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Methodological and methodical basis for the study of two-tiered anthropogenic landscapes

The study of anthropogenic landscapes is an urgent topic in modern geography and ecology. Anthropogenic landscapes arise due to the anthropogenic activity impact on nature and have a two-tiered structure consisting of natural and anthropogenic components. The study of these landscapes requires a scientifically substantiated methodological and methodical basis that will allow us to collect, analyze and interpret data on the subject.

The purpose of the article is to consider the methodological and methodical aspects of the study of the two-tiered anthropogenic landscapes. It aims to define the theoretical foundations and practical approaches to the study of these landscapes, as well as to analyze the methods of data collection and processing that provide information about the natural and anthropogenic components of the landscape.

Main material. The article discusses the basic concepts and theoretical foundations of the study of two-tiered anthropogenic landscapes, including their classification and identification. The author considers methodological approaches to the study of anthropogenic landscapes, including the use of various methods of data collection and processing, analysis of cartographic material and the use of geographic information systems.

The scientific significance of this article lies in the fact that it provides new approaches to the study of the two-tiered nature of anthropogenic landscapes, which we can use in further scientific research and practical activities. The results of this study can be useful for geographers, ecologists and other specialists involved in the study and protection of nature.

Conclusions and further research: The study of the two-tiered nature of anthropogenic landscapes uses a variety of methods that help scientists better understand and assess the impact of anthropogenic activities on the natural environment. The use of geoinformation analysis, socio-geographical research, statistical analysis and other methods allows us to get a more complete picture of the two-tiered system, taking into account various aspects of the interaction between the anthroposphere and the biosphere. The study of the two-tiered nature of anthropogenic landscapes is an important part of modern geography and ecology. The use of classifications, integrated methodologies and geoinformation analyses helps to investigate the relationship between human activity and natural environment.

Keywords: *two-tiered, anthropogenic landscapes, research methodology, method.*

Introduction. The modern world is experiencing a high level of anthropogenic activity, which leads to significant changes in natural landscapes. The study of the two-tiered nature of anthropogenic landscapes will allow us to understand better the nature and extent of transformations that occur under the influence of human activity.

First of all, it should be noted that understanding the interaction between natural and anthropogenic components of landscapes is key to sustainable development. The two-tiered nature of anthropogenic landscapes indicates that different aspects of nature and society are intertwined, influencing each other, and the study of this interaction helps to develop more effective strategies for environmental management and preservation.

The study of the two-tiered nature of anthropogenic landscapes requires an integrated approach that combines geography, ecology, archaeology and social sciences. This contributes to a comprehensive understanding of human interaction with the environment, which is key to solving modern environmental problems.

Thus, the research results can serve as a scientific basis for developing sustainable development strategies. Understanding the internal structure of anthropogenic landscapes will contribute to the rational use of resources, conservation of biodiversity and reduction of negative impact on nature.

Therefore, the study of the methodological and methodical basis for the research of the two-tiered nature of anthropogenic landscapes is a relevant and important task that will contribute to scientific progress and the development of more sustainable and effective strategies in landscape management.

Background premises. Anthropogenic landscapes are distinguished by the fact that they are shaped by human activities, which take various measures, such as artificial irrigation or marsh drainage, to support their own existence. The landscapes that emerge under the influence of such activities gradually move to a state where human influence almost completely or completely ceases, and they acquire features similar to natural landscapes.

According to the Encyclopedic Dictionary of Geographical Terms, the types of anthropogenic landscapes vary and depend on the degree of human influence in terms of depth and nature. We find terms such as "altered landscape", "disturbed landscape", and "transformed landscape". We also define the term "cultural landscape", which does not differ significantly from the already mentioned term "transformed landscape"[4].

S.V. Trokhymchuk [13], using as example the Ukrainian Carpathians, considers anthropogenic landscapes and proposes their typology:

1. Landscapes that have been disturbed under the influence of long-term but superficial human activity, for example, grazing.

2. Landscapes with a little change, where crop areas occupy less than 25% of the territory.

3. Moderately altered landscapes, where the areas of developed land cover between 25 and 50% of the territory.

4. Landscapes with significant change, where the land is already developed from 50 to 75% of the territory.

5. Landscapes that have undergone profound change, with more than 75% of the territory developed.

6. Urbanized landscapes.

Scientists often point out also the importance of distinguishing between natural and anthropogenic complexes among modern landscapes. Natural landscapes remain unchanged by human influence, while anthropogenic complexes are completely determined by human economic activity. Among anthropogenic landscapes, there are anthropogenic and technogenic complexes [6].

The purpose of the article is to consider the methodological and methodical aspects of the study of two-tiered anthropogenic landscapes, including their classification and identification.

Summary of the main material. In the analysis of anthropogenic landscapes, anthropogenic complexes include agricultural, forestry, water management and recreational landscapes, while technogenic complexes include mining, industrial, belligerent and road complexes. There is also a classification of anthropogenic landscapes, such as field, meadow-steppe, aquatic, forestry, and industrial-urban.

Most of the above-mentioned studies conducted in the 50s and 60s of the twentieth century focused on the study of the natural and anthropogenic interaction in modern landscapes and identified anthropogenic landscapes as an important element of the classification. The diversity of anthropogenic landscapes themselves remained unexamined at that stage of landscape science development.

The next stage in the research was started by the outstanding landscape scientist and founder of the school of anthropogenic landscape science, F.M. Milkov. He was the first to put forward the principles of systematization of anthropogenic landscapes based on the types of human activity and the changes that this activity causes in nature. The scientist emphasizes that the classification of anthropogenic landscapes implies their division into groups according to any characteristic, and there can be an infinite number of such classifications. Some of the proposed classifications include:

Classification of anthropogenic landscapes by content, which takes into account differences in the structural components of anthropogenic complexes:

1. Agricultural complexes (cultivated fields, cultivated meadows);

2. Forest complexes (secondary forest, artificial forest plantations);

3. Water complexes (lakes, reservoirs);

4. Industrial complexes (including transport);

5. Settlement complexes - landscapes of settlements, from small to huge cities.

This classification of anthropogenic complexes is the most significant, since each type of anthropogenic complex has its own unique features that require special approaches and methods for their study. The entire scope of anthropogenic landscape science can be divided into five main branches: agricultural, forestry, water management, industrial and settlement landscape science.

There is also a classification of anthropogenic complexes depending on the degree of human intervention in the natural order. Although all of these complexes are the result of human activity, the depth of their impact on nature is different. It is important to distinguish between the following types:

1. Anthropogenic landscapes are complexes created by humans and non-existing previously in nature. These include mounds in the steppe, polders displaced on the seabed, and other similar objects.

2. Altered (transformed) anthropogenic landscapes are characterized by the fact that some of their components have been directly affected by humans. An example is a birch grove that replaces an oak forest, or a wormwood-fescue pasture that has emerged on the site of a feather grass steppe. In such landscapes, anthropogenic changes in vegetation can be noted, but they do not go beyond one type, such as the replacement of an oak forest with a birch forest or the transformation of a steppe into a wormwood steppe. When a change in vegetation type occurs in one landscape complex as a result of human activity, we can speak of the emergence of an anthropogenic complex. Such complexes include, for example, shelterbelts or wastelands formed on the site of deforestation.

The genesis of anthropogenic complexes is determined by the variety of human activities behind their emergence. It is important to distinguish between the following genetic groups of anthropogenic landscapes:

1. Technogenic landscapes are complexes that arise as a result of various construction processes: industrial, economic, road, water management. Anthropogenic landscapes are very diverse, including quarries with dumps, reservoirs with lakes, and upland ramparts.

2. Slash and burn landscapes are complexes associated with deforestation, which leads to the formation of fields, meadows, wastelands, and settlements on the site of the deforested area.

3. Ploughed or arable landscapes are anthropogenic complexes formed as a result of ploughing up areas with herbaceous vegetation, such as field landscapes.

4. Pyrogenic landscapes are complexes caused by the burning of forests, steppes and other vegetation types for the purpose of using the land for arable land or improving the grass cover. This factor determines the structure of many forest, steppe, forest-steppe and savannah areas.

5. Grassland-digression landscapes are complexes that arise as a result of irregular grazing. Such pastures are covered with knotweed and plantain, and it is often difficult to define clear boundaries between natural landscapes affected by grazing and anthropogenic pasture-digression landscapes.

The classification of anthropogenic complexes according to the purpose of their formation is divided into:

1. Direct anthropogenic landscapes are programmed complexes that result from deliberate economic activities, such as the creation of lakes in gullies, the formation of large reservoirs in river valleys, or the planting of forest belts for protection.

2. Associated anthropogenic complexes are those that are not directly created by humans, but are the result of natural processes activated or caused by human economic activity, such as ravines in the place of furrows or road ditches, swamps in the flood zone of a reservoir, various forms of underground karst in areas of anthropogenic activity. Often, the accompanying anthropogenic complexes become predominant in modern landscapes.

Thus, scientific research indicates that each type of anthropogenic landscape has its own unique dynamics and interaction with the natural environment.

The most important component of anthropogenic landscapes are industrial areas where production and technological facilities are concentrated. This may include plants, factories, power plants and other industrial facilities. Observing the dynamics of these landscapes allows us to determine the impact of industry on nature and the effectiveness of environmental measures.

Agricultural anthropogenic landscapes are the areas occupied by agricultural activities. This includes fields, orchards, farms and other areas used for agricultural production. It is important to study changes in such landscapes to understand the impact of agricultural activities on soil resources, biodiversity and soil quality.

Transport landscapes include road complexes, railways, airports and other infrastructure facilities that serve transport. The dynamics of transport landscapes affects not only the mobility of society, but also has a significant environmental footprint caused by the construction and operation of transport networks.

Housing and communal landscapes include areas of residential development, public services and infrastructure. Changes in these landscapes are associated with the development of cities and villages, as well as the growing demand for public services. The study of these landscapes helps to ensure comfortable living conditions for the population and to determine the impact of densely populated areas on the environment.

Recreational landscapes are areas for recreation and entertainment. Parks, forests, sports complexes and other areas intended for recreation and physical activity are also affected by anthropogenic activities. Studying these landscapes allows us to develop

strategies to preserve the natural environment and meet the recreational needs of the population.

The two-tiered nature of anthropogenic landscapes is a concept that describes a modern landscape consisting of two main levels of anthropogenic impact. Currently the notion of two-tiering is studied rather poorly, but it can be observed in anthropogenic landscapes. It is possible to draw through lines between two-tiering and altitudinal differentiation, but these concepts are quite different. Altitudinal differentiation is based on the diversity and change with altitude of climatic factors and their impact on vegetation, while two-tiering arises as a result of all landscape-forming factors, primarily lithogenic (geological structure of the territory, relief and their development), climatic, hydrological (functioning of surface waters), hydrogeological (groundwater), soil, and plant factors [8]. The two-tier system is divided into two tiers: surface and underground.

For example, the Kryvyi Rih landscape-technical system has a vivid example of two-tiered anthropogenic landscapes; in mining landscapes, the surface tier is caused by the emergence of dumps, quarries, spoil heaps, and sludge pits [7]. The underground tier of mining landscapes is divided into mines (shafts, quarries, drifts, shanks), adits and sinkholes. The KLTS settlement landscape also consists of surface and underground layers. The surface tier is characterized by residential buildings (multi-storey residential buildings, industrial enterprises, various shopping centers, cultural and art centers, etc.) The underground tier of the settlement landscape includes a high-speed tram, which moves on both aboveground and underground lines; this type of tram traffic is typical only for the territory of the KLTS [7].

To study the biodiversity of anthropogenic landscapes different methods are used, and the first method is an integrated geographical approach. To understand the interaction between the anthroposphere and the biosphere, it is necessary to combine geographical analysis, ecological research, archaeological discoveries and social aspects. By applying this approach, researchers can gain a more complete picture of the impact of human activity on natural components [12].

Geoinformation analysis is a key methodological tool in the study of the two-tiered nature of anthropogenic landscapes. A geographic information system is a complex for collecting, storing and analysis spatial geographic data and related information about objects. In a narrower sense, it is a software tool that provides users with the ability to interact with a digital map of the area and additional information about objects [10].

A geographic information system complex may include spatial databases, raster and vector graphics editors, and spatial analysis tools. This tool is used in various fields, such as cartography, geology, meteorology, land management, ecology, municipal administration, transport, economics, defense, and others [5].

To solve the tasks related to spatial data processing, the method of geographic information analysis is traditionally used, which includes various functions for creating, editing and analysis spatial data and their thematic processing. Geoinformation analysis, or spatial analysis, is the process of identifying geographical patterns and relationships between research objects using geographic information systems. This process covers a variety of operations that can be performed using a geographic information system.

Another important component of the methodology is conducting environmental and geographical expeditions in the field. Studies show that expeditions allow to analyze the impact of anthropogenic activities in specific areas by studying the interaction between people and the environment in detail [9].

Social geographical analysis determines the influence of human factors on the formation of two-tiered anthropogenic landscapes. The object of study of social geography is the central figure - the human being. The study examines various aspects of society, social groups, territorial communities and other human groups. The central object of social geography, as in regional social geography, cannot be studied separately from the integral social space and time, in interaction with real geospatial and temporal coordinates [11].

Thus, the methodology of studying the two-tiered nature of anthropogenic landscapes combines various approaches covering geography, ecology, geoinformation analysis and social sciences. This balanced combination allows us to reveal a large body of knowledge that defines the modern interaction between humans and nature in the context of anthropogenic activity.

The methodical basis for the study of the two-tiered nature of anthropogenic landscapes plays a crucial role in forming a comprehensive and objective view of the interaction between people and nature. The study of anthropogenic landscapes is carried out at the physical and geographical (landscape) level, mainly by the methods of classical landscape science regarding their genesis, which also involves the use of methods inherent in anthropogenic landscape science [2].

All anthropogenic landscapes evolve in space and time, having their past, present and future. This requires the widespread use of historicism methods in their study. The current structure of anthropogenic landscapes depends on their previous history of development. Thus, the method of cartographic reconstruction becomes the key to analysis the dynamics and history of anthropogenic landscapes. The application of this method leads to the creation of a historical and genetic series of maps that reflect key time periods in the development of these landscapes. These maps can be of a geocomponent or landscape character. The depth of historical sections of the anthropogenic landscapes being reconstructed depends on the economic development of the territory and the purpose of the study [1].

For example, when studying the history of the formation of settlement landscapes in the forest-steppe, the Paleolithic period should be taken into account for the forest-steppe landscape of the Podilska and Prydniprovska uplands and the Neolithic period (the Dniester and Southern Bug riverside) for agricultural landscapes. The historical depth of the study allows us to identify the specifics of landscape development and optimize their development.

The analysis of paleogeographic, archaeological, historical, archival, literary and cartographic sources, as well as the results of various scientific studies, can be used to create maps and map schemes of historical sections of anthropogenic landscapes. Additionally, toponymy, old-timers' stories, old photographs, and other sources can be used. Historical and genetic series of maps are becoming a valuable tool for obtaining quantitative characteristics necessary for rational nature management and development of projects for optimization of landscape complexes [3].

When shaping anthropogenic landscapes, humans mainly seek to introduce them into the natural environment in a reasonable and responsible manner, striving for rational and harmonious interaction. Otherwise, their transformation requires additional costs or quickly leads to destruction and transformation into cultural objects. For these reasons, the method of natural-anthropogenic coexistence is key in the study of anthropogenic landscapes. It becomes important to consider the anthropogenic landscape not only as a separate element, but also as a component of an interacting paragenetic system (e.g., reservoir - coastal strip, protective forest belt - adjacent field).

Since anthropogenic landscape structures are not always easy to distinguish from natural variants (for example, a swamp becomes the actual bottom of a sand pit, or an artificial forest plantation resembles a natural forest, or a reservoir resembles a natural lake), the comparative method of natural analogues is critical. This approach allows us to establish similarities and highlight differences between anthropogenic landscapes and their well-studied natural counterparts. An important element is the consideration of the anthropogenic landscape not only as a separate element, but also as a component of an interacting paragenetic system, such as a reservoir - coastal strip or a protective forest belt - adjacent field.

The areography method appears to be the most promising for a detailed study of small-scale anthropogenic landscapes. Its essence is to show on the map the areas of development of the main classes or subclasses of anthropogenic landscapes in the form of solid areas or symbols. The choice of the mapping method depends on the specifics of the object and the availability of source material. In particular, appropriate symbols can be used to show the location of urban, water and industrial landscapes, while the locations of agricultural and forest anthropogenic landscapes can be shown with solid hatching.

Although the areographic method is widely used in general anthropogenic landscape studies, it is of secondary importance in regional studies. In addition to these approaches, it is also reasonable to use the methods of specialized sciences related to the relevant classes of landscapes in the study of anthropogenic landscapes. For example, when analyzing agricultural landscapes, methods of soil science and agrophytocenology can be used, and for forest anthropogenic landscapes, methods of forestry, botany, geobotany, and others as well.

Thus, the study of the two-tiered nature of anthropogenic landscapes provides an opportunity to understand their nature and interrelationships better. The use of the areographic method becomes key in this context, as it allows to visualize the areas of development of the main classes or subclasses of anthropogenic landscapes at different levels, to note their features and interactions.

The areographic method is used to represent the two-tiered nature of anthropogenic landscapes on a map, with symbols or areas representing the upper and lower levels. For example, appropriate symbols can be used for urban, water and industrial landscapes on the upper tier, while agricultural and forested anthropogenic landscapes can be indicated by a solid shading on the lower tier.

Additionally, it is important to take into account the different sectoral approaches to the study of built landscapes to analyze their two-tiered nature.

Historical depth expressed by the outcome analysis method, becomes an important element in the study of two-tiering. Taking into account the development of anthropogenic processes at different levels and their interrelationships with the environment contributes to a deeper understanding of the structure and evolution of anthropogenic landscapes.

Conclusions. The methodological basis for studying the two-tiered nature of anthropogenic landscapes is a set of various methods that allow scientists to understand and assess better the impact of human activity on nature. The combination of geoinformation analysis, socio-geographical research, statistical analysis and other methods creates a more complete picture of the two-tiered landscape, taking into account the various aspects of the interaction between the anthroposphere and the biosphere.

The study of the two-tiered nature of anthropogenic landscapes is an integral part of modern geography and ecology. Taking into account classifications, using integrated methodologies and geoinformation analyses contributes to the formation of a complete map of human-nature interaction. Research in this area helps not only to understand the past, but also to become the basis for developing strategies for sustainable development and ecosystem conservation for future generations.

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МЕТОДОЛОГІЧНА ТА МЕТОДИЧНА ОСНОВА ДОСЛІДЖЕННЯ ДВОЯРУСНОСТІ АНТРОПОГЕННИХ ЛАНДШАФТІВ

Дослідження антропогенних ландшафтів є актуальною темою в сучасній географії та екології. Антропогенні ландшафти виникають в результаті впливу антропогенної діяльності на природу і мають двоярусну структуру, що складається з природного та антропогенного компонентів. Вивчення цих ландшафтів вимагає наявності науково об-ґрунтованої методологічної і методичної основи, яка дозволить збирати, аналізувати та інтерпретувати дані про них.

Метою статті є розгляд методологічних та методичних аспектів дослідження двоярусності антропогенних ланд-шафтів. Вона спрямована на визначення теоретичних засад і практичних підходів до вивчення цих ландшафтів, а також на аналіз методів збору та обробки даних, які дозволяють отримати інформацію про природний і антропоген-ний компоненти ландшафту.

Основний матеріал. У статті розглянуті основні поняття й теоретичні засади дослідження двоярусних антро-погенних ландшафтів, включаючи їх класифікацію та виявлення. Також розглянуті методичні підходи до дослідження антропогенних ландшафтів, включаючи використання різних методів збору і обробки даних, аналізу картографічно-го матеріалу та використання геоінформаційних систем.

Наукове значення даної статті полягає в тому, що вона надає нові підходи до дослідження двоярусності антро-погенних ландшафтів, що можуть бути використані в подальших наукових дослідженнях та практичній діяльності. Результати даного дослідження можуть бути корисними для географів, екологів та інших спеціалістів, які займають-ся вивченням і охороною природи.

Висновки і подальші дослідження. Дослідження двоярусності антропогенних ландшафтів базується на різно-манітних методах, які допомагають науковцям краще зрозуміти та оцінити вплив антропогенної діяльності на при-родне середовище. Використання геоінформаційного аналізу, соціально-географічних досліджень, статистичного аналізу та інших методів дозволяє отримати більш повне уявлення про двоярусність, з урахуванням різних аспек-

тів взаємодії між антропосферою та біосферою. Дослідження двоярусності антропогенних ландшафтів є важливою частиною сучасної географії та екології. Використання класифікацій, інтегрованих методологій та геоінформаційних аналізів допомагає дослідити взаємозв'язок людської діяльності на природне середовище.

Ключові слова: *двоярусність, антропогенні ландшафти, методологія досліджень, метод.*

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