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Abattoir operations, waste generation and management in the Tamale metropolis: Case study of the Tamale slaughterhouse

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The study was conducted to assess the rate of effluent generation and management at the Tamale abattoir. It also investigated the methods adopted in processing animal carcasses, including handling/transportation to retail centres. The investigative approach to data collection was adopted in combination with desk research and other strategies. Waste material generated was estimated based on calculations by Aniebo et al. (2009). The results show that on average, about 55 cattle, 50 sheep and 20 goats were slaughtered daily at the abattoir, leading to an annual production of 2,475 tons of beef, 270 tons of mutton and 94 tons of chevon. These represent 12, 1.6 and 0.5% of the 2010 national output of meat in Ghana. The number of livestock (125) slaughtered daily results in 0.7 ton of blood, 0.5 ton of gut contents, 0.4 ton of waste tissues and 0.7 ton of bone. These translate into a total of 1,159.7 tons of blood, 822.9 tons of intestinal contents and 636.5 tons of waste tissues discharged into the environment annually. Handling and transporting carcasses to the various points of sale is generally done under unhygienic conditions, exposing the meat to all sorts of contaminants. With only one old wretched meat van serving the abattoir, majority of butchers (93%) resort to the use of other deficient means including bicycles and taxis (booth) to transport meat to the market, posing a serious threat to the health of consumers.

Key words: Abattoir, environment, intestinal content, tissue waste, biogas.

INTRODUCTION

The Food and Drug Laws/guidelines of Ghana require that imported livestock products and those produced locally meet the requirements specified under the relevant Ghana Standard for Meat and Meat Products (First Databank (FDB), 2004). Although the laws provide butchers and importers of meat with guidelines that ensure high safety and quality standards as well as a comprehensive procedure for bringing their activities into compliance with the law, enforcement appears to be a problem. Currently, activities at the Tamale abattoir apparently meet (partially) only 30% of the requirements specified under the relevant standard for meat production and none of the storage requirements (FDB, 2004).

Abattoir operations are meant to recover the edible portions of slaughtered animals for human consumption. In the process, significant quantities of waste materials including organic and inorganic solids are generated (Red Meat Abattoir Association (RMAA), 2010; Steffen & Kirsten Inc, 1989). The solid waste consists mainly of bones, undigested ingest and occasionally aborted foetuses while the liquids comprise of blood, urine, water, dissolved solids and gut contents. Some researchers

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Table 1. Data for estimating abattoir effluent.

Waste category	Cow	Goat
Blood/head (kg)	12.6	0.72
Intestinal content/head (kg)	8.0	1.25
Waste tissue (kg)	6.4	0.80
Bone/head (kg)	11.8	2.06

Source: Aniebo et al. (2011).

point out that abattoir activities are responsible for the pollution of surface and underground waters as well as air quality which indirectly affect the health of residents living within the vicinity of abattoirs (Odoemelan and Ajunwa, 2008; Patra et al., 2007; Raymond, 1977). In addition, primary producers in affected water bodies may be destroyed by such pollutants, which may directly affect fish yield, with serious consequences on diet (Aina and Adedipe, 1991).

Wrongful discharge of blood and animal faeces into streams may cause oxygen-depletion as well as nutrient-over enrichment of the receiving system which could cause increased rate of toxin accumulation (Nwachukwu et al., 2011). Humans may also be affected through outbreak of water borne diseases and other respiratory and chest diseases (Mohammed and Musa, 2012).

Abattoir waste disposal in many developing countries including Ghana has been a major challenge for years. In most cases, waste materials are disposed of without regard to sound environmental management practices, thus making them harmful to humans and other terrestrial and aquatic life. Studies from Nigeria and Ghana show that many abattoirs in the respective countries either deposit waste materials in the immediate environs or dispose of them directly into water bodies, some of which serve as sources of water for the abattoirs (Adelegan, 2002; Osibanjo and Adie, 2007; Weobong, 2001). Some people argue that the practice is mainly due to lack of or inadequate waste recovery and treatment facilities (Adeyemo et al., 2009).

In Ghana, increasing demand for animal products especially meat has led to increase in the volume of abattoir waste generation and there are growing concerns about the current situation. An enquiry into activities of the main abattoir in the Tamale metropolis showed that effluent water from the facility was highly polluted (Weobong and Adinyira, 2011), with all the measured parameters exceeding acceptable standards set by the Environmental Protection Agency (EPA) of Ghana. The study further revealed that residents within the community where the slaughterhouse is located complained of stench from the effluent, pollution of their water sources and frequent disease outbreaks among others. Concerns have also been raised about the manner in which carcasses are prepared and subsequently handled en route to the markets.

This study therefore sought to estimate the volume of meat produced at the abattoir and the corresponding effluent generated (solid and liquid) given that nothing seems to have changed by way of proper waste disposal since the last study revealed a rather worrying situation. The study as well investigated the process of meat processing and handling at the abattoir and during transportation to the markets. The outcome of the study is expected to first raise consciousness about the level of waste generation at the abattoir and the potential health and environmental implications if nothing is done to halt the situation. It is secondly expected that documentation of the findings will help to raise awareness about the unconventional methods employed in handling/ transporting meat from the abattoir to the various market centres in the metropolis and the potential for contamination.

METHODOLOGY

The investigative approach to data collection was adopted in combination with desk research (secondary data collection) and other strategies. The main abattoir in Tamale was selected for this study. Data on the number of ruminants (cattle, goats and sheep) slaughtered daily was collected (through participant observation) between April and June, 2013. This was backed with data obtained from records on abattoir operations. Additional information was collected through questionnaire administered to butchers and interviews with key informants (veterinary experts and meat inspectors) using interview schedule. Waste materials generated from abattoir operations was estimated based on calculations by Aniebo et al. (2009) (Table 1). The computations were done using average data on body weight for the respective ruminants and carcass weight per 1,000 kg.

This study also assumed that volume of waste generated from the slaughter of sheep is equal to that for goat. The estimated figures from Aniebo et al. (2009) were therefore applied to sheep. Quantity of meat produced was also estimated using data (average) from the Ministry of Food and Agriculture (MOFA) (Table 2), computed from carcass weight and number of livestock slaughtered.

Meat production (Mt) = (Off take rate (%) × Estimated population × Carcass weight of animal (kg)/1000. Carcass weight = Average livestock weight (kg) × (carcass wt%) / 100 (MOFA, 2011). For purposes of this study however, off take rate × estimated population stated in the formula was substituted with the observed number of livestock slaughtered daily at the abattoir.

RESULTS AND DISCUSSION

Entry requirements

The butcher industry is clan-related and dominated by members of the Nakohigu clan (Dagbani) meaning butchers' clan. The setup is a form of traditional/political system controlled by a Chief with various officers who play different roles as pertains in the traditional clan system. Butchers who do not belong to the regular clan but have been initiated and accepted into the business are in the minority, referred to as Bajobihi. Membership of the Tamale abattoir is currently made of 13% Bajobihi

Table 2. Data for estimating meat production.

Livestock	Av. Livestock wt. (kg)	Carcass (% of live animal wt.)	Carcass wt. of animal (kg)
Cattle	250	50	125
Sheep	25	60	15
Goats	22	60	13

Source: MOFA (2011).

Table 3. Meat production at the Tamale abattoir (Mt).

Livestock	Livestock numbers	Av. production/ day	Av. production/ year	% of 2010 production
Cattle	55	6.88	2,475	12.38
Sheep	50	0.75	270	1.60
Goats	20	0.26	93.6	0.49

Estimated using field data, 2013 and Table 2

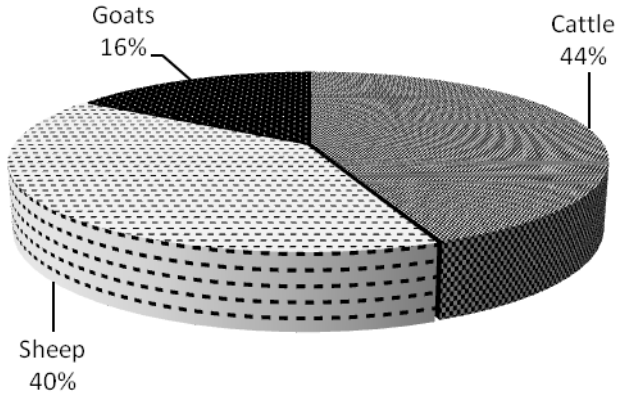

Figure 1. Composition of ruminants slaughtered daily at the Sheshegu abattoir.

and 87% Nakohigu. The current composition was described as a marked improvement of the situation 15 to 20 years earlier. According to one key informant, it was virtually impossible for individuals who are not members of the clan to operate as butchers. Traditionally, non-clan members are made to perform certain initiation rites. They present two (2) knives and an unspecified amount of money to the Chief who performs the necessary rituals. It was popularly believed that any individual (Nakohigu) who is not interested in becoming a butcher still have to go through the ritual and occasionally feed the knives with blood by participating in slaughter operations. Refusal to comply, according to some key informants, could result in madness or failure in any attempted business undertaking.

Meat production and handling at the abattoir

On the average, 125 ruminants were slaughtered daily at the abattoir. Composition of the respective ruminants slaughtered daily at the abattoir is represented in Figure 1. Table 3 shows the average (daily and yearly) estimates (Mt) of the quantity of meat produced. The results show that annually, 2,475 tons of beef, representing over 12% of the 2010 national output for Ghana (MOFA, 2011) came from the abattoir. In addition, about 1.6 and 0.5% of the 2010 national output of mutton and chevon, respectively was produced. These results show that activities at the abattoir contribute significantly to the total national meat output, providing employment for a number of people in the metropolis. There are however, serious concerns regarding the methods adopted in processing and handling of the meat as well as management of waste materials.

Waste generation and management

The 55 cattle, 50 sheep and 20 goats slaughtered daily lead to the generation of about 0.7 ton of blood, 0.5 ton of gut contents, 0.4 ton of waste tissues and 0.7 tons of bone. These translate into annual total of 1,159.7 tons of blood, 822.9 tons of gut contents and 636.5 tons of waste tissues discharged directly into the environment (Table 4). A total of 1,237.4 tons of bone that would otherwise have been part of the annual waste generation was excluded because they are often sold together with the meat. In other words, between 2005 when the abattoir was commissioned and 2013, an estimated 8,117,928 tons of blood, 5,760,300 tons of intestinal contents and 4,455,360 tons of waste tissue have been discharged into the environment. Blood and liquid intestinal fluids are washed into a drain that empties right at the premises of the abattoir (Figure 2). The drain only serves as means of carrying effluent out of the main building. These are washed by rains into nearby streams and dugouts that serve as sources of water for other communities. Solid

Table 4. Waste generation at Sheshegu abattoir.

Waste category	Cattle/day	Goat/day	Sheep/day	Total/day	Total/yr
Blood/Head(kg)	693	14.4	36.0	743.4	1,159,704
Intestinal content/Head(kg)	440	25.0	62.5	527.5	822,900
Waste tissue/Head(kg)	352	16.0	40.0	408.0	636,480
Bone/Head(kg)	649	41.2	103.0	793.2	12,37,392

Source: Field data (2013).

Figure 2. Drain carrying a mixture of blood and intestinal fluid.

Figure 3. Abattoir assistant carting intestinal waste (A) to dumping site (B) close to abattoir.

intestinal contents are collected in wheelbarrows and deposited at designated points (Figure 3A and B).

The abattoir waste materials are entirely organic that can either be composted or recycled and used for various activities, yet they are left to degrade, producing bad stench. Degrading heaps of gut contents at the site serve as breeding grounds and sanctuary for pests that become a nuisance for abattoir workers, visitors as well as residents around the facility. Bone waste is currently not a problem because they are often sold together with the meat.

The abattoir currently lacks basic facilities including cold storage facility despite the vast potential of the industry. It appears that the limited facilities provided have been run down over the years. Although officials of the veterinary services were seen inspecting meat, many other health and sanitation concerns have been ignored by the authorities. Although abattoir waste carries high levels of microorganisms that may be harmful to humans, they are an excellent substrate for generating biogas (Rabah et al., 2010). The study revealed that about 1,159.7 tons of blood, 822.9 tons of intestinal contents

Figure 4. Open burning of fur with tyres and firewood (A). Carcass processing on the floor close to a pile of gut contents (B).

and 636.5 tons of waste tissues are discharged annually. This volume of waste when properly managed (composted or digested) will in addition to reducing the sanitation and health challenges round the facility, produce other benefits (for example, manure) for farmers and biogas for home and other uses. It has been estimated that 1 kg of fresh animal waste produce about 0.03 m^3 of gas (methane) per day (FAO, 1996).

Theoretically, about 25,000 m^3 of biogas can be produced annually from the 822.9 tons of gut contents alone. It is popularly believed that the potential to generate biogas from abattoir waste is a good opportunity to enhance their activities (HDR, 2010). In other words, it could lead to improvements in efficiency and general approach to meat processing. For instance, if the abattoir is able to produce biogas for use, there will be reduced demand for firewood and lorry tyres, consequently saving some forest resources and the environment.

Meat handling and transportation

Some butchers were cited preparing carcasses on the wet, dirty floor outside the abattoir and very close to the heap of waste materials (Figure 4B). Before this stage, and immediately after animals are slaughtered, the fur is burnt off in the open using firewood and lorry tyres (Figure 4). At least five fire points were counted daily over the period, each producing smoke continuously between 7.30am and 11:00am. It was however observed that firewood constituted the greater part of the fuel. In other words, use of lorry tyres was relatively minimal compared to other places in the country where they constitute the main energy base (Nyinah, 2002). Apart from the danger it poses to the health of consumers, the practice also produce lots of smoke that pollute the area (Figure 3B). The facility is generally operating under unhygienic conditions due to lack of certain basic amenities. Since it was commissioned somewhere in 2005, it has not been rehabilitated hence most of the facilities have been run down.

Handling and transportation

There are major problems with the manner in which animal carcasses are handled during slaughter, loading and transportation from the abattoir to various points of sale in the metropolis. There is only one old, wretched meat van used to transport meat to the markets. Thus, majority (93%) of the butchers convey their meat on bicycles, motorbikes (Figure 5A) and motorised tricycles, popularly known as motor king (Figure 5B), as well as in booth of taxis under very unhygienic conditions. In most cases, meat is simply packed and transported without regard to safety measures. These practices affect the quality of meat sold on the market, with serious consequences to the health of consumers. For instance, Adzitey et al. (2010) in a study to ascertain the quality of chevon and mutton sold in three major meat shops in the Tamale metropolis concluded that samples from all the shops were contaminated with microbes (*Streptococcus* spp., *Staphylococcus* spp., *Enterococcus* spp., *Salmonella* spp. and *Escherichia* coli). They indicated that although the bacterial count for the samples were below 107 where spoilage occurs (Warriss, 2001), the presence of certain strains of these bacteria cause food-borne infections.

Conclusion

Operations at the Tamale abattoir contribute significantly to meat supply in the municipality. However, there are serious problems with the conditions under which car-casses are processed. Carcass handling in the course of

Figure 5. Images showing chevon (A) and Beef (B) ready to be transported to the market.

transportation to various retail centres within the municipality is also poor. But for the wrong approach to waste management, the volume of effluent generated at the abattoir is a potential resource that can be utilised to enhance operations as well as serve other sectors of the economy. For instance DeCo is a registered Ghanaian NGO that produce organic fertilizer for small-scale farmers (DeCo, 2011). It operates decentralized composting plants in the Northern region of Ghana using various kinds of biodegradable waste materials. Collaboration between the existing statutory regulatory bodies, municipal assemblies and major stakeholders (including DeCo) will help to address some of the pressing challenges of waste management at the abattoir. There is also the need for more robust monitoring and sanction regime (FDB, 2004) by the Veterinary Services as well as Food and Drugs Authority to ensure that meat processing and handling conform to the basic health and environmental standards.

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