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Full Length Research Paper

Operational impacts of the Tamale abattoir on the environment

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The study was conducted to assess the water and noise quality of the Tamale abattoir to evaluate their effects on the environment. The abattoir is located in Tamale, the regional capital of the Northern Region of Ghana. Data on noise quality was taken using the Integrated Noise Level Meter at five different locations. The results of maximum and minimum noise levels generated at the abattoir were 95.4 and 60.4 dB(A), respectively, which exceeded EPA's (Environmental Protection Agency) standard of 70 and 60 dB(A), respectively. Generally the influent met the recommended standard for treated water quality except for faecal and total coliform counts of 36 and 84 CFU, respectively, instead of 0 CFU recommended by EPA. The effluent was highly polluted and did not meet the set standards for effluent discharges into the environment. The extremely high levels of BOD (3300 mg/L) and low dissolved oxygen (0 mg/L) were strong indications of high organic pollution in the effluent. Effluent faecal coliforms level of 450,000/100 ml and total coliforms of 550,000/100 ml were recorded. Residents of the community where the abattoir is located complained about bad odour, pollution of their water source (dam) from the effluents and the outbreak of maggots, flies and diseases such as malaria, typhoid, dysentery and diarrhea.

Key words: Abattoir, water quality, coliforms, biochemical oxygen demand (BOD), noise quality, environment.

INTRODUCTION

Human activities which lead to pollution of the environment and a disruption of ecosystem functionality contribute impurities in the form of industrial, domestic, agricultural and chemical wastes to the environment. In many parts of the world, human activities impact negatively on the environment and biodiversity. Some of the consequences of man-made pollution include transmission of diseases by water borne pathogens, eutrophication of natural water bodies, accumulation of toxic or recalcitrant chemicals in the soil, destabilization of ecological balance and negative effects on human health (McLaughlin and Mineau, 1995; Sinha, 1997; Bridges et al., 2000; Boadi and Kuitunen, 2003; Amisu et al., 2003).

Meat processing facilities produce solid, liquid and gaseous wastes. Solid and liquid 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. The meat processing wastes come from stockyards, abattoirs and packing plants, etc; all these contain blood, fats, protein, gut contents, heavy metals, antibodies, hormones and other substances (Itodo and Awulu, 1991).

In many developing nations, e.g. Nigeria, many abattoirs dispose of their waste directly into streams or rivers and also use water from the same source to wash slau-ghtered meat (Adelegan, 2002). The situation is not any different in Ghana where most liquid and gaseous wastes are released in to the immediate environs of the abattoir. In some instances, the solid wastes are deposited with other urban wastes some distance from the abattoir; the Kumasi Abattoir for instance dumps its solid wastes into the Subin River about a kilometer upstream of Asago, a small peri-urban community (Weobong, 2001).

Abattoir wastes contain several pathogenic species of

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bacteria which affect animal and human health (Figueras, 2000; Cadmus et al., 1999; Coker et al., 2001).

Efforts have been geared towards curbing the menace of pollution around the world, particularly by the United Nation's organs e.g., United Nations Environmental Programme. There are many international conferences and protocols to this effect; Rio de Janeiro Conference of 1992 was a major effort, collating previous environmental issues and bringing them to the fore.

Environmental Impact Assessments (EIA) are used as planning tools to give the environment its due place in the decision making process by clearly evaluating the environmental consequences of a proposed activity before action is taken. The construction and operation of development projects such as the Tamale Abattoir must comply with certain legislative requirements, including compliance with laid down environmental impact assessment procedures. It is a requirement in Ghana under the Environmental Protection Act 490 and the Environmental Assessment Regulation LI 1652, that development projects of this nature should be subjected to an EIA, whose objective is to identify potential impacts that the project will have on the environment and to propose adequate and appropriate measures to mitigate the negative impacts and enhance the beneficial ones. The enforcement of these regulations however is ineffective. Many companies/ establishments consequently operate in situations which are damaging to the environment.

Objectives of study

The study assessed the impacts of the abattoir on the environment at its operational stage. Specifically, it focused on the following:

1. Examined the water quality of the influents and effluents of the abattoir.
2. Measured the noise generated at the abattoir.

MATERIALS AND METHODS

Study area

The study was carried out at the Tamale Abattoir in Shishegu a suburb of Tamale Metropolis (Figure 6). Tamale is the Northern Regional capital city in Ghana. The metropolis covers a land area about 930 km² with a population of 293,881 (Ghana Statistical Services, 2000). The metropolis lies between latitudes 9°.15' and 9°.30'N of the equator and between longitudes 0°.45' and 10°W of the Greenwich meridian, at an altitude of 183.3 m above sea level. It is in the guinea savanna belt and experiences unimodal rainfall lasting from five to six months, that is, April/May to September/October. Temperatures fluctuate between 15 and 43°C with an annual mean temperature of 28.1°C. The annual mean rainfall, relative humidity, wind speed, sunshine hours and solar radiation are 1033 mm, 61%, 138 km/day, 7.3 h and 19.6 MJ/m/day, respectively. Shishegu lies along the main road linking Tamale and Tolon, the district capital of Tolon-Kumbungu. The abattoir, which started operating on 30th September, 2005 has a total land area of about 14000 m^2. It is about 3 km from Tamale. It has a staff capacity of 16, that is, 6 assembly staff made up of the officer in charge and his deputy, 2 veterinary officers with 2 revenue collectors and 10 labourers. The butchers number well over a hundred and are not considered as staff.

Collection and analysis of water samples

Water samples (influent and effluent) were collected into sterilized 2.5 ml dissolved oxygen (DO) bottles and transported under dark conditions to the Ghana Water Research Institute laboratory, Tamale, for analysis. The bottles were used to aseptically draw water from the inflow pipes in the abattoir (influent) and waste water which run into the drainage system just as it left the slaughter pavements. Sample bottles were placed on ice during transportation to the laboratory. Water samples were collected fortnightly over a three month period, from February to April (dry season). There were a total of six collections (dates) from each sampling point for the influent and effluent.

Physico-chemical parameters such as biochemical oxygen demand (BOD_5), dissolved oxygen (DO), total suspended solids (TSS), were used to determine the water quality and pollution effects from abattoir wastes. The Azide modification method was used to determine the initial dissolved oxygen (DO). Biochemical oxygen demand (BOD_5) was computed from the difference between initial and final DO (APHA, 1998).

Total and faecal coliform loads were determined by filtering 100 ml of sample water through HA-type Millipore, cellulose filters with a pore size of 0.45 µm using of a Welsh Thompson vacuum pump. Serial dilutions were used for the effluent samples to bring the load to readable levels through a trial run. Sample water dilutions (10^1 to 10^9) were prepared with 0.1% buffered peptone water (BPW) (Oxoid CM 509). The filter was then placed on a Petri dish containing M-FC agar and incubated for 24 h at 44 ± 1°C for faecal coliforms and 36 ± 1°C for total coliforms.

Noise level measurements

The 1900 Integrating /Logging sound level meter was used in measuring noise levels at the abattoir. Measurements were taken at peak periods between 9am and 11am, and off peak periods between 6am and 7am. The equipment was mounted and readings taken inside the abattoir and within 20 m north, south, east and west of the abattoir. Five readings were taken in each location (cohort) and the averages computed.

Qualitative data collection

Additional data for this study was collected through the use of questionnaire and interviews.

Semi structured questionnaires were administered to at least one member of all the houses within one kilometer (1 km) east, west, north and south of the abattoir. This brought the total number of respondents to twenty-one (21). Questionnaires were also administered to ten staff of the abattoir, including one (1) veterinary officer, five (5) butchers, one (1) environmental health officer, one (1) labourer and two (2) district assembly revenue officials to obtain data on how the abattoir is affecting the environment.

Interviews were held with key informants such as consultants from Environmental Health, Waste Management, the Environmental Protection Agency (EPA) and the Management of the Tamale Abattoir to obtain information on the general management, waste management, the various components and the operational activities

Table 1. Water quality of influents and effluents at the Tamale Abattoir.

Parameter	Influent	EPA-Ghana/ Ghana standards board standards for drinking water (influent)	Effluent	EPA Ghana's standards for efluents
Dissolved oxygen (DO) (mg/L)	4.6	4-15	0	>50
Biological oxygen demand (BOD)(mg/L)	2.2	0.5	3,300	<50
Total suspended solids (TSS) (mg/L)	4		2567	<50
Turbidity (NTU)	4.8	<5	>1000	<75
Faecal coliforms (CFU/100 ml)	36	0	450,000	<10
Total coliforms (CFU/100 ml)	84	0	550,000	<400

Table 2. Noise generated at the abattoir with the activities at each location.

Location	Max. level dB(A) (Peak period)	Min. level dB(A) (Off-peak period)	Activity
EPA-Ghana Standards	**70 (day)**	**60 (night)**	***STANDARDS+***
Northern Cohort	80.8	61.7	Food vendoring
Western Cohort	98.8	60.4	Smoking of animals and hide making
Southern Cohort	97.7	61.1	Kraal for animals' rest, registering and inspecting animals
Eastern Cohort	97.2	60.2	Security post and parking of trucks
Inside Abattoir	102.3	58.7	Slaughtering and dressing animals and some sales of meat
Mean value	95.4	60.4	

of the abattoir.

RESULTS

Water quality

The results of the physico-chemical parameters for the influent [BOD_5 (2.2 mg/L^{-1}), DO (4.62 mg/L^{-1}), TSS (42 mg/L^{-1}), colour (10 TCU) and turbidity (4.8 NTU)] were within EPA-Ghana's standards for drinking water (influent) (Table 1). Microbial parameters (total coliforms 84 CFU and faecal coliforms 36 CFU) however failed to meet these standards (Table 1).

Effluent water quality was however highly polluted. The results showed that none of the measured parameters were within acceptable EPA-Ghana standards. Dissolved oxygen, BOD and TSS values of 0, 3300 and 2567 mg/L were obtained; colour (>1000), turbidity (>1000), faecal coliforms (4.5×10^5) and total coliforms (5.5×10^5) were also obtained (Table 1).

Noise levels

Contrary to the Sheshegu community's perception that noise is not a problem for them the study revealed that the abattoir generated noise is above the acceptable levels set by the EPA-Ghana (Table 2). Peak noise levels ranged from 80.8 in the northern cohort to 102.3 dB(A) inside the abattoir. Off-Peak levels ranged from 58.7 inside the abattoir to 61.7 dB(A) in the northern cohort (Table 2).

DISCUSSION

Water quality

The results show that unlike other abattoirs in West Africa (Adelegan, 2002; Adesemoye, 2006) the Tamale Abattoir uses relatively very clean water for its operations. The slight failure in microbial standards is due mainly to contaminated containers used in fetching water from the main tank which is sometimes filled by tanker service; pipe borne water supply to the abattoir is irregular.

The observed high BOD can be attributed to the high organic load resulting from meat wastes, skins, blood, salts and rumen contents carried in the effluent. This scenario is not unique to the Tamale Abattoir (Quinn and Mcfarlane, 1989; Ajeam and Ragee, 2000; Bush, 2000) (Figure 1).

High organic (and inorganic) loading of the effluent was further manifested in the extremely high total suspended solids and turbidity values as well as the huge coloration of the effluent (Figure 2).

Sheshegu community members observed that there has been a change in the colour of their water since the abattoir started operating. According to them, wastewater from the abattoir is disposed into drains around it, which

Figure 1. Interior of abattoir where slaughtered animals are being processed on the floor, close to drains. Pipe from which influent is obtained is also shown behind man.

Figure 2. External drain carrying effluent from abattoir.

empty onto the land (also confirmed by management of Tamale abattoir) and finally drains into the seasonal stream and community dam that supply the community with water (Figures 3 and 4).The community is connected to water supply from the Ghana Water and Sewage Company however water supply from this company is highly irregular.

High total and faecal coliform counts in the effluent is a strong indication of high pollution and hence it is not safe to dispose it into the environment. The high counts may be due to the excreta from the intestines some of which is washed to the effluent. Cattle, sheep and goats are usually slaughtered with their blood, part of the dung and abdominal content washed on cemented pavements in the abattoir. The solid waste is collected and dumped outside. The remains are then washed away and the wastewater runs through open drains of the abattoir to bigger adjoining drains outside the abattoir to the neighborhood without any treatment. This situation is prevalent in a number of African countries, including Nigeria (Adesemoye et al., 2006). The presence of faecal coliform in the effluent indicates recent faecal contamination - meaning that there is a high risk that pathogens are present (Figueras, 2000; Cadmus et al., 1999; Coker et al., 2001). Meanwhile, there are a number of methods for waste treatment to meet public health and conservation requirements, which result in the destruction of pathogens and the mineralization of the organic components of sewage prior to discharge (Liu et al., 2002; Boadi and Kuitunen, 2003). However, in Ghana, like many developing countries, the discharge of untreated wastes into the environment is still a problem, despite the establishment of National laws (Adeyemo, 2003; Weobong, 2001).

The community members observed that the odour emanating from the abattoir is highly repugnant. They attribute the outbreak of maggots, flies and diseases as impacts of the abattoir on the environment. Solid waste is dumped just around the abattoir not far from the settlements whilst liquid waste eventually ends up draining into the community dugout. During the raining season, the solid waste is washed and spread into the houses, causing maggot and fly infestations which lead to the subsequent outbreaks of diseases such as typhoid, dysentery and diarrhea, as pertains in other developing countries (Salami, 1998; Hinton et al., 2000; Inglis and Cohen, 2002; Amisu et al., 2003).

Noise levels

The noise was generated by several sources and activities at the site. These included noise made by the workers and traders, slaughter animals, motor bikes, processing activities within the slaughterhouse, plant machinery, and service vehicles including trucks and forklifts for haulage of animals to the site and dispatch of meat from the site. Noise levels in all sections and at all times exceeded the acceptable limits (Table 2)

It was observed that the noise recorded inside the abattoir 102.3 dB (A) was the highest. This is because all the processing activities such as slaughtering and dressing of animals and some product sales go on there. Slaughtering resulted in a lot of noise due to the large numbers (over hundred) butchers doing the slaughtering at the same time.

The northern cohort recorded the least noise level, 80.8 dB (A), although it is very close to the main road linking Nyankpala and Tamale. This could be attributed to the fact that there was irregular vehicular passage, and there were times when there was no vehicular passage at all.

High noise levels in industries are unwanted not only because they are hazardous to hearing but also because they are a hindrance to communication and cause unnecessary stress upon people who receive no immediate or direct benefit from the noise producing system. Prolonged exposure to noise levels above acceptable limits has negative health implications. The EPA Ghana has rated (AKOBEN ratings) both the Accra and Kumasi (the Capital and second largest cities in Ghana) Abattoirs RED. This is because they have failed to meet the requirements for monitoring and reporting, and best environmental practices as far as noise and waste management is concerned (EPA, 2010). Five colors are used for this rating. These include GOLD, GREEN, BLUE, ORANGE and RED, indicating environmental performance ranging from excellent to poor (EPA, 2010).

Conclusion

The study revealed that the operations of the Tamale Abattoir have some negative impacts on the environment and the people of Sheshegu where it is located. Noise generated from various activities and equipments at the abattoir are above the maximum allowable levels set by the EPA-Ghana. This has long term health implications for residents and workers at the abattoir.

The water used by the abattoir for its operations (influent) is generally of good quality. Physico-chemical parameters are within acceptable limits; microbiological parameters are however slightly above limits.

Solid and liquid wastes generated at the abattoir are highly polluted. Effluent physico-chemical and microbiological parameters exceeded the EPA-Ghana standards. The effluent drain eventually empties in to the Sheshegu community dam; the low lying lands of the community are subsequently seasonally flooded with abattoir wastes. Disease prevalence and occurrence has increased since the establishment of the abattoir. The stench emanating from the abattoir waste is highly repulsive. It therefore instructive to treat the abattoir wastes appropriately and properly dispose them to avert

Figure 3. External drain carrying effluent towards community.

Figure 4. Community dug-out.

Figure 5. Vultures flying around the abattoir.

Figure 6. Front view of abattoir.

serious health effects for residents and workers. It is equally important that EPA Ghana carries out its AKOBEN ratings on the Tamale Abattoir in order to bring to the public domain the real situation of the abattoir in terms of its environmental ratings (Figures 5).

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