

# Assessment of Vjosa River Water Quality Using Chemical Parameters

Marsela Alikaj<sup>1\*</sup>, Lirika Kupe<sup>1</sup>, Elona Bahiti<sup>1</sup>, Alma Imeri<sup>1</sup>, Irena Duka<sup>2</sup>

<sup>1</sup>Department of Agronomic Sciences, Faculty of Agriculture and Environment, Agriculture University of Tirana, Tirana, Albania

<sup>2</sup>Department of Environment and Natural Resources, Faculty of Agriculture and Environment, Agriculture University of Tirana, Tirana, Albania

\*[malikaj@ubt.edu.al](mailto:malikaj@ubt.edu.al)

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## Abstract

Albania possesses a diverse range of water ecosystems. The objective of water quality assessment is to identify sources of pollution and develop sustainable strategies for managing water resources. Pollution from both natural and anthropogenic sources has the potential to cause harm to aquatic ecosystems. Of particular concern is nutrient enrichment, which can have adverse effects on surface water quality. Excessive nutrients can lead to eutrophication in surface waters, causing algae blooms and significant alterations in the water ecosystem's biodiversity. Our study aimed to evaluate the Vjosa River's water quality based on chemical parameters. The Vjosa River is a vital water ecosystem in Albania, the Balkans, and Europe, renowned for its biodiversity and water quality. Our investigation was carried out from November 2021 to May 2023. Five water sampling points were chosen in the Vjosa River and water samples were analysed for nutrient forms such as nitrogen and phosphorus. The values of ammonium ranged from 0.06 mg/l to 0.14 mg/l, while NO<sub>2</sub> ranged from 0.014 to 0.066 mg/l, and NO<sub>3</sub> range from 0.47 mg/l to 0.66 mg/l. The concentration of phosphates ranged from 0.024 to 0.068mg/l. Based on most of the chemical parameters analysed, water quality in the Vjosa River is of high quality when compared to the WFD standards.

**Keywords:** *Water quality; Physicochemical parameters; Vjosa River*

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## INTRODUCTION

The Vjosa River is a crucial resource in Albania, deemed the "Blue heart of Europe" and renowned as the final untamed river for its diverse range of species. Moreover, it has been declared a National Park. Limited scientific studies exist concerning the river's water ecosystem and the surrounding area of the National Park. Additionally, there have been some evaluations of microorganisms present in the water [1]. The Vjosa Wild River National Park is host to a plethora of rare wildlife species, encompassing over 150 species of winged insects, 91 taxa according to [2], [3] and 34 taxa according to [4]. It also boasts around 60 molluscs, a minimum of 31 species of fish [5], 31 of reptile, 257 of bird, and roughly 70 mammals, alongside more than 350 plant species. In its entirety, the Vjosa River is considered the habitat for 1175 species of flora and fauna. In order to maintain biodiversity and healthy ecosystems, the quality of water is essential. Therefore, in this instance, the evaluation of water quality is crucial. The aim of assessing water quality is to recognise the origins of contamination and devise plans for the sustainable management of water resources [6]. The rise in nutrients within water ecosystems can induce the decline of water quality on the surface via eutrophication processes. Consequently, toxic cyanobacterial algal blooms may proliferate [7]. Continuous evaluation of the Vjosa River is crucial to sustain water quality and conserve the biodiversity of the water ecosystem. The objective of this study was to assess the water quality of the Vjosa River through chemical analysis and draw comparisons with the WFD.

## MATERIAL AND METHODS

### *The case study area*

The Vjosa River is located in the north-western region of Greece and south-western Albania. Its source is situated in Greece, specifically in the Pindus Mountains. As it makes its way towards Albania, it passes by the town of Çarshovë and flows through the cities of Përmet, Këlcyrë, Tepelenë, Memaliaj, Selenicë, and Novoselë until it eventually empties into the Adriatic Sea. The total span of the river is 272 km, 80 km of which are within Greek territory, while 192 km belong to Albania (Figure 1).

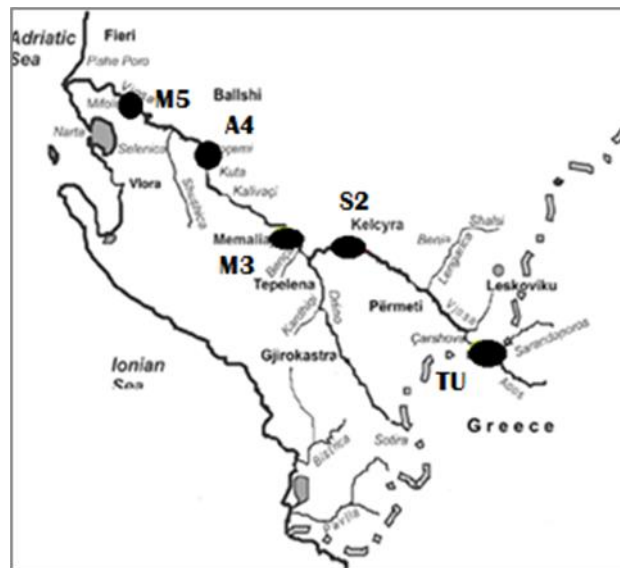


Figure 1. Vjosa River and the sampling points

### *Water sampling*

Thirty water samples were taken from five points along the Vjosa River during six expeditions from November 2021 to May 2023. The pH, temperature, and dissolved oxygen levels were measured on-site using portable apparatus 340. Water samples were collected using 1.5 litre plastic containers with no preservatives added. The samples were transported to the laboratory in refrigerated containers at a controlled temperature of 4°C and were subsequently analyzed within 24 hours. The laboratory responsible was accredited and belonged to the Department of Environment and Natural Resources at the Agricultural University of Tirana.

### *Monitoring parameters*

The chemical parameters of the samples underwent analysis, including chemical oxygen demand (COD), biochemical oxygen demand (BOD<sub>5</sub>), NH<sub>4</sub><sup>+</sup>, NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>, and PO<sub>4</sub><sup>3-</sup>. The analyses were carried out in accordance with the ISO standard methods (ISO 7150:1984; ISO 7890/1:1988; SShen 26777:1993; ISO 6878:2004); [8- 11] and were compared against the WFD standard.

**COD** was determined by the method of the organic matters' oxidation in the presence of KMnO<sub>4</sub> at the boiling point and H<sub>2</sub>SO<sub>4</sub>. At the end of the oxidation phase, KMnO<sub>4</sub> unconsumed reacts with oxalic acid, whose remnants are also defined by KMnO<sub>4</sub>.

**BOD<sub>5</sub>** was determined by OXI-top system during 5 days of incubation.

**N-NO<sub>2</sub>**-content was determined by the reaction of nitrite present in the sample tested with the reagent amino-4 benzene sulfonamide in the presence of orthophosphoric acid pH 1,9, making diazotic salt, which creates a complex of pink color with N-(naftyl-1) diamino-1,2 dihydrochloride ethane (added with the reagent amino-4 benzene sulfonamide). The absorbance was measured at 540 nm.

**N- NO<sub>3</sub><sup>-</sup>** content was determined by spectrometric measuring in 324 nm the absorbance of the compound created by the reaction between nitrites and dimethyl-2,6 phenolics in the presence of sulfuric and phosphoric acid, creating nitro-4 dimethyl-2,6 phenol.

**P-PO<sub>4</sub><sup>3-</sup>** was determined-by acid digestion of persulphate, all forms of phosphates are altered to orthophosphate, which with antimony-molybdate and antimonyl potassium tartarated form the complex antimony-phosphate-molybdate, which is reduced by ascorbic acid thus forming a blue molybdene complex whose intensity is in function of the quantity of total phosphorus. The results can be read on Specord S-10 UV-VIS spectrophotometer, wavelength 885 nm.

**N-NH<sub>4</sub><sup>+</sup>**, Spectrometric measurement at about 655 nm of the blue compound formed by reaction of ammonium with salicylate and hypochlorite ions in the presence of sodium nitro pentacyanoferrate (III) (sodium nitroprusside).

## RESULTS AND DISCUSSIONS

The mean values of each chemical parameter from six completed expeditions are reflected in Table 1. Temperature readings range from 16°C at station S2 to 17.9°C at M5, while pH values range from 7.84 at station S2 to 8.24 at M3. Dissolved oxygen (DO) measurements also varied from 7.38 at M5 to 8.52 at TU. Based on the WFD standard, the waters of the Vjosa River are classified as Class I in terms of protection of fish life. Furthermore, the dissolved oxygen (DO) values meet first-class standards according to this criterion, as they exceed 7 mg/l.

**Table 1.** Average values of chemical parameters at Vjosa River

Parameters	temp.	pH	DO	COD	BOD5	NH <sub>4</sub> <sup>+</sup>	NO <sub>2</sub> <sup>-</sup>	NO <sub>3</sub> <sup>-</sup>	PO <sub>4</sub> <sup>3-</sup>
Unit	°C		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
TU (TRI URAT)	16,43	8,23	8,52	1,39	1,35	0,14	0,06	0,57	0,06
S2 (SAJMOLA)	16	7,84	7,65	1,76	1,46	0,06	0,02	0,60	0,05
M3 (MEMALIA)	17,45	8,24	7,94	1,49	1,16	0,09	0,01	0,47	0,03
A4 (ANEVJOSE)	17,17	8,08	7,92	1,62	1,46	0,08	0,01	0,52	0,02
M5 (MIFOL)	17,9	8,03	7,38	2,01	2,25	0,07	0,04	0,66	0,02
MIN	16	7,84	7,38	1,39	1,16	0,06	0,01	0,47	0,02
MAX	17,9	8,24	8,52	2,01	2,25	0,14	0,06	0,66	0,06
AVERAGE	16,9	8,05	7,88	1,65	1,54	0,09	0,03	0,56	0,04
STDEV	0,76	0,16	0,42	0,24	0,41	0,03	0,02	0,07	0,01

Biological Oxygen Demand (BOD) is not considered an actual pollutant, as it refers to the amount of oxygen required by microorganisms to decompose organic waste in water (WFD). When the available oxygen is used up in the process of aerobic degradation, it is no longer available for these organisms. Therefore, controlling BOD levels is important for maintaining healthy aquatic ecosystems. However, high BOD levels indicate a larger risk of oxygen depletion, which can harm aquatic organisms such as fish.

The values of BOD<sub>5</sub> in Vjosa River range from 1.16 mg/l at M3 to 2.25 mg/l at M5. In this conditions Vjosa River is classified as class I for this parameter.

Chemical Oxygen Demand (COD) is a quantification of the oxygen amount consumed during the chemical decomposition of organic and inorganic substances. In the Vjosa River, the COD values adhere to the first class of the WFD standard, with values ranging from 1.39mg/l at TU station to 2.01 mg/l at M5 station.

Nitrate is a nitrogen compound that, along with phosphorus, is a key nutrient for plant and algae growth. Excessive nutrient levels can result in overgrowth of vegetation and algae blooms. In freshwater bodies, eutrophication risks are typically connected to phosphorus pollution, although there are indications that nitrogen compounds can also contribute to eutrophication [12].

The analysis of the ionic compound of nitrogen and phosphorus reveals a favourable outcome. Nitrate levels in the waters of Vjosa River vary from 0.47 mg/l at M3 to 0.66 mg/l at M5. Following the WFD guidelines, these waters qualify as being of good quality. The NO<sub>2</sub>- levels vary between 0.01 mg/l to 0.06 mg/l and are within the first and second class of water quality stipulated by WFD. Ammonium is a significant parameter due to its toxicity towards aquatic organisms, including fish. The quality of water in the Vjosa River is considered high, with values ranging from 0.06 mg/L to 0.14 mg/L.

Phosphorus is an essential nutrient for plant growth and phosphates are not toxic to humans. However, it is crucial to control the amount of phosphates in water ecosystems to prevent eutrophication [13]. The situation in the Vjosa River is favourable, with phosphate values ranging from 0.02mg/l to 0.06mg/l. According to the Water Framework Directive [14], the water quality is within the range of first-class to second-class. This indicates a situation of eutrophication, ranging from oligotroph waters (0.04mg/l) to the beginning of mesotrophic waters (0.1mg/l). It is crucial to control the water quality to prevent further eutrophication. On the other hand, in flowing bodies of water, the presence of phosphates at natural or background levels (0.05mg/l), means we need not be concerned about the potential impact on aquatic biodiversity.

## CONCLUSION

The ecosystem along the Vjosa River is the most significant natural one in all of Albania. The river's water quality is of the utmost significance because it is both one of the most beautiful rivers and an essential location for the maintenance of a healthy habitat for plants and animals. As a result, the chemical parameters that are used to determine the quality of the water show that the situation is favorable. The nitrate concentration of the Vjosa River ranges from 0.47 mg/l at the M3 gauge to 0.66 mg/l at the M5 gauge. The Water Framework Directive (WFD) guidelines indicate that these bodies of water have a satisfactory level of quality, as their levels of nitrogen dioxide (NO<sub>2</sub>) fall within the first and second classes, respectively. Phosphate concentrations in the Vjosa River are in a favorable range, ranging from 0.02 mg/l to 0.06 mg/l, so the situation there is favorable. The Water Framework Directive (WFD) places the quality of the water somewhere between first and second class. Nevertheless, the water in this river is of the highest quality in the country and can be used for any purpose.

## ACKNOWLEDGMENT

We gratefully acknowledge the National Agency for Scientific Research and Innovation (NASRI) which supports financially our project, entitled "Assessment of the ecology of the waters of the Vjosa River catchment based on microalgae and physic-chemical parameters".

## CONFLICT OF INTERESTS

The authors confirm that there is no conflict of interests associated with this publication.

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DOI 10.1285/i15910725v44p51, 51-58. <http://siba-ese.unisalento.it> - © 2022 Università del Salento

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