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Assessment of state of aquatic ecosystems of Volynsk region as to the level of anthropogenic load

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The purpose. To assess anthropogenic load and to determine ecological state of basins of small rivers of Volynsk region. **Methods.** Calculation of anthropogenic load and classification of ecological state of basins of small rivers of Volynsk region is carried out with the help of logical-mathematical model «Basin of Small River» on 4 independent models of basic subsystems of water-collecting area: radioactive impurity of territory, use of lands, use of river flow, quality of water. Inductive factor of anthropogenic load is studied according to procedure of anthropogenic load and classification of ecological state of basins of small rivers of Ukraine. **Results.** On the basis of calculation of anthropogenic load and classification of ecological state of basins of small rivers they got results which testify to absence of «good» ecological state in basins of small rivers of Volynsk region. It was fixed that for 44% of the probed rivers ecological state matched to classification «changes are negligible», 33 % had «satisfactory» state, and 22% had « very bad » ecological state of basins. State «changes are negligible» had the rivers Tsir, Stokhod, Veselukha, Kormin; «satisfactory» — the rivers Vyzhevka, Turiya, Konopelka, and «very bad» — the rivers Chornoguzka and Lypa. River waters (even in boundaries of one native zone) were various enough on chemical content. It was caused by physiographic features of their formation and factors of economic activities of people. **Conclusions.** It is established that general state of basins of small rivers of Volynsk region as a whole is satisfactory. Assessment of anthropogenic load on water-collecting area is very important, first of all, for formation of nature protection activity within the limits of river drainage area.

Key words: *surface waters, water-collecting area, anthropogenic load, quality of water, ecological state.*

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Introduction (problem statement). Increasing anthropogenic impact on the environment, its pollution with waste production, leads to a significant deterioration of the ecological state of all its components, including water objects. Among the latter, the most vulnerable are small rivers, which are used primarily for the needs of communal and agricultural, industry and are at the same time wastewater discharge points. All this leads to a deterioration of the ecological state of the river basins.

The river basin is an indicator of the state of the environment that undergoes a certain anthropogenic pressure, resulting in changing landscapes, soils, forests, water quality, flora and fauna. In connection with this particular actuality is the study of anthropogenic load and determination of the ecological status of the basin of the river as a single geosystem. After all, the restoration of the natural-ecological balance in the water and water-bearing ecosystems of the rivers of Ukraine, as well as the creation of conditions for environmentally safe water use, is possible only on the basis of the definition of their current ecological status, which will make it possible first of all to implement water management and ecological zoning of the territory of Ukraine, to develop engineering and organizational principles for solving problems , existing in river basins [1-4].

It is possible to assess the ecological status of the basins of the rivers of Ukraine with the help of an ecosystem approach based on the logical and mathematical model of the hierarchical structure. This model makes it possible to evaluate: 1) the actual ecological status of river basins as a whole and within separate subsystems (radioactive contamination of the territory, use of land resources, use of river runoff, water quality); 2) the effect of changes in individual indicators on the state of subsystems and basin ecosystems in general [5].

Analysis of recent research and publications. An estimation of anthropogenic load from different positions is devoted to a number of scientific studies. Methodical approaches to determining the criteria for estimating anthropogenic loading on small river basins are highlighted in the scientific works of A.V. Yatsyk, P.I. Kovalchuk, L.B. Byshovets, A.P. Chernyavskaya [5], O.V. Kirilyuka [6], Z.V. Timchenko [7] et al. The anthropogenic factor in the formation of the hydrological regime of small rivers of Western Polissya of Ukraine is highlighted in [3].

Significant scientific interest is made by I.Y. Miskovets [9], which analyzes the ecological status and evaluates various types of anthropogenic load on the basins of small rivers of the Volyn region.

The purpose of the research is estimation of anthropogenic loading and determination of the ecological status of the basins of small rivers of the Volyn region.

The object of the study was the Vyzhivka, Turia, Cir, Stokhid, Veselukha, Chernogurzka, Lipa, Konopelka and Kormin rivers.

To accomplish this goal it was necessary to solve the problem: to estimate quantitatively and qualitatively anthropogenic condition in river basins according to different indicators within the limits of separate subsystems; to determine the level of anthropogenic loading and the overall ecological status in the river basins; to substantiate environmental measures to improve certain indicators of individual subsystems..

Materials and methods. The calculation of anthropogenic load and assessment of its impact on the ecological systems of the rivers of the Volyn Oblast are performed on the basis of the classification (assessment) of the state of the main natural systems (subsystems) - land and water resources, water quality by chemical, toxicological, bacteriological and radiation pollution [1; 4].

The logic-mathematical model of the hierarchical structure built on the ecosystem principle allows us to trace the status of river basins according to different indicators within individual subsystems ("Radioactive contamination of the territory", "Use of land", "Use of river runoff", "Water quality") and river basin in as a whole Under this structure it is possible to evaluate not only the general state of the river basin, but also to form an idea of how the changes in individual subsystems indicators affect the state of the whole system of the basin [1; 2]. This is important for the formation of environmental activities in the basins of specific rivers.

Research results. Water resources of the Volyn region are sufficient to meet all the needs of the economy. Of great importance in the region are surface waters, which are represented by 130 rivers and 235 lakes. Most rivers in the Volyn region originate outside the Main European Watershed, and only a few of them (Turia, Stokhid, Vyzhivka, etc.) do not go beyond the boundaries of the oblast. Among the rivers belonging to the Dnipro basin, the largest in the region are Pripyat, Styr, Turia, Stokhid [5].

As a result of economic activity, there is a change in the geoecosystems of water catchments, the transformation of natural systems. Deforestation, the introduction of agricultural land in large areas of land, their ruin, ameliorative measures that are carried out in ecologically unreasonable widespread, the development of wind and water erosion - all this was reflected in the state of the river catchment.

It should be noted that the Polissya zone of Ukraine is generally less grown than the forest-steppe zone and the Steppe zone, but is characterized by large areas of drained lands. Therefore, it is impossible not to take into account the effect of drainage reclamation on the groundwater regime in the adjoining territory.

The above specific conditions of land use, as well as the duration of the existence of reclamation systems, their location in the catchment, and the nature of processes that in varying degrees characterize the effect of reclamation, should be taken into account in the calculation of anthropogenic load.

It should be noted that for the analysis of the state of land use at the catchment of small rivers of the Volyn oblast, the source information was the data of the State Land Cadastre of Ukraine, projects of agricultural land management, soil survey materials and technical documentation for the establishment of water protection zones and coastal strips of rivers and reservoirs, regional schemes anti-erosion measures, river passports, etc. On the basis of these informative materials, within each basin, the area of agricultural land, arable land, forests and afforestations, water mirrors, swamps and wetlands, the level of urbanization, lands with a natural state (forests and afforestation, under water, hayfields, pastures, perelogues) and the area of eroded lands, as well as the annual soil erosion. Among indicators of the use of land resources a special place occupies the indicator of the forestness of the basin.

To determine the optimal parameters of the woodiness of a particular river, a systemic logic-mathematical model for calculating the anthropogenic load on the small river basin is used. This led to changes in the initial indicators of land use. Calculations for this model were carried out by the method of gradual approximation. It has been established that in the basins of the vast majority of investigated rivers, land resources are used unsatisfactorily. The main influence on this indicator is on foresight, natural state and cultivation.

It should be emphasized that according to calculations for small rivers of Ukrainian Polissya, the optimal forests of the catchments are more than 50% with the total forest cover for the mixed forest zone - up to 40%. The forest cover of the Ukrainian Polissya currently stands at 26.1%. With a much less ecological need in the

forestry of Ukraine in general, and Ukrainian Polesye in particular, agricultural development of the country's territory exceeds 72%, and cultivation reaches more than 57%; the share of arable land in the total area of agricultural land is almost 80%, and under meadows and grazing only 12,9%.

Estimating the share of forestness in the rivers basins studied, it was found that the most important are the Veselukha rivers (50.5%), Kormin (49.3%), Stokhid (46%), Tsir (44.2%), Konopelka (42.5%). In the remaining river basins, the forest is less than 35%. The smallest value of forests is the Chornohuzhne river basin, only 7%.

The share of the catchment area used by agriculture varies from 33.7% (Veseluk River) to 81.2% (Chernogurzka river), with predominantly from 38 to 49%. The vulnerability of water catchments also fluctuates in considerable limits - from 17.8% to 70.1% at preferential values of 20-32%. Particularly significant fluctuations of this indicator are the use of land resources, such as erosion (soil erosion). It is in the range of less than 2 t / ha a year to 33.2 t / ha a year (Lipa River).

It was established that 44% of the forested area of the river basins under study was estimated as "below the norm" and "unsatisfactory", by the degree of natural state of such rivers – 33%, for agricultural development – 22%, for agriculture – 33%, for urbanization – 11% and erosion – 44%. Consequently, the analysis of the state of land resources in the basins of the Volyn region shows that most of the indicators are unsatisfactory and do not meet the ecologically acceptable.

In general, the state of land use for most of the basin of small rivers in the region is estimated as "good" and "satisfactory". Pools of the Stokhid and Veselukha rivers are estimated as "close to the norm" for this indicator. Only the Chornohuzhka and Lipa basins have an "extremely unsatisfactory" state of land use.

As it was emphasized above, the nature and condition of the use of water resources of rivers are closely related to the level and characteristics of economic activity. It is clear that this state has a great influence on the direct taking of water from the rivers and underground aquifers. Characteristics of the main indicators of their use are due to the fact that almost all the water taken for research in the rivers is carried out directly from the channels of rivers and from the underground aquifers, which have a hydraulic connection with the river and it is drained. In individual river basins (in particular Veselukha River), the entire water intake falls into the underground part of the river flow, ie, the water is only taken from the underground horizons. For half of the small rivers that are selected for the calculations, the water intake from the underground horizons is greater than or equal to the catchment from the river.

In the basins of the studied rivers where the industrial facilities are located, the largest part of the water used is used for production needs. Virtually everywhere small rivers are the source of agricultural water supply – on individual rivers, up to 70% of the water resources that are involved in commercial traffic are spent on these needs. For household and household needs 10-25% of the total amount of river water used is spent.

An important indicator of the state of water use is the value of irreversible water consumption, which quantitatively characterizes the extent of the river's drainage. In most small rivers, the reduction of river runoff in average water years does not exceed 10% at the expense of water use; in small years these values increase, reaching 25-40% in very shallow years.

To characterize the state of water use of small rivers, the main indicators of water use were calculated. Thus, according to the results of the assessment (classifications) of the use of water resources of small rivers of the Volyn Oblast, taking into account the combined effect of all indicators (qi), it was established that 78% of the basins were evaluated as "good" status assessed (river Vyzhivka, Turia, Tsir, Stokhid , Veselukha, Konopelka, Kormin); 11% – "Satisfactory" (Lipa River); 11% – "catastrophic".

It should be noted that the chemical composition of the river water, even within a single natural zone, is quite diverse. This is due to the physical and geographical peculiarities of their formation, which is valid now, even when the economic activity was still insignificant and did not affect the quality of water. Today, even more diversity of factors of economic activity of people has joined the diversity of local physical and geographical factors [4; 11-13].

The step-by-step application of the model "Water Quality" made it possible to make a general assessment (classification) of water quality. The results of this assessment are as follows: contaminated water (IV quality class) have Vyzhivka, Turia, Cir, Stokhid, Veselukha, Konopelka, Kormin rivers. Very polluted (VI class quality) water of the Chornohuzhka and Lipa rivers. Note that on most rivers, the amount of drain needed for the breeding of sewage is much larger than that observed not only in the shallow, but also in the average water years.

According to the results of the study, there is not a single small river that would have a "good" ecological status. In 44% of the studied rivers, "changes are minor", 33% have "satisfactory" status. However, 22% of the ecological status of the pools is "very bad". As "insignificant changes", the state of the basins of the rivers Tsir, Stokhid, Veselukha, Kormin was estimated; "Satisfactory" – the Vyzhivka, Turia, Konopelka and "very bad" rivers in the Chornohuzhka and Lipa rivers.

In order to improve the environmental situation in the basins of the Volyn Oblast, it is first necessary: to comply with the current requirements of the Environmental Law; to establish water protection zones along river channels; to strictly control discharges and to comply with water purification requirements.

Conclusions

Summing up the results of the conducted estimation of anthropogenic loading on the basins of small rivers of the Volyn region, it can be argued that overall their overall ecological status is satisfactory. Despite the complexity of the issue of the rationing of anthropogenic loading on river basins, using the logic-mathematical model "Small River Basin", it is possible to establish for each river the values of load that do not lead to loss of self-cleaning ability of its ecosystem. Note that the assessment of anthropogenic load on the river basin is very important, first of all, for the formation of environmental activities within the river catchment. All this outlines the prospect of further research of small rivers of Ukraine, which should focus on detailed assessment of the ecological status of their basins.

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