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WATER RESOURCES OF THE KHOROSTKIV TERRITORIAL COMMUNITY: ECOLOGICAL STATUS, WATER USE PROBLEMS, OPTIMISATION MEASURES

The article analyses the ecological state of surface water resources of the Khorostkiv territorial community (TC). According to the results of laboratory tests, pathogenic microorganisms, bacteriological indicators exceeding the regulatory requirements, faecal contamination and high content of organic matter were detected in the surface water bodies of the Khorostkiv TC. In addition to the pollution of surface water bodies in the Khorostkiv TC, an important environmental problem worth paying attention to is the lack of sanitary protection and water protection zones for rivers and ponds, as well as the littering of the coastal strip. It was found that the water supply network of the Khorostkiv territorial community includes only the water supply network of the town of Khorostkiv (30 km, unsatisfactory condition), since there are no centralised water supply systems in rural settlements. In the sources of centralised water supply in Khorostkiv, the levels of ammonium nitrogen and colour are exceeded. Hydrochemical analysis of water samples from private wells in Khorostkiv and the villages of Peremyliv and Khlopivka confirmed compliance with the requirements of SanR&R № 400. The volume of daily water consumption and water disposal was analysed. The main sources of pollution of the community's water resources and the volume of wastewater discharges were identified. Priority areas for improving the ecological state of water resources of the Khorostkiv community are substantiated.

Keywords*: surface water, groundwater, pollutants, water supply, water disposal, territorial community (TC).*

Relevance of the study. The current trends of global and regional climate change, reduction of fresh water reserves, and lowering of groundwater levels require the intensification of all forms and methods of water conservation. To ensure the rational use and scientifically sound protection of hydrological resources, preliminary research and study of the state of surface and groundwater are necessary. Studying hydroecological problems and developing ways to solve them will be especially relevant at the local level of territorial communities (TC). As these are new administrative units whose environmental policies are still being formed, it is important to emphasize the need to conserve and rationally use water resources in various sectoral community development programmes. Therefore, the study of the current state and optimization of water use in the Khorostkiv territorial community is a relevant and important scientific and practical task. The results of the study have important applied significance for the implementation of the Environmental Protection Programme in Ternopil Region for 2021-2027, the Programme for the Development of Water Management and Water and Environmental Improvement of the Environment in Ternopil Region for 2021-2024, and the Development Strategy of the Khorostkiv Territorial Community for 2019-2026.

Analysis of recent publications on the research topic. A number of interesting and important studies have been carried out in the river basins of Ternopil region. The basin systems of small rivers of Western Podillya were studied by Lyubomyr Tsaryk, Ivan Kovalchuk, Petro Tsaryk, Bogdan Zhdaniuk, Ihor Kuzyk (2020, 2021) [21, 23], who analysed the state, change trends, perspectives of nature management and nature protection optimization. Barna I. and Sofinska O. (2022) [2] carried out the analysis of the flood regime of the Dniester River (within Ivano-Frankivsk and Ternopil regions). The regulation of economic activities on ponds and reservoirs in the Nichlava River basin is substantiated in Melnyk Y., Tsaryk L., Kuzyk I. (2022) [9]. Geo-ecological studies of the Seret River were conducted by Stetsko N. (2018) [14]. Problems of natural resource management and nature protection in the Kachava river basin were studied by Yankovska L. and Novytska S. (2022) [25]. The transformation of geo-ecological processes in the Dzhuryn river basin is covered in Bakalo O., Tsaryk L., Tsaryk P. (2018, 2020) [1, 18]. The geo-ecological assessment of the land use structure of the small Hnizdechna River basin was carried out by Kuzyk I., Vitenko I., Tsaryk V. (2022) [7]. The rivers of the Husiatyn territorial community are described in the publication by Liubyi A., Yankovska L., Novytska S. (2023) [8]. However, the study of water resources in the context of territorial communities of Ternopil region is just beginning, and our work is a relevant contribution to this area of research.

The object of our study is the groundwater and surface water resources of the Khorostkiv territorial community. The subject is the ecological state and peculiarities of the use of water resources of the Khorostkiv community. The aim of the study is to assess the hydroecological state of surface and groundwater resources of the Khorostkiv territorial community, analyse the structure of water use and substantiate the priority areas for improving the ecological state of water bodies in the studied territory.

Materials and methods of the study. The

theoretical and methodological basis of the study is the fundamental provisions of hydrology, geoecology and geographical local history, ecological and constructive geography. The research is based on the ecological and geographical approach, which involves a comprehensive analysis of the hydroecological state of water resources of the Khorostkiv territorial community. The study used both general scientific methods: generalisation and systematisation, analysis and synthesis, statistical, descriptive, and special methods: landscape-geochemical, geoinformation, cartographic, evaluation, geo-ecological analysis and expert assessments.

Results and discussion. The Khorostkiv urban territorial community is located in the Chortkiv district of Ternopil region with a population of 14,155 and a total area of 183.6 km2. The community consists of 10 settlements: the town of Khorostkiv, the villages of Velykyi and Malyi Hovyliv, Karashyntsi, Kluvintsi, Peremyliv, Verkhivtsi, Soroka, Uvysla, and Khlopivka [15].

The water fund of the Khorostkiv TC covers about 280 hectares (1.5% of the total area), almost 57% of which is concentrated in the town of Khorostkiv. The land occupied by ponds and reservoirs prevails in the structure of the Khorostkiv community water fund (Fig. 1). Natural waterways (rivers and streams) in the community cover 54 hectares of land, most of which are in Khorostkiv (21 hectares). There are 61 hectares of man-made watercourses, and 158 hectares of ponds in the Khorostkiv TC, of which 127.3 hectares are ponds in Khorostkiv.

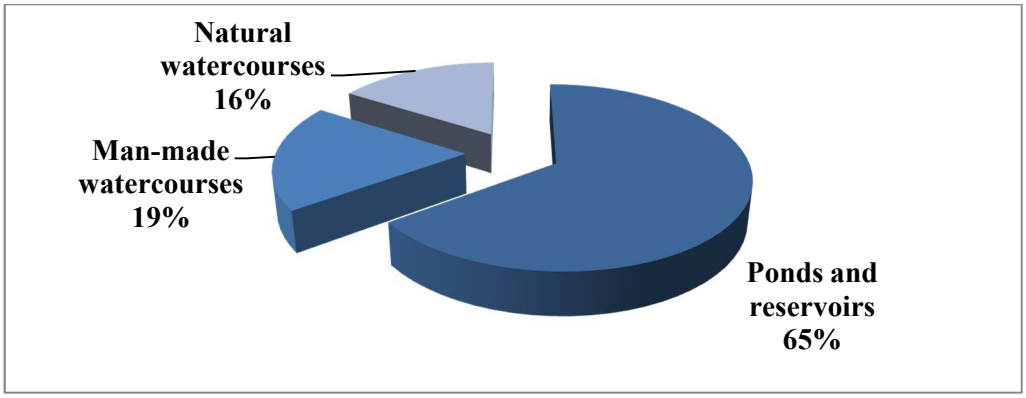

Fig. 1. Structure of the water fund lands of the Khorostkiv TC

The surface water resources of the Khorostkiv TC are represented by 14 ponds, 1 reservoir and 6 rivers (Taina River, Chornytsia River, Poplavy River, Rudka Velyka River, Rudka Mala River, Holodni Stavy River). The longest river in the community is the Taina River, a right tributary of the Hnyla River (Dniester basin). The river is 46 km long and the basin area is 327 km^2. The river slope is 2.0 m/km. The floodplain is bilateral, largely swampy, and up to 100 m wide. The channel is meandering, 5-7 m wide. The watercourse freezes in December and thaws in March. The flow is regulated by ponds, the water from which is partially used for agricultural purposes.

The main sources of pollution of water bodies in the Khorostkiv TC are rain and municipal wastewater, as well as enterprise effluents. Municipal wastewater is characterised by a high concentration of detergents, organic substances, biogenic components, etc. [13]. The ingress of such chemical compounds into surface water bodies causes the phenomenon of eutrophication [16].

The surface water bodies of the Khorostkiv TC are exposed to significant anthropogenic impact. This is especially the case with the Taina River, into which the municipal utility company (MUC) “Kommunalnyk” discharges its wastewater. According to the Environmental Passport of Ternopil region [5], we found that over the past 10 years, “Kommunalnyk” in Khorostkiv has discharged 281 thousand m^3 of waste water into the Taina River. These wastewater discharges included about 287 tonnes of pollutants (Fig. 2). In 2020, the Regional Office of Water Resources in Ternopil Region measured the composition and properties of the wastewater of Khorostkiv's "Kommunalnyk". The results of the analyses are shown in Table 1.

According to the statistics of the State Water Agency of Ukraine [3], 133 thousand m3 of wastewater was discharged within the Khorostkiv TC in 2021, of which 40 thousand m3 were polluted. Therefore, we can calculate the polluted wastewater discharge coefficient (PWD) [10] into the Taina River, which is as follows: PWD = Vpolluted / Vtotal = 40 / 133 = 0.3.

The results of the calculations showed that the coefficient of polluting wastewater discharge into the Taina River is 0.3. From this, we can conclude that the concentration of pollutants in the wastewater discharged into the river is not high. However, if the trends of polluted water discharge continue, there is a risk of deterioration of the ecological parameters of the watercourse.

Table 1

Indicators of wastewater composition
Khorostkiv Municipal Utility Company "Kommunalnyk" [17, p. 113-114]

№	Hydrochemical parameters	Measurement results	Measurement error ±Д
1	Ammonium nitrogen, mg/dm^3	1,95	±0,17
2	Nitrite ions, mg/dm^3	0,24	±0,07
3	Nitrate ions, mg/dm^3	12,2	±3,05
4	Phosphate ions, mg/dm^3	2,1	±0,21
5	COD, mgO2/dm^3	78,8	±15,7
6	BOD5, mgO2/dm^3	14,8	±1,05
7	Suspended solids, mg/dm^3	15,0	±3,0
8	Chloride ions, mg/dm^3	64,0	±6,4
9	Sulphate ions, mg/dm^3	69,0	±6,9
10	Total iron, mg/dm^3	0,3	±0,01
11	Oil products, mg/dm^3	0,05	±0,02
12	Liquids, mg/dm^3	0,3	±0,03
13	Hydrogen index, pH unit	7,2	±0,04
14	Dry residue, mg/dm^3	882,0	±44,1

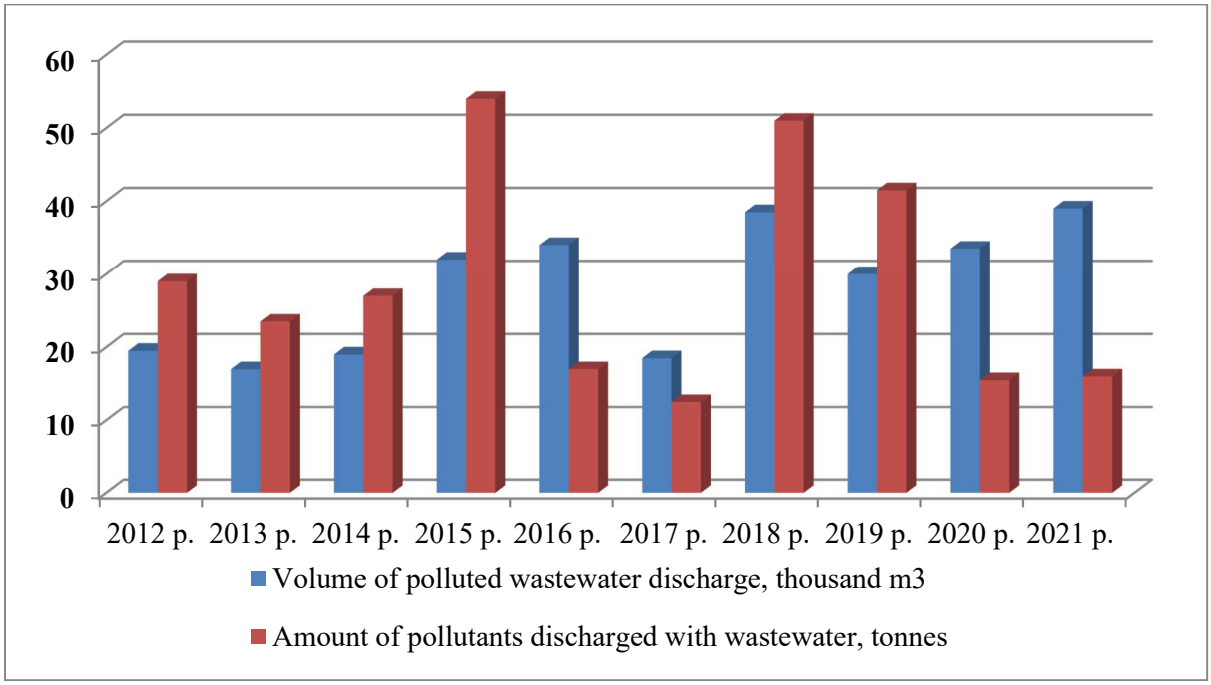

Fig. 2. Dynamics of waste water discharge by Khorostkiv Municipal Utility Company "Kommunalnyk" into the Taina River

In order to determine the quality of surface water resources of the Khorostkiv TC, in September 2020, local authorities conducted relevant laboratory studies. Water samples were collected from 5 water bodies: the Holodni Stavy River in Khorostkiv, the Taina River in Velykyi Hovyliv village, and three ponds in Khorostkiv, Peremyliv and Khlopivka villages [17].

The bacteriological laboratory of the State Institution "Ternopil Regional Laboratory Centre of the Ministry of Health of Ukraine" examined the water mass of surface water bodies for compliance with the requirements of the State Sanitary Rules (SSR 173-96) [24] for microbiological indicators. According to the results of the studies, pathogenic enterobacteria in 1 dm^3 of water were detected in all samples, according to the lactose-positive coliforms (LPC) index, the water of any sample did not meet the regulatory requirements, and the E.coli index in three samples was found to be non-compliant. Therefore, it was found that the index of LPC and E.coli in the surface water bodies of the Khorostkiv TC exceeds the normative indicators. This indicates faecal contamination of water bodies. In addition, based on these indicators, it is possible to state a high content of organic matter in water samples, the concentration of which increases as a result of the death of aquatic organisms,

mainly phytoplankton and higher aquatic vegetation [11, p. 114-115].

Water samples were analysed for physical and chemical parameters in the sanitary and hygienic laboratory of the State Institution "Ternopil Regional Laboratory Centre of the Ministry of Health of Ukraine". Two water samples (ponds in Khorostkiv and Peremyliv) did not meet the requirements of State Sanitary Regulations (SSR 173-96) in terms of chemical parameters. The results of the studies of water samples from surface water bodies of the Khorostkiv TC are presented in Table 2.

Table 2

Results of the study of water samples from surface water bodies of the Khorostkiv TC [17, p. 114]

Sampling location	Research results			
	Lactose-positive E. coli index	E. coli index	pH	Oxidation
Khorostkiv, confluence of the Holodni Stavy River into the Taina River	38 730	120 330	8,08	6,3
Khorostkiv, pond near the distillery	130 000	200	8,52	11,2
Khlopivka, village pond	198 630	4410	7,87	4,9
Peremyliv, village pond	36 550	200	8,96	19,2
V. Hovyliv, the Taina River	>242 000	>242 000	7,71	5,5

In addition to the pollution of surface water bodies in the Khorostkiv TC, an important environmental problem worth paying attention to is the lack of sanitary protection and water protection zones for rivers and ponds, as well as the littering of the coastal strip. During the autumn-winter period of 2022-2023, we recorded three illegal landfills in the Tayna River Valley. There are unauthorised local landfills in the villages of Kluvintsy, Verkhivtsi and Malyi Hovyliv.

Therefore, the ecological status of surface water resources in the Khorostkiv TC can be assessed as satisfactory with steady deterioration trends. The main hydro-ecological problems of the community are high volumes of polluted wastewater discharged by Kommunalnyk; uncontrolled discharges by private households; non-compliance with the State Sanitary Rules of certain bacteriological and physicochemical indicators of surface waters of the town of Khorostkiv and the village of Peremyliv; and the presence of illegal landfills in river valleys and near water bodies.

The main sources of water supply for the consumers of the Khorostkiv TC are underground aquifers, which are exploited by artesian wells. The hydrogeological conditions of the study community allow solving the issue of water supply at the expense of groundwater. The fresh groundwater reserves can be considered sufficient in terms of quality and quantity with current production volumes. The daily water intake from underground aquifers for the needs of centralised water supply of the Khorostkiv community settlements is 0.1 thousand m3/day. Rural settlements are supplied with drinking water from private mine wells [17, p. 57].

Thus, the water supply network of the Khorostkiv territorial community includes: the water supply network of Khorostkiv (30 km, unsatisfactory condition); there are no centralised water supply systems in rural settlements [15].

According to the Khorostkiv Town Council, the water quality of the town's water supply network from artesian wells meets the requirements of Sanitary and Epidemiological Norms 2.2.4.-171-10 [12], except for the indicators of colour, ammonium nitrogen and total hardness (Table 3). The results of the sanitary and microbiological study conducted at the State Institution "Ternopil Regional Laboratory Centre of the Ministry of Health of Ukraine" meet the requirements of Sanitary and Microbiological Standards 2.2.4.-171-10 [12].

Besides the centralized water supply sources, we analyzed the hydrochemical parameters of groundwater from private wells in the community. According to the results of water samples from wells in Khorostkiv and the villages of Peremyliv and Khlopivka, taken at the State Institution "Ternopil Regional Laboratory Centre of the Ministry of Health of Ukraine", it was found that there were no exceedances of the MPCs for physicochemical and sanitary-toxicological indicators in the water samples studied, and that the water quality generally meets the requirements of SanPiN No. 400 [12] and other industry standards (GOST). The hydrogen pH value is within the normal range (6.5-8.5) (Table 4).

Table 3

Parameters of tap drinking water in the town of Khorostkiv [17, p. 121]

Indicator	**Norma** [12]	**Khorostkiv town, Khorostkiv water supply network**		**Khorostkiv, artesian well №1**		**Khorostkiv, artesian well №2**	
		2019	**2020**	**2019**	**2020**	**2019**	**2020**
pH	6,5-8,5	6,9	7,0	7,0	7,2	7,3	7,2
Oxidation, mg/dm^3	≤5	1,04	2,0	1,12	1,12	0,96	1,44
Ammonium nitrogen, mg/dm^3	0,5	*2,7*	*3,9*	*2,7*	*2,7*	*4,0*	*2,7*
Nitrite nitrogen, mg/dm^3	0,5	0,013	0,21	0,011	0,018	0,03	0,023
Nitrate nitrogen, mg/dm^3	50	3,84	3,85	3,3	3,85	2,74	2,75
Total hardness,	≤7	*8,0*	*10,0*	*8,5*	*8,0*	*10,0*	*8,5*
mg-eq/dm^3	≤2	0,88	0,15	0,93	0,93	1,03	0,12
Total iron, μg/dm^3	≤20	*25*	*30*	*30*	*30*	*30*	*25*

Table 4

Sanitary and chemical indicators of groundwater safety and quality of private wells in the Khorostkiv territorial community

Parameter name	**Norma** [12]	**Sample №1**	**Sample №2**	**Sample №3**
pH	6,5-8,5	7,12	7,13	6,9
Dry residue, mg/dm^3	≤1500	390,0	420,0	375,0
Total hardness, mmol/dm^3	≤10,0	6,4	7,8	7,2
Total alkalinity, mmol/dm^3	≤6,5	6,0	6,4	6,5
Total iron, mg/dm^3	≤1,0	0,0	0,0	0,0
Calcium, mg/dm^3	≤130	114,0	128,0	120,0
Magnesium, mg/dm^3	≤80	8,5	17,0	14,6
Sulphates, mg/dm^3	≤500	17,3	15,6	11,0
Chlorides, mg/dm^3	≤350	17,7	39,5	21,3
Ammonium, mg/dm^3	≤2,6	0,0	0,3	0,0
Sodium, mg/dm^3	≤200	10,8	6,0	9,0
Nitrates by NO3, mg/dm^3	≤50	4,2	16,5	6,6
Sample №1 - Khorostkiv town, Sample № 2 - Peremyliv village, Sample №3 - Khlopivka village				

We also examined the quality of drinking water from three public wells in the Khorostkiv community (Table 5). According to the results of the sanitary and microbiological examination of water samples, no total coliforms and pathogenic enterobacteria were detected in 1 dm3. However, in the well in 4 Muzeina Street, Khorostkiv, an excess of nitrate nitrogen and total water hardness was recorded. An excess of total hardness was also observed in the water sample in 74 Nezalezhnosti Street, Khorostkiv.

Table 5

Hydrochemical parameters of drinking water from public wells in the Khorostkiv territorial community

Indicator	**Norma [12] м**	**Khorostkiv, 74 Nezalezhnosti str.**	**Khorostkiv, 4 Muzeina str. м.**	**Karashyntsi, (near the school)**
pH	6,5-8,5	6,98	7,02	7,12
Oxidation, mg/dm^3	≤5	0,96	2,32	1,04
Ammonium nitrogen, mg/dm^3	0,5	0,18	0,29	0,23
Nitrite nitrogen, mg/dm^3	0,5	0,02	0,03	0,03
Nitrate nitrogen, mg/dm^3	50	43,5	*82,3*	35,7
Total hardness, mg-eq/dm^3	≤7	*11,5*	*15,8*	4,8

Taking into account the fact that there is no centralised water supply in the rural settlements of the Khorostkiv TC, and that the household and drinking water supply is provided by mine wells and individual wells, we conducted a study of the quality of drinking water in the wells of private households in the community. The total water hardness of private wells in Verkhivtsi village was determined in the Environmental Chemistry Laboratory of Ternopil V. Hnatiuk National Pedagogi-

cal University. Water samples were taken from five private households: sample No. 1 - 11 Hrushevsky Street; sample No. 2 - 22 Shkilna Street; sample No. 3 - 13 Zarichna Street; sample No. 4 - 1 Lesia Ukrainka Street; sample No. 5 - 15 Tsentralna Street.

Thus, according to the results of the study of water in the wells of private households in Verkhivtsi village of the Khorostkiv TC, it was found that the total hardness of the water samples under study is within the permissible limits. A slight exceedance of the permissible limits is observed in samples No. 1 and No. 4 and amounts to 7.3 mol×eq/dm3. The optimum and lowest water hardness is in sample No. 5 at 15a Tsentralna Street (Fig. 3).

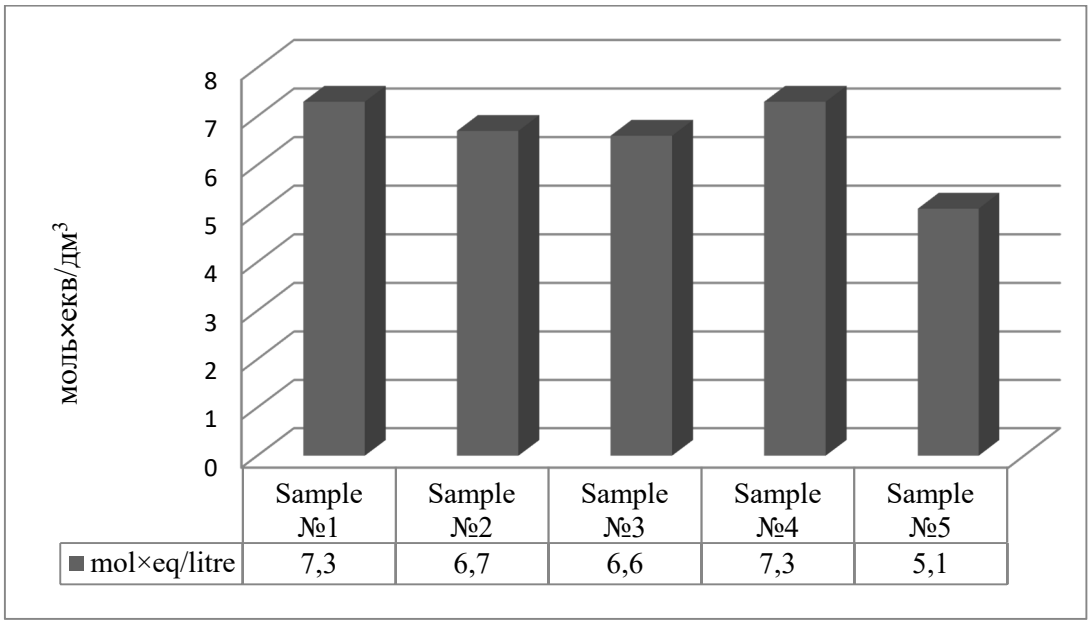

Fig. 3. Results of determining the total water hardness of private households' wells in Verkhivtsi village, Khorostkiv TC

Thus, according to the results of labora-tory tests of groundwater quality in the Khorostkiv community, it was found that the sources of centralised water supply in Khorostkiv do not comply with Sanitary and Epidemiological Norms 2.2.4.-171-10 in terms of ammonium nitrogen and colour. In private wells in Khorostkiv and the villages of Peremyliv and Khlopivka, no exceedances of the MPCs for physicochemical and sanitary-toxicological parameters were recorded. Exceedances of nitrate nitrogen and total water hardness parameters were observed in water samples taken from the public well in Khorostkiv at 4 Muzeiana Street. The determined total hardness of water in the wells of private households in Verkhivtsi village does not exceed the normative values and ranges from 5.1-7.3 mg×eq/dm3.

The water use of the Khorostkiv TC, like any other administrative unit, includes water supply and sewerage. The 30 km long water supply network of the Khorostkiv TC provides centralised water supply to 15.5% of the community's residents [17, p. 57]. In the Khorostkiv TC, 37% of the housing stock and 100% of social infrastructure facilities are provided with centralised water supply [17, p. 58]. Of all the settlements in the community, only the town of Khorostkiv is provided with centralised water supply. Other settlements use mine wells and private wells for water supply, which are mainly located on private plots. The town's water supply networks are about 80% worn out. The poor condition of the water supply network is one of the main social and environmental problems of the community [15].

An analysis of the structure of water use in the Khorostkiv TC showed that in 2021, 81 thousand m3 of water was withdrawn from natural water bodies, including 54 thousand m3 from underground water intakes [3]. The community used 62 thousand m3 of fresh water, including 55 thousand m3 for drinking and sanitary needs and 7 thousand m3 for production needs [3] (Fig. 4).

Considering the need to provide the residents of the Khorostkiv community with one hundred per cent centralised water supply, we have determined the projected volume of drinking water for the needs of the community's population, which is about 3.2 thousand m3/day (Table 6). The water supply standard for the town of Khorostkiv is 250 litres per person, for rural settlements 200 litres per person, in accordance with the State Building Standards (SBS B.2.5.-74:2013) [4]. The unaccounted costs for the town of Khorostkiv were assumed to be 10%, for rural settlements - 5%. The coefficient of hourly irregularity of water consumption for the town of Khorostkiv is 1.3, for

rural settlements - 1.2 [17, p. 84].

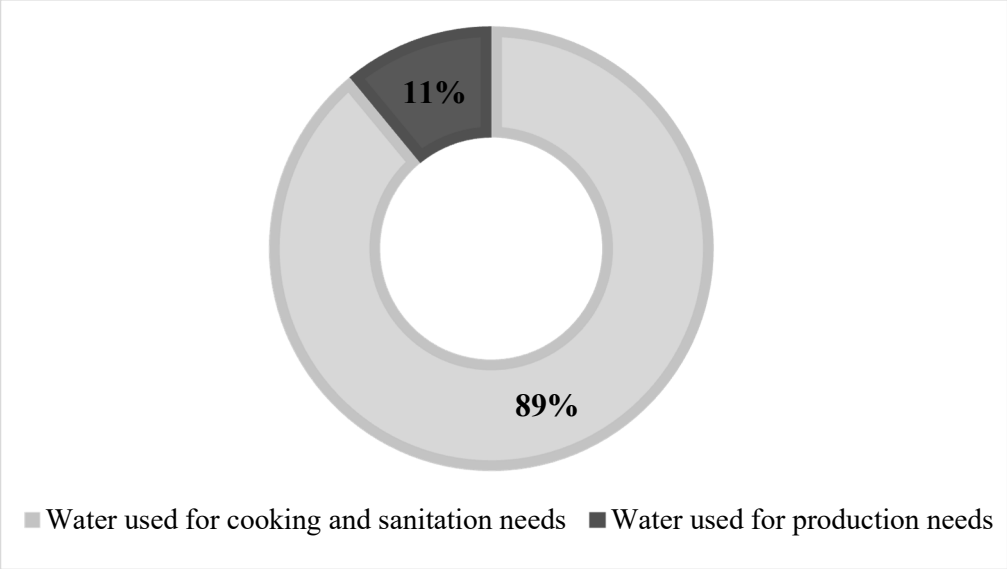

Fig. 4. Structure of water supply in Khorostkivska AH

Table 6

Projected volumes of domestic and drinking water consumption and sewerage for the needs of the population of the Khorostkiv TC

Settlement	**Population**	**Water consumption, thousand m3/day**	**Water disposal, thousand m3/day**
Khorostkiv	6740	1,68	1,51
Uvysla	1280	0,26	0,25
Kluvintsy	1100	0,22	0,21
Khlopivka	1060	0,21	0,20
Peremyliv	1060	0,21	0,20
Velykyi Hovyliv	945	0,19	0,18
Soroka	735	0,15	0,14
Karashyntsi	485	0,10	0,09
Verkhivtsi	400	0,08	0,07
Malyi Hovyliv	350	0,07	0,06
Together in the community		*3,17*	*2,91*

According to the data provided in the Planning Scheme of the Khorostkiv TC [17], the volumes of water supply and sewerage of recreational and health facilities of the com-munity are 0.126 thousand m3/day, respecti-vely. Taking into account that there are two poultry farms on the territory of the Khorostkiv community, the projected volumes of water supply and sewerage for agricultural needs (poultry and livestock) will be 3 thousand m3/day. The projected volumes of water supply and sewerage for industrial needs of the Khorostkiv TC in accordance with the norms of SBS B.2.5.-75-2013 [4] are shown in Table 7 [17].

Table 7

Projected volumes of water supply and sewerage of industrial facilities of the Khorostkiv territorial community [17, p. 86]

Name	**Area under industrial facilities, ha**	**Water consumption, thousand m3/day**	**Waste water discharge, thousand m3/day**
Water of drinking quality	474,7	0,194	0,172
Water of technical quality		0,450	0,404
Together in the community		*0,641*	*0,577*

Thus, the total daily and annual consump-tion of potable water, considering the needs of the population (3.17 thousand m3/day), recrea-tional and health facilities (0.126 thousand m3/day), agricultural (3 thousand m3/day) and industrial enterprises (0.194 thousand m3/day) of the Khorostkiv community will be 6.5 thousand m3/day. Taking into account the technical quality water (0.45 thousand m3/day), the volume of daily

water consumption in the Khorostkiv TC will be about 7 thousand m3/day.

At the same time, the total volume of water disposal of the Khorostkiv community, including household wastewater from the population (2.91 thousand m3/day), recreation-nal and health facilities (0.126 thousand m3/day), agricultural (3 thousand m3/day) and industrial enterprises (0.577 thousand m3/day) will be 6.6 thousand m3/day [17, p. 88].

It is worth noting that the sewage system of the Khorostkiv community operates in only one settlement - the town of Khorostkiv. Sewerage is available to 11% of the community's residents. Both centralised and individual water supply consumers are con-nected to the system. The condition of the town's 18 km-long sewerage network is unsatisfactory, with 80% of it in need of replacement. In 2016, Khorostkiv reconstructed its wastewater treatment facilities and installed the BIOTAL system for biological treatment of domestic wastewater. The design capacity of the municipal wastewater treatment plant is 200 m3/day.

The volume of total water discharge in the Khorostkiv TC in 2021 amounted to 134 thousand m3 of water. In the reporting year, 133 thousand m3 of wastewater was discharged into the surface water bodies of the study area. This included 40 thousand m3 of polluted return (wastewater) and 93 thousand m3 of normatively clean water without return water treatment (Fig. 5). The volume of recycled water use amounted to 132 thousand m3 of water [3]. Within the study area of the Khorostkiv TC, wastewater treatment was not carried out in 2021.

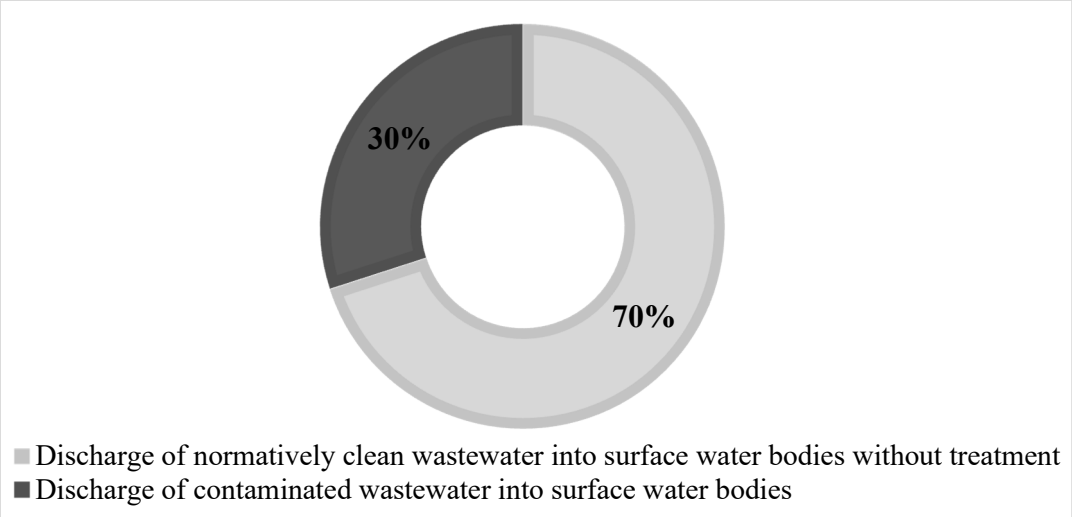

Fig. 5. The structure of sewage disposal in the Khorostkiv TC

Special attention should be paid to the problem of wastewater disposal of individual estates in the Khorostkiv territorial community. The urgency of this problem is due to the transfer of private households to boiler heating and water supply from local wells. To collect wastewater, septic tanks (cesspools) were built in the yards. Only a small proportion of them meet the requirements. Most of them allow wastewater to seep into the ground. At a distance of 10-20 metres from the septic tanks, there are drinking water wells that will eventually receive infiltrate. The quality of drinking water is deteriorating signify-cantly. In addition, the problem of wastewater removal and disposal remains unresolved. Local residents mostly dispose of wastewater in forest plantations, ravines, gullies, and fields. This results in large-scale uncontrolled pollution of soil and groundwater horizons within settle-ments and their environs [6, 22].

Having carried out a comprehensive environmental assessment of the surface and groundwater of the Khorostkiv territorial community, we have developed a number of measures that will help improve the ecological condition of water bodies:

1. The relevant specialists of the community's administrative apparatus should monitor the sanitary condition of the commu-nity's small riverbeds, floodplains, slopes and banks of water bodies and watercourses.

2. Ensure the implementation of measures to maintain a favourable hydrological regime and sanitary condition of riverbeds, water protection zones and coastal protection strips.

3. Monitoring compliance with the requirements of environmental legislation on the preservation of water protection zones, coastal protection strips and compliance with restrictions on management in the river valley.

4. Clear the banks and channels of small rivers from overgrown grasses and fallen trees that impede normal flow.

5. Eliminate illegal landfills along the

valleys of the Holodni Stavy, Taina and Chornytsia rivers, and establish a system of solid waste management at the local community level.

6. Take measures to prevent the discharge of untreated and insufficiently treated wastewater into the community's surface water bodies.

7. Increase the forest cover of the Taina River basin by removing highly fertile and unproductive arable land from cultivation, and create protective forest plantations along roads, rivers, reclamation ditches, around ponds, lakes, wastelands and vacant lots [22].

8. To reorient the development of the territories of the river valleys of Taina, Mala Rudka, Velyka Rudka, Chornytsia to make them suitable for recreation, sports and tourism.

9. Increase the protected area of the Khorostkiv TC, including by creating new protect-ted areas of hydrological profile.

10. Promote the environmental culture of the local population, conduct environmental education events to engage an active part of the community in environmental protection activities.

In the context of optimising and improving water use in the Khorostkiv TC, it is necessary, first of all, to carry out routine repairs of water pipelines in Khorostkiv. The next step should be the reconstruction of sewage treatment facilities in the town and the repair of the sewerage collector. To ensure quality water supply to social institutions, the artesian well on Sichovykh Striltsiv Street needs to be restored. It is also necessary to develop a plan for the construction of a water supply network and ensure the proper operation of public utilities in the area of water supply to the community. The main areas for optimising water use in the Khorostkiv community are shown in Fig. 6.

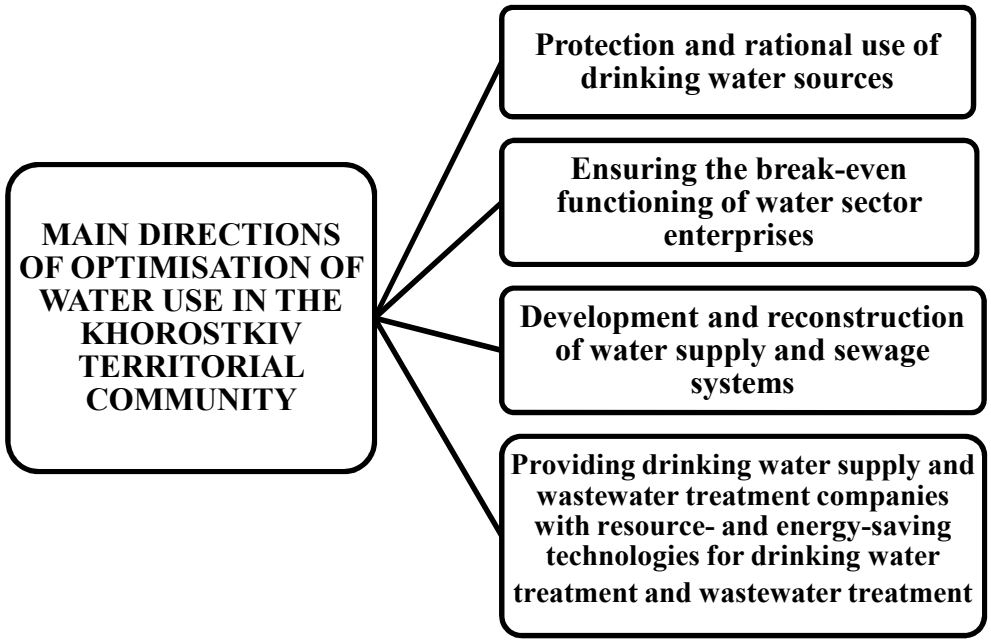

Fig. 6. Main directions of water use optimisation in the Khorostkiv territorial community

An important way to enhance the ecological status of water bodies in the Khorostkiv TC is to improve coastal areas (especially within sanitary protection zones), bank protection, and current and scheduled repairs of hydraulic structures. Special-purpose greenery should be created on the coastal areas to improve the sanitary and hygienic condition of the coastal territories and to organise new recreational zones.

The geoecological analysis of the state of water use in the Khorostkiv TC revealed that one of the problematic aspects of community develop-ment is the poor condition of the Khorostkiv water supply networks and their absence in rural settlements. Strategic goal №. 2 of the "Strategy for Sustainable Development of the Khorostkiv Town Amalgamated Territorial Community" [15] envisa-ges the network of water supply and sewerage systems in the community. To achieve this goal, it is envisaged to develop a compre-hensive prog-ramme of water disposal and water supply in the com-munity.

We have prepared several proposals for a promising programme of sewerage and water supply in the Khorostkiv community:

- Inventory of existing water intakes and waste water discharge sites with determination of technical, economic, sanitary, epidemio-logical

and environmental parameters;

- Reconstruction of water intakes from underground sources in the town of Khorostkiv and installation of new artesian water intake wells;

- Construction of a unified water supply system for the community's settlements for domestic, drinking and firefighting needs;

- In the villages of Karashyntsi, Peremyliv, Verkhivtsi, Kluvintsy and Soroka, in order to ensure uninterrupted water supply to the residents, it is necessary to build an artesian well with a water tower and a separate water supply system;

- Treatment of surface water run-off from the settlement areas, construction of a rainwater drainage system in the central part of Khorostkiv.

The Planning Scheme of the Khorostkiv Territorial Community provides for the installation of a sewerage system in all settlements with a population of more than 2,000 people. At the same time, industrial enterprises that discharge household wastewater with a high content of harmful substances are expected to build local pre-treatment facilities. The financial costs of the proposed measures are borne by business entities [17, p. 88].

The document also envisages the construction of two group sewage treatment plants for the community's settlements:

1) sewage treatment plant near the village of Uvysla to treat wastewater from Khorostkiv, Velykyi Hovyliv, Malyi Hovyliv, Karashyntsi, Khlopivka and Uvysla;

2) treatment facilities near the village of Kluvintsy to treat wastewater from the settlements of Peremyliv, Verkhivtsi and Kluvintsy [17, p. 88].

The design of the Khorostkivska community sewage treatment plant should include a full cycle of biological wastewater treatment using closed-type treatment plants with thermal and mechanical treatment of sludge. A sanitary protection zone of up to 150 m in width is envisaged around the treatment plant. The capacity of the designed treatment facilities is 5 thousand m3/day [17, p. 89].

It is also planned to treat wastewater with bioplateau type plants, using "metatanks" to produce biogas. Heat pumps will be used to extract low-potential heat energy from waste-water to reduce thermal pollution of water bodies during discharge. It is proposed to increase the productivity of the projected wastewater treatment facilities by introducing the latest technologies for wastewater treat-ment, post-treatment and disinfection [17, p. 89].

The problem of contamination of surface water bodies and groundwater horizons, especially groundwater, by wastewater from individual estates and private households requires a comprehensive solution. Wastewater removal should be regulated by an agreement between the owners of septic tanks and the management of the nearest municipal wastewater treatment facilities, which specifies the frequency of removal [6]. Receipts for wastewater disposal should be recorded in appropriate records and the frequency of wastewater removal should be controlled. This problem should be handled by a separate service, similar to the one that handles solid waste collection. The local level coordinator for solving this problem could be the inspector for landscaping and environmental protection of the territorial community. Implementation of this approach will help to solve the extremely urgent and dangerous problem of groundwater pollution faced by residents of almost all territorial communities in Ternopil region [22].

Priority areas for improving the ecological status of water resources in the Khorostkiv TC should take into account the real state and problems associated with the use of water resources, anthropogenic pressure on water bodies and the economic opportunities of the community. The development of a practical action plan to restore or improve the ecological status of specific water bodies remains a prospect for further research. It is clear that measures to renaturalise watercourses should be developed on a basin basis. In this case, measures should be justified for not only rivers and reservoirs directly, but also for coastal protection strips and water protection zones [24], for river basins, water intakes, wastewater treatment plants, etc. A set of such measures will help to optimally address the problems related to water quality in water bodies, rational water use, water pollution and the growing anthropogenic load on basin systems.

Therefore, the priority areas for impro-ving the ecological state of the Khorostkiv community's water resources are, first of all, the introduction of preventive mechanisms for the pollution of water bodies and watercourses; reducing the anthropogenic load on small river basins by reducing ploughing and increasing the community's forest cover; ensuring compliance with the requirements of the current legislation on fresh water intake and waste water discharge by municipal and industrial enterprises.

Conclusions. Therefore, the ecological status of surface water resources in Khorostkiv TC can be assessed as satisfactory with steady deterioration trends. The main hydroecological problems of the community are the non-compliance of certain bacteriological and physicochemical indicators of surface waters of

Khorostkiv and Peremyliv villages with the State Sanitary Rules; the presence of illegal landfills in river valleys and near water bodies.

Special attention should be paid to the problem of wastewater disposal in individual estates of the Khorostkiv territorial community, as "septic tanks" (cesspools) have been built to collect wastewater in the yards, most of which allow wastewater to seep into the ground. In addition, the problem of sewage removal and disposal remains unresolved. Local residents mostly dispose of wastewater in forest plantations, ravines, gullies, and fields. This results in large-scale uncontrolled pollution of soil and groundwater horizons within settlements and their environs.

The priority directions for improving the state of water resources are the reconstruction and construction of new sewerage systems, treatment facilities, centralised water supply systems, especially in rural settlements of the Khorostkiv community, and the creation of hydrological protected areas.

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Анотація:

Світлана НОВИЦЬКА, Ігор КУЗИК, Любов ЯНКОВСЬКА, Наталія ТАРАНОВА. ВОДНІ РЕСУРСИ ХОРОСТКІВСЬКОЇ ТЕРИТОРІАЛЬНОЇ ГРОМАДИ: ЕКОЛОГІЧНИЙ СТАН, ПРОБЛЕМИ ВОДОКОРИСТУВАННЯ, ЗАХОДИ З ОПТИМІЗАЦІЇ

У статті акцентується на актуальності дослідження сучасного стану водних ресурсів та оптимізації водокористування Хоростківської територіальної громади, оскільки територіальні громади (ТГ) – це нові адміністративні одиниці, екологічна політика яких ще формується, тому важливим є підкреслити необхідність збереження і раціонального використання саме водних ресурсів у різних галузевих програмах розвитку громад.

З'ясовано, що поверхневі води громади представлені 6 малими річками та 14 ставками. Загалом їх екологічний стан Хоростківської ТГ можна оцінити як задовільний із стійкими тенденціями до погіршення. Основними джерелами забруднених водних об'єктів є стічні води МКП «Комунальник» та неконтрольовані скиди приватних домогосподарств. За результатами лабораторних досліджень, виявлено, що у поверхневих водних об'єктах Хоростківської ТГ зустрічаються патогенні мікроорганізми, спостерігається перевищення нормативних вимог бактеорологічних показників, наявне фекальне забруднення і високий вміст органічних речовин. Встановлено, що за останні 10 років у річку Тайну (найбільшу річку у громаді) було скинуто 281 тис. м^3 стічних вод, з якими у водотік потрапило 287 т забруднюючих речовин. Окрім забруднення поверхневих водних об'єктів Хоростківської ТГ, важливою екологічною проблемою, на яку варто звернути увагу, є відсутність санітарно-захисних і водоохоронних зон річок і ставків, а також засмічення прибережної смуги.

Виявлено, шо мережа водопостачання Хоростківської територіальної громади включає виключно водопровідну мережу міста Хоростків (30 км, стан – незадовільний), оскільки у сільських населених пунктах системи централізованого водопостачання відсутні. У джерелах централізованого водопостачання м. Хоростків фіксується перевищення показників азоту амонійного і кольоровості. Гідрохімічний аналіз проб води із приватних свердловин міста Хоростків та сіл Перемилів і Хлопівка підтвердив відповідність вимогам СанПіН №400. У структурі водокористування Хоростківської громади переважає використання води на питні та санітарно-гігієнічні потреби. За 2021 рік у громаді було забрано із природних водних об'єктів 81 тис. м^3 води, у тому числі із підземних водозаборів – 54 тис. м^3. Обсяг добового водоспоживання у Хоростківській ТГ, з врахуванням води технічної якості, становить близько 7 тис. м^3/добу. Водночас, за добу сумарний обсяг водовідведення складає 6,6 тис. м^3. За 2021 рік у поверхневі водні об'єкти Хоростківської громади було скинуто 133 тис. м^3 стічних вод, з яких 30% – забруднених.

Обґрунтовано, що разом із реконструкцією каналізаційних систем, очисних споруд, систем централізованого водопостачання, пріоритетними напрямками покращення екологічного стану водних ресурсів Хоростківської громади, насамперед, є запровадження превентивних механізмів забруднення водойм і водотоків; зменшення антропогенного навантаження в басейнах малих річок шляхом зменшення розораності та збільшення лісистості громади; забезпечення дотримання вимог чинного законодавства щодо забору свіжої води і скидання відпрацьованих вод комунальними і промисловими підприємствами.

Ключові слова: поверхневі води, підземні води, забруднюючі речовини, водопостачання, водовідведення, територіальна громада (ТГ).

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