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EVALUATION OF THE WATER QUALITY OF THE SHKUMBINI RIVER IN THE ELBASAN AREA

SUMMARY

Albania is a country rich in water reserves such as rivers and lakes. The Shkumbin River is one of the main rivers with a length of 181 km. The watershed of this river (2445 km), includes the eastern and central part of Albania, and is characterized by forested areas. Part of the water is collected from deforested areas with high erosion. Natural factors (erosion) are dominant in the upper stream of the river, contributing to the values of TSS and different metals. But the anthropogenic factor, which is related to urban emissions and industrial activities, has a big impact. This happens in the middle stream of the river flow (Elbasan field). For this purpose, the water quality of the Shkumbini river was monitored for 4 years (2017-2020) in two stations (Labinot and Paper). Ten physico-chemical parameters. pH, Total hardness (TH), Nitrite (NO^-_2), Nitrate (NO^-_3), Chloride (Cl^-), Alkalinity, TSS and TDS, DO and Conductivity (EC) were analyzed and compared with WHO standard values and NIVA classification. The evaluation shows that we have an impact of human and industrial activity on the river waters. Determining the level of anthropogenic pollution is very important since about 28,000 ha of agricultural land is irrigated by this river.

Keywords: water quality, industrial activity, Shkumbini river, antropogenic pollution, erosion.

INTRODUCTION

Rivers, along with lakes, are an important part of surface fresh water. Fresh water is a vital commodity, both to sustain life and for the global economy. Water plays an important role for organisms and humans. Therefore, regular water quality monitoring is considered a top priority for all countries in the world (Bahmel *et al*., 2016).

However, the quality of global water has rapidly declined for decades due to the impact of both natural and anthropogenic factors (Vadde *et al*., 2018). Nowadays, the evaluation of fresh water quality is important to determine the purpose of its use, such as for domestic use, irrigation, industrial use. Water quality evaluation aims to identify the sources of water pollution and develop a strategy for sustainable water source management, maintaining and promoting human health and other social and economic growth (Carrol *et al*., 2006).

The rapid economic development has made river water pollution one of the most common environmental issues in all countries, especially in developing countries (Perrin *et al*., 2013).

The human impact on the surface waters could cause changes in the regime of water flow and in the surface water quality due to discharges of pollutants at specific locations (point sources) like wastewater treatment plants (WWTPs), or through surface/subsurface flows (non-point sources) (Carey and Migliaccio, 2009). Additionally negative impact could be rendered by indirect factors, such as atmospheric precipitation, land management and climate change (Benateau *et al*., 2019).

Rivers serve as vital sources of water for population, irrigation, industry and other applications, it plays an important role in the economic development of watersheds (Shrestha *et al*., 2007). Since untreated urban water, discharges from various industries and agricultural discharges are discharged into rivers, they are under the pressure of permanent pollution. To analyze causes of water pollution and formulate river management policies, it is necessary to assess river water quality scientifically and objectively (Fulazzaki *et al.,* 2009).

The quality of surface waters is identified in terms of their physical, chemical and biological parameters (Lukas, 2010). The quality of river water is characterized by a high level of heterogeneity in time and space, due to geological changes and vegetation in the catchment basin. This often creates difficulties to identify the sources of pollution, which are necessary to effectively control pollution, in addition to building successful strategies for minimizing the sources of pollution (Sing *et al*., 2005).

The ecological balance maintained by the quantity and quality of water determines the way of life of a people. On the other hand, polluted water is the greatest source of disease and besides debasing, the land also becomes unfit to sustain life (Sheldon, 2012).

The utility of river water for various purposes is governed by physico-chemical and biological quality of the water. In this paper, an assessment of the water quality of the Shkumbin river was made by analyzing the progress of some physico-chemical parameters. This evaluation was done in two monitoring stations, to understand the effect of urban pollution on the waters of this river.

The discharge of untreated urban water has a impact on the water pollution of the Shkumbin River. In the Elbasan city, there is no separation of rainwater from sewage, they are mixed in common collectors and discharged directly into the river. In addition, industrial waters of steel processing plants, chrome production and oil refining are discharged into the river Shkumbin.

The main purpose of this study is to determine the physico-chemical parameters of the waters in the river Shkumbin, in order to make an assessment of the environmental and quality condition of this river. To achieve this, water quality parameters (pH, conductivity, dissolved oxygen, Total Hardness TH, alkalinity, TDS, TSS, nitrites, nitrates and chlorides) were determined every May for four years 2017-2020, and the obtained data were compared with International standards WHO and NIVA classification.

MATERIAL AND METHODS

The study area includes the middle stream of the river Shkumbin, or the area of the Elbasan plain. In the upper stream of its flow, the Shkumbin river is especially polluted by material particles related to erosion and mineralization from the rock formations in which it flows.

Going down to the field of Elbasan, the flow becomes slower, causing a part of the suspended materials to sediment. Anthropogenic pollution of the river water occurs precisely in the area of the Elbasan field. To see the progress of the pollution, samples were taken at two extremes, at the entrance and exit of the Elbasan field, which are represented by the stations in Labinot and Papër (Fig. 1).

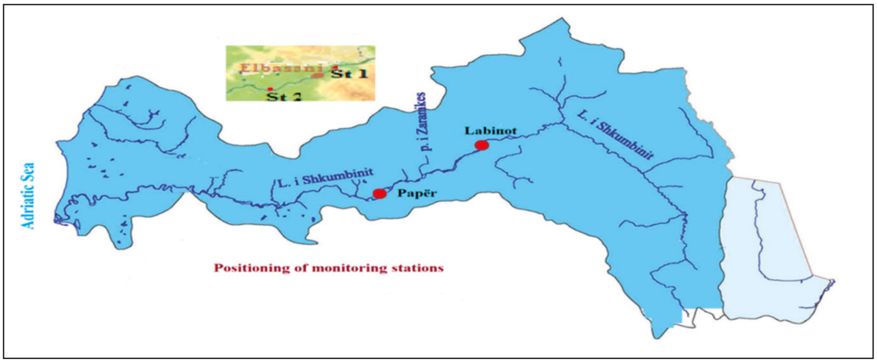

Fig. 1- Positioning of monitoring station.

Sampling was carried out in May every year, to avoid the effect of different flows throughout the months of the year. In the month of May, the flow of the Shkumbin river is approximately its annual average of 60-70 m3/sec.

The monitoring stations are located in Labinot (N: 41.15941, E: 20.17667) and Papri (N: 41.04765, E: 19.96175)

PET bottles of 1.5 l were used for sampling. Taking the sample was done in the middle of the water flow at a depth of 50 cm. To eliminate possible changes, the samples were treated with sulfuric acid until pH 2 and were transported to the laboratory in a cooling box at a temperature of 4^0 C, according to the defined standards.

Conductivity, temperature, pH, total dissolved solid (TDS) and dissolved oxygen (DO) were measured directly with camera multimeter Hach (Sension 156). The total suspensed solids (TSS) was determined after filtration on Whatman filter glass with 0.45 μm membrane. Alkalinity and total hardness were determined by volumetric method. The content of nutrients (NO_2 and NO_3) were determined by the spectrophotometric method, respectively at 540 nm and 220-270 nm.

RESULTS AND DISCUSSION

Changes in water quality are reflected in its physico-chemical and biological properties, and these are generally affected by various anthropogenic activities. In the study area is the city of Elbasan as well as many residential centers, whose population reaches 200,000 inhabitants. All the sewage of the city is discharged into the river through 4 collectors, untreated, affecting the quality of the water. While the deposition of industrial slag or urban waste, near the river, affects the pollution of the river along with others, especially from heavy metals. A number of factories also operate in this area (one steel smelting factory, two factories for the production of ferrochrome, oil processing, cement production, as well as several factories for the processing of agricultural products and oil production), which discharge the water they use. in the river. In the field of Elbasan, which lies on both sides of the river, with a length of 20 km and a width of up to 7 km, an intensive agriculture has been developed, which causes the pollution of the river from the use of pesticides or different fertilizers by farmers (Bethrellos *et al*., 2008). All these factors have a direct impact on the Shkumbin river water quality indicators.

Below we present the values of the measured physico-chemical indicators (Tab. 1 and Tab. 2).

In order to have a clearer idea about the change in the values of the analyzed parameters in the stations over the years, a graphic representation is made in Fig. 2 and Fig. 3.

Tab. 1- Values of EC, TH, TDS. TSS and Clorides by stations.

Param/station	EC (μS/cm)	Hardness mg/L	TDS mg/L	TSS mg/L	Cloride (mg/L)
Labinot 2017	278	276	167	30	16.2
Paper 2017	334	328	215	76	27.8
Labinot 2018	286	242	156	24	13.6
Paper 2018	352	315	201	87	25.3
Labinot 2019	291	260	173	32	18.2
Paper 2019	356	298	232	72	28.2
Labinot 2020	282	264	182	29	15.6
Paper 2020	341	332	234	75	27.4

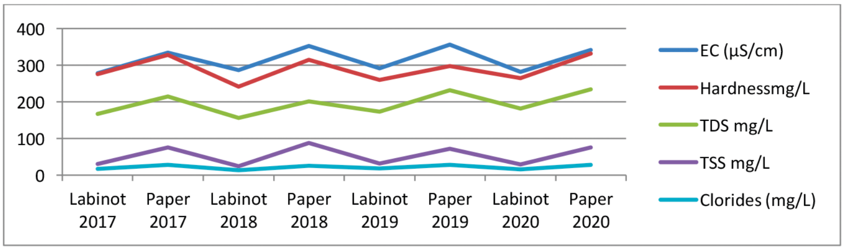

Fig. 2- Graphic presentation of the change in the values of EC,TH,TDS,TSS and chliride in stations according to years.

Tab. 2-Values of DO, pH, Alkalinity, Nitrate and Nitrite by stations.

Param/station	DO (mg/L)	pH	Alkalinity mmol/L	Nitrate mg/L	Nitrite µg/L
Labinot 2017	10.3	7.5	0.28	0.83	4
Paper 2017	9.6	8.3	0.41	1.82	9
Labinot 2018	9.8	7.8	0.33	0.67	3
Paper 2018	9.4	8.4	0.39	1.74	8
Labinot 2019	10.1	7.8	0.29	0.72	2
Paper 2019	9.5	8.5	0.45	1.68	8
Labinot 2020	10.4	7.6	0.32	0.81	3
Paper 2020	9.7	8.2	0.42	1.78	7

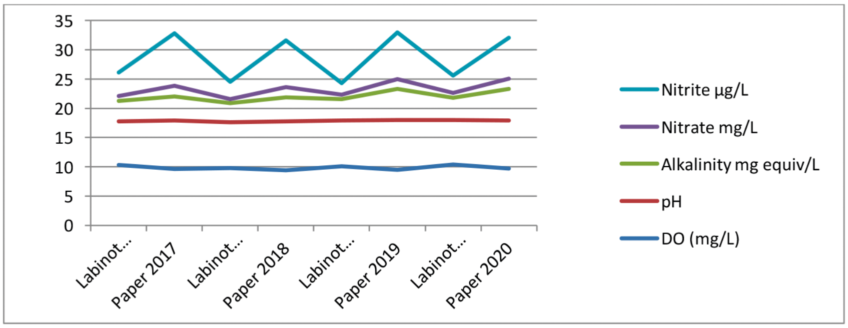

Fig. 3- Graphic presentation of the change in the values of DO,pH, alkalinity,nitrate and nitrite in stations according to years.

Conductivity

Conductivity in water is influenced by inorganic dissolved solids such as chloride, sulfate, sodium, calcium, etc. The conductivity of streams and rivers is influenced by the geology of the area through which the water flows (Fig. 1).

The allowed value of conductivity for river waters according to the NIVA classification must be lower than 600µS/cm (micro Siemens/cm). It is clear from Tab. 1 that the conductivity values are within the norms. The change in conductivity values in two stations is related to urban discharges as well as the dissolution of various salts in the area of the metallurgical plant, (Tab. 1) where during the course of the river, various residues from metal processing (slag, coal ash, etc.) have been deposited. The change in conductivity values follows the same trend as that of chlorides, since salinity and conductivity are proportionally dependent, as can be seen from the graphs (Fig. 2).

TDS and TSS

The high value of TDS (Total Dissolved Solids) in water can be caused by residues of organic materials and molecules originating from raw water (sewage), such as detergents, water-soluble surfactants and soap molecules. Looking at the obtained data and comparing it with values according to NIVA classification, the water of the river Shkumbin is within the norms.

Regarding the TSS (Total Suspended Solids) values, the water of the Shkumbin river, at the Papri station (Tab. 1), is classified according to the NIVA classification, between levels 2 and 3. According to the data (Tab. 1), we see that this parameter at the Labinot station is classified at level 1. This change in classification is related to the urban and industrial discharges that occur behind the Labinot station, as well as to the agricultural activity in this area.

Tab. 3- Parameter values for drinking water according to WHO and classification according to NIVA(Norwegian Institute for Water Research) (Bartli, 2000).

Parameters	Units	WHO	NIVA sclassification				
			I	II	III	IV	V
Total Hardness	(mg$CaCO_3$/)	500					
PH		6.0-8.5	6.0-8.5	6.0-8.5	6.0-8.5	5.5-9.0	<5.5 ->9.0
Conductivity	(µS/cm)	400	200	300	400	-500	-600
DO	(mg/L)	5-7	>7	>6	>5	>3	<3
TDS (mg/L)	(mg/L)	500-1000	<300	<500	<800	<1200	<1200
TSS (mg/L)	(mg/L)	50	<40	<60	<80	<100	>100
Alkalinity	(mmol/L)	0.2	> 0.2	0.05-0.2	0.01-0.05	< 0.01	0.00
Chloride	(mg/L)	250	<50	<200	<300	<400	>400
Nitrate	(mg/L)	< 50	<1	<3.4	<7	<11	>11
Nitrite	(µg/L)	3	<2	<5	<20	<50	>50

Dissolved oxygen DO

Dissolved oxygen in water, expresses the free amount of oxygen available to living organisms. Free oxygen or DO is needed for respiration and other biological and physical processes that occur in water. It expresses the “health” of a water body.

The measured DO values fluctuate between 9.4 and 10.4 (Tab. 2), indicating that the water of the Shkumbin River is within the WHO standards and is classified at level 1 according to the NIVA classification. River water with a DO parameter value of 4.7-6.5 can still be used for recreational facilities, freshwater fish farming, livestock and agriculture (EPA 2012).

Total Hardness

The hardness of water is related to the presence of divalent ions of Ca and Mg in the form of bicarbonates or carbonates, but also as sulfates and chlorides.

The strength of the water of the Shkumbin River is mainly caused by the dissolution of carbonate rocks. The catchment basin of the river is located in an area containing limestone rocks with dolomite content ($CaCO_3$, $MgCO_3$). Parts of these rocks are dissolved by the rainwater or by the river water itself, passing the water body.

However, the water hardness values, which range from 242 mg/L $CaCO_3$ to 342 mg/L $CaCO_3$, are lower than the limit value set by WHO.

Nitrate and nitrite

Nitrate anions (NO_3) are found in natural water as a result of bacteriological oxidation of nitrogenous compounds in the soil. Nitrates are created according to an oxidation reaction of NH_3 and NH_4^+. The concentration of these anions increases rapidly in summer, when the nitrification process develops very intensively. Another important source of nitrates in surface waters is precipitation, which absorbs nitric oxides and converts them into nitric acid. A large part of nitrate anions (NO_3) enters the surface waters together with urban waste water, industrial water and from agricultural farms. Nitrate anions (NO_3) are one of the indicators for the degree of pollution with organic substances. Nitrate ion values in the Papri station (Tab. 2), are below the WHO standards and are classified at level 1 according to the NIVA classification, while the nitrites in the Papri station have values higher than those of the WHO standard and are evaluated at level 2 or 3 of the NIVA classification.

pH

pH is a parameter that determines the quality of water and suitability for use in industry or agriculture. Raw water from industrial activities, urban areas, agriculture etc, when discharged into rivers can potentially change the pH of the water and disrupt the life of aquatic organisms that are sensitive to pH changes.

From the obtained data, it can be seen that during the four years we have almost the same fluctuation of pH values, moving from the Labinot station to the Papri station (Fig. 3). This is due to urban discharges but also industrial discharges. However, comparing the obtained values with the WHO values, we say that the pH values are within the usage values. While according to the NIVA classification the water of the river Shkumbin is classified at level 1 (pH values 7.5 - 8.5).

Alkalinity

The alkalinity of river waters is related to the presence of salts of weak acids, mainly bicarbonates but also carbonates. The alkalinity of the Shkumbin river water is within the WHO standards and according to the NIVA classification (Tab. 3) it is classified at level 1. The increase in alkalinity from the Labinot station to the Papri station is caused by agricultural activity, industrial and urban discharges.

CONCLUSIONS

The water quality of the Shkumbin River in the study area is within the defined values. The increase in the TSS content and nitrites in the Papri station is related to the sewage discharges of the city of Elbasan in this river. Careful management of the situation, the construction of a sewage treatment plant would have a very positive effect on the improvement of water quality.

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