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Effect of Abattoir Activities on the Ground Waters around Bodija and Akinyele Abattoirs in Oyo State

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Abstract**—** *This study was carried out to examine the effect of abattoir activities on ground waters around Bodija and Akinyele abattoirs in Oyo state. The work was premised on the fact that untreated wastes from the abattoir are discharged directly into open drainage which flows into a nearby stream. Sixty structural questionnaires were administered and retrievedin the study areas with thirty used in each of the two abattoirs. The survey shows that 100% of the abattoir operators in both abattoirs disposed wastes manually using spade, 90% sweep and wash the wastes into open drainages as 90% do treat their wastes before disposal at the dumping site. Physical, chemical and microbiological analysis of water samples from the well around the two abattoirs revealed no significant different in the two abattoirs. Turbidity, Total dissolved solid (TDS), and total suspended solid (TSS) were significantly higher in Akinyele abattoir than Bodija abattoir. Total coliform count (TCC) was 6.3x105 in the well around Bodija abattoir and was not significantly lower than that around Akinyele abattoir which was 7.6x105. Although Total aerobic count (2.1x106) was higher in the wells around Bodija than those around Akinyele (1.7x106) the result clearly shows that both total aerobic count and total coliform count are beyond the maximum permissible limits from bodies in charge of Health and Environment. Biochemical oxygen demand (BOD) in Bodija (5.06) was also significantly higher than that of Akinyele (2.95). This result shows that more pollutants are present in the wells around Bodija abattoir. The high microbial load and its health implications confirm the need to enforce treatment of abattoir wastes before dumping into the environment and provision of portable water for the abattoir operators and the dwellers around the abattoirs.*

Keywords**— Abattoir; Wastes; Water quality, Pollution.**

I. INTRODUCTION

The importance of water to human and other biological systems cannot be over emphasized as water shortage or its pollution can cause severe decrease in productivity and deaths of living species. [1] observed that water quality degradation interferes with vital and legitimate water quality uses at any scale. Pollution of water resources reduces the availability of clean and safe drinking water to most of the world's population. [2] reported that in developing countries an estimated 80% of all diseases and over one third of deaths are caused by consuming contaminated water.

Waste generated by abattoirs include liquids and solid waste, made up of paunch content, bones,horns, and faecal components, slurry of suspended solids, fat, blood and soluble materials [3]. These wastes tend to be worrisome due to the high content of putresible organic matter, which can lead to the depletion of oxygen and an impairment or disruption of water eco-functionality and a preponderance of disease-causing organisms.

[3] Identified improper management and supervision of abattoir activities as a major source of risk to public health in South Western Nigeria as abattoir wastes contain several pathogenic species. There is no special waste disposal system or treatment. Dung is piled up and waste water containing blood and dung are discharged into a nearby stream without treatment. These result into pollution of surface and underground water especially of the abattoir and residents in the abattoir vicinity.

While the slaughtering of animals results in significant meat supplies, a good source of protein and production of useful by-products such as leather, skin and bones, the processing activities involved sometimes result in environmental pollution and other health hazards that may threaten animal and human health. In most developing countries, location and operation of abattoirs are generally unregulated they are usually located near water bodies where access to water for processing is guaranteed.

There is also the major challenge of handling animal by-products, waste products and effluents from processing activities at the abattoir. The problem of unhygienic nature and practices in abattoirs in Nigeria could also to a large extent affect the surrounding ecosystem. It has been implicated with pollution of the soil, surface and ground

water [4] and [5]. In many developing nations like Nigeria, many abattoirs dispose off their waste directly into streams or rivers and also use water from the same source to wash [6].

The need to avoid ground water pollution and the associated human health risks in meat slaughtering operations is of paramount importance in our society makes this study of great importance. This study examined the socio-economic characteristics of abattoir operators in Bodija and Akinyele slaughtering houses, identified the various waste management practices in the selected abattoirs, chemical and microbiological properties of utility waters around the slaughtering houses, identified the pollutants present in the utility water around the study areas.

II. RESEARCH METHODOLOGY

The study was carried out in Ibadan, the capital city of Oyo State, Nigeria. It is located on geographic grid reference longitude 3° 5E, latitude 7° 20N with a population of over 3 million people [7] and having Federal, State and Local Government participation in meat processing hygiene and inspection. Two major abattoirs within Ibadan were purposively selected for this study, which were Bodija and Akinyele Abattoirs.

The primary data for the study was obtained using a well-structured questionnaire which was designed for the abattoir users to obtain information on ownership, year of establishment, available facilities in the abattoir, average number of animals killed per day, operation and activities, waste disposal methods employed, and other abattoir management issues.

Study population of this study consists of the abattoir operators in the study areas while thirty questionnaires were administered in each of the abattoirs to abattoir operators so as to assess their ethical behaviours. The investigator collected the questionnaires on the spot to ensure that all questionnaires were properly filled and collected emblock.

The second study was conducted where well water samples located within 0-250m radius along each of the two abattoir premises were collected and analysed for physical and chemical properties which included Temperature, Turbidity, pH, Dissolved oxygen (D.O), Total suspended solid (T.S.S), and Biochemical Oxygen Demand (B.O.D), also the levels of the following metals in the water samples was determined: copper, iron, zinc and lead. In addition to this, total microbial count and identification was done.

A total of six well water samples were used at Bodija abattoir while three well samples were used at Akinyele slaughter slab. In Akinyele, there were only three wells within the range of study. Well water samples were collected in 500ml PVC plastic containers previously cleaned by washing in non-ionic detergent, rinsed with tap water and later soaked in 10% HNO_3 for 24 hours and finally rinsed with deionized water prior to usage. For Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD]- testing, samples were collected in 150 ml bottles. During sampling, sample bottles were rinsed with sampled water three times and then filled to the brim. To ensure that changes in sample properties did not occur while in transit to the laboratory, the bottles were placed in a cooler box, and appropriate preservation methods were applied.

The samples were labelled and transported to the laboratory. Samples were collected two times a week (Wednesdays and Fridays) for a period of three weeks. Parameters like temperature and P^H were done on the spot of sample collection. Temperature was measured with the aid of mercury in bulb thermometer while the P^H was measured with a P^H meter. Physico-chemical parameters such as biochemical oxygen demand (BOD), dissolved oxygen (DO), total suspended solids (TSS), were used to determine the water quality and pollution effects from abattoir wastes. All chemical tests were done based on standard methods- [8]. Data collected through the survey were analysed using descriptive analysis.

III. RESULTS AND DISCUSSION

Table.1: Demographic status of abattoir operators

Location Variable	Bodija n=30 Frequency/ %	Akinyele n=30 Frequency/ %	Total n=60 Frequency/ %
Age (yrs)			
20-40	25(83.30)	20(66.70)	45(75.00)
41-60	4(13.30)	10(33.30)	14(23.33)
Above 60	1(3.30)	0.00(0.00)	1(1.67)
Gender			
Male	29(96.70)	29(96.70)	58(96.67)
Female	1(3.30)	1(3.30)	2(3.33)
Marital status			
Single	1(3.30)	0.00(0.00)	1(1.67)

Married	29(96.70)	30(100.00)	59(98.33)
Religion			
Christian	12(40.00)	0.00(0.00)	12(20.00)
Islam	18(60.00)	30(100.00)	48(80.00)
Household size			
1-5	14(46.70)	12(40.00)	26(43.33)
6-10	13(43.30)	14(46.70)	27(45.00)
11-15	3(10.00)	4(13.30)	7(11.67)
Educational level			
No formal education	3(10.00)	13(43.30)	16(26.67)
Primary education	13(43.30)	17(56.60)	30(50.00)
Secondary education	12(40.00)	0.00(0.00)	12(20.00)
Adult education	2(6.70)	0.00(0.00)	2(3.33)

Percentage in parenthesis.

Table 1 above revealed that 75% of the operators were between the ages of 20-40 years. This result clearly contradicted the general (non-documented) belief that abattoir operators and meat sellers are majorly elderly people. Also 96.62% were males while the remaining 3.33% were females. This was close to the report of [9] who reported 100% abattoir workers to be male. This result shows that this job is dominated by males, this might not be unconnected with the nature of the job and the general belief that the trade is for men. Result also shows that 50% of the respondents with all of them 40% from Bodija abattoir.

Table.2: Number of cattle slaughtered per day

Number of animals	Bodija n=30	Akinyele n=30	Total n=60
60-120	2(6.70)	30(100.00)	32(56.67)
121-180	2(6.70)	0.00(0.00)	2(2.30)
181-240	10(33.30)	0.00(0.00)	10(16.67)
Above 240	16(53.30)	0.00(0.00)	16(27.78)
Total	30(100.00)	30(100.00)	60(100.00)

Percentage in parenthesis.

Result from table 2 above shows that 6.7% of the respondents submitted that an average of 61-120 cattle are slaughtered per day in Bodija market while 6.7% also agreed that the number of cows slaughtered per day is between 121-180 about 33.3% affirmed that 181-240 were usually slaughtered however 53.3% agreed that more than 240 cattle are slaughtered in Bodija market per day. This result is in line with the findings of [10] that reported about 350 cattle per day from their personal observation. However, in Akinyele cattle market, all the respondents (100%) agree that a range 61- 120 cattle are slaughtered per day at the market. This shows that more cattle are slaughtered at Bodija than Akinyele. This result may be subjective as most of the traders usually have fear of disclosing the true picture of their performance for the fear of taxation. This enormous number of cattle being slaughtered daily implies that much waste and waste water are being released into the neighbouring environment and may be hazardous to the environment.

Table.3: Available facilities in the two abattoirs

Location	Bodija n=30		Akinyele n=30		Total n=60	
Variables	Frequency/(%)		Frequency/(%)		Frequency/(%)	
	Yes	No	Yes	No	Yes	No
Water closet	22(73.30)	8(26.70)	8(26.70)	22(73.30)	30(50.00)	30(50.00)
Incinerators	4(13.30)	26(86.70)	5(16.7)	25(83.30)	9(15.00)	51(85.00)
Refuse disposal bay	20(66.10)	10(33.30)	4(13.30)	26(86.70)	24(40.00)	36(60.00)
Lairage	25(83.30)	5(16.7)	25(83.30)	5(16.7)	50(83.30)	10(16.70)
Proper drainage	13(43.30)	17(56.70)	7(23.30)	23(76.7)	20(33.30)	40(66.70)
Sick bay	5(16.7)	25(83.30)	19(63.30)	11(36.70)	24(40.00)	36(60.00)
Slaughter unit	29(96.70)	1(3.30)	29(96.70)	1(3.30)	58(96.70)	3(3.30)
Dressing unit	15(50.00)	15(50.00)	17(56.70)	13(43.30)	32(53.30)	28(46.70)

Percentage in parenthesis

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Table 3 above showed that higher proportion (60%, 85%, 66.7% and 60%) of the respondents submitted that there is no refuse disposal bay, incinerator, proper drainage and sick bay respectively in their abattoirs. This explored the different facilities available in the two abattoirs and ascertained that there has not been any improvement on the findings of [11] who reported that the state of some abattoirs in Nigeria is such that encourages unsanitary practices as they are usually without modern waste disposal facilities. This condition will present the abattoir operation as a threat to the society despite the service they render.

The table however revealed that 50% of the total respondents with 73.3% from Bodija affirmed the availability of water closet toilet in the abattoir for their use but from Akinyele, 73.3% disagreed with this. This shows that not all abattoirs have toilet facilities and from personal observation, they only have pit latrines in Akinyele and it is located close to the abattoir. 66 .1% of the respondents from Bodija abattoir confirmed that they have a refuse disposal unit, and 86.7% from Akinyele disagreed. This also shows that while Bodija has this facility, Akinyele abattoir did not. Incinerator is not available in both abattoirs with 86.7% and 83.3% of the respondents from the two abattoirs not agreeing with this respectively. Lairage is present in both markets as 83.3% of the respondents from each of the abattoirs affirmed it.

The table also shows that what is available in most of our abattoirs cannot be referred to as proper drainage system as 66.7% of the total respondents support this fact. Also, majority of the respondents in Bodija abattoir (83.3%) agreed that they do not have a sick bay for their animals while 63.3% from Akinyele said they have it thus giving an average of 40% affirming it and 60% answered in the negative. The implication of this is that majority of the abattoir do not have this facility. Ante mortem inspection unit which is very important for the inspection of animal due for slaughtering is not available in most of our abattoirs as 60% confirmed this while 40% disagreed. This result is in line with previous studies [11] and [12].

Table.4: Type of waste generated in the abattoir

Waste	Bodija n=30		Akinyele n=30		Total n=60	
	Yes	No	Yes	No	Yes	No
Fat	25(83.30)	5(16.70)	13(43.30)	17(56.70)	38(63.30)	22(36.70)
Blood	23(76.70)	7(23.30)	21(70.00)	9(30.00)	44(73.30)	16(26.70)
Bone	23(76.70)	7(23.30)	23(76.70)	7(23.30)	46(76.70)	14(23.30)
Hoof and horns	28(93.30)	2(6.70)	24(80.00)	6(20.00)	52(86.70)	8(13.30)
Faecal material	25(83.30)	5(16.70)	19(63.30)	11(36.70)	44(73.30)	16(26.70)
Rumen and gut content	25(83.30)	5(16.70)	24(80.00)	6(20.00)	49(81.70)	11(18.30)
Foetus	22(73.30)	8(26.70)	21(70.00)	9(30.00)	43(71.70)	17(28.30)
Wastewater	29(96.70)	1(3.30)	23(76.70)	7(23.30)	45(75.00)	15(25.00)
Slurry liquids	28(93.30)	2(6.70)	24(80.00)	6(20.00)	52(86.70)	14(23.30)

Percentage in parenthesis.

The result in table 4 above shows wastes generated in the abattoirs with the answer 'yes' having the majority. High percentage (> 70%) of the respondents agreed that fat (63.3%), blood (73.3%), bone (76.7%), hoof and horn (86.7%), faecal material (73.3%), rumen contents (81.7%), foetus (71.7%), wastewater (75%) and slurry liquid (86.6%) are parts of the wastes produced in the study areas. This result is in agreement with the findings of [13] and [3] who identified all the products mentioned above as waste generated in various abattoirs across the country. It is important to know that where any of these waste products are poorly managed they constitute great threat to ground water in the immediate environment.

Table.5: Method of abattoir waste removal

Method of waste removal	Bodija n=30 Frequency (%)		Akinyele n=30 Frequency (%)		Total n=60 Frequency (%)	
	Yes	No	Yes	No	Yes	No
Manual scraping with spade	30(100)	0(0.00)	30(100)	0(0.00)	60(100)	0(0.00)
Sweeping and washing into open drainage	26(86.0)	4(13.3)	28(93.3)	2(6.7)	54(90)	6(10.0)
Mechanical scraping	2(6.7)	28(93.3)	1(3.3)	29(96.7)	3(5.0)	57(95.0)
Hydraulic flushing	2(6.7)	28(93.3)	2(6.7)	28(93.3)	4(6.67)	56(93.33)

Percentage in parenthesis.

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Table 5 shows that all respondents (100%) agreed that they usually employ manual form of waste removal by scraping with spade, and that they (90%) usually sweep and wash the waste into open drainage (table 5). This is in line with the findings of [6] who reported that animal blood is released untreated into the flowing stream while the consumable parts of the slaughtered animals are washed directly into the flowing water in many developing nations. Result further shows that majority of the respondents (95%) agreed that they do not use mechanical scraping and 93.3% confirmed not using hydraulic flushing. This result thus shows that our abattoir operators are yet to adopt modern method of removing abattoir waste.

Table.6: Method of treating abattoir waste

Waste treatment methods	Bodija n=30 Frequency (%)	Akinyele n=30 Frequency (%)	Total n=60 Frequency (%)
No treatment	28(93.7)	26(86.6)	54(90.0)
Chemical treatment	0(0.0)	4(13.3)	4(6.6)
Burning	1(3.3)	0(0.0)	1(1.7)
Chemical treatment and burning	1(3.3)	0(0.0)	1(1.7)

Percentage in parenthesis.

Since majority of the respondents (90%) agreed that they do not treat their wastes (table 6), it implies that most abattoirs in this country do not treat their waste in anyway before disposing it off. This result is in agreement with the findings of [14] who reported that there is no special waste disposal system or treatment in our abattoirs. Dung is piled up and waste water containing blood and dung are discharged into a nearby stream without treatment. This results into pollution of surface and underground water especially of the abattoir and residential area around the abattoir vicinity. Bones and hooves collected in the abattoir are burnt at the abattoir site causing smoke and air pollution in the environment.

Table.7: Disposal of wastes

Disposal methods	Bodija n=30 Frequency (%)	Akinyele n=30 Frequency (%)	Total n=60 Frequency (%)
Disposal in the nearby river	7(23.3)	23(76.7)	30(50.0)
Burning	3(10.0)	3(10.0)	6(10.0)
Disposal at the dump site	20(66.7)	4(13.3)	24(40.0)
Total	30(100.0)	30(100.0)	60(100.0)

Percentage in parenthesis.

Table 7 shows that majority of the respondents from Bodija (66%) usually dispose abattoir waste at the dumpsite while at Akinyele abattoir, majority of the respondents (76.7%) usually dump the waste into nearby river. The implication of this result is that disposal in the nearby river and disposal in the dumpsite are the two major ways of disposing abattoir waste in Ibadan. This probably account for pollution of air, land and water in abattoir vicinity as reported by [14] that there is no special waste disposal system or treatment. Dung is piled up and waste water containing blood and dung are discharged into a nearby stream without treatment. This results into pollution of surface and underground water especially of the abattoir and residents in the abattoir vicinity. This result is also in line with those of [15], [6] and [4]. These methods of waste disposal are dangerous for the quality of both ground and surface water in the abattoir environment.

Table.8: Perception of both Bodija and Akinyele respondents on waste disposal methods

Items	SA	A	U	D	SD
My waste disposal method constitutes a threat to the environment	13(21.7)	34(56.7)	5(8.5)	7(11.7)	1(1.7)
My waste disposal method is a source of pollution to a nearby well water	7(11.7)	5(8.5)	10(16.7)	29(48.3)	9(15)
My waste disposal method is a source of pollution to play grounds in the neighbourhood	10(16.7)	5(8.5)	14(23.3)	28(46.7)	3(5.0)
My waste disposal method constitutes a barrier to	8(13.3)	7(11.7)	8(13.3)	30(50.0)	7(11.7)

the free flow of water in nearby stream					
My waste disposal method can lead to outbreak of disease in the neighbourhood	15(25)	10(16.7)	6(10)	18(30)	11(18.4)

Percentage in parenthesis

KEY: SA- Strongly agree A-Agree U-Undecided
D- Disagree SD-Strongly disagree

Table 8 shows that 56.7% of total respondents agreed that their waste disposal methods constitute a threat to the environment while 50% of the total respondents disagreed that the way of disposing waste in their abattoirs can constitute a barrier to free flow of water. In addition, 50% of the respondents disagreed that their unhealthy way of disposing abattoir waste can lead to outbreak of disease in the neighbourhood. This is in agreement with the discovery of [16] who studied environmental impact of abattoirs on water bodies in Kigali city. When this result is closely examined, it can be seen that majority of the respondents that disagreed are from Akinyele abattoirs since they earlier agreed that their waste disposal method might constitute a threat to the environment; their latter disagreement might not be unconnected with the fact that most of them are not as educated as their counterparts from Bodija, as such may not fully appreciate the consequence of improper waste disposal habits on the immediate environment.

Table.9: Constraint to waste utilisation

Constraint	Bodija n=30 Frequency (%)		Akinyele n=30 Frequency (%)		Total n=60 Frequency (%)	
	Yes	No	Yes	No	Yes	No
Lack of utilization skill	18(60)	12(40)	26(86.7)	4(13.3)	44(73.3)	16(26.7)
Irritation and labour scarcity	20(66.7)	10(33.3)	26(86.7)	4(13.3)	46(76.6)	14(23.3)
Lack of vehicle and transportation cost	18(60)	12(40)	22(73.3)	8(26.7)	40(66.7)	20(33.3)
Difficulty to burn during rainy season	18(60)	12(40)	17(56.7)	13(43.3)	35(58.3)	25(41.7)
High cost of pit and chemical	25(83.3)	5(16.7)	9(30)	21(70)	34(56.6)	26(43.3)

Percentage in parenthesis

Table 9 shows that 73.3% of the total respondents identified lack of knowledge and skill required as a constraint to waste utilization but 76.6% said irritation and labour scarcity are part of the constraint responsible for their inability to utilize waste. Lack of vehicle to transport the waste and transportation cost was identified by 66.7%, while 58.3% identified difficulty to burn the waste during rainy season as major constraints. Meanwhile, 56.6% identified high cost of pit and chemicals as constraints. The implication of this result is that inability to utilize waste is the reason abattoir waste is poorly managed in this part of the world.

Table.10: Effects of abattoir operations on the physical, chemical and microbiological properties of well water samples in Bodija and Akinyele abattoirs.

Values and constituents	Bodija abattoir	Akinyele abattoir	**Maximum permissible limits
P^H range	6.78 ± 0.01^a	6.54 ± 0.01^b	6.5 - 8.5
Temp (^{0}C)	27.5 ± 0.81	27.8 ± 0.81	40
TDS (mg/l)	571.14 ± 6.01^a	417.28 ± 6.01^b	500
TSS(mg/l)	0.86 ± 0.01^a	0.41 ± 0.01^b	NG
Turbidity(mg/l)	4.45 ± 0.07^a	4.95 ± 0.07^a	5
D O (mg/l)	5.31 ± 0.01^a	4.80 ± 0.01^a	5
BOD (mg/l)	5.06 ± 0.16^a	2.95 ± 0.16^b	NG
Cu (ppm)	0.00 ± 0^a	0.00 ± 0^a	1
Fe (ppm)	0.00 ± 0.01^a	0.05 ± 0.01^a	0.3

Pb (ppm)	0.00 ± 0^a	0.00 ± 0^a	0.01
Zn (ppm)	0.03 ± 0.03^a	0.16 ± 0.03^a	3
Total aerobic count(cfu/ml)	$2.1 \times 10^6 \pm 0.05^a$	$1.7\times 10^6 \pm 0.05^a$	< 0.01
Total coliform count(cfu/ml)	$6.3 \times 10^5 \pm 0.18^a$	$7.6 \times 10^5 \pm 0.18^a$	0

Note: All values are mean± standard error of mean

Mean with the same superscript on the same row are not significantly different.

* * FEPA, (1991)., [21], [19] NG = No guideline.

Table 10 shows that the temperature of the samples collected ranges between 27.5^0C and 27.8^0C with the pH values of between 6.54 and 6.78 both of which fall within the FEPA acceptable limit. These values compare well with the past results of [17] and [10], which were 7.0 - 8.3, and 6.92-8.18, respectively. This implies that the pollution level of this study is relatively lower compared with their study locations. Total dissolved solids from Bodija market is higher 571.14 than the standard value which is 500 ± 6.10 (NIS value) and is higher than the permissible limit (500), while that of Akinyele is lower / below the permissible limit (417.28). Turbidity of well water samples in the two location was below the maximum permissible level of 5, with Bodija having 4.45± 0.07 and Akinyele having 4.95± 0.07, but generally from this result, the well samples from Akinyele can be said to be more turbid than that of Bodija, therefore, processing water samples from Akinyele can be more expensive than those from Bodija abattoir because turbidity has been linked with process control in treating water, and high turbidity according to [18] can indicate problems with treatment process especially, coagulation, sedimentation and filtration. Table 10 further shows that the dissolved oxygen (D.O) contents which determines the amount oxygen available for aquatic life was 5.31 in Bodija and 4.8 at Akinyele. Total suspended solids (TSS) were 0.86 and 0.41 at Bodija and Akinyele respectively and they were significantly different from each other while biochemical oxygen demand (BOD) in Bodija (5.06) was also significantly higher than that of Akinyele (2.95). This result shows that more pollutants are present in the wells around Bodija abattoir.

The result above shows that when the values from both abattoirs are compared with that of [19] the level of the following heavy metals – copper (Cu), zinc (Zn), iron (Fe) and lead (Pb) in the wells around the two abattoirs is well below the maximum permissible limit. The result is in line with the work of [17] where they reported that all the aforementioned metals fall within the normal range recommended by [20], [21].

The result clearly shows that both total aerobic count and total coliform count are beyond the maximum permissible limits from bodies in charge of Health and Environment. The well water samples were found to be heavily polluted with microorganisms. The presence of bacteria and coliform should pose a great concern because the presence of coliform indicate recent feacal contamination and the well water samples in question are not only used to wash meat, they act as drinking water to residents especially Akinyele residents. The World Health Organisation [20] recommends zero values for total coliform count.

Table.11: Effect of abattoir operation on a particular day of the week on the utility water of the residents

Values and constituents	Wednesdays	Fridays
P^H range	6.48 ± 0.02^a	6.52 ± 0.02^a
Temp(^{0}C)	27.52 ± 0.8^a	27.70 ± 0.8^a
TDS (mg/l)	613.44 ± 12.34^a	527.89 ± 12.34^a
TSS(mg/l)	0.67 ± 0.02^a	0.61 ± 0.02^a
Turbidity(mg/l)	5.01 ± 0.10^a	4.57 ± 0.10^a
DO(mg/l)	6.30 ± 0.14^a	4.25 ± 0.14^b
BOD(mg/l)	7.05 ± 0.25^a	2.30 ± 0.25^b
Cu(ppm)	0.00 ± 0^a	0.00 ± 0^a
Fe(ppm)	0.031 ± 0.01^a	0.016 ± 0.01^a
Zn(ppm)	0.86 ± 0.02^a	0.83 ± 0.02^a
Pb(ppm)	0.00 ± 0^a	0.00 ± 0^a
Total aerobic count(cfu/ml)	2.8×10^{6a}	1.4×10^{6b}
Total coliform count(cfu/ml)	1.1×10^{6a}	3.7×10^{4b}

Mean with the same superscript on the same row are not significantly different.

The days that were purposely considered were Wednesdays (being a midweek) and Fridays (a time of weekend activities is expected to pick up).

Note: All values are mean± standard error of mean

The result from table 12 shows that the values of turbidity, P^H, temperature, TSS and TDS on Wednesdays were not significantly different from the values obtained on Fridays while the values of dissolved oxygen (DO) and biochemical oxygen demand (BOD) were significantly different from each other on both days. The implication of this result is that the dissolved oxygen content and biochemical oxygen demand (BOD) which both have to do with the quality of the water have higher values on Wednesday as compared with Friday. Since BOD indicates the amount of putrescible organic matter present in water, it implies that the level of pollution on Wednesdays is higher than that of Fridays. This might make the cost of treating such water to be higher. Also, it may also mean and implies that less oxygen is available for aquatic life in the water on Wednesdays as compared with Fridays for the number of wells sampled. This is in line with the report of [16] who reported Lower DO usually after the effluent is discharged into the water.

IV. CONCLUSION AND RECOMMENDATIONS

Though the water quality was generally still above recommended standards, it is however under threat if the present habit of discharging untreated abattoir wastes continues. Residents living in abattoir vicinity may in no distant time begin to experience severe consequences of pollutants from abattoir activities located in their neighborhood. In view of the findings of this work, and in addition to the fact that the abattoir is located in the heart of the town, and also, in view of the fact that the discharge of untreated abattoir wastes may continue unabated and to ensure that health of the dwellers around the abattoir is guaranteed the following recommendations are hereby made:

(i) The management body of the abattoir should see to enforcement of adequate environmental protection in the surroundings of the abattoir through effective management of abattoir wastes.

(ii) Immediate steps should be taken to put in place machinery that will enable treatment of the abattoir wastes before they are disposed.

(iii) Public awareness and enlightenment on possible effect of pollution from abattoir wastes should be made on regular basis by relevant agencies.

(iv) Portable water should be regularly provided for the abattoir operators and the dwellers around the abattoirs.

(v) Efforts should be made to commence activities towards the relocation of the abattoir to an area away from residential areas.

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