

ECOLOGICAL STATE OF THE RIVERS
IN THE ZHOVKVA DISTRICT OF THE LVIV REGION

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Abstract. Observation of the surface water state is carried out to determine its quality (contaminant content) based on the results of analytical control. The analysis of surface water was made according to the polluting sources of the object. It resulted in the proposed management decisions on directions and measures to improve the state of surface water.

Key words: observation, research, pollution, surface water.

1. Introduction

Nowadays, the environmental situation in the region is characterized by problems that were created decades ago. The prospects for improving the environment depend not so much on the intention to implement environmental measures, but on the actual possibilities of eliminating the consequences of environmental damage already caused.

When assessing the environmental situation in the region as a whole, a series of inherent trends, both negative and positive, should be mentioned. On the one hand, there are examples of significant environmental pollution and ecological danger, on the other hand, in the region there are areas with clean and attractive environment and nature reserves.

One of the major and indispensable resources of Earth is water resources. Rivers are the major source of water supply and use in the economy of the Lviv region. Nowadays, the use of rivers and river basins is extensive. This is noticeable in the consequences of river valley development when there is excessive deforestation, dominated by high plowing, land reclamation, residential and industrial development, etc. These factors contribute to an increase in the flow of pollutants into the river, the destruction of the riverbed, a decrease in the river runoff, etc.

The development of the national economy in the area is closely linked to the prospect of heavy use of rivers and sometimes the only sources of water supply. To use a reservoir, it is necessary to evaluate the properties and composition of water in terms of its suitability, that is, to evaluate the quantity and quality of water at a particular time.

Water quality in reservoirs is influenced by many factors. It is mostly influenced by the flow and removal of wastewater chemicals, the movement and dilution of pollutants that get into the water from adjacent territories, as well as chemical processes during the interaction of pollutants with natural water components. Biochemical, biological, physicochemical, and physical processes that occur directly in the aquatic environment are particularly important.

2. Presentation of the main material

The Zhovkva district is located in the northwestern part of the Lviv region, with a total area of 1294 km². According to geomorphological conditions, the territory of the Zhovkva district belongs to the Volyn - Podolsk plateau. A minor part of the district (southwestern) is in the Podilskyi subregion, where the geomorphological area of the Humpback Roztochia Plateau stands out. Most of the area is a subdomain of the inner Plain of the Upper Bug and the Styr, with two geo-morphological areas:

1. Zander-Aluminum plain of Rata (the northern part of the district);
2. Strand of Pobuzhia (the southern part of the district).

The slight inclination of the terrain and water-resistant chalk deposits contribute to the water-logging of the Rata. Among the sands of the valleys, there are

boulders of rocks of northern origin, transferred by the melting waters of the glacier. These glacial waters widened the Rata valleys and also lowered the inter-rivers, which now poorly stand out in the form of flat ridges. In some places to the east of the village of Turin, we can observe wetland due to the close water-resistant chalk deposits close to the surface. This relief is most widespread north of Zhovkva.

Water resources of the Zhovkva district play an important role in people's lives and the economy. Water is used as a source of drinking, technical, agricultural water supply, fisheries, etc. Surface waters of the district are

presented by rivers, lakes, and ponds. Since the main European watershed passes in the Zhovkva district, it is dominated by small rivers – the sources of the Western Bug.

The hydrographic network on the territory of the Zhovkva district is rather dense and belongs to the Western Bug River basin, it comprises small rivers, streams, lakes, artificial reservoirs, ponds. The average density of the river network, taking into account rivers less than 10 km long, is 0.35 km/m², and without it – 0.22 km². General characteristics of the rivers of the area are presented in Table 1.

Table 1

Characteristics of the rivers in the area

River	The length in the region, km	The basin, the river belongs to	The number of settlements found along the coastal strip, p.	Number of dams (reservoirs), p.	The number of pipelines, passing through the rivers, units				The number of pressure head sewers which cross the reservoir, units
					gas -	oil -	ammonia-	product-	
The Malekchivka	7	Western Bug	1	–	–	–	–	–	–
The Yarychivka	11.2	Western Bug	3	1	–	–	–	–	–
The Mlynivka	17	Western Bug	3	1	1	–	–	–	–
The Dumna	21	Western Bug	4	–	–	–	–	–	–
The Kapelivka	3	Western Bug	1	–	–	–	–	–	–
The Rata	34	Western Bug	4	1	–	–	–	–	–
The Telychka	10	Western Bug	2	–	–	–	–	–	–
The Moshanka	32.8	Western Bug	3	–	–	–	–	–	–
The Richka	13	Western Bug	2	–	–	–	–	–	–
The Marusja	16	Western Bug	3	–	–	–	–	–	–
The Bila	32	Western Bug	4	–	1	–	–	–	–
The Ugrynka	15	Western Bug	3	–	–	–	–	–	–
The Divna	10	Western Bug	3	–	–	–	–	–	–
The Svyňa	38.5	Western Bug	7	–	1	–	–	–	1
The Balanda	19	Western Bug	3	–	1	–	–	–	–
The Derevanka	36	Western Bug	5	–	1	–	–	–	–
The Kysljanka	12	Western Bug	1	–	–	–	–	–	–
The Chervonech	11	Western Bug	1	–	–	–	–	–	–
The Geldech	12	Western Bug	2	–	1	–	–	–	–
Total	350.5		55	3	6	–	–	–	–

Surface water is still a polluted natural resource. The ecological status of the surface waters of the area is influenced by various factors that are closely related, namely: soil pollution, atmosphere, change in landscape structure and technogenic congestion of the territory, inefficient work of sewage and treatment facilities, failure to mark in nature the cartographic materials of coastal protective strips and water protection zones, as well as their non-observance, especially in the settlements.

The ecological assessment of surface water quality by relevant categories is carried out in accordance with the “Methodology of ecological assessment of surface water quality by relevant categories”, which was developed and approved by the Decree of the Ministry of Ecological Security of Ukraine No. 44 of March 31, 1998, as an interagency guideline regulatory document. [4]

The standard base of the “Methodology for ecological assessment of surface water quality by relevant

categories” is the system of ecological classifications of surface water quality. Specialized environmental classifications in this system are divided into three blocks:

Block of indicators of salt composition (by criteria of mineralization, ionic composition; by criteria of contamination of fresh hypo- and oligogaline waters by the components of salt composition; by criteria of contamination of salty β -mesogaline waters by the components of salt composition);

Block of trophic-saprobiological (ecological-sanitary) indicators;

Block of indicators of the content of substances of toxic and radiation action and the level of toxicity (by the criteria of the content of specific substances of toxic action; by the level of toxicity of fresh and brackish waters; by the criteria of the content of specific indicators of radiation action).

Using the above methodology and the results of the measurements of surface water quality, an ecological assessment of surface water quality was carried out according to the following categories:

– the surface waters of the Rata River belong to the second and third classes of quality. The third class is in the river line of the Rata River, the town of Rava-

Ruska, the Svynia River, the town of Zhovkva, the Rata River, the village of Volytsia, the Zheldets River, the town of Velyki Mosty, the Moschanka River, and the Bila River;

– according to the indicators of the salt block, the surface waters of the basin belong to the I–III quality classes;

– according to the indicators of the tropho-saprobiological block, the surface waters of the basin belong to the II–IV quality classes. The IV class is in the river line of the Rata River, the town of Rava-Ruska, after the discharge from treatment facilities;

– according to the indicators of the block of specific indicators of the toxic effect, the surface waters of the Rata basin belong to the second and third quality classes; the second class is in the Zheldets River in the village of Kupychvolia.

– the calculations conducted to determine the water quality class showed that the indicators of the nitrogen group (ammonia nitrogen, nitrates, and nitrites) had the greatest effect on the deterioration of the water quality class and its transparency. Detailed information on the environmental assessment of the surface water quality is presented in Fig. 1.



Water quality class symbols:

● – the first quality class, ○ – the second quality class, ○ – the third quality class, ● – the fourth quality class

Fig. 1. Ecological price of reliable water region of Zhovkva district

Analyzing different approaches to the methods of determining the quality of water, we used the most effective method of ecological assessment of the surface water quality by categories. [4, 6].

Observation of the surface water quality in the Zhovkva district in 2018 was carried out on 7 approved dams. Based on these observations, the water quality analysis was carried out, namely:

– **Indicators of contaminants in dam No. 1 (the Rata river, the town of Rava-Ruska):**

- 02.21.2018. The recorded excess in total phosphorus was 3.32 MPC;
- 24.04.2018. The recorded excess in total phosphorus was 3.77 MPC; SPAR – 1.07 MPC;
- July 22, 2018. Compared with the normative indicators for reservoirs for fisheries, the recorded excess in phosphates was 7.24 MPC; total iron – 4.3 MPC; SPAR – 3.93 MPC.

– **Indicators of contaminants in dam № 2 (the Rata River, the village of Volysia):**

- In I and II quarters, the excess in total iron was 1.3 MPC; phosphates – 1.41 MPC;
- July 22, 2018. The excess in total iron was 5 MPC; phosphates – 1.12 MPC; sulfates – 1.05 MPC.

– **Indicators of contaminants in dam № 3 (the Derevenka River – the right-bank tributary of the Rata River).**

- 02.21.2018. The excess in total iron was 3 MPC; nitrite ions – 2.5 MPC; sulfates – 1.02 MPC; phosphates – 2.35 MPC;
- 24.04.2018. The excess in phosphates was 1.82 MPC;
- July 22, 2018. The excess in ammonium ions was 4.88 MPC; nitrite – 12.5 MPC; phosphates – 15.88 MPC; total iron – 3 MPC.

– **Indicators of contaminants in dam № 4 (the Svyntia River, the town of Zhovkva):**

- 02.02.2018 The excess in total iron was 2.7 MPC; nitrite ions – 3.13 MPC; sulfates – 1.05 MPC; phosphates – 2.41 MPC;
- 24.04.2018. The recorded excess in total iron was 1.7 MPC; phosphates – 9.41 MPC;
- July 22, 2018. The recorded excess in ammonium ions was 14.28 MPC; phosphates – 18.82 MPC; total iron – 7 MPC

– **Indicators of contaminants in dam № 5 (the Bila River):**

- 02.21.2018. The excess in the indicators for fish farms on the Bila River within the villages is absent;

- 24.04.2018. The excess in ammonium ions was 10.4 MPC; nitrite – 4.5 MPC; phosphates – 19.95 MPC; total iron – 4.5 MPC;

- July 22, 2018. The recorded excess in ammonium ions was 13.2 MPC; nitrite – 3.25 MPC; phosphates – 19.41 MPC; total iron – 4.5 MPC.

– **Indicators of contaminants in dam No. 6 (the Moshchanka River):**

- 02.21.2018. The excess in total iron was 3.1 MPC; sulfates – 1.07 MPC;
- 24.04.2018. The excess in total iron was 1.3 MPC; phosphates – 1.41 MPC;
- July 22, 2018. The recorded excess in phosphates was 6.47 MPC; total iron – 3 MPC.

– **Indicators of contaminants in dam No. 7 (the Zheldets River, the village of Kupychvolia)**

- In I and II quarters, the sulfate excess of 1.1 MPC was recorded;
- July 22, 2018. The recorded excess in ammonium ions was 1.56 MPC; phosphates – 14.71 MPC; iron total. – 3.4 MPC; SPAR – 12.5 MPC.

In total, 31 environmental samples were taken in river basins. 795 component determinations were made, 4.4 % of which exceeded the maximum permissible concentrations of pollutants.

Detailed information is presented in Table 2.

According to the indicators, the total surface water quality in the Zhovkva district can be divided into three types: slightly polluted, moderately polluted, and very dirty. Such differences in the water quality classes are caused by the influence of natural and anthropogenic factors, which include the inflow of pollutants with such tributaries as the Svyntia River, the Rata River, the Bila River, the Moshchanka River and others. It should also be noted, that the quality of water is significantly deteriorated due to human activity. The discharge of untreated and inadequately treated municipal and industrial wastewater occurs due to the physical and moral deterioration of wastewater treatment plants and the lack of funds for their construction, repair, and reconstruction. Due to prolonged operation without the ongoing repair of water supply and sewerage systems, most water supply and sewerage facilities in the region are in poor technical condition, which is constantly deteriorating. The private sector and non-compliance with the boundaries of coastal protection zones and water protection zones contribute significantly to the pollution of the surface water,

Table 2

Observation of surface waters of Zhovkva district

No. p/n	Reservoir	River	Number of samples selected	% of all samples within the reservoir	Number of component definitions	Number of samples exceeding the MPC	% of total excess
1.	The West Bug	The Rata	12	37.50	303	12	37.5
2.		The Svynia	6	18.75	174	6	18.8
3.		The Bila	4	12.50	98	4	12.5
4.		The Dymnyi Stream	2	6.25	56	2	6.3
5.		The Derevenka	3	9.38	72	3	9.4
6.		The Moshchana	3	9.38	72	3	9.4
7.		The Zheldets	1	3.13	20	1	3.1
Total			31	96.89	795	31	97

Conclusions

According to the results of the environmental assessment of the rivers in the Zhovkva district, it is established that water quality is in poor ecological condition. The major cause of surface water pollution is the discharge of untreated and inadequately treated wastewater into water bodies. The main measures to improve the state of surface water bodies are the reconstruction of sewage treatment plants, construction and repair of residential sewage networks of settlements. The implementation of relevant environmental measures is also topical nowadays. These include:

- fight against water erosion and siltation;
- clearing the river bed, the banks of the rivers and their tributaries from household debris, branches, trees, and boulders that contribute to the erosion of the banks and flooding;
- planting trees on the slopes of the river banks;
- conservation of wetlands in the river valleys and their tributaries.

References

- [1] Gholodovsjka O. Ja., Kovaljchuk O. Z.: Visn. Nacional. universytetu "Ljvivjsjka politehnika", 2009, 44, 206. (in Ukrainian)
- [2] Reghionaljna dopovidj pro stan navkolyshnjogho pryrodnogho sere dovyssha u Ljvivjskij oblasti v 2009 roci. (in Ukrainian)
- [3] Gholodovsjka O. Ja., Meljnyk K.: Stalyj rozvytok – stan ta perspektyvy : materialy mizhnarodnogho naukovo gho sympoziumu SDEV'2018, Ljviv-Slavsijke, Ukrajina, 2018, 157. (in Ukrainian)
- [4] Metodyka ekologichnoji ocinky jakosti poverkhnevykh vod za vidpovidnyy kategorijamy. Kyjiv: Symvol-T, 1988, 28. (in Ukrainian)
- [5] Zvit pro ekologichnyj monitoryng Ljvivjskoji oblasti za 2016 rik. Derzhavne upravlinnja okhorony navkolyshnjogho pryrodnogho sere dovyssha v Ljvivskij oblasti. (in Ukrainian)
- [6] Metodyka rozrakhunku koeficijenta zabrudnenosti pryrodnokh vod: KND 211.1.1.106-2003 Orghanizacija ta zdijsnennja sposterezhenj za zabrudnennjam poverkhnevykh vod (v systemi Minekoresursiv). K., 2003, 25. (in Ukrainian)
- [7] Zakhidno-Buzjke basejnove upravlinnja vodnykh resursiv: veb-sajt. <http://zbbuvr.gov.ua/>
- [8] Voznjuk N. M.: Visn. Nac. un-tu vodnogho ghospodarstva ta pryrodokorystuvannja (NUVGhP).– Rivne, 2006, 1(33), 3. (in Ukrainian)
- [9] Voznjuk N. M.: Ocinka ekologichnogho stanu ukrajinskoji chastyny basejnu riky Zakhidnyj Bugh : avtoref. dys. kand. sil.-ghosp. nauk; Derzh. aghroekol. un-t. Zhytomyr, 2006, 19. (in Ukrainian)
- [10] Kalenichenko L.: Vodne ghospodarstvo Ukrajiny, 2005, 4, 40. (in Ukrainian)
- [11] http://www.confcontact.com/2013-specproekt/gu2_vostrikova.htm
- [12] Mokin V., Kryzhanovskij Je., Varchuk I., Skoryna L.: Vodne ghospodarstvo Ukrajiny, 2016, 3, 39. (in Ukrainian)

- [13] Mokin V., Ghavrykov Ju., Kryzhanovskij Je., Ghavenko O., Kocjuba Je.: *Vodne ghospodarstvo Ukrainy*. 2014, 2, 23. (in Ukrainian)
- [14] Stepova O. V., Bulavenko R. V., Roma V. V.: *Visn. Poltav. derzh. aghrar. akad.*, 2012, 1, 181. (in Ukrainian)
- [15] Meljnijchuk M. M., Chyr N. V.: *Naukov. visn. Volynsjkogho derzhavnogho un-tu im. Lesi Ukrainky*. 2007, 2, 245.
- [16] Sablij L. A., Zhukova V. S.: *Visnyk Nac. un-tu vodnogho ghospodarstva ta pryrodokorystuvannja: zbirnyk naukovykh pracj*, 2010, (49), 25. (in Ukrainian)
- [17] <http://zakon2.rada.gov.ua/laws/show/z0403-02>
- [18] Zapoljskij A. K.: *Vodopostachannja, vodovidvedennja ta jakistj vody*. Vyshha shk., Kyjiv. 2005.
- [19] Anthonisen A. C., Loehr R. C., Prakasam T. B. S., Srinath E. G.: *J. Water Pollution Control Federation*. 1976, 48, 835. (in Ukrainian)
- [20] Bljashyna M. V., Sablij L. A.: *Naukov. visnyk Nac. un-tu vodnogho ghospodarstva ta pryrodokorystuvannja: zb. nauk. pracj*, 2012, 4 (60), 95. (in Ukrainian)