CHALLENGES AND OBSTACLES TO THE IMPLEMENTATION OF SUSTAINABLE DEVELOPMENT GOAL 6 IN UKRAINE (CASE OF THE ROS' RIVER)

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Goal 6 of the sustainable development is "Clean water and sanitation" ("Ensure availability and sustainable management of water and sanitation for all"). Protection, sustainable use and restoration of water resources are urgent tasks for Ukraine, especially in the conditions of a full-scale war. The paper considers challenges and obstacles on the way to achieving sustainable use of water resources of the Ros' River. Achieving goal 6 should mean improving the work of water-using enterprises (sewage treatment facilities, hydroelectric power plants, etc.) in such a way as to minimize their negative impact on the ecological state of the Ros', which in turn should ensure the proper quality of water for water supply, land reclamation, and tourism and recreation. The focus is on the form of ownership (state or private) of enterprises that use water from the Ros' River, how this or that form of ownership encourages enterprises to use water resources carefully, as well as the presence and effectiveness of mechanisms of influence on violators of environmental protection legislation of Ukraine in this field. In 2022 the special petition to the President of Ukraine was created and signed (E-petition…). It was called "About the development and implementation of a project to save the Ros' River with its further use to restore the water supply of all rivers of Ukraine and their tributaries – small rivers." Taking into account the status of Ukraine as a candidate for accession to the European Union, it makes Ros' River being a good object for the investigations.

Keywords: Ros' River, HPP, sewage treatment facilities, goal 6 of the sustainable development, water resources

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Introduction

Water is the only substance that is critically necessary for life. And the most fundamental requirement for human health and wellbeing is access to clean water, proper sanitation, and good hygiene.

There are 17 global *Sustainable Development Goals* (SDGs) thanks to the 2030 Agenda for Sustainable Development, which was approved by all UN members in 2015. The 17 SDGs are an urgent call for action by all countries – developed and developing – in a global partnership (The 17 Goals, 2024). Sustainable Development Goal 6 declares the importance to provide everyone with access to clean water and proper sanitation. The Goal has 8 targets to be achieved by 2030 covering the main areas of water supply and sanitation and sustainable water resource management. But progress in achieving the targets is still small.

SDG Progress Report-2024 on Goal 6 says the following. None of the SDG 6 targets are on track to be met. Global progress on implementing integrated water resources management remains slow – 49 % in 2017, 54 % in 2020, 57 % in 2023, not on track to reach the 2030 target (91 %). The world has experienced a net increase in permanent surface water between 2005 and 2022, much of which resulted from climate change and reservoir filling. Countries that implement the most extensive monitoring programs show that water quality is degrading since 2017 (Report..., 2024). Such filling of reservoirs with low progress in the implementation of integrated water resources management and degradation of water quality is characteristic of the Ros' River.

Ukraine is on the 32nd place among 40 in terms of drinking water provision in Europe and is on the list of countries threatened by water scarcity. At the same time, 75 % of the water supplied to consumers is taken from surface sources – rivers. The existing problems with the outdated water supply stations and sewage treatment plants, which are unable to cope with the current loads and do not meet modern requirements for water and wastewater treatment, were worsened by the destruction and damage to water infrastructure, caused by the full-scale war (WAREG, 2023). Only in the first year of the full-scale war losses in water supply and sewerage sector due to the conduct of hostilities on the territory of Ukraine have been estimated at approximately USD 7.5 billion (World Bank Group, 2023).

Ukraine belongs to the countries with insufficient supply of water resources and is one of the least water-supplied European countries. The river network of Ukraine is not dense (the average value is 0.34 km/km2), there are no large natural reservoirs, and few reserves of underground water. The specific supply of river runoff in Ukraine is about 1000 m3 per person per year, which is 2.5 times less than in Sweden and Germany, 3.5 times less than in France and 5 times less than in Great Britain. According to the latest World Bank report, Ukraine is somewhere between Chad and Sudan in terms of drinking water supply (Shevchenko, 2021). Therefore, the protection, rational sustainable use and restoration of water resources and river ecosystems are currently very urgent tasks for Ukraine.

Materials and Methods

We used open data on enterprises that cause the greatest damage to the ecological state of the water resources of the Ros' River (the hydropower plants and the sewage treatment plants), their forms of ownership, as well as precedents regarding their violation of Ukrainian environmental legislation and the response of state authorities to this were analyzed. Two main objects are in focus: The Stebliv hydro powerplant (owned by FEA "Novosvit", tax number 30594406) and the sewage treatment facilities of Bila Tserkva city (owned by the "Bilotserkivvoda" LLC, tax number 38010130). To process geographically coordinated data, GIS *MapInfo Professional* was employed.

General information about the object river

The Ros' is aright tributary of the largest river of Ukraine – the Dnipro. The length of the Ros` is almost 350 *km* long, and the area of its drainage basin is about 13 thousand square kilometers (Figure 1).

13 000 km^2 – this is less than 4.5 % of the total area of the Dnipro basin within Ukraine, but this is almost equal to the territory of Montenegro.

Ros' is a river that mainly flows in the Dnieper Upland, within the Vinnytsia, Kyiv and Cherkasy regions of Ukraine (Babii et al., 2016). The river basin also partially covers the Zhytomyr region. The map of Ros' River basin is represented on Figure 2.

Figure 1. The Ros' River basin on the map of Ukraine
Made with GIS *MapInfo Professional* using (The Ros' river, 2010)

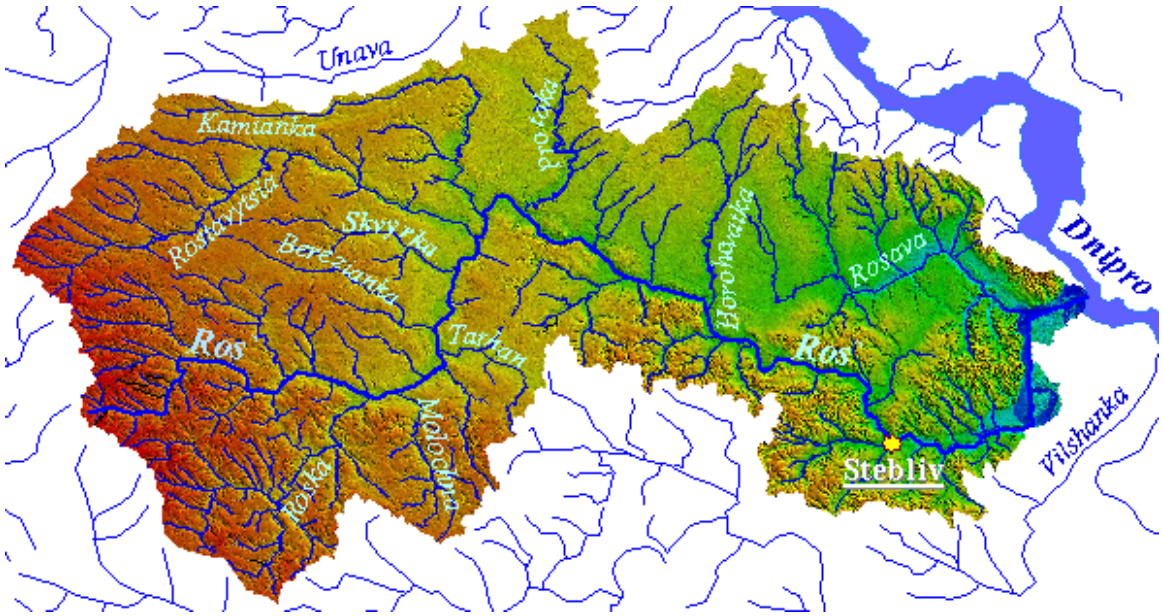


Figure 2. Basin and river system of the Ros' River
Made using GIS *MapInfo Professional*

Analysis of topographic maps *M-35-95* and *M-36-98* (Maps…) shows that the fall of Ros' (the difference in elevation between the river's source and the river mouth) – 204 *m*. An important indicator for the development of hydropower is the *stream gradient* (or *slope*) – the fall divided by the total length of the river. Due to the upland flow, the stream gradient of the Ros' is almost 0.6 *m/km*. The stream slope of the Dnipro River, for example, is only 0.11 *m/km* (Shvets et al., 1957).

The main ecological problems of the Ros' River are (Khilchevskyi et al., 2009):

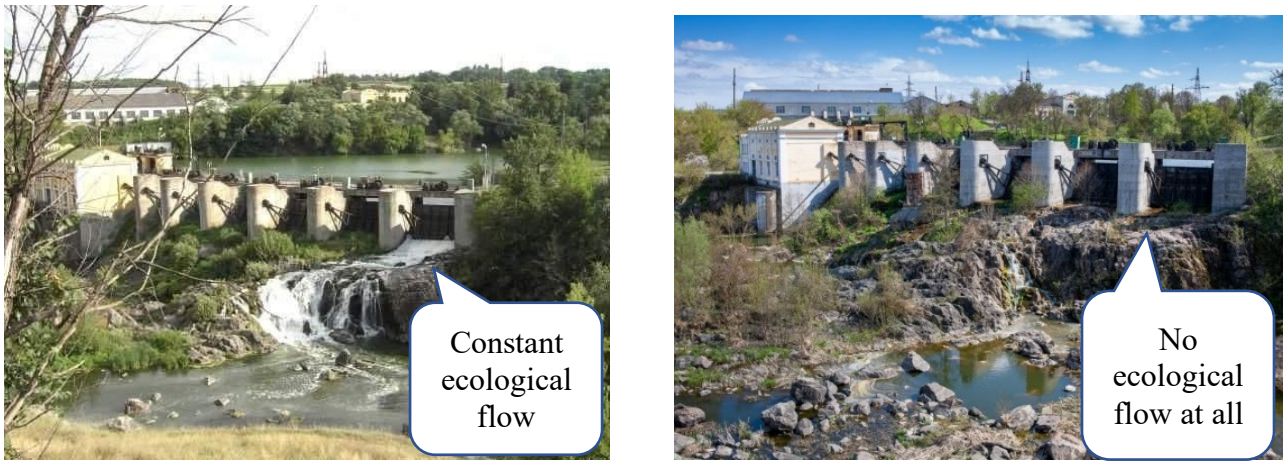
- excessive flow regulation;
- sewage pollution;
- plowing of the banks.

Since this river is a source of water supply for domestic and industrial users, recreation and tourism in several regions of Ukraine, while it suffers from a number of environmental problems and is therefore in the focus of environmental specialists, it is a good example for considering problems and challenges on the way to implementation 6 goals of sustainable development. In addition, the problem of the ecological state of the Ros' River is currently in the special focus of attention Ministry of Environmental Protection and Natural Resources of Ukraine (Strilets, 2023).

Results and Discussion

The enterprises that cause the greatest damage to the water resources of the Ros' River are privately owned.

The Stebliv HPP. The Stebliv HPP (Figure 2, 3), is the most harmful HPP for this river. It shuts the river's flow to almost zero, causing maximal eutrophication. While the plant was leased but still in state ownership, the lessee ensured a constant, uninterrupted natural (environmental) flow of water through the dam of at least 2.4 m^3/s (Figure 3a), thus complying with environmental protection legislation. The river flow was shut down in 2015 by the owner of the HPP after its privatization (Figure 3b).



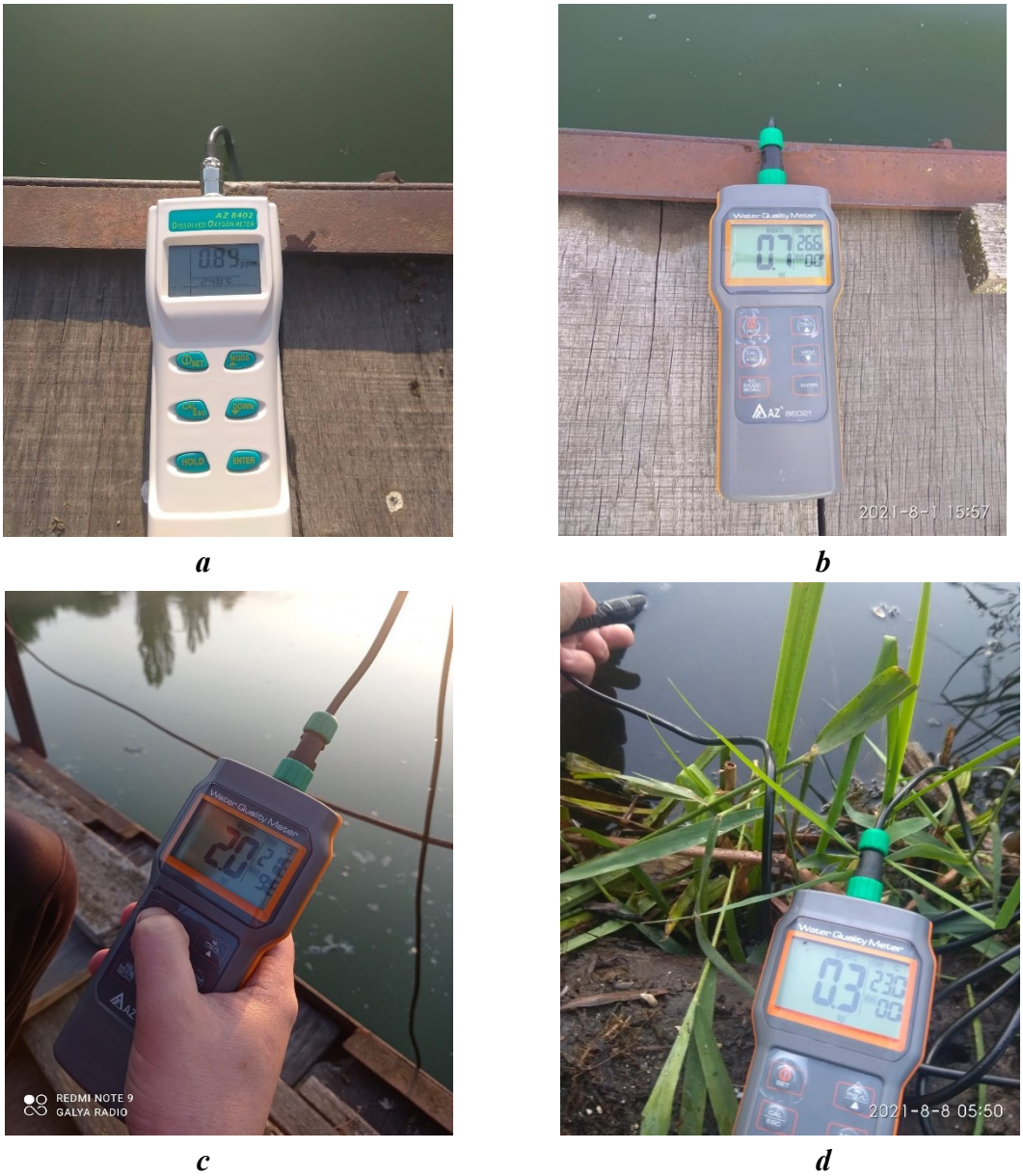
a **b**

Figure 3. Stebliv HPP: a – being in the state property; b – being in the private property

The design of the turbines of this hydropower plant ensures the production of electricity with relatively significant water consumption. Currently, the water level of the reservoir allows Stebliv HPP to work no more than 4-5 hours a day. The rest of the time, it has to ensure continuous environmental flow of water, but it does not. None of the penalties or the courts made the owner to

return the river's flow to the normal value. Violation of the hydrological regime of the Ros' River and its reservoirs by the owner of the Stebliv HPP is described in more detail by the corresponding author in a separate paper (Berezovyi, 2023), also by the other authors (Pedchenko, 2006).

Such extreme shutdowns on the river flow lead to the dropping of the dissolved oxygen level both in Stebliv reservoir and downstream, which causes the death of aquatic bioresources. The cases when the oxygen dropped down the minimal level of 4 mg/dm^3 have been recorded by the public organization "Save Ros'" (Figure 4).



a ***b***

c ***d***

Figure 4. The dissolved oxygen measurements done by the public organization "Save Ros'" downstream the Stebliv HPP: *a* – 3 July 2019, *b* - 1 Aug 2021, *c* – 8 Aug 2021, *d* – 21 Jun 2023

Such down drops of the oxygen levels are usually short-termed outliers, so they are not reflected in averaged (monthly average) data from state laboratories (EcoWaterMon, 2018), Figure 5.

However, even the few hours drop of the oxygen can cause a fish plague, as it was recorded in 2018 (2plus2, 2018) and in 2021 (Kukharchuk, 2021).

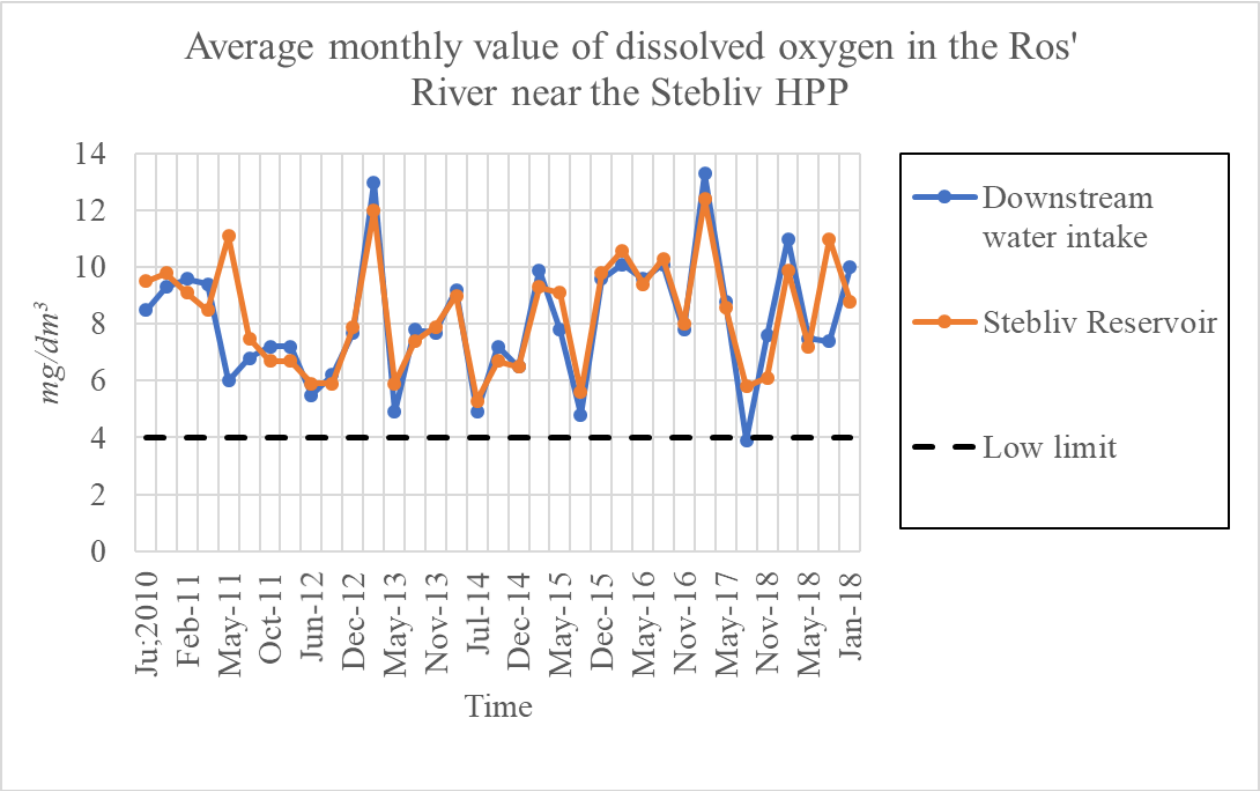


Figure 5. Average monthly value of dissolved oxygen in the Ros' River near the Stebliv HPP by the state laboratory (EcoWaterMon, 2018)

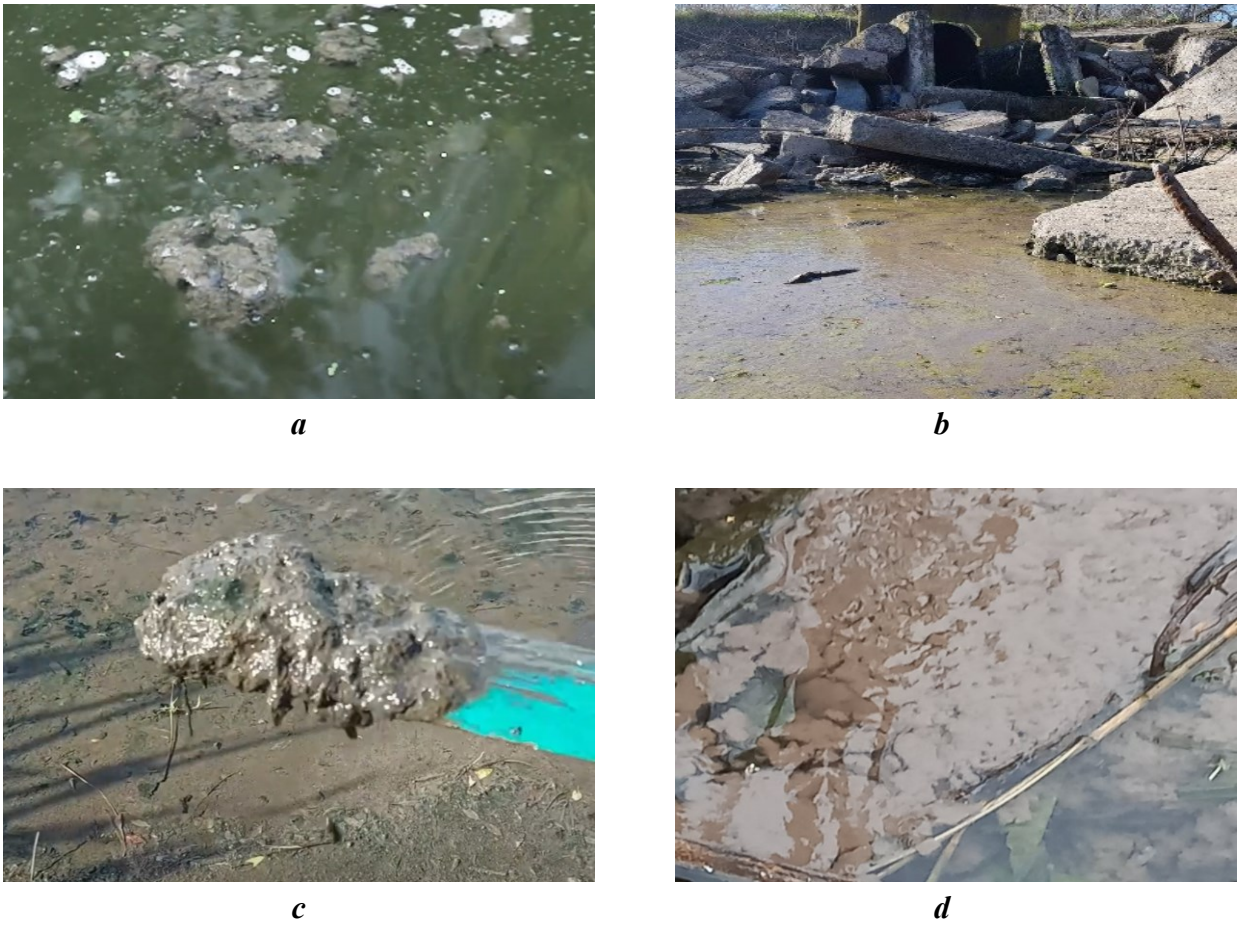
The "Bilotserkivvoda" LLC. The "Bilotserkivvoda" LLC is a private company that holds the sewage treatment facilities of Bila Tserkva city in a concession starting from 2013, and is the biggest polluter of the Ros' River. Its impact on the environmental state on the whole region was described in details in the paper (Grabovska et al., 2021). The sewage discharge into the Ros' River is shown on Figure 6.

a ***b***

Figure 6. Sewage discharge of "Bilotserkivvoda" LLC: *a* – the discharge pipe; *b* – the polluted place of the river near the pipe

The sewage treatment facilities of the Bila Tserkva city were built according to the classic scheme, which provides for mechanical and chemical water treatment using primary sedimentation tanks, aeration tanks and secondary sedimentation tanks, as well as biological ponds. In this treatment scheme, activated sludge is used, which after processing must be dewatered and taken to sludge sites (fields), drained, and subsequently disposed of.

Starting from 2013 people of local communities repeatedly recorded the facts of pollution of the Ros' river by the company's wastewater, mostly in the spring (examples are shown in Figure 7).



a ***b***

c ***d***

Figure 7. Wasted activated sludge and its remains found in the Ros' River in different years: *a* – 2018, *b* – 2020, *c* – 2022, *d* – 2024

After a certain public outcry regarding the massive pollution of the river revealed by the public, in 2018 the Basin Water Monitoring Laboratory of the Interregional Office for the Protection of Dnipro Reservoirs Massifs conducted quarterly monitoring of the hydro-chemical state of the river 500m downstream from the sewer pipe, as well as at drinking water intakes in settlements upstream and downstream (EcoWaterMon, 2018), Figure 8. The results presented in Figure 9 demonstrate that important indicators were usually higher near the sewer pipe and often exceeded the limits.

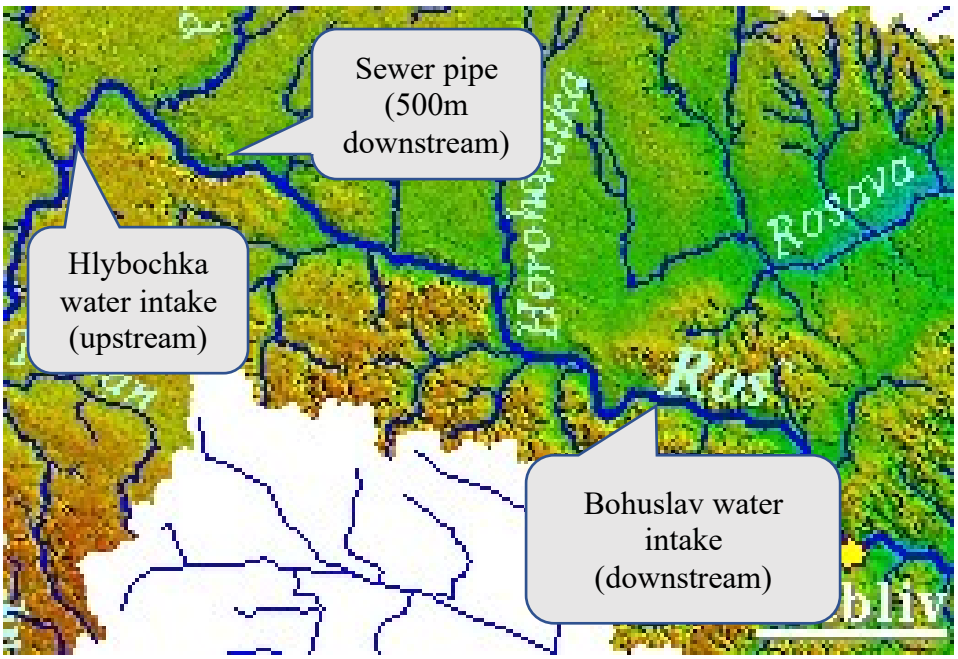
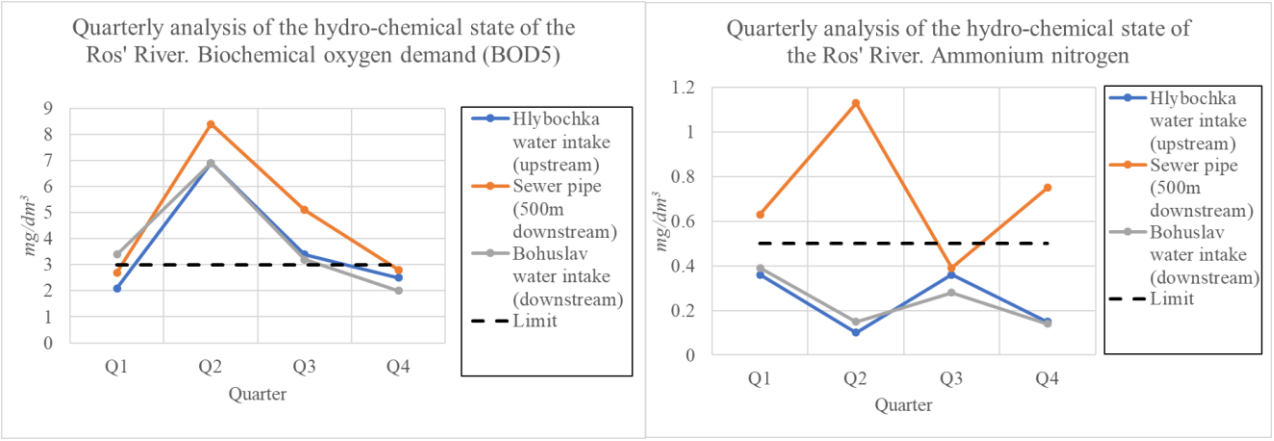
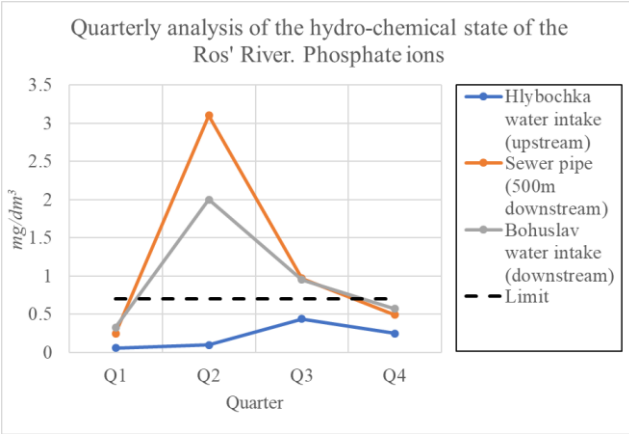


Figure 8. The map of the points of the quarterly monitoring of the Ros' River hydro-chemical state



a

b



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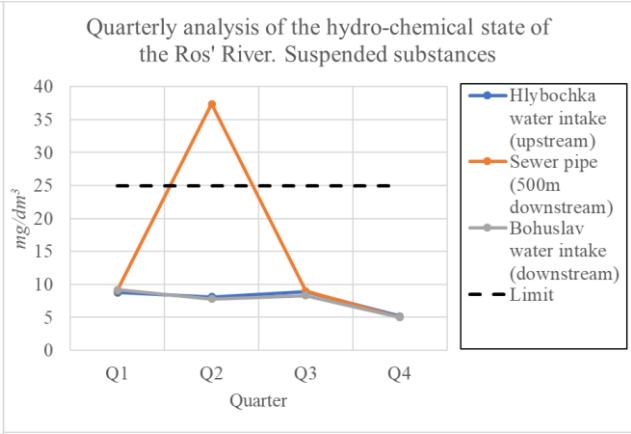

d

Figure 9. Quarterly analysis of the hydro-chemical state of the Ros' River in 2018: *a* – Biochemical oxygen demand (BOD5), *b* – Ammonium nitrogen, *c* – Phosphate ions, *d* – Suspended substances

The Table 1 represents the results of sanitary and microbiological study of water from the Ros' River done on the 7th of June 2022 (after one of the pollutions was discovered and reported by the author) by Myronivka branch of The State Institution "Kyiv Regional Center of Disease Control and Prevention of the Ministry of Health of Ukraine". Exceeding the indicators of Escherichia coli in the river indicates its pollution by sewage, and the location indicates the involvement of this particular enterprise.

Table 1. The results of sanitary and microbiological study of water from the Ros' River done on the 7th of June 2022

Test point in relative to the sewage disposal pipe location	The index of lactose-positive *Escherichia coli*, *units/dm*^{3}(limit <5000)
500 m upstream	2300
Exact place	24000
500 m downstream	70000

According to the Investigative Monitoring Report of the Dnipro Riser Basin done by EU Water Initiative Plus for the Eastern Partnership Countries in 2021 (EUWI+, 2021) the waste water of the "Bilotserkivvoda" LLC was the main negative factor affecting the Ros' River water quality. Moreover, the "Bilotserkivvoda" LLC was mentioned as one of the 2 main polluters of the Dnipro River Basin.

Discharging of the waste (used activated sludge) directly into the river is a gross violation of sewage treatment technology. However, the maximal fee the company ever payed per year was approx. UAH 50 000 – EUR 1150.

In Ukrainian legislation there are no effective mechanisms of influence on private business by the state regarding environmental protection. On the contrary, there are a number of legislative incentives for the maximum use (depletion) of these resources. The interests of private business are better protected by law than the natural environment is. An unacceptable situation often occurs: it is economically more profitable for entrepreneurs to pay fines for environmental law violations than to comply with legal requirements.

It should be noted that the predominance of business sectors based on the use of natural resources over technological and intellectual sectors based on is characteristic of a developing countries. Figure 10 illustrates it on a simple example of the sectoral GDP of USA and Saudi Arabia in 2011.

At the same time, the low percentage of agriculture in the GDP of Saudi Arabia is caused by the country`s poor agro-climatic conditions – hot tropical climate and desert soils – and a shortage of water resources. Therefore, by the way, the achievement of Sustainable Development Goal 6 is even more urgent for Saudi Arabia than for most other countries in the world.

The structure of Ukraine`s GDP for the same period was as follows: 62.6 % of added value was created in the service sector, 29.2 % in industry and construction, 8.3 % in agriculture (UkrStat, 2013).

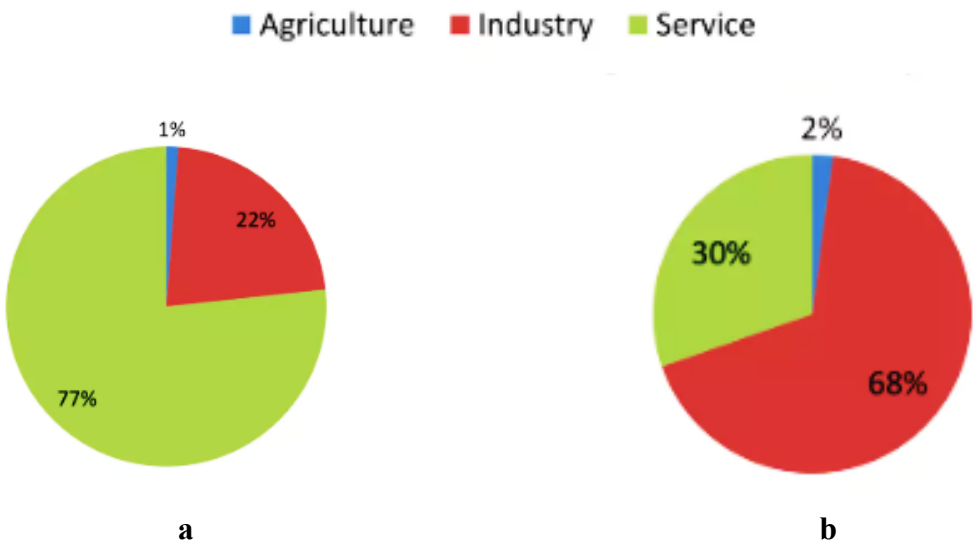

Figure 10. The sector wise GDP share in 2011: a – USA; b – Saudi Arabia
Source: Babul, 2012

The countries with a higher level of economic and technological development (relatively richer ones) have more percentage of service in its economy, which is less harmful for the environment. Unfortunately, less developed countries (relatively poorer ones) have more percentage of industry – especially mining – and agriculture in its economy, which is obviously more harmful for the environment. This dependency was described in more details in the papers (Babul, 2012) and (Wirtz et al., 2015).

Conclusions

Sustainable development ensures careful use of natural resources, particularly the balance of use and conservation. But business means the maximum use of resources. Thus, due to the use of the Ros` River by businessmen for the production of electricity, the natural flow of water from the reservoir of the Stebliv HPP decreased from 2.4 m^3/s to almost 0. Therefore, an important measure to achieve sustainable water use in the Ros' River region and in Ukraine is the introduction of water-saving production technologies and non-resource-intensive industries in general. International support for Ukraine is important for these needs, especially in the conditions of Russia's aggressive war.

Changes to the legislation and new measures to comply with it are also needed. It should be economically more profitable for entrepreneurs to comply with legal requirements than to pay fines for environmental law violations. In order to improve the Ukrainian environmental legislation, in particular regarding the protection of water resources, it is necessary to study the experience and best practices of the EU in achieving Sustainable Development Goal 6.

Conflict of interest

The authors state no conflict of interest.

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