Research Article GU J Sci 36(4): 1404-1412 (2023) DOI: 10.35378/gujs.964138

Gazi University

Journal of Science

http://dergipark.gov.tr/gujs

Locational Characteristics and Impact of Attenda Abattoir, Ogbomoso, Nigeria

Samson OLANREWAJU[1, *], Fadilat GARBA[2], Yetunde BABAYEMI[3]

[1]*Department of Urban and Regional Planning, Osun State University, Osogbo, Nigeria*
[2]*Department of Geography and Environmental Management, Nassarawa State University, Keffi, Nigeria*
[3]*Department of Pure and Applied Chemistry, Osun State University, Osogbo, Nigeria*

Highlights

- This paper assesses the locational characteristics and impact of Attenda Abattoir.
- It was discovered that the abattoir has affected the environmental quality of the host neighbourhood.
- Relocation of the abattoir and urban renewal of the host neighbourhood were proffered.

Article Info

Received: 15 July 2021
Accepted: 28 Sep 2022

Keywords

Locational characteristics
Landuse
Environmental impact
Pollution

Abstract

The study examined the locational characteristics and impact of attenda abattoir, Ogbomoso town, Oyo State, Nigeria. To achieve this, a ring of a 100-meter radius was delineated around the abattoir, and a landuse inventory was done. Thereafter, observation and measurement were done daily in the abattoir for a month, excluding Sundays. To assess the impact of the abattoir, water samples were obtained from Point of Discharge (POD) of wastewater to the stream, 30 meters, 60 meters and 90 meters on the course of the stream. Also, samples were obtained from a well each, found within 30 meters, 60 meters, and 90 meters from the abattoir. The water samples were, among others, tested for pH Conductivity and Lead. Obtained data were subjected to descriptive statistics such as frequency count and percentage. Tables were also used to summarise data. The closest landuse to the abattoir is a 40 km stream with a setback of 2.6 meters. This setback is used as a waste dump. In the abattoir, an average of 19 cows are killed daily. For this operation, an average of 1153.7 litres of wastewater is generated and discharged into the nearby stream. Hence the pH value of the stream is 5.20, 5.35, 5.41 and 5.40 respectively at POD, 30 meters, 60 meters and 90 meters. Also, the concentration of Lead (Fe^{2+}) in water samples is higher than Federal Environmental Protection Agency (FEPA) limits of 0.01mg/l. The study, among others, recommends relocation of abattoir and urban renewal of abattoir area.

1. INTRODUCTION

An abattoir is a premise for inspection, slaughtering, processing, and, either or both, preservation and storage of meat products for human consumption. This facility must be registered and approved by relevant government agencies to have satisfied hygienic standards [1]. Slaughtering of animals in abattoirs aids continuous meat supply and easy access to by-products like leather and skin. However, the location of these abattoirs, their planning and management, tend to influence the neighbourhood characteristics of their host. Such influences, among others, include environmental quality, socioeconomic characteristics, landuse changes and dynamics.

Abattoir operations produce a characteristic highly organic waste which includes condemned meat, bones, horns, hairs and aborted foetuses. These are, at first, compiled in these abattoirs and further managed on-site, or transported to waste management sites for further treatment. Liquid waste generated at the abattoir is usually composed of dissolved solids, blood, gut contents, urine and water. Poor management of these wastes can be associated with environmental challenges such as pollution of all variants [2]. For instance, animal dung, when poorly managed, produces nitrous oxide which is the most damaging of the greenhouse gases being 320 times more effective than carbon dioxide in the atmosphere [3]. This has grave implications for the health and environmental livability of the areas around abattoirs. It is even worrisome, in Nigeria and other rapidly urbanising countries of the global south, as abattoirs that used to be located at the

*Corresponding author, email: Samson.olanrewaju@uniosun.edu.ng

periphery of towns and cities, due to increasing urbanisation, have shifted to central places either within market hubs or residential areas. Hence, residents have long term exposure to the pollution associated with various operations in abattoirs.

The condition described above is not exclusive to the only abattoir in Ogbomoso town. Its strategic location coupled with the rising demand for meat supply associated with the increasing population of the town has resulted in more activities, waste, and environmental impact of the abattoir. It is therefore necessary to assess the locational characteristics and impact of the abattoir. This is to proffer recommendations that will aid the sustainable development of the study area, and other landuses with similar characteristics.

2. LITERATURE REVIEW

Issues on the location of abattoirs and their waste management, especially in developing countries, have attracted research interest. This may be associated with the evident poor management of the abattoirs, and the absence of laws guiding its establishment and waste management in developing countries. In their study of developing countries, [4] as far back as 1979 reported that the slaughtering of animals in Nigeria abattoirs, is carried out in unsuitable buildings, and by untrained slaughter men, and butchers that are unaware of sanitary principles. Waste management, especially at the disposal stage, is a major challenge in abattoir management [2, 5]. Rapid urbanisation has further worsened the impact of these abattoirs, as residents, due to urbanisation, now live close to these facilities, thereby having a direct impact on the pollution emanating from them. Also, an increase in abattoir operations associated with an increase in meat demand and population growth in the area directly influence the number of pollutants emanating from the abattoir. These, therefore, reduce the environmental quality of the abattoirs and their immediate environment. The health of a city can be linked to the health of its dwellers, while the health of its dweller is influenced by the quality of the environment. Medical experts were reported by [6] to have associated some diseases with abattoir activities which include pneumonia, diarrhoea, typhoid fever, asthma, wool sorter diseases, and respiratory and chest diseases.

Abattoir waste produces odours which interfere with the quality of life and can be a source of severe localized air pollution. Some of the odorous compounds like Sulphides, Mercaptans, Amines, Organic acids, etc. are tenacious. They cling to clothing and other articles and can persist for long periods. Such can be carried to far distance from the abattoir. The groundwater quality in the vicinity of abattoirs in Nigeria has been reported to be adversely affected by the seepage of the abattoir's affluent [5]. Also, since traditionally, abattoirs are usually located in proximity to a stream, the water quality of the streams is usually affected, thus having long-range health impacts on consumers. The high concentration level of heavy metals in stream water in the Gwagwalada area of Abuja, Nigeria was traced to abattoir operations in the area [7].

Abattoir wastes contain materials that have oxygen demand; therefore, runoff from abattoir waste piles can affect the quality of nearby streams. Low levels of dissolved oxygen and ammonia toxicity in such streams could result in the death of fish. Also, eutrophication (excessive vegetative growth) in stream channels, which occurs because of the nutrients (nitrogen and phosphorus) in abattoir effluent, can reduce the size of receiving stream channels, which may cause over-flooding and its associated damages. In addition to reducing streams' physical and chemical quality, pathogens from abattoir effluent can be transmitted to humans via water-based recreations. It is, therefore, necessary that an evaluation of abattoirs and their neighbourhood be made for the determination of their operational impact and their intensity. This will inform urban planning recommendations for the achievement of sustainable development in these areas.

3. STUDY AREA AND METHODS

Ogbomoso town lies on latitude $8^{0}10^{1}$ North of the equator and longitude $4^{0}10^{1}$ East of the Greenwich Meridian, within the derived Savannah region of Nigeria. The town is bordered by Oyo town (the secondary town in Oyo State) to its Southwest, Ilorin (the state capital of Kwara State) to the North, while Iwo and Ede (both secondary cities in Osun State) lie to its southern and eastern side respectively. The Strategic location of Ogbomoso and its trading relationship with its adjoining towns positively influenced its economic strength, thus its population increase, urbanization and associated high demand for meat. Also,

Attenda abattoir (Figure 1) is the only major abattoir in the Ogbomoso region – comprising five Local Government Areas i.e; Ogbomoso North, Ogbomoso South, Surulere, Orire and Local Government Areas.

To meet its meat and related products demand, operations in the abattoir are intensive. The abattoir, originally sited at the present day Ilorin Motor Park, was because of its environmental impact and the need for sustained water, was moved to its current location in the year 1981. A location which was, as of then, isolated and directly beside the Ori- Oke seasonal stream. The abattoir is now at the centre of the Ori-Oke – Oke Aanu urban enclave of the town and is bordered to the south by residential developments, in the north by an office complex, and in the west and east by schools and shops respectively. The abattoir is about 200meters from the main road (Ibadan-Ilorin road). The quantum of activities in the abattoir and its location necessitates that its impact be evaluated.

This research is expository, and its data were sourced from both primary and secondary sources. The secondary data utilised for the study include information on landuse, and environmental impact which were obtained from relevant literature such as journals, and textbooks. Also, Google Earth was used in the delineation of the area around the abattoir. To assess the landuse characteristics of the area around the abattoir, a 100-meter radius was delineated around the facility, and a landuse inventory of the delineated area was done. Although no document states the setback of abbatoir to adjoining development in the state, the delineation of a 100-meters radius is informed by the researcher's intention to examine the impact of the abbatoir within an electric pole distance – which is considered as the closest to the closest possible radius. Thereafter, observation and measurement were made for a month, excluding Sundays when operations were not carried out in the abattoir. Observations made include daily numbers of cows killed, the volume of wastewater utilised in the slaughter slab, and characteristics of the semisolid waste disposed of daily.

To assess the characteristics of the waste, 5kg of daily disposed semisolid waste in the abattoir were collected, sorted and each constituent was weighed. To assess the impact of the abattoir, water samples were obtained from Point of Discharge (POD) of wastewater to the stream, 30 meters, 60 meters and 90 meters on the course of the stream. Also, samples were obtained from each well found within 30 meters, 60 meters, and 90 meters from the abattoir. Collection of samples at intervals to determine the distance decay, if any, of the abattoir. The obtained water samples were tested for pH, Conductivity, Lead, Dissolved Oxygen, Cadmium, and bacterial content - Salmonella sp. and E. coli, using the procedure of [7]. Obtained data were subjected to descriptive statistics such as frequency count and percentage. Tables were also used to summarise data.

Figure 1. *Locational Map of Attenda Abattoir, Ogbomoso, Oyo State*

4. DISCUSSION OF RESULTS

This section discusses the findings that were made during the research. It captures the locational and landuse characteristics, the waste characteristics, and the impacts of the abattoir.

4.1. Landuse and Locational Characteristics of the Abattoir

The abattoir is located along Oke aanu – Apake road, which is adjacent to the Ilorin- Ibadan Expressway. The nature of traffic along these corridors, and their strategic characteristics within the town, influence the dominancy of the abattoir, and its landuse characteristics. As summarised in Table 1, Attenda abbatoir is adjoined to the right and rear sides by residential and educational land uses respectively. This further confirms that the abattoir is located in a prime location which promotes a high daily influx into the area. Activities in the abattoir cum its adjoining landuses generate high traffic volume on its serving transport corridor. This is worsened as the abattoir, like other adjoining landuses in the area, does not have a parking space. As a result, on-street parking takes place on the corridor, thereby causing traffic congestion and accidents. More concerning, in this case, is the vulnerability of LGEA Basic School, which is adjacent to the abattoir.

The closest land cover to the abattoir is the about 40 kilometres long stream that adjoins it to the left (Table 1). There is a setback of 12.6 meters between the abattoir slab and the stream. This setback, despite being small, is used as a dumpsite for the collection of various wastes from both slaughtering slabs and other activities within the abattoir. Hence, seepages of liquid and semi-solid wastes from this dumpsite flow into the adjoining stream. Also of note and worrisome is that buildings in proximity to the abattoir have a setback that is lesser than a minimum of 3 meters (Table 1). This may influence the severity of the impact of the abattoir on these landuses - as there are traces of seepages of liquid waste on the walls of wells in nearby houses to the abattoir.

A ring of 100 meters radius (with area=πr^2) covering an area of 31420 meters was delineated around the abattoir. In this delineated area, the abattoir itself covers 2%, while the predominant landuse - residential development covers about 85% (Table 2). This informs that the abattoir is located within a residential neighbourhood. Residents of this neighbourhood utilise water for various domestic purposes. Unfortunately, water from wells in various houses, especially those in proximity to the abattoir, is polluted by the underground seepages from the waste dump in the abattoir. Hence residents resort to purchasing portable water from vendors. This condition, air pollution from burning activities, and noise associated with various activities in the abattoir negatively affect the environmental quality and liveability of the neighbourhood.

Other major landuses in the area are educational (4.6%) and commercial (6.0%). The educational landuses in this area are LGEA Basic School, Ori- Oke Grammar School, and Office of the Zonal Inspector of Education. Commercial activities in the area, except for a few hotels, are predominantly informal. The informal commercial activities include restaurants, grocery shops and other petty trading centres. Although the commercial landuses in the area appear to be complementary to abattoir operations, their characteristics such as unhygienic handling and its inordinate location along road corridors further burden the neighbourhood. Also, there is an evident conflict between adjoining landuses and abattoir operation, such that the liveability of the entire urban fabric is threatened – this calls for urban planning intervention.

Table 1. *Locational Characteristics of Attenda Abbatoir*

Landuse	Landuse Type	Distance
Closest Landuse/Landcover	Stream	1.3 meters
Landuse to the Right	Residential	2.1 meters
Landuse to the Left	Stream	1.3 meters

Landuse to the Front	Educational	6.8 meters
Landuse to the Rear	Residential	2.4 meters

Table 2. *Landuse characteristics of Delineated Area around Attenda Abbatoir*

Landuse	Landuse Type (%)	Area covered (m^2)
Residential	85	26707
Commercial	6	1885.2
Institutional	2.4	785.5
Recreational	0	0
Industrial	0	0
Educational	4.6	1445.32
Agricultural	0	0
Abattoir	2	628.4

4.2. Waste Characteristics and Impacts of Attenda Abattoir

This section discusses the waste characteristics and impacts of attenda abattoir, Ogbomoso, Nigeria. To appraise waste characteristics, an inquiry was first made into the operational capacity of the abattoir. To achieve this, a surrogate, Average Number of Cows (ANC) was used. The ANC for each day of the week is calculated as the total number of cows killed for each day in a month divided by the total days of observation in that month – in this case, 4 times.

An average of 19 cows are killed in the abattoir daily. This operation, aside from immediate butchering, attracts other complementary economic and social activities. These include retailing of meats and fish, processing and sales of hides and skins, and several petty trading. Generally, because of its strategic role in meat production in Ogbomoso and its adjoining towns, operations in the abattoir is high. There is however a difference in the quantum of daily operations in the abattoir. For instance, relatively high ANC values were recorded on Mondays (ANC = 22.75) and Saturdays (ANC = 19). This informs that there are more operations and trades in the abattoir on these days compared to other days of the week. Possible reasons for this include high weekend demand, for meats, for events and stock up, and increase market demand on Mondays by restaurants, food sellers and other consumers – since there is no operation in the abattoir on Sundays. A high quantum of operations in the abattoir attracts an influx of traffic into the abattoir, its neighbourhood and along the adjoining Ori-Oke – Oke-Anu road. Worrisome is that students of the adjoining schools may be victims of accidents, especially on days of high traffic.

An average of 1153.75 litres of wastewater is generated at the abattoir's slaughter slab daily. This is usually either discharged directly into the adjoining stream or drained through the earth channel to a canal within 100 meters of the abattoir. while leftovers are allowed to spill into surrounding open space (Table 3). Meanwhile, there is a relatively higher discharge of wastewater on Monday (1312.5 litres), compared to other days. This may not be disconnected from the high ANC observed on this day. For 5kg of semisolid waste in the abattoir, there is an average of 43.3% of bones and horns, 29.83% of dung, 27.66% of skin and hides, and 11.2% of other things. Waste categorised as others are non-abattoir related wastes such as nylons, cans e.t.c. These wastes, as earlier described, are poorly managed.

Table 3. *Waste characteristics of Attenda Abbatoir*

Day	The average number of cows killed daily	Average daily waste water (Litres)	Semi-Solid Waste									
			Bones and Horns		Dung		Skin and Hides		Others		Total	
			(kg)	%	(Kg)	%	(Kg)	%	(kg)	%	Total	%

Monday	22.75	1312.5	2.125	42.5	1.85	37	1.275	25.5	0.425	8.5	5.0	100
Tuesday	17.25	1137.5	2.675	53.5	1.2	24	1.125	22.5	0.275	5.5	5.0	100
Wednesday	15.5	1250	1.75	35	1.55	31	1.7	34	0.85	17	5.0	100
Thursday	12.25	1115	2.125	42.5	1.6	32	1.275	25.5	0.425	8.5	5.0	100
Friday	14.75	910	2.1	42	1.25	25	1.65	33	0.8	16	5.0	100
Saturday	19	1197.5	2.225	44.5	1.5	30	1.275	25.5	0.6	12	5.0	100
Average	19	***1153.75***	***2.16***	***43.33***	***1.49***	***29.83***	***1.383***	***27.66***	***0.562***	***11.2***		

4.3. Impacts of Wastes from Attenda Abattoir

As summarised in Table 4, the pH value of wastewater at POD is 5.20, which indicates that wastewater from the slaughter slab is slightly acidic. Meanwhile, the increasing pH values of 5.35, 5.41, and 5.40 respectively for water samples obtained from 30 meters, 60 meters, and 90 meters away from the point of discharge, informs of another possible source of pollution or activities along the course of the stream. While the cause of these differences is not further investigated, it may not be disconnected from the neutralisation effect of the stream. The acidic nature of the stream indicates that the aquatic ecosystem is threatened by the discharge of wastewater from abattoir operations. Most streams have a neutral to slightly basic pH of 6.5 to 8.5, however, stream water with a pH value of less than 5.5 may be too acidic for fish to survive in, while one with a pH value that is greater than 8.6 may be too basic [8]. Similarly, water samples obtained from wells, at different distances from the abattoir, are slightly acidic. For instance, the pH value of water samples obtained from wells at 30m from the abattoir is 6.45, while the value of those obtained from wells at 60m and 90m is 6.00 – hence not potable. Drinking water must have a pH value of 6.5-8.5 to fall within Environmental Protection Agency (EPA) standards [8].

Conductivity, a measure of the flow of electrical current through a solution, is expressed in units of microSiemens (*u*S). Its concentration level in water is influenced by the presence of ions. The water sample obtained from POD has the conductivity of 675.0 (µs/cm), this declined to 670(µs/cm) at 30 meters, and further to 650(µs/cm) and 630(µs/cm) respectively at 60 meters and 90 meters (Table 4). High conductivity of the water samples and their distance decay informs that the adjoining stream is polluted by waste discharges from the abattoir. On the contrary, water samples obtained from wells in proximity to the abattoir have low conductivity. For instance, the water sample obtained from a well at 30 meters from the abattoir had a conductivity value of 235.52(µs/cm), while that of 60 meters and 90 meters are 233.40(µs/cm) and 230.00(µs/cm) respectively (Table 4). Generally, the observed conductivity of water samples suggests that abattoir operations pollute both surface and underground water in the area – although this is within the limit of 1000(µs/cm) [9].

When compared with the Federal Environmental Protection Agency (FEPA) limit, there is a comparatively high concentration of heavy metals (i.e Fe^{2+}, Cd^{2+}, and Pb^{2+}) in water samples obtained from different points on the stream, and wells around the abattoir. For instance, at POD, the concentration of Lead is 0.70mg/l, this further declined to 0.63mg/l at 30 meters, and to 0.62mg/l and 0.45mg/l at 60 meters and 90 meters respectively. Similarly, a water sample from a well at 30 meters has a Lead concentration of 0.05 mg/l, while those obtained from 60 meters and 90 meters respectively have a concentration of 0.04 mg/l and 0.02 mg/l. The observed concentration levels of lead in water samples are higher than the FEPA limit of 0.01mg/l.A high concentration of this heavy metal may be associated with the seepage and dilution of abattoir effluent from the dump site into the stream, and underground water. Exposure to Lead beyond the FEPA limit, over a short period, may cause abdominal pain, constipation, memory loss, and fever;

while long term exposure, especially at high levels, may cause anaemia, weakness, kidney and brain damage, and death [8,9].

Similarly, there is a high concentration of Iron (Fe^{2+}) in the adjoining stream to the abattoir in the area. For instance, at POD the concentration level of Iron is 0.53 mg/l, while at 30 meters, 60 meters, and 90 meters on the stream, the concentration levels of Fe^{2+} in the water samples are 0.41mg/l, 0.32mg/l, and 0.31mg/l respectively. Apart from the relatively high concentration of Iron in the water samples, there is a distance decay in the concentration of Fe^{2+} in the stream. This may be traced to the various dilution that takes place along the course of the stream. Water samples obtained from wells around the abattoir also have a relatively high concentration of Fe^{2+}. For instance, the Fe^{2+} concentration of water samples obtained from wells at 30 meters, 60 meters, and 90 meters are 0.05mg/l, 0.04mg/l, and 0.02mg/l respectively. These are also higher than the Fe^{2+} limits of 0.3 mg/l as stated by [10 -13].

The health implication of these includes poisoning of residents from the overtime usage of the water. Intake of Iron poisoned water can lead to hemochromatosis, liver problem, and diabetes. Plants that are drained with the stream may develop Cirrhosis, or be poisoned, which when consumed may affect the health of its consumers. Unfortunately, these effects are accumulative, and such may take time before it is symptomatic in affected residents.

An inquiry into the bacteriological property of the water samples reveals the presence of salmonella sp. in the samples obtained from both stream and wells around the abattoir. Salmonella sp. causes salmonellosis, a common bacterial disease that affects the intestinal tract. The bacterium is an etiological agent of more severe systemic diseases such as typhoid and paratyphoid fevers [14,15]. The intake of water from infected wells, and exposure to water from the stream renders residents vulnerable to one or more of the diseases. Similarly, the presence of *E. Coli* is observed in water samples obtained from both the stream and wells around the abattoir. Although most strains of ***E. coli*** are not harmful but are part of the healthful bacterial flora in the human gut. However, some types can cause illness in humans, including diarrhoea, abdominal pain, fever, and sometimes vomiting. Some other types of ***E. coli*** infection can lead to urinary tract infections, respiratory illness, pneumonia, and other illnesses like meningitis [16].

Table 4. *Waste Characteristics of Attenda Abbatoir*

Parameters (mg/l)	POCD	S = 30 meters	S =60 meters	S = 90 meters	W within 30 meters	W within 60 meters	W within 90 meters	FEPA LIMITS
Ph	5.20	5.35	5.41	5.40	6.45	6.00	6.00	6-9
Conductivity(µs/cm)	675.0	670.0	650.0	630.0	235.52	233.40	230.00	1000
Iron (Fe^{2+}) (mg/l)	0.53	0.41	0.32	0.31	0.31	0.31	0.32	0.3
Cadmium (Cd^{2+})(mg/l)	0.18	0.13	0.09	0.004	0.001	0.000	0.000	0.003
Lead (Pb^{2+})(mg/l)	0.70	0.63	0.62	0.45	0.05	0.04	0.02	0.01
Salmonella Sp	Present	Present	Present	Present	Present	Present	Present	
E-coli	Present	Present	Present	Present	Present	Present	Absent	

As used in the Table, S= Stream; W = Well; POCD= Point of Closest Discharge

5. CONCLUSION AND RECOMMENDATIONS

The study has been able to inquire into the locational appropriateness and environmental impact of attenda abbatoir in Ogbomoso. It has also been able to expose the environmental impact of poor planning of the landuse. To address these, the following recommendations are proffered.

The abattoir should be relocated to the exterior part of the town. The new location should be accessible, and well connected to various parts of the town. Also, the new location should afford space for setbacks. The proposed location for the new abattoir is Abata village (Figure 2) along Ogbomoso- Osogbo road. The

choice of the proposed location is informed by its accessibility and the abbatoir can inform infrastructural development and promotion of related commercial activities in the suburb region of the metropolis.

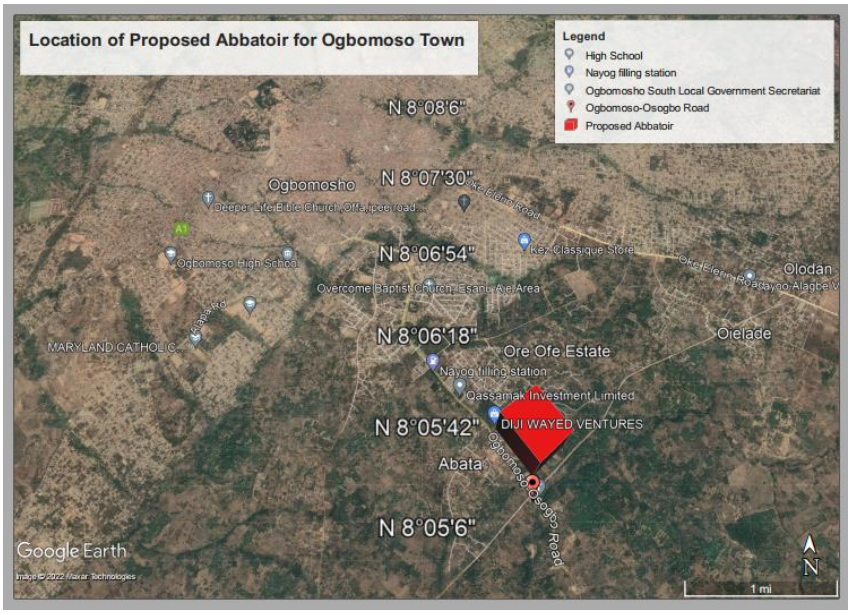

Figure 2*. Locational Map of Proposed Attenda Abattoir, Ogbomoso, Oyo State*

The new abattoir should have provision for necessary equipment and functional units such as cold rooms, skinning machines, slaughtering machines, wastewater receivers, and changing rooms. Waste collection and processing plant should also be made available and linked to the abattoir, this will aid the processing of wastes into fertilisers and other useful products on site.

After relocating the abattoir, urban renewal should be carried out at its current location and adjoining areas. This includes total clearing of all wastes from the abattoir's dump and treatment of its adjoining stream. Nearby wells, especially those within 90 meters to the abattoir, should be treated for heavy metals, and bacteria. Residents in proximity to the abattoir, as well as butchers, should be encouraged to visit the hospital for check-ups.

In conclusion, the place of landuse planning in the overall achievement of environmental management cannot be underestimated. Hence landuses as the element of urban fabric must be complementarily knitted to achieve sustainability.

CONFLICTS OF INTEREST

No conflict of interest was declared by the authors.

REFERENCES

[1] Alonge, D. O., Textbook of Meat Hygiene in the Tropics, Ibadan, (1991).

[2] Lewis, R. J., Hawleys Condensed Chemical Dictionary, 12th Edition, New York, (1993).

[3] Chukwu, O., "Analysis of Groundwater Pollution from Abattoir Waste in Minna, Nigeria", Research Journal of Dairy Sciences, 2(4): 74-77, (2008).

[4] Edwards, E., Hector, O.A., Norman, G.A., Silverside, D., "Slaughter Facilities for Tropical Conditions: A Guide to the Selection and Costing of Appropriate Systems", London, (1979).

[5] Sangodoyin, A.Y., Agbawhe, O.M., "Environmental Study on Surface and Ground Water Pollutants from Abattoir Effluents", Bioresource Technology, 1(41): 193-200, (1992).

[6] Oyedemi, D.T.A., "The Impact of Abattoir Location and Management on Surrounding Residents in Ibadan, Nigeria", Masters of Technology Thesis, Ladoke Akintola University of Technology, Ogbomoso, 12-25, (2000).

[7] Magaj, J.Y., and Chup, C.D., 'The Effects of Abattoir Waste on Water Quality in Gwagwalada, Abuja Nigeria", Ethiopian Journal of Environmental Management, 5(4): 51–63, (2012).

[8] https://www.thedailystar.net/health/what-should-be-the-ph-value-drinking-water-138382. Access Date: 13.04.2020

[9] https://www.webmd.com/food-recipes/food-poisoning/what-is-e-coli#1. Access Date: 13.04.2020

[10] Sridhar, M.K.C., Government/Private Sector Partnership. Effective Tool for Solid Waste Evacuation and Management, Prost Publishing, Nigeria, (1988).

[11] Ezeoha, S. L., "Pollution and Biogas Production Potentials of Abattoir Wastes", Masters of Engineering Project Report, University of Nigeria, Nsukka, 10-35, (2000).

[12] Raymond, C. L., Pollution Control for Agriculture, Academic Press Inc., New York, (1977).

[13] Tove, S., "Slaughter House Cleaning and Sanitation", Animal Product and Health Paper No 53, Food and Agricultural Organization, 15-45, (1985).

[14] Caterina, L., Lucia, B., Rossella, B., Elisabeth, G., Simon, T., and Valter, T., "*Salmonella* in Surface and Drinking Water: Occurrence and Water-mediated Transmission", Food Research International 45(2): 123-130, (2012).

[15] http/www.Irishstatutebook/1988/en/act/pub/0008/index. Access Date: 12.05.2021

[16] https://www.medicalnewstoday.com/articles/68511. Access Date: 13.04.2020