

An Evaluation of Slaughterhouse Facilities and Waste Management Practices in Tarauni Local Government Area, Kano State, Nigeria

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Abstract

Wastes such as liquid wastes and solid wastes usually generated in most slaughter houses remained major sources of environmental pollution due to poor waste management practice. In this paper, the types of waste management practice and facilities in slaughterhouses in Tarauni Local Government Area of Kano State, Nigeria are discussed. The different types of wastes generated in the local slaughterhouse and the methods of managing the wastes were identified. A mixed-methods approach was employed, combining site observations, and semi-structured interviews with management staff and slaughterhouse workers in the study areas. The study identified blood, offal, bones, hides/skins, wastewater, and manure as the primary waste types generated, it also revealed the inadequacy of effective waste management practices. The significant challenges found in waste management practices in Tarauni include a lack of proper waste disposal facilities, inadequate funding, and insufficient knowledge and training among staff. A common consensus among stakeholders on the importance of improving waste management practices by incorporating an integrated waste management system, improved facility layout, technological innovations, and sustainability features has been proposed.

Keywords: Slaughterhouse, Waste Management, Animal Welfare, Architectural Innovation, Sustainable Practices, Tarauni, Kano State.

Introduction

Slaughterhouses are the primary facilities for meat processing and as sure play a critical role in the meat industry (Wang et al., 2021). The meat industry relies heavily on good slaughterhouses for efficient processing of meat that are safe for human consumption. However, in most developing countries like Nigeria, Slaughterhouses in operation lack good infrastructure such as proper roofing, water supply, and waste management systems (Ovuru et al., 2024). Lack of these facilities has made the processing of meat unhygienic leading increased risk of disease transmission, compromising both public health and environmental safety

In Kano state of Nigeria, most slaughterhouses are facing challenges of modern infrastructures and inadequate waste management practices. The current practice of

management of waste generated in slaughterhouses such as open dumping of the solid waste and direct discharge of liquid waste has posed serious danger to public health (Bello et al., 2015). The outdated architectural design of many facilities further exacerbates these issues, compromising both animal welfare and worker safety (Ibrahim et al., 2021).

Tarauni Local Government Area has a long-standing tradition of livestock farming and meat processing in an area popularly known as Yan-awaki, which is integral to the local economy and culture. The slaughterhouse in Tarauni has been used for processing of meat for the community and this has been a major source of the economic for the L. G. A. The processing of the meat is based on the traditional model which involves slaughtering, evisceration, and butchering. This model does generate substantial wastes such blood, offal, bones, hides, water, and gaseous emission. Wastes such as blood and bones are collected and used as fish feed and poultry feed respectively. The other wastes like waste water are usually discharged into the river and this can cause so much environmental degradation which poses serious health risks to the local population (Al-Gheethi et al., 2021).

The lack of modern infrastructure and proper waste management protocols often leads to inefficient handling of these wastes. There has been pressure on the slaughterhouse due migration of people from the villages to the urban centers. Therefore, there is need to evaluate their operational frameworks and waste management strategies for the purpose of improvement on waste management practices to meet modern standards for hygiene and efficiency sustainability (Borkfelt, 2022, Kassung, 2023)).

Fernandes Junior and Pinto (2022) highlight the importance of lean manufacturing principles in slaughterhouse design, demonstrating that optimizing layout and process flow can lead to significant improvements in throughput and resource utilization. Kim et al. (2023) providing a comprehensive review of robotic technologies being implemented in pork and beef slaughtering processes. Kabeyi and Olanrewaju (2022) discussed the potential for converting slaughterhouse waste into energy, presenting a performance analysis and design of slaughterhouse biodigesters. This approach not only addresses waste management issues but also contributes to the facility's energy needs, reducing its environmental footprint. Wang et al. (2021) further emphasize the importance of sustainable design in modern slaughterhouses, describing them as "buildings of control and reform" that integrate advanced technologies and sustainable practices to improve operational efficiency and reduce environmental impact.

Fernandes Junior and Pinto (2022) demonstrated that reconfiguring facility layouts reduced processing times by 28% in Brazilian beef plants, while Kim et al. (2023) highlighted robotic systems' role in improving precision during pork carcass division. Modern slaughterhouse design integrates lean manufacturing principles and automation to optimize workflow. Sustainability innovations now drive morphological changes, exemplified by biodigesters converting organic waste into energy, a practice Kabeyi and Olanrewaju (2022) found could offset 40% of a facility's power needs. However, Al-Gheethi et al. (2021) caution that developing nations often lack infrastructure to manage the 500–1,000 kg of daily waste

(blood, offal, wastewater) generated per facility, leading to open dumping practices that contaminate local ecosystems (Bhunias et al., 2022). Case studies in Nigeria reveal persistent challenges, with Ovuru et al. (2024) reporting only 12% of slaughterhouses having functional wastewater treatment systems, while Adebawale (2019) and Dada et al. (2021) documented direct effluent discharge into water bodies in Abeokuta and Ibadan, respectively.

Emerging solutions blend circular economy principles with localized adaptations. Philipp et al. (2021) and Choudhury et al. (2024) advocate membrane bioreactors for wastewater reuse, while Maliha et al. (2023) demonstrated leather byproduct valorization could generate \$2.8M annually for mid-sized facilities. Energy recovery systems, particularly biogas plants using slaughter effluent, show promise—Vilvert et al. (2020) calculated a 300-cattle facility could produce 1,200 kWh/day. However, regulatory gaps hinder progress; Wong et al. (2024) found only 33% of developing nations have slaughterhouse-specific waste policies. In Nigeria, Ibrahim et al. (2021) linked poor waste management to 18% higher zoonotic disease incidence, prompting calls for context-sensitive regulations that balance modernization with cultural practices (Ekpunobi et al., 2024). These developments highlight the need for morphology that harmonizes technological innovation with socio-environmental realities.

Ovuru et al. (2024) provide a comprehensive review of slaughterhouse facilities in developing nations, highlighting the challenges in sanitation, hygiene practices, and sustainable management systems. In many developing nations, including Nigeria, inadequate infrastructure and a lack of proper waste management systems lead to improper disposal methods. Bhunias et al. (2022) highlight that in rural areas of developing countries, slaughterhouse waste is often disposed of in open dumps or water bodies, posing significant environmental and health risks. Adebawale (2019) describes a case study in Abeokuta, Nigeria, where waste management practices were found to be inadequate, with improper disposal of blood, offal, and wastewater. Similarly, Dada et al. (2021) identify significant environmental hazards and health risks associated with slaughterhouses in Ibadan, Nigeria, emphasizing the need for improved waste management practices and facility design.

Recent research has focused on developing innovative solutions for slaughterhouse waste management. Philipp et al. (2021) review various treatment methods for slaughterhouse wastewater, emphasizing the potential for water recycling and reuse. They discuss technologies such as membrane filtration, advanced oxidation processes, and biological treatments that can effectively treat wastewater for non-potable applications within the slaughterhouse. Alam and Naseem (2023) provide a comprehensive review of conventional and emerging technologies for slaughterhouse wastewater treatment, highlighting the potential of nanobubble technology for efficient pollutant removal.

The concept of a circular economy is gaining traction in slaughterhouse waste management. Ravi et al. (2023) discuss circular economy practices in the leather products

industry, which can be applied to slaughterhouse waste valorization. This approach focuses on transforming waste into valuable resources, aligning with sustainable environmental management principles. Vilvert et al. (2020) explore the minimization of energy demand in slaughterhouses, estimating the potential for biogas production from effluent, further emphasizing the importance of integrating renewable energy systems into slaughterhouse design.

This paper aims to address these issues by exploring contemporary architectural designs and incorporate sustainable waste management strategies for slaughterhouses in Tarauni Local Government Area, Kano State that will safeguard public health while respecting local customs related to meat processing and consumption.

Method

The types of wastes generated in the Slaughterhouse in Tarauni Local Government Area were evaluated through site observations, semi-structured interviews with seven (7) Management staff members, and a quantitative survey of thirty one (31) workers of the Slaughterhouse and Management Personnel.

Results

The results based on data collected through Site observations, Semi-Structured Interviews with seven (7) Management Staff members, and a Quantitative Survey of the thirty one (31) workers of the slaughterhouse and Management Personnel are presented in figures 1 and 3.

Types of Waste Generated at Tarauni Slaughterhouse

The study revealed six main types of waste generated at the Tarauni slaughterhouse: blood, offal, bones, hides/skins, wastewater, and manure. All respondents (100%) identified blood, offal, bones, hides/skins, and wastewater as major waste types, while 80.6% mentioned manure. This indicates a diverse range of waste streams that need to be managed effectively.

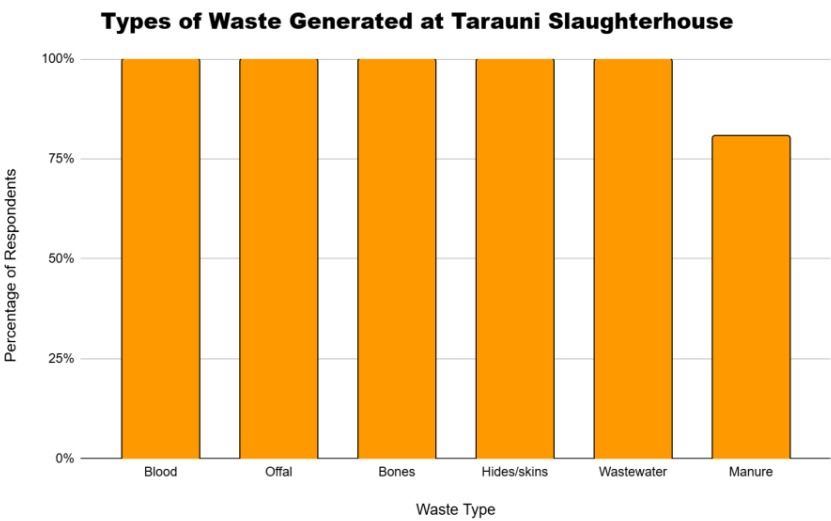


Figure 1: Types of Waste Generated at Tarauni Slaughterhouse

All respondents (100%) identified blood, offal, bones, hides/skins, and wastewater as major waste types generated at the slaughterhouse. Manure was also mentioned by a significant majority (80.6%). This indicates a diverse range of waste streams that need to be managed effectively.

Quantity of Waste Generated:

The daily waste generation at the Tarauni slaughterhouse was significant. The majority of respondents (58.1%) reported that 500-1000 kg of waste is generated daily, while 25.8% indicated more than 1000 kg. This highlights the substantial volume of waste that needs to be managed on a daily basis.

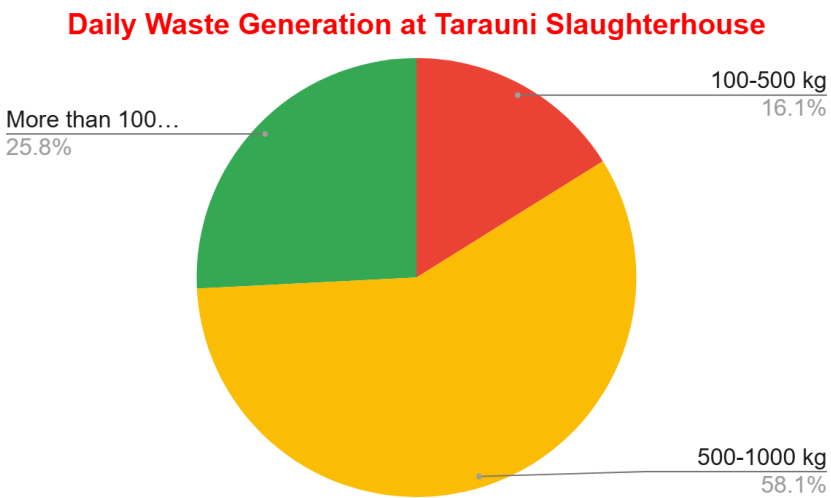


Figure 2: Daily Waste Generation at Tarauni Slaughterhouse

The majority of respondents (58.1%) reported that the slaughterhouse generates between 500-1000 kg of waste daily, with a significant portion (25.8%) indicating more than 1000 kg. This highlights the substantial volume of waste that needs to be managed on a daily basis.

Current Waste Management Practices:

The study revealed concerning waste management practices at the facility. 93.5% of respondents reported open dumping of solid waste, while 100% indicated direct discharge of liquid waste. Additionally, 100% reported no specific management practices for emissions. These findings highlight a critical lack of proper waste management infrastructure and practices.

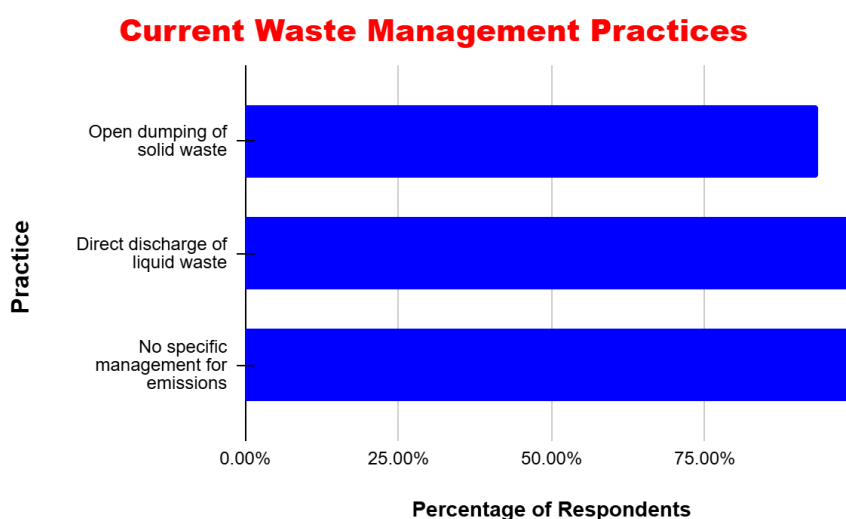


Figure 3: Current Waste Management Practices

The data reveals concerning waste management practices, with 93.5% reporting open dumping of solid waste and 100% indicating direct discharge of liquid waste. This suggests a critical need for improved waste management systems and infrastructure.

Challenges in Waste Management:

Several key challenges in waste management were identified. All respondents (100%) reported a lack of proper facilities and inadequate funding as major challenges. Additionally, 90.3% cited a lack of knowledge/training, and 71% mentioned insufficient manpower. These challenges underscore the need for comprehensive improvements in infrastructure, funding, training, and staffing.

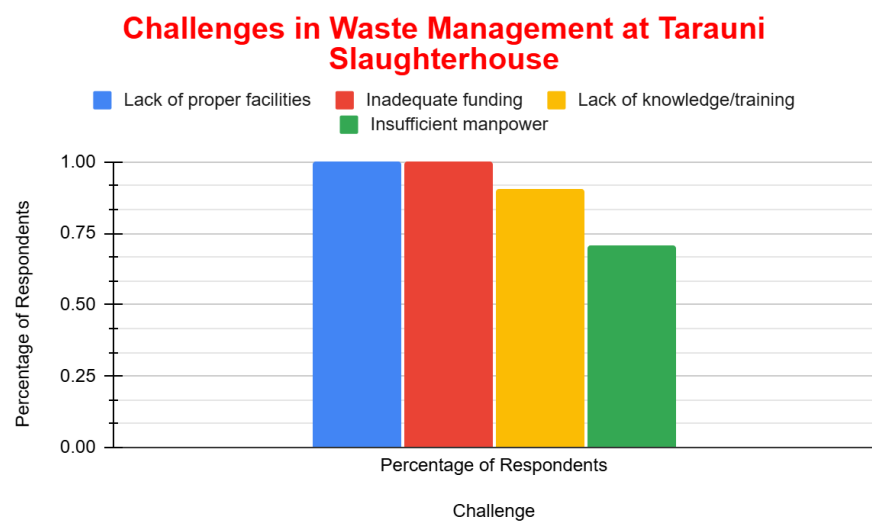


Figure 4: Challenges in Waste Management

These challenges underscore the need for comprehensive improvements in infrastructure, funding, training, and staffing to address waste management issues effectively.

Importance of Improving Waste Management:

There was a strong consensus among respondents on the importance of improving waste management practices. 93.5% considered improving waste management to be very important, while 6.5% viewed it as somewhat important. This unanimous recognition of the need for improvement provides a strong basis for implementing changes in waste management practices at the Tarauni slaughterhouse.



Figure 5: Importance of Improving Waste Management

An overwhelming majority (93.5%) of respondents consider improving waste management to be very important, with the remaining 6.5% viewing it as somewhat important. This unanimous recognition of the need for improvement provides a strong basis for implementing changes in waste management practices at the Tarauni slaughterhouse. Plates 1, 2 and 3 below show how ineffectively how waste manages, and poorly space coordinated in Tarauni Slaughterhouse.



Plate 1: The picture shown Tarauni Slaughterhouse in Tarauni local government Kano state which currently not architecturally well-defined

Source: Authors fieldwork (2024).





Plate 2: The picture shown Tarauni Slaughterhouse in Tarauni local government Kano state which currently has poor waste management handling practices.

Source: Authors fieldwork (2024)



Plate 5: The picture shown Tarauni Slaughterhouse in Tarauni local government Kano state which has ineffectively coordinated slaughtering spaces for different functions.

Source: Authors fieldwork (2024)

Discussion

The findings of this study highlight the urgent need for improved waste management practices at the Tarauni slaughterhouse in Kano State, Nigeria. The research revealed that the facility generates substantial amounts of diverse waste types, including blood, offal, bones, hides/skins, wastewater, and manure, with the majority of respondents reporting 500-1000 kg of waste produced daily. Current waste management practices were found to be severely inadequate, with open dumping of solid waste and direct discharge of liquid waste being prevalent. The study identified several key challenges impeding effective waste management, including lack of proper facilities, inadequate funding, insufficient knowledge and training among staff, and manpower shortages. Despite these challenges, there was a strong consensus among respondents on the critical importance of improving waste management practices. These findings underscore the complex and multifaceted nature of the waste management issues at the Tarauni slaughterhouse, reflecting broader challenges faced by slaughterhouse facilities in developing countries. The results emphasize the need for a comprehensive approach to redesigning the facility, incorporating modern waste management systems, sustainable technologies, and staff training programs to address the identified issues effectively and align the slaughterhouse with contemporary standards of hygiene, efficiency, and environmental sustainability.

Conclusion

This study has highlighted the critical need for improved waste management practices at the Tarauni slaughterhouse in Kano State, Nigeria. The research revealed significant

challenges in current waste management, including inadequate facilities, improper disposal methods, and a lack of sustainable practices. The findings indicate that the slaughterhouse generates substantial amounts of diverse waste types, with the majority of respondents reporting 500-1000 kg of waste produced daily. The study also identified a strong consensus among stakeholders on the importance of improving waste management practices. Based on these findings, a comprehensive redesign proposal has been developed, incorporating an integrated waste management system, improved facility layout, technological innovations, and sustainability features. This redesign aims to address the identified issues and align the slaughterhouse with modern standards of hygiene, efficiency, and environmental sustainability. The proposed changes have the potential to significantly reduce environmental impact, improve public health outcomes, and enhance operational efficiency. Future research should focus on the implementation and evaluation of these proposed improvements, as well as exploring their applicability to other slaughterhouse facilities in similar contexts. This study contributes to the growing body of knowledge on sustainable slaughterhouse operations and provides practical recommendations for improving waste management practices in developing countries.

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