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Environmental Protection and Improvement of Water Quality as a Factor in the Development of Tourism in the Erenik River

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ABSTRACT

This paper examines the impact of urban discharges on the water quality of the Erenik River in the city of Gjakova, Kosovo which is the most of key factor in developing the tourism. The primary goal of this project-based research was to provide results through water analysis in order to show the impact of urban discharges on the water quality for the tourists coming. The research was carried out by taking water samples at the entrance and exit of the Erenik River, while the measured parameters of the analyses were: temperature, pH value, electrical conductivity, turbidity, permanganates, phosphorus; and chlorides. Due to the conditions, measurements were not performed for: biological and chemical expenditure, dissolved oxygen, and alkalinity of the water. In order to achieve reliable results, the experimental research model was used, applying the techniques and methods of water analysis during the period of November-December 2021. The analyzed water result and the final findings showed that urban wastes affect the water quality, in particular the pollution from the discharges in the river potentiating the condition in which the Erenik River is found.

Keywords: parameters, rivers, urban discharges, water analysis, water quality.

INTRODUCTION

In general, based on the research available, Kosovo's watercourses, whose waters according to their destination and quality level are classified into classes according to the level of water quality and the purposes for its use, excluding mineral and thermal waters, are divided into different categories i.e., the watercourse included in this paper is that of a river. Erenik springs from Mountain of Junik, at 'Maja e Zeze' and passes through the mountains of Erenik, and at the outlet of Gjakova, flowing into the river 'Drini i Bardhe'. Right at the source of the Erenik River is the highest peak of Kosovo-Gjeravica, at 2,656 m above sea level (AMK, 2017) According to the data of (ASK, 2003) the average annual flow of the Erenik is 11 m^3/s, which makes this river the largest branch of the 'Drini i Bardhë'. Moreover, the Erenik River is considered a lowland river, because 2/3 of the river's flow passes through the low part of the plain, which is at an altitude between 300 and 500 m. In the past, the Erenik River had a great economic role because it served for the operation of mills, it served for irrigation, for the extraction of stones for construction, the extraction of sand and gravel, as and served for fishing (Daci 2014). The Hydro-meteorological Institute of Kosovo keeps track of the river waters in Republic of Kosovo territory. The water quality of these rivers is assessed using physical, chemical, and heavy metal analyses. Forty-eight permanent monitoring stations make up this network, with measurements occurring at the sources every six months and every month at some stations along the river flow. The Kosovo Environmental Protection Agency monitors the condition of surface waterways based on this data and creates reports (Luzha, 2015). According to the information from the Ministry of Environment, Spatial Planning and Infrastructure's official website, the legal framework for water generally meets the requirements

for the management, development, and efficient use of groundwater sources. The level of environmental pollution in the Republic of Kosovo significantly exceeds the norms of the European Union (Dreshaj et al. 2022). The country's government should pay special attention to investments in this country.

Law No. 2004/24 on Kosovo Waters – the purpose of this law is:

- To protect water resources from pollution, overuse, and misuse;
- To establish the procedures and guiding principles for the optimal distribution of water resources based on utilization and purpose;
- To ensure the sustainable development and use of water resources, which are essential for public health, environmental protection, and socioeconomic development of Kosovo;
- To accurately assess the regulatory capacity for the management of water resources (the Ministry of Environment, Spatial Planning and Infrastructure, 2019).

Furthermore, according to Article 20 of the Water Law (No. 2004/24), municipalities have the following responsibilities when it comes to managing water resources: managing local water supply resources, natural resources, public money, and public wells and waterways. The provision of public water supply services is under the purview of municipalities, as per Kosovo's Law on Local Self-Government (no. 03/L-040). Service Agreements that municipalities enter into with the relevant regional businesses that provide their services in the individual municipality should be used to implement this competence of theirs in the area of water supply and sewerage services (the Ministry of Environment, Spatial Planning and Infrastructure, 2020). To summarize, the Strategic Plan for Water is put in place for a 20-year term with the potential for government amendment every five years. (Kosovo Environmental Strategy, 2003). What is more important, is that in Kosovo the climate is very favorable for tourists (Kuqi et al. 2022) because four seasons are adjusted in accordance with official calendar and in rare cases the climate happens to be different, for instance, the winter season is snowy each year (Kuqi, 2018). Environmental assessments are the procedures that ensure that environmental implications are considered before decisions are made (Hasanaj, 2022). The substantial change in the environmental condition remains a prerequisite for the development of tourism and overall socioeconomic development, the attraction of investments and tourists. Moreover, the environment is one of the strongest factors in human security and the image of Gjakova as a place with vision and attractive long-term plans to invest and relax in these beautiful natural places.

Kosovo experiences all types of atmospheric precipitation. Precipitation in the form of rain in valleys and snow in mountains are the two types of precipitation that are most significant. The nation's average temperature varies from +30 °C in summer to -10 °C in winter. (AMK, 2017).

Emphasizing the importance of water on the sustainable environment, the Kosovo Strategy for the Environment Report (2003) states that water is an important natural resource and as such has an irreplaceable role for the life of living beings on earth, a necessary resource for the development of the country's economy, and plays an essential role in climate regulation which also affects the development of tourism, because tourists can enjoy the four sites according to the calendar. Therefore, the management and conservation of water resources, fresh water ecosystems, and drinking water is of vital importance for the country. Except for the upper Iber River, which rises in Montenegro and empties into Ujman Lake, the majority of Kosovo's water resources are domestically sourced. Drini i Bardh, Ibri, Morava e Binça, and Lepenci river basins make up the hydrography of Kosovo's watercourses.

Three marine catchments – the Black Sea, Adriatic Sea, and Aegean Sea – are streamed by the rivers of Kosovo. The Ibri, Sitnica with its banks (Llapi, Drenica), the Morava, and the Binça are the principal rivers that drain into the Black Sea watershed. Drini i Bardhe and its tributaries (Lumbardhi of Peja, Lumbardhi of Deçani, Lumbardhi of Prizren, River of Klina, Erenik, Mirusha, Toplluha, and Plava) are included in the Adriatic Sea. In turn, the Nerodime branch of the Lepenci River is a part of the Aegean Sea (Daci, 2014) (Table 1).

While water sources are greater than in the eastern portion of Kosovo, groundwater resources are few and concentrated mostly in the western section of Kosovo. The Dukagjin plain has the highest potential for subsurface water, per the Kosovo Water Master Plan 1983–2000 (ASK, 2017).

In Kosovo, there are several regional water providers: KRU Prishtina (Prishtina), Southern Hydro-region (Prizren), Hydrodrin (Pej), Mitrovica (Mitrovica), Radoniqi (Gjakova), Hydro-Morava (Gjilan), Bifurkacioni (Ferizaj), and NPH

Table 1. Rivers in Kosovo [ASK, 2017]

Name	The length within the territory of Kosovo in km
Drini i Bardhe	111.5
Sitnica	110
Lumbardhi i Pejës	56
Morava e Binçës	67
Lepenc	50
Ereniku	38
Ibri	85
Lumbardhi i Prizrenit	36

Ibr-Lepenc. In 2016, the Regional Water Companies' public systems provided water to around 89.59 percent of Kosovo's population, leaving 10.41 percent of the population without access to a water supply (ASK, 2020). Finally, the assessment should occur throughout the year to track how much and how urban discharges affect water quality and increasing the development of tourism in the country, because without a clean environment there can't even be developed tourism.

The purpose of this paper was to show more closely the impact of urban discharges on rivers in the Republic of Kosovo, a little more special emphasis has been placed on the 'Erenik River' in Gjakova, where the analyses have been carried out.

MATERIAL AND METHODS

Environmental analysis involves the detection of arsenic, copper, chromium, nickel, silver, selenium, mercury, and other elements in water matrices, even at extremely low quantities, whether as a result of industrial operations or waste disposal, soil degradation, lead pipes, or acid rain. It is crucial for environmental scientists to use trustworthy techniques and equipment that can produce the results that are compatible with recognized regulatory standards and detection thresholds (Elmer, 2020).

The Western Balkans Investment Framework report from 2016 states that seven regional water corporations with licenses manage Kosovo's drinking water supply (KRU). Regional Water Companies are responsible for collecting and, when practical, transferring wastewater to treatment facilities. They also draw water from artificial reservoirs, use it, and deliver it to households, businesses, and institutions. The levels of connectivity of urban areas (almost 99%) and rural areas to public supply systems range significantly (61%). The majority of the homes without access to public water systems are located in distant areas. The percentage of people who possess their own supply is about 18%.

Table 2. Availability of water supply system **[**Kosovo Population Census, 2011]

Nature of supply	Household units	Percentage
Water supply provided by the public service	204,365	69.6%
Water supply provided by other sources	82,609	28.2%
Piped water supply inside the building outside the household unit	899	0.3%
Piped water supply outside the building	3,413	1.2%
Water supply is not available at all	2,157	0.7%
Total	293,443	100.0%

Accordingly, around 69.6% of Kosovo's population receives water from public systems run by Regional Water Companies, while approximately 29% receives water from private or other non-KRU administered systems. The remaining 0.7% of the population does not have access to water supply services. The type of supply, the number of housing units, and the proportion of the water supply system are displayed in Table 2 (Kosovo Population Census, 2011; KSA, 2017).

As stated beforehand, the main purpose of this paper was to analyze the water quality at the entrance and exit of the Erenik River in Gjakova. The results of measuring the parameters showed the impact of urban discharges on water pollution. By measuring some parameters as follows: temperature, pH value, electrical conductivity, turbidity, chlorides, permanganates, and phosphorus. In turn, the following parameters listed below were not measured: biological and chemical expenditure, dissolved oxygen, water alkalinity.

On the basis of the findings from the analyses and the physical-chemical characteristics, the performance analysis makes it possible to identify the best solutions for the water quality in the Erenik River at both the entrance and the discharge. In order to carry out the quality assessment of the water that supplies the settlement, water samples were taken at the entrance and exit of the Erenik River (samples distributed from November to December 2021). The water was taken before and after leaving the river to analyze some of the main parameters that show how much urban waste affects its quality. The qualitative assessment consisted of analyzing 6 main physical-chemical indicators.

RESULTS AND DISCUSSION

For the sources of the Erenik River, analyses were carried out for the assessment of water quality, and the indicators measured (Table 3). On the basis of the measured parameters, we discussed the results for all the phytochemical characteristics extracted in Bishtazhin and Smolica, in the Erenik river in Gjakova.

Physical characteristics

To evaluate whether the water is polluted or not, it is crucial to check the physical qualities of the water quality. According to ASK (2013) the physical characteristics are defined through water that is colored may be contaminated, and clean water is colorless. Organic substances can also be indicated by color. 15 TCU is the highest permissible limit for the color of drinking water (true color unit). Clear water does not absorb light and is not turbid. Turbidity in the water may be a sign of water contamination.

Pure water is never flavored or odorized. If there is a taste or smell, it can be a sign of contaminated water. Temperature were determined whether or not water is drinkable does not directly depend on temperature. However, temperature is a crucial physical component that affects water quality in natural water systems like lakes and rivers.

If the water has been filtered to eliminate suspended solids, the number of solids that are still present in the solution represents the total dissolved solids. Dissolved solids in water that are greater than 300 mg/l have a deleterious impact on both industrial products and living things (ASK, 2022).

Table 3. Results of physical-chemical analyses of the Erenik River

Variables	Results	Standard deviation
Temperature	M1 = 7 °C M1 = 8 °C	1.00
Conductivity	M1 = 174.4 µS/cm M2 = 161.5 µS/cm	12.9
Turbidity	M1 = 4.00 M2 = 1.05	3.95
Permanganates	M1 = 0.48 M2 = 0.8	0.40
Phosphorus	M1 ≥ 5 mg/L M2 = 4.45 mg/L	0.55
Chlorides	M1 = 15.95 M2 = 7.09	8.86

Note: Samples: M1 – Bishtazhin, M2 – Smolica.

Water temperature

One of the most fundamental characteristics of water is temperature, and many other metrics rely on temperature to be accurate. It can be tracked thermal loading or unloading and thermocline variations, which have an impact on the wellbeing of aquatic animals and organisms, using temperature data. The high temperatures can be harmful to many aquatic creatures. The oxygen supply is constrained because warm water has reduced oxygen solubility (Dallas & Rivers-Moore, 2012).

The temperature of the water was taken with a thermometer. Water temperature plays an important role in the solubility of O_2 and other gases in river water, so it must be measured. As the temperature decreases, the solubility of O_2 in water increases, but on the other hand, the oxidative process of the dissolution of organic substances will increase, which negatively affects the development of the living world in the waters. An average temperature of 15 ºC is generally suitable. In the case of the analyses of this study, the temperature was 7 ºC in Bishtazhin or the outlet of the river and 8 ºC in Smolica. Given the results, it can be concluded that the temperature was relatively below average and available for drinking water considering that for drinking water, the temperature around 10 ºC is desirable, while it should not be more than 25 ºC.

Turbidity

The indicator of water clarity is turbidity. Water quality is frequently impacted by suspended sediments, including clay, silt, and silt particles, which frequently enter water from disturbed locations. Pollutants like heavy metals, herbicides, or phosphorus may be present in suspended sediments. Suspended particles enhance the water's turbidity, also known as "turbidity" or "haze," by decreasing the depth of light penetration into the water (Wilson, 2019).

The variety of flora that grows in the water is influenced by turbidity, particularly extreme turbidity. The water that is turbid can reveal details about the condition or wellbeing of the body of water itself. It is vital to remember that just because the water appears to have high turbidity does not mean it actually does. Short-term turbidity "events" can be transient and have minimal overall impact on the system; however,

the level can harm the ecology if it drastically changes and maintains that drastic fluctuation. Every place where turbidity is monitored should have historical data in order to detect trends and record its occurrence, just like with any other water quality indicator.

As for the composition of turbidity, it consists of suspended inorganic substances, dispersed organic substances, microscopic organisms, etc. (Boci & Hamiti, 2015). Turbidimeters by construction are nephelometers, which indicate the number of reflected rays at an angle of 90° from the entrance angle. The scale of the instrument is 0–100 nephelometric units NTU. Turbidity is most commonly measured using a turbidimeter with formazin polymer standards. The method is based on the effect of the reflection of light rays from the sample containing particles in a colloidal, suspended or emulsifying state. The number of reflected rays is proportional to the turbidity of the sample, which is compared to the reflectance given by the standard used. The results of turbidity in Bishtazin/outlet were M1 = 4.00 while at the entrance of the river the result shows that there was lower turbidity, namely M2 = 1.05, giving an average Mean = 3.95 NTU.

Specific conductivity of water

Using a portable dyonic tester, the specific conductivity of water is calculated and expressed in microns per cm at 25°C. To directly calculate the dissolved salt level in ppm, the specific conductivity is multiplied by a factor (often 0.65) (Kucherov, 2022). The results shown by the measurements that M1 = 174.4 μS/cm, and M2 = 161.5 μS/cm.

Chemical characteristics

To ascertain the chemical properties of water, chemical water analysis is used. Total solids, suspended solids, pH readings, water hardness, and the presence of chlorides are all included in this. Natural water's chemical composition is a reflection of the rocks and soils it has come into touch with (Shah, 2017). Water quality is also impacted by treated municipal and industrial effluent, as well as agricultural and urban discharges. The chemical properties of water are also impacted by microbial and chemical changes.

Determination of pH

In practically every application involving water quality, pH measurement is a critical factor. Numerous treatment procedures for wastewater depend on pH, which is regulated as part of the discharge permit. High or low pH levels in environmental sampling and monitoring might be a sign of pollution. A digital pH-meter can be used to determine the pH level. It can also be assessed using a color indicator. When indicators are introduced to a water sample, the resulting color is compared to a standard color representing a pH value that is known (Chandler, 1988).

According to Helmenstine (2019) if the pH of water is 7 it is alkaline, and if it is less than 7 it is acidic. In the considered case the pH is less than 7 and it can be said that the water is alkaline. In most cases, the presence of calcium and magnesium bicarbonates is what makes water alkaline. Some of the same substances that generate hardness also cause alkalinity. In contrast, the presence of mineral acids, carbon dioxide, iron and aluminum sulfate, etc. contributes to acidity.

The pH of municipal water supplies should be as close to 7 as possible. By reacting with them, low pH water can harm pipe lines and other objects (corrosion). Alkaline water can harm the human physiological system and cause sedimentation (smell) in pipes and problems with chlorination (for disinfection). First, the apparatus was saturated with a buffer solution of known pH value (pH = 4 and pH = 7 at 25 ºC), acting according to the instructions for use, and then the pH of the water sample was measured.

The amount of soluble matter suspended in water can be determined with the help of the residue. The general residue gives data on the total amount of soluble matter; the evaporated residue represents the amount of soluble matter, while the residue after calcination represents the amount of mineral matter which cannot be removed by calcination. Loss during calcination gives a rough estimate of the organic matter content of the water, although certain mineral matter is also volatilized during calcination. It represents the difference between the evaporation residue and the residue after calcination.

Alkalinity, as defined by Kondratiev et al. (2017), is the capacity of natural water to counteract the addition of acid. Total alkalinity is the quantity of acid needed to reach a given pH (4.3–4.8). Alkalinity can be used to approximate total alkalinity as follows:

$$\textit{Total alkalinity} = HCO_3^- + 2CO_{32}^- + OH^- - H^+$$

Determination of chlorides

Chlorides make up the majority of the anions in natural waters that can enter as pollution through sanitary and industrial streams, according to Wu et al. (2021). Chlorides in natural waterways vary in concentration. Sodium chloride is the most common type of chloride, and water with a chloride concentration of roughly 250 mg/l tastes salty. Chlorides were determined by titrating with potassium chromate as an indicator and silver nitrate as a reference solution. Therefore, the chloride level in the treated water that will be made available to the general population should not be more than roughly 250 ppm. As a result, the findings showed that the presence of chlorides was twice as present at the entrance of the Erenik River with about M1 = 15.95 than at the exit of Bishtazin M2 = 7.09, with an average difference of about mean = 8.86.

Phosphorus

Various methods of measurement exist for phosphorus, since it can take many different forms. The orthophosphate test is more frequently used because it is quick and important. Otherwise, further sample preparation and specific equipment for its digestion are needed for total phosphorus measurement. Moreover, orthophosphate measurement has become crucial for the efficient monitoring and removal of phosphorus from waterways. Orthophosphate concentration is typically determined in a laboratory setting using wet chemical analysis with reagents and colorimetry (The Water Research Foundation, 2015). However, because of the potential for chemical cost reductions and the utility of continuous data, online orthophosphate analyzers are growing in popularity. In the case of the Erenik River, they indicate the approximate presence of phosphorus both at the entrance and at the exit of the Erenik River, namely: M1 ≥ 5 mg/L, M2 = 4.45 mg/L.

Cultural-historical monuments in the city of Gjakova

Historical cultural monuments in the city of Gjakovo (Fig. 1), to the right of the monument is the old Bazaar of Gjakovo „Sulejman Vokshi" there is the entrance to the „Old Bazaar", which parks an area with cultural and historical heritage. The Old Bazaar is known for its importance in economic development. This area was built during the time of the Ottoman Empire in the century. XIV and consists of 4 parts (Charshia e Madhe, Jamia e Hadum, and Church of Shend Ndout). At that time, there were about 900 shops in Çarshi where various crafts were processed. Even today, in Çarshi there are still some shops that are used for the same purposes.

The region of Gjakova is a territory with high geomorphological values. All present important values in completing the tourist offer. The relief with attractive shapes represents the tourist potential which includes shapes of special interest to visit. All forms are found in the relief, starting from the high peaks as tourist motifs which lead to the beautiful landscape with deep gorges such as Drini Bardhë Canyons, Kusarve Cave, etc. The long-standing tradition of this region in the field

Figure 1. City Gjakova

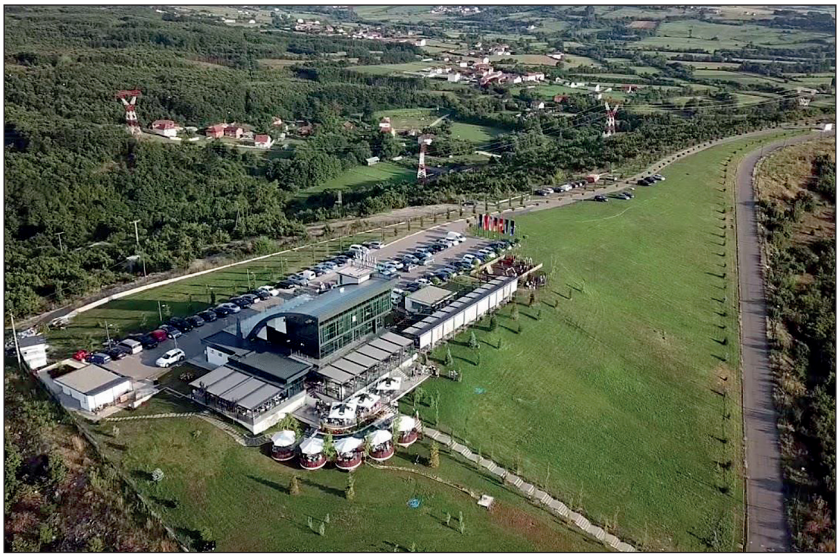

Figure 2. Restaurant "Radoniqi"

Figure 3. Bridge in Terzinjve

of tourism has influenced that there are a number of hotel facilities, which offer good conditions for accommodation and relaxation. Gastronomy is also one of the main elements that sets this city apart in terms of the craftsmanship and tradition of preparation (Fig. 2). The Erenik River has two branches, one originates in Bjeshka Rrasa e Zogut, and the other branch in Bjeshke e Junik near the Lakes of Gjeravica and flows into the Drinin e Bardhë River in the east at Ura e Terzinjve (Fig. 3). The annual flow of Erenik is 11 m^3/s, which makes this the great river of the White Drin.

CONCLUSIONS

According to the measurements, the water that the city of Gjakova receives is fresh water, because it contains few mineral compounds and pollutants. However, urban waste has a negative impact on the water quality of the Erenik River. Water conservation and sustainable availability cannot be overstated because it is essential for humans and other life forms. Numerous human activities and pollution, which in turn affect the ecosystem and lead to numerous climate changes, pose a serious threat to the availability of clean water. Some enterprises continue to discharge untreated wastewater into water bodies, despite the fact that numerous methods of wastewater treatment are being investigated by various industries and treatment plants.

Therefore, the proper encouragement of compliance with the rules of environmental protection will be extremely beneficial for the environment and, indirectly, for people, which will also influence a local tourism person. Water resources will be improved

and preserved if these environmental protection policies are taken into account when determining the goals and objectives of the various parties involved in environmenta. To create a strategy for the preservation of the environment and the development of tourism. A lot of cleaning of green spaces should be required: parks, promenades; cleaning of rivers, mountain areas to attract as many tourists as possible.

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