ASSESMENT OF THE SEMAN BASIN WATER QUALITY, ALBANIA, BASED ON PHYSICAL-CHEMICAL PARAMETERS DURING 2020-2024

VANELA GJEÇI[1], FLORA QARRI[2], PRANVERA LAZO[3]

[1]Directory of Environmental Data Management, Chemicals, Laboratory Analyses and Innovation, National Environmental Agency, Tirana, Albania

[2]Department of Chemistry, Faculty of Technical Sciences,

University "Ismail Qemali", Vlora, Albania

[3]Department of Chemistry, Faculty of Natural Sciences,

University of Tirana, Tirana, Albania

e-mail: vanelagjeci2006@yahoo.com

Abstract

It is important to protect surface water for a safe environment, as the quality of surface water is threatened daily by anthropogenic factors such as urban wastewater discharge, illegal river extraction, agricultural run-off, waste deposits, and urban and rural discharges. Water monitoring is important for protecting the water resources because it can help to identify the pollution sources, determine the risk of pollution, and develop management strategies for pollution control. This study presents the monitoring results performed in Seman Basin, Albania for the period 2020–2024 in accordance with the Water Framework Directive (WFD) for the surface water bodies. The water quality was assessed using physical-chemical parameters, nutrient content, water quality index, and the limit values of WFD, where the Class III-moderate status is the minimum acceptance limit for water quality. Cluster analysis identified the similarity in the environmental situation of sampling sites based on monitored parameters. The association of sampling sites at each cluster appointed urban, rural, industrial, and agricultural activities as primary sources affecting the water quality of Seman Basin. Assessing the data, it is estimated that the Gjanica River is polluted by urban and industrial discharge into the water body without treatment. The research suggests additional *treatment for the water of the Gjanica River, particularly in sewage treatment and industrial discharges, for meeting appropriate water quality standards.*

Key words*: *Semani basin, pollution control, Water Framework Directive, industrial discharge

Përmbledhje

Është e rëndësishme të mbrohen ujërat sipërfaqësore për një mjedis të sigurt, pasi cilësia e ujërave sipërfaqësore kërcënohet çdo ditë nga faktorë antropogjenë si shkarkimi i ujërave urbane, gerryerja e paligjshme e lumenjve, ujërat nga tokat bujqësore, depozitat e mbetjeve dhe shkarkimet urbane dhe rurale. Monitorimi i ujit është i rëndësishëm për mbrojtjen e burimeve ujore sepse mund të ndihmojë në identifikimin e burimeve të ndotjes, përcaktimin e riskut të ndotjes dhe zhvillimin e strategjive të menaxhimit për kontrollin e ndotjes. Ky studim paraqet rezultatet e monitorimit të basenit të Semanit, Shqipëri për periudhën 2020–2024 në përputhje me Direktivën Kuadër të Ujit për trupat ujorë sipërfaqësorë. Cilësia e ujit u vlerësua duke përdorur parametrat fiziko-kimikë, përmbajtjen e lëndëve ushqyese, indeksin e cilësisë së ujit, dhe vlerat limite të DKU, ku Klasa III - Statusi i moderuar është kufiri minimal i pranimit të cilësisë së ujit. Analiza e grupeve identifikoi ngjashmërinë në situatën mjedisore të stacioneve të kampionimit bazuar në parametrat e monitoruar. Grupimi i stacioneve të kampionimit në secilin grup të përcaktuar urban, rural, industrialë dhe bujqësorë si burime parësore që ndikojnë në cilësinë e ujit të basenit të Semanit. Nga vlerësimi i të dhënave, është vlerësuar se lumi Gjanica është i ndotur nga shkarkimet urbane dhe industriale në trupin ujor pa trajtim. Hulumtimi sugjeron trajtim shtesë për ujin e lumit Gjanica, veçanërisht në trajtimin e ujërave të zeza dhe shkarkimet industriale, për përmbushjen e standardeve të duhura të cilësisë së ujit.

Fjalë kyçe: *Baseni Semanit, kontrolli i ndotjes, Direktiva Kuadër e Ujit, shkarkime industriale.*

Introduction

Water is an essential resource for human health, agriculture, energy production, transport, and nature. Rivers are considered an important source of water supply since they serve as fundamental natural resources for sustaining ecosystems and human life (Wang, 2022). Securing sustainable management of water in aquatic ecosystems and protecting the water quality remains one of the key challenges of all time in Europe. The quality of water is of utmost importance for both human and environmental well-being and needs constant attention from the users and decision-makers (Zhang, 2019).

The results from the second River Basin Management Plan show that European waters remain under pressure from multiple sources (EEA Report, 2018). These pressures affect the functioning of water-related ecosystems, contribute to biodiversity loss, and threaten the long-term delivery of ecosystem services and benefits to society and the economy. To ensure sustainable management of water resources, further policy action will be needed to improve the coherence between economic, societal and environmental goals (EEA Report, 2018). In addition, the population growth, rapid urbanization, and industrialization have made water more important (Ho, 2019). Consequently, the condition of river water is crucial for sustainable development worldwide. The dynamics of rivers regarding circulation, development, and use have been altered significantly due to climate change and elevated human interventions. This underscores the necessity for a coordinated equilibrium between the conservation of rivers and human endeavours (Wang, 2022).

Man-made activities in industry, agriculture, urbanization, and the discharge of untreated urban waste and climate change are the primary factors causing the degradation of aquatic ecosystems (Akhtar, 2021; Ma, 2020; Borgwardt, 2019; Poikane, 2019). Water degradation followed with the change of physical-chemical parameters and nutrient content (Amic, 2018). The primary cause of river degradation is nutrient pollution (EEA Report, 2018), which forces to establish technical guidelines (Poikane, 2019) and the threshold values for ensuring a healthy ecological condition as a primary objective of Europe's aquatic environment (Poikane, 2019). The Water Framework Directive 2000/60/EC and Semani Final River Basin Management Plan (Ministry of Agriculture and Rural Development, 2019) have increased the availability of information to the public and are providing a much better understanding of chemical status and pressures, as well as the measures to reduce them and achieve good environmental status of this basin.

This study aims to periodically control the water quality parameters to ensure that the surface water bodies achieve good ecological and chemical status with respect to physical-chemical parameters and nutrient content, which must meet the required quality standards for these parameters, and identify the possible factors affecting the level of these parameters. BOD, COD, ammonium, nitrite, and phosphate are the most important parameters that linked with anthropogenic impact in surface water quality are pointed as a major pollution source of river water (Ministry of Agriculture and Rural Development, 2019). The main influence on the environmental condition of surface water comes from human activities, so the environmental surveillance should include a continuous measurement of these parameters to see if any changes have occurred or are occurring (Bolan, 2024).

Materials and methods

Sampling stations in the basin

Semani Basin is a watershed of 5649 km2 formed by four rivers: Semani, Osumi, Devoll, and Gjanica.

The Semani River is 281 km long, discharging in the Adriatic Sea, south of the lagoon of Karavasta. Before going into the sea, the Semani River joins the Gjanica River, which passes through the city of Fieri. Devoll River originates from the southeast of the Morava Mountain, which is one of the two main branches of Semani. The Devoll River is 196 km long with a catchment area of, 3139 km2 and an average height above sea level of 960 meters, mainly fed by surface waters.

The Osumi River is the second main branch of the Semani River, 161 km long with a catchment area of 2150 km2 and an average height above sea level of 828 meters.The Gjanica River, which is not the main tributary of the basin, is regarded as the most polluted river in Albania impacted by oil extraction in the area of Patos-Marinza and the Oil Refinery Plant in Ballsh. Gjanica passes through the Fieri urban area before joining the Semani River.

Selection of the sampling sites was done in accordance with a full representative criterion of water quality depending on the human activities, taking into consideration the whole river, selecting a reference sampling station at the upper river stream where there is no anthropogenic pressure, sampling sites near the urban areas to assess the sources of pollution, and a sampling point at the end of the river stream before discharging into the sea.

Table 1: Geographic coordinates of sampling sites of Seman Basin

No.	Sampling code	River name	Sampling point	Geographical coordinates
1	Dv0	Seman	Bilisht – Treshi Bridge	N 40.097375 E 20.559940
2	Dv1	Devoll	Bridge Kuçovë – Kozarë	N 40.828943 E 19.910695
3	Os1	Osum	Lapan Bridge	N 40.428487 E 20.287148
4	Os2	Osum	Uznovë	N 40.692906 E 19.963038
5	Os3	Osum	Bridge Vajgurore	N 40.799671 E 19.872007
6	Gj4	Gjanica	Bridge of Fieri City	N 40.727032 E 19.559529
7	Se5	Seman	Mbrostari Bridge	N 40.7508138 E 19.571987
8	Se6	Seman	Mujalli, Libofshë	N 40.785480 E 19.564333

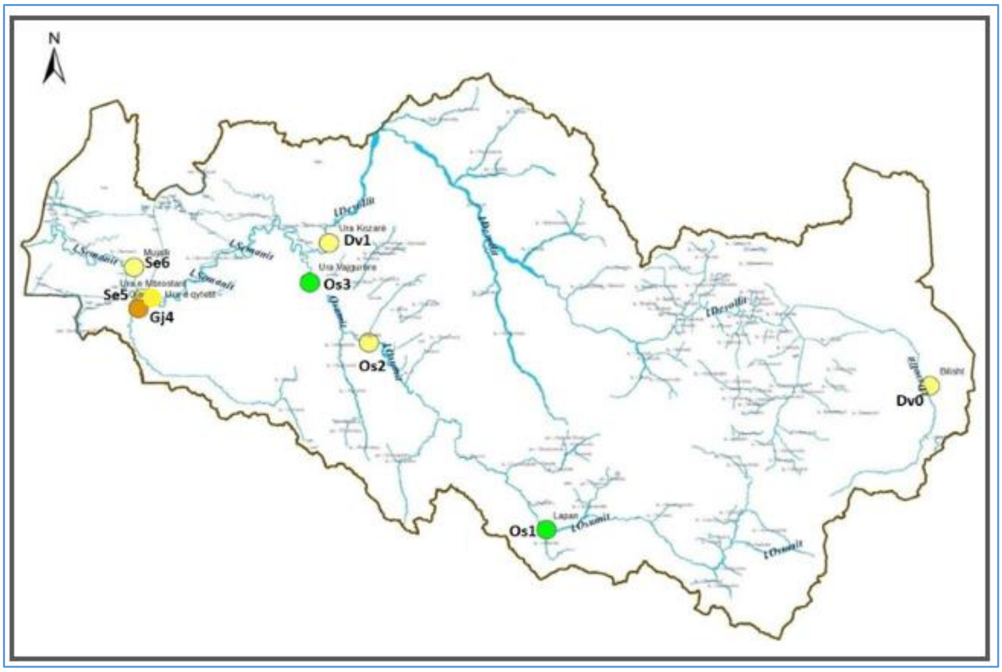


Figure 1. Schematic map of Semani Basin catchment monitoring sites

Sampling procedure

Sampling is the first and the most important step in the monitoring chain. It is done in accordance with the requirements of standard sampling method (ISO 5677-3, 2024). Water samples are packed in a PTF container and they are transported to the laboratory within 24 hours using a cooling box at a temperature +4°C. All the samples are handled in accordance with the requirements of sampling and handling the samples to the laboratory (ISO 5677-3, 2024).

Physical – chemical parameters

Physical-chemical parameters (water temperature, pH, alkalinity, salinity, electric conductivity, dissolved oxygen, COD, BOD_5) and nutrient content (nitrite, nitrate, ammonia, total phosphorous, orto – phosphate, and total suspended solids) were monitored for the water quality assessment. The quality assessment and classification are done based on the limit values established by Water Framework Directive 2000/60/EC.

The physical - chemical parameters were measured on site using a portable multi-meter instrument, AQUALYTIC AL 15. All the other parameters are determined using standard methods accredited in accordance with ISO 17025:2017 requirements. Nutrients content in water have been analysed by using spectrophotometric methods, performed in Specord 40 spectrophotometer. Spectrophotometric analysis Chemical analysis was performed at the Central Laboratory of the Albanian Environmental Agency, in Tirana.

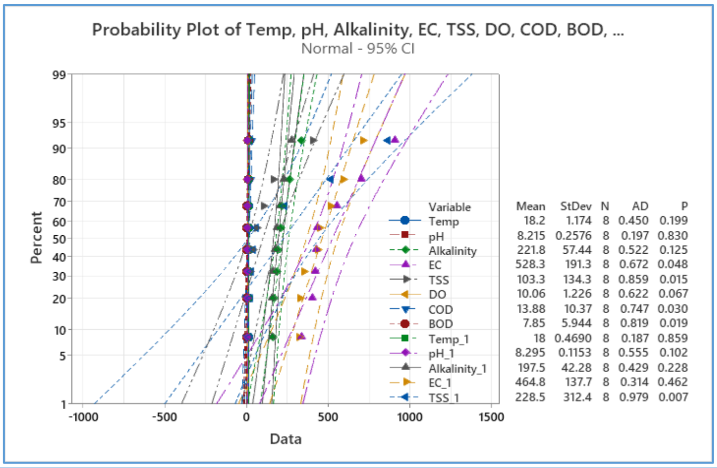
Statistical Analyses

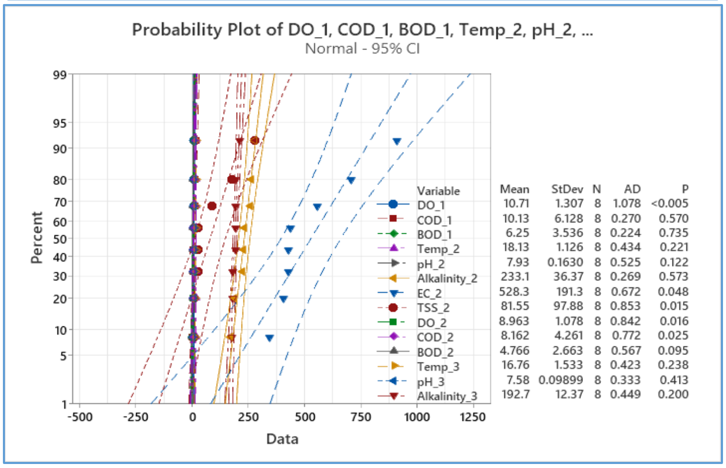
Statistical analysis was performed using the MINITAB 21 software. The measured parameters are processed by descriptive statistics to investigate the level and variation of the data, and the linkage with each – other. This probability distribution of the data is realized by the Anderson-Darling test, $p > 0.05$. The environmental data are very complex and this complexity depends on various factors such as: meteorological because of the season in which the samples are taken, anthropogenic factors, agriculture runoff, factors that are not always recognized and are usually predicted through the relationship between the investigated parameters. The interpretation is made through multivariate analysis (Krishnan, 2023; Liu, 2021; Wolf, 2021; Elkorashey, 2022). During the assessment of the environmental quality of a region, cluster analysis can be used to identify small subgroups characterized by adequate similarity regarding environmental status (Krishnan, 2023).

Results and discussion

Physical-chemical parameters

The Anderson Darling test is used to assess the probability of a normal distribution for the physical-chemical data collected from water samples in the Semani Basin between 2020 and 2024 (Figure 2). Physical-chemical data were processed by descriptive statistical analysis. The results are shown in Table 2.


Probability Plot of Temp, pH, Alkalinity, EC, TSS, DO, COD, BOD, ...
Normal - 95% CI
Percent
Data
Variable
Temp
pH
Alkalinity
EC
TSS
DO
COD
BOD
Temp_1
pH_1
Alkalinity_1
EC_1
TSS_1
Mean StDev N AD P
18.2 1.174 8 0.450 0.199
8.215 0.2576 8 0.197 0.830
221.8 57.44 8 0.522 0.125
528.3 191.3 8 0.672 0.048
103.3 134.3 8 0.859 0.015
10.06 1.226 8 0.622 0.067
13.88 10.37 8 0.747 0.030
7.85 5.944 8 0.819 0.019
18 0.4690 8 0.187 0.859
8.295 0.1153 8 0.555 0.102
197.5 42.28 8 0.429 0.228
464.8 137.7 8 0.314 0.462
228.5 312.4 8 0.979 0.007


Probability Plot of DO_1, COD_1, BOD_1, Temp_2, pH_2, ...
Normal - 95% CI
Percent
Data
Variable
DO_1
COD_1
BOD_1
Temp_2
pH_2
Alkalinity_2
EC_2
TSS_2
DO_2
COD_2
BOD_2
Temp_3
pH_3
Alkalinity_3
Mean StDev N AD P
10.71 1.307 8 1.078 <0.005
10.13 6.128 8 0.270 0.570
6.25 3.536 8 0.224 0.735
18.13 1.126 8 0.434 0.221
7.93 0.1630 8 0.525 0.122
233.1 36.37 8 0.269 0.573
528.3 191.3 8 0.672 0.048
81.55 97.88 8 0.853 0.015
8.963 1.078 8 0.842 0.016
8.162 4.261 8 0.772 0.025
4.766 2.663 8 0.567 0.095
16.76 1.533 8 0.423 0.238
7.58 0.09899 8 0.333 0.413
192.7 12.37 8 0.449 0.200

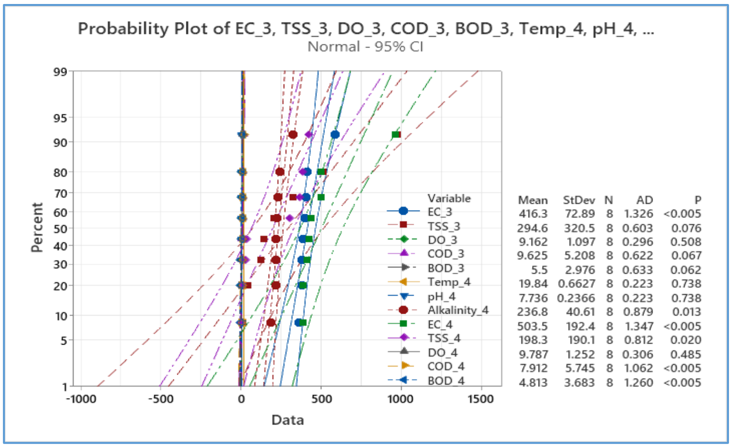


Figure 2. Probability plot of physical-chemical parameters

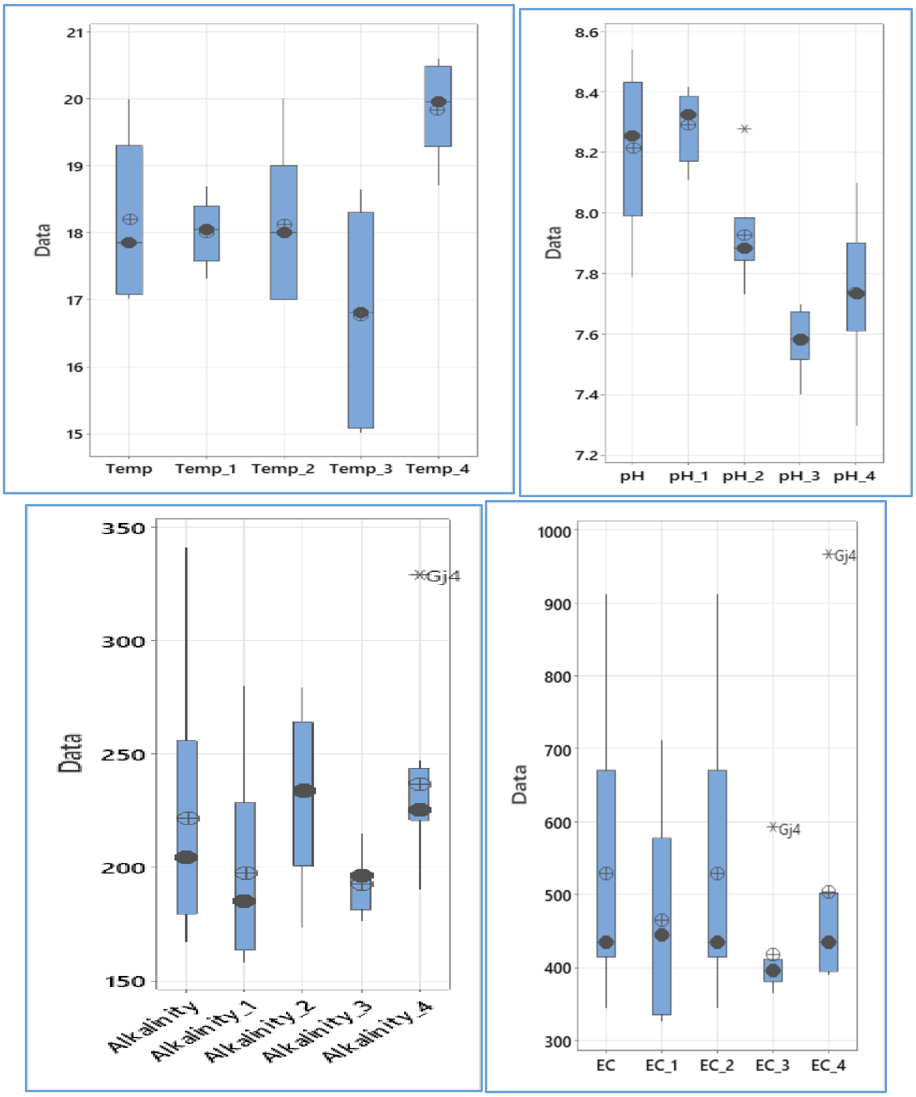
The probability plot revealed a normal distribution ($p > 0.05$) for most of the measured parameters, except DO and TSS measured on 2021, EC measured on 2023, and EC, COD, and BOD data measured on 2024) by indicating that these data were not stable and affected by various factors. It is confirmed by high CV% values (Table 2, CV% ≥ 75%) of these data.

Table 2: The data of statistical parameters of raw concentrations

Variable	**Mean**	**StDev**	**CV%**	**Min**	**Q1**	**Median**	**Q3**	**Max**
Temp	18	1.17	6	17	17	18	19	20
pH	8	0.26	3	8	8	8	8	9
Alkalinity	222	57	26	167	180	205	256	341
EC	528	191	36	344	414	434	670	912
TSS	103	134	130	9	13	53	151	408
DO	10	1.23	12	8	10	10	11	12
COD	14	10	75	4	6	11	25	31
BOD	8	6	76	2	3	6	14	17
Temp_1	18	0.469	3	17	18	18	18	19
pH_1	8	0.115	1	8	8	8	8	8

Alkalinity_1	198	42	21	158	164	185	229	280
EC_1	465	138	30	325	334	444	577	712
TSS_1	229	312	137	21	29	55	453	872
DO_1	11	1.31	12	8	11	11	11	12
COD_1	10	6.13	61	2	6	9	16	20
BOD_1	6	3.54	57	1	3	7	10	11
Temp_2	18	1.13	6	17	17	18	19	20
pH_2	8	0.16	2	8	8	8	8	8
Alkalinity_2	233	36	16	174	201	234	264	279
EC_2	528	191	36	344	414	434	670	912
TSS_2	82	98	120	9	15	30	155	280
DO_2	9	1.08	12	8	8	9	9	11
COD_2	8	4.26	52	5	5	6	11	17
BOD_2	5	2.66	56	2	3	4	6	10
Temp_3	17	1.53	9	15	15	17	18	19
pH_3	8	0.099	1	7	8	8	8	8
Alkalinity_3	193	12	6	176	182	196	197	215
EC_3	416	73	18	363	381	395	411	592
TSS_3	295	321	109	12	67	175	468	980
DO_3	9	1.10	12	7	9	9	10	11
COD_3	10	5.21	54	5	6	9	11	21
BOD_3	6	2.98	54	3	3	5	6	12

Note: Min – minimum; Max – maximum; Q1 – the 1st quartile; Q3 – the 3rd quartile; Temp – water temperature; Alk – alkalinity; EC – electrical conductivity; TSS – total suspended solids; DO – dissolved oxygen; COD - chemical oxygen demand; BOD - biochemical oxygen demand


Data
21
20
19
18
17
16
15
Temp
Temp_1
Temp_2
Temp_3
Temp_4
Data
8.6
8.4
8.2
8.0
7.8
7.6
7.4
7.2
pH
pH_1
pH_2
pH_3
pH_4
Data
350
300
250
200
150
Gj4
Alkalinity
Alkalinity_1
Alkalinity_2
Alkalinity_3
Alkalinity_4
Data
1000
900
800
700
600
500
400
300
Gj4
Gj4
EC
EC_1
EC_2
EC_3
EC_4

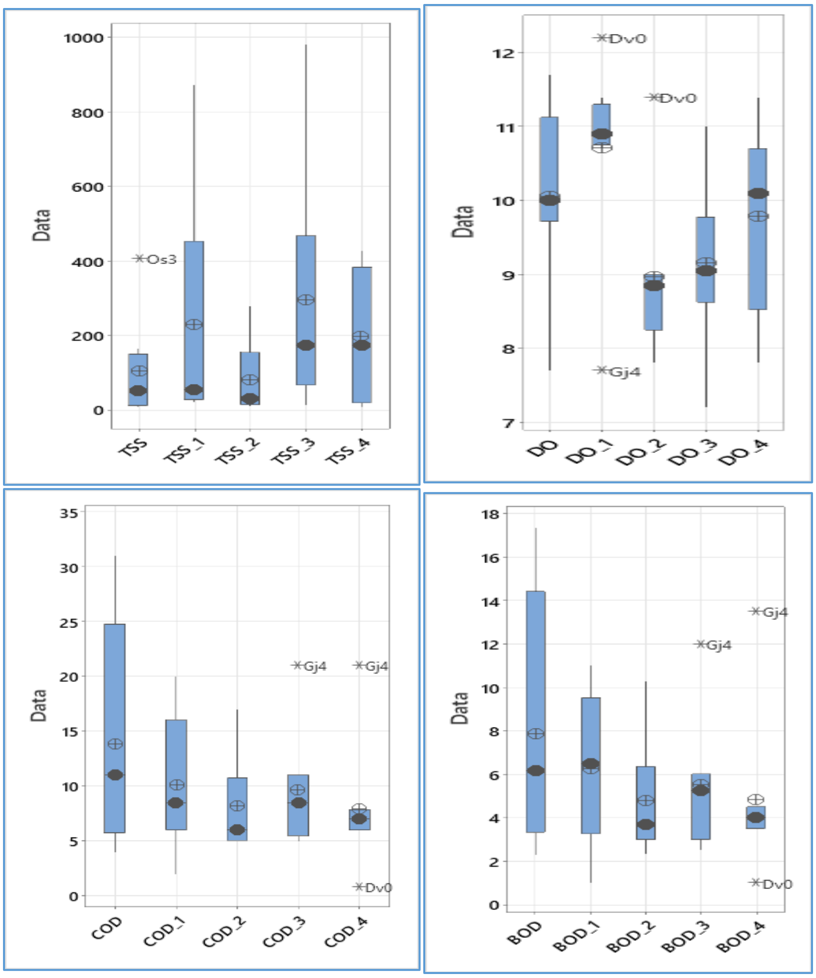


Figure 3. Box-plot diagram of physical-chemical average data of Seman Basin analysed on 2020 to 2024

Box-plot diagram of physical-chemical data of Seman Basin analysed on 2020 to 2024 revealed that the data of temperature, pH, and DO varied in a relatively narrow range by indicating a stable situation of these data. Alkalinity, EC, and TSS showed relatively high fluctuation by indicating the presence of seasonal variation of these data. BOD and COD, which vary under the influence of anthropogenic factors, show a decline trend from 2020 to 2024, indicating an improvement in the water quality of the Seman Basin.

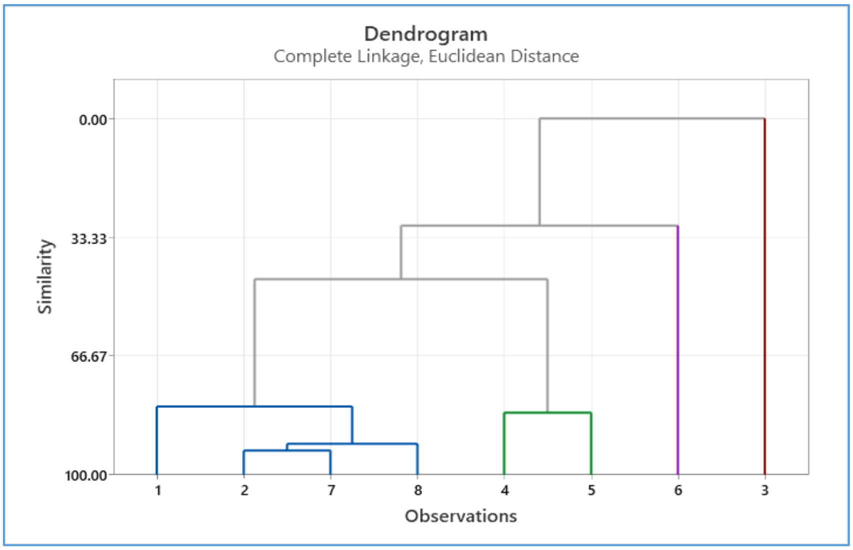


Figure 4: The dendrogram derived from cluster observation analysis on the basis of physical-chemical data

The dendrogram derived from cluster observation analysis on the basis of physical-chemical data revealed four clusters with different similarities of monitoring sites. The first cluster have grouped together the sites Dv0, Dv1, Se5, and Se6 (No. 1, 2, 7, and 8), which show high similarities in their environmental status evaluated by physical-chemical parameters. These monitoring sites has a huge industrial pressure in Korça (station Dv0), Berati (station Dv1) and Fieri (stations Se5 and Se6). This pollution is related to oil industry in Fieri region, where the operation and separation of waters from oil industry are discharged directly to the Semani River and its tributaries or are re-injected in to the subsurface, which pose risks in pollution of underground water.

A similar situation is present in Berati (mainly in Kuçovë) where oil industry continues to pollute the Devoll River and the nearby irrigation channels. Korça Region is rich in minerals, mining activity in the past in Korça region, where the acid mine drainage and solid waste have continuously threatened the water resources in the region (Directive 2000/60/EC). The same, cluster 2 grouped together the sites Os2 and Os3 (No. 4 and 5) that show relatively high similarities between them regarding their environmental status evaluated by physical-chemical parameters. These monitoring sites have urban pressures from urban water discharge. The sites Gj4 (No. 6) and Os1 (No. 3) stand alone in cluster 3 and 4. Gj4 site show very low similarity with cluster 1 and cluster 2, only 27%, while Os1 site revealed a totally different environmental status with other sites, with a similarity of 0%. The monitoring site Gj4 shows impact of industrial emissions, while Os1 has high impact of urban and agriculture run -off.

Nutrients

Nutrients are an important indicator of surface water quality because inorganic nitrogen (nitrate and ammonia) and phosphorus control the growth of aquatic plants. The presence of nutrients in water plays an important role for the growth of aquatic life (Reinl, 2022) and turn to hazardous in excessive contents by affecting in water eutrophication. Besides, the excessive growth of aquatic plants in water ecosystems can cause the decrease of the dissolved oxygen concentrations in streams to the levels that may not sustain certain species of organism in water (CADDIS, 2025).

Fresh water gets nutrients from runoff and discharge of organic matter (Reinl, 2022) that come from both point sources (specific discharge points) and nonpoint sources (pollution dispersed over general land area). To understand and interpret the water data, we need to look at the natural background and threshold values of the water systems, which are a key element in the further characterization of the water bodies (Rahman, 2020). The limited values of the Water Framework Directive are used as threshold values for water systems, since they have not been assessed yet for Albanian water systems. High concentrations of nutrient in water indicate those are likely affected by urban and/or agricultural activities, including both point and nonpoint source contributions (EPA, 2021). The probability distribution of nutrients determined for the period 2020 to 2024 is shown in Figure 5.

The probability plot diagrams (Figure 5) revealed a non-normal distribution ($p < 0.05$) by indicating that the data were affected by various factors. It is confirmed by descriptive statistical analysis of nutrient data, particularly very high variations (CV% > 75%) and Q3 values close to median values (Table 3) by indicating that the data are screwed right.

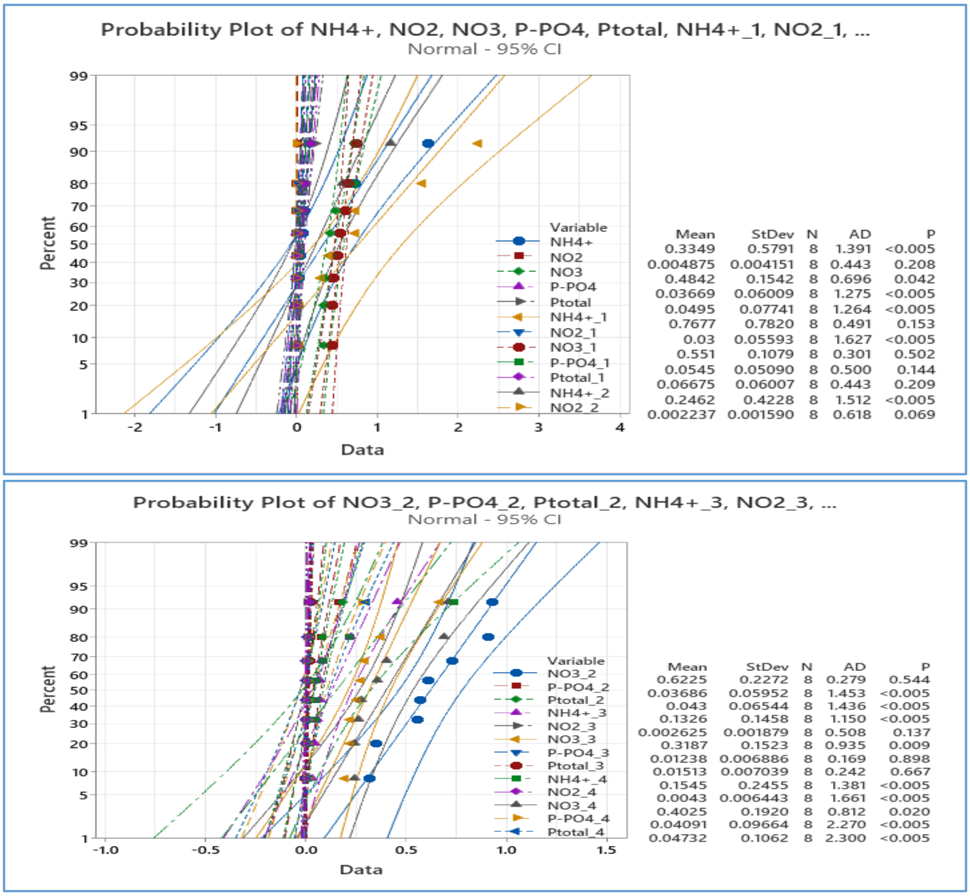


Figure 5. Probability plot of the nutrient data of Seman Basin determined on 2020 to 2024

Table 3: Descriptive Statistics Data of Nutrients Content in Seman River water

Variable	Mean*	StDev	CV%	Min*	Q1*	Median*	Q3*	Max*
NH4+	0.335	0.579	173	0.014	0.026	0.066	0.573	1.64

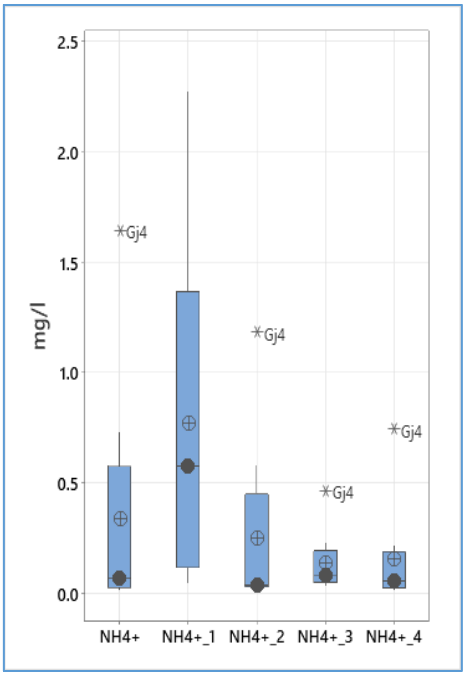
NO2	0.0049	0.004	85	0.0009	0.0011	0.0036	0.0079	0.013
NO3	0.484	0.154	32	0.347	0.356	0.433	0.665	0.72
P-PO4	0.037	0.060	164	0.003	0.0044	0.0063	0.055	0.176
Ptotal	0.050	0.077	156	0.006	0.0073	0.011	0.073	0.229
NH4+_1	0.768	0.782	102	0.042	0.115	0.576	1.36	2.27
NO2_1	0.030	0.056	186	0.002	0.0025	0.009	0.029	0.166
NO3_1	0.551	0.108	20	0.44	0.445	0.535	0.635	0.738
P-PO4_1	0.055	0.051	93	0.009	0.013	0.035	0.098	0.148
Ptotal_1	0.067	0.060	90	0.012	0.0143	0.0495	0.114	0.175
NH4+_2	0.246	0.423	172	0.026	0.029	0.036	0.448	1.18
NO2_2	0.0022	0.0016	71	0.0009	0.00102	0.0018	0.0029	0.0057
NO3_2	0.623	0.227	37	0.32	0.403	0.59	0.865	0.93
P-PO4_2	0.037	0.060	161	0.0046	0.0062	0.0077	0.063	0.17
Ptotal_2	0.043	0.065	152	0.007	0.0092	0.012	0.071	0.19
NH4+_3	0.133	0.146	110	0.031	0.0485	0.077	0.193	0.46
NO2_3	0.0026	0.0019	72	0.0009	0.00093	0.0024	0.0044	0.0058
NO3_3	0.319	0.152	48	0.2	0.230	0.27	0.36	0.67
P-PO4_3	0.012	0.0069	56	0.002	0.008	0.012	0.018	0.024
Ptotal_3	0.015	0.0070	47	0.004	0.0102	0.015	0.021	0.025
NH4+_4	0.155	0.246	159	0.012	0.024	0.055	0.188	0.74
NO2_4	0.004	0.0064	150	0.0009	0.0013	0.0018	0.00402	0.02
NO3_4	0.403	0.192	48	0.250	0.255	0.320	0.620	0.710
P-PO4_4	0.041	0.097	236	0.0041	0.0049	0.0066	0.011	0.28
Ptotal_4	0.047	0.106	224	0.0068	0.009	0.0094	0.014	0.31

* in mg/l

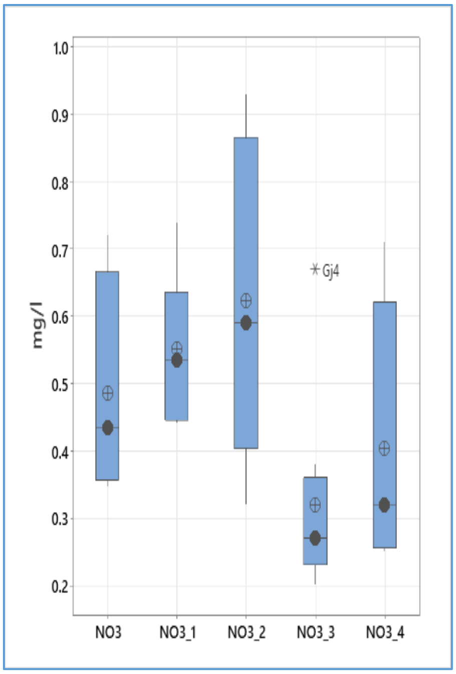
As is seen from the data of Table 3 and box-plot diagram of nutrients concentration data in Seman Basin, the concentration ranges of nitrate (0.32 mg/l to 0.93 mg/l) and nitrite (0.006 mg/l to 0.166 mg/l) were lower than the level established by World Health Organization Guidelines (WHO,2004) for surface water (50 mg/l and 1.0 mg/l respectively). In general, ammonium content revealed higher concentration levels than the World Health Organization Guidelines (WHO,2004) recommended level for surface water (0.3 mg/l), which indicates a polluted state sourced from agricultural, sewage, and other nitrogen pollution.

Phosphate and phosphorus total content in surface water derived from anthropogenic sources. Both of those showed similar trends with ammonium, BOD, and COD in water samples of Seman Basin (Figures 3 and 5).

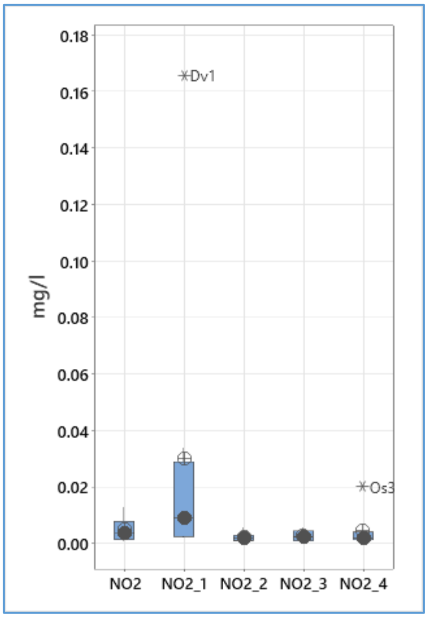
All these parameters together with phosphate and phosphorus content are responsible for water eutrophication. The same as BOD and COD, ammonium, nitrite, phosphate, and total phosphorus which vary under the influence of anthropogenic factors, show a clear decline trend from 2020 to 2024, indicating an improvement in the water quality of the Seman Basin.



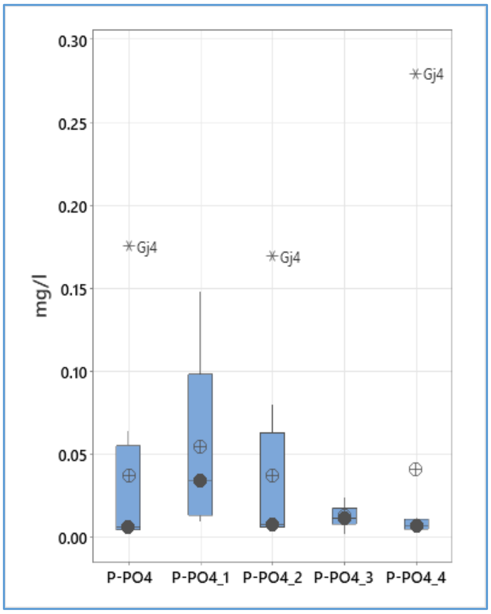
2.5
2.0
1.5
1.0
0.5
0.0
mg/l
Gj4
Gj4
Gj4
Gj4
NH4+
NH4+_1
NH4+_2
NH4+_3
NH4+_4



1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
mg/l
Gj4
NO3
NO3_1
NO3_2
NO3_3
NO3_4



0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
mg/l
Dv1
Os3
NO2
NO2_1
NO2_2
NO2_3
NO2_4



0.30
0.25
0.20
0.15
0.10
0.05
0.00
mg/l
Gj4
Gj4
Gj4
P-PO4
P-PO4_1
P-PO4_2
P-PO4_3
P-PO4_4

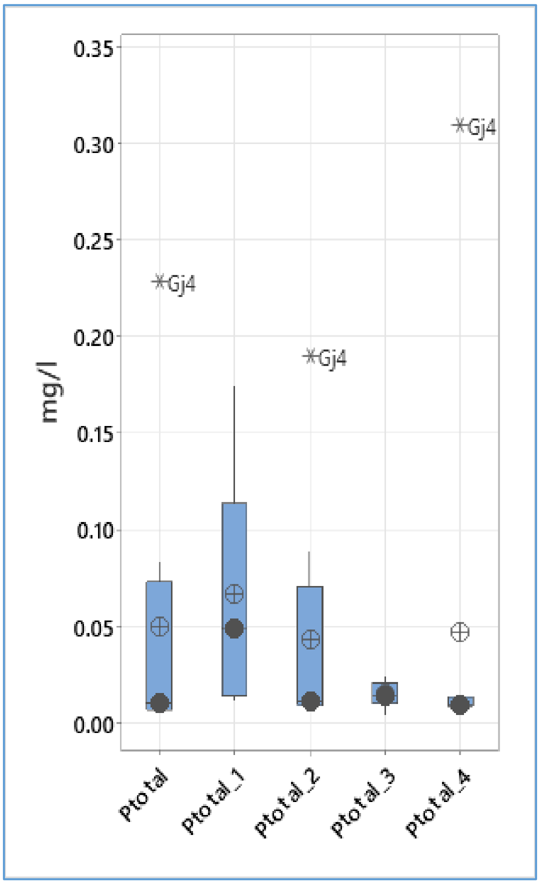


Figure 6. Box-plot diagram of nutrients concentration data in Seman Basin

Based on the similarity in the level and distribution of nutrient contents in Seaman Basin studied by cluster analysis the monitoring sites of Seman Basin were grouped in four clusters (Figure 5).

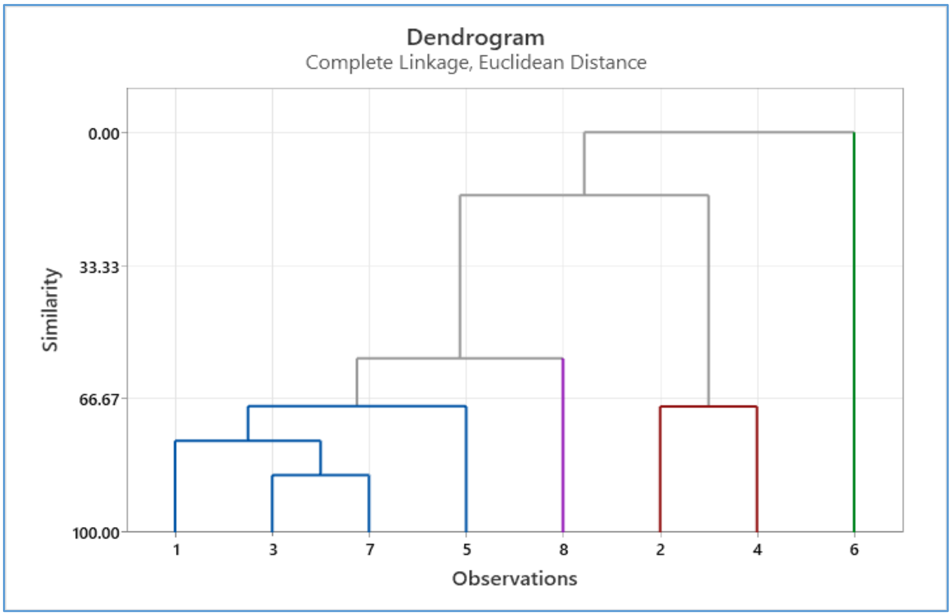


Figure 7. The dendrogram derived from nutrient contents data and cluster observation analysis

The dendrogram (Figure 7) derived from cluster observation analysis on the basis of nutrient data revealed four clusters with different similarities of monitoring sites. The first cluster have grouped together the sites Dv0, Os1, Os3, Se5, and Se6 (No. 1, 3, 5, 7, and 8), which show relatively high similarities in their environmental status evaluated as we have agriculture run – off and urban discharge.

Cluster 2 grouped together the sites Dv1 and Os2 (No. 2 and 4) that show relatively high similarities between them. These two monitoring stations have the same flow and they are rural stations with high impact of agriculture pressure. The sites Gj4 (No. 6) (No. 3) stand alone in cluster, Gj4 site show a totally different environmental status compared with other sites, with a similarity of 0%. This site is affected by industrial pollution is higher and evident as of deep oil processing industry and the Ballshi refinery as well.


a.


b.

c. 

Figure 8 Views from sampling sites: a. Se_5 – Mbrostari Bridge; b. Gj_4 – Bridge of Fieri City (before intervention); c. Gj_4 – Bridge of Fieri City (after rehabilitation)

Conclusions

This paper presents an assessment of the chemical status in Semani Basin taking into consideration the data from 2020 to 2024. All the parameters are analysed in the National Environmental Agency laboratory accredited by the General Directorate of Accreditation with certificate LT 111 26.07.2021. Analysing the monitoring data, the reference station resulted without any anthropogenic pressure and the water quality within the limits of quality standards. High anthropogenic impact was found by moving the river down streams near the urban areas the level of pollution is over the allowed values.

The main contributors of pollution are urban discharge and industrial emissions, and in rural monitoring sites was found the impact of different fertilizers used in agriculture. The improvement in the environmental quality of the Gjanica River is due to the investments made by Fieri Municipality in urban discharge treatment and the increased awareness of local activities regarding the emission limits in the surrounding area. Strengthening inspection from the Environmental Inspectorate is also a key factor in decreasing the environmental emissions caused by activities operating in the area, since in the last two years it is strongly worked to fulfill all the requirements of the environmental permits.

References

Amić A.Tadić L, (2001): “Analysis of Basic Physical-Chemical Parameters, Nutrients and Heavy Metals Content in Surface Water of Small Catchment Area of Karašica and Vučica Rivers in Croatia” Environments. 5(2):20. https://doi.org/10.3390/environments5020020

Akhtar N., Syakir Ishak MI, Bhawani SA, Umar K, (2021): “Various Natural and Anthropogenic Factors Responsible for Water Quality Degradation” A Review. Water. 13(19):2660, https://doi.org/10.3390/w13192660

Borgwardt F., Robinson L., Trauner D., Teixeira H., Nogueira AJA, Lillebø AI, G Piet, Kuemmerlen M, T. O'Higgins, McDonald H., Arevalo-Torres J., Barbosa AL ., Iglesias-Campos A., Hein T., Culhane F., (2019): “Exploring variability in environmental impact risk from human activities across aquatic ecosystems” The Science of The Total Environment, 652.1396–1408. DOI: 10.1016/j.scitotenv.2018.10.339

Bolan,S. Padhye LP., Jasemizad T., Govarthanan,M. Karmegam N., Wijesekara H, Amarasiri,D, Hou D., Zhou P., Biswal BK., Balasubramanian R., Wang H., Siddique KHM., Rinklebe J., Kirkham B., Bolan N., (2024):“Impacts of climate change on the fate of contaminants through extreme weather events” Science of The Total Environment. 909.168388. https://doi.org/10.1016/j.scitotenv.2023.168388

Causal Analysis/Diagnosis Decision Information System (CADDIS), (2025)

https://www.epa.gov/caddis/dissolved-oxygen, updated February

Elkorashey.R.M, (2022) “Utilizing chemometric techniques to evaluate water quality spatial and temporal variation. A case study, Bahr El-Baqar drain”, Egypt, Environmental Technology & Innovation, 26, 02332. https://doi.org/10.1016/j.eti.2022.102332

EPA, Factsheet on water quality parameters, (2021)

https://www.epa.gov/system/files/documentsparameter-factsheet_nutrients.pdf

Ho J.Y., Afan H.A., El-Shafie A.H., Koting S.B., Mohd N.S., Jaafar W.Z.B., Lai Sai H., Malek, M.A., Ahmed, A.N., Mohtar, W.H.M.W, Elshorbagy A. & El-Shafie A., (2019): “Towards a time and cost effective approach to water quality index class prediction” Journal of Hydrology, 575, 148–165, https://doi.org/10.1016/j.jhydrol.2019.05.016

ISO 5677 – 3 (2024) – Guideline for sampling in rivers.

Krishnan S. & Firoz M, (2023) “Assessment of regional environmental quality using cluster analysis. Environmental Development” 45.100832.

https://doi.org/10.1016/j.envdev.2023.100832, Liu J., Zhang D., Tang Q., Xu H., Huang S., Shang D. & Liu R., (2021): "Water quality assessment and source identification of the Shuangji River (China) using multivariate statistical methods", PLoS One, 22, 16(1), e0245525. doi: 10.1371/journal.pone.0245525

Ma J., Wu S., Shekhar NVR, Biswas S., Sahu AK, (2020): "Determination of Physicochemical Parameters and Levels of Heavy Metals in Food Waste Water with Environmental Effects" Bioinorganic Chem Appl.2020:8886093 doi:10.1155/2020/8886093

Ministry of Agriculture and Rural Development "Semani Final River Basin Management Plan", (2019)

http://ambu.gov.al/public/Semani%20Final%20RBMP_Final_Eng_June2019.pdf

Poikane S., Kelly MG., Salas Herrero F., Pitt JA., Jarvie HP., Claussen U., Leujak,W. Lyche Solheim A., Teixeira H., Phillips G., (2019): "Nutrient criteria for surface waters under the European Water Framework Directive: Current state-of-the-art, challenges and future outlook", Sci Total Environ, 695:133888. doi: 10.1016/j.scitotenv.2019.133888,

Poikane S, G´abor V´arbír´o, Kelly MG., Birk S., Phillips G., (2021): "Estimating river nutrient concentrations consistent with good ecological condition: More stringent nutrient thresholds needed" Ecological Indicators. 121.107017.

https://doi.org/10.1016/j.ecolind.2020.107017

Publications Office of the European Union, Luxembourg EEA Report 7, (2018): "Assessment of Status and Pressures 2018", https://www.eea.europa.eu/publications/state-of-water

Rahman A, Tiwari KK, Mondal NN, (2020): "Assessment of hydro chemical backgrounds and threshold values of groundwater in a part of desert area" Rajasthan, India. Environmental Pollution 266(3).115150. https://doi.org/10.1016/j.envpol.2020.115150

Reinl K.L., Harris T.D., Elfferich I., Coker A., Zhan Q., De Senerpont Domis L.N., Morales-Williams A.M., Bhattacharya R., Grossart H.P., R.L, North & Sweetman J.N, (2022): "The role of organic nutrients in structuring freshwater phytoplankton communities in a rapidly changing world", Water Research, 19, 118573. https://doi.org/10.1016/j.watres.2022.118573

S SH EN 872, (2005): Water quality – suspended solids determination – gravimetric method with glass fibers filtration ISO 7150:1984 Water quality – Ammonium determination – spectrometric method

S SH EN 26777, (1993): Nitrite determination - spectrometric method

S SH ISO 15705, (2002): Water quality – COD determination (ST-COD) – Sealed test kits method

Standard methods for examination of water and wastewater, 5210 Biochemical Oxygen Demand (Bod), 24th Edition, (2023): Respirometric method with Oxi – top system

S SH EN ISO 6878, (2004): Water quality – Ortho phosphate determination– spectrometric method with ammonium molybdate

S SH EN ISO 6878, (2004): Water quality – Total phosphorous determination– spectrometric method with ammonium molybdate

S SH EN ISO 9963-1, (1999): Alkalinity determination – Titrimetric method

Water Framework Directive 2000/60/EC of the European Parliament and the Council, 23 October 2000 establishing a framework for Community action in the field of water policy (2000)

Wang H., & Rivers H. He, (2022): "Linking nature, life, and civilization" RIVER, 1:25–36, https://doi.org/10.1002/rvr2.7

Wolf S., Esser V., Schüttrumpf H. & F Lehmkuhl, (2021) "Influence of 200 years of water resource management on a typical central European river. Does industrialization straighten a river', Environmental Sciences Europe, 33, 15.

https://doi.org/10.1186/s12302-021-00460-8

World Health Organization (WHO), (2004) "Guidelines for Water Quality" Third Edition, World Health Organization (WHO), Geneva

Zhang Q. & Li Z., (2019): "Development of an interval quadratic programming water quality management model and its solution algorithms" Journal of Cleaner Production, 119319

https://doi.org/10.1016/j.jclepro.2019.119319