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HYDROLOGICAL AND HYDROCHEMICAL ASSESSMENT OF WATER STATUS OF THE SOUTHERN BUG RIVER WITHIN THE BOUNDARIES OF VINNICHCHINA

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It is highlighted that in modern conditions, the surface waters of land are subject to significant anthropogenic influence, as a result of which their natural state is significantly changed and the possibility of using certain water bodies for economic and drinking needs is significantly limited. Since the drinking water supply of Ukraine is carried out mainly at the expense of surface water, objective information about the condition of water bodies, established on the basis of hygienic and ecological criteria, becomes extremely important and relevant. It was established that the influence of the economic and household activities of the village of Kolyukhiv, Vinnytsia region, on the pollution of the South Bug River within its borders is determined by the influx of nitrogenous substances, which lead to an increase in the concentration of ammonium nitrogen, nitrites and nitrates. The source of nitrogen input to the river water is surface runoff washing and the development of soil erosion processes from the adjacent shorelines, which are used for homestead farming and gardening. As a result of the research, it was found that in a sample of water taken from the South Bug River within the village of Kolyukhiv, Vinnytsia region, 1 km upstream in the forest plantation zone, the hydrogen pH is 7.8, the ammonium nitrogen content is 0.3 mg/l nitrite concentration – 2.7 mg/l, nitrate content – 39.6 mg/l, calcium content – 86.0 mg/l, chloride – 147.4 mg/l, and in the selected water sample 1 km downstream in the zone of intensive farming (homesteads), the hydrogen pH was 8.4, the content of ammonium nitrogen was 0.8 mg/l, the concentration of nitrites was 3.7 mg/l, the concentration of nitrates was 69.3 mg/l, the content calcium – 96.6 mg/l, chlorides – 164.2 mg/l. The main way to limit the flow of nitrogenous substances into the river is to observe sanitary protection zones along the river's perimeter. The sanitary and protective zone of the South Bug River should be 100 m, and in fact it is 10 m within the village. Therefore, the main measure is the expansion of the sanitary and protective zone to 100 m and its observance, which will allow reducing the content of ammonium nitrogen in the river water by 62% , nitrates – by 27%, nitrites – by 48%.

Key words: *water, river, ecological condition, excess, environmental protection measures, nitrates, nitrites.*

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Introduction. The ecological state of surface waters undergoes constant changes in space and time. This is due primarily to their intensive, irrational use. The quality of the surface water of large and small rivers depends on their pollution by wastewater from industrial enterprises and communal services, as well as on the surface runoff of the territories of settlements, industrial facilities, agricultural lands, etc. After all, small rivers create prerequisites for the zonal regularity of the formation of water quality flow resources of large rivers (Akbayeva et al., 2019; Zabokrytska et al., 2006). Therefore, the problem of pollution of small rivers and their hydroecological analysis are quite relevant today. Timely monitoring of the quality of the surface water of small rivers is necessary for the analysis and generalization of information about the state of water bodies, forecasting its changes and the development of scientifically based recommendations for making appropriate management decisions in the field of water resources use and protection (Wang et al., 2016; Akbaeva et al., 2020).

The main principles of modern water and ecological policy are established by the Law of Ukraine "On the State-wide Program for the Development of Water Management", which defines the main directions of this policy: rational and ecologically safe use of water resources; increasing the technological level of water use; development and implementation of new innovative technologies, which provide for the prevention of surface water pollution and the disposal of wastewater treatment routes (Khilchevskyi et al., 2009).

Despite the requirements of this and other laws of Ukraine, about 9.6 billion m^3 of insufficiently treated wastewater, including 2.9-4.0 billion m^3 of contaminated water, is dumped into basins annually (Akbayeva et al., 2014; Rahaman et al., 2005). The population of 40% of the territory of Ukraine consumes water that does not meet the requirements of the standards. About 4 billion m^3 of polluted sewage is discharged into the reservoirs of Ukraine every year.

The water deficit in Ukraine is already 4 billion m^3 (Iurasovet al., 2011; Iatsyk et al., 2003). There are 63.000 small rivers with a length of 186.000 kilometers on the territory of Ukraine. Of the total number of small rivers, about 60.000 (95%) are very small (less than 10 kilometers long) and their total length is 112.000 km. There are 3.212 small rivers with a length of 10 km or more with a total length of about 74.000 km. Thus, in the Dnipro basin there are 1.387 (43%), Dniester – 453 (14%), Southern Bug – 367 (11.4%). The average length of a small river in Ukraine is 3 km, and the average density of the river network is 0.31 km/km^2, and for the mountainous regions of the Carpathians – 1.49 km/km^2 (Iurasov et al., 2012; Viter, 2021).

The degradation and drying up of small rivers will inevitably lead to the degradation of large rivers, therefore the problem of their preservation and rehabilitation is one of the most acute for our country, therefore today in Ukraine there are more than 2.8 thousand sewage treatment plants for the treatment of polluted waters, with independent discharge of wastewater in water objects. Among them, biological treatment facilities – 60%, mechanical – 35% and physical and chemical – 5%. More than 300 cities have facilities for complete biological purification, however, as practice shows, purification takes place at best by 70–85%. In order to protect water and prevent pollution, it is necessary to speed up the introduction of a new procedure for limiting discharges and fees for discharges of polluting substances (Linhoss et al., 2015; Palmer et al., 2006).

At the same time, it should always be remembered that the development of all branches of the economy depends on the state of the state's water resources, which consist of surface, underground and waste water (. Alyautdinov et al., 2017; Mapira, 2011).

Materials and methods. Our research was conducted in the form of comprehensive hydrometric and hydrological characteristics of the South Bug River, which flows within the boundaries of the village of Kolyukhiv of the Tyvriv territorial community of the Vinnytsia region.

Ecological assessment of water is carried out in accordance with the "Methodology of ecological assessment of surface water quality by relevant categories". This assessment is based on the analysis of various indicators of water quality, which include criteria of salt composition, tropho-saprobiological criteria and the content of substances that may have a toxic or radiation effect. Strict adherence to officially published analytical methods is a necessary condition for ecological assessment of surface water quality. At the same time, the following stages are involved: the stage of primary grouping and processing of initial data; the stage of determining the classes and categories of water status according to individual indicators; generalization of water quality assessment by individual indicators by individual blocks, which establish integral values of classes and categories of water quality; determination of the summary assessment of the water quality of the specified water body in general or its individual parts for a certain period of observation. The most important aspect of the methodology of natural water quality research is the correct and justified sampling (Metodyka vidboru prob vody dlia laboratornoho doslidzhennia, 2023).

The results of the analysis of river water obtained from different sampling sites were equated to the established standards, comparing with the MPC. Sampling was carried out in accordance with the "Methodology of water sampling for laboratory research" (Iatsyk et al., 2006). Sampling of water samples from the Southern Bug River within the village of Kolyuhiv was carried out in two designated places from a depth of 0-20 cm from the water surface: 1 km upstream in the area of forest plantations (background), which allows establishing the background level of hydrochemical parameters of the river water; after 1 km downstream in the zone of intensive farming (homesteads), which allows determining the amount of anthropogenic impact of the economic and domestic activities of the population of the settlement on the ecological state of the water (Klymenko et al., 2012).

Sampling of water samples for analysis of chemical indicators was carried out in accordance with the developed SSU ISO 5667-6:2009 Water quality. Sampling of samples. Part 6. Guidelines for sampling water from rivers and streams. For an objective assessment of the chemical indicators of water analysis, before taking a sample, it is necessary to rinse the vessel with water, into which the liquid for analysis is to be taken. After taking samples, they are promptly sent for research. For chemical analysis, this time is 6-8 hours. To prevent dirt from getting into the water during transportation, the container must be carefully closed. It is also worth avoiding direct exposure to sunlight, especially if the sample is sent in a plastic container. Devices for sampling surface water should ensure the tightness of the chamber with the sample (DSTU ISO 7150-1:2003 Yakist vody, 2003).

When taking water samples from the surface layer (0.5 m), the tightness of the chamber is not mandatory. The material of the samplers must be chemically stable and exclude the possibility of changing the composition of the sample that was taken during the time that it is in the chamber of the sampler. The design of devices for extraction involves the use of containers of different capacities of 0.25; 0.5; 1; 2; 3; 5; 10; 20; 30; 50 dm^3. In order to ensure the conservation of surface water samples, the devices for the primary processing of samples must be equipped with dispensers with a capacity of 1 to 10 cm^3. Devices for storing samples must ensure that the composition and properties of water remain unchanged from the moment of its selection to the time of measurement. Sample storage devices must be made of chemically resistant material. The capacity of devices for storing water samples should be chosen from the following: 0.25; 0.5; 1; 2; 3; 5; 10; 20; 30; 50 dm^3. For transporting water samples, the devices must be installed in a container that ensures their storage in winter and summer conditions. Samplers must ensure sampling from a depth of up to 2; 5; 10 m and be manufactured in a modification that makes it possible to simultaneously take samples from different horizons and conduct temperature measurements at the same time as taking the sample (DSTU ISO 6777-2003, 2003).

The obtained indicators were compared with standards – maximum permissible concentrations of pollutants in water. Laboratory studies were carried out in the certified and accredited Scientific Measuring Agrochemical Laboratory of the Department of Ecology and Environmental Protection of the Educational and Scientific Institute of Agricultural Technologies and Nature Management of theVinnytsia National Agrarian University in two repetitions.

Results. The hydrography of the Vinnytsia region is represented by a dense network of rivers, lakes, ponds, swamps and underground waters. The rivers of the region belong to the basins of the Southern Bug, the Dniester and the Dnieper (the Ros River). They are mainly fed by snow and rain and belong to the type of plains. The density of the river network in the region is 0.14-0.21 km per 1 sq. km (including rivers less than 10 km long). River valleys are 1 to 2 km wide. The height of the slopes of the valleys reaches 180 m. These slopes are moderately steep, but sometimes they are also steep. In the floodplains of rivers, there are mostly meadows or bushes, sometimes – swamps (Vradii, 2023).

Rivers in the region are characterized by a significant channel slope (especially in Transnistria). In connection with this, their flow is very fast (0.2-0.7 m/sec). The riverbeds are winding. Some of them have thresholds. In most rivers, depths of 0.3-0.8 m prevail, in floodplains they increase to 1.5-4 m.

The largest river that flows through the territory of the region for a considerable length (317 km) and divides it into two almost equal parts is the Southern Bug. The length of the Southern Bug is 792 km, the area of the basin (together with Ingul) is 63.700 square km The Southern Bug is the third largest river in Ukraine. It originates on the Volyn-Podilsky upland near the village. Kupela in the Khmelnytskyi region at an altitude of 340 m above sea level. After receiving the Buzhok, Vovk and Ikva tributaries, the Southern Bug near the villages of Guli and Dumenka (Khmilnytskyi district) enters the territory of the Vinnytsia region (Khaietskyi, 2022).

The village of Kolyukhiv is almost divided in half by the Southern Bug River. Near the village there are two ponds directly connected to the South Bug River (Fig. 1).

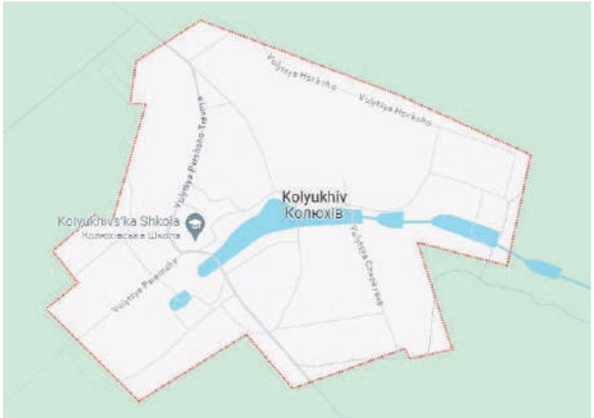

Fig. 1. The South Bug River within the boundaries of the village of Kolyuhiv

The length of the South Bug River within the village of Kolyuhiv is 10 km, the area of the basin is 211 km². The river valley is V-shaped, with dissected slopes. The river valley is narrow in the upper reaches. The floodplain is bilateral, with a width of 30-40 to 100-200 m. The river is slightly winding, branched, hollow in the upper reaches, and forms islands in the lower reaches. The width of the river is from 1-10 to 40 m, the depth is 0.4-0.8 m, the maximum is 2.2 m. The slope of the river is 14 m/km. The current speed is 1.4 m/s (Table 1).

The South Bug River flows within the boundaries of the village of Kolyuhiv initially to the northeast, in the middle course to the north, in the lower course to the northeast again. The bed and bottom of the South Bug River is stony, covered with boulders, sometimes littered with rock fragments.

The river of the Southern Bug is deeply cut into the rocks, because the main role belongs to the processes of deep erosion. The Southern Bug River is characterized by a mixed supply with a predominance of rain and snow. The role of soil nutrition is insignificant. The hydrological regime of the river is very complex. The annual course of flow and levels is

Table 1

Hydrological and hydrometric characteristics of the South Bug River within the boundaries of the village of Kolyukhiv

№	Parameter	Unit	Size
1.	Length	km	10
2.	Pool area	km^2	211
3.	River valley	form	V-shaped
4.	Floodplain width	m	30-200
5.	The width of the river	m	1-40
6.	Average depth of the river	m	0.4-0.8
7.	The maximum depth of the river	m	2.2
8.	The slope of the river	mk/m	14
9.	Flow speed	m/c	1.4

characterized by sharp fluctuations, frequent floods that occur at all times of the year: in spring – from melting snow, in summer and autumn. On average, 20-30 peaks of water level rise are observed per year – from intense rains, in winter – due to sudden thaws. There is no permanent ice cover on the river.

The undisturbed river valley has its own characteristic vegetation. The creation of a peculiar microclimate and mode of moistening due to the water flow contributes to a certain independence of the biocenoses of the river floodplain from the surrounding conditions. Typical natural complexes of floodplains are: alluvial arenas of freshly washed sediments, meadows of varying degrees of moisture, floodplain forests – moist and overmoistened, represented by willow trees, alder trees, and sedges.

The aquatic vegetation of the watercourse is represented by thickets in the form of a strip along the banks of the watercourse. A characteristic belt in the distribution of plants: wetland groups (hydrophytes), followed by a belt of submerged aquatic plants – hydatophytes.

The main factors that determine the quantitative and qualitative indicators of the South Bug River within the village are the village's domestic wastewater and water intake belonging to different quality categories. From a structural point of view, the largest polluter of the reservoir is the homesteads of the village (51% of the total volume of discharges), the housing and communal economy of the village of Kolyukhiv (34%), and agriculture (15%).

The first water sampling site of the Southern Bug River within the village of Kolyukhiv allows establishing the background level of the river's water quality indicators. The second place of water sampling shows the results of the economic and domestic influence of the village population on the state of the river. The results of laboratory tests are presented in Tables 2 and 3.

In a sample of water taken from the South Bug River within the village of Kolyuhiv 1 km upstream in the area of forest plantations, the hydrogen pH value was 7.8 with an optimal value of 6.5-8.5 pH. Thus, the reaction of water is beneficial for hydrobionts. The content of ammonium nitrogen was 0.3 mg/l at the MPC value of 0.5 mg/l, which is a safe level and 1.1 times lower than the MPC. The concentration of nitrites in the water of the South Bug River within the village of Kolyuhiv 1 km upstream in the area of forest plantations was 2.7 mg/l with a maximum permissible concentration of 3.3 mg/l, which is 1.2 times lower than the MPC and is safe the content of nitrates in the water was 39.6 mg/l at the MPC of 45.0 mg/l, which is 1.1 times lower and, accordingly, safe. Also, there was no excess of calcium content – 86.0 mg/l at MPC 180 mg/l and chloride content – 147.4 mg/l at MPC 350 mg/l in the water of the South Bug River within the village of Kolyuhiv. Thus, the calcium and chloride content was 2.1 and 2.4 times lower than the MPC, respectively.

The total water hardness was 2.9 mg-eq./l, and the mineralization was 71.0 mg/l. However, these indicators are not standardized and do not affect the ecological state of the water in the river. Therefore, the content of all studied pollutants in the water of the South Bug River within the village of Kolyukhiv 1 km upstream in the area of forest plantations was lower than the maximum permissible concentrations, no pollutants were detected there.

Table 2

The hydrochemical composition of the water of the Southern Bug River in the area of forest plantations (background)

Hydrochemical index	Unit	Actual content	Permissible concentration limit
Hydrogen pH indicator	pH units	7.8	6.5-8.5
Ammonium nitrogen	mg/l	0.3	0.5
Nitrite	mg/l	2.7	3.3
Nitrates	mg/l	39.6	45.0
Calcium	mg/l	86.0	180
Chlorides	mg/l	147.4	350
Total hardness	mg-eq./l	2.9	-
Mineralization (dry residue)	mg/l	71.0	-

Table 3

Hydrochemical composition of the water of the South Bug River in the zone of intensive farming (homesteads)

Hydrochemical index	Unit	Actual content	Permissible concentration limit
Hydrogen pH indicator	pH units	8.4	6.5-8.5
Ammonium nitrogen	mg/l	0.8	0.5
Nitrite	mg/l	3.7	3.3
Nitrates	mg/l	69.3	45.0
Calcium	mg/l	96.6	180
Chlorides	mg/l	164.2	350
Total hardness	mg-eq./l	3.9	-
Mineralization (dry residue)	mg/l	74.4	-

In a sample of water taken from the South Bug River within the village of Kolyukhiv 1 km downstream in the zone of intensive farming, the homesteads were subject to organic pollution and had much higher values than in the zone of forest plantations. In particular, the hydrogen pH indicator was 8.4 at a normal pH of 6.5-8.5 and was within the normal range (Table 3).

The content of ammonium nitrogen was 0.8 mg/l and was 1.6 times higher than the maximum permissible concentration. The concentration of nitrites was 3.7 mg/l and was 1.1 times higher than the MPC. The concentration of nitrates in the water of the South Bug River was 69.3 mg/l, which was 1.5 times higher than the maximum permissible concentration. The calcium content in the water was 96.6 mg/l, which is 1.9 times lower than the MPC. The same applies to chlorides: 164.2 mg/l is 2.1 times lower than the MPC.

A comparison of water quality indicators of the South Bug River background and in the pollution zone showed that the content of ammonium nitrogen increased by 37.5% – from 0.3 mg/l to 0.8 mg/l and exceeded the maximum permissible concentration (Fig. 2).

The nitrite content also increased along the stream from 1 km upstream in the zone of forest plantations to 1 km downstream in the pollution zone by 72.9% – from 2.7 mg/l to 3.7 mg/l and exceeded the maximum permissible concentration (Fig. 3).

The concentration of nitrates during the specified period of the river flow increased: from 39.6 mg/l to 69.3 mg/l – by 57.1% and exceeded the MPC (Fig. 4). At the same time, the concentrations of calcium, chlorides, total hardness and mineralization did not change significantly: respectively, they increased by 16.8%, 1.0% and 3.4%, there was a lower MPC and no harm.

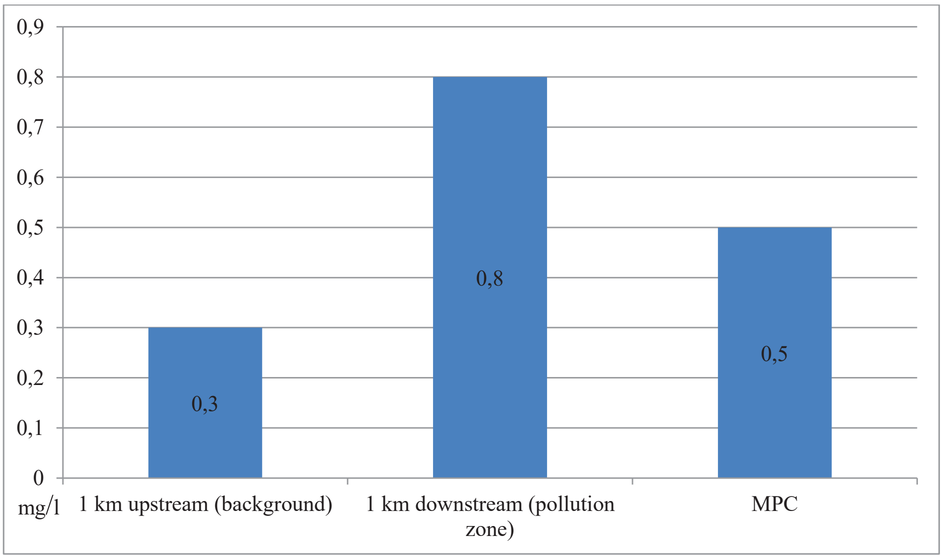

Fig. 2. Dynamics of the concentration of ammonium nitrogen in the water of the South Bug River within the boundaries of the village of Kolyuhiv

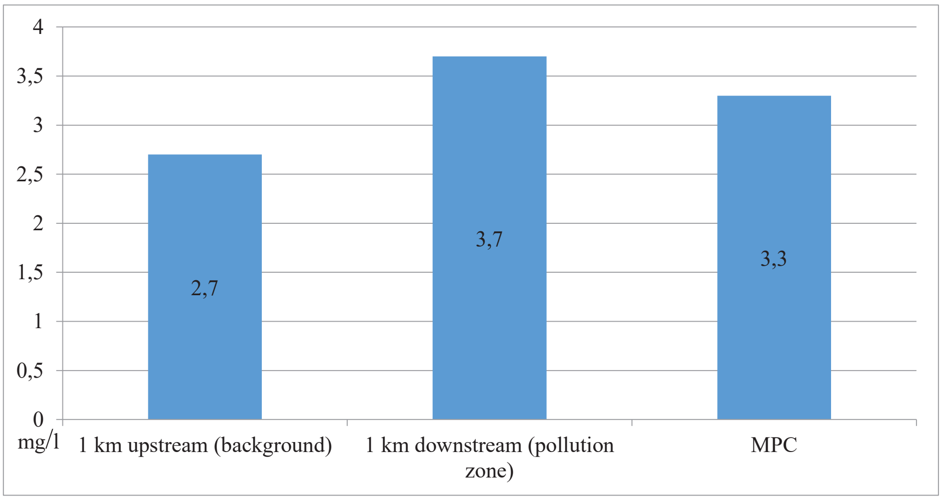

Fig. 3. Dynamics of nitrite concentration in the water of the South Bug River within the boundaries of the village of Kolyuhiv

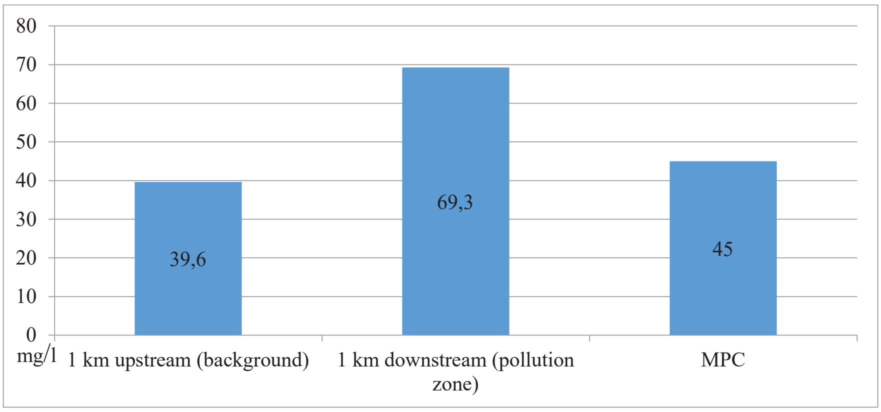

Fig. 4. Dynamics of nitrate concentration in the water of the South Bug River within the boundaries of the village of Kolyuhiv

Thus, it was established that the influence of the economic and domestic activities of the village of Kolyukhiv on the pollution of the South Bug River within its borders is determined by the influx of nitrogenous substances, which lead to an increase in the concentration of ammonium nitrogen, nitrites and nitrates. The source of nitrogen input to the river water is surface runoff washing and the development of soil erosion processes from the adjacent shorelines, which are used for homestead farming and gardening.

Discussion. In general, the main problems that negatively affect the water quality of the Southern Bug River arise as a result of inappropriate treatment of domestic wastewater, weak control over the discharge of industrial wastewater, loss and destruction of catchment areas, irrational location of industrial enterprises, deforestation and irrational methods of agriculture (Afanasiev et al., 2014). The industrial and agricultural load on river ecosystems and the environment in general is constantly increasing, especially in recent decades (Tkachuk et al., 2012; Tkachuk et al., 2016). According to the data obtained by other scientists, the results of hydrochemical measurements indicate the contamination of the water of the South Bug River with nitrates, nitrites, organic compounds and phosphates (Khaietskyi, 2022; Viter, 2021).

But in general, the quality of water according to most chemical indicators is safe and can be used for cultural and household and economic and drinking needs (Khilchevskyi et al., 2018).

Khaietskyi H.S. proves that environmental risks from economic activities that were carried out and are being carried out in the Vinnytsia region necessitate the use of a comprehensive approach to study long-term trends and patterns of changes in surface water quality indicators. The problem of qualitative and quantitative depletion of water resources is becoming more acute every year (Khaietskyi, 2018).

According to Morozova L.P., in order to improve the condition of surface water bodies, it is necessary to identify priority areas of environmental activity. Today, the issue of analyzing the state of the surface waters of the Southern Bug River in control bodies remains relevant (Morozova, 2022). Conducting monitoring studies makes it possible to assess the ecological condition of the Southern Bug River, identify the main water management and ecological problems, and determine the main directions of nature management in the river basins (Iurasov et al., 2012). Determining the water quality of the Southern Bug River is of great importance for assessing the ecological state of the city of Vinnytsia, the main directions of water protection activities, improving the ecological state of each water body and establishing ecological water quality standards. The conducted assessment based on hydrochemical indicators showed that the quality of the surface waters of the South Bug River basin in the territory of the Vinnytsia region, according to most indicators, is significantly below the maximum allowable concentrations for reservoirs for hospital water use (Mudrak, 2011).

Conclusions. As a result of the conducted research, it was established that in a sample of water taken from the South Bug River within the village of Kolyukhiv, Vinnytsia region, 1 km upstream in the area of forest plantations, the pH of hydrogen was 7.8, the content of ammonium nitrogen was 0.3 mg/l, nitrite concentration – 2.7 mg/l, nitrate content – 39.6 mg/l, calcium content – 86.0 mg/l, chloride – 147.4 mg/l, and in the selected water sample 1 km downstream in the zone of intensive farming (homesteads), the hydrogen pH was 8.4, the content of ammonium nitrogen was 0.8 mg/l, the concentration of nitrites was 3.7 mg/l, the concentration of nitrates was 69.3 mg/l, the content calcium – 96.6 mg/l, chlorides – 164.2 mg/l. The main way to limit the flow of nitrogenous substances into the river is to observe sanitary protection zones along the river's perimeter. The sanitary and protective zone of the South Bug River should be 100 m, and in fact it is 10 m within the village. Therefore, the main measure is the expansion of the sanitary and protective zone to 100 m and its observance, which will allow reducing the content of ammonium nitrogen in the river water by 62%, nitrates – by 27%, nitrites – by 48%.

References:

1. Afanasiev, S., Bedz, N. & Bodnarchuk, T. (2014). Plan upravlinnia richkovym baseinom Pivdennoho Buhu: analiz stanu ta pershocherhovi zakhody [South Bug River Basin Management Plan: Status Analysis and Priority Measures]. TOV "NVP "Interservis", Kyiv. 188 s. (in Ukrainian).

2. Akbaeva, L., Mamytova, N., Tulegenov, E., Adilbektegi, G. & Szoskiewicz, K. (2020). Studying the ability to self-purify reservoirs and reservoirs of the Arshalyn district of the Akmola region. Environmental Management and Tourism, 5(11), 1095-1104.

3. Akbayeva, L., Muratov, R., Zhamangara, A., Beisenova, R. & Zhantokov, B. (2014). Seasonal dynamics of phytoplankton and bacterial plankton characteristics. Biosciences Biotechnology Research Asia, 11(3), 1087-1093. http://dx.doi.org/10.13005/bbra/1493

4. Akbayeva, L., Tulegenov, E., Omarbayeva, A., Kobetaeva, N., Nurgalieva, Z., Nurkeyev, Y., Martišová, P., Vietoris, V. & Zhanabayev, A. (2019). Ecotoxicological studies of Akmola region lakes. Pot avinarstvo Slovak Journal of Food Sciences, 13(1), 25-31. https://doi.org/10.5219/824

5. Alyautdinov, A.R., Ushakova, L.A., Artamonova, T.V., Korshenko, A.N. & Pogozeva, M.P. (2017). Using information technologies for estimating the water quality in the eastern part of the Finnish gulf. InterCarto InterGIS, 23(1), 286-296. https://doi.org/10.24057/2414-9179-2017-1-23-286-296

6. DSTU ISO 7150-1:2003 Yakist vody. (2003). Vyznachannia amoniiu. Chastyna 1. Ruchnyi spektrometrychnyi metod [Water quality. Determination of ammonium. Part 1. Manual spectrometric method] (ISO 7150/1:1984, IDT). (in Ukrainian).

7. DSTU ISO 6777-2003. (2003). [Water quality. Determination of nitrites. Spectrometric method of molecular absorption]. Yakist vody. Vyznachannia nitrytiv. Spektrometrychnyi metod molekuliarnoi absorbtsii (ISO 6777:1984, IDT). (in Ukrainian).

8. Iatsyk, A.V. (2003). Vodohospodarska ekolohiia. Osnovy hidrolohii sukhodolu [Water management ecology. Basics of terrestrial hydrology]. Heneza, Kyiv. 400 s. (in Ukrainian).

9. Iatsyk, A.V., Zhukynskyi, V.M., Cherniavska, A.P. &Yezlovetska, I.S. (2006). Dosvid vykorystannia «Metodyky ekolohichnoi otsinky yakosti poverkhnevykh vod za vidpovidnymy katehoriiamy» (poiasnennia, zasterezhennia, pryklady) [Experience of using the "Methodology of environmental assessment of the quality of surface water according to the relevant categories" (explanation, caveats, examples)]. Kyiv: Oriiany. 44 s. (in Ukrainian).

10. Iurasov, S.M., Safranov, T.A. & Chuhai, A.V. (2011). Otsinka yakosti pryrodnykh vod [Assessment of the quality of natural waters]. ODEU, Odesa. 164 s. (in Ukrainian).

11. Iurasov, S.M., Safranov, T.A. & Chuhai, A.V. (2012). Otsinka yakosti pryrodnykh vod: navchalnyi posibnyk [Assessment of the quality of natural waters]. Ekolohiia, Odesa. 168 s. (in Ukrainian).

12. Khaietskyi, H.S. (2018). Ekolohichni problemy malykh richok Podillia ta zakhody shchodo yikh vyrishennia [Ecological problems of small rivers of Podillia and measures to solve them]. Naukovi zapysky VDPU. Seriia: Heohrafiia, 30(3-4), 106-112 (in Ukrainian).

13. Khaietskyi, H.S. (2022). Stan yakosti vody richky Pivdennyi Buh u mezhakh Vinnytskoi oblasti [The state of water quality of the Pivdenny Bug River within the Vinnytsia region.]. Naukovyi visnyk Vinnytskoi akademii bezperervnoi osvity. Seriia “Ekolohiia. Publichne upravlinnia ta administruvannia”, 1, 26–33 (in Ukrainian).

14. Khilchevskyi, V. K., Chunarov, O. V. & Romas, M. I. (2009).Vodni resursy ta yakist richkovykh vod baseinu Pivdennoho Buhu [Water resources and river water quality of the Southern Bug basin]. Nika-Tsentr, Kyiv. 184 s. (in Ukrainian).

15. Khilchevskyi, V.K., Kurylo, S.M. & Shersteyuk, N.P.(2018). Chemical composition of different types of natural waters in Ukraine. Journal of geology, geography and geoecology, 27, 1, 68–80. DOI: https://doi. org/10.15421/111832.

16. Klymenko, O.M. & Statnyk, I.I. (2012). Metodolohiia pokrashchennia ekolohichnoho stanu richok Zakhidnoho Polissia (na prykladi r. Horyn) [Methodology for improving the ecological condition of the rivers of Western Polissia (on the example of the Horyn River)]: monohrafiia. NUVHP, Rivne. 206 s. (in Ukrainian).

17. Linhoss, A. & Ballweber, J. (2015). Incorporating uncertainty and decision analysis into a water sustainability index. Journal of Water Resources Planning and Management, 141(12), 208-217. https://doi.org/10.1061/(ASCE)WR.1943-5452.0000554

18. Mapira, J. (2011). Rriver pollution in the city of Mutare (Zimbabwe) and its implications for sustainable development. Journal of Sustainable Development in Africa, 13(6), 181-194.

19. Metodyka vidboru prob vody dlia laboratornoho doslidzhennia.(2003). [Methods of water sampling for laboratory research]. URL: https://studopedia.com.ua (data zvernennia: 19.08.2023) (in Ukrainian).

20. Morozova, L.P. (2022). Dynamika pokaznykiv khimichnoho ta biokhimichnoho spozhyvannia kysniu v r. Pivdennyi Buh za 2016–2020 rr. [Dynamics of indicators of chemical and biochemical oxygen consumption in the South Bug River for 2016–2020.]. Zbalansovane pryrodokorystuvannia, 1, 90–99. doi: https://doi. org/10.33730/2310–4678.1.2022.255216 (in Ukrainian).

21. Mudrak, O.V. (2011). Ekolohiia. Navchalnyi posibnyk dlia studentiv VNZ [Study guide for university students]. VAT “Miska drukarnia”, Vinnytsia. 520 s. (in Ukrainian).

22. Palmer, M. & Bernhardt, E. (2006). Hydroecology and river restoration: Ripe for research and synthesis. Water Resources Research, 42(3), 1-4. https://doi.org/10.1029/2005WR004354

23. Rahaman, M.M., Mizanur M. & Varis O. (2005). Integrated Water resources management: evolution, prospects and future challenges. Sustainability: Science, Practice, & Policy, 1(1), 15–21.

24. Romanenko, V.D., Zhukynskyi, V.M. & Oksiiuk, O.P. (2001). Metodyka vstanovlennia i vykorystannia ekolohichnykh normatyviv yakosti poverkhnevykh vod sushi ta estuariiv Ukrainy [Methodology for establishing and using ecological standards for the quality of surface waters of land and estuaries of Ukraine]. Kyiv. 48 s. (in Ukrainian).

25. Tkachuk, O.P. & Vereshchak, V.L. (2012). Ekolohichnyi stan richky Pivdennyi Buh [Ecological condition of the South Bug River]. Zbirnyk naukovykh prats Vseukrainskoi mizhvuzivskoi naukovo-praktychnoi konferentsii studentiv ta mahistriv «Ekolohichni problemy Ukrainy ta shliakhy yikh vyrishennia», 28-29 (in Ukrainian).

26. Tkachuk, O.P. & Chernetska, O.O. (2016). The main Environmental Problems in Vinnytsia Region in 2015. International youth agricultural forum: collection thesis. VNAU, Vinnytsia. 29–30 (in Ukrainian).

27. Viter, N.H. (2021). Analiz stanu vody richok Vinnytskoi oblasti. [Analysis of the state of water in the rivers of the Vinnytsia region]. Silske hospodarstvo ta lisivnytstvo, 22, 196–207 (in Ukrainian).
28. Vradii, O.I. (2023). Vplyv rivnia mineralizatsii pytnoi vody na vmist v nii vazhkykh metaliv [The influence of the level of mineralization of drinking water on the content of heavy metals in it]. Silske hospodarstvo ta lisivnytstvo, 4(31), 192–208. doi:10.37128/2707-5826-2023-4-14 (in Ukrainian).
29. Wang, B., Shao, D., Mu, G., Wang, Z. & Li, X. (2016). An eco-functional classification for environmental flow assessment in the Pearl River Basin in Guangdong, China. Science China Technological Sciences, 59(2), 265-275. https://doi.org/10.1007/s11431-015-5926-9
30. Zabokrytska, M.R., Khilchevskyi, V.K. & Manchenko, A.P. (2006). Hidroekolohichnyi stan baseinu Zakhidnoho Buhu na terytorii Ukrainy [The hydro-ecological state of the Western Bug basin in the territory of Ukraine]. Nika-Tsentr, Kyiv. 184 s. (in Ukrainian).

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Гідрологічна та гідрохімічна оцінка стану води річки Південний Буг в межах Вінниччини

В сучасних умовах поверхневі води суші зазнають значного антропогенного впливу, в результаті якого суттєво змінюється їх природний стан та значно обмежується можливість використання окремих водних об'єктів для господарсько-питних потреб. Оскільки питне водопостачання України здійснюється в основному за рахунок поверхневих вод, вкрай важливою й актуальною стає об'єктивна інформація щодо стану водних об'єктів, встановлена на основі гігієнічних та екологічних критеріїв.

Встановлено, що вплив господарсько-побутової діяльності села Колюхів Вінницької області на забруднення річки Південний Буг в його межах визначається надходженням азотистих речовин, що призводять до зростання концентрації амонійного азоту, нітритів і нітратів. Джерелом надходження азоту до води річки є змив поверхневого стоку та розвиток ерозійних процесів ґрунту з прилеглих берегових ліній, які використовуються для присадибного господарства і ведення городництва. В результаті проведених досліджень виявлено, що у відібраній пробі води з річки Південний Буг в межах села Колюхів Вінницької області за 1 км вище по течії в зоні лісових насаджень водневий показник pH становить 7,8, вміст амонійного азоту – 0,3 мг/л, концентрація нітритів – 2,7 мг/л, вміст нітратів – 39,6 мг/л, вміст кальцію – 86,0 мг/л, хлоридів – 147,4 мг/л, а у відібраній пробі води за 1 км нижче по течії в зоні інтенсивного ведення господарювання (присадибні ділянки), водневий показник pH склав 8,4, вміст амонійного азоту – 0,8 мг/л, концентрація нітритів – 3,7 мг/л, концентрація нітратів – 69,3 мг/л, вміст кальцію – 96,6 мг/л, хлоридів – 164,2 мг/л. Основним способом обмеження надходження азотних речовин до річки є дотримання санітарно-захисних зон по периметру річки. Санітарно-захисна зона річки Південний Буг має становити 100 м, а фактично вона становить у межах села 10 м. Тому основним заходом є розширення санітарно-захисної зони до 100 м та її дотримання, що дозволять зменшити вміст амонійного азоту у воді річки на 62%, нітратів – на 27%, нітритів – на 48%.

Ключові слова: *вода, річка, екологічний стан, перевищення, природоохоронні заходи, нітрати, нітрити.*