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PROBLEMS OF NATURAL RESOURCE MANAGEMENT AND NATURE PROTECTION IN THE KACHAVA RIVER BASIN

The modern irrational use of water and land resources has led to a violation of the ecological balance, the destruction of natural landscape complexes of river valleys and the territories adjacent to them, and the pollution of water bodies. The basin as a special spatial unit of the biosphere is the most promising for the multi-faceted study of nature, economy, and nature management.

The purpose of the research is to analyze the structure of land use in the Kachava River basin, the peculiarities of agricultural, industrial, transport and recreational nature use, their impact on the environment, the level of anthropogenic transformation of geosystems, the development of land use optimization measures.

Thanks to the analysis of the structure of land use in the Kachava River basin, it was found that it deviates significantly from scientifically based norms (anthropogenically transformed territories predominate (72.9%), including arable land (62.2%). Excessively high and ecologically dangerous plowing of land was found: in many cases, the land is plowed up to the river bed, because of this, the eco-corridors in the basin, which are an important link of the eco-network, are cut off. The coefficient of anthropogenic transformation of the geosystems of the Kachava River basin was calculated (according to the method of P. Shishchenko), which is equal to 7.2 and indicates a high level of transformation of the geosystems of the studied territory.

A positive balance of greenhouse gases has been established in the river basin due to a large share of arable land (1079 tons of CO_2 per year), as well as due to the operation of livestock complexes (approximately 300 tons of CO_2 per year) due to internal fermentation and processing of manure.

The impact of industrial facilities on the environment was analyzed and measures to reduce the negative impact were proposed. The level of traffic load in all settlements of the Kachava River basin was studied. The calculation method established an excess of average CO emissions from motor vehicles in the villages of Romanivka, Malyi Khodachkiv, and Kolodiivka.

The recreational load and recreational capacity of the territory were studied. The ecological condition of the Kachava River, Romanivskyi, Kolodiivskyi and Malochodachkivskyi ponds was analyzed according to physical and hydrobiological (Wudivis method) indicators.

Measures to optimize land use in the Kachava river basin are proposed: it is proposed to reduce arable land by 97.65 hectares (5.7%) mainly due to afforestation; creation of two new protected objects (a landscape reserve near the village of Malyi Khodachkiv and a botanical reserve in the forest in the village of Romanivka). The submitted proposal will contribute to increasing the share of ecostabilization lands under natural vegetation from 27 to 33% of the total area of the river basin and achieving the formation of a continuous ecocorridor that will connect the objects of the nature reserve fund.

Key words: *nature resource management, optimization, anthropogenic transformation, river basin, ecological situation.*

Introduction. The irrational use of water and land resources has led to a violation of the ecological balance and the emergence of such problems as the pollution of water, the destruction of natural landscape complexes of river valleys and adjacent territories. The relevance of this study is related to the change in the ecological state of the Kachava River basin due to the influence of anthropogenic factors. The basin as a special spatial unit of the biosphere is the most promising for the multi-faceted study of nature and economy and for environmental management.

The object of the study is the Kachava River basin. The subject of the study is the peculiarities of nature use and geoecological condition in the Kachava River basin.

The purpose of the research is to analyze the structure of land use in the river basin, the features of agricultural, industrial, transport and recreational nature use, their impact on the environment, the level of anthropogenic transformation of geosystems, and substantiation of land use optimization measures.

Literature review. I. Kovalchuk, G. Honcharenko, O. Merezhko, Ya. Molchak, L. Tsaryk, O. Pylypovich, Yu. Andreychuk, N. Kruta, O. Bakalo, and others have conducted scientific studies of the nature management processes of basin systems. Thus, Yu Andreychuk has carried out complex ecological and geographical studies of the Koropets River basin within the Western Podillia. N. Kruta investigated the ecological and geographical state of the basin system of the Lug River. The geoecological analysis of the river basins of the Sumy region was carried out by O. Danylchenko, the geoecological state of the Luga river basin by I. Netrobchuk, the transformation of the ecological and geographical processes of the Djuryn river basin was assessed by O. Bakalo. etc. Among other important scientific studies are: rivers

and their basins in the conditions of technogenesis (Yu. Molchak et al., 2004); transformation of landscape ecosystems of the river valleys of Central Pobuzhzhia (G. Honcharenko et al., 2009); geoecology of the upper Dniester basin system (Pylypovich O.V., Kovalchuk I.P., 2017). The basin as an integrated natural and economic system is the territory of interaction of nature and society, where natural, economic and socio-demographic processes are interconnected, and therefore the principles of the basin concept can be effectively used when solving territorial planning tasks.

Research methods. When performing the work, the following research algorithm was used (Fig. 1.).

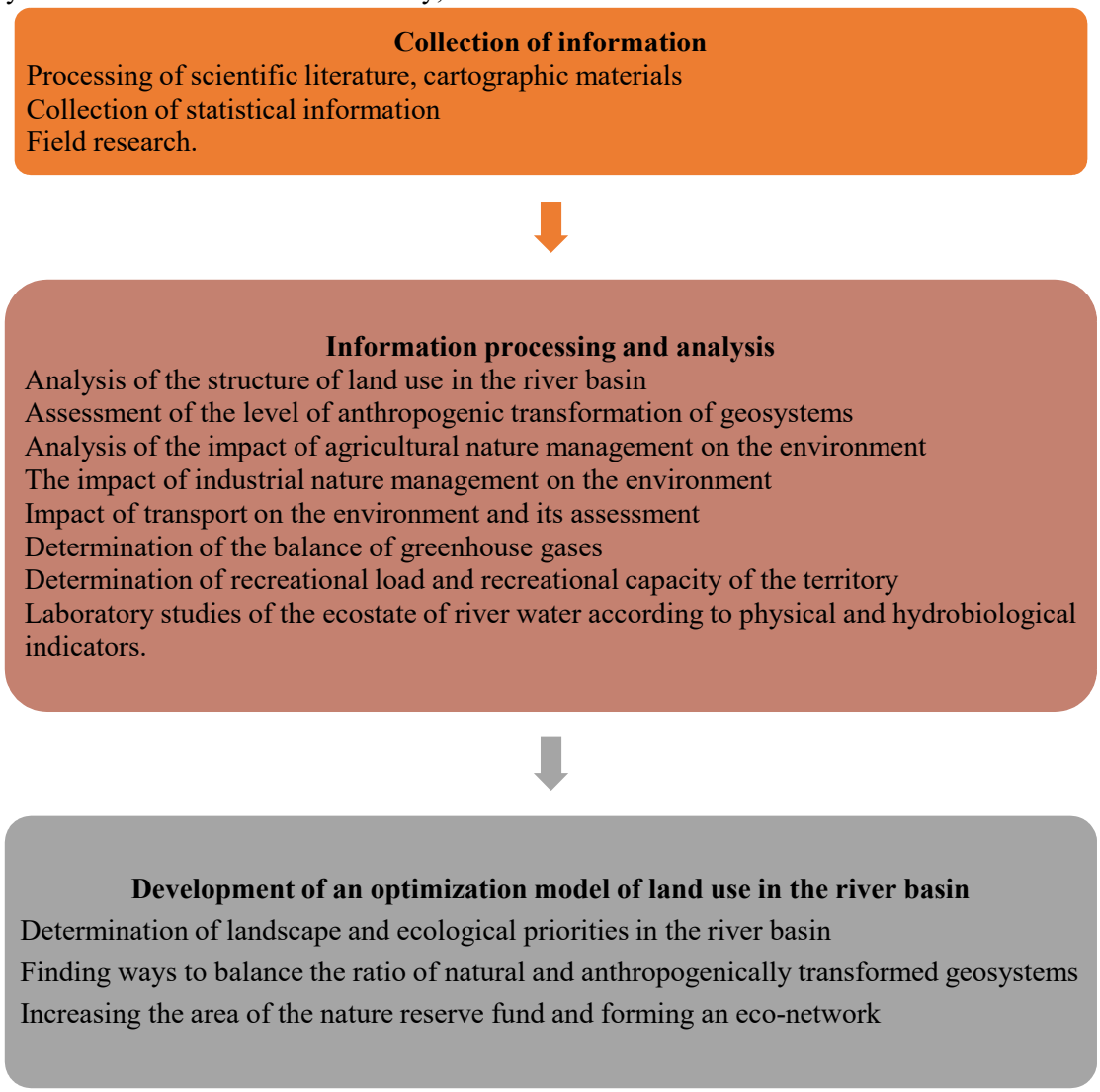

Fig. 1. Block model of research

The first stage is information gathering.

Processing of scientific literature (including encyclopedic editions) and cartographic materials; collection of statistical information on the structure of land use in the river basin; field research: collection of information about objects of nature use and ecological problems of the studied territory.

The second stage is information processing and analysis.

Analysis of the level of imbalance of the land use structure (according to Yu. Odum). Assessment of the level of anthropogenic transformation of the geosystems of the river basin (according to the methodology of P. Shishchenko) [13]. Determination of the balance of greenhouse gases (emissions and absorption) according to the structure of land use [17]. Analysis of the impact of agricultural nature management on various components of the environment, assessment of greenhouse gas emissions from animal husbandry [17]; the impact of industrial (including mineral resource nature management) on the environment; impact of transport on the environment, estimation of the volume of motor vehicle emissions [8]; determination of the recreational influance and recreational capacity of the territory [4], analysis of the problems of recreational nature use. Laboratory studies of the ecostate of water in the Kachava River according to physical [6] and

hydrobiological (Wudiviss method) indicators [5].

The third stage is the development of an optimization model of land use in the river basin.

When developing an optimization model, the following are taken into account:

- landscape and ecological priorities in the river basin (consists in ranking the types of functions of geosystems in the order of their importance for a given territory, taking into account the current ecological situation, general trends and needs of socio-economic development) [12] .

- ratio of natural and anthropogenically transformed geosystems;

- implementation of the task of increasing the area of the nature reserve fund in accordance with the State Regional Development Strategy in terms of preserving biological and landscape diversity and increasing the area of the nature reserve fund.

Analysis and discussion .

General characteristics of the river basin. The Kachava River is located on the territory of the Ternopil administrative district. It originates from the southwestern side of the village of Poplava, flows mainly to the northwest through the villages of Kostyantynivka and Malyi Khodachkiv, in the village of Romanivka it flows into the Terebna River - the left tributary of the Hnizna Gnyla River. The river is crossed by road T 2002. The length of the river is 11 km, the slope of the river is 2.2 m/km. It is formed from many nameless streams and water. The area of the Kachavy River basin is 49,3 km2 [14].

The Kachava River flows within the Podilsk Highlands. The territory of the river basin is mostly represented by floodplains and low terraces composed of alluvial loams and sandy loams with various herbaceous meadows on sod-meadow soils; by valley slopes on forest-like loams, partially wooded with oak-hornbeam vegetation on eroded chernozems and gray forest soils; flat plakors, composed of light loam loess-like loams with deep, low-humus chernozems formed on them, which are now under agricultural cultivation, and were previously covered with meadow grasses, in some places with small marshes.

The following villages are located in the river basin: Romanivka, Magdalivka, Teklivka, Kolodiivka, Zherebky, Halushchyntsi, Malyi Khodachkiv, Kostyantynivka.

In the northeastern part of the village of Romanivka, there is the Romanivskyi Pond, which was formed on the Kachava River in the 80s of the last century and is a popular recreation spot. Romanivskyi pond is in state property and is intended for fishing needs. The greatest depth is 8 meters. The area is 32.8001 ha. Other ponds are smaller in size and are located in such settlements as Kolodiivka, Zherebky, Galushchyntsi, Malyi Khodachkiv.

The problem of unbalanced land use. The analysis of the structure of land use in the Kachava River basin made it possible to establish its deviation from scientifically based norms.

The analysis of statistical data shows that anthropogenically transformed lands (72.9%) prevail in the Kachava River basin, including arable land (62.2%), buildings, streets and squares (5.1%), yards (3.7%), roads (0.7%), other lands (in particular for industrial purposes) (1.2%).

The highest percentage of arable land (more than 70%) is in the villages of Teklivka (79.8%), Magdalivka (75.4%), Kolodiivka (71.5%), on the other hand, in the villages of Galushyntsi (46.3%). %) and Kostyantynivtsi (49.3%) less than half of the territory is occupied by arable land.

The available indicators of plowing in the Kachava River basin were compared with the optimal ones (30%, according to Yu. Odum). Exceeding the optimal indicators by 1.5 times (the village of Galushyntsi) - 2.7 times (the village of Teklivka) indicates a significant imbalance in the land use structure of the studied territory.

10.7% of the territory is under construction and infrastructure facilities. A slight excess of the optimal indicator (10%, according to Yu. Odum) is in the villages of Zherebky (15.9%), Kostyantynivka (12.4%), Galushchyntsy (12.1%).

Natural lands occupy 27.1% of the total area of the river basin, including hayfields and pastures (20.2%), gardens (0.7%), forests (0.7%), shrub plantations (0 .7%), swamps (0.7%). This indicator is more than twice lower than optimally necessary (60%, according to Yu. Odum), which indicates the need to optimize land use in the studied territory. The territory's forest cover is very low (only 0.7%). There are forests only near two settlements: the village of Malyi Khodachkiv (1.1 hectares) and the village of Romanivka (11.1 hectares).

The largest areas of hayfields and pastures are in the village of Galushchyntsy (35%), the smallest - in the village of Magdalivka (5.8%). The largest number of gardens is in the village of Romanivka (6.0%), and the smallest is in the villages of Kolodiivka and Zherebky (0.1%).

The river valley is swamped in some places, namely within the boundaries of the villages of Magdalivka (1.0%), Malyi Khodachkiv (1.6%), Kostyantynivka (5.2%), Romanivka (0.4%).

The coefficient of anthropogenic transformation of geosystems in the Kachava River basin, determined by us according to the method of P.Shishchenko [13], equal to 7.2, which indicates a

high level of transformation of geosystems in the studied territory.

The balance of greenhouse gases also depends on the structure of land use, because with a low percentage of natural lands, the process of photosynthesis takes longer, which slows down the oxygenation of the air and the absorption of CO_2 [17]. Our calculations show that for this reason, 1079 tons of CO_2 is produced excessively in the territory of the river basin per year.

Agrarian nature management. Most of the territory in the Kachava River basin is under agricultural cultivation. For example, the arable lands of the agricultural company "Selo Produkt" (in the village of Romanivka) in some places are so close to the bed of the Kachava River that there is no doubt that pesticides and mineral fertilizers get into its waters, which in turn are carried into the pond. Thus, the use of fertilizers, the accumulation and processing of manure, the strengthening of the erosion processes of plowed lands lead to the pollution of the river and pond with compounds of Phosphorus and Nitrogen. The use of plant protection products leads to the pollution of surface and underground waters with toxic substances, and the use of fuel for agricultural machines can lead to water pollution with petroleum products, which significantly affects the ecological state of the aquatic ecosystem [15]. It is also worth noting that currently part of the land near the Romanivsky pond, which used to be a pasture, has been plowed, and therefore, the reservoir along the coastline of a considerable length has lost its "buffer" territory, becoming even more unprotected from agricultural pollutants. A similar situation is observed in other villages. Therefore, plowing of the lands of the river basin is excessively high and ecologically dangerous (62.2%). In many cases, the land is plowed up to the river bed, which can be observed in the villages of Romanivka (along two tributaries and on the coast of the Romanivsky pond), Malyi Khodachkiv (near eight streams), Galushyntsi (to nine tributaries), Zherebky (near eight streams), Kostyantynivka (along four tributaries), Magdalivka (one tributary), Teklivka (two streams), Kolodiivka (one tributary). Because of this, eco-corridors, which are an important link of the eco-network, have been cut off in the basin. The high rate of land plowing is the reason for the positive balance of greenhouse gases over the territory of the river basin (1079 tons of CO_2 per year).

Livestock farms have a significant impact on the environment. For example, the farm in the village of Romanivka is located near the Romanivsky pond, so livestock grazing takes place on the floodplain of the river and on the shore of the pond. As a result of planar washing, organic pollutants often enter reservoirs, which leads to eutrophication of the reservoir, a decrease in the content of dissolved oxygen in the water, which leads to the death of hydrobionts and phytoplankton. Drinking such water leads to an outbreak of gastrointestinal diseases, poisoning of birds and animals. As a result of the operation of the livestock complex, pathogenic microorganisms accumulate and atmospheric air is polluted with molecular nitrogen, hydrogen sulfide, ammonia, and other compounds. Our calculations prove that greenhouse gas emissions from this farm amount to 37.28 tons (as a result of internal fermentation and manure processing). The soils of the territory adjacent to the farm are polluted by an excessive amount of organic substances, some of which enter the surface and underground waters. Since such livestock complexes are typical for every village in the Kachava River basin, the total volume of greenhouse gas emissions will be 8 times greater - approximately 300 tons.

Water use. Two types of water supply are practiced in the villages of the studied territory: centralized and decentralized. The second type of water use still prevails - the use of wells. Water from wells is used for centralized water supply (there are several in each village).

There is no centralized sewage system in the villages and local sewage treatment facilities. Various types of septic tanks, latrines for sewage, covered street toilets with cesspools, etc. are common in these settlements. At the same time, underground tanks for receiving sewage are usually not hermetic. In this regard, the probability of contamination of the water of the first aquifer is very high.

There is little **industrial use** of nature in the Kachava River basin, but there are several small industrial facilities: a furniture enterprise (SAMM) in the village of Romanivka and brick factory LLC "Western Trading Organization" in the village Malyi Khodachkiv. There is a facility of the mining industry - Galushchynetsky quarry, with an area of 45.75 hectares, where limestone is extracted with a capacity of 700,000 tons per year.

There is only one industrial facility on the territory of the village of Romanivka - the furniture production company "SAMM". Mainly tyrsoplite is used for production. The enterprise is located on the outskirts of the village, surrounded by several residential buildings and agricultural land. The distance between this object and the Kachava River is approximately 500 m in a straight line, and between Romanivskyi Pond - approximately 900 m. Furniture production has a negative impact on the environment throughout the entire production

cycle. For example, sawing produces solid waste such as wood dust, shavings and sawdust. During the mechanical processing of wood (planing, sawing, milling, grinding, etc.), in addition to the previously listed waste, abrasive dust is also added. Vapors of toxic substances are formed during gluing, polishing and technological aging. Heat, abrasive dust, and such toxic substances as: butanol, ethanol, butyl and ethyl acetate, acetone, xylene are generated during preparation, drying, and technological aging. We offer the arrangement of a sanitary protection zone with a width of at least 50 m.

"Western Trading Organization" LLC produces bricks in Malyi Khodachkiv. This organization is located on the outskirts of the village, approximately 500 meters from the Kachava River. As a result of atmospheric air pollution by exhaust gases of motor vehicles, quarry equipment, mechanisms and the close location of the enterprise to the water body, the transfer of pollutants into the reservuar can be observed, thereby contaminating it.

Galushchynetsky quarry is one of the main production units of PrJSC “Ternopil quarry”. The quarry specializes in the production of products for the metallurgical, construction, sugar and other industries. At the end of 2015, a new plant with a production capacity of over 2,500 t/day was opened in the Galushchynetsky quarry. Among the important features: the processing of mining mass with its primary cleaning before crushing has been implemented in the new workshop, which ensures the production of the highest quality products. The quality and characteristics of such products make it possible to provide raw materials for the leading industry of limestone consumption - metallurgy. The quarry's capacity allows for the production of more than 700,000 tons of finished products per year. Atmospheric pollution during mining operations occurs mainly due to dust and gases. Atmospheric air pollution by gases during the operation of internal combustion engines of machines and mechanisms and noise pollution are also happens. Extraction of mineral raw materials leads to the formation of an anthropogenic mining landscape on large areas. During field exploitation, large areas of agricultural land are taken out of use. The topography of the area is changing, and there is also a risk of displacement of aquifers or flooding of the quarry.

Transport nature management.

Transport routes pass through the territory of the Kachava River basin:

- of international importance: M 12 "Stryy-Ternopil-Kropivnytskyi-Znamyanka" and of European importance - E 50 "Brest-Makhachkala", which coincide.

- of local importance - T 2002 "Ternopil-Skalat-Zhvanets".

The first route runs closer to the Kachava River - at a distance of 500 m, the second - 100 m. Highway T 2002 crosses the watercourse 8 times, having impact on the water body with emissions from mobile sources of pollution.

The highest level of traffic load is in the villages of Romanivka (19,680 cars/day), Malyi Khodachkiv and Kolodiivka (over 17 thousand cars/day). Such a high indicator of transport load is connected with the fact that the above-mentioned transport routes pass through these settlements. Since the villages of Galushchyntsy and Zherebky are 1 km and 4 km from the M 12 E 50 highway, respectively, and Kostyantynivka, Magdalivka and Teklivka are 2 km, 6.5 km and 7 km from the main transport routes.

The level of their traffic load is 4-8 thousand cars per day (Table 1) and is mostly caused by the transport of local residents.

Table 1.

The level of traffic load in the Kachava River basin

Settlement	Average traffic load per hour	Average traffic load per day	Average volumes of emissions CO, mg/m3	Intensity of movement
Romanivka	820	19680	9,1	High
Maly Khodachkiv	740	17784	8,3	Average
Kolodiivka	720	17280	8,1	Average
Haluschyntsi	360	8640	4,2	Low
Zherebky	300	7200	3,6	Low
Konstantinovka	360	8640	4,2	Low
Magdalivka	240	5760	2,9	Low
Teklivka	180	4320	2,3	Low

** according to the results of the authors' research*

Our calculations of CO emissions show that the largest carbon monoxide emissions occur on the highway in the village of Romanivka - 9.1 mg/m^3, which is almost twice as high as the standard limit (5.0 mg/m^3). In the village Malyi Khodachkiv and Kolodiivka with an average traffic

load of 720 - 740 cars / hour, CO emissions reach 8.1-8.3 mg/m^3, which also indicates an excess of the MPC. In other settlements, the level of traffic load is low, so CO emissions (2-4 mg/m^3) do not exceed the MPC.

Recreational nature use. Since the construction of the Romanivskyi Pond, this place has become one of the recreation centers of the local population, as well as vacationers from the nearby villages and the city of Ternopil. In October 2014, the Ternopil Regional Cup for catching predatory fish by spinning from the shore was held here.

There are many vacationers on the pond in summer. It is used not only as a place for fishing, but also for swimming or just spending time in nature. Beaches, gazebos, picnic tables are located along the coast, which attracts visitors. Our research has proven that an average of 86 people per day rest in the coastal zone of the reservoir (the actual recreational load in the coastal zone of the reservoir).

Recreational load on the coast of Romanivskyi Pond does not exceed the recreational capacity of the territory – 116 people [16]. The recreational capacity was determined by the formula:

V=(N×S×C)/D [4], where:

V – recreational capacity; N – norm of recreational load on the territory; S – territory area, km^2; C – duration of the recreational period, days; D - the average duration of stay of tourists and vacationers on the territory, days [4].

However, due to the lack of a sufficient number of garbage containers, the pond and the coastal area are polluted with solid waste.

Malochodaskyi Pond is located outside the village. This is a channel-type reservoir with an area of 12.77 hectares. It is used for breeding fish (silver crucian carp, carp, perch and pike). Recently, the ecological condition of the reservoir is unsatisfactory and continues to deteriorate.

In the village of Kolodiivka, there is a pond with an area of eight hectares, the good ecological condition of which is the merit of the local community, whose residents observe restrictions on fishing. All members of the fishermen's association follow the rules of fishing (you can catch fish only in a certain period, carp weighing less than a kilogram must be released back into the reservoir, they also release large fish, the so-called "mothers", take care of the cleanliness of the shore) and therefore there are few violations. Similar associations of fishermen have already been organized in the villages of Halushchyntsy and Zherebky, where there are also ponds popular among the local population.

The basin of the small river is an indicator of the state of the environment caused by the level of anthropogenic load on the components of its landscape complexes. Irrational use of water and land resources, their pollution leads to deterioration of the physical properties of water: transparency decreases, turbidity, color increases, unpleasant taste and smell appear (Table 2).

Table 2.

Physical indicators of water quality (autumn, 2021)

	Kachava River	Romanivskyi Pond	Malokhodachkivskyi Pond	Kolodiivskyi Pond
Temperature	+8	+9	+9	+10
Scent	Weak swamp	Weak fish	Expressive swamp	Weak fish
Transparency	26 cm	28 cm	18 cm	30 cm
Turbidity	35.1 cm	32.6 cm	50.4 cm	30.5 cm
Color	30°	32°	42°	32°

** based on the results of the authors' research*

According to regulations, the intensity of the smell of water that can be used for recreational purposes should not exceed 2 points (weak smell); the transparency of the water behind the ring is considered good, at least 40 cm, 20-30 cm is permissible, and water with a transparency of less than 20 cm requires cleaning; turbidity of water - not lower than 23 is considered good, acceptable - 30.5-45.5, and water with transparency less than 45.5 requires cleaning; the color of the water should be below 20°, water with a color of up to 40° is considered acceptable for use [3].

Thus, the analysis of the physical indicators of the water proves that they are satisfactory in all reservoirs, except for the pond in Malyi Khodachkiv. This means that it cannot be used for recreational purposes.

To assess the ecological condition of the Kachava River and the Romanivskyi Pond in terms of hydrobiological parameters, we used the Woodyviss method [5]. As a result of our research, it was found that the Kachava River is an α-mesosaprobe type of water body and is characterized by the 4th water quality class (dirty), and the pond is a β-mesasaprobe type of water body and is characterized by the 3rd water quality class (polluted).

Therefore, since reservoirs are used for

recreational purposes, it is worth applying measures to improve their ecological condition: increase the level of greening of the basin; to conduct actions to clean water bodies from solid household waste; installation of more garbage containers near recreational areas of ponds; regulate the level of recreational load; cultivation of ponds in abandoned places and on beaches; to carry out ecological educational work among the local population; strengthening control and fines for clogging water bodies.

Approaches to optimizing land use in the Kachava River basin.

When developing the optimization model of land use, the following were taken into account:

- landscape and ecological priorities of the studied territory (ranking of types of functions of geosystems in the order of their importance for taking into account the current ecological situation, general trends and needs of socio-economic development) [12].

- ratio of natural and anthropogenically transformed geosystems;

- implementation of the task of increasing the area of the nature reserve fund in accordance with the State Regional Development Strategy in terms of preserving biological and landscape diversity and increasing the area of the nature reserve fund.

Optimization of land use

1. Determination of development priorities of the river basin territory.

One of the priority directions of nature use in the Kachava River basin is agricultural in connection with favorable conditions for the development of agriculture (availability of fertile soils, flat relief of the territory, climatic conditions, etc.).

The presence of water bodies requires more attention to the development of recreational nature use with the provision of appropriate infrastructure for this.

The need for the formation of an eco-network, the implementation of the State Regional Development Strategy for the preservation of biological and landscape diversity, and the increase of the area of the nature reserve fund puts the development of nature as a priority. protected nature management among the most important. The valley of the Kachava River could act as an eco-corridor of local importance, which is currently a problematic task due to the high plowability of the territory.

2. Finding ways to balance land use. Anthropogenically transformed land occupies 72.9% of the total area of the river basin, of which 62.2% is under arable land, and the rest (10.7%) is under buildings, streets squares, etc. This indicates deviation from the optimal indicators by 2 times. It should also be noted that the share of land under forests is not just insufficient, but also critical (0.7%). To improve the situation, we suggest afforestation of the sloping areas of the river basin, namely slopes with a steepness of more than 15^0, as well as ravines and streams. This will contribute to the growth of forest cover in the territory to 6.4%. Taking into account the excessive and ecologically dangerous plowing of the lands of the river basin, it must be reduced by 5.7% due to the afforestation of the lands. It will also provide an opportunity to restore eco-corridors. So, in the village of Halushyntsi, the river is not only plowed close to the channel, but also flows close to the quarry. The total area to be afforested is 24.19 hectares. Between the villages of Zherebky and Kolodiivka, along the Kachavy River and its eight tributaries, arable land stretches. This territory could become an eco-corridor for such a protected object as the "Zherebky" botanical reserve. The total area of land subject to afforestation is 21.59 hectares. In Malyi Khodachkiv, the streams and the shoreline of the pond are unforested. A similar situation exists between this settlement and the village of Romanivka. The total area of land that we propose to cover with forest vegetation is 12.81 hectares.

In the village of Kostyantynivka, it is necessary to afforest 15.68 hectares of land, mainly along the tributary of the Kachava River. The section of the river that flows through the villages of Magdalivka and Teklivka is forested, but there are no forested areas outside these settlements. The total area of land proposed for afforestation is 17.24 hectares. In the village of Romanivka, greening of the northwestern part of the coast of the Romanivka pond and the river valley, which is located between this settlement and the village of Galushchyntsi, is proposed. The area of land to be afforested is 2.67 hectares.

Therefore, thanks to the afforestation of the proposed territories in the Kachava River basin, it is possible to form a continuous ecocorridor that will connect the objects of the nature reserve fund, the number of natural geosystems will increase by 97.65 hectares (5.7%), which will be almost 33% of the total pool area. This indicator is also not optimal, so it is necessary to search for lands that could be planted with gardens, afforested, in order to bring the share of natural lands to at least 40%.

3. Increasing the area of the nature reserve fund.

When forming an optimization model of land use of the Kachava river basin, it is worth mentioning the objects of the nature reserve fund

already available on its territory:

- Galushchynetsky landscape reserve (51 hectares), where fragments of the ridge-hilly transkarst upland, composed of reef limestones are protected. Steppe vegetation listed in the Red Book of Ukraine and regionally rare species grows here: *Stipa capillata, Sempervivum ruthenicum Cotoneaster melanocarpus, Carex humilis, Adonis vernalis, Asplenium ruta-muraria, Allium podolicum, Galium verum, Trinia multicaulis, Salvia nutans, Jurinea calcarea* [9];

- The remnants of the Sarmatian Sea (a geological natural monument of local importance), an outcrop of the northwestern exposure, up to 20 meters high, composed of dense limestones of the Miocene period (more than 5 million years old) with the remains of ancient marine flora and fauna.

- The Zherebki botanical reserve of local importance is a fragment of the Tovtrova ridge with an area of 9.6 hectares, where meadow-steppe and rock phytocenoses are protected. Particularly valuable species are rare and endangered plant species of the region (*Stipa capillata, Adonis vernalis, Sempervivum ruthenicum, Carex humilis)* [10].

We also consider the creation of new objects of the nature reserve fund to be promising. We recommend paying special attention to the wetlands of such settlements as Magdalivka, Malyi Khodachkiv, Kostyantynivka, Romanivka. Among the rare species are *Acorus calamus Lathyrus odoratus* and others.

The forest in the village of Romanivka (18.34 ha) is promising for protection. It is currently used for logging and recreation. Residents of nearby villages collect mushrooms and berries here. Ash, birch, maple, hornbeam, birch, spruce, pine, oak predominate among the trees. Animals include hares, roe deer, squirrels, foxes, badgers and wild boars. Among the mushroomsthere are *Armillaria mellea, Suillus luteus, Pleurotus ostreatus, Agaricus silvaticus, Lycoperdon perlatum, Clitocybe nebularis, Amanita phalloides, Amanita muscaria* and others. *Sambucus nigra, Corylus avellana, Prunus spinosa, Hippophae rhamnoides, Viburnum opulus* are found among the berries. Among the plants listed in the Red Book, there are *Galanthus nivalis, Leucojum vernum*, and others.

We propose to create a botanical reserve, which will increase the percentage of the area under nature reserves in the river basin by 1.1%. If the proposed optimization measures are implemented, the coefficient of anthropogenic transformation of the Kachava River basin (according to the methodology of P.G. Shishchenko) will decrease from 7.2 to 6.4, that is, from high to medium.

Therefore, we have proposed measures to optimize land use in the Kachava river basin and to form an integrated network of nature conservation areas. It is proposed to reduce the arable land by an average of 97.65 hectares (5.7%) mainly due to afforestation. We also propose to organize a landscape reserve on the territory of the marsh in Malyi Khodachkiv and a botanical reserve in the forest in the village of Romanivka on a total area of 24.4 hectares, which will make it possible to increase the share of protected areas in the river basin to 1.5%.

CONCLUSIONS. Thanks to the analysis of the structure of land use in the Kachava River basin, its significant deviation from scientifically based norms was revealed (anthropogenically transformed territories predominate (72.9%), including arable land (62.2%). Excessively high and ecologically dangerous plowing was revealed: in many cases, land is plowed up to the river bed, because of this, eco-corridors, which are an important link of the eco-network, are cut off in the basin. The plowed area of the territory is exceeded by 1.5 - 2.7 times.

We propose to reduce arable land by 97.65 hectares (5.7%) mainly due to afforestation. The submitted proposal will contribute to increasing the share of land under natural ecostabilization lands from 27 to 33% of the total area of the river basin and achieving the formation of a continuous eco-corridor that will connect the objects of the nature reserve fund. If the proposed optimization measures are implemented, the coefficient of anthropogenic transformation of the Kachava River basin (according to P. Shishchenko's method) will decrease from 7.2 to 6.45 (from high to medium). It is also proposed to organize two new protected objects.

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Анотація:

Любов ЯНКОВСЬКА, Світлана НОВИЦЬКА, Наталія ТАРАНОВА. ПРОБЛЕМИ ПРИРОДОКОРИСТУВАННЯ ТА ОХОРОНИ ПРИРОДИ В БАСЕЙНІ РІЧКИ КАЧАВИ

Сучасне нераціональне використання водних і земельних ресурсів призвело до порушення екологічної рівноваги й виникнення таких проблем як забруднення водойм, руйнування природних ландшафтних комплексів річкових долин та прилеглих територій. Басейн як особлива просторова одиниця біосфери найбільш перспективний для багатоаспектного вивчення природи та економіки і для управління навколишнім середовищем.

Метою дослідження є аналіз структури землекористування в басейні річки Качава, особливостей аграрного, промислового, транспортного та рекреаційного природокористування, їх впливу на довкілля, рівня антропогенної трансформації геосистем та розробка заходів з оптимізації землекористування.

Завдяки проведеному аналізу структури землекористування в басейні річки Качава виявлено значне її відхилення від науково обґрунтованих норм (переважають антропогенно перетворені території (72,9%), у тому числі, рілля (62,2%)). Виявлено надмірно високу і екологічно небезпечну розораність: землі у багатьох випадках розорані аж до русла річки, що можна спостерігати у всіх селах, через це екокоридори, що є важливою ланкою екомережі, у басейні обриваються. Обчислено коефіцієнт антропогенної трансформації геосистем у басейні річки Качава (за методикою П.Г. Шищенка), що дорівнює 7,2 і свідчить про високий рівень перетвореності геосистем на досліджуваній території. Встановлено позитивний баланс парникових газів над територією річкового басейну у зв'язку із великою часткою земель під ріллею (1079 т CO_2 в рік), а також внаслідок функціонування тваринницьких комплексів (в результаті внутрішньої ферментації та обробки гною) – приблизно 300 т.

Проаналізовано вплив на довкілля промислових об'єктів, запропоновано заходи із зниження негативного впливу. Досліджено рівень транспортного навантаження в усіх населених пунктах басейну річки Качава. Розрахунковим методом встановлено перевищення середніх обсягів викидів СО від транспортних засобів у селах Романівка, Малий Ходачків та Колодіївка.

Досліджено рекреаційне навантаження та рекреаційну ємність території. Проаналізовано екостан р. Качава, Романівського, Колодіївського та Малоходачківського ставів за фізичними та гідробіологічними (метод Вудівісса) показниками.

Запропоновано заходи з оптимізації землекористування в басейні річки Качава: пропонується скоротити орні землі в середньому на 97,65 га (5,7%) за рахунок здебільшого заліснення; створення двох нових заповідних об'єктів (ландшафтного заказника біля с. Малий Ходачків та ботанічного заказника у лісі біля села Романівка). Подана пропозиція сприятиме зростанню частки земель під природними екостабілізаційними угіддями з 27,1 до 33% від загальної площі річкового басейну та досягти формування суцільного екокоридору, який з'єднає між собою природно-заповідні об'єкти.

Ключові слова: природокористування, оптимізація, антропогенна трансформація, басейн річки, екологічна ситуація.

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