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IMPACT OF HUMAN ACTIVITIES ON PHYSICOCHEMICAL PARAMETERS AND NUTRIENT DISTRIBUTION IN THE SURFACE WATER OF AYETORO COMMUNITY, ILAJE, SOUTH WEST NIGERIA

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ABSTRACT

The present study has undertaken to assess the impact of human activities on physicochemical parameters and nutrient distribution in the surface water of Ayetoro community in Ilaje area, South West, Nigeria. In the study, eight sampling sites along the river course have been chosen based on the objectives of the study and potential source of pollution. The physicochemical parameters- temperature, pH, DO, salinity, electrical conductivity (EC) and total dissolve solid (TDS) were measured in-situ using Hanna HI 9828. Nitrate (NO_3^-), phosphate (PO_3^{2-}) and sulphate (SO_4^{2-}) were determined using standards methods and procedures. These were later analyzed using UV/VIS Spectrophotometer (Model- Jenway 6705). A comparison of the measured parameters with the national and international standards set by FAO (1973), FEPA (1991) and WHO (2008). Only TDS and EC concentrations were significantly different (ANOVA, $p \leq 0.05$) across the sample stations.

Keywords: Human activities, physicochemical, nutrient, surface water, Ayetoro community.

INTRODUCTION

In recent years, concerns have been expressed over the deteriorating state of the world's coastal and inland aquatic ecosystems due to the introduction of different types of organic, inorganic pollutants and nutrient enrichment from intentional and unintentional hydrologic alteration, unregulated dumping of untreated sewage, toxic effluents, untreated industrial and urban wastes, excessive nutrient loadings, medicinal residues, fertilizers chemical run-offs and crude oil pollution (Omaka *et al*., 2014; Benson *et al*., 2015). Good quality of water resources depends on a large number of physico-chemical parameters and monitoring of these parameters are essential for the determination of magnitude and source of pollution load (Reddi *et al*., 1993). Nutrient availability has increased in almost every aquatic ecosystem around the world. The source of this eutrophication is primarily anthropogenic activities largely caused by the poor and unhygienic living habit of people as well as the unfriendly environmental practices of factories, industries and agricultural practices, resulting in the discharge of effluents and untreated wastes (Adeola *et al*., 2015). Most importantly, worldwide rapid intensification of agriculture and deforestation has increased nutrient and sediment runoff from terrestrial systems, causing a staged increase of nitrate and phosphate fluxes towards the majority of the world's freshwater and marine ecosystems (Tilman and Lehman, 2001; Smith, 2003). Basically, when eutrophication occurs, there is a bloom in the growth of algae which leads to reduction of the oxygen level in the water body and this is known as hypoxia leading to odor and taste problems, fish death, and loss of biodiversity. Therefore, understanding the dynamics of nutrients carried within the marine environment is critical for resource management and prevention of eutrophication (Luo *et al.,* 2011). The chemical characteristics of seawater provide an insight into the existing health status of the marine environment. Nitrate ions (NO_3^-), phosphate ions (PO_4^{3-}) and sulphate ions (SO_4^{2-}) are the ionic forms of the essential nutrients nitrogen, phosphorous and sulphur respectively, which are essential to growth and reproduction of plants and animals. Aquatic species depend on the surrounding water to provide their nutrients. Although a wide variety of minerals and trace elements can be classified as nutrients, those required in most abundance by aquatic species are nitrate and phosphate (Peavy *et.al.,* 1985).
The aim of this research is to investigate the impact of human activities on some physicochemical parameters and nutrient distribution on the water surface in Ayetoro area of Ilaje, Southwestern Nigeria.

MATERIALS AND METHOD

Study Area

In the present investigation, the study area (Figure 1) is bounded by Latitude 6°13.785'N and longitude 4°38.975'E, within the Mahin mud coast of Nigeria. This sediment in the mud coast was deposited due to low energy wave transportation in the environment. This brings about high muddy deposition when the long shore current moving east to west collides with the coming waves which slow down the energy. The main types of vegetation are Mangrove forest and coastal, Freshwater swamp forest, Savanna, stunted rain forests of the sand ridges and mainland margin.

Figure 1: Map of Ondo State Showing Ilaje Local Government

Collection of Water Samples
Water samples were collected with a plastic 2-litres van Dorn sampler into acid-cleaned polyethylene bottles and per-chloric acid was used to fix the nutrient immediately. The physicochemical parameters (temperature, salinity, conductivity, pH and dissolve oxygen) were taken in-situ with Hanna HI 9828. Water samples collected for analyzing dissolved nutrients were filtered through membrane filters of 0.45 micrometer pore size at the time of sampling and then preserved in a cooler of ice (usually, below 5˚C) and taken to the laboratory for analysis. Nitrates, phosphates and sulphates were determined using UV/VIS Spectrophotometer (Model- Jenway 6705) at 420nm, 880nm and 420nm (Ademoroti, 1999).

Data Analysis
Data generated on concentrations of each physicochemical parameter and nutrient was analyzed for spatial variation using one way analysis of variance (ANOVA). Also, correlation analyses were performed on the water physicochemical parameters and nutrients to see how they all relate with each other during the period of this study. The study of correlation reduces the range of uncertainty associated with decision making**.** Correlation between two parameters provides a strong indication for a single reason for their variation**.** The data analysis was done by using SPSS package version 20.

RESULTS AND DISCUSSION

Temperature
Temperature of surface water is associated with seasons, time of measurement during the day, weather conditions, size of water mass and coordinates of the water (latitude and longitude). Temperature influences the growth and distribution of flora and fauna as it is the most variable factor of environment and play a vital role in chemical and biological activities. The amount of nutrients in water bodies along with higher temperature favors the growth of algae and aquatic weeds (Welch, 1952). The temperature distribution of the surface water is shown in figure 2, sample station 2 and 7 has the highest (29.23^{o}C) and least value (28.56^{o}C) of temperature respectively and mean value of 28.87^{o}C. The surface water temperature at all the sample stations were within the acceptable range (20-33^{o}C) as recommended by FEPA, 1991 and WHO, 2008 ($<40^{0}$C). Temperature levels observed in this study is in agreement with results of previous studies, 28.95 to 29.05°C (Mohan et al. 2013). The statistical analysis at 95% confidence level showed that there was no significant difference (P>0.05) across the sampling stations but there was a significant difference (P<0.5) within the physicochemical parameters.

pH
pH shows the intensity of the acidity or basicity character of a solution and is controlled by the dissolved chemical compounds and biochemical processes in the solution (Saksena and Kaushik, 1994). It is usually monitored for assessments of aquatic ecosystem health, irrigation and drinking water sources, industrial discharges and surface water runoff. In the present study, the pH values ranged from 6.51 to 7 (Figure 2). The highest pH value was obtained at station 2 and the least value at station 5 and 6. The slight acidic nature of the water could be as a result of addition of chemical pollutants from agriculture waste and also due to the increase in the rate of organic matter decomposition by the microbial respiration, which may be increase CO_2 (Ganesan, 1992). These pH values recorded in this study were relatively similar to 6.53 to 6.78 recorded by Ajibare (2014) at Ayetoro community surface water. The pH values at all the sample stations were within the permissible limit set by FAO (1994), FEPA (1991) and WHO (2008). The pH values were well within the susceptible range for drinking water (6.5-8.5), optimal aquatic productivity (6.5-9.0) and livable range of 5.5-10 (Wetze, 2001). However, a one-way ANOVA at 95% confidence level indicated that pH showed no significant difference (P>0.05) across the sampling stations but there was a significant difference (P<0.5) within the physicochemical parameters.

Dissolved Oxygen
DO is one of the most important parameter. Its correlation with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification etc. (Premlata, 2009) and used as an indicator of tropic status of the water (Vidya *et al*., 2012). Concentration levels of DO below 5.0 mg/L adversely affect aquatic life while concentration below 2.0 mg/l may lead to death for most fishes (Chapman, 1996). Thus in the present study, DO ranged from 1.1 to 4.1 mg/l (Figure 2). The DO level of this water has a low variation and it is relatively low as compared with other result by Ajibare (2014) and Adesuyi *et al*. (2015). The DO values at all the sample stations were below the permissible limit set by FEPA (5-7.5mg/l). A lot of factors could be responsible for these findings low DO could have resulted from high levels of bacteria activities and large amounts of rotting plants whereas station 2 with lowest DO was obtained at the point of sewage discharge. The statistical analysis at 95% confidence level showed that there was no significant difference (P>0.05) across the sampling stations but there was a significant difference (P<0.5) within the physicochemical parameters.

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Salinity
Salinity is one of the important factors that influence the abundance and distribution of the animals in the water body. It is an important ecological variable and important in some chemical processes, also has a strong effect on nutrients levels at the coastal areas (OSPAR, 1997). The salinity of the surface water in this study ranges from 0.29 to 3.3‰ (Figure 2). The Salinity of the surface water is a clear indication of both fresh and brackish habitat (Egborge, 1994). Salinity of the sample stations were directly correlated to TDS (r=1.00) and EC (r=1.000). It also showed high positive correlation with SO_4^{2-} (r=0.903) and negative correlation with pH(r= -0.922). At 95% confidence level the statistical analysis showed that salinity has no significant difference (P>0.05) across the sampling stations but there was a significant difference (P<0.5) within the physicochemical parameters.

Electrical conductivity (EC)
It is a measurement of water's capacity for carrying electrical. The conductivity of seawater in any season is determined by the presence of total concentration ions, mobility, valence, relative concentrations and the temperature of the system. From our result the conductivity varied in the range 599µS to 6085µS with a mean value of 3448.12µS/cm (Figure 2). Station 7 has the highest value of EC (6085µS/cm). EC values at all the sample stations were above the permissible limit set by WHO (900µS/cm) except sample station 8. However, sample stations 1, 2, 3 and 8 were below the permissible limit (3000 µS) quoted by FAO. This simply means that samples contained fewer amounts of dissolved salts at these stations. The high value of EC at other sample stations could be as a result of chemical pollutants of urban or agro origin to the environment. Since, the conductivity of the water is a function of the number of charged ion in solution; it is another measure of dissolved materials. This can be indicated from the direct correlation (r =1.000) values with total dissolved and salinity recorded (Table 1). EC of the sample stations was also strongly correlated with pH (r = -0.914) and SO_4^{2-} (r = 0.984). The statistical analysis at 95% confidence level showed that there was significant difference (P<0.5) across the sampling stations and within the physicochemical parameters.

Total Dissolve Solid (TDS)
Total dissolved solids show the salinity behavior of the marine environment. Water containing more than 500 mg/L of TDS is not considered as desirable for drinking water supplies (Dahiya and Kaur, 1999). Water with high TDS is undesirable or harmful for human and aquatic life. The present study showed that TDS values varied from 3056 to 299 mg/L (figure 2). Sample stations 2, 3 and 8 were within the permissible limits of WHO (1000mg/L) for drinking while sample stations 1, 2, 3, 8 and 9 are below the recommended limit quoted by FAO for irrigation water (Ayers and Westcot, 1994). The high value of TDS recorded in the river water might be due to agricultural runoff, discharge of wastes from the town. TDS of the sample stations was directly correlated to EC (r=1.000), Salinity (r=1.000), strongly correlated with pH (r= -0.920) and SO_4^{2-} (r=0.984) (Table 1).The statistical analysis at 95% confidence level showed that there was significant difference (P<0.5) across the sampling stations and within the physicochemical parameters.

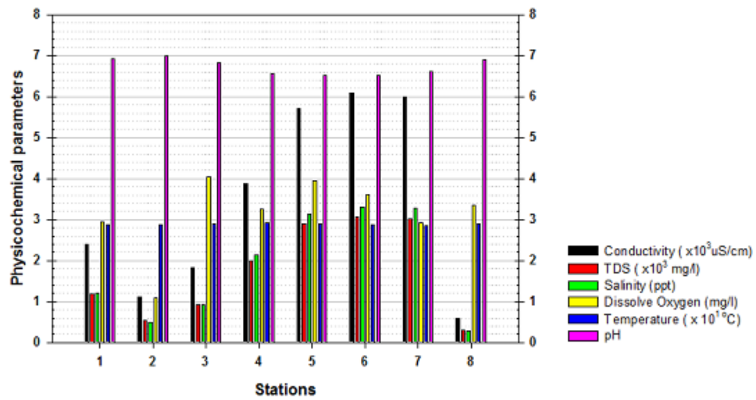

Figure 2: Physicochemical parameters concentration

Nitrate
Nitrogen exists in water both as inorganic and organic species, and in dissolved and particulate forms. Inorganic nitrogen is found both as oxidized species nitrate (NO_3^-) and nitrite (NO_2). Nitrate is considered as the most stable and predominant inorganic nitrogen form in seawater which are produced naturally as part of the nitrogen cycle, when a bacteria breaks down toxic ammonia wastes first into nitrite, then into nitrate. Nitrates stimulate the growth of plankton and water weeds that provide food for fish. In this present study, nitrate values ranged from17.44 to 35.76mg/l (figure 3) with the mean value of 28.49mg/l. The highest and lowest values were found at station 4 and station 9 respectively. The concentrations of nitrate at all the sample stations were above the permissible limit quoted WHO (11mg/l) and FEPA (10mg/l). Human and animal waste, industrial effluent, use of fertilizers and chemicals, sewage through drainage system were major contributory factors to the high concentrations of nitrate in these surface waters. At 95% confidence level the statistical analysis showed that nitrate has no significant difference (P>0.05) across the sampling stations but there was a significant difference (P<0.5) within the physicochemical parameters.

Phosphate
Phosphorous is a limiting nutrient for algal growth and therefore controls the primary productivity of a water body. Phosphate occurs in low quantity in the marine environment as many aquatic plants absorb and store phosphorous many times their actual immediate needs. High concentrations of phosphate are largely responsible for eutrophic conditions in a water body (Khan *et al*., 2012; Kidu, *et al*., 2015). Phosphate values at the sample station ranged from 0.20 to 3.92 mg/l (figure 3) with an average mean value of 0.86mg/l. The maximum and minimum values were observed in sample station 1 and 8 respectively. Phosphate values were below permissible limit (5mg/l) set by FEPA in all the sample stations. Mathew and Pillai (1990) reported that the higher concentration of phosphate in coastal waters might be enriched by freshwater drainage. The addition of super phosphates applied in the agricultural fields as fertilizers and alkyl phosphates used in households, as detergents can be other sources of inorganic phosphates (Bragadeeswaran *et al.,* 2007). The statistical analysis at 95% confidence level showed that there was no

significant difference (P>0.05) across the sampling stations but there was a significant difference (P<0.5) within the physicochemical parameters.

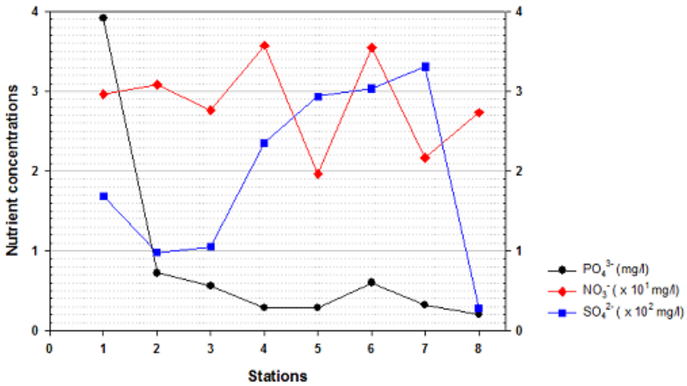

Figure 3: Nutrients concentration in the surface water

Sulphate

Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals. Discharge of industrial wastes and domestic sewage tends to increase its concentration (Manivaskam, 2005). The sulphate value of the studied stations ranged from 27.86 to 330.90mg/l (figure 3) with a mean value of 195.38mg/l. The maximum and minimum values were observed at sample station 7 and 8 respectively. Sample station 5, 6 and 7 has value of sulphate above the permissible limit quoted by WHO (250mg/l). Sulphate showed high positive correlation with EC (r = 0.984), TDS (r = 0.984), Salinity (0.982) and high negative correlation with pH (r = -0.867) (Table 1).

Table 1: Pearson correlation calculated for physicochemical parameters and nutrient

	COND	TDS	SAL	DO	TEMP	pH	NO3	PO4	SO4
COND	1								
TDS	1.000**	1							
SAL	1.000**	1.000**	1						
DO	0.37	0.379	0.382	1					
TEMP	0.01	0.029	0.031	0.499	1				
pH	-.914**	-.920**	-.922**	-0.563	-0.38	1			
NO3	-0.194	-0.19	-0.197	-0.2	0.266	0.077	1		
PO4	-0.209	-0.214	-0.223	-0.154	-0.292	0.421	0.139	1	
SO4	.984**	.984**	.982**	0.267	-0.025	-.867**	-0.162	-0.114	1

** Correlation is significant at the 0.01 level (2-tailed). NO3 – Nitrate, PO4 – Phosphate, SO4 - Sulphate

Conclusion

The present investigation on the impact of human activities on physicochemical parameters and nutrient distribution in the surface water of Ayetoro community was carried out and compare with the environmental protection agencies standard (FAO, FEPA and WHO). The temperature and pH values at all sample stations are within the permissible limit quoted by FEPA, WHO and FAO, FEPA, WHO respectively. DO and Phosphate values at all the sample stations were below the permissible limit set by FEPA. The sulphate and nitrate values at all the sample stations were above the permissible limit quoted by WHO and FEPA. The values for TDS at sample station 4, 5, 6 and 7 were above the permissible limit recommended by FAO and WHO. EC values at all the sample stations were above the permissible limit quoted by WHO except sample station 8

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