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The Effect of Nasarawa Central Abattoir Effluent on the Receiving River, Nasarawa, Nasarawa State, Nigeria.

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***Abstract*- The impact of effluent from the Nasarawa Central Abattoir (NCA) on the receiving body of water was verified using parameters from Physico-Chemical and microbiological qualities of water. The results obtained from the investigations carried out on the samples from segment of the adjoining river which directly received the effluent discharged from the abattoir were quite revealing. Samples of water were collected at distances 0 m (point of discharge), 5 m, 10 m, and 15 m from the source of effluent discharged. The fifth sample was obtained 73 m upstream of the point of effluent discharged to furnish information on ambient conditions of the river prior to pollution. The drop in Dissolved Oxygen (DO) level of the river from an ambient value of 7.16 mg/L to 6.71 mg/L at the point of discharge was indicative of pollution with increased Total Solid (TS) from 1039 mg/L to 1125 mg/L. Findings also showed that the various water samples collected were all contaminated with Escherichia coli (E. coli) and other enteric bacteria. The presence of coliform staphylococcus aureus highlighted the activity of micro-organisms which are associated with water borne diseases. The receiving river was confirmed polluted by the effluents discharged into it. Invariably, this constitutes hazards to the environment and the unsuspecting local dwellers that used the water from the river for domestic, recreation, and food production.**

***Index Terms*— Abattoir, Coliform, Effluent, River body, Pollution**

I. INTRODUCTION

Abattoir, is a place where animals are killed for consumption. It is any facility used for or in connection with the slaughter of animals whose meats is intended for human consumption. A slaughter house does not include a place situated on a farm according to Adelegan [2]. The abattoir industry is a crucial component of livestock industry in Nigeria, providing domestic meat supplies to over hundred and eighty (180) million populace and employment opportunities for the teeming population, Nafamda, et al [5]. However, abattoirs are known all over the world to pollute the environment either directly or indirectly from their various processes. Abiola [1] argued that waste water from an abattoir is a particularly concentrated source of oxygen consuming wastes . Contamination of river body and land from abattoir wastes which typically contain fat grease, hairs, feathers, flesh, manure, undigested feed and grit, blood, bones and process water (with high organic level) could constitute a significant environmental and health hazard. The quest for safe drinking water is of prime importance to human sustenance and economic development and this is one of the core pursuits of the Sustainable Development Goals (SDGs) which is to ensure the availability and sustainability of potable water for all by year 2030 [11].

The main waste from the abattoir comes from killing, processing and clean up operations hide removal or dehairing, paunch handling, rendering, trimming. The wastes contain blood grease, inorganic and organic solids, and salts and chemical added during processing operations. The excessive production of organic matter leads to the buildup of "sludge" and the mineralization process which consumes all dissolved oxygen from a water column, Adeyemo [3]. Organic effluents also frequently contain large quantities of suspended solids which reduce the light available to photosynthetic organisms and on settling out, alter the characteristics of the river bed, rendering it an unsuitable habitat for many organisms. The presence of ammonia is often prominent escalating the effluent toxic index.

II. THE STUDY AREA

The study was conducted at the Nasarawa Central Abattoir sited 500 m from Nasarawa Local Government Council headquarters (along ‘down base’ area) of Nasarawa State, Nigeria (see figure 1), The local government is about 167 km from Lafia, and 100 km from Abuja the federal capital city of Nigeria. According to the 2006 population census [9] [6], it has a population of 189,835 with total area coverage of 370.7 km. It is within Guinea Savannah, and the tropical climate condition of the study area is not far from the climatic condition of Nigeria (Raining and Dry seasons) with an average temperature of 28^0C, and a mean annual rainfall of 1,357 mm by the Nigerian Meteorological Agency [8]. The abattoir is situated at an average altitude of 450 m above mean sea level (MSL). It lies at latitude 8°31'N and longitude 7°45'E. The slaughter house is divided into different sections; the butchering section; where the animals are rendered; the rinsing section where the parts of the animals are rinsed and the dung pit where the intestines are emptied. This investigation was carried out at the beginning of raining season when water Samples were collected. Wastes from the abattoir are collectively discharged into the river and the soil without treatment, thus underpinning the significance of this research work.

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Figure 1: The Study Area

III. FIELD SURVEY AND SAMPLING EXERCISE

The field survey and sampling exercise were carried out just at the beginning of the raining season in May. A section of one hundred and three meters (103 m) distance was measured. A point source/mixing zone of pollution caused by the abattoir effluent discharge into the river was identified. Thereafter, water samples representing the various span affected by the pollution were obtained. Water samples were obtained from four points spread over thirty meters (30 m) downstream of the effluent discharge point. An ambient water sample was also obtained to give information on the water quality prior to pollution, making a total of five sampling points. The sampling range was limited to one-hundred and three meters (103 m) because of another major domestic effluent discharge into the river. This effluent is drained from a large number of houses with poor septic tank systems. The effluent looks brackish, suggesting that the Biochemical Oxygen Demand (BOD) would be very high. This other pollution takes place about one-hundred and thirty meters (130 m) away from the mixing zone of the abattoir effluent. Table 3.3 captures the sampling point spanning 103 m measured along the river centerline. Sample point A is the actual point (or mixing zone) where the effluent flowing from the abattoir meets with the river body. Sample point B. This is located five meters (5 m) downstream from the mixing zone of the discharged effluent. The position of sample point C is situated ten meters (10 m) downstream of the effluent-mixing zone. Some rendering activities that include roasting of the animal skin takes place at close distance from this point. Part of the soot from this activity ends up in the river. Moreover, blood and paunch contents from the abattoir find its way directly into the river some five meters (5m) away from this point. Sample point D is located fifteen meters (15 m) downstream of the effluent-mixing zone. The presence of shrubs and weeds at the riverbed impacts the velocity of the flowing river at this point. Located seventy-three meters (73 m) upstream of the effluent discharge point is Sample Point E. This sample was to reflect the ambient water quality and to serve as a control sample.

IV. LABORATORY ANALYSIS

The standard analytical method employed for the Physico-Chemical parameters determination of water and wastewater were from American Public Health Association series of Standard Methods of Examination of Water and Effluent [4].

Samples analyzed for dissolved oxygen were stored in glass bottles, and analyzed. The Total Dissolved Solid was determined using Electrometric method. The Temperature, Conductivity, pH and Turbidity were all determined using

Electrometric method. Nitrate, nitrate Nitrogen, Suspended solids, Iron and Zinc were determined with the aid of a Colorimetric. Total Coliform was obtained using Membrane and finally Faecal Coliform and Faecal Streptococci were obtained using Filtration Techniques.

V. RESULTS AND DISCUSSION

A. Physical Parameter

The electrical conductivity (EC) is a parameter that defined the Total Dissolved Solids (TDS).The measured electrical conductivities of the analyzed water samples ranged between 66.0 us/cm to 993 us/cm with average value of 530 us/cm. The highest value of electrical conductivity was at point "A" (0 meter) showing the highest presence of dissolved solid contributed by anthropogenic activities and run-off of various soil type. While the lowest electrical conductivity is at the control point (73 m). The hydrogen-ion concentration is an important parameter in both natural waters and polluted water. It is a very important factor in the biological and chemical polluted water treatment. Water and polluted water can be classified as neutral, alkaline or acidic according to the following pH ranges: pH of seven indicates neutral; pH greater than seven spells alkaline and a value of pH less seven define acidity. The result showed that all the samples including the control point were greater than seven (see Table 3.1). The test result showed sample "A" which is the discharge point of the abattoir effluents has a total dissolved solid (TDS) of 665 Mg/L which is above the World Health Organization acceptable standard [12] [13] (see the summary Table 3.4). Suspended solid (SS) in samples "B" (at 5 m), "D" (15 m) and the control sample (73 m) are respectively high (see Table 3.1). Suspended solids in water mainly comprise of silt, sand and minerals eroded from the land. This reduces the water storage capacity of the water body and may also block the sunlight required for photosynthesis.

Table 3.1: Physical Parameters of the Water Samples from the River

Sample Dist. (m)	pH Value	Conductivity (us/cm)	Turbidity (NTU)	Temp. (°c)	Dissolved Solid (mg/L)	Suspended Solid (mg/L)	Total Solid (mg/L)
0	7.83	993	567	28.5	665	460	1125
5	7.54	66	362	28.5	44	1285	1329
10	7.64	61.1	647	29.3	41	524	565
15	7.95	70.5	337	28.6	47	1280	1327
73	7.63	60.4	227	28.6	41	998	039

A. Chemical Parameter

The dissolved oxygen (DO) at the respective sampling points were found high than the optimum dissolved oxygen of natural water (see Table 3.2). The optimum Dissolved Oxygen (DO) in natural waters is 4-6 mg/L which is essential for supporting aquatic life. Any decrease in this value is indicative of pollution. The obtained data represents the level of pollution in the river by non-conservative constituents that is those constituents that are chemically/biochemically reactive at the peak period of effluent discharge by the abattoir. Oxygen-Demand includes domestic and animals sewage, biodegradable organic compounds and industrial wastes from food processing plants, meat-packing plants, slaughter-houses, paper and pulp mills. All these wastes undergo degradation and decomposition by bacterial activity in presence of Dissolved Oxygen (DO) and this result in rapid depletion of Dissolved Oxygen (DO) from the water, which is harmful to aquatic organisms.

Table 3.2: Chemical Parameters of Samples from the River

Sample Dist. (m)	Zinc (nig/L)	Iron (mg/L)	Nitrate (mg/L)	Nitrate/ Nitrogen (mg/L)	Dissolved Oxygen (mg/L)
0	1.39	1.26	3.50	0.79	6.71
5	0.29	0.37	0.30	0.07	6.80
10	0.28	0.33	0.00	0.00	7.44
15	0.31	0.40	0.33	0.08	7.22
73	0.10	0.30	0.00	0.00	7.16

B. Microbiological Parameters

Contaminants of biological origin are primarily from animal and human wastes. Organic matters and bacteria are measured by Biological Oxygen Demand (BOD) and coliform count. Table 3.3 represents bacteriological tests performed on the water samples from each sampling point. To achieve this, the total volume of oxygen gas taken up by micro-organisms is measured in a period of 5 days at 20°C. Micro-organisms utilized oxygen to decompose complex organic molecules present in the water in their aerobic processes. The result provides a measure of the total amount of micro-organisms in the samples, and of the nutrient available to them. It is the most extensively used parameter of organic pollution applied to polluted water, surface and groundwater, averred by Odeyemi [10] The determination of Dissolved Oxygen (DO) is the basis of Biochemical Oxygen Demand (BOD) test, which evaluates the pollution index of polluted water. It represents the quantity of oxygen required by bacteria and other microorganisms during the biochemical degradation and transformation of organic matter present in water under aerobic conditions.

The coliform count determines the presence of harmful bacteria in the water.

Table 3.3: Microbiological Parameters

Sample Distance (m)	Total Coliform (cfu/IOOmL)	Feacal Coliform (cfu/IOOmL)	Feacal Streptococci (cfu/IOOmL)
0	505	130	165
5	349	100	129
10	440	100	147
15	490	140	160
73	230	80	105

Table 3.4: Summary of the Physico-Chemical and Micro-Biological Parameters of Water Samples

Parameter	Range	Mean	World Health Organisation		Nigeria Standard (NSDWQ)
			Acceptable Level	Max. Permissible	
PH	7.54 -7.95	7.72	6.5	8.5	6.5-8.5
Turbidity (NTU)	227 - 647	427.4	5	25	5
Conductivity (us/cm)	60.4-993	250.2	500	1500	1000
Temperature (C)	28.5-29.3	28.7	-	-	Ambient
Dissolved Oxygen (mg/L)	6.71-7.44	7.07			
Suspended Solid (mg/L)	460-1285	909.4	-	-	-
Zinc (mg/L)	0.10-1.39	0.474			3
Iron (mg/L)	0.30-1.26	0.532			0.3
Nitrate (mg/L)	0.00-3.5	0.826	45	50	50
Total Dissolved Solid (mg/L)	41-665	167.6	500	1500	500
Nitrate as Nitrogen (mg/L)	0.00-0.79	0.188			
Total Coliforms (cfu/IOOmL)	230-505	402.8			10
Faecal Coliform (cfu/IOOmL)	80-140	110			0
Faecal Streptococci (cfu/IOOmL)	105-165	141.2			0

Source: WHO (2004)

V.CONCLUSION AND RECOMMENDATION

It is abundantly clear from the foregoing, that the river is polluted by the activities of the abattoir. This is evident from the high level of contamination as revealed by the laboratory analysis. The Dissolved Oxygen dropped from the ambient value of 7.44 mg/L to 7.16 mg/L. The compliance of the river water with World Health Organization (WHO) and Nigeria Standard of Drinking Water Quality (NSDWQ) guidelines as reflected in Table 3.4 showed that the Total Dissolved Solid (TDS), Turbidity and Total Suspended Solid (TSS) were 39% compliant. Hence, the effluent from the abattoir constitutes potential hazards to the people and the environment. The results also indicated that the various samples were contaminated with harmful bacteria. The high level of pollutants found in the water samples are practical demonstration of the negative impact of the existence of natural retention pond that retained wastes emanating from the abattoir before getting to the river body. The parameters which are indicators of pollution need to be improved; otherwise, the continual usage of the water for domestic purposes will affect human health. Regular monitoring exercises should be carried out on the activities of abattoirs in order to ensure that effluents standard and other sanitary conditions are strictly observed. The findings from this research work could serve as baseline information for the ministry of agriculture, water resources and environment, and other stake holders in the industry

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