradual deterioration, loss of valuable properties and qualities, decline [21], but improvement is also possible, since the loss during degradation of one system leads to the improvement of another one. Thus, the destruction of rocks and minerals leads to the formation of soils with completely different properties. Degradation of the natural complex –natural or anthropogenic simplification of the complex, reduction of economic and aesthetic potential up to irreversible changes that lead to the impossibility of performing by natural complex the socio-economic functions; and anthropogenic degradation is a gradual decrease in the complexity, energy potential and capacity of the natural system, almost irreversible in real time, associated with human activity.

Soil degradation is considered in two aspects: in a broad sense, it is any process that causes deterioration of soil properties and reduction of its fertility, which may be the result of natural causes or improper agrotechnical techniques; in a narrow sense - the processes of soil leaching and podzolisation when forest vegetation attacks on them [20].

Considering the real repeatability and natural-economic significance of the consequences, deflation and water erosion are considered to be one of the most destructive processes of natural complexes, which is a consequence of not only agro-climatic conditions, but also of an integral

expression of the negative effects of other degradation processes that destroy the soil structure, create conditions for flushing, scouring and blowing [18].

Even the current generation of living remembers how in 1954 after the development of virgin lands, black dust storm rose in the air all plowed virgin soil to a depth of 20-25 cm, and in 1969, a black storm swept the North Caucasus, the Volga region, Ukraine, Moldova, when on an area of 18 to 23 million hectares was demolished layer of soil thickness of 7-8 cm, and in the area of wind corridors the entire arable layer up to 25 cm [15].

According to A.N. Kashtanov [16], having adopted the anthropocentric paradigm, the world civilization eventually received a large-scale degradation of soils (more than 2 billion hectares), water resources, flora and fauna, the atmosphere, creating a threat to life on Earth. Over the past 20 years, the rate of growth of eroded and deflated land reaches 6-7 % every 5 years, i.e. up to 1.5 million hectares per year, and the average annual loss of soil with the combined manifestation of wind and water erosion is estimated at about 15 t / ha. The disappointing forecast is that total soil losses from eroded land could be around 750-800 million tonnes, containing 32 million tonnes of humus, 4.8 million tonnes of gross phosphorus, 60 million tonnes of potassium and 8.8 million tonnes of total nitrogen [15].

The task of researchers is timely detection, prevention of catastrophic changes in the environment, assessment of the degree of degradation of agricultural landscapes [12].

The advantage of any science, as you know, is the clarity of its theory, which contributes to the precise definition of the concepts used in science and that is especially necessary at the present stage of knowledge. Geographical science is complex, which determines the significant complexity of the studied relations. As E. K. Voishvillo wrote [3], "when it comes to complex connections and relations, one intuition and common sense presented in the forms of conventional reasoning is not enough; the exact logic of the formalized language is needed".

As the majority of definitions are an explanation of the concepts transmitted through the terms, so the generally accepted terms need definitions to clarify and limit their meaning, and newly introduced or variously understood to construct new concepts. Obviously, one should strive to clarify the terms used in cases where their meaning may raise doubts, so that such usage would seem the most reasonable or convenient.

The specificity of the term "erosion" is also determined by the degree of development of science, and, during the study of the object, the concept of the term was specified and refined. Thus, in the Great Soviet encyclopedia (1978), the term erosion means complete or partial destruction, damage to the surface, under the influence of certain processes or external influences. There erosion is understood as the process of destruction of rocks and soils by water flows and manifests itself in the form of direct mechanical action, causing the weighing (and entrainment) of solid particles or their movement on the water surface by water flow. The agricultural encyclopaedic dictionary (1958) gives the following interpretation of the term: erosion is the eroding and washing away work of flowing water. Erosion is associated with the development of the earth's surface forms-the formation of secondary watersheds and valleys, and from the point of view of Geology erosion is slow movement on the earth's surface of loose weathering products, their removal from high places (denudation) and accumulation in low places (accumulation). In A Brief Geographical Encyclopedia (1964) noted that erosion-a flush of flowing water rocks and soils, caused by a complex of processes: a) direct mechanical action of the flow causing weighing (and entrainment) by the flow of solid particles or their movement

on the water surface; б) dissolution of rocks by water; в) corrosion (abrasion and grinding) of the flow bed by water-borne particles, as well as the particles themselves; г) excitation of electric charges of the opposite sign in the water-solids system, which contributes to the suspension of small particles. Finally, in the Dictionary of the Russian language (1988) erosion is interpreted as the process of destruction of the soil, the earth's crust produced by water, ice or wind and leads to numerous types of erosion (table 1) [23].

Table 1

Degradation of natural complexes under the influence of erosion [23].

Type of degradation of natural complex	Degradation changes of natural complexes	Measures to prevent degradation of natural complexes
1. Space and volcanic	The complete destruction of natural systems	Absent
2. Mechanical	Weathering of rocks under the influence of water, wind and temperature	The first stage of soil formation
3. Biological	Destruction of rocks under the influence of living systems	The emergence of a new element of natural complexes - soil
4. Chemical	Chemical dissolution of rocks and soil components	The emergence of mobile nutrition elements and the soil solution
5. Hydrological	The erosion of the soil. Destruction of natural complexes with the formation of potholes, ravines, valleys	Reduced soil fertility, loss of energy
6. Physical	Grinding, abrasion of the bed bottom with water. Transfer of soil particles by wind	Destruction of natural complexes
7. Electromechanical	Excitation of electric charges of the opposite sign in the water-solid particles system	Absent

The list of sources with different but very similar interpretations of the term erosion can be continued, but it is easy to see that the term is interpreted very widely and vaguely. In this regard, the famous scientist M. N. Zaslavsky [13] considered it inappropriate to combine in one term – soil erosion-soil flushing and soil blowing processes, rightly believing that when under one term is often hidden very diverse phenomena, clarity of terminology becomes particularly relevant, because without it it is impossible to further investigate the patterns of manifestation of various processes that destroy the soil, and to develop theoretical foundations and ways to prevent these processes. Therefore, it was proposed to call the destructive effect of the wind on blowing, transfer and deposition of soil particles by deflation, and washout and erosion of soil by surface runoff of temporary water flows - erosion.

We share the opinion of a number of scientists [23] that existing in dictionaries and other sources interpretations of the term "erosion", with the receipt of new data should be expanded, because they do not pay attention to the biological destruction of rocks, the role of

thermodenudation processes in connection with climate change, do not identify universal connections in ecosystems that are associated with energy. It should be noted that erosion is not only the process of destruction, but also the accumulation and transformation of energy in ecosystems, participating in the processes of circulation of substances and energy in the biosphere. The researchers believe that in the process of destruction of rocks and soil involved not only water and wind power, but also living organisms, and various geological and space factors, and the very emergence of the soil is most directly related to the destruction of rocks with the participation of solar energy and living organisms.

The idea of the unity of the mechanisms of water and wind erosion is not in doubt, but until now the theoretical foundations of water and wind erosion of soil are considered separately, despite the fact that all the authors recognize the unity of the laws to which the mentioned process of degradation is subject [14]. The unified theory of soil erosion, therefore, needs to summarize the views and results of these works [5.6.7.8].

For the development of the unity of the mechanism of water and wind erosion, the equation of the critical flow rate (water or wind), indicating the beginning of erosion of homogeneous soil, is derived and tested on experimental material [7,8]. Thus, the existence of a limit in the reduction of the critical flow rate under the influence of soil particle grinding is theoretically justified, and the equation of the critical flow rate for a homogeneous model soil is obtained and experimentally substantiated. It follows from the above that in the framework of the proposed approach, the minimum critical flow velocity is theoretically established as a function of the size of soil particles, and the particle sizes for which the critical velocity is the lowest for a given soil and the value of this velocity are found.

Without diminishing local successes within improvement of the uniform theory of soil erosion, in modern conditions it is necessary, obviously, to use landscape approach to an assessment of this concept as to processes of degradation of natural complexes all parties of the biosphere are covered. In this regard, the existing until recently understanding and expression of the essence of erosion can be refined and interpreted as the process of destruction and movement of rocks and soils as a result of the interaction of different geological, biotechnical, abiotechnical factors, human activities that lead to changes in small biological and large geological circulation of substances in natural and agricultural landscapes [5,6,7,8].

The solution to the problem of land degradation during the changes taking place in the world requires the transfer, along with science and practice, of environmental education to a qualitatively new level, the result of which should be a developed system-thinking, understanding of the role and place of man in nature, awareness of the need for human-biosphere interaction, preservation of the biosphere as a prerequisite for the development of mankind and modern civilization [23].

According to N. M. Mamedov and I. T. Suravegina [19], one of the main reasons for environmental irresponsibility is not the development of the content of basic knowledge on ecology, but ignoring the fundamental natural-scientific and biological foundations of modern ecology and focusing not on the causes of environmental problems, but on their consequences-environmental disasters; a sharp reduction in time for the study of fundamental natural disciplines; inconsistency of the current level of development of natural science to the state of environmental education. It should be added that in terms of higher education, between courses

of ecology and other subjects of the natural science cycle need not an empirical approach, but the solution of environmental problems at the theoretical level of research.

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