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Research Article

WATER QUALITY STATUS AROUND ANIMAL DUNG IN ADIABO RIVER CATCHMENT OF ODUKPANI LOCAL GOVERNMENT AREA OF CROSS RIVER STATE - NIGERIA

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Abstract:

The study examined the impact of animal dung on water quality status in the study area. To achieve this, water samples from the river were collected in pre-washed 250ml plastic container. Before the samples were to be collected, the plastic containers were rinsed twice with the river water. The actual collection of samples were done by stepping into the river body, filing the plastic container to the brim. The samples after collection were transported in a cooler and preserved at 40C prior to laboratory analysis. The samples were analyzed in the laboratory for physico-chemical, heavy metals and bacteriological parameters using standard methods. The pollution index (P…) as outlined by Amadi was employed as a method of rating that shows the composite influence of individual parameters on the overall quality of water. The results revealed that the river is strongly polluted with bacterial such as total coliform arising from dumping animal dung from the abattoir with a P… value of 3.13. The mean value of 19.5mg/100ml exceeds the permissible level of WHO. The WHO recommends a zero (0) per 100ml of total coliform count for drinking water. Besides temperature that shows slightly pollution owing to the activities of factories/industries in this hydrospheric environment, other parameters depict no signs of pollution as their P1 values are less than one (P…<1).

KEY WORDS:

Quality status, Animal dung, Adiabo river catchment, Odukpani, Cross River – Nigeria.

INTRODUCTION:

The use of water is restrained by its quality which makes it unhealthy for a particular use. Thus, water quality depends on the physical, chemical and biological composition of water and an understanding of the physico-chemical as well as biological composition of water will enhance the detection of future deviation in water quality (Eze and Abua, 2003; Abua et al, 2012).

According to GESAMP (2001), Contamination of the coastal marine environment by sewage and animals dung from Abattoir leads to significant numbers of infectious diseases linked to bathing and swimming in marine waters and to the consumption of seafood. Human exposures to toxins associated with algae blooms also impose significant risks. Nonetheless, most illnesses are caused by pathogens, which are biological/infectious agents that cause diseases or illnesses including diarrhea, cholera, dysentery, typhoid, and hepatitis hence, pathogenic, bacteria can survive in the sea from a few days to several weeks; viruses can survive in water, fish or shellfish for several months while the hepatitis virus can remain viable in the sea for over a year.

A global study of the World Health Organization (WHO) estimates that bathing in polluted seas causes some 250 million cases of gastroenteritis and upper respiratory disease every year. Many studies

show that respiratory and intestinal diseases ad infections among bathers rise as a direct consequence of increasing amounts of sewage pollution in the water GESAMP (2001). According to Shuval (2003), the estimated economic loss globally, caused by pathogenic micro organisms is about $12 billion per year. Seafood contaminated by harmful algal blooms causes significant health problems and a study done by the European Environment Agency (EEA, 2005) showed that the socio-economic impact of Greece, Italy and Spain is around 329 million annually.

The number of 'dead zones', which are areas of anaerobic conditions at the sea bottom, due to increased amounts of nutrients, has doubled since 1990 (GPA/UNEP, 2006). A “dead zone” appears off Luoisiana in the Gulf of Mexico each summer caused by excessive amounts of nitrogen flushed down the Mississippi River.

The prevention of pollution at source, thee precautionary principle and the prior licensing of water discharged by competent authorities have become key element of successful policies for preventing, controlling and reducing inputs of hazardous substances, nutrients and other water pollutants from point sources into aquatic ecosystems. The continuous drive to increase meat production for the protein needs for the ever increasing rate of human population in the state to compliment the increasing number of tourists in Cross River State has some pollution problems attached (Eze and Abua, 2003).

In Nigeria and Cross River State as well as around Adiabo Community in Odukpani Local Government Area, pollution arises from activities in meat production as a result of failure in adhering to good manufacturing practices (GMP) and good hygiene practices (GHP). Consideration is hardly given to healthy practices during animal transport to and from the abattoir, during slaughter and dressing. In the study area, there is no special waste disposal system or treatment, as such, dung piled up and waste water containing blood and dung are discharged into the nearby river and streams without treatment.

This leads to pollution of surface water around the abbatoir and residents in the area whose main source of domestic water supply is this river get infected with a lot of water borne diseases. The bones, hooves gathered from such activities while being processed, results to air, soil and water pollution.

The impact of human activities in and around the slaughtering sites in felt on the physical environment and adjourning streams and river where \these waste are been discharged. This disrupts or set an imbalance in the aquatic ecosystem as well as the immune status of aquatic organisms in such heavy polluted streams/river. Also, indiscriminate disposal of animal dung impact significantly on human health in the area, as the only river that sustains the inhabitants water requirement needs is contaminated by discharged animal dungs and other sources of pollution. These result in myriad of health related problem.

The aim of this study is to assess the impact of animal dung on the water quality status of the study area.Objectives are:

To examine the physico-chemical and biological parameters of the water quality in the study area.
To determine the pollution level of the water samples;
To examine the heavy metal contents of the river and to proffer solution towards ameliorating problems associated with river pollution in the study area.

MATERIALS AND METHOD

Study Area

Adiabo Community lies between longitude 080 181East and latitude 050 031North. It is found in Odukpani Local Government Area of Cross River State. Okurikang bound it in the North, in the South by Ikot Essien and Esuk-out, in the west by the Calabar river and Okot Omin in the East.

Adiabo falls approximately along the coastal fringes of the state where the rainy season last for about 9-11 months with the dry months having less than 60mm of rainfall. The nearness to the Atlantic Ocean has a moderating effect on the temperature with a recorded mean of about 280c (Akpabio et al, 2006).

FIELDWORK

Sampling technique

This was preceded by a reconnaissance survey to the study site. The sample size adopted for the study was the river (Esuk mbakara) adjourning Adiabo abattoir. The purposive sampling was used to choose three sampling stations/points along the river. Water samples from the river were collected in pre-washed 250ml plastic containers and rinsed with the river water. The actual collection of samples was done

by stepping into the river body, filling the plastic container to the brim. The samples after collection were transported in a cooler and preserved at 40C prior to laboratory analysis.

Laboratory Analysis

Standard field equipments were used to measure pH (WTW pH 90 meter); temperature and conductivity (WTWLF 90 meter); dissolve oxygen (DO) and its percentage (WTWOX 196 Micro Processor Oximeter). These measurements were taken at the points of sample collection to avoid variations in temperature, dissolved oxygen (DO) and other parameters during transit. This was made possible by the portability nature of the field equipment.

The heavy metals (Iron, copper, zinc and chromium) with same AAS after sample digestion with nitric-perchloric acid mixture (5:1). TDS was determined gravimetrically while nitrate, sulphate and phosphate were analysed using modular iron chromotograph (Metrohm, Switzerland) having a metrohom IC-709 programmable pump, metrohm IC-733 suppressor module and 9, metrohm IC-733 conductivity detector. Total coliform was analysed using presumptive count (technique).

Analytical Tool

The statistical techniques employed for analysis was the Pollution Index (PI). Pollution Index (PI) is a method of rating that shows the composite influence of individual parameters on the overall quality of water (Amadi, 2011; Amadi et al; 2012). The rating has values starting from zero to five above (Table II), reflecting the relative importance individual quality parameter and divided by the recommended standard (Si) for the maximum plus the minimum values and the summative divided by two as shown below. Water quality and its suitability for drinking purpose can be examined by determining its quality index (Caerio et al; 2005; Prasad & Kumari, 2008; Prasad & Mondal, 2008; Amadi, 2012). Pollution index (PI) is given as thus:

$$P\ldots = \sqrt{\frac{\left(\frac{C_i}{S_i}\right)^2 Max + \left(\frac{C_i}{S_i}\right)^2 Min}{2}}$$

Where PI: Pollution index
C_i: Mean concentration
S_i: Nigerian Standard for Drinking Water Quality (NSDWQ, 2007).

Table 1:Summary of Results for Physico-chemical Parameters of Water Samples

Parameters	Minimum	Maximum	Mean
pH	5.49	5.86	5.67
Temperature	26.0	36.2	26.1
Do (mg/l)	2.8	3.0	2.9
BOD (mg/l)	0.6	1.0	0.8
TDS (mg/l)	17.0	33.0	25.0
Conductivity (us/cm)	34	63	48.5
No_3 (mg/l)	1.896	2.016	1.956
No_2	0.000	0.009	0.003
$NH_4$0.010	0.024	0.016	
Sulphate ($S0_4$) (mg/l)	1.710	3.169	2.440
Phosphate (Po_4) (mg/l)	0.004	0.012	0.008
$S10_2$	1.126	1.126	1.012

Table II:Summary of Statistical Results of Water Samples from the Area

Parameter	Minimum	Maximum	Mean	NSDWQ	Pollution Index
pH	5.49	5.86	5.68	7.50	0.76
Temperature (O^c)	26.0	26.2	26.1	25	1.04
DO (mg/l)	2.8	3.0	2.9	10.00	0.36
BOD (mg/l)	0.6	9.0	0.8	10	0.08
TDS (mg/l)	17.0	33.0	25	500.00	0.052
Conductivity (us/cm)	34	63	48.5	1000.0	0.05
No_3 (mg/l)	1.896	2.016	1.956	10	0.11
No_2 (mg/l)	0.000	0.009	0.003	10	0.003
Sulphate So_4	1.710	3.169	2.440	250	0.06
Phosphate Po_4 (mg/l)	0.004	0.012	0.008	200	.00045
Fe (ppm)	0.098	0.382	0.24	0.30	0.83
Cr (ppm)	0.000	0.000	.0	0.05	0
Cu (ppm)	0.004	0.006	0.005	0.05	0.10
Zn (ppm)	0.014	0.026	0.020	3.00	.00695
Total Coliform (100ml)	11	28	19.5	10.00	3.13

Table III:Water Quality Classification based on Pollution Index (Caerio et al; 2005; Amadi et al.; 2012)

Class	Pollution Index	Status
Class 1	PI<1	No pollution
Class 2	PI: 1 -2	Slightly polluted
Class 3	PI: 2 -3	Moderately polluted
Class 4	PI: 3 -5	Strongly polluted
Class 5	PI:>5	Seriously polluted

This study adopted the polluted index (PI) to examining the quality status of Esuk Mbakara River in Adiabo, Cross River State, Nigeria. The applicability of the pollution index on physico-chemical, heavy metal and bacteriological data revealed that the river is strongly polluted with bacterial such as total Caliform arising from animals dung from the abattoir. Thus, a PI value of 3.13 indicate strongly polluted (see table ii and iii). Furthermore, the mean value of 19.5mg/100ml exceeds the permissible level of WHO. The WHO recommends a zero (0) per 100ml of total Coliform count for drinking water, meaning, water should have no concentration hence, the water should be treated to make it potable for human consumption.

Besides temperature that shows slightly polluted owing to the activities around this hydrospheric environment, other parameters depict no signs of pollution as the (PI) values are less than one (PI<1).

Table (i) depicts information on the physico-chemical parameters of Adiabo river across the sampling points. The level of pH range from 5.49-5.86 with a mean value of 7.50. This implies that the river is acidic, this affects the metal solubility and hardness of the water. Aquatic organisms are heavily affected by pH because, most of their metabolic activities are pH dependent.The degree of temperature happened to be low. The pH ranges from 260c – 26.20c with a means of 26.10c. These concentrations are normal and have minimal effects on acidity.

The contents of Dissolved Oxygen (DO) ranges from 2.8-3.0 with a mean of 2.9mg/l. The depletion of Dissolved Oxygen (DO) was due to the enormous amount of organic load which required high level of oxygen for chemical oxidation and breakdown.

The concentration of Biochemical Oxygen Demand (BODs) varied from 0.6-1.0mg/l with a mean value of 0.8mg/l. The relatively high value of 1mg/l recorded could be attributed to the discharge of organic waste directly into the river from adjourning abattoir. This perhaps reveals that the river has low level of organic pollution.

The concentration of total dissolved solids (tds) ranged between 17.0mg/1 and 33.0mg/1. The content of electrical conductivity was with a range value of 34-63 and mean of 48.5 us/cm. The values for sulphate and phosphate ranges from 1.71-3.16mg/l and 0.004-0.024mg/l and mean values of 2.44 and 0.008 mg/l respectively.

The level of heavy metals in Esuk Mbakara river, Adiabo depicted in table (i) reveals that the level of Iron (Fe) was high ranges from 0.098-0.382 ppm. The concentration of Chromium (Cr) was zero 0.000 ppm.

The level of copper (Cu) was slightly the same ranging from 0.004-0.006 ppm with (0.002ppm) while that for zinc (Zn) were low (range = 0.014 -0.026) with a mean value of 0.020 ppm. The sources of heavy metal in the river could be attributed to agro-chemical industries as well as some engineering works along the coast of the river. The accumulation of Iron (Fe) as well as Copper (Cu) by algae hydrocarbon

reticulation affects fish, as fish usually preys upon algae and planktonic as well as benthic organisms.

CONCLUSION

The physico-chemical parameters of Esuk-mbakara river differ significantly from WHO permissible limit. This implies that the water is not suitable for human consumption. The level of dissolve oxygen (Do) and bio-chemical oxygen (BOD) were high indicating enormous load of organic compound released into this hydrospheric environment. The source of heavy metal in the river could be attributed to agro-chemical industries as well as some engineering work along the shorelines of the river. Bacteriologically speaking, the river was adversely contaminated with a Pollution Index (PI) value for coliform court of 3.3. Hence, the mean value of 19.5 mg/100ml exceeds the permissible level of WHO as the WHO recommends a zero (0) per 100ml of total coliform count for drinking water. Therefore, there is the need to device a precautionary principle when selecting water quality parameters and establishing water quality criteria to protect and maintain individual use of water.

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