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RESEARCH ARTICLE

ABATTOIR WASTE DUMPING MODEL FOR SUSTAINABLE DEVELOPMENT IN KANO  
METROPOLIS

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ABSTRACT

The study aimed at proposing abattoir waste dumping model for sustainable development in Kano Metropolitan, Kano State Nigeria. The study used both qualitative and quantitative research design. The quantitative method employed was observation checklist. While qualitative method employed was interview. Two sample techniques were used for sample of the respondents. Method of data analysis employed were mapping out the abattoirs in the study area, proximity and nearest neighbour analysis were used using Geographic Information System (GIS). On the other hand, the study reveals that the volume of ASW generated annually is very huge which can jeopardize to the lives of people and environment in general if left unchecked. It is also revealed that the previous methods of abattoir operation used to take place in 20<sup>th</sup> century were very systematic. The following recommendations are suggested: all abattoirs should comply with abattoir's rules and regulation. It is recommended that a proper planning should be put in place to avoid encroaching of people close to abattoir or establish new abattoir close to residential area.

KEYWORDS

Abattoir, abattoir waste, composition of abattoir waste, abattoir workflow

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## Introduction

Population is dynamic and always creates changes in the socio-economic and environmental setting of an area. The global population is projected to reach 9.3 billion in 2050 (Kajiwara and Tsuru, 2012). This leads to changes in eating habits, lifestyles, and waste generation, among other factors. The world population doubled from 1961 to 2014, increasing from 3 billion to 7 billion people, respectively. The volume of meat also quadrupled from just 70 million tons to 300 million tons consumed between 1961 and 2012, leading to an increase in abattoir waste generation (Kajiwara and Tsuru, 2012).

Abattoir is one of the facilities that should be located around residential areas, not too far from the people. This facility produces organic waste which, as a result of non-compliance with abattoir laws, can put residents around the abattoir at greater risk. The abundant waste and microbial organisms obtained during abattoir processing pose a significant challenge to effective environmental management and are also associated with a decrease in the quality of life of the human population residing close to these abattoirs (Adeyemo, 2002). Air and water qualities within residential areas are also polluted by abattoir activities, especially where effective waste treatment and disposal systems are not practiced (Bello and Oyedemi, 2009).

However, the abattoir sector generates a huge amount of organic waste. The source of abattoir waste starts from unloading, keeping in the stockyard, lairage, killing, removal of hide, paunch handling, trimming, processing, just to mention a few (Omole and Ogbiye, 2013). Similarly, abattoir operations result in the generation of numerous waste and microbial organisms that pollute the environment and pose a serious threat to human health and quality of life (Abdullahi, Kadarman, Hassan, and Madobi, 2015; Bello and Oyedemi, 2009).

However, in order to reduce the danger of abattoir location and control the effects of ASW on the environment and people, several guidelines have been established by both government and non-governmental agencies such as FAO (2011), the Federal Ministry of Environment (2005), NESREA (2009), the National Environmental Health Practice Regulations (NEHPR) (2016), and REMASAB (2003). Despite

these guidelines, many people do not comply, leading to ongoing environmental problems such as land, air, and water pollution in the study area. Therefore, based on this background, this research work aims to address the gap left by previous researchers by proposing a suitable model for the disposal of abattoir solid waste in Kano Metropolitan local government areas.

## Literature Review

### Abattoir

Abattoir is an authorized and approved building registered by the controlling authority where animals are slaughtered and prepared for human consumption (Alimentarius, 1993; Bello, Kwaga, and Raji, 2011). An abattoir is a place for receiving and holding livestock, butchering and dressing carcass animals, chilling processed carcass products, boning and packaging carcasses, freezing finished carcasses and packaged products, rendering processes, drying skins, treating wastewater, and distributing processed materials (Abubakar & Bello, 2023). The purpose of an abattoir is to provide hygienic and clean animal slaughtering services, ensure proper utilization of animal by-products (waste), and minimize the negative effects of waste on the environment by controlling waste generation and disposal systems.

### Abattoir Waste

Abattoir waste materials are entirely organic and can be recycled or composted for various activities, yet they are often left to rot, creating a foul odor in the surrounding area. The decaying heaps of gut contents serve as breeding grounds for mosquitoes, flies, and other pests, which can be a nuisance to the entire community.

A feasibility study conducted by the Ondo State government in 2004 revealed that most of the waste generated comes from households, abattoirs, poultries, piggeries, markets, and small-scale industries, totaling 280 tons per day (Bayode, 2011). Since slaughterhouse waste poses a particular hazard, trained workers should be responsible for its collection and disposal to ensure that it is disposed of in properly maintained sites.

### Composition of Abattoir Waste

It is reported that virtually 75% of abattoir wastes generated are gathered in open pits or landfills. Wastes generated through abattoir activities consist of animal parts that have no perceived value to the slaughterhouse operator or consumers (Banks and Wang, 2004). Here, all butchers generate different types of waste – solid, liquid, or gaseous – at different places.

Similarly, not all carcasses are consumed; the total amount of waste generated per animal slaughtered is approximately 35% - 50% of the original animal mass or weight (Buendia, Fernandez, Villasenor, Rodriguez, 2008; World Bank, 1998). A significant part of the carcass becomes waste. Approximately 50–54% of each cow, 52% of each sheep or goat, 60–62% of each pig, 68–72% of each chicken, and 78% of each turkey end up as meat consumed by human beings, with the remainder becoming waste after processing (Adeyemi & Adeyemo, 2007).

### Guideline for Establishing Abattoir

Relevant Site information should include (EPA, 2002; NUPI, 1994; LMA, 2000;):

- I. The closeness to existing and future housing developments and to land zoned to permit housing or other land uses not compatible with proposed development;
- II. The site hydrology: flood liability, site drainage and closeness to water courses and ground water resources used for domestic, agricultural or town water supply;
- III. The prevailing wind conditions;
- IV. The landform and the likely direction of draft of odor or effect of noise;
- V. Directions of major cattle supply inlets and proximity to cattle market;
- VI. The erosion hazard; the local road network; corridors for power and other services; and suitability of the site for possible disposal areas.

## Materials and Methods

### Types and Sources of Data

Two types of data were used: primary and secondary data. The primary data included the coordinates of abattoir locations and compliance with operational and environmental standards. Primary data were sourced from

traditional heads of butchers, chairmen of butchers' associations, and officers from the Agriculture Department in the sampled abattoirs. The quantitative sources of data were observation checklists, GPS, and GIS techniques. For the qualitative source of data, in-depth interviews were used.

On the other hand, the secondary type of data with its sources includes the following:

- ✓ Kano State Butchers Multipurpose Enterprise (2020): number of abattoirs and their locations
- ✓ Kano Ministry for Local government (2020): officers from Agriculture Department of each local government areas.

### Quantitative Data Collection

- a. **Global Positioning System (GPS):** The Garmin CX76 model device was used to take coordinates of all abattoirs in the study area to map their spatial distribution in a Geographical Information System (GIS) software environment (ArcGIS 10.3 Model). Similarly, the coordinates of the proposed dumping site for ASW and the burning site for metropolitan abattoirs were taken and input into the ArcGIS 10.3 Model, which showed the sites.
- b. **Weight Scale:** To calculate the amount of abattoir solid waste generated in kilograms (KG), a weight scale was used to measure the weight of all solid waste from carcasses. There are two methods for determining the weight of an animal:
  1. **Indirect Method:** This method, known as Schaeffer's method, uses a formula developed by Schaeffer. It is widely accepted as a valid method for determining the body weight of adult cattle and other ruminants. Schaeffer's formula is:

$$W = \frac{L * G^2}{300}, \quad W = \frac{Length * Girth^2}{300} \dots \dots \dots (i)$$

Where:

W = is the live weight of animal in pounds,

L = is the Length of animal measured from the shoulder to the pin bone measured in inches and

G = is the Girth or the entire circumference of the body measured behind the point of elbowing measured in inches;

2. **Direct Method:** here, animal is weighed on weight scale directly

For the purpose of this study, the direct method was employed. Nine research assistants were employed to obtain the average weight of an animal and the weight of waste generated for every operation within a month. For daily operated abattoirs, three days of each week were sampled (2 busiest and 1 scanty operation days were taken). The averages of these counts and measurements were used. To estimate the abattoir solid waste generated per annum, the following formula was used:

$$ASWG = \Sigma(ASWb + ASWp + ASWh + ASWhn + ASWcb + ASWh) * N * Y \text{ -----(ii)}$$

Where:

*ASWG = Abattoir solid waste generated*

*ASWb = bone, ASWp = paunch, ASWhn = horn, ASWcb = clotted blood, ASWh = leg & head,*

*N = total number of animals slaughtered per operation,*

*Y = total number of animals slaughtered per year*

## Methods of Data Analysis

On the other hand, GIS analysis was performed to determine the distance between abattoirs in Kano metropolitan area and proposed dumping and burning sites. The selection of the proposed dumping and burning sites was based on guidelines provided by the following institutions: EPA (2002), MOE (2005), LMA (2000), NEHPR (2016), and NESREA (2009). According to the guidelines, the dumping site should be located 500m to 1000m away from residential areas, have access to transportation networks, be in a non-floodable area, situated on the leeward side, and have sufficient space for future expansion.

## Result and Discussion

### Estimation of Animals Slaughtered in Kano State Slaughterhouse

Each camel produces 48.6% solid waste, while the average waste generated from cattle per head is 44.2 kg and solid waste generated from goats/sheep is 7.3 kg. It is found that

approximately 2,079,120 goats/sheep, 315,396 cattle, and 46,872 camels are slaughtered annually in the whole of Kano State. Approximately 5,474 goats/sheep, 838 cattle, and 129 camels are slaughtered every day in Kano State, which is more than four times all operations in a week by weekly abattoirs. This is due to the demand for meat in areas with high population and economic activities. Additionally, more than half of this waste is generated from abattoirs in Kano metropolitan area.

### Abattoir Workflow in Kano State

This workflow was practiced from the 1980s to the early 2000s, but now the practice is considered ill-advised, as stated by Sarkin-pawa (2020). The workflow practiced in the abattoir is summarized from the data collected from Sarkin Pawa and Chairmen of the butchers' association in Kano (2020) as follows:

- a) **Receiving:** Animals are received 12 to 24 hours prior to slaughtering (Figure 1). This spot serves as a resting room where animals are kept for 12 hours. In this stage, waste can be reduced by not giving them food, and what is in their stomach would be excreted. Most of the waste here is feed leftover, feces, and urine. Management of waste can easily be done here. In the 1980s to the early 2000s, animals were kept in the receiving room (stockyard) for at least 6 hours, but nowadays abattoirs do not practice such activities. This causes abattoir premises to be spoiled with waste (which is supposed to be generated at the stockyard).
- b) **Holding:** Received animals are registered, and ante-mortem inspection is carried out by a certified veterinarian. The veterinarian decides whether to accept or reject the animals received for slaughtering based on the animals' body condition and health status. The abattoir rejects animals that have visible signs of illness or are emaciated (Figure 1). This practice is not followed in Kano abattoirs, where post-mortem inspection is only done on carcasses that show physical signs of certain diseases. Waste is also generated here, but only a meager amount compared to the stockyard.

c) **Stunning:** Stunning method is practiced, which renders animals unconscious for easy handling. This was practiced only when NIMAP was opened. This stunning method contravenes Islamic Law; hence Islamic Scholars were against it, and the government accepted it and banned it. All abattoirs in Kano metropolis do not practice this method. This is because all that people do is guided by their religion, so slaughtering is also included (Figure 1).

d) **Bleeding:** Bleeding is accomplished by severing the jugular vein of stunned animals. To enhance blood drainage to a nearby ditch, the floor of the slaughterhouse is constructed to be sloped. The minimum time taken for bleeding and the amount of blood per animal is given by DARD (2009) as follows:

- ✓ Cattle: 8 minutes, 13–15 litres blood
- ✓ Calf: 6 minutes, 2–7 litres blood
- ✓ Sheep: 6 minutes, 1.3–2 litres blood.

The main waste generated by this activity is liquid (blood). If the blood is dried up, it becomes solid waste instead of liquid. In some abattoirs in Kano, such as Mayankar Unguwa Uku, the blood is dried up and sold to poultry feed producers.

e) **Flaying/skinning:** The entire process of flaying is carried out on the floor in almost all abattoirs in Kano State, which is worn and cracked. This causes meat to be contaminated, which becomes a problem for human health. However, the main waste generated at this spot is skin/hide. This waste is not a problem for the environment as every day skins are dumped in an isolated room. Salt is applied to them to avoid bad odor (air pollution).

f) **Evisceration:** Evisceration and washing take place on the floor, in the same spot as flaying. Fat, pieces of meat, paunch, gall bladder, condemned meat, to mention a few, are the main waste generated here.

g) **Carcass Splitting:** Skinned and eviscerated animals are split into four quarters on the same floor because the hoisting system was not functional (Figure 1). From that floor, these quarters of meat are brought to the floor within the abattoir for selling. Pieces of meat, bones, fat, and marrow, among others, are major waste gathered in the carcass split point in

Kano abattoirs. The method used for waste management here is consumption. People use these pieces of meat, bones, fat, and others in their soup. The waste becomes recycled and serves as edible.

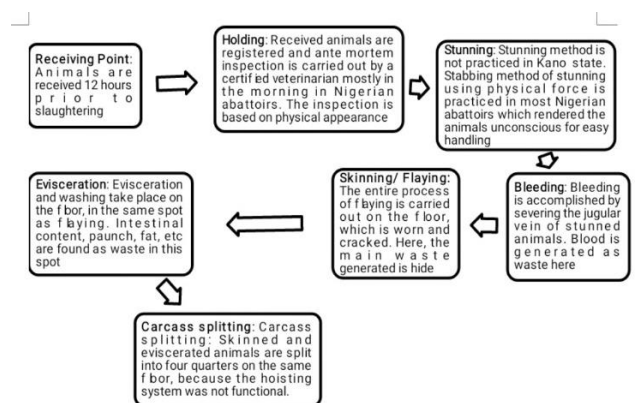


Figure 1: Abattoir workflow in Kano State

Source: Field observation, (2020)

However, meat processors have a culture of separating ASW for economic motives. So, separation should continue at the abattoir premises based on some containers with different colors (for example, green container for paunch, white for bones, red for clotted blood, black for hooves, ash for horns, amber for pieces of fat, among others). For the abattoir management and government, this simple model (Figure 2) is hoped to work in order to minimize the negative effects of ASW on the people in proximity to abattoirs and utilize ASW for full environmental and socioeconomic benefits.

### Abattoir Model for Effective Utilization of ASW

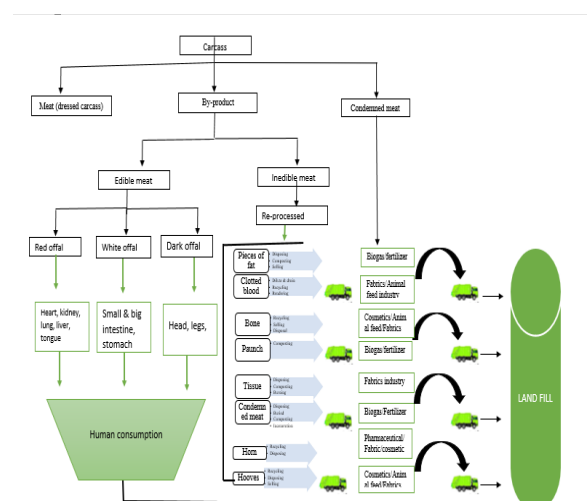


Figure 2: Abattoir model for effective utilization of ASW

Source: Field observation, 2020

**Proposed Abattoir Solid Waste Dumping Site in Kano metropolitan**

This simple model states that once an animal is slaughtered, fresh meat should be separated for further processing or selling. By-products in the abattoir are divided into two categories: edible by-products such as red, white, and hard offal, and inedible by-products which include paunch, bones, horns, hooves, clotted blood, and so on (Figure 2). The most common methods of utilizing this animal slaughter waste (ASW) as stated by the respondents are recycling, burning, disposing, and burying. Both disposing and burying should be integrated into either composting or recycling. A zero-waste abattoir approach should be adopted, where all ASW is either directly recycled or indirectly recycled through composting. Vehicles should be provided for transporting ASW to Panisau (Figure 3) for metropolitan abattoirs, which produce more waste than non-metropolitan abattoirs in a month. This will centralize the utilization center for ASW. All pharmaceutical, fabric, and cosmetic companies should collect their ingredients from the abattoir premises. For animal feed companies, cooling facilities should be provided for preserving and selling such food. Any remaining by-products after biogas and fertilizer production should be sent to a landfill. The amount of by-products that will go to the landfill will be very minimal.

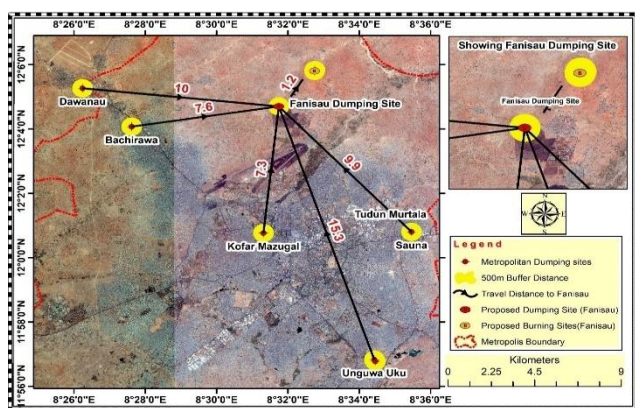


Figure 3: Proposed Metropolitan Dumping Site of ASW

Source: Fieldwork, 2020

On the other hand, the reason for choosing Panisau as the dumping site is that all abattoirs in Kano metropolitan local government areas are located close to residential areas, which pose threats to the lives of people there. However, Panisau is far from residential areas (more than 500 meters, above the required distance) and located on the western side

of the people living in Panisau town. Similarly, the Panisau area is located on an underlying basement complex formation rock, which may not affect underground water in the area. Geographically, it is not too far from all abattoirs in Kano metropolitan local government area (with the farthest abattoir distance being 15.3 km) (Figure 4).

Another reason for proposing Panisau as a dumping site is that it is close to the transportation network – not more than 200 meters. It is also found that there is no graveyard or administrative building close to the proposed site (the distance of the abattoir or dumping site to the graveyard or administrative block should be more than 300 meters). Additionally, from an economic perspective, it is not too costly to transport ASW to the Panisau site. Both biogas and fertilizer could be produced there in Panisau. Some of the factors considered for establishing an industry are proximity to raw materials (ASW) and the market (metropolitan people can patronize biogas and farmers can get cheap fertilizer). This will boost the economic status of Kano State.

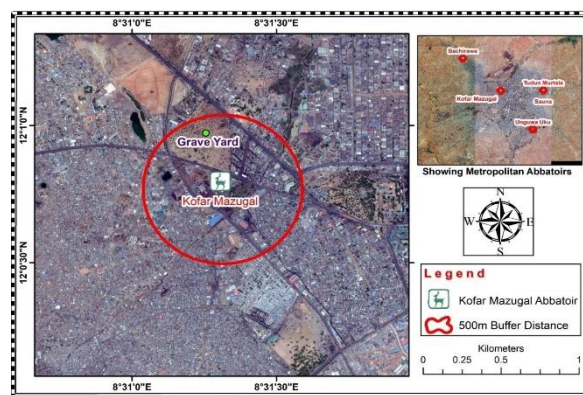


Figure 4: Abattoir in relation to residential area

Source: Fieldwork, 2020

**Conclusion and Recommendations**

With regards to the findings of this study, the researcher arrived at the following conclusions: most abattoirs do not comply with the rules and regulations that guide their activities. It was found that the way abattoir operations were conducted in the 20th century was very systematic as opposed to nowadays. The study concluded that most abattoir operations negatively

affect neighboring communities. Therefore, a proposed ASW dumping site was modeled in the Panisau area (as the area met all the criteria set by regulatory bodies). The following recommendations are suggested:

1. Compliance with all abattoir rules and regulation should be emphasised.
2. A proper planning should be put in place to avoid encroaching of people close to abattoir or establish new abattoir close to residential area.
3. Investors should be invited to start up processing abattoir by-products near the dumping site.

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