Study of Physical-Chemical Characteristics of Discharge Wastewater in Lepenc Basin

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Abstract—**Pollution caused by the discharge of wastewater into the Lepenc river basin is diverse and directly affects the quality of life of the inhabitants of this area. This paper aims to investigate the physicochemical characteristics of pollution from wastewater discharges, build the water balance of the entire basin, and identify the risk to human life due to lack of drinking water. From the hydrological point of view, the Lepenc river basin is divided into sub-basins, and the results obtained by experimental measurements show that wastewater pollution varies from one sub-basin to another and depends on the amount and origin of wastewater. Combined analysis of the available amount of water and the need for clean water, which is based on parameters that are out of the water balance below the water stress limit, the need for wastewater treatment is a necessity and that continuous water discharge of contaminants in the water basin is unacceptable or in other words very dangerous. The results showed that some analyzed parameters are outside the acceptable limits for drinking water such as TSS with values above 75 mg/L, BOD_5 with values up to 9.42 mg/L, NH_4^+ up to 9.48 mg/L, and PO_4^{3-} up to 1.76 mg/L. On the other hand, the waters of the Lepenci river basin had low heavy metal pollution during the observed period. Therefore, routine monitoring of wastewater in the Lepenc Basin is recommended to prevent the risk of pollution of the basin, where many communities use this source for drinking water.**

Index Terms—**Hydrological water balance, Lepenc river basin, monitoring, wastewater treatment, water pollution.**

I. Introduction

Water is essential for life and we should all play a role in protecting and improving the aquatic environment as well as the appropriate ecosystem. The health of an aquatic ecosystem depends on its physicochemical and biological characteristics [1], [2].

We must work together to make the right choices for the aquatic environment, which will benefit human health, increase the value of the environment and benefit the economy. In the current situation around the world, the poor quality of water discharged from households, industries, and shopping malls contains different levels of pollutants.

This poor quality of discharged water is the result of poor management of discharged water and food waste. These pollutants are intentionally or accidentally discharged into the environment, which is discharged directly or indirectly into public sewers and landfills [3].

In developing countries, about 80% of urban wastewater is used for irrigation, paying (70-80) % for food safety and the life of urban communities [4].

The importance of water supply areas, catchment water quality and wastewater treatment and disposal is recognized by presenting the methods of analysis for each component in one part for all types of water.

The Lepenc River Basin, which includes the Nerodime and Lepenc rivers, is one of Kosovo's most picturesque and ecologically rich areas, with great potential for tourism and enjoyment and admiration of the aquatic environment. The wide Lepenc river basin includes four interconnected municipalities and cities, Ferizaj, Shtrpca, Kaçanik and Hani i Elezit. Most of the population is concentrated in these urban areas, but over 30 large rural villages are evenly distributed across the Lepenc River Basin.

The highest population density is in the cadastral unit of Ferizaj, in the center of Ferizaj. Since all urban wastewater is discharged directly into the Lepenc River Basin without any form of treatment, there is a significant degradation of water quality moving from quiet mountain areas to urban areas on the border with Macedonia.

The effects of climate change are already evident. In the last ten years, we have experienced extreme floods and droughts in some basins. Forecasts suggest that water resources could be increasingly depleted in the future, but at the same time, we have a significant increase in population. Therefore, harmful pressures on water resources and water quality are likely to increase in the future.

All these pressures have detrimental effects on citizens and the ecosystem. We have to act. All those who use, enjoy, and commercially use the aquatic environment of the Lepenc River Basin should play their part in its protection.

This paper aims to examine the state of water quality in the Lepenci river basin in the period from 2017 to 2019 by assessing the impact of some physicochemical parameters for determining the level of wastewater pollution by building a water balance of the Lepenci basin and studying their effects on water stress region.

II. Methodology

A. Study Area

The Lepenc River Basin (674 km^2 on the Hani i Elezit border) is located in the southeastern part of Kosovo and shares an international border with Northern Macedonia in the southwest and southeast of the border and is approximately 650 km^2 in size. To the northeast of Hani i Elezit, the Lepenc river basin covers 10 km^2 of the territory of Macedonia and is therefore cross-border.

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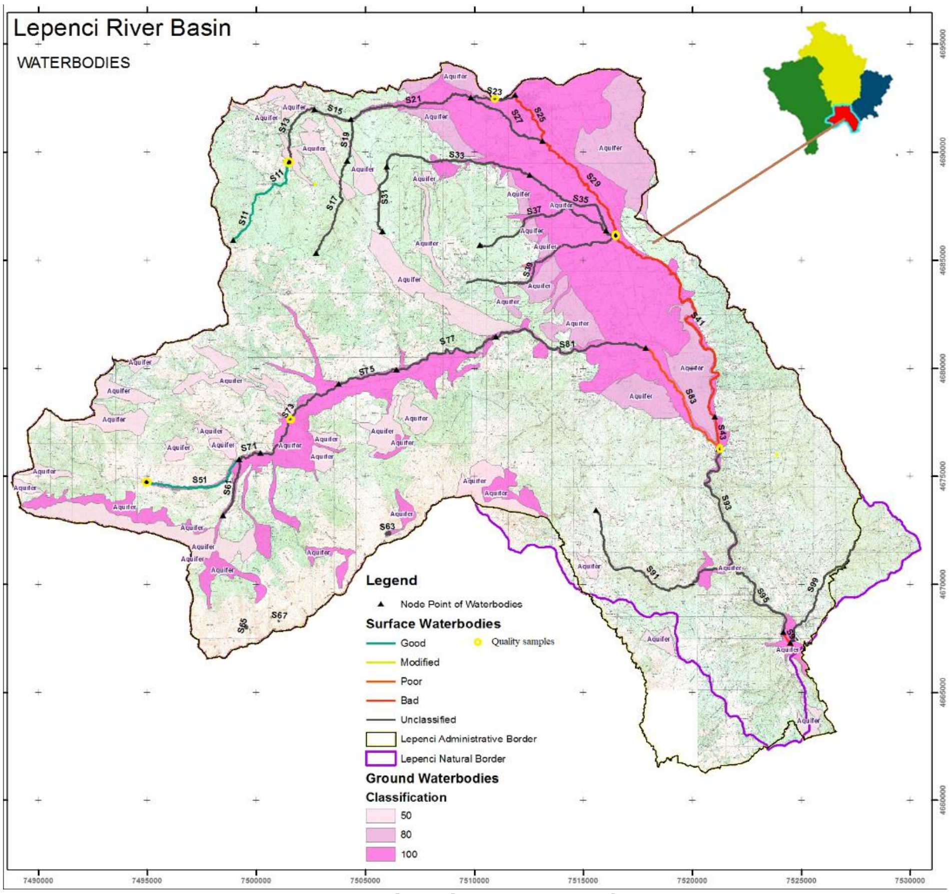

Fig. 1. Monitor and sampling station network map.

The topography in the southwest is dominated by the Sharr mountain range, whose range forms the border with Macedonia with an absolute altitude of 2500 m.

These western parts get significant amounts of snow in the winter months. Focused on the city and municipality of Shterpce, Sharr Mountain National Park is an important feature.

The western and northern borders of the basin are the Jezerc mountain range, with an altitude of 1700 m. In hydrogeological terms, the Lepenc river basin is divided into sub-basins that make up the Lepenc river basin itself, in each sub-basin monthly water quality samples are taken as shown in Fig. 1.

B. *Water Balance*

An important feature of the Lepenc river basin is the determination of water balance. This shows the main annual water transfers to and from the river basin. Before the water leaves the river basin (either as river runoff or evaporation from plants and soil), it can also be temporarily stored (in lakes and surface reservoirs, groundwater, or snow reservoirs). It is necessary to calculate the water balance to know if there are significant changes in any of the key parameters over a long period of time, which may create pressures in the future.

At the beginning of the computer simulation of catchment water balance, the main purpose was the estimation of runoff for water yield studies, and calculated monthly totals of runoff were the main interest. Today, a vast range of models is used in different climates according to water balance purposes [5] - [11].

The water balance has been defined as “the balance between the income of water from precipitation and snowmelt and the outflow of water by evapotranspiration, groundwater recharge, and streamflow” [12].

Water balance is an effective tool for planning and assessment on the catchment scale, application of water supply and distribution, wastewater management, and flood assessment [13], [14], especially in the case of unmeasured ponds [15], [16].

Long-term changes in water conservation in catchments, including surface and groundwater, are expressed as residues (accumulated or dispersed water) in the water balance equation (amount of snow and ice that can be removed) [17].

$$P - R - ET = \frac{dS}{dt} \quad (1)$$

where dS/dt is the total change in water in the basin, P is the average amount of precipitation, ET is evapotranspiration and Q is the discharge of surface water into the main drain of the basin.

This form is usually applied to the monthly water balance when significant changes in river basin accumulation can occur during different months, such as snow accumulation during winter or groundwater discharge during summer. These differences may be important for seasonal water analyzes.

However, during the period of a full hydrological year, changes in the accumulation are usually considered zero, as the basin is considered to be in “equilibrium”. Therefore, the water balance is simplified to:

$$P - E = F \ (units\ are\ mm) \quad (2)$$

Because evaporation is difficult to measure in the field, while precipitation and leakage are easy to measure, the ET value is usually derived from subtraction. Evapotranspiration was measured by vortex covariance at the US-CZ3 site within the basin at 30 - minute intervals starting in 2008. [18].

C. Physical-Chemical Analysis

Since 2003, the Kosovo Hydrological and Metrological Institute (HMIK) has been conducting monthly water quality samples for surface water quality in the Lepenc River Basin, in principle, at six locations each month. The data were made in the laboratory of the Hydrological and Metrological Institute of Kosovo in Pristina [19]. The most important parameters that give a good indicator of overall water quality are dissolved oxygen (DO), chemical oxygen consumption (COD), biological oxygen consumption (BOD_5), ammonia (NH_4^+), and phosphates (PO_4^{3-}). Continuous monitoring in this way helps us to assess the quality of our water, identify incidents of pollution and determine whether the quality has deteriorated over time, contrary to the main objectives of the Water Framework Directive.

Various water quality studies have found that anthropogenic activities have a significant negative impact on water quality in the lower parts of large rivers [20], [21].

Water-related environmental quality has been shown to be far from adequate due to unknown characteristics of wastewater [22].

As the name implies, a DO test measures the concentration of oxygen dissolved in a water or wastewater sample. DO measurement most often takes place using an electronic meter fitted with a specialized DO probe.

Determination of BOD is performed using Standard Methods 5210 [22]; the method consists of placing the sample in a full, hermetically sealed bottle and incubating the bottle under certain conditions for a certain time. BOD measures how much-dissolved oxygen (DO) is consumed by microorganisms to decompose organic matter under aerobic conditions. The BOD test involves incubating a closed sample of water at 20°Cfor five days, followed by measuring the change in oxygen content before and after incubation.

COD measures how much DO is consumed by oxidizing organic matter and inorganic compounds such as ammonia or nitrite under controlled conditions. The COD test usually involves dissolving a sample of water in a sealed vial of potassium dichromate and sulfuric acid at 150 ℃ for 2 hours. The flasks are read on a spectrophotometer to determine the results.

Other chemical parameters such as metals and nutrients were determined according to standard analytical methods for testing water and wastewater [23].

For the determination of ammonia-N, we used the method with selective electrode methods. The selective electrode method for measuring ammonia in a distillate is suitable for determining a wide range of organic nitrogen concentrations. Selective electrode methods and automated colorimetric methods can be used to measure ammonia in digestate without distillation.

For the determination of PO_4^{3-} we used the method with Acid Persulfate Digestion Method is most used for the range from 0.06 to 3.5 mg P/L.

III. Results and Discussion

Long-term climate monitoring (precipitation, wind, temperature, solar radiation, and pressure) is critical to the issue of sustainability. Long-term increase in the average temperature (as seen in Fig. 2 where the monitored temperature report for a year is presented) or the maximum daily or reductions of water resources due to climate change can significantly affect our agriculture or say the possibility of insurance of drinking water. Average temperatures ranged between -2.5°C in January and 19 °C in August, and evaporation was 430 mm. The highest value of evapotranspiration was recorded in August, with higher temperatures.

The highest month of precipitation is May (with 81 mm), while in January-February and March a total of 53 mm of precipitation falls. The average annual altitude reaches 576 mm, while the maximum rainfall reaches 755 mm and the minimum 381 mm.

The maximum monthly rainfall was recorded at the top with 157 mm, while the lowest was in July and October as seen in Fig. 3.

From Table V, the measured values of sub-basin precipitation for the river basin and the values of drainage from two measuring stations were used.

In the case of a measured basin, the annual values are calculated using equation (3):

$$P\ (958) - R\ (440) = ET\ (518)\ mm \quad (3)$$

Assuming equation (4), the entire surface of the river basin on the border of Northern Macedonia (673.73 km measured +12.19 km ruthlessly) can be calculated by the full water balance in terms of volume:

$$P\ (646) - R\ (297) = ET\ (349)\ mm^3 \quad (4)$$

When done correctly, weather stations can give important short-term (6-24) hours of warnings about possible extreme weather situations (wind, sub-zero temperatures, extreme precipitation, etc.).

In hydrogeological terms, the Lepenc river basin is divided into sub-basins (management units) that make up the Lepenc river basin itself.

The results of physicochemical parameters in the Lepenc river basin divided into six sub-basins (control units) as shown in Table I-III were monitored for three years.

We need to calculate an "average measured area" by analyzing rainfall and drainage at the sub-basin level.

At this stage, we are not able to fully assess the “state of the water body” due to a lack of capacity and technical data, especially with regard to specific biological and chemical elements.

As an authorized measure, we have approximated five status classes with the Water Framework Directive using the thresholds from Annex 1 of Directive 2006/44/ EC [24] and Directive 75/440/EEC [25], to determine physical-chemical quality classes for the five main water quality indicators as given in Table IV.

All experimental data are shown in Table I-III, while those results that do not comply with Directive 2006/44/EC are shown in Fig. 4.

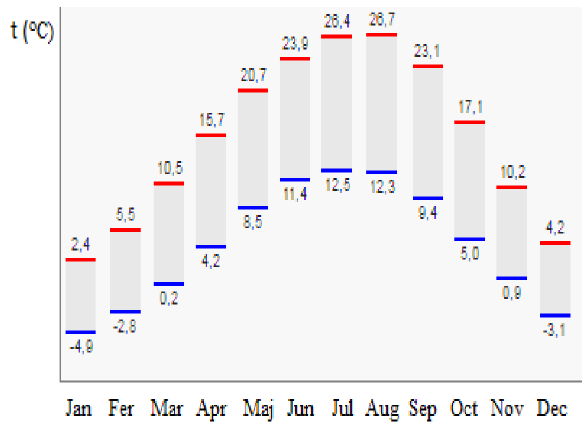

Fig. 2. Average temperatures.

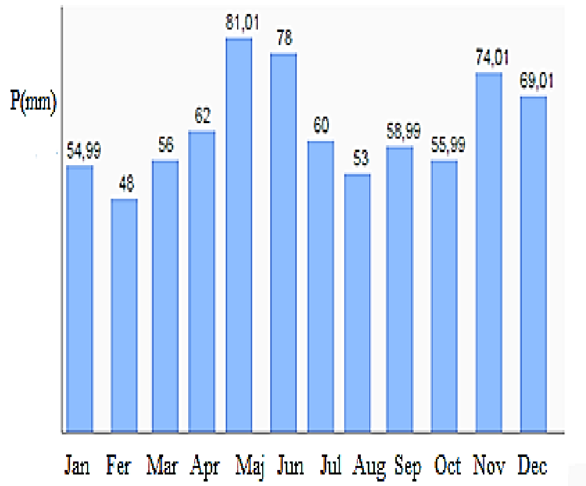

Fig. 3. Average precipitation.

Since suspended solids represent all mineral and organic particles found in wastewater. The obtained results show that TSS values range between 78 mg/l and 1241 mg/l, with an average lead of 431 mg/l. Reactions to TSS are very high at 50 mg/l which is considered the wastewater standard for direct discharges.

TABLE I: AVERAGE ANNUAL VALUES OF ANALYZED PARAMETERS IN LEPENC BASIN

Parameter	2017						
	Unit	Jezerc	Gerlic ë	Prevall ë	Nerodime	Ka çanik	Hani i Elezit
Temperature	ºC	9.3	9.5	8.8	10.9	9.7	10.7
TSS	mg/L	131	384	78	1214	168	429
pH	-	8.2	8.3	8.4	8.6	8.9	9.2
Electrical conductivity	μScm^{-1}	129.5	465.6	86.4	473.4	214.6	265
DO	mg/L	9.22	5.52	9.75	6.3	9.27	8.86
COD	mg/L	0.18	18.7	0.32	15.5	22.5	22.1
BOD_5	mg/L	0.07	6.95	0.12	5.78	8.36	8.34
NH_4^+	mg/L	0.27	1.67	0.14	1.84	0.32	0.85
PO_4^{3-}	mg/L	0.33	1.01	0.027	0.73	0.066	0.376
Cr^{3+}	mg/L	0.0023	0.0029	0.0025	0.00821	0.0059	0.00129
Cd^{2+}	mg/L	0.0042	0.0036	0.0047	0.0012	0.0027	0.0048
Ni^{2+}	mg/L	0.028	0.052	0.044	0.031	0.052	0.029
Zn^{2+}	mg/L	0.0291	0.025	0.032	0.0175	0.047	0.059
Mg^{2+}	mg/L	0.079	0.325	1.274	0.582	0.1668	0.2174
Fe^{2+}	mg/L	0.05	0.121	0.0389	0.131	0.1245	0.1359
Pb^{2+}	mg/L	0.019	0.009	0.016	0.0028	0.19	0.16

TABLE II: AVERAGE ANNUAL VALUES OF ANALYZED PARAMETERS IN LEPENC BASIN

Parameter	2018						
	Unit	Jezerc	Gerlic ë	Prevall ë	Nerodime	Ka çanik	Hani i Elezit
Temperature	ºC	8.7	8.9	9.5	9.9	10.2	10.4
TSS	mg/L	201	550	154	955	462	571
pH	-	8.1	8.0	8.3	8.5	8.7	9.0
Electrical conductivity	μScm^{-1}	287.5	556.8	61.5	562.7	287.6	371
DO	mg/L	9.49	6.22	8.3	9.8	9.35	9.0

COD	mg/L	0.21	20.37	0.49	23.6	25.4	24.8
BOD_5	mg/L	0.08	7.56	0.18	8.78	9.42	9.21
NH_4^+	mg/L	0.345	3.99	0.265	3.61	0.91	1.84
PO_4^{3-}	mg/L	0.11	1.76	0.029	0.93	0.168	0.544
Cr^{3+}	mg/L	0.0022	0.0029	0.0027	0.0082	0.0061	0.0013
Cd^{2+}	mg/L	0.0041	0.0035	0.0043	0.00132	0.0029	0.004
Ni^{2+}	mg/L	0.029	0.054	0.045	0.033	0.053	0.03
Zn^{2+}	mg/L	0.031	0.0264	0.033	0.0181	0.048	0.0624
Mg^{2+}	mg/L	0.082	0.331	1.275	0.585	0.1671	0.2181
Fe^{2+}	mg/L	0.051	0.122	0.0392	0.132	0.1251	0.1362
Pb^{2+}	mg/L	0.02	0.011	0.017	0.0029	0.121	0.167

TABLE III: AVERAGE ANNUAL VALUES OF ANALYZED PARAMETERS IN LEPENC BASIN

Parameter	2019						
	Unit	Jezerc	Gerlicë	Prevallë	Nerodime	Kaçanik	Hani i Elezit
Temperature	°C	8.7	9.2	8.4	9.2	9.7	10.1
TSS	mg/L	31.3	573	84	857	312	730
pH	-	8.3	8.4	8.5	8.7	8.8	9.1
Electrical conductivity	μScm^{-1}	116	556.5	214.5	557.7	275	348
DO	mg/L	7.56	1.22	7.2	5.2	4.97	4.42
COD	mg/L	0.13	19.01	0.27	15.5	11.7	14.1
BOD_5	mg/L	0.05	7.05	0.1	5.72	4.32	5.23
NH_4^+	mg/L	0.07	9.88	0.12	9.3	1.14	2.72
PO_4^{3-}	mg/L	0.16	1.58	0.012	0.81	0.59	0.783
Cr^{3+}	mg/L	0.0024	0.0031	0.0028	0.0081	0.006	0.00132
Cd^{2+}	mg/L	0.0043	0.0033	0.0034	0.0013	0.0028	0.0046
Ni^{2+}	mg/L	0.030	0.055	0.046	0.033	0.054	0.031
Zn^{2+}	mg/L	0.032	0.027	0.0331	0.018	0.0475	0.063
Mg^{2+}	mg/L	0.091	0.334	1.282	0.587	0.1672	0.1282
Fe^{2+}	mg/L	0.052	0.1221	0.041	0.137	0.1252	0.1365
Pb^{2+}	mg/L	0.021	0.0101	0.0172	0.00291	0.124	0.165

The concentration of DO during 2017 varies at all sampling sites and has values between 5.52 and 9.97 mg O_2/L with a mean value of 7.74 mg O_2/L, while during 2018 the value of DO is from 6.22 and 9.8 mg O_2/L and 9.8 mg O_2/L and in 2019 it is characterized by a lower concentration of DO of 1.22 and 7.56 mg O_2/L. Found high values of DO 9.0 mg O_2/L, claim that the discharge of wastewater caused serious organic pollution in rivers since the decrease of DO was mainly caused by the decomposition of organic compounds.

BOD_5 profiles during the sampling period generally ranged from (0.05–9.4) mg/L, while COD ranged from (0.13–25.4) mg/L. BOD_5 in the aquatic system is caused by high levels of organic matter such as leaves. The recommended value for BOD_5 is **7** mg/L according to Directive 2006/44/EC.

Mean NH_4^+ levels in wastewater runoff were very high in the range of (0.07-9.3) mg/L. It also requires urgent intervention in the construction of a wastewater treatment plant as this is unacceptable for the water body. The recommended value for NH_4^+ is 1 mg/L according to Directive 2006/44/EC.

Another nutrient analyzed for our study was PO_4^{3-}, whose concentration varied on average between (0.012 and 1.76 mg/L). An increase in PO_4^{3-} in domestic wastewater is expected due to food, specifically meat, processing, washing, etc. The recommended value for PO_4^{3-} is 0.7 mg/L according to Directive 2006/44/EC.

The results of the experimental test for Cr^{3+} have a value of (0.008 to 0.0049) mg/L (available in tables 1, 2, and 3) and the recommended value for Cr^{2+} is 0.005 mg/L according to Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water.

The results of the experimental test for Cd^{2+} have a value of (0.0012 to 0.0049) mg/L (available in tables 1, 2, and 3) and the recommended value for Cd^{2+} is (0.001-0.005) mg/L according to Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water.

The variation of Zn^{+2} concentrations is within the (0.0175 –0.063) mg/L interval, below 1.0 mg/L, which is the maximum accepted value of the Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water.

TABLE IV: CLASSIFICATION SCHEME FOR THE PHYSICAL-CHEMICAL QUALITY PARAMETERS OF SURFACE WATER

Parameter	Physicochemical quality class					Compliance control criteria
	1	2	3	4	5	
DO [mgO_2/L]	⩾7	⩾6	⩾4	⩾2	<2	▪ Minimum
BOD_5 [mgO_2/L]	⩽3	⩽3	⩽3	⩽3	>15	▪ N=12: 95% ▪ N<12: maximum
NH_4^+ [mgNH_4^+ /L]	⩾0.04	⩾1.0	⩾1.0	⩾6.0	>6.0	▪ N=12: 95% ▪ N<12: maximum
PO_4^{3-} [mgPO_4^{3-}/L]	<0.05	⩽0.2	⩽0.4	⩽1.0	>1.0	▪ N=12: 95% ▪ N<12: maximum

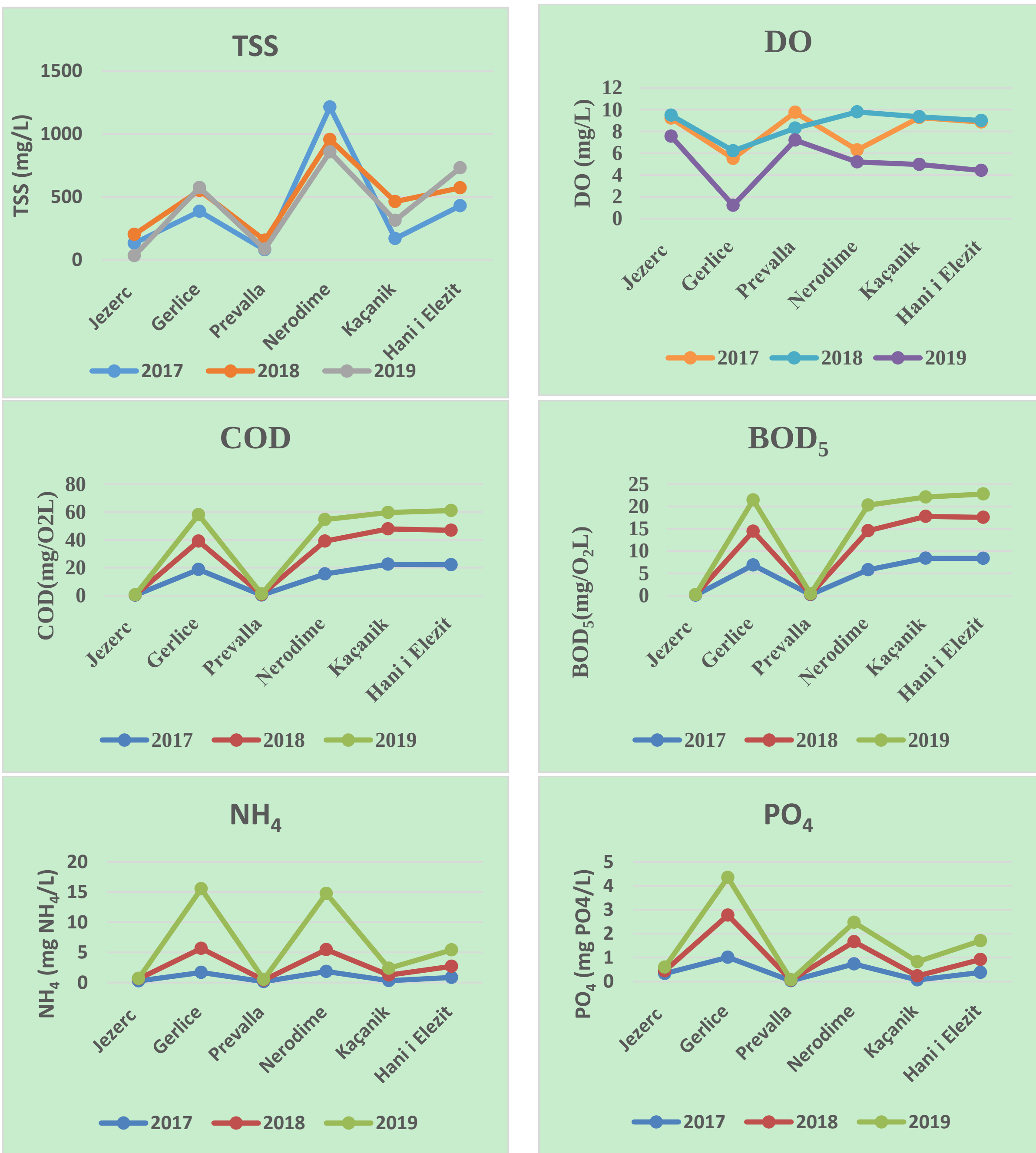

Fig. 4. Graphs of main quality parameters of Lepenc basin throughout years 2017-2019.

Basin discharges were measured at 15-minute intervals using a combination of established Parshall-Montana flows, dams, and manual flow rate estimation curves [26]. Table V shows the data for approximating the amount of precipitation and drainage of the Lepenc river basin sub-basins during the years 2017-2019.

TABLE V: APPROXIMATION OF RAINFALL AND DRAINAGE OF LEPENC RIVER BASIN SUB-BASINS

The name of the Management Unit	Unit ID	Area (km^2)	Precipitation (month/year) (by $\bar{x}$ isohypsa)	Measured precipitation $\left(area \cdot \frac{P}{I \cdot A}\right)$	Drainage (month/year)	Measured drainages $\left(area \cdot \frac{R}{I \cdot A}\right)$
Jezerc	1	51.63	1025	876	367	367 R_c= 42%
Ferizaj	2	53.40	700		367	
Plestina	3	62.68	900		367	
Kacanik	4	55.97	800		367	
Bitija	5	103.5	1100	1083	550	550 R_c= 51%
Brezovica	6	93.57	1100		550	
Sterpce	7	54.98	1000		550	
Nikaj	8	57.19	850	876	367	367 R_c= 42%
Hani i Elezit	9	140.852	950		367	
Measurement area	**Σ**	673.73		958 (mm)		440 (mm)

Table V shows that "The Rc Drainage Coefficient" of the River Basin is simply Drainage/Precipitation = 46% as a measured average for all basins. However, at sub-basin levels, this value covers that the removal rate above Brod is about 51% and for the rest of the basin it is 42%. Water balance is key to data and finding the effects of climate change on pool water availability.

For example, if precipitation decreases or evaporation increases (as a result of global warming), it will have a direct negative impact on the amount of water we have in the river basin information in the years to come.

The results of the analyzed parameters in the Lepenc basin (Tables I-III) confirm the pollution coming from the sewage system, even though the river was self-cleaning. This approach compensates for the year-on-year variations in the assessment, which better represents the overall state of surface water quality.

In simple terms, we conclude that an average of 646 mm of precipitation will fall into the pond. Of this, 349 mm ^{3}will be lost by evaporation. A balance of 297 mm is discharged from the river basin as a basin.

Annual renewable water sources are a very important feature. This tells us how much water is available for use (use or consumption) each year.

Consumption is water that is used but not returned to the catchment (eg by transfer to a nearby river basin, bottled water, etc.). Although the Lepenc River Basin is quite above the United Nations water stress threshold, it should be noted that without artificial storage to withdraw flow, a significant percentage of *RWR* is not actually available for use as it may be lost in the downstream river basin. This is especially true in the case of high discharge periods of April, May, and June.

Based on the existing water use register, the total annual use of surface water (rivers + springs) is about 18.7 mm or 6.3% of annual renewable sources. Including underground use, this figure increases to 21.3 mm ^{3} or 7.2%. Although this is a relatively low percentage, it is a fact that in the months of low inflows in August, September, and October, some economic units use excessive water, especially in cases where irrigation is active.

Rivers based on ecosystems (fauna, flora) have evolved over hundreds of years depending on the natural course of the river (for example spring floods, and low summer flows). The flow regime (volume changes) is mainly affected by the pond according to the seasons and the volume is usually set as the average monthly flow. In Elez-Han, the average long-term flow for May was 16.2 m^3/s but was reduced to 3.8 m^3/s in August. The local ecosystem will naturally adapt to these long-term changes.

However, if due to artificial influences the natural flow regime has changed significantly in a short period of time (month/year), then this can be very detrimental to the local ecosystem, and in extreme cases, the ecosystem can be permanently degraded.

To protect ecosystems from these impacts, the concept of minimum ecological flow has been introduced. This is the minimum monthly flow that must be maintained in the river to support the river-dependent flora and fauna. The so-called "biological elements" are an important and critical component of water body health.

For this reason, it is important that the total utilization of each water body in each given month does not deplete the river flow below the estimated minimum ecological flow.

IV. CONCLUSIONS

The available data allow an approximate hydrological water balance at the Lepenc River Basin-scale, but they are sufficient for a complete water balance for the Lepenc River Basin.

Based on the research, we conclude that a comparison with the needs and availability of water shows that water stress can occur under the Nerodima basin. Further analyzes can be concluded which include regional differences and the construction of a complete water balance on the basin scale for verification.

We can also conclude that the water demand can be substantiated by determining the efficient use of water and future water needs in the region, taking into account the needs for drinking water supply, agriculture (irrigation), and industry.

Proper determination for the maximum utilization of the amount of renewable water supply should be done respecting the living conditions in the river and the sustainable use of groundwater bodies.

From the table 5, it can be concluded that the physicochemical quality of the water of the river Nerodime significantly deteriorates between Jezerc and Gërlica. Also, the water quality of the Lepenc River (before it flows into the Nerodime) between Brezovica and Kaçanik is deteriorating, but not as much as in the Nerodim River. The physicochemical quality of the Lepenc River near the border with Macedonia can be described as "poor".

However, the mean values of most physicochemical parameters tested (DO, BOD_5, COD, TSS, NH_4^+ and PO_4^{3-}) in all Lepenc river basins showed a large non-compliance with different regulatory standards as most of the tested physicochemical parameters exceeded recommended release levels and could pose significant health and environmental risk to communities.

These communities use water taken from the river basin for drinking and household use without treatment and can affect the health of the aquatic environment in the catchment water.

The paper found that there is a negative impact on the physicochemical characteristics of the catchment due to the discharge of inadequately treated wastewater from wastewater treatment plants.

Study recommendation:

1) Prevention of new sources of pollution (over time the amount of water pollution is increasing),
2) Continuous measurements at embedded measuring stations, including levels and stocks; food can be separated from the food curve (safe part required):

Construction of reliable meteorological stations that provide at least precipitation and temperature data;

Construction of a groundwater monitoring area.

3) Efficient wastewater treatment from wastewater treatment plants to avoid river basin pollution.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

All authors conducted the research; analyzed the data; wrote the paper, and all authors have approved the final version.

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