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Scientific paper
ISSN 0351-9465, E-ISSN 2466-2585
https://doi.org/10.62638/ZasMat1270

Zastita Materijala 66 (3)
644 - 652 (2025)

Water quality of Shkumbini River, Albania: evaluated by physical-chemical parameters and nutrient content

ABSTRACT

Water is an important natural resource that supports the lives of humans and the environment.Monitoring the quality of fresh water is important for water quality assessment and for ensuring a good quality objective. It is very necessary to test the nutrient and physical-chemical parameters of water in respect of national and/or EU standards before it is used for different purposes, such as drinking, domestic, agricultural, and industrial water. This study deals with the water quality assessment of the Shkumbini River based on the distribution and level of physical-chemical parameters and nutrients along the river. The study was performed in March 2022 by applying in-situ measurements of water quality parameters combined with chemical analysis of nutrient content. The results revealed the geographical position, the related urbanization and human activity, as well as weather variation along the river catchment as primary factors affecting the changes in river water quality. Although the number of sampling sites is small (N=4), it is noted that the measured results for all parameters obey the normal distribution (tested by Anderson-darling test, p > 0.05) and were characterized by low variation (CV% < 25%), except TSS which showed a moderate variation (CV% = 49%). The water quality parameters resulted in a lower level than the permitted values, by indicating good water quality in the Shkumbini River. It is confirmed by the WQI index, which ranged in a good water quality status (71 < WQI < 90) for all monitoring stations. It is probably related to low water temperatures and a rainy period in March. The outcomes demonstrate the effectiveness of the water quality parameters and the model employed for assessing water quality.

Keywords:*river water, sampling, water quality,physical-chemical parameters,nutrient.*

1. INTRODUCTION

The surrounding environment is a complex system that consists of land, water, air, and living organisms that are influenced by various natural and human factors, establishing certain balances between them. As a result of intense human activity, these balances have changed, which has caused the destruction of natural ecosystems. Pollution is a serious problem as it passes into the soil, water, and air and then passes into the food chain, posing a risk to human health and living organisms. Water is a key resource for the development of every human activity and is the most important natural resource of life throughout the world. The world's freshwater resources are very unevenly distributed, compared to the world population density [1]

Regional and seasonal differences in the study area, land use and erosion processes, the spatial scale of sampling sites, the extent and type of human activities in the catchment, and the time of sampling all affect river water quality [2,3]. Urban areas with intensive human activity and rapid land use change are vulnerable to water degradation [4]. As a result of human activity in the downstream regions of most river basins, the water quality of these basins exhibits significant changes that have a detrimental impact on the rivers' health, particularly in terms of their water supply for daily life, industry, and agriculture[5].

Limited water resources and water quality have become major problems throughout the world, resulting in a global water crisis for billions of people [1, 6]. Water quality monitoring following the Water Framework Directive (WFD) shows that the study of the environmental situation and water quality is complex, including various biological, chemical, and physical-chemical parameters. The balance between water demands, water quantity,

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Paper received: 01. 10. 2024.
Paper accepted: 08. 10. 2024.

and water quality is a critical problem in many regions of the world, increasing the demand for a sustainable water resources management approach [6]. Waste disposal and the use of various chemicals in urban, industrial, and agricultural processes can cause serious water pollution. Water eutrophication is an important environmental issue in surface water, groundwater, and marine systems that is strongly related to the increase of nutrient content in water, mainly affected by human activities and atmospheric deposition [7].

The presence of macronutrients like carbon, nitrogen, and phosphorus is essential for the growth of aquatic life in freshwater [8], but high levels are dangerous for aquatic life. In addition to natural sources, manmade inputs and erosion carried out by runoff are the main sources of nutrients in fresh water [8]. Changes in nutrient flux in heavely populated areas can induce spatial and temporal variations in nutrient and physical-chemical parameters in water. The level and the technology used for sewage treatment and nutrient removal are significant factors contributing to the fluctuations in nutrient and physical-chemical parameters in water [4] that cause the eutrophication of water ecosystems. Eutrophication of waters is associated with the enrichment of nitrogen (N) compounds like nitrite (NO_2^-), nitrate (NO_3^-),ammonium (NH_4^+), and phosphate (PO_4^{3-}) content in water that can cause the presence of algal blooms and macrophytes in certain waters, depletion of dissolved oxygen in water, degradation of aquatic ecosystems, and loss of key aquatic species. EPA 2001 water quality standards [9] include several parameters, such as chemical, physical, and biological parameters, that directly affect the water quality.

This study is focused on the water quality of the Shkumbini River, an important river located in the central part of Albania. Water quality assessment was based on water physical-chemical parameters such as temperature, pH, dissolved oxygen (DO), TSS, nutrients (N-NO_2^-, N-NO_3^-, N-NH_4^+, P-PO_4^{3-}).

2. MATERIAL AND METHODS

General view of Shkumbin River

The Shkumbin River i is positioned in central Albania, originating from the mountainous area of Valmara (Korce), and flows into the Adriatic Sea near the Karavastase Lagoon. Since it passes through areas with high chrome, nickel, and iron minerals, the industrial area of Elbasan with high industrial activity of chrome, nickel, and iron metallurgy, as well as cement, as well as urban and industrial area of Elbasan, it is affected by various manmade factors.

Four monitory sites along the Shkumbin River were selected in this study (Fig. 1). The selection of the monitoring sites was carried out by taking into account the geographical position, urban, industrial, and agricultural pollution factors, erosion conditions, etc. The hydrological parameters of the Shkumbini River are shown in Table 1, and the map of the area and sampling positions are shown in Fig. 1.

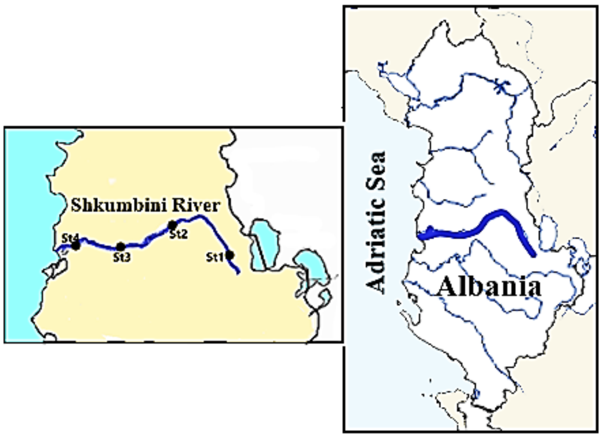

Figure 1. The position of sampling sites: St.1- Qukes; St.2 – Fushe Labinot; St.3 - Mjekes; St.4 - Rogozhina

Table 1. Hydrological parameters of the Shkumbin River [10]

Length	Surface	Altitude	Flow	Modulus of flow	Average amount of mineralization
km	km^2	m	m^3/sec	l/sec/km^2	mg/L
181.4	2445	753	61	25.2	317

St. 1 is located close to the Qukes, a small village with only 650 inhabitants, which is selected as a clean area. Shkumbini River passes at a significant thickness of topsoil area in this zone, which is characterized by moderate erosion.

St. 2 is located next to the Qukes area. It is characterized by relatively flat mountainous terrain. The area is relatively sparse in population settlements. It is a rural area with activities in agriculture, farming, and tourism.

St. 3 is located in Mjeke, just in the exit to Elbasan town with 100,903 inhabitants. The river runs through the Shkumbini valley. The river water of this station is heavily impacted by urban and industrial activity in this area.

St. 4 is located at the exit of Rogozhina town. Shkumbin River runs approximately 2 km from the Rrogozhina center. This station is located at the end of the river, between Rogozhina and the river-mouth. The area is characterized by flooding, river erosion, and massive exploitation without criteria of the inert materials.

Table 2. Description of demographic and economic situation of sampling areas

Sites	Qukes	Labinot-Fushe	Mjekes - Elbasan	Rogozhin
Geographical	41.07773, 20.45920	41.13463, 20.15593	41.08056, 20.04315	41.06439, 19.65285
Population (2012 Census)	650	7,058	More than 110,000 inhabitants	22,148
Agriculture activity	Rural area, Agriculture, farming	Rural area, Agriculture, farming	Urban area, Agriculture, farming	Urban area
Industrial activity	No	No	Metallurgy, Cement production, etc	Small enterprices

Water sampling method

Sampling was performed based on the standard methods "Standard Methods for the Examination of Water and Wastewater" with the APHA(1998) standard method [11] and ISO Standard 5667-1: 2006 [12]. The samples were filtered with 0.45 µm Millipore nitrocellulose filters. To clean the membrane, the initial part of the filtered water was poured. Water samples for metal analysis were taken in 0.5 PET bottles pre-cleaned in the laboratory. Water samples for nutrient analysis were taken in 100 ml glass bottles. For metals, the PET bottles were washed with 10% v/v nitric acid, and then rinsed several times with pure deionized water. The samples were transported during the same day to the laboratory using cold boxes to maintain the temperature of +4 °C. The samples were stored under standard conditions until analysis. During transportation, the water samples were treated with chemicals to maintain the stability of the parameters taken in the study, as shown in Table 3.

Table 3. Samples storage conditions

Parameter	BOD	NH_3, NO_2^-, NO_3-	DO
Consevation conditions	4° C, dark bottles	pH<2, H_2SO_4	In the presence of chemical fixation reagents for DO, dark bottles

Determination of physico-chemical parameters

Physical-chemical parameters such as water temperature, pH, dissolved oxygen (DO), total dissolved solids (TDS), salinity and electrical conductivity were measured in situ using a portable multiparameter apparatus (HACH type sension 156). Suspended solids (TSS) were determined by filtration on a pre-weighed filter with a pore size of 0.42 µm. The filter was weighed again after drying at 105℃ for 2 hours to constant weight. Nutrient content (N-NO_3^-, N-NO_2^-, NNH_4^+, P-PO_4^{3-}) was determined according to standard APHA (1998) procedures [11] using UV-Vis spectrophotometric methods using a Specord 40 spectrophotometer.

Data analysis

Water quality index (WQI) was used to assess the water quality of Shkumbini River. In order to measure the pressures of natural and anthropogenic effects to water bodies, the aquatic classification system, which covers rivers, estuaries, coastal and groundwater bodies [13], is used. Classification of water quality means the categorization of water bodies based on water quality parameters, which have a certain effect on the pollution level of water bodies. Classification takes into consideration two main criteria: the destination of use, like as drinking water, for aquatic life, agricultural, or industrial use, and commercial, industrial, navigational, recreational, wildlife conservation and aesthetic purposes, and the second, taking into consideration the environmental health of water bodies.

The simple water quality index (WQI), which is based on five water quality parameters, temperature, biological oxygen demand (BOD), total suspended sediment (TSS), dissolved oxygen (DO), and conductivity, is used in this study. A higher value of WQI indicates better water quality. Surface water bodies are classified using a system of five quality classes that vary from 0 to 100, with five different ranges from 91 to 100 as excellent water quality, 71 to 90 as good water quality, 51 to 70 as average water quality, 26 to 50 as fair water quality, and 0 to 25 as poor water quality [13].WQI is calculated by the following equation[14]:

$$WQI = \frac{\sum qn * Wn}{\sum Wn}$$

Where

qn = Quality rating of n^th^ water quality parameter. Wn= Unit weight of water quality parameter. All WQI data of this study were calculated through the online simple index calculator.

Cluster analysis was used to better understand the relationships and behavior of multivariate data. Sorting a data collection of observations and/or variables into comparable group variables that differ from one another [15, 16]. Cluster analysis is a data-separating method groups of different observations and/or variables into different clusters that differ from each other [15]. The obtained clusters consist of variables with high similarity and as high as possible distances between the clusters [15, 16]. The correlation distance, calculated as d=1-r (r represents the correlation coefficient), is mentioned as the most appropriate distance measure [15, 17]. In addition, the Euclidean distance that evaluates the similarity between two objects based on the squared distances between the data points is also used in cluster distance calculation [17]. Cluster analysis is widely used to group together the parameters with high similarity and to assess the factors affecting the complexity of the environment.

3. RESULTS AND DISCUSSIONS

Chemical-physical parameters

The experimental results of the chemical-physical parameters of the Shkumbin River samples are given in Table 4.

Table 4. Experimental results of chemical-physical parameters

Sampling Sites	Temperature	pH	Alkalinity	EC	TSS	DO	BOD	WQI
	°C		(mg/l)	(µs/cm)	(mg/l)	(mg/l)	(mg/l)	
St1	13.7	7.82	187	315	38.2	10.6	3.5	87
St2	16.4	8.01	203	348	69.5	9.1	4.7	78
St3	17.8	7.77	192	323	137	9.3	4.2	73
St4	17.6	8.18	265	344	97	8.9	5.1	74

Table 5. Results of the statistical analysis performed by "descriptive statistics" (in mg/l)*

Variable	Temp (°C)	pH	Alkalinity*	EC (µs/cm)	TSS*	DO*	BOD*	WQI
Mean± StDev	16.4 ± 1.9	7.9 ± 0.19	212 ± 36	333 ± 16	85 ± 42	9.8 ± 0.8	4.4 ± 0.7	78 ± 6
CV%	12	2	17	5	49	8	16	8
Minimum	13.7	7.8	187	354	38.2	8.9	3.5	73
Median	17	7.9	198	333	83.3	9.8	4.5	76
Maximum	17.8	8.2	265	348	137	10.7	5.1	87

Although the number of sampling sites is small (N=4), it is noted that the measured results for all parameters obey the normal distribution (tested by Anderson-darling test, $p > 0.05$). With the exception of TSS (CV% = 49%), all other parameters result in a fairly low variation (CV% < 25%), and vary in a narrow range. Quite important are the results of the WQI index, which show a good water quality (71 < WQI < 90) for all monitoring stations, which is probably affected by low water temperatures and a rainy period of March.

Temperature

The temperature level depends mainly on the temperature of the environment and the speed of the water flow. The temperature of the samples taken in the study ranged from 13.7 to 17.8 °C. The minimum temperature (13.7 °C) was measured at station St1, followed by station St2 (16.4° C). Both of these stations are located in mountainous areas with different geographical heights, which has affected the temperature of the environment in these areas and the speed of water flow in these areas. The other two stations (St3 and St4), positioned in plain areas and closer to the Adriatic Sea, show higher temperatures. Changes in the temperature values of water systems are caused by changes in various chemical processes in water, such as the dissolution of oxygen in water, in various chemical reactions, or in the activity of organisms or microorganisms in water that affect the fermentation of pollutants and the eutrophication of natural waters. With all that, the level of temperature variance is low (CV% = 12 %), which is not the main reason for the level of pollution in the Shkumbin River during the spring when the monitoring was carried out.

pH

Monitoring the pH of water systems is of particular importance as it is a very important parameter which mainly depends on the nature of the ions dissolved in them, with a tendency of basic values mainly in carbonate areas. On the other hand, pH is an indicative parameter of the degree of eutrophication of waters when it goes to acidic values, indicating the presence of urban discharges, urban waste, industrial discharges, or biological processes of plants or aquatic algae such as photosynthesis or respiration of algae. The pH values of the samples taken in the study fluctuate in a fairly narrow range (7.8 to 8.2) with values within the range of normal values (6 to 9) recommended by the EPA for surface waters [18].

Alkilinity

The alkalinity of Shkumbin river samples fluctuated from 187 to 265 mg/l (CaCO3). The minimum value was observed at station St1 and the maximum value at station St4. The alkalinity of natural water samples is related to the presence of carbonate salts, hydrogen carbonate, or oxide-hydroxides in the water. It indicates the presence of carbonate, bicarbonate, or hydroxide in water. It shows how able the water is to neutralize the acids.

Elektrical Conductivity (EC)

The EC values of the samples taken in the study fluctuate in a fairly narrow range, from 315 µS/cm (St4) to 348 µS/cm (St2) accompanied by a very low variation (CV% = 5%), showing a stable situation during the monitoring period. High conductivity values are thought to be influenced by industrial, agricultural, and rural activities. The conductivity value in water is affected by the presence of dissolved solids such as anions or cations, and higher salinity in water indicates higher water conductivity.

Total suspended matter(TSS)

The TSS values of the samples taken in the study fluctuate in a wide range, from 37.2 mg/l (St1) to 137 mg/l (St3), associated with a very high variation (CV% = 49%). The TSS values in the samples taken in the study are higher than the values recommended by the European Community (< 10 mg/L). Such a situation can be caused by different conditions of erosion in different areas, by different parameters of the speed of water flow in areas with high slopes, as well as by the conditions of anthropogenic pollution in areas where spills can be identified as solid in water.

Disolved oxygen (DO)

The DO content in Shkumbini river water varies from 8.9 mg/l in summer (S4) to 10.6 mg/l (ST1). The content of DO in surface waters is related to the dissolution of oxygen present in the air and the process of photosynthesis in water. The level of DO in surface waters depends on a number of factors, such as water temperature (the amount of DO increases with increasing temperature), the speed of water flow, which positively affects the values of DO, the level of pollution, which negatively affects the values of DO, etc. The DO level is essential for the survival of aquatic creatures and an important indicator of surface water pollution or eutrophication. The highest levels of DO were found in the first station (St1), which is favored by a high flow rate due to the area's fraction as well as by low levels of pollution as it is located far from urban and rural areas.

Biological oxygen demand (BOD)

The content of BOD in the Shkumbini River water varies from 3.5 mg/l to 5.1 mg/l. The lowest BOD content was found at station St1, near the source of the Shkumbin River, which is associated with a fairly low level of pollution in it. The highest value of BOD was found in station St4 (Rrogozhina), a rural area with high agricultural activity.

WQI

Based on the WQI results presented in Table 3, the water quality of Shkumbini River showed good level (71 < WQI < 91). Water quality is strongly related with population and land use along the water bodies [19]. It is verified in our result which consisted with higher WQI values near the river spring in mountain area with scarce population, and an increase in lowland characterized by relatively high populatin and industrial, agricultural, and dayly life.

Nutrients

The content of nutrients (mg/l) in the water of the Shkumbin River is given in Table 6, while the results of the statistical analysis in "descriptive statistics" are given in Table 7.

Table 6. The content of nutrients (mg/l) in the water of the Shkumbin River

Sampling Sites	NH_4^+-N	NO_2^--N	NO_3^--N	P-PO_4^{3-}-P
St1	0.062	0.004	0.45	0.023
St2	0.187	0.006	0.31	0.039
St3	0.275	0.011	0.23	0.034
St4	0.386	0.014	0.29	0.048

Table 7. Results of the statistical analysis performed by "descriptive statistics"

	NH_4^+-N	NO_2^--N	NO_3^--N	P-PO_4^{3-}
Mean	0.228	0.0088	0.320	0.0360
Median	0.231	0.0085	0.300	0.0365
St. Deviation	0.137	0.0046	0.093	0.0104
CV %	60	52	29	29
Minimum	0.062	0.004	0.230	0.0230
Maximum	0.386	0.014	0.450	0.0480

From the results of the statistical analysis, it is noted that the average values of each parameter are quite close to the median values, accompanied by relatively low variation for NO_3^-N and P-PO_4^{3-} (CV % = 29 %) and moderate for NH_4^+-N and NO_2^- N (CV % resulted 60 % and 52 % respectively). This shows that the values of NO_3^--N and P-PO_4^{3-} are more stable than those of NH_4^+-N and NO_2^--N.

Nitrate (N-NO_3^-)

Based on the WQI results presented in Table 3, the water quality of the Shkumbini River showed a good level (71 < WQI < 91). Discussion of water quality is strongly related to population and land use along the water bodies (Pu et al. 2019). It is verified in our result, which consisted of higher WQI values near the river spring in mountain areas with scarce population and an increase in lowland characterized by relatively high population and industrial, agricultural, and daily life.

Nitrite (N-NO_2^-)

The concentration of NO_2^- - N (mg/l) in the Shkumbini river water samples is relatively low and fluctuates in the levels from 0.004 mg/l to 0.014 mg/l, with an average concentration of 0.0088 mg/l. According to the results shown in Table 5, it turns out that the profile of the change in the concentration of NO_2^- - N increases by passing from the source (St1) with minimum content to other stations, which, for the same reason as for nitrates, may have been influenced by levels of different discharges of urban waste and livestock waste in these areas. Another possible source of nitrites could be hydroplankton and sewage discharges, which are also related to the degree of urbanization of the areas where the samples were taken. On the other hand, nitrites in fresh waters are found as intermediate compounds obtained through the microbial reduction of nitrates or from the process of ammonium oxidation. The level of nitrites in unpolluted waters is usually lower than 0.01 mg/l [18] expressed as nitrogen (N) content. The level of NO_2^- - N content in the water samples of stations St1 and St2 was lower than 0.01 mg/l, while in stations ST3 and St4, it was higher than this level. As expected, this shows different levels of pollution at these stations. Stations St3 and St4 located in urban and urban-rural areas present a higher level of pollution than stations St1 and St2 located in residential areas.

Ammonium (N-NH_4^+)

Ammonium present in water systems originates from the microbiological decomposition of nitrogenous compounds, organic matter, and secretion by various aquatic organisms. Ammonium also derives from anthropogenic sources, such as industrial processes, urban sewage discharge, animal stables, or fermentation of urban waste discharged into the environment. Unpolluted natural waters contain relatively small amounts of ammonium, usually at a level lower than 0.02 mg/l NH_4^+ - N [18]. Ammonium content in Shkumbini river water ranges from 0.062 mg/l to 0.386 mg/l NH_4^+ - N. The lowest level was found at station ST1, and the highest level was found at station S4. The profile of the change of ammonium content in the station obtained in the study varies according to the order NH_4^+ - N of ST1toNH_4^+ - N of ST4 which is related to the degree of urban emissions and livestock in these areas. The levels of NH_4^+ - N in the samples taken in the study are several times higher than normal values, which indicates a high level of pollution. This can be caused by eutrophication of water.

Phosphate (PO_4^{3-}-P)

The content of phosphates in the studied stations along the Shkumbin River varies in values from 0.023 to 0.048 mg/l PO_4^{3-}—P. All measured values are lower than the recommended level (0.1 mg/l PO_4^{3-}—P) [18]. The phosphate concentration values show a low variation (CV% = 29 %), which indicates a stable state along the Shkumbin River. Phosphates in water come mainly as a result of human activity, among the main sources of phosphates in the environment, we can mention sewage discharges in urban areas, urban water discharges with phosphorus content from the use of different detergents, etc. The monitoring period (March) is characterised by abundant rainfall; therefore, pollution from areas with high agricultural activity is another factor of anthropogenic phosphate pollution. Likewise, the erosion or washing away of soils and rocks in the areas where the river passes is another source of phosphates in the water. Mention that the two extremes of minimum and maximum phosphate values were found, respectively, in stations St1 (a clean area near the source of the Shkumbin River) and St4 (a rural area with agricultural and industrial activity).

Multivariate analysis

There are few data, only four monitoring sites, for performing a Pearson correlation analysis and detecting the associations between the investigated parameters. For this reason, the similarity in the spatial distribution of each parameter was compared, as well as the cluster analysis of the measured variables was performed, which is precisely based on the similarity between the parameters used to evaluate the water quality of the Shkumbin River. The spatial distribution of physical-chemicaland and nutrients data are shown in Figure 2.

Only five pairs of parameters showed very high and significant correlations ($p < 0.05$). Cluster analysis was performed based on correlation coefficient distances (Figure 3).

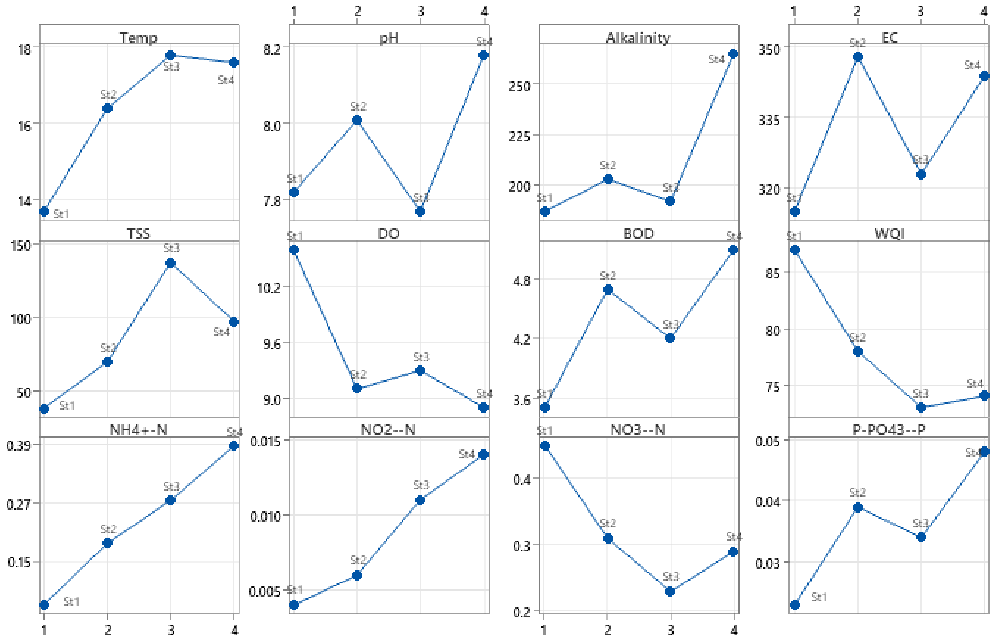

Figure 2. Spatial distribution of physical-chemicaland and nutrients data

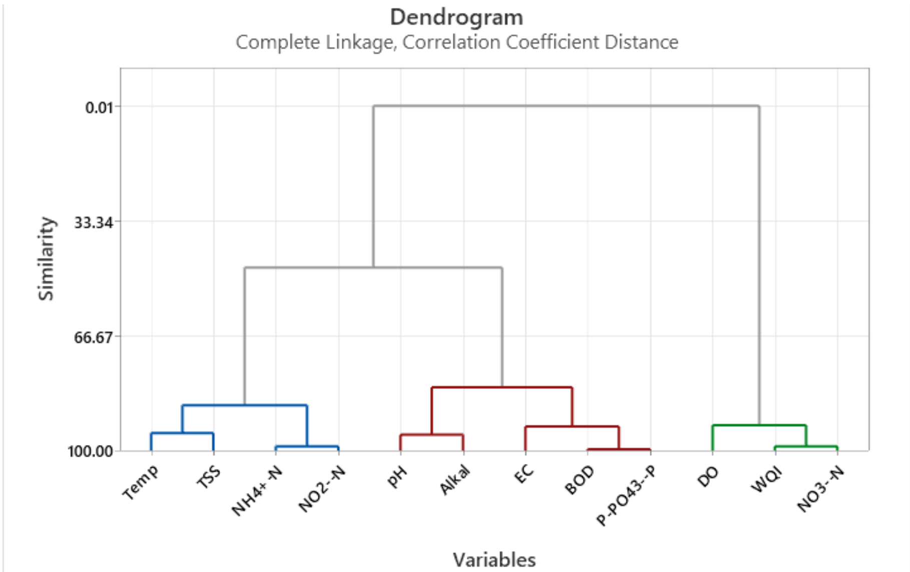

Figure 3. Dendrogram of cluster analysis

Final Partition

	Variables
Cluster 1	Temperature, TSS, NH_4^+-N, NO_2^--N
Cluster 2	pH, Alkalinity, EC, BOD, P-PO_4^{3-}-P
Cluster 3	DO, WQI, NO_3^--N

Present data yielded three main clusters with relatively high distances between them, i.e., similarity of 47% between the first and second clusters and 0.01% between the two first clusters and cluster 3. The moderate similarity (47%) between clustrs 1 and 2 could be explained by the behaviors and origin of their parameters, which are primary affected by anthropogenic factors and the water temperature.

Cluster 1 is composed of four parameters: temperature, TSS, NH_4^+-N, and NO_2^-N. The measured temperature ranged from 13.6 to 17.8 °C. In such a narrow range, it could appear to have small effects on the water parameters. According to Zhu et al. (2023), the temperature could affect the internal release of NH4-N that is gradually accelerated as the temperature rises, followed by a biogeochemical transformation of N, which is an important factor affecting the N content of a water body. In addition, temperature affects the nitrogen flux rate at the interface of sediment and water [20].

Cluster 2 contains pH, alkalinity, EC, BOD, P-PO_4^{3-}—P. The acidity of the water impacts the phosphorus content in the water. P retention from the sediment decreased as pH increased [21]. The phenomenon is adverse in desorption of phosphate radical ions from the ferric hydroxide colloid and the release of more phosphate into water [22]. Domestic waste was a dominant source of BOD in the Mediterranean area [23]. The same as BOD, PO_4^{3-}—P is an indicator of untreated domestic waste contamination in areas with high urban density.

Cluster 3 is composed by three water quality parameters, DO, WQI, and NO_3—N. Nitrates in water represent the oxide state of nitrogen nutrients, which have a direct effect on oxygen content in water bodies. In addition, DO content in surface water indicates directly the water quality. Higher DO content and WQI show a better water quality.

4. CONCLUSIONS

This study revealed that the nutrients and physical - chemical parameters are the basis for the environmental assessment of surface water quality.

Parameters such as temperature, pH, electrical conductivity, BOD, and nutrients are mostly varied according to the position of the stations in relation to urbanisation and human activity in them.

The investigated water quality parameters resulted in lower levels than the permitted values. The concentrations of nitrate and nitrite were generally lower than the level established by WHO, 2004 [24] for surface water (50 mg/l for nitrates and 1.0 mg/l for nitrites). On the other hand, ammonium has high concentration levels, which exceed the recommended level of surface water (0.3 mg/l) set by WHO (2004). Statistical analysis can be successfully used in the interpretation of environmental data as it highlights the phenomena that lead to the classification of the environmental status of the studying object.

Water quality in the Shkumbini River was found to be good, with a WQI value of 71 to 90. Low water temperatures and high precipitation during the March monitoring period most likely have an impact on it. It is an efficient method for monitoring of fresh quality.

For the near future, it will remain the responsibility of local authorities to increase measures for the treatment of urban and industrial waste waters particularly near urban areas.

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IZVOD

KVALITET VODE REKE ŠKUMBINI, ALBANIJA, PROCENJEN PREMA FIZIČKO-HEMIJSKIM PARAMETRIMA I SADRŽAJU HRANLJIVIH MATERIJA

Voda je važan prirodni resurs koji podržava živote ljudi i životne sredine. Praćenje kvaliteta slatke vode je važno za procenu kvaliteta vode i za obezbeđivanje cilja dobrog kvaliteta. Veoma je neophodno ispitati hranljive i fizičko-hemijske parametre vode u skladu sa nacionalnim i/ili EU standardima pre nego što se ona upotrebi u različite svrhe, kao što su voda za piće, domaćinstva, poljoprivredna i industrijska voda. Ova studija se bavi procenom kvaliteta vode reke Škumbini na osnovu distribucije i nivoa fizičko-hemijskih parametara i hranljivih materija duž reke. Studija je izvedena u martu 2022. primenom in situ merenja parametara kvaliteta vode u kombinaciji sa hemijskom analizom sadržaja hranljivih materija. Rezultati su otkrili geografski položaj, povezanu urbanizaciju i ljudske aktivnosti, kao i vremenske varijacije duž rečnog sliva kao primarni faktori koji utiču na promene kvaliteta rečne vode. Iako je broj mesta uzorkovanja mali (N=4), primećuje se da izmereni rezultati za sve parametre poštuju normalnu distribuciju (testirano Anderson-Darling testom, p > 0,05) i da ih karakteriše mala varijacija (CV% < 25%), osim TSS koji je pokazao umerenu varijaciju (CV% = 49%). Parametri kvaliteta vode su rezultirali nižim nivoom od dozvoljenih vrednosti, ukazujući na dobar kvalitet vode u reci Škumbini. To potvrđuje VKI indeks, koji se kretao u dobrom statusu kvaliteta vode (71 < VKI < 90) za sve stanice za praćenje. Verovatno je to povezano sa niskim temperaturama vode i kišnim periodom u martu. Rezultati pokazuju efikasnost parametara kvaliteta vode i modela korišćenog za procenu kvaliteta vode.

Ključne reči: *rečna voda, uzorkovanje, kvalitet vode, fizičko-hemijski parametri, hranljiva materija*

Naučni rad
Rad primljen: 01.10.2024.
Rad prihvaćen: 08.10.2024.

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