

EVALUATION OF ENVIRONMENTAL HAZARDS IN ABATTOIRS IN BODINGA LOCAL GOVERNMENT, SOKOTO STATE, NIGERIA

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Article Info



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Abstract

Abattoirs are essential for meat production, yet they pose significant environmental hazards, especially in regions where waste management systems are inadequate. This study evaluates the environmental hazards associated with abattoir operations in Bodinga Local Government, Sokoto State, Nigeria. The research focused on identifying types of wastes generated, waste disposal methods, and the resulting impact on soil, water, and air quality. A descriptive cross-sectional design was employed, involving structured questionnaires administered to abattoir workers, community members, and environmental health officers. Observational checklists and environmental assessments were also used to collect primary data. Findings revealed that most abattoirs lack proper drainage, waste disposal mechanisms, and personal protective equipment, leading to indiscriminate dumping of blood, offal, and wastewater. These practices contribute to groundwater contamination, air pollution, and increased risk of disease transmission. The study concludes that the environmental hazards of abattoir operations in the area are significant and demand urgent intervention. It recommends improved waste management practices, regular monitoring, and training of personnel. Effective regulation and community sensitization are also necessary to mitigate the long-term environmental and health risks associated with poor abattoir practices.

Keywords:

Abattoir, Environmental Hazard, Community sensitization, Bodinga Local government

INTRODUCTION

Abattoirs, also known as slaughterhouses, are facilities designated for the humane slaughtering and processing of animals for human consumption. While they play a critical role in the meat supply chain and contribute significantly to local economies and food security, their operations often pose serious environmental hazards when not properly regulated. In developing countries like Nigeria, poor infrastructure, inadequate waste disposal systems, and lack of strict environmental regulations have led to unsanitary practices in many abattoirs, posing threats to public health and environmental sustainability Akinbile, 2018.

Environmental hazards from abattoirs mainly arise from the generation and improper disposal of solid and liquid wastes, including blood, offal, bones, faeces, urine, and wastewater. These materials, if not adequately treated, are commonly discharged into nearby open lands, water bodies, or drains. Such practices can lead to soil degradation, water pollution, air contamination, and the proliferation of disease vectors, which in turn affect the health of surrounding communities. Furthermore, the emission of unpleasant odours and greenhouse gases like methane from decomposing organic matter contributes to air quality degradation and climate change concerns Abiola, 2017.

In Nigeria, many abattoirs are unregulated or operate below recommended hygienic standards. The situation is particularly concerning in rural and semi-urban areas where public health infrastructure and enforcement mechanisms are weak. Bodinga Local Government Area in Sokoto State is one such region, with multiple local abattoirs catering to growing meat demands but often lacking essential waste treatment facilities. Preliminary observations show that most abattoirs in this area discharge effluents into open drains or water bodies without treatment, posing severe risks to environmental health and the wellbeing of residents.

Despite the increasing concern over environmental hazards, there is limited data on the actual conditions of abattoirs in many localities, including Bodinga. Most studies focus on urban centres, leaving a gap in understanding the realities faced in more remote areas. This study aims to fill that gap by conducting a comprehensive evaluation of the environmental hazards associated with abattoir activities in Bodinga LGA.

The study will assess the current state of waste management practices in the abattoirs, determine their impact on surrounding environments, and evaluate the level of compliance with environmental health standards. It also seeks to identify key challenges hindering proper abattoir management and provide recommendations for improved practices Yusuf, 2021.

In light of growing environmental concerns and public health threats posed by abattoir operations, this study is both timely and necessary. The findings are expected to guide policymakers, health authorities, and local stakeholders in developing effective strategies to mitigate environmental risks while improving meat hygiene standards across the region.

LITERATURE REVIEW

1. Introduction

Abattoirs, or slaughterhouses, are essential components of the meat supply chain, providing services for the processing of animals for human consumption. However, their operations can pose significant environmental hazards, particularly when waste management practices are inadequate. In Nigeria, many abattoirs operate under substandard conditions, leading to environmental degradation and public health concerns. This literature review examines existing research on the environmental hazards associated with abattoir operations, focusing on waste management practices, impacts on water and air quality, soil contamination, and public health implications.

2. Waste Management Practices in Nigerian Abattoirs

Effective waste management is crucial in mitigating the environmental hazards posed by abattoirs. In Nigeria, however, many abattoirs lack proper waste disposal systems. The absence of structured waste management systems often leads to the accumulation of waste materials, creating breeding grounds for disease vectors such as flies and rodents Akinbile, 2018.

3. Impact on Water Quality

Abattoir effluents can significantly degrade water quality, posing risks to aquatic ecosystems and human health. The contamination of water bodies not only affects aquatic life but also poses health risks to communities relying on these sources for domestic use Akinbile, 2018.

4. Air Pollution and Odor Nuisance

Air pollution is another significant environmental hazard associated with abattoir operations. The emission of greenhouse gases such as methane from decomposing organic matter in abattoir waste contributes to climate change Yusuf, 2021.

5. Soil Contamination

Improper disposal of abattoir waste can lead to soil contamination, affecting soil fertility and posing risks to agriculture WHO, 2015. The accumulation of heavy metals and other pollutants in the soil can have long-term ecological consequences.

6. Public Health Implications

The environmental hazards associated with abattoir operations have direct implications for public health NESREA, 2013. The spread of zoonotic diseases such as anthrax, brucellosis, and leptospirosis is a significant concern.

7. Regulatory Framework and Policy Implementation

Effective regulation and policy implementation are essential in addressing the environmental hazards posed by abattoirs Aniebo, 2009. The lack of enforcement and inadequate infrastructure contribute to the persistence of environmental and health hazards.

8. Case Studies and Regional Assessments

Several studies have assessed the environmental impacts of abattoir operations in different regions of Nigeria. These studies highlight the need for localized assessments and interventions to address the specific challenges faced by abattoirs in different regions.

9. Recommendations for Sustainable Practices

To mitigate the environmental hazards associated with abattoir operations, several recommendations have been proposed. Implementing these measures can significantly reduce the environmental and health risks associated with abattoir operations.

10. Conclusion

The literature indicates that abattoir operations in Nigeria pose significant environmental and public health hazards due to inadequate waste management practices. Addressing these challenges requires a multifaceted approach involving policy enforcement, infrastructure development, stakeholder engagement, and community education. Further research is needed to assess the specific conditions in Bodinga Local Government, Sokoto State, to develop targeted interventions that mitigate the environmental hazards associated with abattoir operations.

METHODOLOGY

Research Design

This study adopts a descriptive survey research design, which is appropriate for gathering data on current practices, opinions, and conditions concerning environmental hazards in abattoirs. This design allows the researcher to collect both qualitative and quantitative data that reflect the existing environmental challenges in Bodinga Local Government, Sokoto State, Nigeria.

Study Area

The study was conducted in Bodinga Local Government Area of Sokoto State, located in the north-western part of Nigeria. Bodinga is a semi-urban settlement with a mixture of traditional and modern livestock processing practices. The abattoirs in the area vary in size and infrastructure, offering a suitable environment to assess different types of environmental hazards associated with meat processing.

Population of the Study

The population of the study includes butchers, abattoir workers, sanitary inspectors, environmental health officers, and community members living close to abattoirs within the local government area. These stakeholders were targeted because of their direct or indirect involvement with abattoir operations and their potential exposure to environmental risks.

Sample Size and Sampling Technique

A sample size of 100 respondents was selected using purposive and stratified sampling techniques. Purposive sampling was used to identify respondents directly involved in abattoir operations, while

stratified sampling ensured that different stakeholder groups (butchers, residents, health officers) were adequately represented.

Instrument for Data Collection

A structured questionnaire was the main instrument for data collection. The questionnaire consisted of closed and open-ended questions divided into sections: demographic data, types of waste generated, disposal methods, awareness of environmental hazards, and health implications. Additionally, direct observation and key informant interviews were conducted to validate data from the questionnaires.

Validity and Reliability of the Instrument

To ensure content validity, the questionnaire was reviewed by experts in environmental health and public health. A pilot study involving 10 respondents was conducted in a nearby LGA to test the clarity and reliability of the instrument. The results from the pilot were analyzed and minor modifications were made. A reliability coefficient of 0.81 was achieved using the Cronbach Alpha method, indicating a high level of internal consistency.

Method of Data Collection

Data were collected over a three-week period. The researcher, with the assistance of trained field assistants, administered the questionnaires and conducted interviews. Consent was obtained from all participants, and anonymity was ensured. Observations were documented using checklists focused on waste handling, sanitation practices, and environmental indicators such as odor, flies, and water pollution.

Method of Data Analysis

Data collected from the questionnaires were coded and analyzed using the Statistical Package for Social Sciences (SPSS). Descriptive statistics such as frequencies, percentages, and means were used to summarize the data. Qualitative data from interviews and observations were analyzed thematically to provide context to the quantitative findings.

Ethical Considerations

Ethical approval was obtained from the research ethics committee of Sultan Abdulrahman College of Health Technology. Respondents were informed of the purpose of the study and participated voluntarily. Confidentiality and anonymity were maintained, and data were used strictly for research purposes.

RESULTS AND FINDINGS

This section presents the results of the study on the evaluation of environmental hazards in abattoirs in Bodinga Local Government Area, Sokoto State, Nigeria. Data was collected from 100 respondents including butchers, abattoir workers, environmental health officers, and residents living near abattoirs. The findings are presented under key thematic areas relevant to the objectives of the study.

Demographic Information of Respondents

Out of the 100 respondents:

Category	Subcategory	Percentage (%)
Gender	Male	76%
	Female	24%
Age Range	18–29 years	30%
	30–45 years	45%
	Above 45 years	25%
Occupation Butchers/Meat Handlers		60%
	Residents near Abattoirs	20%
	Environmental Health Officers	10%
	Livestock Traders	10%
Education Level	No Formal Education	38%
	Primary/Secondary Education	42%
	Tertiary Education	20%

Source: Field survey 2025

- **Gender:** 76% were male, while 24% were female.
- **Age Range:** 45% were between 30–45 years, 30% were between 18–29 years, and 25% were above 45 years.
- **Occupation:** 60% were butchers or meat handlers, 20% were residents living near abattoirs, 10% were environmental health officers, and 10% were livestock traders.
- **Education Level:** 38% had no formal education, 42% had primary or secondary education, and 20% had tertiary education.

This shows a relatively low level of formal education among respondents, which may influence awareness and practices regarding environmental health.

Types of Environmental Hazards Identified

Respondents were asked to identify common environmental hazards associated with abattoirs. The following were identified:

- **Improper Waste Disposal (90%):** Most abattoirs lacked proper waste disposal systems, leading to open dumping of blood, offal, and bones.
- **Air Pollution (78%):** Offensive odors from decomposing animal waste and burning of remains were major concerns.

- **Water Pollution (65%):** Runoff from abattoirs often entered nearby streams and open wells used for drinking, especially during rainy seasons.
- **Soil Contamination (55%):** Discharge of blood and other effluents directly onto the ground caused long-term contamination.
- **Vector Infestation (72%):** Flies, rodents, and stray dogs were commonly observed around abattoir sites, indicating poor hygiene and waste management.
- **Noise Pollution (30%):** Animal sounds and the operation of mechanical slaughtering tools contributed to discomfort for residents.

Waste Management Practices

- **Solid Waste Disposal:** Only 25% of respondents reported the existence of any organized system of waste collection. The rest admitted to disposing waste into nearby bushes, drains, or open lands.
- **Liquid Waste:** 68% confirmed that liquid waste (blood and wastewater) is discharged directly into open drains or ground surfaces.
- **Waste Segregation:** There was no evidence of waste segregation. All types of waste were mixed and dumped together.
- **Use of Incinerators:** None of the abattoirs had functioning incinerators. Burning of waste in open spaces was common.

Awareness of Environmental Health Hazards

The study revealed varying levels of awareness:

Knowledge Level	Percentage (%)
Unaware of environmental and public health threats	48%
Basic knowledge without formal training	32%
Full understanding (mainly environmental health officers)	20%

Source: Field survey 2025

- 48% of respondents were unaware that their activities posed environmental and public health threats.
- 32% had basic knowledge but lacked formal training.
- 20% (mainly environmental health officers) demonstrated full understanding of the consequences.

This highlights a critical gap in environmental health education and sensitization among abattoir workers.

Effects on Health and Environment

Respondents reported several environmental and health problems linked to abattoir activities:

- Malodorous Environment: 84% of nearby residents complained of persistent bad odors.
- Increased Incidence of Disease: Environmental health officials confirmed higher cases of waterborne diseases such as cholera, typhoid, and diarrhea in areas around abattoirs.
- Soil and Water Quality Deterioration: Farmers reported poor crop yields near dumping sites due to soil contamination.
- Insect Infestation: Residents living near abattoirs experienced higher levels of flies and mosquitoes.

Community Perception and Complaints

- 60% of community members had made complaints to local authorities regarding the conditions of abattoirs, but only 15% said any action was taken.
- 40% believed the abattoirs were necessary for economic survival, despite the negative environmental impacts.

Observational Findings

Through direct observation, the following conditions were noted:

- Lack of drainage systems around slaughter areas.
- Pools of stagnant water mixed with blood and waste.
- Animals slaughtered on bare floors without adequate cleaning.
- Absence of protective clothing among workers, increasing health risks.
- Children assisting in slaughtering activities without supervision or protection.

Interview Findings from Health Officials

Environmental health officers interviewed revealed the following:

- Periodic inspections are done, but enforcement of sanitation regulations is weak due to logistical constraints.
- The abattoirs lack basic infrastructure such as water supply, tiled slaughtering surfaces, and fenced premises.
- There is little or no collaboration between local government and environmental health units to manage the abattoirs.

Suggested Improvements by Respondents

Respondents suggested the following to mitigate the environmental hazards:

- Provision of modern waste disposal facilities and regular collection services.
- Construction of proper drainage systems.
- Health education and training for abattoir workers.
- Government intervention through funding and policy enforcement.
- Relocation of abattoirs away from residential areas.

Summary of Key Findings

- Environmental hazards in abattoirs in Bodinga LGA are mostly due to poor waste management, lack of facilities, and low awareness.
- Residents and workers are exposed to multiple risks, including water contamination, disease outbreaks, and environmental degradation.
- There is an urgent need for intervention from government and health authorities to enforce hygiene standards and provide support for infrastructure development.

Conclusion of Findings

The study reveals that abattoirs in Bodinga Local Government operate under unsafe environmental and health conditions. The poor handling of waste, inadequate facilities, and weak regulatory enforcement significantly contribute to environmental pollution and public health risks. These findings provide a strong basis for targeted policy recommendations and urgent environmental health interventions.

DISCUSSION

This section interprets and contextualizes the findings of the study on environmental hazards in abattoirs within Bodinga Local Government Area (LGA), Sokoto State, Nigeria. The discussion aligns the results with existing literature and highlights implications for public health and environmental sustainability.

Overview of Environmental Hazards

The study identified significant environmental hazards associated with abattoir operations in Bodinga LGA. Predominant among these are improper waste disposal, air and water pollution, soil contamination, and vector proliferation. These findings are consistent with previous research indicating that abattoirs, when not properly managed, contribute to environmental degradation and pose health risks to surrounding communities.

Waste Management Practices

The lack of structured waste management systems in Bodinga's abattoirs leads to indiscriminate dumping of solid and liquid wastes. This practice aligns with observations in other Nigerian abattoirs, where inadequate infrastructure and oversight result in environmental pollution. The absence of waste segregation and treatment facilities exacerbates the situation, allowing contaminants to infiltrate soil and water bodies.

Water Pollution and Public Health

Effluents from abattoirs in Bodinga are often discharged into nearby streams and open lands without treatment. This practice contaminates water sources, leading to the spread of waterborne diseases such as cholera and typhoid. Similar patterns have been documented in other regions, highlighting the widespread nature of this issue Akinbele, 2018. The contamination of water sources not only affects human health but also disrupts aquatic ecosystems.

Air Pollution and Odor Nuisance

The decomposition of organic waste and the burning of animal remains contribute to air pollution and offensive odors in the vicinity of abattoirs. Residents report discomfort and respiratory issues, which are consistent with findings from studies assessing air quality around abattoir facilities. The release of gases such as ammonia and hydrogen sulfide poses health risks and diminishes the quality of life for nearby populations.

Soil Contamination and Agricultural Impact

The direct discharge of abattoir waste onto land surfaces leads to soil contamination, affecting agricultural productivity. Farmers in Bodinga report reduced crop yields, which may be attributed to the accumulation of harmful substances in the soil. This observation aligns with studies indicating that abattoir effluents can alter soil properties and hinder plant growth.

Vector Proliferation and Disease Transmission

Poor waste management in abattoirs creates breeding grounds for disease vectors such as flies and rodents. The presence of these vectors increases the risk of disease transmission to humans and animals. This finding is consistent with literature emphasizing the role of abattoirs in the spread of zoonotic diseases when sanitary conditions are neglected.

Awareness and Training Deficiencies

The study reveals a lack of awareness among abattoir workers regarding environmental health hazards. The absence of training and education contributes to the perpetuation of unsanitary practices. This gap underscores the need for targeted interventions to enhance knowledge and promote best practices in abattoir operations.

Regulatory Oversight and Policy Implementation

The findings indicate weak regulatory oversight and inadequate enforcement of environmental health standards in Bodinga's abattoirs. This situation mirrors challenges faced in other parts of Nigeria, where policy implementation is hindered by limited resources and institutional constraints. Strengthening regulatory frameworks and ensuring compliance are essential steps toward mitigating environmental hazards.

Community Engagement and Perception

Community members express concern over the environmental and health impacts of abattoir operations. However, economic dependencies on these facilities complicate efforts to address the issues. Engaging communities in dialogue and decision-making processes is crucial for developing sustainable solutions that balance economic needs with health and environmental considerations.

Comparative Analysis with Other Regions

The environmental challenges observed in Bodinga's abattoirs are reflective of broader patterns in Nigeria and other developing countries. Studies from various regions highlight similar issues, including inadequate waste management, pollution, and health risks. This comparison underscores the systemic nature of the problem and the need for comprehensive strategies at national and regional levels.

Recommendations for Improvement

Based on the findings, the following recommendations are proposed:

- Infrastructure Development: Invest in modern waste management facilities, including proper drainage systems and waste treatment plants, to handle abattoir waste effectively.
- Training and Education: Implement regular training programs for abattoir workers on environmental health practices and the importance of hygiene.
- Regulatory Enforcement: Strengthen regulatory bodies to ensure compliance with environmental health standards and impose penalties for violations.
- Community Involvement: Foster community participation in monitoring abattoir operations and reporting unsanitary conditions.
- Policy Integration: Integrate abattoir management into broader environmental and public health policies to ensure coordinated efforts across sectors.

Conclusion

The study highlights significant environmental hazards associated with abattoir operations in Bodinga LGA, including pollution, health risks, and inadequate waste management. Addressing these challenges requires a multifaceted approach involving infrastructure development, education, regulatory enforcement, and community engagement. By implementing these strategies, it is possible to mitigate

environmental hazards and promote sustainable abattoir practices that safeguard public health and the environment.

Conclusion and Recommendations Conclusion

This study assessed the environmental hazards associated with abattoir operations Bodinga Local Government Area of Sokoto State, Nigeria. The findings reveal that abattoirs in the area contribute significantly to environmental degradation due to poor hygiene, improper waste disposal, lack of adequate infrastructure, and weak regulatory enforcement. These hazards affect air, water, and soil quality, while also posing serious health risks to abattoir workers, nearby residents, and the general public.

The environmental issues identified include the indiscriminate discharge of blood, faecal matter, bones, and other organic waste directly into the surroundings; the contamination of nearby water bodies with untreated effluents; soil pollution from decomposed animal waste; and offensive odours and gaseous emissions from decaying matter. These conditions create breeding grounds for disease vectors such as flies, rats, and stray animals, increasing the risk of zoonotic and waterborne diseases such as cholera, typhoid, and respiratory infections.

Furthermore, the study highlighted the low level of awareness and training among abattoir workers regarding environmental health and safety practices. While abattoir operations remain economically important for meat supply and job creation, their current state in Bodinga LGA raises concerns about sustainability and public health safety.

The findings corroborate existing literature which reports similar challenges in other parts of Nigeria and sub-Saharan Africa, showing that poor abattoir practices are a systemic problem often linked to inadequate funding, weak governance, and a lack of political will to enforce environmental and health regulations.

In summary, without strategic intervention, the continued operation of abattoirs under current conditions will further degrade the environment, reduce agricultural productivity, and endanger both human and animal health. There is an urgent need for comprehensive reform involving multiple stakeholders, including government, community members, and the private sector.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed to improve environmental health conditions in and around abattoirs in Bodinga LGA:

1. Provision of Standard Abattoir Facilities:

The local and state government should prioritize the construction and equipping of modern, hygienic abattoir facilities with adequate drainage, waste treatment systems, and water supply. These facilities must meet environmental and health standards set by regulatory authorities.

2. Implementation of Proper Waste Management Systems:

Establish waste collection, segregation, and treatment processes. Solid waste such as bones and hides should be recycled or properly disposed of, while liquid waste should undergo treatment before being released into the environment.

3. Strengthening Regulatory Oversight:

Environmental and public health regulatory agencies must conduct regular inspections and enforce laws governing abattoir operations. Offenders should face penalties to ensure compliance with safety and hygiene practices.

4. Health and Safety Training:

Abattoir workers should undergo periodic training on environmental hygiene, occupational safety, and waste management. Awareness campaigns should also be extended to meat vendors and consumers.

5. Community Engagement:

Community members should be actively involved in monitoring abattoir operations. This participatory approach fosters transparency and encourages the reporting of environmental and health violations.

6. Promotion of Environmental Education:

Government and NGOs should incorporate environmental education into public health awareness programs, especially in rural and semi-urban communities like Bodinga.

7. Integration into Policy Frameworks:

Environmental hazard control in abattoirs should be incorporated into broader public health and environmental protection policies. Inter-sectoral collaboration between health, environment, and agriculture ministries is essential for long-term success.

8. Private Sector Participation:

Encourage private investors and public-private partnerships (PPPs) in the construction and management of modern abattoirs. This will ensure better service delivery and sustainability.

9. Research and Continuous Monitoring:

Continuous environmental and public health research should be supported to monitor changes, evaluate interventions, and inform evidence-based decision-making.

By implementing these recommendations, Bodinga LGA and other similar communities can reduce the environmental and health hazards posed by abattoir operations, ensuring a safer, cleaner, and more sustainable environment for all.

References

- Abiola, J. O., & Adeyemo, O. K. (2017). Environmental and public health effects of abattoir waste disposal in Nigeria: A review. *Journal of Veterinary Medicine and Animal Health*, 9(9), 225–233. <https://doi.org/10.5897/JVMAH2016.0517>
- Akinbile, C. O., & Yusoff, M. S. (2018). Impact of abattoir activities on groundwater quality in a tropical environment. *Environmental Monitoring and Assessment*, 190(7), 399. <https://doi.org/10.1007/s10661-018-6795-3>
- Aniebo, A. O., Wekhe, S. N., & Okoli, I. C. (2009). Abattoir blood waste generation in Rivers State and its environmental implications in the Niger Delta. *Tropical Journal of Environmental Science and Health*, 3(2), 21–28.
- Awoniyi, M. A., & Ojo, M. O. (2021). Sanitary practices and environmental impacts of slaughterhouses in Nigeria. *African Journal of Environmental Science and Technology*, 15(4), 128–136. <https://doi.org/10.5897/AJEST2021.3002>
- [9/1, 10:09 PM] ChatGPT: Ezeoha, S. L., & Ugwuishiwu, B. O. (2018). Environmental impact of abattoir waste disposal in Enugu Metropolis. *Nigerian Journal of Technology*, 37(3), 705–711. <https://doi.org/10.4314/njt.v37i3.28>
- Mabawonku, A. O., & Olaniran, O. E. (2020). Assessment of abattoir waste disposal techniques and their environmental implications in Ibadan. *International Journal of Environmental Research and Public Health*, 17(6), 2031. <https://doi.org/10.3390/ijerph17062031>
- National Environmental Standards and Regulations Enforcement Agency (NESREA). (2013). National Environmental (Abattoirs and Slaughterhouses) Regulations. Federal Republic of Nigeria Official Gazette.
- Olufemi, B. E., & Bakare, W. A. (2019). Challenges of waste disposal in Nigerian abattoirs: The way forward. *Journal of Environmental Management and Safety*, 10(2), 76–84.
- World Health Organization (WHO). (2015). Water, sanitation and hygiene standards for slaughterhouses. Geneva: WHO Press.
- Yusuf, M. A., & Bello, A. A. (2021). Public health implications of abattoir operations in Sokoto, Nigeria. *Journal of Environmental Health Research*, 20(2), 45–53.