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Evaluation of the water quality parameters of Alulu river in Enugu east local government

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Abstract
The physicochemical evaluation of water from the Alulu River in the Abakpa Nike Axis of the Enugu East Local Government Area in Enugu State is presented in this study. Methods such as gravimetric and titrimetric analysis were performed. The results show that the water's pH (6.37) is low, which means that it is acidic and should not be consumed because it is much lower than the 6.5–8.5 WHO norm. The water sample contains a minor number of ions, as indicated by other calculated metrics like conductivity (90.5 µS/m). Additionally, the sample's colour (430 Pt-Co) and high turbidity (44 NTU) have been adversely affected by the high concentration of total dissolved solids (580.7 mg/L) in comparison to the permissible level of 500 mg/L. Because of the relationships between turbidity, conductivity, and colour, a greater TDS will also result in a higher turbidity level. Additionally, at the time of sample collection, the surrounding air temperature was approximately 25 ^{0}C, but the water sample's temperature was found to be 30.5 ^{0}C. This high temperature is the cause of the water's high turbidity because more substances will dissolve at a higher temperature, which will affect the water's turbidity. Moreover, even while the 5 mg/L of chloride is within the W.H.O. standard, it may not be sufficient to meet the demands of organisms for chlorine because it is so small and does not pose a health danger to any aquatic community. This minute concentration might have resulted from the significant amount of water present during the sample collection period because of the extended rains. Since the concentration of nitrate could not be determined by the analytical technique employed, it was below the detectable limit. Another reason for this can be the time of year the sample was taken. Prolonged rainfall and a significant amount of water are the hallmarks of the rainy season.

Keywords: Water, analysis, quality, parameters, assessment

Introduction
According to reports, water makes about 70 % of the earth's composition (Akaho *et al*., 2022; Okwesili *et al*., 2022; Abubakar *et al*., 2020) [2, 7, 4]. Water availability is essential for the survival of all living things, including human beings and animals (Ocheme *et al*., 2017; Okwesili *et al*., 2022) [6, 7]. Sustaining the level of water in the body is crucial for humans since it is a vital nutrient implicated in all fundamental physiological processes. In addition to being one of the necessities, clean and safe drinking water also has a significant impact on all other facets of living things (Okwesili *et al*., 2023; Ibrahim, 2020) [4]. Our daily routines involve the use of water for domestic purposes (cleaning, bathing, and drinking), outdoor sports, industrial purposes (Ibrahim, 2020) [4], the production of energy, and agricultural purposes (irrigation and farming). In both urban and rural locations, water is advantageous for the construction of all kinds of buildings (Piyush, 2022) [12]. Additionally, it should be mentioned that when water is contaminated with industrial, agricultural, or human waste, it may act as a medium for the spread of infection to people and animals (Ocheme *et al*., 2017) [6]. The incorporation of fertilizers in agriculture, industrialization, human activity, and population growth are the main sources of water contamination. These activities seriously pollute the environment (Piyush, 2022; Patil *et al*., 2012) [12, 11]. Unwanted changes to the physical, chemical, and biological properties of air, water, and soil have put life on Earth in grave danger (Patil *et al*., 2012) [11]. Additionally, studies have shown that anthropogenic contaminations, such as the discharge of untreated industrial effluents into water bodies, are less common than natural contaminations, such as weathering and soil leaching (Patil *et al*., 2012) [11]. Water contamination is also caused by improper drainage and the disposal of household waste (Venkatesan *et al*., 2013) [15]. The process of assessing the quality of water typically entails screening physical and chemical parameters like pH, turbidity, conductivity, temperature, and total dissolved solids. Additionally, heavy metals in the water, like lead, cadmium, copper, and zinc, are analyzed, and the abiotic and biotic status of the ecosystem is assessed. These factors have a significant impact on the quality of water from various sources (Vandana and Yogesh, 2015) [14]. The amount of salt (also known as salinity), bacteria count, dissolved oxygen concentrations, and the number of debris suspended in the water are just a few of the many factors that are used to assess the quality of water. To assess the water quality, additional analysis includes determining the amount of pesticides, herbicides, and other contaminants that can be assessed in different bodies of water (Vandana and Yogesh, 2015) [14].

Materials and Methods
Description of Study Area
The study area is Alulu, a satellite town in Enugu State's Enugu East Local Government Area, which is located along the Abakpa Nike axis. It is a semi-urban community with a lot of business activity, including subsistence farming and welding, furniture manufacture, car repair, and aluminum fabrication. Apart from these operations, Alulu's location on the borders of smaller towns makes it a transit hub for numerous commercial motor packs. The Alulu stream is a

small body of water that travels through the Umuchigbo town and the Alulu axis before draining into other areas of the region. Since the water comes from several sources, its origin is uncertain. Some use it for irrigation, others for car washing, and still others use it for domestic uses.

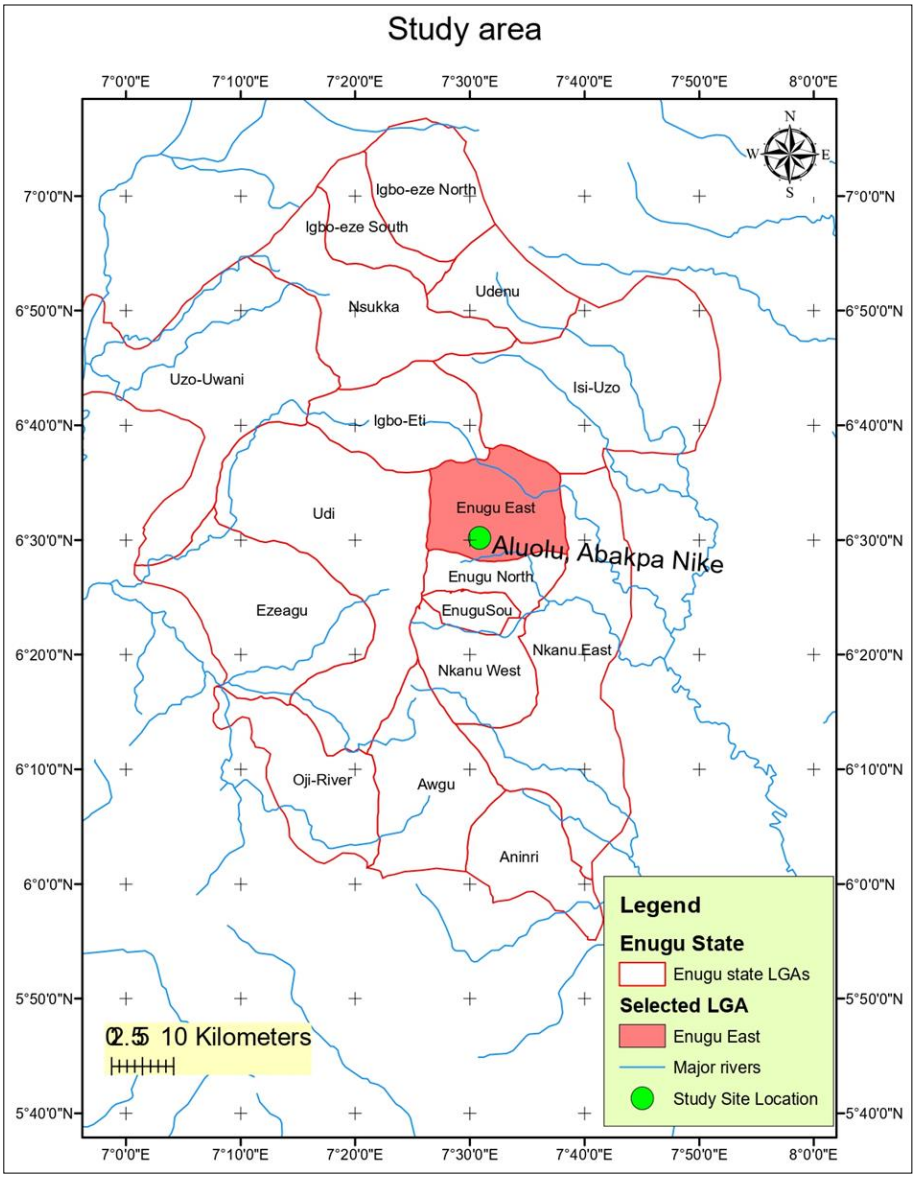

Fig 1

Sample Collection

At about 10:00 AM, fresh water samples were taken from the Alulu stream in the Enugu East Local Government Area of Enugu state. A sterile plastic bottle was used to gather samples. Before being used to collect samples, the bottle was thoroughly rinsed and cleaned with detergent.

Methods

The water sample was analyzed using the standard procedures and techniques of the American Public Health Organization (APHA) and the American Society for Testing and Materials (ASTM), which involved the use of various calibrated standard instruments.

Temperature

A glass thermometer (SP Bel-Art, H-B DURAC) was used on-site, at the sample collecting point, to measure the water sample's temperature. After being cleaned with distilled water, the thermometer bulb was submerged in the liquid. After three minutes, the reading was taken and noted appropriately. This on-site reading is crucial to obtaining an exact temperature during transportation to a laboratory facility, as opposed to one that has already been impacted by environmental factors.

Colour

The sample's colour was compared to a platinum cobalt reference solution using the ALPHA colour measuring standard. The sample's colour value was determined by comparing it to platinum-cobalt standards.

pH

A pH meter (model HI 98130 HANNA, Mauritius, Iramac Sdn. Bhd.) was used to determine the pH of the water sample. Using a clean stirring rod, the obtained water sample was carefully mixed after being transferred into a glass beaker. The pH value was then determined by submerging the pH meter's electrode into the sample and

waiting a few minutes for the reading to stabilize. The pH of a sample can be determined automatically using this method.

Conductivity
For this, a conductivity meter (type HI 98130 HANNA, Mauritius, Iramac Sdn. Bhd.) was utilized. Before usage, the meter was calibrated using a standard solution with a known conductivity. The probe was then submerged in the water sample, and the measurement was taken once the stability indicator vanished.

Turbidity
For this, Arachem (M) Sdn. Bhd.'s automated turbidity meter (model 2100P Turbidimeter HACH, Colombia, USA) was utilized. After adding the water sample, the cuvet was put into the meter and left there for a short while. Following the reading's stabilization, the turbidity value was noted.

Total Dissolved Solids
The TDS in the water sample was measured using the gravimetric method in accordance with APHA standard procedures. The water sample was poured into a measuring cylinder in an amount of 50 ml. It was transferred into a conical flask that had been weighed using a balance and filtered with a 250 mm Whatman filter paper. In a water bath, the sample was heated until it completely evaporated. After cooling, TDS was calculated by measuring the weight of the conical flask.

Test for Chlorides
The following method was used to calculate the chloride content of water samples: By dissolving 2.4 g of powdered AgNO3 in distilled water, silver nitrate (0.0141M) was created, and it was then topped off in a 1000 ml volumetric flask. The 50 mL burette was thoroughly washed before the silver nitrate solution was added. Subsequently, 1.0 ml of potassium chromate indicator was measured with a dropper and added to each 50 mL of water sample, which was measured using a measuring cylinder. The mixture was titrated in the conical flask using the burette's silver nitrate solution until it reached a pinkish-yellow end point. Three titrations were carried out, and the average volume of AgNO3 utilized was noted. Titration was used to establish a blank value.

Test for Nitrates
The nitrate was determined using a spectrophotometer.

Result and Discussion
Result
The result of the analysis carried out on the water sample is shown in the table below.

Table 1: Result of Analysis of water from Alulu Stream in Enugu East Local Government Area

S/N	Parameter	Concentration	WHO Standard
1.	pH	6.37	6.5-8.5
2.	Conductivity (µS/m)	90.5	100
3.	Temperature (^{0}C)	31.0	≤25
4.	Colour (Pt-Co)	430	5
5.	Turbidity (NTU)	44	5
6.	Total dissolved solids (mg/L)	580.7	500
7.	Nitrate NO_3 (mg/L)	BDL	50
8.	Chlolide Cl^- (mg/L)	5.0	250

Discussion
pH
Worldwide variations in freshwater pH are caused by natural processes, human activity, and weather patterns. Extremely low or high pH in water may indicate heavy metal or chemical pollution (Akaho *et al*., 2020). The World Health Organization states that a drinking water's pH should be between 6.5 and 8.5. With a pH of 6.37, this suggests that the water sample from Alulu is acidic, which makes it caustic and unfit for human consumption. Consuming it could have serious negative effects on one's health. The degradation of organic materials into the water body caused by agricultural wastes and refuse disposal may be the cause of this low pH.

Conductivity
Since the conductivity of water is a measure of a solution's ability to conduct electrical current through it and is dependent on the concentration of ions and load of nutrients, it is significant because it indicates the amount of dissolved substances, chemicals, and minerals that are present in the water (Okwesili *et al*., 2022) [7]. Since the majority of salts in water are present in ionic forms, the conductivity of water acts as a reliable and quick indicator of the total dissolved solids in the water (Adhena *et al*., 2020). The examination yielded an electrical conductivity of 90.5 µS/m, which suggests the existence of dissolved ions with the ability to conduct electricity. This might be the consequence of some nearby commercial operations that introduce ions into the water. The welding and aluminum projects being done along the riverbank may be noteworthy causes.

Temperature
A drinking water's temperature can be as low as 25 ^{0}C, according to W.H.O. guidelines. The water from this community has a temperature that is higher than what is considered to be acceptable. At 30 degrees Celsius, there are both organic and inorganic materials present that contribute to turbidity and strongly concentrate solar absorption. As stated by Akaho *et al*. (2020), the temperature is said to increase with increasing TDS.

Turbidity
The turbidity of drinking water is particularly important since high turbidity water is frequently associated with high levels of parasites and other microorganisms that cause diseases like cholera (Umara *et al*., 2016) [13]. The sample's turbidity of 44 NTU is extremely high, far beyond the

W.H.O.'s water consumption standard of 5 NTU. The presence of suspended materials in the water, such as silt, clay, planktons, industrial wastes, and sewage discharge, may be the cause of this high turbidity. The growth of algae, trash discharge, urban runoff, and soil erosion can all cause excessive turbidity in water. excessive TDS is also implied by excessive turbidity.

Colour

The highest value for drinking water should be 5. However, the Alulu water's colour value of 430 indicates that it contains a significant concentration of inorganic ions including iron and manganese, weeds, and domestic and industrial trash (Patil, 2012) [11].

Total Dissolved Solids

TDS is the total of the mg/L concentrations of anions and cations (Sharma and Walia, 2015) [14]. According to Adhena *et al*. (2020), water with a high TDS value is heavily mineralized. According to the study result, the water sample's TDS concentration (580.7 mg/L) is higher above the allowable limit (500 mg/L). The area's commercial activity, like the production of aluminum and furniture, may be the cause of the elevated TDS levels.

Chlorides

Water with chlorides in it tastes salty. It is limited to a qualitative aspect of water. Groundwater and surface water are contaminated by chlorides produced by industrial waste (Mehdi *et al*., 2017) [5]. Various agencies have determined that a maximum allowable level of 250 mg/L for chlorides is appropriate. According to our analysis, the sampling station's chloride content is below the highest amount that is allowed. The timing and season of the sample collection may be to blame for this.

Nitrates

Water nitrate concentrations may rise due to a number of activities, including fertilizer runoff, sewage leaks, septic tank leaks, and erosion of natural deposits. Blue baby syndrome and dyspnea are among the symptoms that affect infants under six months of age (Patil, 2012) [11]. The spectrophotometric approach was unable to detect the nitrate concentration because of the time of year and circumstances surrounding the collection of water samples. The previous week's intense rainfall may have washed the nitrates from the sample collecting site, as it was taken after that.

Conclusion

This study makes it abundantly evident that one of the most important natural resources in the planet is water. Drinking water quality is important for everyone's health and safety within a population. In rural areas, people view surface water—such as rivers and streams—as handy locations to dump waste and rubbish, therefore it is critical to evaluate the utility of water. From the investigation and findings of this study, we can conclude that while the water from the Alulu stream is not ideal for use in commercial, residential, or recreational contexts, it is nevertheless useful for other purposes, such as irrigation, building, and car washing.

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