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Linking Abattoir Operations to Occupational Health Risks and Environmental Contamination: A One Health Assessment in Calabar Metropolis, Nigeria

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Abstract

Abattoir operations are essential components of food production and public health; however, inadequate operational practices may expose workers to occupational hazards and surrounding communities to environmental contamination. This study assessed the association between abattoir operations, occupational health risks, and environmental contamination using a One Health approach in Calabar Metropolis, Nigeria. A cross-sectional study design was adopted across selected abattoirs in Calabar Municipality and Calabar South Local Government Areas. A total of 22 abattoirs duly registered with the Cross River State Ministry of Health were identified across nine locations within the study area. One abattoir was purposively selected from each location based on the inclusion criterion of having been in operation for at least 15 years and 250 respondents, comprising 47 abattoir workers, 59 meat handlers, 138 nearby residents, and 6 environmental health personnel were included in the study based on their availability and willingness to participate in the study. Data were collected through structured questionnaire, observational checklists, and environmental assessment records. Descriptive statistics, Pearson Product-Moment Correlation, and Multiple Regression Analysis were used to test hypotheses at a 0.05 significance level. The findings revealed that poor waste disposal practices, inadequate sanitation facilities, and unsafe slaughtering procedures were major operational challenges associated with environmental contamination and occupational exposure. Common clinical signs suggestive of disease among abattoir animals included diarrhea (30.19%) and hair or skin lesions (8.49%). Similarly, bloody diarrhea was one of the common diseases reported by workers (19.81%) and nearby residents (13.76%). A significant positive association existed between abattoir operational practices and environmental contamination ($r = 0.68$, $p < 0.05$), indicating that poor operational management increased contamination risks. Multiple Regression Analysis further showed that occupational exposure was significantly associated with health-risk scores among workers. Biological hazards had the strongest standardized contribution ($\beta = 0.42$, $t = 6.31$, $p < 0.001$), followed by physical hazards ($\beta = 0.31$, $t = 4.85$, $p < 0.001$) and chemical exposure ($\beta = 0.27$, $t = 3.96$, $p < 0.002$). The study concluded that unsustainable abattoir operations create interconnected risks to human health, animal health, and environmental quality. The study recommends improved waste management systems, strict enforcement of occupational safety standards, routine health surveillance of workers, and integrated One Health interventions to promote safer and sustainable abattoir practices in Calabar Metropolis. These measures will reduce occupational exposure, prevent transmission, protect ecosystems, and strengthen community health resilience.

Keywords: Abattoir operations, Occupational health risks, Environmental contamination, One Health, Calabar Metropolis.

Introduction

Abattoir operations represent an essential component of the global livestock value chain by supporting meat production, food security, employment generation, and economic development (Acosta, 2018). Across the world, slaughterhouses serve as critical points where animals are

transformed into consumable products; however, they also represent potential hotspots for occupational hazards and environmental contamination when proper management systems are lacking. In developed countries such as the United States, Canada, Germany, and Australia, strict regulations, advanced waste treatment technologies, and occupational safety standards have been implemented to reduce risks associated with slaughtering activities (Badgett & Milbrandt, 2020; Richardson, 2021; Schneidewind, Meemken, & Langforth, 2023; McCabe, Harris, Antille, Schmidt, Hill, & Baillie., 2020). Despite these measures, concerns relating to worker injuries, zoonotic disease transmission, wastewater pollution, and antimicrobial resistance continue to attract global attention because abattoirs create direct links between animal health, human health, and environmental conditions (Gufe, Chari, Jambwa, Dinginya, Mahlangu, Marowero, & Machakwa, 2025; Ekpunobi, Adesanoye, Orababa, Adinnu, Okorie, & Akinsuyi, 2024). The increasing recognition of these interconnected risks has strengthened the adoption of the One Health approach, which emphasizes coordinated management of human, animal, and ecosystem health.

In many developing countries, particularly across Africa and Asia, abattoir activities remain largely informal and are frequently associated with poor sanitation, inadequate infrastructure, and ineffective waste management systems. Countries such as Kenya, Ghana, Ethiopia, South Africa, and Tanzania have reported environmental challenges around slaughter facilities, including untreated effluent discharge, accumulation of animal waste, unpleasant odour, and contamination of nearby water resources (Mbugua, 2025; Anaba, 2019, Fayissa, 2025). In Ghana, for example, studies around Kumasi and Accra revealed that slaughterhouse wastewater containing blood, faecal matter, and organic pollutants contributes to environmental deterioration and poses risks to surrounding communities. Similarly, research in Ethiopia and Kenya has shown that abattoir workers experience significant exposure to biological hazards due to direct contact with animal tissues, contaminated materials, and inadequate protective equipment (Rodarte, Fair, Bett, Kerfua, Fasina, & Bartlow, 2023). These challenges demonstrate that poorly managed abattoirs can become sources of public health threats rather than only centres of food production.

Nigeria, as one of Africa's largest livestock-producing countries, has a rapidly expanding demand for meat products due to population growth, urbanization, and changing consumption patterns. Abattoir facilities are distributed across several states, including Lagos, Kano, Kaduna, Oyo, Ogun, Rivers, Delta, Edo, Enugu, Anambra, Benue, Plateau, Nasarawa, and Cross River States. In major urban centres such as Lagos Mainland abattoirs, Bodija Abattoir in Ibadan, Oko-Oba Abattoir in Lagos, and abattoirs in Kano and Kaduna, studies have reported challenges associated with inadequate waste disposal, poor drainage systems, and occupational exposure among workers (Adeyi & Adeyemi, 2019; Agbeni, Ajoge, Promise, Samuel, Evelyn, Franklyn, & Boahene, 2025). Similar concerns have been documented in southeastern and south-southern Nigeria, where abattoir wastewater and solid waste are often released into surrounding environments without adequate treatment. In states such as Rivers, Akwa Ibom, Edo, Delta, and Cross River, increasing urban development around slaughter locations has intensified concerns about environmental pollution and community exposure to abattoir-related hazards.

Although abattoirs contribute significantly to livelihoods through employment opportunities for butchers, meat sellers, transporters, and livestock traders, many facilities in Nigeria still operate under conditions that compromise occupational safety and environmental sustainability. Workers often perform slaughtering activities without adequate personal protective equipment, exposing them to cuts, animal bites, blood-borne pathogens, respiratory problems, and zoonotic infections. Furthermore, indiscriminate disposal of animal remains, wastewater, and blood into drainage channels and open spaces contributes to soil degradation, water pollution, offensive odour, and increased disease vectors. These persistent challenges indicate a gap between the economic importance of abattoir activities and the need for effective health and environmental management systems. The absence of integrated assessments that simultaneously examine worker safety, environmental contamination, and operational practices motivated the need for a One Health-based investigation.

In Calabar Metropolis, Cross River State, abattoir activities have expanded alongside urban growth and increasing demand for animal protein. Locations such as Ediba Road by Cemetery Road, Esuk Otu–Satellite Town, Ikot Ene–Obong, Bacoco/Nasarawa (8 Miles), Edibe-Ebibe off Atabong, Ibesikpo Road, Anantigha–Church Road, Mami Market–Akim Barracks, and Esuk-Nsidung Slaughter serve as important points for livestock slaughtering and meat distribution. However, concerns have emerged regarding waste

accumulation, wastewater discharge, inadequate sanitation facilities, and occupational exposure among workers operating within these environments. Despite the importance of these facilities to food supply and local livelihoods, limited empirical evidence exists on the combined influence of abattoir operations on occupational health risks and environmental contamination in Calabar Metropolis. Therefore, this study was conducted to link abattoir operational practices with occupational health risks and environmental contamination using a One Health assessment approach, providing evidence needed for improved sanitation management, worker protection, and sustainable environmental practices in the study area. Specifically, the study sought to assess environmental impacts associated with slaughtering operations in abattoirs in Calabar Metropolis, examine abattoir waste management practices and indicators of environmental contamination, assess occupational health risks among abattoir workers and compare clinical signs observed among animals, diseases and symptoms reported by abattoir workers and nearby residents around abattoirs in Calabar Metropolis.

The concept of One-Health is not new; its origins can be traced back more than 200 years, evolving from the concept of One Medicine to broader perspectives such as One World, One Health and eventually, One Health (John & Martyn, 2019). In the 21st century, the outbreak of Severe Acute Respiratory Syndrome (SARS) reinforced global awareness of the potential for previously unknown pathogens to emerge from wildlife and spread among animal and human populations. It has become increasingly evident that many emerging infectious diseases are zoonotic in origin, with their emergence and transmission influenced by human activities such as ecosystem disruption, land use changes, agricultural intensification, urbanization, and international travel and trade (Pal, 2013). The One-Health approach recognizes that human, animal, and environmental health are interdependent and cannot be effectively addressed in isolation. Consequently, preventing and managing health risks requires coordinated action across multiple sectors and disciplines. These include human medicine, public health, environmental health, wildlife management, ecology, and food safety and hygiene (Mahendra, Welde & Tanvir, 2014).

There is no single internationally agreed upon definition of One Health. The most common used definition is provided by the United States Centre for Disease Control and Prevention and the One Health Commission, in which One Health is defined as a collaborative, multisectoral, and transdisciplinary approach working at the local, regional, national, and global levels with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants and their shared environment (John & Martyn, 2019). In the context of abattoir operations, the One Health concept provides a valuable framework for understanding the interconnected risks associated with animal slaughter, occupational exposure, food contamination, and environmental pollution. Its application promotes integrated strategies for protecting the health of abattoir workers, ensuring animal health and food safety, reducing environmental contamination, and safeguarding the health of nearby communities.

Methodology

Study Area

Location and size

Calabar metropolis lies between Latitudes 4°54' 00" N and 5°04' 00" N and Longitudes 8°18' 00" E and 8°24' 00" E, and it is bounded by Calabar River to the west, Kwa River to the east, Odukpani Local Government Area (LGA) to northern flank and the estuaries of the Atlantic Ocean in the south. The metropolis covers a land area of 256.51 square kilometers (km²) as seen in Figure 1. Calabar is the capital city of Cross River State, southern Nigeria. It comprises of Calabar Municipality and Calabar South Local Government Areas (LGAs). The study area had a population of 328,878 in 1991 which was projected to 779,441 in 2026. There are 22 wards in both LGAs, 12 in Calabar South and 10 in Calabar Municipality (Erhabor, Usman, Atigbede, Njoku & Itu, 2019).

Socio-economic activities in Calabar Metropolis

Calabar Metropolis has experienced considerable urbanization over the years. The city served as the first administrative headquarters of the Southern Protectorate of Nigeria from 1886 to 1904 and was also one of the earliest seats of local government administration in the former Eastern Region until 1982. In addition, tourism activities such as the Calabar Festival and Carnival constitute a major driving force for the influx of people into the city (Eyo, Ojong, Mbum, Ekpenyong, Apejoye-Okezie, Nwatu, Ahakiri, Apeh, Komomo, Okon, Edu, Nsan, Alobo, Eja & Nyong, 2025). Calabar Metropolis is experiencing continued population growth and urbanization accompanied by increasing demand for food, including meat and other animal source foods. The increasing demand for animal protein makes livestock production, animal trading, slaughtering and meat processing important components of the urban food system (Ettah, Uwah, Igri, Abua, & Ettah, 2025). Calabar Metropolis has 22 registered slaughter houses, comprising 11 cow slaughters, 10 goat and chicken slaughters concentrated around locations such as Ediba Road by Cemetery, Esuk Otu/ Satellite town, Ikot Eneobong, Bacoco/Nasarawa, Edibe-Edibe off Ataobong, Ibesikpo Road, Anantigha Church Road, Mami-Market/Akim Barracks, and Esuk Nsidung (Department of Food Safety, Nutrition and WASH, Cross River Ministry of Health, 2026). The location of the abattoirs is shown in Figure 1.

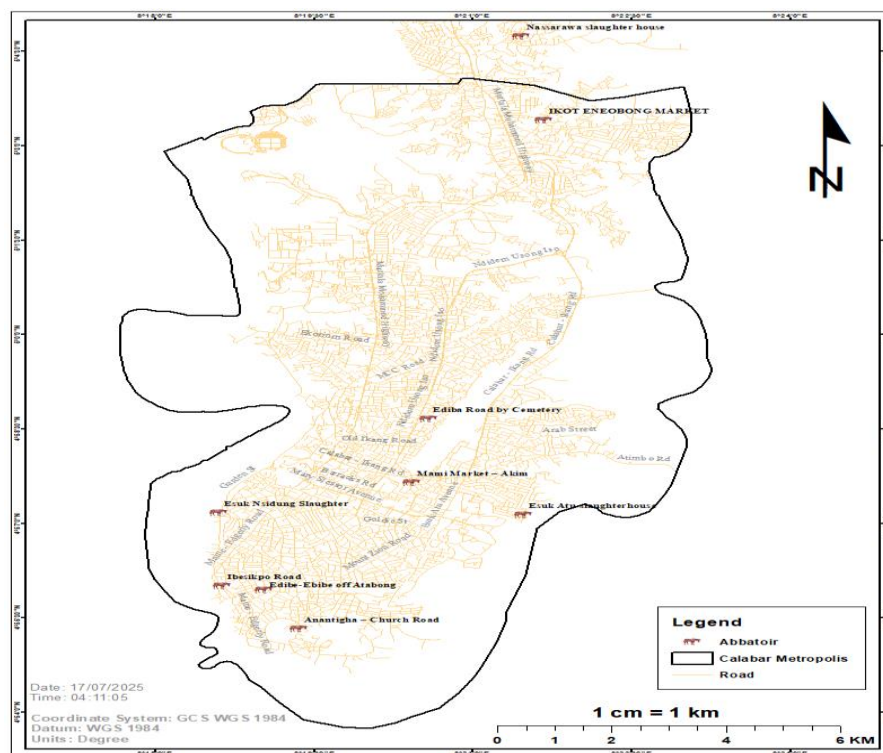


Figure 1: Location of sampled abattoirs in Calabar

Research Design

A cross-sectional research design was adopted to assess the association between abattoir operations, occupational health risks, and environmental contamination within Calabar Metropolis, Nigeria. The study employed a One-Health assessment approach, integrating human health, animal health, and environmental health perspectives, combining a questionnaire survey, environmental assessment with direct observation. This enabled triangulation of respondents reported practices and perceived occupational health risks with observed operational practices and environmental conditions at the abattoirs.

Sampling and sample size

The study adopted a non-probability sampling approach. The study area has a total of 22 abattoirs distributed across nine locations. The abattoirs were categorized based on the major types of animals slaughtered, namely cow, goats, and chicken. One abattoir was purposively selected from each of the nine locations to ensure adequate geographical representation. The selected abattoirs met the inclusion criterion of having been in operation for at least 15 years, allowing long term occupational and environmental impacts associated with abattoir activities. Based on the predominant type of animal slaughtered the selected abattoirs comprised six cow slaughtering abattoirs, two goat slaughtering abattoirs and one chicken slaughtering abattoir. Respondents were purposively selected from four relevant respondent categories based on their direct involvement with abattoir activities, proximity to abattoir operations, availability, and willingness to participate. A total of 250 respondents were recruited for the study comprising 47 abattoir workers, 59 meat handlers, 138 nearby residents, and 6 environmental health personnel.

Data Collection

The study area comprises major abattoir locations across Calabar Municipality and Calabar South Local Government Areas, where livestock slaughtering activities generate occupational exposures and environmental concerns through waste discharge, odour emission, and contamination of surrounding land and water resources (Table 1). Global Positioning System (GPS) was used to obtain the geographical coordinates of the selected abattoirs and their spatial locations within Calabar Metropolis. Data were collected using structured questionnaire to obtain data on occupational exposure of the workers to hazards, availability and usage of personal protective equipment, health problems common among the workers and the nearby residents, clinical signs observed in animals before/during slaughtering, and environmental effects of abattoir operations. Observational checklists were used to observe and record environmental conditions around the abattoir vicinity such as drainage system, accumulation of waste, blood discharge into ground, animal faeces accumulation, wastewater discharge, offensive odour, presence of flies and rodents, occupational safety practices such as wearing of PPEs and to observe animal health. Environmental assessment record was used to obtain evidence such as environmental sanitation inspection, animal health records, records of occupational injuries, records of waste disposal and environmental complaints, where available.

Data Analysis

Data were analyzed using descriptive statistics, including frequencies, percentages, and mean scores used to summarize the data. The hypotheses were tested using Pearson Product Moment Correlation (PPMC) and Multiple Regression analysis at a 0.05 level of significance to determine the relationship between abattoir operational practices, occupational health risks, and environmental contamination.

Results

The results presented in Table 1 show that all assessed abattoir locations experience varying degrees of environmental impacts associated with slaughtering operations. Among the identified sites, Ediba Road by Cemetery Road, Esuk Otu–Satellite Town, Ikot Ene–Obong, and Bacoco/Nasarawa (8

Table 1: Abattoir Locations and Their Environmental Impacts in Calabar Metropolis

Abattoir Location	Major Activities	Identified Environmental Impact	Environmental Level	Risk
Ediba Road by Cemetery Road	Cattle and small livestock slaughtering, meat processing	Accumulation of animal waste, wastewater discharge, offensive odour, drainage pollution	High	
Esuk Otu–Satellite Town	Livestock slaughtering and meat handling	Improper disposal of blood and animal remains, environmental nuisance to nearby residents	High	
Ikot Ene–Obong	Animal slaughtering and meat preparation	Solid waste accumulation, contamination of surrounding soil and water pathways	High	
Mbacoco/Nasarawa (8 Miles)	Commercial slaughtering and meat distribution	Poor sanitation, waste dumping, increased flies and disease vectors	High	
Edibe-Edibe off Atabong	Small and medium-scale slaughter activities	Untreated wastewater discharge and localized environmental pollution	Moderate	
Ibesikpo Road	Slaughtering and meat processing activities	Poor drainage management and odour emission	Moderate	
Anantigha–Church Road	Livestock processing and meat sales	Waste accumulation, sanitation challenges, possible community exposure	Moderate	
Mami Market–Akim Barracks	Meat processing and commercial distribution	Increased organic waste generation and poor waste handling	Moderate	
Esuk-Nsidung Slaughter	Livestock slaughtering activities	Wastewater pollution, poor hygiene conditions, environmental degradation	Moderate	

Source: Fieldwork, 2026.

Table 2: Abattoir Waste Management Practices and Environmental Contamination Indicators

Environmental Contamination Indicators	Frequency	(%)
Untreated discharge of blood and wastewater	75	30
Improper disposal of animal remains	58	23.2
Offensive odour from decomposing waste	42	16.8
Pollution of nearby drainage channels	37	14.8
Accumulation of solid waste around facilities	22	8.8
Presence of flies and disease vectors	16	6.4
Total	250	100

Source: Fieldwork, 2026.

Miles) recorded high environmental risk levels due to the volume of slaughtering activities and inadequate waste management practices. The findings suggest that four of the nine locations (44.4%) were classified as having high environmental risk, mainly because of uncontrolled discharge of blood, wastewater, and animal remains. The remaining locations, including Edibe-Ebibe off Atabong, Ibesikpo Road, Anantigha Church Road, Mami Market /Akim Barracks, and Esuk-Nsidung Slaughter, were reported as having moderate environmental risk, representing 55.6% (5 out of 9 locations). Although these areas showed relatively lower environmental pressure, they still experienced challenges related to sanitation, waste accumulation, and inadequate drainage systems.

The assessment of waste management practices among respondents showed that poor handling and disposal of abattoir waste remain major contributors to environmental contamination in Calabar Metropolis. Out of the 250 respondents surveyed, 75 (30%) reported that animal blood and wastewater were commonly discharged without adequate treatment, while 58 (23.2%) identified improper disposal of solid animal remains as a major environmental challenge. Furthermore, 42 respondents (16.8%) indicated that offensive odour from decomposing waste was a frequent environmental problem around abattoir locations (Table 2).

The findings on occupational health risks presented in Table 3 revealed that abattoir workers are exposed to multiple hazards associated with slaughtering activities. Among the 106 respondents, 33 (31.13%) reported exposure to biological hazards such as animal blood, tissues, and infectious materials. Physical injuries caused by knives, sharp instruments, and animal handling were reported by 24 respondents (22.64%), while 12 respondents (11.32%) identified ergonomic challenges resulting from prolonged standing, lifting, and repetitive tasks.

Table 3: Occupational Health Risks among Abattoir Workers

Occupational Health Risk Factors	Frequency	%
Exposure to animal blood and biological materials	33	31.13
Cuts and injuries from slaughtering equipment	24	22.64
Exposure to chemicals/disinfectants	19	17.92
Musculoskeletal stress from manual activities	12	11.32
Respiratory irritation from odour and dust	10	9.43
Lack of personal protective equipment	48	7.55
Total	106	100

Source: Fieldwork, 2026

The study further evaluated sanitation and safety conditions within abattoir facilities and found significant deficiencies in operational standards (Table 4). The results showed that 29 respondents (27.36%) identified inadequate drainage systems as a major challenge, while 25 respondents (23.58%) reported insufficient availability of protective equipment. Similarly, 11 respondents (10.38%) and 9 respondents 8.50%) indicated that routine environmental inspection and monitoring of workers health were poor.

Table 4: Sanitation and Safety Management Practices in Abattoir Facilities

Safety and Sanitation Indicators	Frequency	Per cent (%)
Inadequate drainage facilities	29	27.36
Lack of personal protective equipment	25	23.58
Poor availability of clean water supply	17	16.03
Insufficient waste treatment facilities	15	14.15
Inadequate routine inspection	11	10.38
Poor worker health monitoring	9	8.50
Total	106	100

Source: Fieldwork, 2026

Common clinical signs suggestive of diseases observed among animals in the abattoir are presented in Table 5. The data indicate that, among the 106 abattoir workers and meat handlers, 32 (30.19%) reported observing diarrhea among animals, while 17 (16.04%) observed nasal discharge.

Table 5: Common clinical signs suggestive of diseases among animals in the abattoir

Clinical signs	Frequency	Per cent (%)
Diarrhea	32	30.19
Hair loss/skin lesion	9	8.49
Breathing difficulty	23	21.70
Nasal discharge	17	16.04
Watery stool	25	23.58
Total	106	100

Source: Fieldwork, 2026.

Table 6 presents data on common diseases and symptoms reported among abattoir workers and nearby residents. Among the abattoir workers, 26.41%, 23.60% and 12.26% reported fever, pneumonia/respiratory illnesses, and dermatophytosis as common illnesses. Similarly, among nearby residents, 48.55%, 17.39%, and 5.80% reported fever, abdominal pain, and dermatophytosis, respectively as commonly experienced diseases and symptoms.

Table 6: Common diseases and symptoms reported among abattoir workers and nearby residents

Diseases	Abattoir workers		Nearby residents	
	F	(%)	F	(%)
Bloody diarrhea	21	19.81	19	13.76
Ringworm/dermatophytosis	13	12.26	8	5.80
Pneumonia/respiratory illness	25	23.60	20	14.50
Fever	28	26.41	67	48.55
Abdominal pain	19	17.92	24	17.39
Total	106	100	138	100

Source: Fieldwork, 2026.

Test of hypotheses

Hypothesis One

H₀: There is no significant association between abattoir operational practices and environmental contamination in Calabar Metropolis.

The Pearson-Product Moment Correlation analysis presented in Table 7 revealed a significant positive association between abattoir operational practices and environmental contamination ($r = 0.68$, $p < 0.05$). This indicates that poor operational practices, particularly ineffective waste disposal, inadequate sanitation, and uncontrolled wastewater discharge, were significantly associated with higher environmental contamination indicator scores. Since the reported p-value (0.000) is less than the 0.05 significance level, the null hypothesis was rejected. Therefore, abattoir operational practices were significantly associated with environmental contamination indicators in Calabar Metropolis.

Table 7: Pearson Product Moment Correlation test for abattoir operational practices and environmental contamination.

Variables	Mean	Standard Deviation	Correlation (r)	p-value	Decision
Abattoir operational practices	3.84	0.76	0.68	0.000	Significant
Environmental contamination	3.91	0.81			Reject H ₀

Source: Fieldwork, 2026

Hypothesis Two

H₀: Occupational exposure to abattoir hazards is not significantly associated with health risks among workers.

The regression analysis in Table 8 indicates all assessed occupational exposure hazards were significantly associated with health risks among abattoir workers. Biological hazards had the strongest positive influence on workers' health scores ($\beta = 0.42$, $t = 6.31$, $p < 0.001$), followed by physical hazards ($\beta = 0.31$, $t = 4.85$, $p < 0.001$) and chemical exposures ($\beta = 0.27$, $t = 3.96$, $p < 0.002$). The result indicates that approximately 52% of variations in occupational health risks were associated with exposure to biological, physical, and chemical hazards. Since all p-values are less than the 0.05 level of significance, the null hypothesis is rejected, confirming that occupational exposures were significantly associated with worker health-risk scores.

Table 8: Regression analysis to test the relationship between workers occupational exposure to hazards and predicted health risks

Predictor Variables	Beta Coefficient (β)	t-value	p-value	Decision
Biological hazards	0.42	6.31	0.000	Significant
Physical hazards	0.31	4.85	0.001	Significant
Chemical exposure	0.27	3.96	0.002	Significant

Source: Fieldwork, 2026

Discussion of findings

The findings of this study revealed that environmental impacts associated with abattoir operations varied across the study locations, ranging from moderate to high levels, with no location recording low environmental impact. This suggests that abattoir activities contribute substantially to environmental stress within Calabar Metropolis, particularly through inadequate waste handling, poor sanitation practices, and ineffective control measures. Similar studies have reported that poorly managed abattoir waste, including blood, animal faeces, intestinal contents, and waste water can contribute to environmental pollution, deterioration of water quality, unpleasant odour, and increased pathogen transmission within surrounding communities (Adeyemi & Adeyemo, 2007). These findings highlight the need for improved waste management infrastructure, and routine environmental monitoring to enhance abattoir operations, minimize environmental contamination, and protect the health of workers and nearby residents (Eyo, Eneyo, Apeh, Ekpo, Ajom, Omubo, Ugbaka, Odinka, Effiom, Imanyi & Ajake, 2026).

The observed poor waste management practices among abattoirs may create favourable conditions for the proliferation of disease vectors such as flies and rodents, which can facilitate the transmission of pathogens between animals, humans, and the environment. This finding is consistent with Food and Agriculture

Organization (2011), that inadequate disposal of animal waste provides breeding sites for vectors and increase likelihood of environmental contamination and zoonotic disease transmission. The findings suggest that existing abattoir management systems may be insufficient to effectively control environmental and occupational risks, indicating the need for stronger regulatory oversight, improved sanitation facilities and compliance monitoring.

The study also identified clinical signs reported among slaughtered animals, including diarrhea, hair loss, and breathing difficulties. Although these observations do not confirm specific animal diseases without laboratory diagnosis, they indicate possible animal health concerns that may have implications for public health. Abattoir workers are frequently exposed to animal tissues, blood, faeces, and other biological materials, which increases their vulnerability to zoonotic infections. Similarly, Maredwane, Hlokwe, Ngoshe, and Adesiyun (2026) discovered that abattoir workers are at increased risk of exposure to zoonotic pathogens due to occupational contact with infected animals and contaminated materials, particularly where appropriate protective measures are inadequate.

The findings further demonstrate that occupational hazards within the abattoir environment are multidimensional, involving biological, physical, chemical, and ergonomic hazards. The high proportion of the respondents reporting exposure to biological hazards suggests increased occupational vulnerability, particularly because activities such as slaughtering, skinning, evisceration, and meat processing involve frequent contact with contaminated animal products. Reports of health conditions such as bloody diarrhea, respiratory symptoms, and abdominal pain among workers and nearby residents may indicate possible health effects associated with environmental and occupational exposure, however, clinical confirmation and laboratory investigations would be required to establish direct casual relationships.

The regression analysis further revealed that exposure to occupational hazards was significantly associated with health risks among workers. The positive beta coefficients indicate that increased exposure to biological, physical, and chemical hazards corresponded with increased levels of reported health risks. Among the hazard categories, biological hazards demonstrated the strongest contribution, suggesting that exposure to animal derived pathogens, blood, faeces, and contaminated materials represent a major occupational health concern among abattoir workers. This finding agrees with Auwalu, Azmi, Norizhar, Yakubu, Olanike & Pei (2016) which identified biological exposure as a leading occupational risk factor among slaughterhouse workers due to their frequent contact with animals and animal waste.

The findings emphasize the importance of strengthening occupational hygiene and safety practices in work places such as abattoirs through consistent provision and utilization of personal protective equipment (PPE), implementation of health surveillance programmes, regular worker training, improved workplace hygiene, and effective enforcement of occupational health regulations (Offiong, Bassey, Oshie, Ita, Tatey, Itam, Iboh, & Otu, 2018; Offiong, Itam, Bassey, Iboh, Nsa, Ita, Oshie, & Ukata, 2018; Eyo, Omubo, Joshua, Ekpe, Oboma, Bassey & Ndiyo, 2025). These findings align with the principles of One Health approach, which recognizes that sustainable control of health risks requires an integrated consideration of human, animal, and environmental factors. Improving abattoir hygiene, waste management practices, and occupational safety contributes directly to achieving the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being) by preventing of occupational injuries, zoonotic diseases and other work-related health risks. Therefore, coordinated efforts involving environmental health officers, veterinary authorities, public health professionals, and abattoir operators are essential for reducing health hazards and promoting sustainable abattoir management practices.

Conclusion

Abattoir activities remain essential components of livestock production, food supply, and economic livelihood in Calabar Metropolis; however, ineffective management practices have created significant environmental and occupational health challenges. The study demonstrated that improper disposal of animal waste, inadequate sanitation infrastructure, poor drainage systems, and limited use of protective equipment contribute to environmental degradation and increase the vulnerability of abattoir workers and nearby residents to health risks. The reported exposure of workers to hazardous materials and the release of untreated waste into the environment highlight the need for urgent interventions to improve abattoir conditions. The One Health assessment approach provides a comprehensive framework for addressing abattoir-related challenges by

recognizing the connection between human health, animal activities, and environmental quality. Sustainable management of abattoir operations in Calabar Metropolis requires collaboration among government agencies, environmental regulators, veterinary authorities, public health professionals, community stakeholders, and abattoir operators. Strengthening environmental monitoring, enforcing occupational safety regulations, improving waste treatment facilities, and promoting hygienic slaughtering practices will enhance public health protection and ensure environmentally sustainable abattoir operations.

Recommendations

Based on the findings from the study, the following recommendations were made;

1. Abattoir operators should establish proper waste management systems, including wastewater treatment facilities, waste collection points, and environmentally safe disposal methods.
2. Government environmental and health agencies should strengthen monitoring and enforcement of sanitation regulations within abattoir facilities across Calabar Metropolis.
3. Abattoir workers should be provided with adequate personal protective equipment, routine medical screening, and occupational health training to reduce exposure-related risks.
4. A One Health management framework should be adopted through collaboration between environmental health officers, veterinary professionals, public health authorities, and community stakeholders to improve abattoir sustainability.

Declarations

Ethical Approval: The assessment of abattoir operations, animal health indicators, and environmental conditions was conducted following relevant institutional and regulatory guidelines. No experimental procedures were performed on animals, and observations were limited to routine abattoir activities. Environmental assessments were carried out with permission from the Department of Food Safety, Nutrition and WASH, Cross River State Ministry of Health, Calabar, while ensuring minimal disruption to normal abattoir operations.

Informed Consent: Participants were informed that their participation was voluntary and that they had the right to withdraw from the study at any stage without any negative consequences. Confidentiality and anonymity of participants' information were maintained throughout the study, and all collected data were used strictly for research purposes.

References

- Acosta, A. (2018). *World livestock: transforming the livestock sector through the sustainable development goals*. Food and Agriculture Organization of the United Nations.
- Adeyemi, I., & Adeyemo, O. (2007). Waste management practices at Bodija abattoir, Nigeria. *International Journal of Environmental Studies*, 64 (1), 71-82. <https://doi.org/10.1080/00207230601124989>
- Adeyi, A. A., & Adeyemi, A. M. (2019). Potential occupational health effects of municipal solid waste management in Nigeria, the case of Lagos and Ibadan. *Ife Journal of Science*, 21(2), 417-430. <https://doi.org/10.4314/ijfs.v21i2.15>
- Agbeni, K. E., Ajoge, H. N., Promise, E. C., Samuel, S., Evelyn, O. O., Franklyn, O. O., & Boahene, B. A. (2025). Environmental pollution and public health implications of poor solid waste management practices in developing countries: Evidence from urban cities in Nigeria. *International Journal of Economics and Management Review*, 3(2), 106-122. <https://doi.org/10.58765/ijemr.v3i2.279>
- Anaba, A. F. (2019). *Working conditions and public health risks in slaughterhouses in Ghana. A case study*

- of Kintampo North Municipal (Doctoral dissertation, University of Education, Winneba). Google Scholar.
- Auwalu, A., Azmi, H., Norizhar, K., Yakubu, M., Olanike, K., & Pei, L. (2016). Occupational hazards among the abattoir workers associated with noncompliance to the meat processing and waste disposal laws in Malaysia. *Risk Management and Healthcare Policy*, 9, 157-163. <https://doi.org/10.2147/RMHP.S9827> -73-
- Badgett, A., & Milbrandt, A. (2020). A summary of standards and practices for wet waste streams used in waste-to-energy technologies in the United States. *Renewable and Sustainable Energy Reviews*, 117, 109425.
- Ekpunobi, N. F., Adesanoye, S., Orababa, O., Adinnu, C., Okorie, C., & Akinsuyi, S. (2024). Public health perspective of public abattoirs in Nigeria, challenges and solutions. *GSC Biological and Pharmaceutical Sciences*, 26(2), 115-127. <https://doi.org/10.30574/gscbps.2024.26.2.0527>
- Erhabor, F.O., Usman, A. K., Atigbede, Y. A., Njoku, C.G., & Itu, C.O. (2019). Analysis of urban growth patterns in Calabar Metropolis using the Shannon Entropy Model. *Sokoto Journal of Geography and the Environment*, 1(2)
- Eyo, E.E., Eneyo, V.B., Apeh, C., Ekpo, E., Ajom, S., Omubo, R. F., Ugbaka, M. K., Odinka, G. E., Effiom, A., Imanyi, V. U., & Ajake, A. O. (2026). Strengthening hotel safety protocols through routine inspections: Evidence of regional compliance disparities in Cross River State, Nigeria. *African Journal of Hospitality Tourism and Leisure*, 15 (2), 419. <https://doi.org/10.46222/ajhtl.19770720.750>
- Eyo, E. E., Omubo, R. F., Joshua, F. G., Ekpe, A. O., Oboma, P. O., Bassey, B. O., & Ndiyo, N. N. (2025). Assessing knowledge and usage of personal protective equipment among hotel employees in Calabar Municipality, Nigeria. *Journal of Occupational Health, Risk Management and Safety*, 1(1). <https://doi.org/10.60787/johrms.vol1no1.20>
- Eyo, E., Ojong, F., Mbum, P., Ekpenyong, I., Apejoye-Okezie, E., Nwatu, E., Ahakiri, F., Apeh, C., Komomo, O., Okon, D., Edu, L., Nsan, K., Alobo, E., Eja, E., & Nyong, C. (2025). Evaluating carnival Calabar as catalyst for diffusion of indigenous socio-cultural values system in Calabar, Nigeria. *International Journal of Interdisciplinary Cultural Studies*, 20 (2). <https://doi.org/10.18848/2r3y8905>
- Fayissa, G. R. (2025). Environmental impact and byproduct management of abattoirs: A case study from selected abattoirs in Northern Oromia, Ethiopia. *Berhan International Research Journal of Science and Humanities*, 9(1), 398-416. <https://doi.org/10.61593/dbu.birjsh.01.09.17>
- Food and Agriculture Organization (2011, December 14). *World livestock 2011: Livestock in food security*. Rome. FAO.
- Gufe, C., Chari, T. A., Jambwa, P., Dinginya, L., Mahlangu, P., Marowero, S. T., & Machakwa, J. (2025). A review on the occurrence of antibiotic-resistant bacteria found in abattoir effluent from resource-limited settings: The necessity of a robust One Health framework. *Sustainable Environment*, 11(1). <https://doi.org/10.108027658511.2025.2464419>.
- John, S. M., & Martyn, J. (2019). The One Health Approach, why is it so important? *Trop Med Infect Dis*, 4(2), 88. <https://doi.org/10.3390/tropicalmed4020088>
- Mbugua, P. K. (2025). Analysis of odor nuisance emitted by Naivasha abattoir, Kenya. *Science Mundi*, 5(2), 108-116. <https://doi.org/10.51867/scimundi.5.2.10>
- Offiong, E., Itam, W., Bassey, T., Iboh, J., Nsa, G., Ita, R., Oshie, F., & Ukata, B.6) (2018). Adequate sanitary facilities as a correlate of good health of student in Cross River State College of Health Technology. *Palgo Journal of Medicine and Medical Science*, 5 (6), 139-145
- Offiong, E., Bassey, T., Oshie, F., Ita, R., Tatey, J., Itam, W., Iboh, J., & Otu, O. (2018). Sanitation variables as a predictor of health of students. *Palgo Journal of Medicine and Medical Science*, 5 (6), 119-129.
- Mahendra, P., Welde, A., & Tanvir, R. (2014). The roles of veterinary, medical and environmental professionals to achieve ONE HEALTH J. *Adv. Vet. Anim. Res.*, 1(4), 148. <https://doi.org/10.5455/javar.2014.a27>
- McCabe, B. K., Harris, P., Antille, D. L., Schmidt, T., Lee, S., Hill, A., & Baillie, C. (2020). Toward profitable and sustainable bioresource management in the Australian red meat processing industry: A critical review and illustrative case study. *Critical Reviews in Environmental Science and Technology*, 50 (22), 2415-2439. <https://doi.org/10.1080/10643389.2020.1712310>

- Pal, M. (2013). Public Health concern due to emerging and re-emerging zoonoses. *International Journal of Livestock Research*, 3, (1), 56. <https://doi.org/10.5455/ijlr.20130305071351>
- Richardson, S. B. (2021). From slow food to slow meat: Slowing line speeds to improve worker health and animal welfare in Canadian abattoirs. *Alberta. L. Rev.*, 59 (1). <https://doi.org/10.29173/alr2666>
- Rodarte, K. A., Fair, J. M., Bett, B. K., Kerfur, S. D., Fasina, F. O., & Bartlow, A. W. (2023). A scoping review of zoonotic parasites and pathogens associated with abattoirs in Eastern Africa and recommendations for abattoirs as disease surveillance sites. *Frontiers in Public Health*, 11, <https://doi.org/10.3389/fpubh.2023.1194964>
- Schneidewind, S. J., Meemken, D., & Langforth, S. (2023). Measures and penalties for animal welfare violations at German abattoirs: A compilation of current recommendations and practices. *Animals*, 13(18), 2916. <https://doi.org/10.3390/ani13182016>