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ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol. 5, Issue 8, pp. 501-507, August, 2014

RESEARCH ARTICLE

THE EFFECT OF ABATTOIR DISCHARGE ON THE OBOT OKOHO STREAM QUALITY IN NASSARAWA VILLAGE CALABAR, NIGERIA

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ARTICLE INFO

Article History:
Received 11th May, 2014
Received in revised form
20th June, 2014
Accepted 31st July, 2014
Published online 31st August, 2014

Key words:

Abattoirs,
Waste discharge,
Downstream,
Pollution and pathogens.

ABSTRACT

The study examined the effect of abattoir discharge on the Obot Okoho Stream. Water samples were collected for laboratory analysis and data in health related diseases were collected from the health centre located at Abenyo Health Centre. Mean values for physico-chemical parameters such as (pH, DO Temperature, turbidity, conductivity, Tss, TDS, BOD, Total coliform and feacal coliform were 65.96mg/L, 12842E3, 3.50 mg/L, 5.69 (Cfu)/100mL, 2.76/100ml respectively. Abeny Health Centre recorded a high case of cholera and typhoid diseases. The t-test showed that there was a significant difference in water quality of Obot Okoho Stream between the upstream and the downstream sections of the abattoir. Waste discharge impacted negatively on the water body at 0.05 significant levels. The recommended that government should ensure that adequate waste disposal system are provided to reduce the negative impact of the waste discharge on the environment.

INTRODUCTION

The continuous quest for increased meat production to augment the protein needs of the ever-increasing world population have resulted in pollution problems especially when the sanitary conditions of areas where animals are slaughtered are not adequately maintained. The manner in which abattoir waste are disposed results in environmental problems since there are no provision of sewage treatment systems for the management of such wastes. In Nigeria, most abattoirs dispose their effluents directly into streams and nearby rivers without any form of treatment and the slaughtered meat is washed and emptied into the same surface water body. The sanitary conditions of places where animals are slaughtered are not maintained adequately and as such it results in environmental pollution. An abattoir is supposed to be a place approved and registered by a controlling authority for hygiene slaughtering, inspection of animals, processing, hygienic presentation and storage of meats for human consumption. Abattoirs all over the world tend to pollute the environment either directly or indirectly from their activities. (Adelegan, 2002). The abattoir in Nassarawa village at 8 miles Calabar is located close to a stream called Obot Okoho and wastes such feaces, animal trimmings, Paunch content; waste water that contains blood, urine and fat that emanates from their activities drains into the stream and contaminates its quality thereby rendering it unsuitable for consumption without proper treatment procedure. Slaughtering process that produces blood and paunch content from the intestine are flushed into open drains which are connected to surface water and a times percolates into groundwater (Adeyemo, 2000). Solid wastes from abattoir includes spoiled meat, undigested ingesta, bones, horns, hair and aborted foetus while the liquid waste are composed of blood, urine and gut content. Livestock waste spills can introduce enteric pathogens and excess nutrient into surface waters and can also contaminate groundwater from infiltration and percolation during rain (Meadows, 1995).

Owing to the absence of a well regulated disposal system in the Nassarawa abattoir, it was observed that the wastes discharged readily littered the surrounding environment thereby degrading its aesthetics. Untreated effluents were drained into a nearby ravine thereby enhancing the spread of contaminated materials into the surrounding water body. The rapid spread of contaminant was aided by the topography, characterized by steep slope which accelerated waste water flow down the hill into the Obot Okoho stream. The inhabitants of this area depend fully on the contaminated stream for their sustenance and drink, bath and wash from the water. This has resulted in some health challenges such as cholera, dysentery and diarrhea. There is also the prevalence of malaria due to the unhygienic condition of the environment. These problems enumerated above prompted this study, so as

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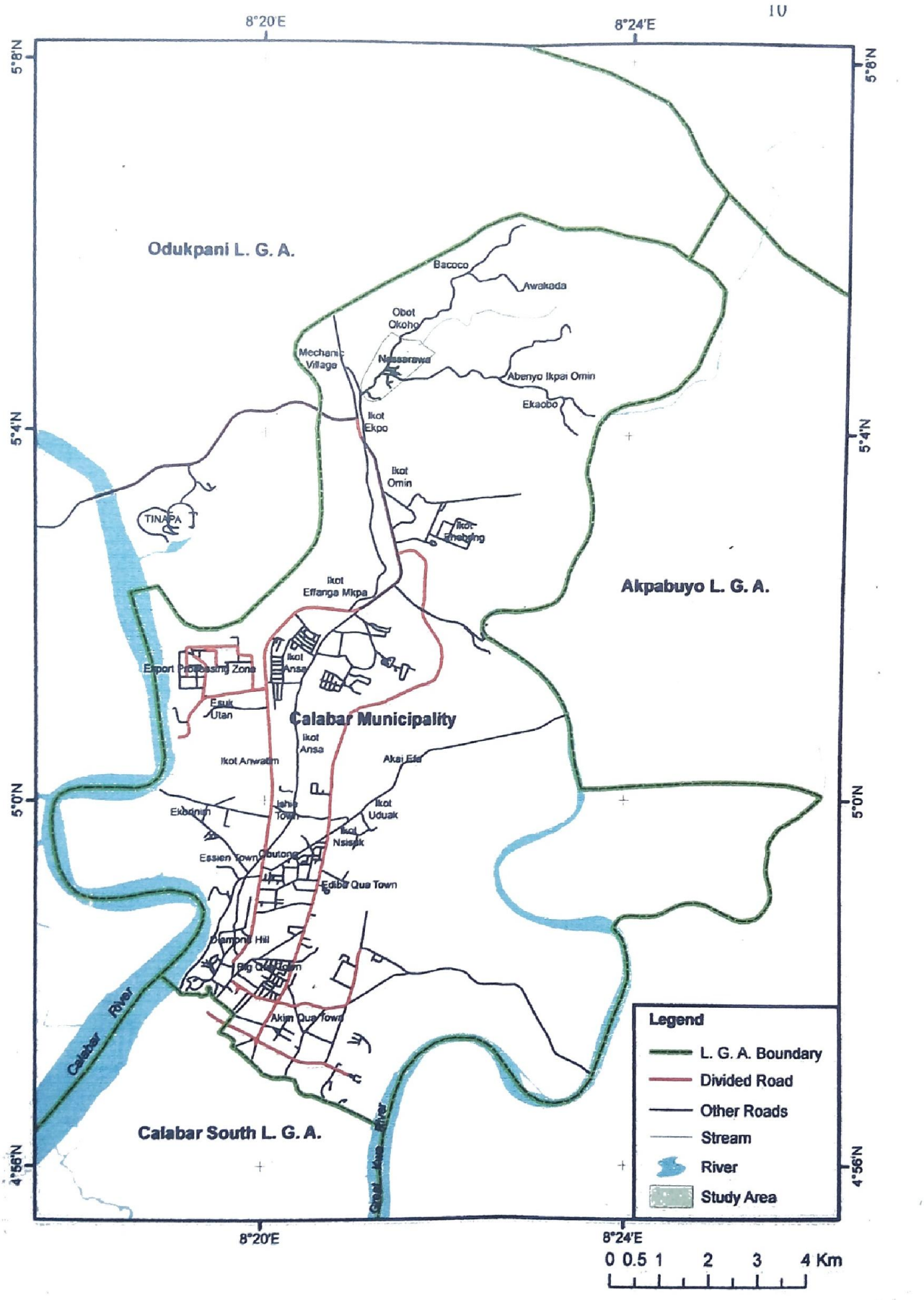


Figure 1. Map of Calabar Municipality Showing the Study Area

to proffer solutions on how to ensure sustainability and encourage harmony between the human activities going on at the abattoir and the environment.

MATERIALS AND METHODS

The field survey was preceded by a reconnaissance survey of the study area. The essence was to familiarize the researchers with the study environment and to be able to classify into areas greatly affected and those unaffected by the abattoir waste disposal activities. The systematic sampling technique was employed to obtain water samples from the upstream and downstream points of waste discharge. Waters for the upstream and downstream were obtained at every 50m distance away from the discharge point. This was done twice a week for about three months from September to November, 2013. The sampling locations were geo-referenced using the Global Positioning System (GPS). The samples were collected in a 250 ml reagent bottle and sealed to exclude air bubble. They were immediately transported in an ice box at temperature of 4^0C to the laboratory for routine water analysis. A ten (10) years data ranging from 2004-2013 was obtained from a nearby health facility known as Abenyo Health Care which was frequently patronized by the Nassarawa community. The data requested for and collected was mainly on;

a) The type of water borne diseases experienced in the study area
b) Total number of cases reported so far since 2003-2013
c) Total number of adults affected
d) Total number of children affected
e) The total number of death recorded

They equipment used in the analyzing water samples are presented in table 1.

The student t-test was used in testing the hypothesis which was stated in both the null and alternate form as follows:

H_o: There is no significant difference in water quality of Obot Okoho stream between the upstream and downstream sections of the abattoir waste discharge point in Nassarawa.
H_i: There is a significant difference in water quality of Obot Okoho stream between the upstream and downstream sections of the abattoir waste discharge point in Nassarawa.

Study Area

Nassarawa community is located in Calabar Municipality of Cross River State, Nigeria. Geographically it lies on latitudes $5^0$02'N and $5^0$20'N and longitude $8^0$20'E and $8^0$24'E of the Greenwich meridian. It is bounded at the North by Odukpani Local Government Area as shown in figure 1 below. The study area falls within the equatorial climatic zone and is characterized by double rainfall maxima with a mean annual rainfall of 3063m (Edet, Okereke, Teme and Esu, 1998). The highest mean monthly temperature is 29^0C and the annual humidity ranged from 75-90 percent (Ileoje, 1991). The study area is drained by three main rivers, namely Calabar River, Cross River and the Great Kwa River. It discharges about 800m^3/sce in the wet season (Ofiong and Edet, 1998). Calabar municipality is underlain by the coastal plan sands that belongs to the tertiary deposits and form an island to the south of the alluvial deposits of the Great Kwa River and Calabar River. The alluvial deposits have, sands, gravels, silt and clay deposits. Nassarawa community is a settlement occupied by Hausas and the inhabitants practiced mixed economy systems made up of fishing, trading, farming and civil service work, but the Nassarawa abattoir falls under the trading sector of the economy.

RESULTS AND DISCUSSION

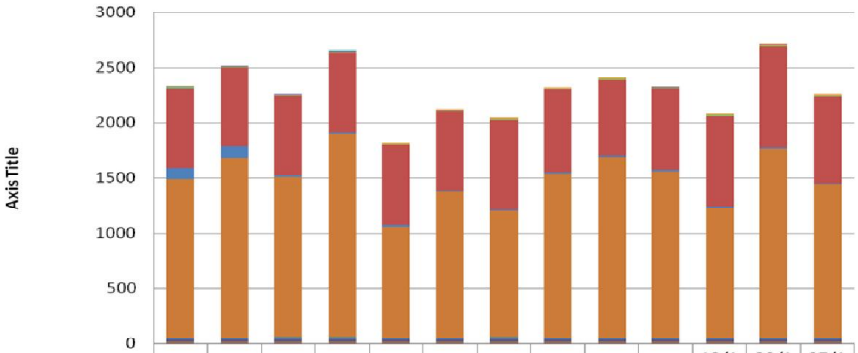
The research revealed that the (pH)values for the upstream ranged from 6.18 - 7.30 with a mean of 6.53 while the downstream being the impacted area ranged from 5.41 – 6.32 with a mean of 5.92 within the three months sampling period as shown in table 2 and 3. This variation indicated that the stream water was more acidic in the downstream than in the upstream within the study area. This was attributed to the direct discharge of waste water from the abattoir. The dissolved oxygen (DO) value for the upstream ranged from 5.30 – 7.00mg/L but in the downstream the mean ranged from 2.40-3.90mg/L with a mean of 2.9mg/L. it was observed that the temperature from the discharge was always high, this has caused the dissolved oxygen value for the downstream to be reduced. This might result in anaerobic condition, putrefaction and development of foul odour in the Obot-Okoho stream. The temperature of the downstream ranged from 25-4^{o}C-27.2^{o}C with a mean of 26.6^{o}C. Turbidity for upstream ranged from 9.20 - 22.0(Ntu) with a mean of 12-54 and that of downstream ranged from 92.0-112.0 with a mean of 98.6.

Table 1. Methods and equipment used for the analysis of physic-chemical parameter of water

Analytical equipment/Method of Reference	Parameters
Cyberscan pH 20 meter	pH. Eh
Cyberscan low 20 conductivity meter	Conductivity, temperature total dissolved solid (TDS)
Microprocessor Oximeter 196	Dissolved Oxygen (DO)
Chloride was measured titrimetrically using silver nitrate and potassium spectropphotometrically by	Chloride (CI) (mg/L)
a)turbidimetry using barium chloride (APHA, 1989)	Sulphate, So_4
b) Diazonization Method (Parsons et al, 1984)	Nitrite (NO_2)
c) As nitrite after reduction in calcium system (Parsons et al, 1984)	Nitrate (NO_3)
d) Molybdenum blue method (Parsons et al, 1984)	Phosphate (Po_4)
e) Formazine standards	Turbidity (NTU)
f) Nesslerization method (APHA, 1995)	Ammonium (NH_4)
Difference between initial oxygen concentration in Biochemistry oxygen sample and concentration after 5 days incubation in dissolved oxygen (DO) bottles at 20^0C (APHA, 1989) demand (BOD_5)	

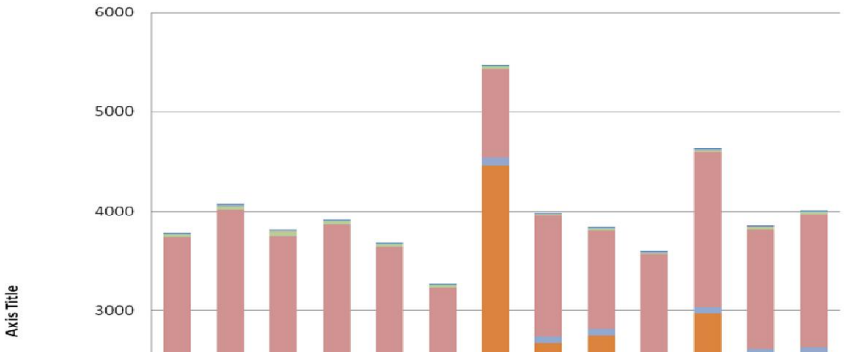
Adapted from APHA (1989, 1995) and Parson's et al (1984)

Figure 2: A chat showing the water quality analysis sampled within Nassarawa abattoir and its environs-upstream



	4/9/2010	11/9/2010	18/9/2010	25/9/2010	2/10/2010	9/10/2010	16/2/2010	23/2/2010	30/2/2010	6/11/2010	13/11/2010	20/11/2010	27/11/2010
Feacal coliform	1	0	0	0	1	1	1	1	1	0	1	2	1
Total coliform	1	0	0	1	1	2	1	1	2	0	0	2	1
BOD	1.6	1.3	0.8	1.6	1.4	1	0.8	0.6	1.1	1	1	1	1.2
Colour	15	17	16	18	15	14	18	15	17	19	19	21	17
TDS	720	720	719	720	717	720	812	752	689	732	821	921	789
TSS	101.2	101.3	10.8	11.2	13.2	10.6	8.2	9.6	10.8	11.6	12.4	12.4	9.5
Sp Cond	1440	1630	1448	1840	1011	1326	1148	1486	1636	1511	1178	1710	1388
Turbidity	9.2	9.3	22	19.2	9.2	9.5	16.2	14.2	10.4	11.6	9.3	11.3	11.7
Temperature	26.8	26.7	26.8	26.7	26.7	26	26.5	26.7	26.9	26.5	26.7	26.8	26.8
DO	6.1	5.7	5.8	6.7	6.3	5.6	7	6.4	6.5	6.4	5.8	5.3	5.5
pH	6.2	6.32	6.7	7	7.2	6.9	6.2	6.18	6.2	6.18	7.3	6.2	6.25

Figure 3: A chat showing water quality analysis sampled within Nsassaraw abattoir and its environs-downstream



	4/9/2010	11/9/2010	18/9/2010	25/9/2010	2/10/2010	9/10/2010	16/10/2010	23/10/2010	30/10/2010	6/11/2010	13/11/2010	20/11/2010	27/11/2010
Feacal coliform	3	2	3	4	3	2	1	4	3	3	4	3	1
Total coliform	4	9	8	4	3	5	2	9	4	9	8	4	5
BOD	3.6	3.6	4.1	4.8	3.7	3.8	3.1	2.9	3.3	2.8	3.1	3.2	3.6
Colour	29	35	48	26	30	29	26	19	21	22	26	26	28
TDS	1615	1600	1321	1461.	1261.	1122	890	1211	996	1136	1561	1198	1321
TSS	61	53	61	80	66	62	72	66.5	62.3	68	62	69.7	74
Sp Cond	1930	2231	2232	2200	2186	1931	2018	2531	2632	2230	2836	2430	2438
Turbidity	106	100	110	97	98	84	102	112	87	99	95	92	100
Temperature	26.6	26.2	26.8	26.9	26	26.4	26.6	26.7	26.6	26.6	26.8	26.7	26.6
DO	2.7	2.7	2.4	2.1	2.6	2.6	2310	3.7	3.2	3.9	3.2	3	2.7
pH	6.3	6.32	5.82	5.98	5.99	6.1	6	5.41	5.96	5.83	5.59	5.84	5.91

Table 2. Result of water quality analysis sampled within Nassarawa abattoir and its environs-upstream

	Station	pH	DO (Mg/L)	Temp (°C)	Turbidity (Ntu)	Elec.Cond (µs/cm)	TSS (Mg/l)	TDS (Mg/l)	Colour	BOD (Mg/l)	Total coliform (Cfu/100ml)	Faecal coliform (Cfu/100ml)
4/9/2010	1.00	6.20	6.10	26.80	9.20	1440.00	101.20	720.00	15.00	1.60	1.00	1.00
11/9/2010	1.00	6.32	5.70	26.70	9.30	1630.00	101.30	720.00	17.00	1.30	0.00	0.00
18/9/2010	1.00	6.70	5.80	26.80	22.00	1448.00	10.80	719.00	16.00	0.80	0.00	0.00
25/9/2010	1.00	7.00	6.70	26.70	19.20	1840.00	11.20	720.00	18.00	1.60	1.00	0.00
2/10/2010	1.00	7.20	6.30	26.70	9.20	1011.00	13.20	717.00	15.00	1.40	1.00	1.00
9/10/2010	1.00	6.90	5.60	26.00	9.50	1326.00	10.60	720.00	14.00	1.00	2.00	1.00
16/2/2010	1.00	6.20	7.00	26.50	16.20	1148.00	8.20	812.00	18.00	0.80	1.00	1.00
23/2/2010	1.00	6.18	6.40	26.70	14.20	1486.00	9.60	752.00	15.00	0.60	1.00	1.00
30/2/2010	1.00	6.20	6.50	26.90	10.40	1636.00	10.80	689.00	17.00	1.10	2.00	1.00
6/11/2010	1.00	6.18	6.40	26.50	11.60	1511.00	11.60	732.00	19.00	1.00	0.00	0.00
13/11/2010	1.00	7.30	5.80	26.70	9.30	1178.00	12.40	821.00	19.00	1.00	0.00	1.00
20/11/2010	1.00	6.20	5.30	26.80	11.30	1710.00	12.40	921.00	21.00	1.00	2.00	2.00
27/11/2010	1.00	6.25	5.50	26.80	11.70	1388.00	9.50	789.00	17.00	1.20	1.00	1.00
Result of water quality analysis sampled within Nsassaraw abattoir and its environs-downstream												
4/9/2010	2.00	6.30	2.70	26.60	106.00	1930.00	61.00	1615.00	29.00	3.60	4.00	3.00
11/9/2010	2.00	6.32	2.70	26.20	100.00	2231.00	53.00	1600.00	35.00	3.60	9.00	2.00
18/9/2010	2.00	5.82	2.40	26.80	110.00	2232.00	61.00	1321.00	48.00	4.10	8.00	3.00
25/9/2010	2.00	5.98	2.10	26.90	97.00	2200.00	80.00	1461.60	26.00	4.80	4.00	4.00
2/10/2010	2.00	5.99	2.60	26.00	98.00	2186.00	66.00	1261.50	30.00	3.70	3.00	3.00
9/10/2010	2.00	6.10	2.60	26.40	84.00	1931.00	62.00	1122.00	29.00	3.80	5.00	2.00
16/10/2010	2.00	6.00	2310	26.60	102.00	2018.00	72.00	890.00	26.00	3.10	2.00	1.00
23/10/2010	2.00	5.41	3.70	26.70	112.00	2531.00	66.50	1211.00	19.00	2.90	9.00	4.00
30/10/2010	2.00	5.96	3.20	26.60	87.00	2632.00	62.30	996.00	21.00	3.30	4.00	3.00
6/11/2010	2.00	5.83	3.90	26.60	99.00	2230.00	68.00	1136.00	22.00	2.80	9.00	3.00
13/11/2010	2.00	5.59	3.20	26.80	95.00	2836.00	62.00	1561.00	26.00	3.10	8.00	4.00
20/11/2010	2.00	5.84	3.00	26.70	92.00	2430.00	69.70	1198.00	26.00	3.20	4.00	3.00
27/11/2010	2.00	5.91	2.70	26.60	100.00	2438.00	74.00	1321.00	28.00	3.60	5.00	1.00

The suspended particles from the abattoir waste discharge increased the turbidity of the downstream. Conductivity value for downstream ranged from 1930-2836 µS/cm with a mean of value of 2.2942E3 while that of the upstream ranged from 1011-1840µS/CM with a mean value of 1.4425E3. This showed that conductivity value was high at the downstream section of the stream due to discharge from the abattoir.

The total suspended solids (TSS) for the downstream ranged from 53-80mg/L with a mean value of 65.96mg/L while that of the upstream ranged from 8.2-101mg/L with a mean value of 24.83mg/L. Total dissolve (TDS) in the downstream ranged from 890-16/5mg/L but that of the upstream ranged from 689-921mg/L. It was seen that this values exceeded the WHO standard of drinking water of 500mg/L. Biological oxygen demand (BOD) and Dissolved Oxygen(DO) for upstream ranged from 0.60-1.60mg/L with a mean value of 1.10mg/L while that of the downstream ranged from 2.80-4.80mg/L with a mean value of 3.50. Total and feacal coliform counts in the downstream were seen to be above the WHO standard of zero total coliform value ranged from 0.00-2.00/100ml for upstream, with a mean of 0.9231 and 0.7692 respectively. The downstream value for total coliform counts ranged from 2.00-9.00/100mL and mean of 5.692. Whereas that of the feacal coliform ranged from 1.00-4.99/100ml with a mean value of 2.769/100ml. this may be associated with high rate of cattle defeacation, offal wash, and littered blood, washed and emptied into the stream. Table 4 revealed the types of water borne diseases that affects the inhabitants of Nassarawa community. Waste generation, pollution and environmental degradation are posing serious threats to health in both the urban and rural areas of Nigeria. The data obtained from Abenyo health centre in Nassarawa community as shown in table 4 indicated that typhoid, hepatitis, cholera and Gastroenterics were the common water borne diseases recorded as a result of waste discharge from the abattoir to the nearby stream in which the inhabitants of this area depends on for their domestic activities and for drinking. Cholera was seen to be the most prevalent water borne disease followed by typhoid. For the (10) ten years record obtained, the total number of people that fell sick as result of chorea were (six hundred and sixty four (664) and the total number of death was one hundred and forty three (143) whereas people that fell sick from typhoid were three hundred and six while twelve (12) death were recorded.

Table 3. mean and standard deviation of water quality analysis from upstream and downstream of Idim Obot Okoho, Nassarawa

Parameters	Station	N	Mean	Std. deviation	Std. error mean
pH	Upstream	10	6.5254	.43121	.11960
	Downstream	10	5.9200	.24903	.06907
DO	Upstream	10	6.0846	.51128	.14180
	Downstream	10	2.9154	.50472	.13998
Temperature	Upstream	10	26.6615	.22927	.06359
	Downstream	10	26.5769	51178	.14194
Turbidity	Upstream	10	12.5462	4.18581	1.16094
	Downstream	10	98.6154	8.09875	2.24619
Specific conductivity	Upstream	10	1.4425E3	235.97444	65.44753
	Downstream	10	5.2942E3	270.22495	74.94692
TSS	Upstream	10	24.8308	33.94212	9.41385
	Downstream	10	65.9615	6.94389	1.92589
TDS	Upstream	10	7.5631E2	63.78922	17.69195
	Downstream	10	1.2842E2	227.30022	63.04174
Colour	Upstream	10	17.0000	2.00000	.5570
	Downstream	10	28.0769	7.28539	2.02060
BOD	Upstream	10	1.1077	.30403	.08432
	Downstream	10	3.5077	.54077	.14998
Total coliform	Upstream	10	.9231	.75955	.21066
	Downstream	10	5.6923	2.52932	.70151
Feacal Coliform	Upstream	10	.7692	.59914	.16617
	Downstream	10	2.7692	1.01274	0.28022

This record indicated that people fell sick as a result of the water utilized for drinking and domestic purposes which was contaminated from waste discharge from the abattoir into the surrounding stream. The student t-test was used for testing the hypothesis formulated which states that, there is no significant difference in water quality of Obot Okoho stream between the upstream and downstream sections of the abattoir waste discharge point in Nassarawa. The result revealed that the abattoir waste discharge has impacted negatively on the water body downstream at a significant level > 0.05.

Conclusion

In the production of animal for food, more attention should be focused on the interactions between animals and the environment, thereby utilizing environmental conditions and structures in which produce wholesome and safe animal food, and also reduce environmental pollution and the associated health risk. The result revealed that abattoir activities have negatively impacted on the environments and its inhabitants. Pathogens from waste water of the slaughtered animals have the potential for surviving in this environment, and thus affecting animals and human health, there is need for the establishment of waste water treatment facility capable of filtering blood from the waste water and rendering the pathogens inactive. The high coliform counts at the abattoir was associated with high rate of cattle defecation, offal wash, littered blood and the emptying of the paunch content on the bare ground. Finally abattoir should be excluded from facilities to be located within residential neighborhood but should be treated or classified as industrial or agricultural land use. The researchers therefore recommended that there is need for adequate treatment of waste water that emanates from abattoir to ensure decontamination before sending it to the environment. The government should ensure that technologically advanced waste disposal systems are provided for the inhabitants. Abattoirs should be more out of residential areas and established close to agricultural farms to serve as manures for plant growth. Ministry of health should arrange for a periodic sanitary hygienic evaluation of abattoirs and slaughter houses and ensure that they enforce the existing health and hygiene regulations. Finally the development of compost and biogas should be encouraged; this will ensure a sustainable agricultural system which is independent of external inputs.

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