pp(1-9)

EFFECT OF ABATTOIR WASTE ON WATER QUALITY IN KWATA SULEJA AREA OF NIGER STATE, NIGERIA

Gana, D. N. and Emigilati, A. M.

Department of Geography, Federal University of Technology, P.M.B 65, Minna, Niger State Nigeria

Email: davidgana8@gmail.com

Abstract: *The study assessed the influence of abattoir waste on water quality in Kwata Suleja area of Niger State. Data analyses were carried out using frequency- percentage technique, statistical mean, correlation analysis and were presented in figures and tables. The study revealed that microbiological elements have exceeded maximum level and the elements included Total Coliform and E. coli. Total Coliform ranges from 87cfu to 283cfu within the study area and the maximum allowable limit is 10cfu. E. coli found within the study area ranges from 13cfu in sample A^2 to 75cfu in sample downstream and the maximum allowable limit is 0cfu. The finding also shows incidence of waterborne diseases in the study area like cholera, diarrhea and typhoid are on the increase and this is attributed to poor drinking water quality. Year 2011 has the highest Diarrhea occurrence in the study area with 1,285 occurrence, 2014 has the highest cholera occurrence with 198 and 2008 has the highest Typhoid occurrence with 204 in the study area. The finding also shows that provision of more boreholes in the study area ranked the highest with 238 (79%) respondents, illumination on promising influences of pollution from abattoir wastes ranked second with 43 (14%) respondents and provision of pipe-borne water ranked the least with 21 (7%) respondents. The values obtained for both faecial and total coliform counts for all the sample stations exceed the various standard suggested by Nigerian Standard for Water Quality for various water uses. Thus, the Suleja surface water/ground water is highly polluted with faecial contaminants and as such unfit for domestic use.*

Keywords: *Abattoir waste, Coliform, E-Coli, Kwata, Water-borne disease*

1. INTRODUCTION

Production of livestock is considered a potential food for the world's needy people and livestock production activities, especially as the abattoir produce series of pollutants including slaughter wastes. If the wastes generated from slaughter are not managed properly particularly when liquidated through waterways, may host enteric pathogens as well as excess nutrients into surface water (Alonge, 2001; Meadows, 2005).

Human activities add contaminations in the form of chemical, agricultural, domestic as well as industrial wastes to water bodies (Barken, 2006). Wastes from meat processing operations have a tendency to be troublesome as a result of their high constituent of putrescible organic matter that may lead to the weakening of oxygen and cause water supply deficiency (Figueras, 2000). The meat processing wastes come from packing plants, stockyards as well as abattoirs, etc. all these contain protein, gut contents, fats, antibodies, heavy metals, hormones, blood as well as other substances (Itodo, 2011). In country like Nigeria, there so many abattoirs marshal of their waste which is directly through the rivers or streams as well as also use water from the same source to wash slaughtered meat (Adelegan, 2002).

Surface/ground water is the most available in the world, up till now the most contaminated as a result of anthropogenic, nevertheless happily, controllable activities (Adeyeye, 2010). Surface water is found mainly in the hinterlands. In most advance countries, especially the undeveloped areas where drinkable water supply is a near rarity, most of the dwellers rely solely on surface water in streams, brooks, rivers, ponds and lakes. Unfortunately, most of our rural dwellers do not appreciate the enormity of the risk attached to unhygienic water use.

Cooper *et al.* (2009) stated that effluents obtained from abattoir reaching rivers contribute major levels of phosphorous, biochemical oxygen demand along with nitrogen as well as other nutrients, bring about from stream toxic waste. Sangodoyin (2012) also stated that the ground water eminence in surrounding area of the abattoir were harmfully pretentious by discharge of abattoir seepage and water eminence of getting watercourse that was situated away from the abattoir.

1.1 Statement of the Problem

The aim of this study was to examine the extent to which abattoir wastes have affected the surface/ground water quality in Suleja area of Niger State. The objectives of the study are to:

- Assess the extent and quality of the presence of bacteriological characteristics of ground/surface water in the study area;
- Identify and examine the incidence of water-borne diseases in the study area;
- Investigate the relationship between the abattoir wastes and the prevalent water-borne diseases in the study area; and
- Identify the preventive/mitigation measures put in place against the influence of abattoir wastes on water quality.

1.2 Study Area

Suleja Area lies between latitude 9°6'13.8'' and 9°17'49.35'' north of the equator and longitude 7°6'58.6' and 7°12'18.41' east of Greenwich Meridians.

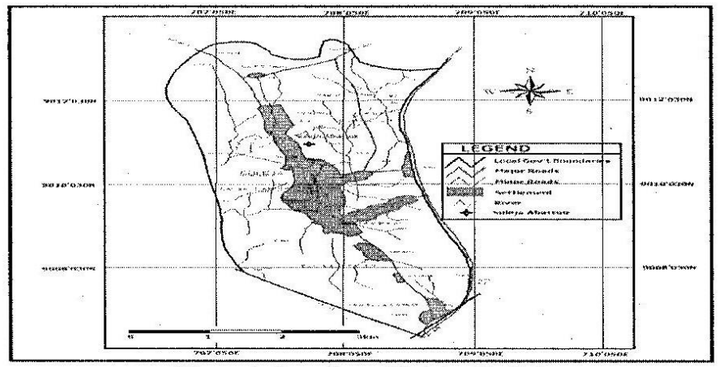

Figure 1: Location of Suleja Abattoir

It has an area of 136.33 sq km. The LGA is only 110km south-east of the State Capital Minna and bounded by the Federal Capital City of Abuja at the west in just about 65km away. Suleja lies on the physiographic unit known as central highland and is located on relatively high grounds of over 1200 feet or 366m above sea level. The official population figure for Suleja LGA in the last census 2006 is estimated at 216, 578 people (NPC, 2006).The area is characterized by a dry season from November to March/April, and a wet season from April/May to October. It has a relatively high annual rainfall of 1540mm (60.63inches) concentrated into three months of July/August and September, each above 300mm. the rainfall sometimes are very torrential and the effect on the environment is very disastrous. The run-off sometimes causes stream channel which eventually lead to gully.

2. Research Methodology

The sources of data used in this study include both primary and secondary and the detail of the sources of data are as follow: The primary sources of data employed in this study were obtained directly from the field and the data generated were used in the analysis section of the study. The primary data sources include: collection of water samples from a river/stream upstream and downstream location close to the abattoir, two wells and two boreholes all in downstream location in the study area, questionnaire administration, oral interviews and reconnaissance survey. Water samples from a river/stream upstream and downstream location close to the abattoir, two wells and two boreholes all in downstream location in the study area were used to achieved objective one of the study. The secondary data sources include information from relevant maps, dissertations, textbooks, newspapers, journals, unpublished texts, published texts, collection of e-books and the internet. Other secondary data include collection of data on the occurrence of water borne diseases especially typhoid, diarrhea and dysentery in the study area from the Department of Primary Health Care and Disease Control of the Niger State Ministry of Health and Primary health Care Services in the study area. Water samples collected from the field were analysed for physical, chemical and bacteriological characteristics according to the Nigeria Standard for Drinking Water Quality (NSDWQ, 2007) Standard Methods for the examination of water and waste water and this test was carried out at a standard laboratory in Niger State Water Board Minna, Nigeria. This help in achieving objective one of this study. Diseases occurrence data obtained were on annual basis for a period of 10 years (2005 to 2014) and this was converted into mean annual value using the mean statistical technique and this was used in achieving objective two of this study. Spearman's rank Correlation was used to test the relationship between the abattoir waste and prevalent of water-borne diseases in the study area which helped in achieving objective three of this study. Abattoir waste serve as X value and prevalent of water-borne diseases serve as Y value. All data and information gathered through the utilisation of questionnaire was analyze through frequency percentage of data analysis. The frequency-percentage procedure is highly instrumental and effective in analysis of data obtained from the questionnaire. This was used to achieve objective four of the study.

3. Results and Discussion

This section present results obtained from the water samples, questionnaire and water-borne diseases obtained from Suleja General Hospital and Suleja Abattoir. Descriptive and inferential

analysis was carried out on the information gotten from the water samples, questionnaire and water-borne diseases.

3.1 Analysis of Bacteriological Characteristics of Ground/Surface Water

The study revealed that microbiological elements have exceeded maximum level and the elements included total coliform and E. coli. Total coliform ranges from 87cfu to 283cfu within the study area and the maximum allowable limit is 10cfu. E. coli found within the study area ranges from 13cfu in sample A^2 to 75cfu in sample downstream and the maximum allowable limit is 0cfu. The health implication of these microbiological elements in this study include meningitis, bacteraemia, urinary tract infections, diarrhea, haemolytic anaemia as well as acute renal failure. The turbidity ranged between 6NTU and 461NTU and exceeded the allowable limits of NSDWQ Standard.

Table 1: Physio-chemical, Microbial and Chemical analysis Results

SN	PARAMETERS	A^1 (1m)	A^2 (4m)	B^1 (80m)	B^2 (493m)	U/STREAM (335m)	D/STREAM (398m)	D^1 (900m)
1.	Temperature (^{0}C)	25.2	25.3	25.5	25.3	25.3	25.1	25.1
2.	Colour (PtCo)	0	0	0	0	17	550	15
3.	Odour	UO	UO	UO	UO	Obj.	UO	UO
4.	pH	7.69	7.85	7.93	7.73	8.25	8.34	8.22
5.	Ferrous Iron (mg/L)	0.01	0.03	0.01	0.01	0.04	2.40	0.01
6.	Total Hardness (mg/L)	161.0	339.0	122.0	73.0	201.0	201.0	109.3
7.	Total Dissolved Solid (mg/L)	200	565	144	65	154	155	151
8.	Nitrate (mg/L)	115.8	158.2	57.9	23.8	50.3	329.4	50.2
9.	Turbidity (NTU)	0	0	0	0	6	461	6
10.	Manganese (mg/L)	0.20	0.80	0.20	0.0	0.3	4.0	0.2
11.	Electrical Conductivity (µS/cm)	405	113.7	288	132.2	309	311	225
12.	Phosphate (mg/L)	2.0	0.5	0.0	0.0	0.9	1.0	0.8
13.	Sulphate (mg/L)	10.0	8.0	7.0	0	7.0	26.8	5.2
14.	Chloride (mg/L)	73.5	176.4	41.9	47.9	85.3	87.9	81.1
15.	Total Alkalinity (mg/L)	38.0	36.0	51.0	35.0	56.0	340.0	43.9
16.	Residual Chlorine (mg/L)	0.01	0.03	0.00	0.02	0.13	88.0	0.11
17.	Fluoride (mg/L)	0.03	1.05	0.02	0.39	1.87	2.20	1.85
18.	Zinc (mg/L)	0.35	0.34	0.28	1.10	0.78	0.84	1.05
19.	Total Coliform (cfu/100ml)	120	123	148	283	87	248	130
20	E. Coli (cfu/100ml)	49	13	34	54	63	75	60

Obj.-Objectionable; **UO**-Unobjectionable; **m**-meter

Nitrate ranged between 23.8mg/l and 329.4mg/l at the study area. Nitrates can be dangerous to individuals when they go beyond tolerable levels for the reason that our entrails can break them

down into nitrites which affect the capability of red blood cells to transmit nitrogen. Nitrates levels exceeded innocuous limits at Suleja abattoir as well as other places where water samples were taken except the borehole water sample. There were high alkaline values in the study area and it ranges from 36 to 340 and this might be as a result of caustic soda used in shambles process specifically for the period of washing of animal skins. The turbidity ranged between 6NTU and 461NTU and exceeded the tolerable limits of NSDWQ Standard. At high turbidity levels, water loses its capability to provision diversity of aquatic organism due to obstruction of light. The high levels of Total Dissolved Solids may be associated with high level of turbidity in the water samples. The levels of phosphate are within acceptable limits and there may not be danger of enrichment leading to eutrophication.

3.2 Incidence of Water-borne Diseases

Patronage of hospitals and other health care facilities in Suleja is on the increase. The rapidly increasing populace attached with the weakening environs are some of the influences accountable for this tendency. Hospital records have established high occurrence of cholera, diarrhea, typhoid, guinea worm as well as dysentery in the study area and some of these diseases are shown in Table 4.2. Out of many costs of municipal ecological dreadful conditions, destruction to human well-being is by far the uppermost. It has a direct link among wastes obtained from abattoir as well as public health in terms of water related diseases such as typhoid, cholera as well as diarrhea in the study region.

Table 2: Incidence of Waterborne Diseases in the Study Area

Year	Cholera	Diarrhea	Typhoid
2005	4	465	46
2006	2	523	55
2007	1	483	53
2008	5	546	155
2009	8	467	63
2010	11	97	55
2011	3	1,285	92
2012	1	533	45
2013	26	655	204
2014	198	572	103
Total	259	5626	871

Source: General Hospital Suleja, 2015

Incidence of waterborne diseases in the study area shows cholera, diarrhea and typhoid are on the increase and this is attributed to poor drinking water quality that has a E.Coli of 75cfu which is greater than the accepted level.

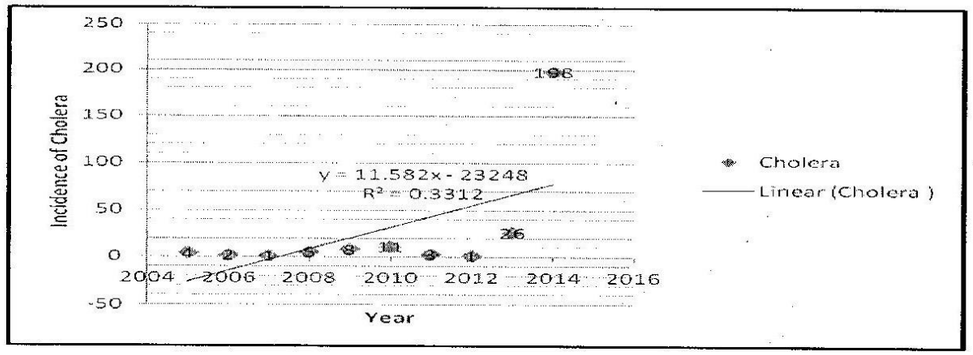

Figure 2: Incidence of Cholera Occurrence within the Study Area

Year 2011 has the highest Diarrhea occurrence in the study area with 1,285 occurrence, 2014 has the highest Cholera occurrence with 198 and 2008 has the highest Typhoid occurrence with 204 in the study area.

Incidence of cholera occurrence in the study area shows sharp increase with the highest incidence recorded in 2014 with 198 occurrence. The lowest was in the year 2012.

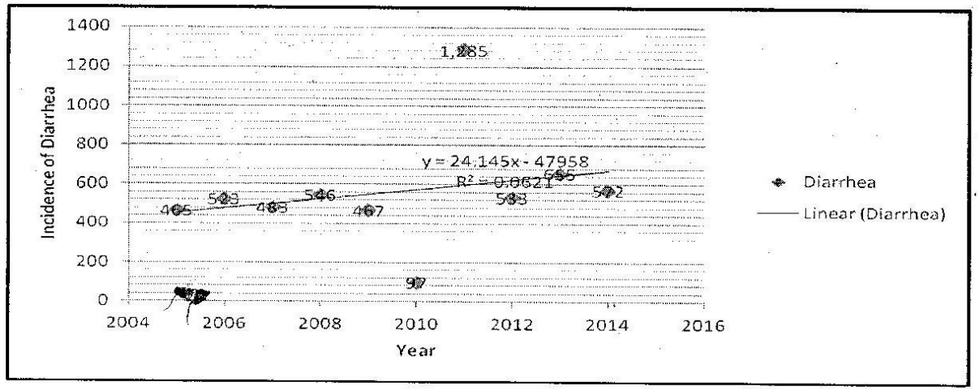

Figure 3: Incidence of Diarrhea Occurrence within the Study Area

Incidence of Diarrhea occurrence in the study area shows that diarrhea occurrence is on the increase and year 2011 ranked the highest with 1,285 diarrhea cases. Year 2010 has the least diarrhea occurrence in the study area. Human health are undergoing continuous degradation by increasing amount of abattoir wastes being produced in Suleja Abattoir. Incidence of typhoid occurrence in the study area shows that typhoid occurrence is on the increase and year 2013 ranked the highest with 204 typhoid cases. Year 2005 has the least typhoid occurrence in the study area.

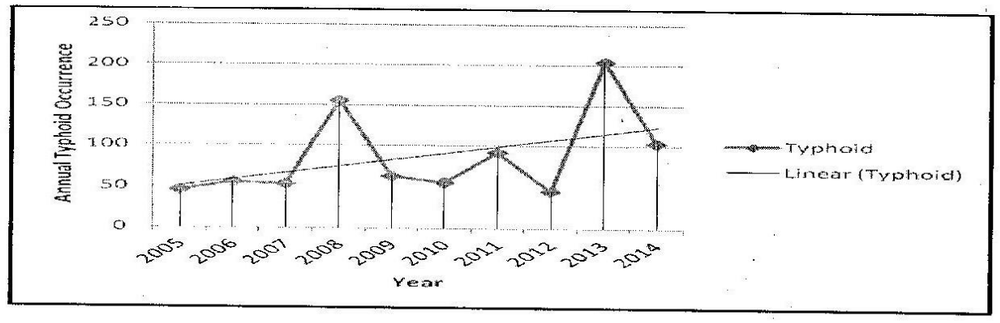

Figure 4: Incidence of Typhoid Occurrence within the Study Area

3.3 Relationship between Abattoir Wastes and the Prevalent Water-borne Diseases

Suleja abattoir operations are meant to convalesce the edible parts of slaughtered livestock for human consumption. In the process, significant amounts of waste substances including inorganic as well as organic solids are produced. The waste obtained from solid comprises mostly of undigested ingest, bones as well as irregularly terminated fetuses, however the liquids contain of urine, blood, water, gut contents as well as dissolved solids.

Table 3: Correlation between occurrence of water-borne diseases and livestock wastes generated per year

Correlations

			Occurrence of Water-borne diseases	Average livestock carcass/wastes per year (tonnes)
Spearman's rho	Occurrence of Water-borne diseases	Correlation Coefficient	1.000	.070
		Sig. (2-tailed)	.	.
		N	2	2
	Average livestock carcass/wastes per year (tonnes)	Correlation Coefficient	.070**	1.000
		Sig. (2-tailed)	.	.
		N	2	2

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3 reveals that there is high positive correlation between the occurrence of water-borne diseases and abattoir wastes generated in the study area and the correlation value was 0.70. This shows that the higher the number of livestock slaughtered in the study area, the higher the abattoir wastes generated and this will lead to more water-borne diseases in the area. Other factors also contribute to water-borne diseases in the study area and they include indiscriminate disposal of solid waste, unhygienic environment and inadequate.

3.4 Mitigation Measure put in Place against the Influence of Abattoir Wastes on Water Quality in the Area

Mitigation measures put in place include provision of more boreholes in the study area, provision of pipe-borne water in the area and public awareness and enlightenment on possible impacts of pollution from abattoir wastes as shown in Figure 5.

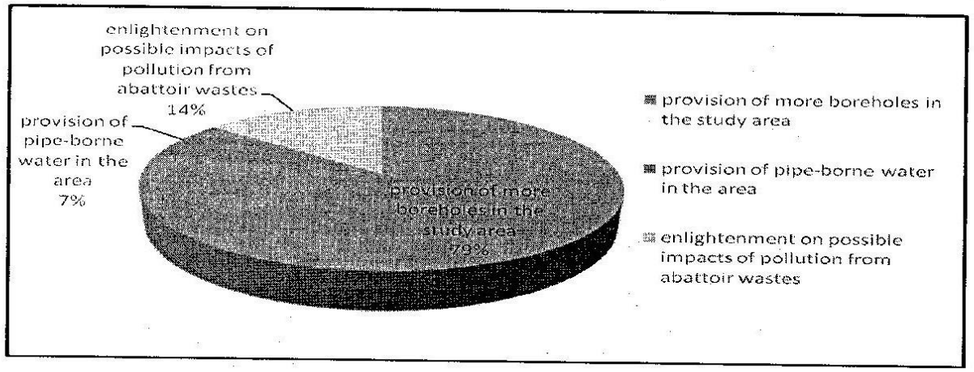

Figure 5: Mitigation measures put in place against the influence of abattoir wastes

As indicated in Figure 5, provision of more boreholes in the study area ranked the highest with 238 (79%) respondents, enlightenment on possible impacts of pollution from abattoir wastes ranked second with 43 (14%) respondents and provision of pipe-borne water ranked the least with 21 (7%) respondents. This shows more practical measures need to be put in place to reduce the influence of abattoir wastes on both surface and ground water.

4. Conclusion

From the results, it is observed that majority of waste generated from the slaughtered animals and there wastes are not pickled before their exoneration into the Suleja apparent water which certainly get into the ground water. This could affect the distribution and diversity of the aquatic biota inhabiting the stream and the larger surface water bodies that the stream feed are also at a disadvantage. It could also encourage the spread of water-borne diseases. The values obtained for both faecial and total coliform counts for all the sample stations exceed the various standard suggested by Nigerian Standard for Water Quality for various water uses, thus, the Suleja surface water/ground water is highly polluted with faecial contaminants and as such unfit for domestic use. Studies of this nature are important in enabling us understand the impact of abattoir waste especially in tropical waters where little is known. It's therefore recommended that regular monitoring exercises should be carried out by NISEPA and representatives of the municipal government on the activities of abattoirs in order to ensure those effluents standards and other good sanitary conditions are maintained.

REFERENCES

Adelegan, J.A. (2004). Environmental Policy and Slaughterhouse Waste in Nigeria". *Proceedings of the 28th WEDC Conference*. Calcutta, India. 3-6.

Adeyeyé, E.I. (2010). Determination of Major Elements in Fish, Associated Water and soil sediments from some freshwater ponds, Ghana. *Journal of Chemical Publishing Company,* 5(2): 322-327.

Akinro, A.O., Ologunagba, I.B. & Olotu, Y. (2009). Environmental Implications of Unhygienic Operation of a city abattoir in Akure, Western Nigeria. *ARPN Journal of Engineering and Applied Sciences*, 4(9): 311-315.

Alonge, D. O. (2001): Textbook of Meat Hygiene in the Tropics Farmcoe Press, Ibadan. 58pp.

Barken, J.C. (2006). *Lagoon Design* and *Management for Livestock.* Waste Treatment and Storage; water quality and management for North Carolina cooperative Extension, North Carolina, U.S.A.

Cooper, R.N., Hoodle, J.R. & Russel, J.M. (2009). Characteristics and Treatment of Slaughter House Effluent in New Zealand. *Prog. Water Technology*, 11: 55-68.

Figueras, J. J. (2000). Monitoring Bathing waters; a practical Guide to the Design and Implementation of Assessment and Monitoring program for WHO. 13 – 17.

Itodo, I.N. (2011). Effects of Total Solids concentration of Poultry, Cattle, and Piggery waste. *American society of Agricultural Engineers Journal,* 3 (2): 56-68

Meadows, R. (2005). Livestock Legacy. *Environmental Health Perspectives,* 103(12):1096-1100.

Sangodoyin, A.Y. (2012). Environmental Study on Surface and Ground Water Pollutants from Abattoir Effluents. *Bioresource Technology*, 41(2): 193-200.

World Health Organization (WHO). 2007. Report on infectious diseases, overcoming antimicrobial resistance. http://www.who.int/infectious-disease-report. (Verified December, 2014).