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Environmental Quality Assessment of the Marine Coastal Ecosystem Annaba, Under the influence of the Seybouse River : Physical and Chemical Contamination and Metal Contamination of Surface Waters – Annaba, Algeria

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Abstract

The coastal area of Annaba in Algeria is facing a lot of problems because of things that people are doing. The Seybouse River is putting things into the Mediterranean Sea. This study wants to see how bad the environment is in the area of Annaba because of the Seybouse River. We are looking at things like the temperature and pH of the water. Also if there are bad metals like lead and cadmium in the water.

We will take water samples from the river mouth and the coastal area near it. We will check the water for things like temperature. How salty it is. We also want to know if there are metals like copper and zinc in the water.

We will compare what we find with what's allowed by the environmental standards. This will help us see how contaminated the water is and if it is bad, for the environment.

The study of the Annaba coastal marine ecosystem will give us an idea of what is happening to the environment. We will see how the Seybouse River is affecting the water quality in the area of Annaba.

The results of this study may help us come up with a plan to keep an eye on the environment and reduce pollution in the area of Annaba. This will help us manage the environment of Annaba in a better way

Keyword: Annaba coastal ecosystem; Seybouse River; environmental quality; physicochemical parameters; surface water; metal contamination; heavy metals; water pollution; Mediterranean Sea; assessment.

Introduction

Water resources are essential for health, economic growth and keeping natural ecosystems healthy. Rivers are very important because they provide drinking water help with farming, support industries and keep life going.. As more people are born and as industries, cities and farms grow there is more pressure on surface water. This has caused water quality to get worse in parts of the world.

The quality of river water is affected by both human causes. The kind of rocks in the area the weather and how water moves all affect the mix of chemicals in the water. But when waste water is poured in industry dumps waste and farming runoff gets into rivers it changes the waters chemistry. These problems often mean salt, nutrients organic stuff and tiny amounts of metals in the water. This makes the environment less healthy. Limits what the water can be used for.

Watersheds in the Mediterranean area are at risk of water quality problems. The climate there has rain, long periods without rain and big changes in how much water flows in rivers. These natural conditions along with human activity can make it easier for bad stuff to move and build up in rivers. Because of this keeping an eye on the quality of surface water is now very important. It helps check the environment find where pollution is coming from and help manage water resources in a way.

The Seybouse–Meboudja watershed is in the northeast of Algeria. It is one of the important river systems in the country and is very important for water used at home for farming and for factories. The area has a lot of people living in it and big industrial areas near El Hadjar and Annaba. In these places steel making, making fertilizer, mechanical work and cities growing add pressure, on the environment. Also farming is done over the basin.

may enhance the transfer of nutrients and other contaminants into surface waters during times when it rains. Because water quality depends on different factors that interact with each other looking at one single factor by itself is usually not enough to get a full picture of how a river system is doing. Combining types of tests with water quality indices has become more and more helpful for describing the chemical conditions of water and comparing different places where they check the water. One of these methods is the Weighted Arithmetic Water Quality Index, which's a simple and useful tool for showing the overall quality of surface water and checking how good it is for different uses.

Even though the Seybouse–Meboudja watershed is very important for the environment there are not studies that describe how it has changed over time and space recently. Specifically there are not studies that look at things like major ions, signs of organic pollution and trace metals over several years in a row. This kind of information is very

important for understanding the chemical processes that affect the watershed and for helping to create plans to protect water resources.
So the purpose of this study is to look at the chemical makeup of surface water from eight places where they take samples between 2021 and 2024 check how the different factors change in space and over time use the Weighted Arithmetic Water Quality Index to see how good the water is overall look at how some trace metals like iron, lead, cadmium, zinc, copper and chromium're spread out and give scientific information to help manage and protect the surface water in the Seybouse–Meboudja watershed, in a better way.
may enhance the transfer of nutrients and other contaminants into surface waters, particularly during rainfall events.
Because water quality depends on numerous interacting physicochemical variables, the interpretation of individual parameters alone is often insufficient to provide a comprehensive evaluation of river systems. Integrated approaches combining physicochemical analyses with water

2. Materials and Methods

2.1 Study Site

The present study was carried out in the Seybouse–Meboudja watershed, located in northeastern Algeria within the Annaba region (Figure 1). The Seybouse River is one of the country's major hydrographic systems, draining a catchment area of approximately 6,470 km² before discharging into the Mediterranean Sea near Annaba. The watershed plays a strategic role in the region by supplying water for domestic consumption, agricultural irrigation and industrial activities. Owing to its geographical position and socioeconomic importance, the basin is subjected to increasing environmental pressures associated with rapid urbanization and industrial development.
The study focused on the Meboudja sub-watershed, one of the principal tributaries of the Seybouse River. Oued Meboudja crosses the highly industrialized area of El Hadjar, where several major industrial facilities are located, including steel production plants, fertilizer manufacturing units and mechanical industries. In addition to industrial effluents, the river receives domestic wastewater from nearby urban areas and diffuse agricultural runoff, making this watercourse one of the most environmentally vulnerable sectors of the watershed. These combined anthropogenic pressures strongly influence the hydrochemical characteristics of surface waters and may promote the accumulation of dissolved salts, nutrients, organic matter and trace metals.
The watershed is characterized by a Mediterranean climate, with hot, dry summers and mild, rainy winters. Most annual precipitation occurs between October and April, whereas summer is marked by low rainfall and high evaporation rates. These seasonal climatic conditions strongly influence river discharge, dilution processes and the transport of dissolved constituents, leading to temporal variations in water quality throughout the hydrological cycle.
From a geological perspective, the basin is composed of limestone, marl, sandstone and Quaternary alluvial deposits, which naturally contribute to the mineralization of river water through weathering and water–rock interactions. Nevertheless, the hydrochemical composition of the Seybouse–Meboudja river system is not controlled solely by geological factors. The combined effects of industrial discharges, municipal wastewater and agricultural practices frequently exceed the natural geochemical background, particularly in downstream reaches where human activities are concentrated.
Agriculture represents another major economic activity within the watershed. Extensive cultivation of cereals, vegetables and fruit trees is accompanied by the use of fertilizers and irrigation practices that may enhance the transport of nutrients toward surface waters during rainfall events. Consequently, both agricultural runoff and industrial pollution contribute to the spatial variability of water quality observed along the river system.
To investigate the spatial and temporal evolution of water quality, eight monitoring stations (S1–S8) were selected along the Seybouse–Meboudja river system (Figure 1). The sampling network extends from upstream areas with relatively limited anthropogenic influence to downstream sectors increasingly affected by urban, agricultural and industrial activities. This distribution was designed to characterize pollution gradients and evaluate the cumulative impact of human activities on the physicochemical quality of surface waters. Water samples were collected annually during the period 2021–2024 under comparable hydrological conditions to ensure the consistency of the monitoring programme.

Table 1. The geographic coordinates of the sampling stations

Station	Latitude	Longitude	Caracterisitics
S1	36.70	7.60	Upstream reference station with limited anthropogenic influence
S2	36.78	7.70	Agricultural area receiving moderate runoff
S3	36 .82	7.76	Urbanized sector with increasing human activities
S4	36.85	7.81	Urbanized sector with increasing human activities
S5	36.87	7.83	Industrial influence begins to increase
S6	36.89	7.87	Highly industrialized sector near El Hadjar
S7	36.91	7.91	Downstream sector receiving cumulative industrial and urban discharges
S8	36.93	7/96	Downstream station located before the confluence with the lower basin

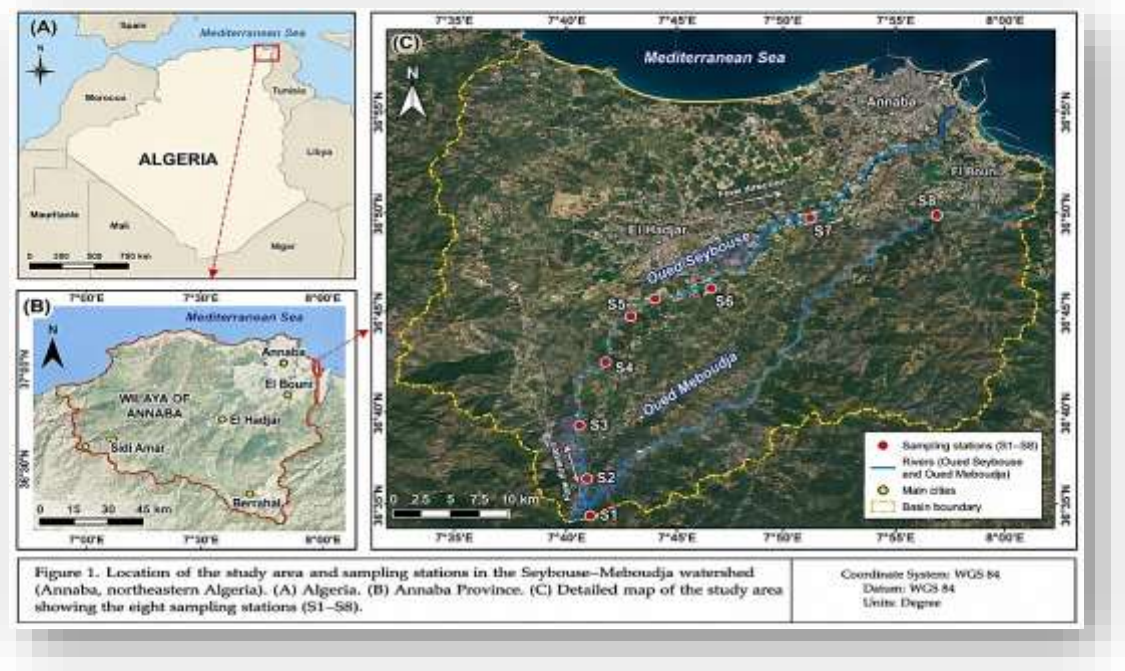

Figure 1. Location of the Seybouse–Meboudja watershed and the eight sampling stations (S1–S8), northeastern Algeria.

2.2 Sampling Strategy

To see how the water quality of the surface water changes in places and at different times we chose eight monitoring stations along the Seybouse-Meboudja river system. We wanted to cover the areas in the watershed from the parts upstream that are not affected much by people to the parts downstream that are more affected by farming, cities and industries. This way we could see how the water quality changes. Find out if there are any pollution problems along the river.

We collected water samples from the surface a year from 2021 to 2024, when the water was flowing in a similar way so we could compare the results. At each station we collected the samples in bottles that we had rinsed with distilled water and then with water from the river. After we collected the samples we kept them cool. Took them to the laboratory as soon as possible so the water would not change much.

We measured the temperature, pH and how well the water conducted electricity at each station using instruments that we had calibrated. We then took the samples to the laboratory. Measured the other characteristics of the water like the amounts of different minerals and metals. We did this in the way every time so we could trust the results and compare them.

2.3 Physicochemical and Trace Metal Analyses

We wanted to know what was in the surface water so we measured things like temperature, pH, how well the water conducted electricity and the amounts of minerals like calcium, magnesium and sodium. We also measured the amounts of nutrients and organic matter in the water. We chose these things because they tell us about the quality of the water and how it might be affected by people.

We measured the temperature, pH and how well the water conducted electricity away using our special instruments. We then took the samples to the laboratory. Measured the other characteristics of the water using standard methods.

We also measured the amounts of metals like iron, lead and zinc in the water using methods that the laboratory uses all the time. We kept the samples cool. Took them to the laboratory as soon as possible so the water would not change much. We then used the results to see how the water quality changed in places and at different times and to calculate the Water Quality Index.

2.4 Water Quality Index (WQI)

We used the Water Quality Index to get an idea of the quality of the surface water. This index combines characteristics of the water into one number so we can compare the water quality in different places and, at different times. It also tells us if the water is good enough for people to use.

We used ten characteristics of the water to calculate the Water Quality Index, including pH, how well the water conducted electricity and the amounts of minerals. We chose these characteristics because they tell us about the quality of the water and how it might be affected by people.

To figure out the quality rating for each thing we measured we used an equation.

The quality rating for each parameter, which we call Qi is calculated by taking the measured concentration, which we call Vi and subtracting the value, which we call Vo then dividing by the standard permissible value, which we call Si minus the ideal value and multiplying by 100.

This gives us: Qi = Vi. Vo / Si. Vo * 100.

Here is what each of these things means:
* Vi is the amount of something that we actually measured in the water.
* Si is the permissible value, which is the amount of something that is allowed in the water.
* Vo is the value, which is what we want the amount of something to be in the water. For things this is 0 but for pH it is 7.0.
We also need to calculate the weight for each parameter, which we call Wi.
We do this by dividing a proportionality which we call K by the standard permissible value, Si.
The proportionality constant K is calculated by taking the reciprocal of the sum of the reciprocals of the permissible values Si.
This is written as: $K = 1 / \sum(1 / Si)$.
Then we calculate the Water Quality Index, which we call WQI by using the weighted arithmetic method.
This means we multiply each quality rating Qi, by its weight Wi and add them all up then divide by the sum of all the relative weights, Wi.
This gives us: $WQI = \sum(Qi * Wi) / \sum Wi$.
The standard values and ideal values and relative weights we used for the parameters we selected are shown in Table 2.
We used the Water Quality Index to get a sense of the quality of the water

Table 2. Standard values, ideal values and relative weights used for the calculation of the Water Quality Index (WQI).

Parameter	Unit	Standart value si	Ideal value v_0	Relative weight wi
PH	-	8.5	7.1	0.4336
EC	µS/cm	1500	0	0.00246
Ca	mg/L	75	0	0.04913
Mg	mg/L	50	0	0.07370
Na	mg/L	200	0	0.01843
k	mg/L	12	0	0.30708
CL	mg/L	250	0	0.01474
SO_{4+}	mg/L	250	0	0.01474
HCO3	mg/L	300	0	0.01228
NO_3	mg/L	50	0	0.07370

The calculated WQI values were classified into five water quality categories according to Brown et al. (1972), as presented in Table 3.

Table 3. Classification of Water Quality Index (WQI).

WQI	Water quality
0–25	Excellent
26–50	Good
51–75	Poor
76–100	Very Poor
>100	Unsuitable for drinking

Statistical Analysis
A descriptive statistical analysis was done to summarize the physicochemical and trace metal data from the eight sampling stations during the 2021–2024 monitoring time. For every parameter the minimum maximum, average and standard deviation were found to explain the changes in surface water quality over space and time.
To help understand the results the physicochemical parameters that showed the most important changes were shown in graphs. These graphs were used to show the patterns found at the sampling stations and during the study period.
A Pearson correlation analysis was done to look at how the physicochemical parameters and trace metalsre connected and to find the main links that affect the water chemistry.
All the calculations and the data visuals were done with Microsoft Excel. The Water Quality Index (WQI) was then calculated from the data using the weighted method mentioned earlier.

Results and Discussion

General Hydrochemical Characteristics
Thirteen physicochemical parameters and six trace metals were checked to look at the water quality in the Seybouse–Meboudja watershed. Because there were many variables studied only the most important parameters that showed big changes in space and time were shown in graphs. The other parameters were used in the idea of water quality and in the calculation of the Water Quality Index (WQI).
Electrical Conductivity (EC)
Electrical conductivity (EC) had an increase from the upper stations (S1–S3) to the lower stations (S6–S8) during the study (Figure 2). The smallest EC numbers were at Station S1 (1015–1335 µS/cm) while the biggest numbers were at Station S8 going up to 4360 µS/cm in 2023. The stations in the middle (S4–S5) had an increase in conductivity showing more minerals in the water as it moved through the watershed. Even though there were changes over the four times the data was collected the pattern in space stayed the same with 2023 having the

highest EC numbers. The higher EC in the part might be because of more minerals from natural processes and, from city, farming and factory areas. These results show that the water has minerals as it moves from the upper part to the lower part of the Seybouse–Meboudja watershed

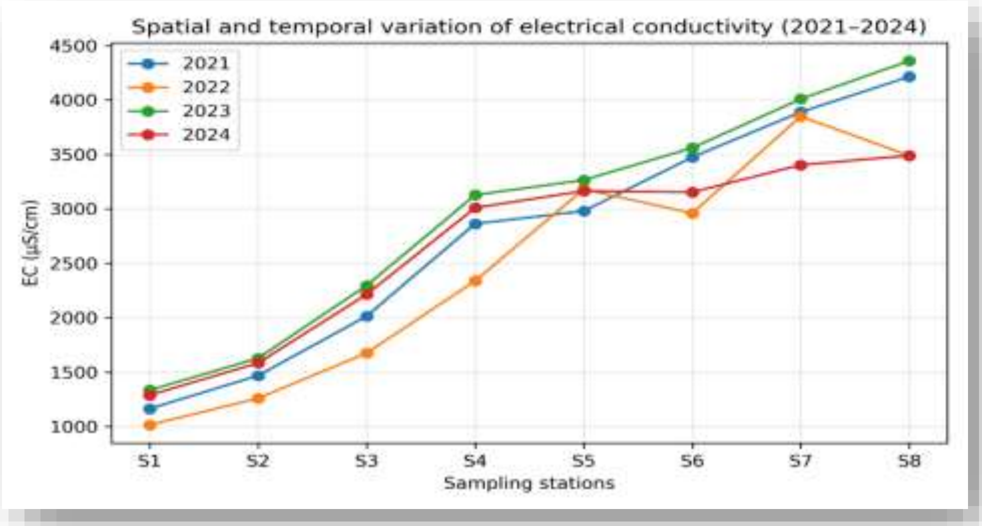

Figure 2. Spatial and temporal variation of electrical conductivity (EC) in the Seybouse–Meboudja watershed during the study period (2021–2024).

3.3 Biochemical Oxygen Demand (BOD_5)

The Biochemical Oxygen Demand, which is also called BOD_5 was clearly higher at the stations that're downstream like S6 to S8 compared to the stations that are upstream like S1 to S3 during the whole time we did the study as you can see in Figure 3. At Station S1 the Biochemical Oxygen Demand was the lowest it was between 10 and 15 milligrams per liter. But at Station S8, the Biochemical Oxygen Demand was the highest it went up to 42 milligrams per liter in the year 2024. The stations in the middle like S4 and S5 had Biochemical Oxygen Demand values that kept going up which means there was organic pollution in the water as you move along the watershed. The Biochemical Oxygen Demand also changed over time. The year 2024 usually had the Biochemical Oxygen Demand values at almost all the stations where we took samples but the year 2022 had lower Biochemical Oxygen Demand values. The fact that the Biochemical Oxygen Demand keeps going up as you move downstream suggests that there is more biodegradable organic matter in the water, which could be because of wastewater from cities water that runs off from farms and waste, from factories. So overall the water quality is getting worse as you move from the part to the downstream part of the Seybouse–Meboudja watershed and this is because of the high Biochemical Oxygen Demand

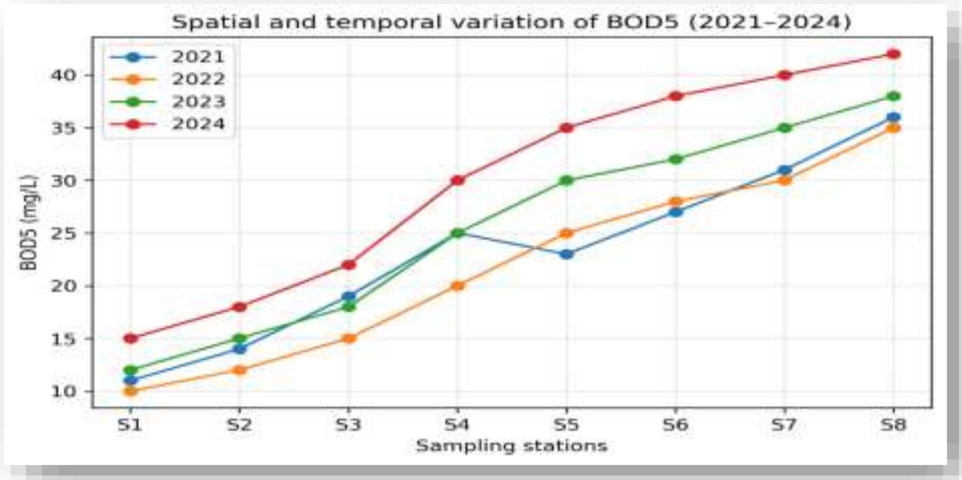

Figure 3. Spatial and temporal variation of biochemical oxygen demand (BOD_5) in the Seybouse–Meboudja watershed during the study period (2021–2024).

3.4 Biochemical Oxygen Demand (BOD_5)

Biochemical oxygen demand (BOD_5) showed a spatial increase from the upstream stations (S1–S3) to the downstream stations (S6–S8) throughout the study period (Figure 3). The lowest BOD_5 values were found at Station S1 ranging from 10 to 15 mg/L while the highest values were seen at Station S8 reaching 42 mg/L in 2024. Stations in the middle (S4–S5) had a rise in BOD_5 concentrations showing increasing organic pollution along the watershed. Changes over time were also clear with 2024 having the BOD_5 values at almost every sampling station while 2022 had much lower amounts. The constant rise in BOD_5 points to a growing buildup of biodegradable organic matter, which could be connected to the mix of urban wastewater, agricultural runoff and industrial waste. Overall these findings show a worsening of organic water quality from the upstream areas, to the downstream areas of the Seybouse–Meboudja watershed.

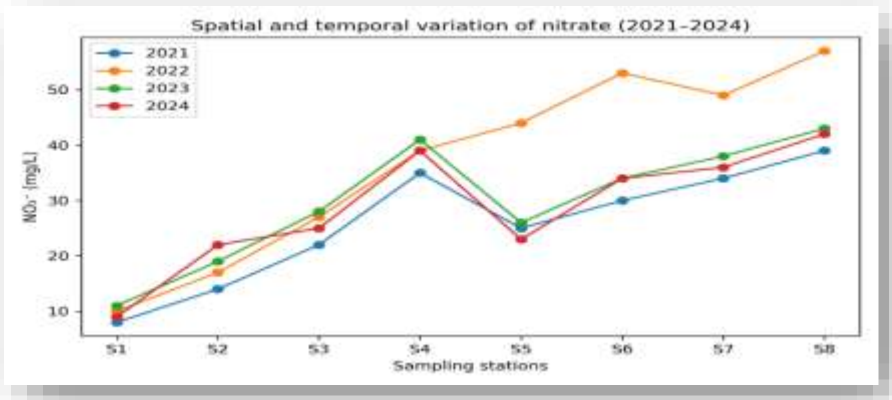

Figure 4. Spatial and temporal variation of nitrate (NO_3^-) concentrations in the Seybouse–Meboudja watershed during the study period (2021–2024).

3.5 Iron (Fe)

Iron (Fe) concentrations exhibited a pronounced spatial increase from the upstream stations (S1–S3) to the downstream stations (S6–S8) during the study period (Figure 5). The lowest Fe concentrations were recorded at Station S1, ranging from 0.40 to 0.90 mg/L, whereas the highest concentration (4.70 mg/L) was observed at Station S8 in 2024. A marked increase was evident from Station S4 onwards, with consistently higher concentrations at the downstream stations. Temporal variations indicated a gradual rise in Fe concentrations throughout the monitoring period, with 2024 generally exhibiting the highest values, while 2022 showed comparatively lower concentrations at most stations. The observed spatial and temporal patterns suggest an increasing influence of anthropogenic activities, particularly industrial discharges, together with natural geological weathering processes that may contribute to iron enrichment in surface waters. Overall, the results indicate a progressive increase in Fe concentrations from upstream to downstream sections of the Seybouse–Meboudja watershed

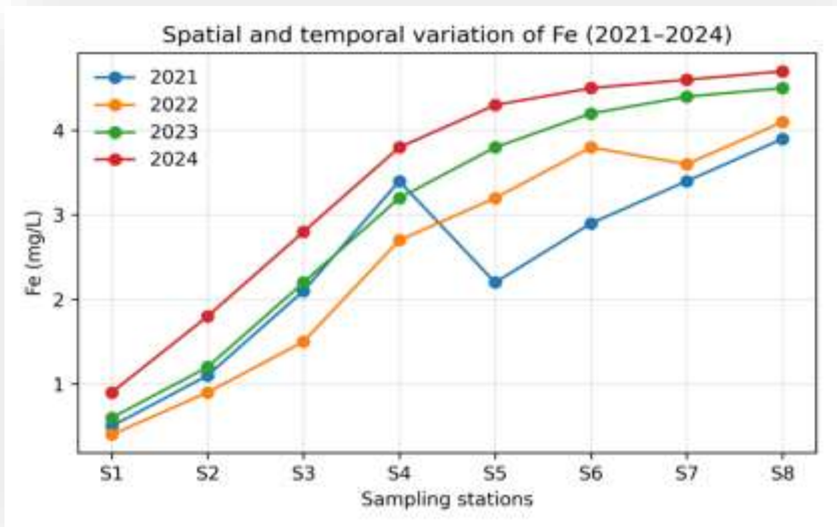

Figure 5. Spatial and temporal variation of iron (Fe) concentrations in the Seybouse–Meboudja watershed during the study period (2021–2024).

3.6 Trace metals

The way lead, cadmium, zinc, copper and chromium are spread out over space and time is shown in Figure 6. Generally most of these trace metals are found in amounts as you move from the stations near the beginning of the river like S1 to S3 to the stations near the end like S6 to S8. This means the water quality gets worse as you move along the Seybouse-Meboudja watershed.

The amounts of these metals also changed over time. Usually the water had the lead, cadmium, zinc, copper and chromium in 2024. There was less of these metals in the water when we first started checking.

Zinc and copper levels went up regularly as you moved along the river.. Lead, cadmium and chromium levels went up and down a lot which shows that the amount of pollution coming into the river changed from one station to another and from one year to another.
The reason there is more of these metals in the water near the end of the river may be because of all the pollution from factories, wastewater from cities and runoff from farms. These are the ways that people are putting metals into the river.
Overall we found that there are more and more trace metals in the water near the end of the river. This shows that what people are doing is having an bigger impact on the quality of the water, in the river.

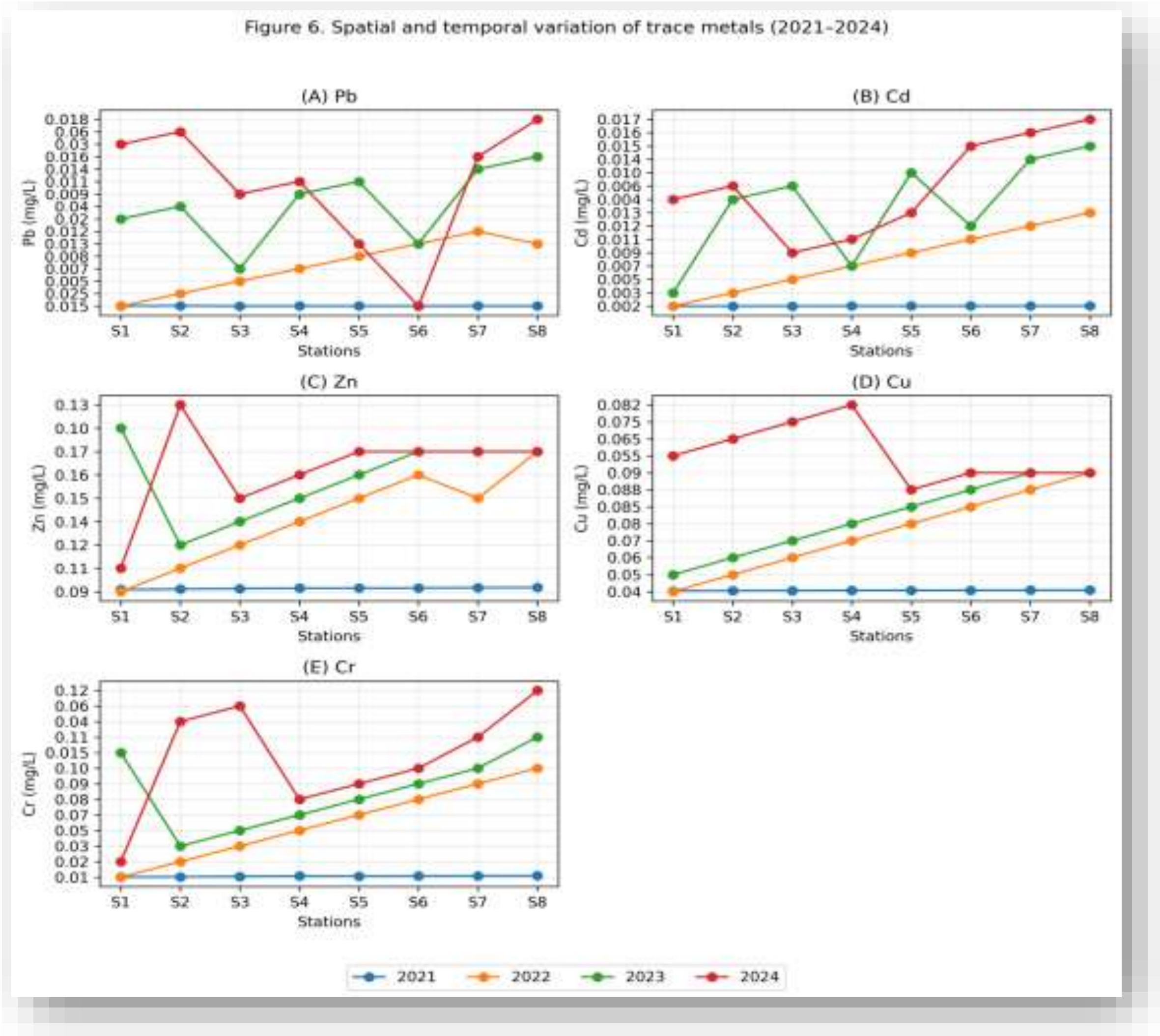

Figure 6. Spatial and temporal variation of trace metal concentrations (Pb, Cd, Zn, Cu and Cr) in the Seybouse–Meboudja watershed during the study period (2021–2024).

3.7 Water Quality Index (WQI)

Figure 7 shows how the Water Quality Index (WQI) changes in space and time. The Water Quality Index (WQI) values and the water quality classes for the eight monitoring stations during the study period from 2021, to 2024 are given in Table 4.

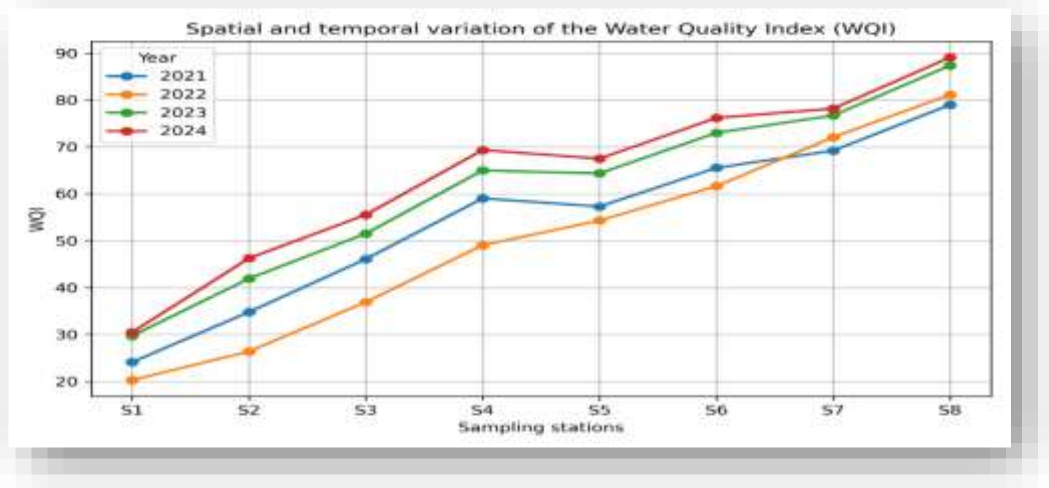

Figure 7. Spatial and temporal variation of the Water Quality Index (WQI) in the Seybouse–Meboudja watershed during the study period (2021–2024

Table 4. Water Quality Index (WQI) values and corresponding water quality classes for the eight monitoring stations (2021–2024).

Year	Station	WQI	Water quality
2021	S1	24.10	Excellent
2021	S2	34.80	Good
2021	S3	46.10	Good
2021	S4	59.04	Poor
2021	S5	57.30	Poor
2021	S6	65.56	Poor
2021	S7	69.24	Poor
2021	S8	79.03	Very Poor
2022	S1	20.24	Excellent
2022	S2	26.38	Good
2022	S3	36.92	Good
2022	S4	49.04	Good
2022	S5	54.32	Poor
2022	S6	61.66	Poor
2022	S7	72.10	Poor
2022	S8	81.17	Very Poor
2023	S1	29.70	Excellent
2023	S2	41.93	Excellent
2023	S3	51.53	Poor
2023	S4	65.01	Poor
2023	S5	64.38	Poor
2023	S6	73.03	Poor
2023	S7	76.74	Very Poor
2023	S8	87.41	Very Poor
2024	S1	30.46	Excellent
2024	S2	46.26	Excellent
2024	S3	55.55	Poor
2024	S4	69.36	Poor
2024	S5	67.53	Poor
2024	S6	76.22	Very Poor
2024	S7	78.21	Very Poor
2024	S8	89.13	Very Poor

The WQI results revealed a clear spatial deterioration in surface water quality from the upstream to the downstream sections of the Seybouse–Meboudja watershed. Stations S1 and S2 generally exhibited relatively good water quality throughout the study period, with WQI values ranging from 20.24 to 46.26, indicating relatively good water quality and limited anthropogenic influence.

Station S3 showed a gradual decline in water quality, changing from the Good category in 2021 and 2022 to the Poor category in 2023 and 2024. Similarly, Station S4 was classified as Good only in 2022, whereas Poor water quality was recorded during the remaining years. Station S5 consistently belonged to the Poor category throughout the monitoring period, suggesting moderate and persistent water quality degradation.

The most degraded conditions were observed at the downstream stations (S6, S7 and S8), where WQI values ranged from Poor to Very Poor. Station S6 remained in the Poor category between 2021 and 2023 before deteriorating to Very Poor in 2024. Station S7 exhibited a similar trend, shifting from Poor in 2021–2022 to Very Poor during 2023–2024. Station S8 consistently recorded the highest WQI values and remained within the Very Poor category throughout the entire study period, with the maximum WQI value (89.13) observed in 2024.

Overall, the WQI values indicate a progressive decline in surface water quality from upstream to downstream and a slight temporal deterioration at most downstream stations between 2021 and 2024. This spatial and temporal pattern is consistent with the environmental setting of the watershed and may reflect the cumulative influence of urban wastewater, agricultural runoff and industrial activities in downstream areas

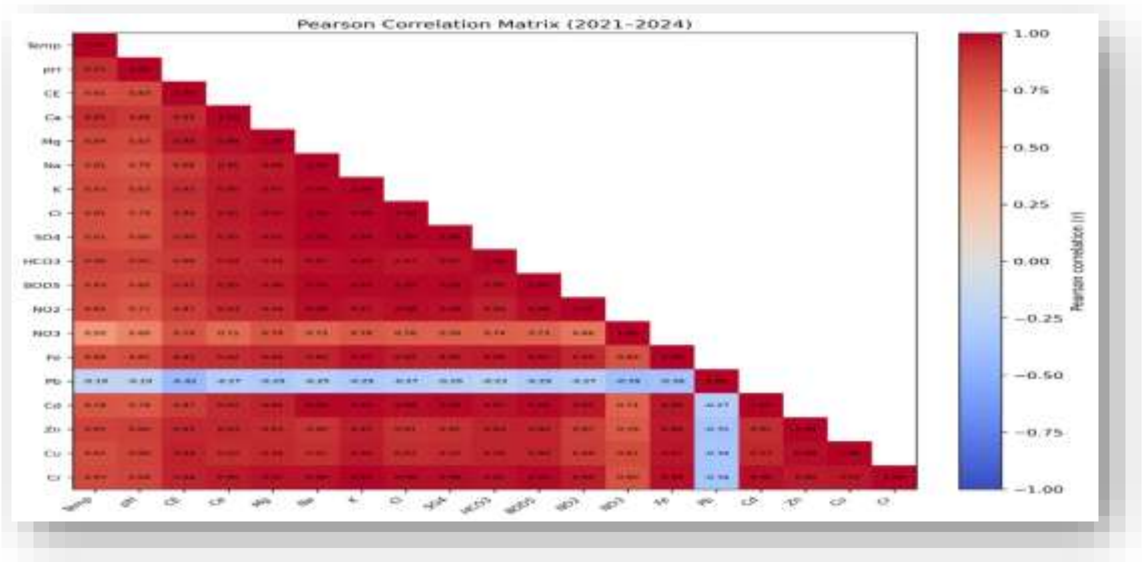

Figure 8. Pearson correlation matrix of the investigated physicochemical parameters and trace metals in the Seybouse–Meboudja watershed during the study period (2021–2024).

The Pearson correlation matrix, which is Figure 8 shows us how the physicochemical parameters and trace metals are related to each other. We saw that electrical conductivity and the major dissolved ions, like calcium and magnesium are closely connected. This means that as the water becomes more mineralized these variables increase together. The same thing happens with major ions they all change in the same way in the surface water.

We also found that some trace metals are connected to the parameters. This means that when the metal concentrations change it is because of changes in the water chemistry. However the strength of these connections is different for each metal, which suggests that they come from sources and are affected by different things. Overall the correlation matrix matches the patterns we saw during the study and shows that mineralization plays a role in controlling the water chemistry of the Seybouse–Meboudja watershed.

4. Discussion

The study of the Seybouse–Meboudja watershed showed that the surface water quality changed a lot over space and time from 2021 to 2024. Most of the parameters we looked at increased as we moved from the top of the watershed to the bottom, which means the water quality got worse. This was especially true for conductivity, biochemical oxygen demand, nitrate and iron. It seems that the effects of mineralization and human activities add up as you move downstream.

As the electrical conductivity increased so did the concentrations of the dissolved ions. This shows that the water becomes more mineralized as it flows downstream. This makes sense given the geology of the watershed. It also suggests that wastewater, agricultural runoff and industrial discharges are contributing to the problem. The fact that the water has dissolved constituents downstream shows that both natural processes and human activities are affecting the river water.

The biochemical oxygen demand and nitrate concentrations followed a pattern, with the highest values at the downstream stations. This means that there are organic and nutrient inputs as you move downstream which could be coming from wastewater, agriculture and industry. Even though the values changed a bit from year to year the overall pattern stayed the same which suggests that these pressures are always there.

The concentrations of trace metals like iron also increased as we moved downstream. This suggests that there are sources of contamination, in the watershed. The way these metals are distributed matches the location of facilities and populated areas. The Seybouse–Meboudja watershed has a lot of things affecting its water chemistry and it is important to understand these connections to protect the water quality

situated in the parts of the basin, where pollutant inputs are expected to be more significant.

The Water Quality Index provided an integrated assessment of these variations and clearly showed the progressive decline in water quality along the Seybouse–Meboudja watershed. Upstream stations generally remained within the Good categories whereas downstream stations were classified as Poor or Very Poor. This classification matches the increase in mineralization organic pollution and trace metal concentrations confirming the cumulative impact of human activities on surface water quality.

The Pearson correlation analysis further supported these observations by revealing relationships among several physicochemical parameters and trace metals. The strong associations between conductivity and the major dissolved ions indicate that these variables change at the same time with increasing mineralization whereas the correlations involving some trace metals suggest that changes in metal concentrations are closely linked to changes in water chemistry. These statistical relationships support the interpretation of the processes affecting water quality throughout the watershed.

Overall, the combined use of analyses, trace metal determination the Water Quality Index and Pearson correlation analysis provided a comprehensive evaluation of surface water quality in the Seybouse–Meboudja watershed. The consistency found among these approaches strengthens the interpretation of the results and shows the growing influence of human activities, on downstream water quality

Conclusion

This study looked at the water quality in the Seybouse–Meboudja watershed in Northeastern Algeria. We checked the water at places and times to see how good or bad it was. We looked at things like how oxygen the water had and how much dirt was in it. We also checked for things like metals that should not be in the water.

The water quality got worse as you moved downstream. This means that the water was cleaner near the start of the river and got dirtier as it moved towards the end. We found salt and other bad things in the water downstream. This is because of things that people have done to the land around the river.

We used something called the Water Quality Index to get a sense of how good or bad the water was. This index helped us see that the water was very good near the start of the river but got very bad near the end. The bad water was because of what people did on the land. We also looked at how different things in the water were connected to each other.

So we learned a lot about the water in the Seybouse–Meboudja watershed. We think that our study will help people make plans to keep the water clean. We need to keep watching the water to make sure it does not get worse. We should also check the water at times of the year and look for other bad things that might be, in it. This will help us understand what is hurting the water and how to stop it. The Seybouse–Meboudja watershed is a river system and we need to take care of it.

Références

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