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Assessment of Airborne Particles Generated During Cattle Processing

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Abstract
This paper investigates the environmental implications of pollution stemming from cattle processing facilities in Port Harcourt, Nigeria, focusing on air quality degradation due to suspended particulate matter (SPM). Utilizing a fully randomized block design, data on $SPM_{2.5}$ and SPM_{10} concentrations were collected over a twelve-month period from five slaughterhouse locations. The findings revealed consistently elevated levels of SPM across all sites, exceeding the recommended standards set by the World Health Organization. Analysis indicated that industrial activities associated with cattle processing, such as combustion processes and waste disposal, significantly contribute to air pollution in the study area. The implications of high SPM levels extend beyond immediate health risks to include broader environmental concerns, particularly regarding climate change and biodiversity loss. This study underscores the urgent need for intervention measures to mitigate the adverse impacts of pollution from cattle processing on both human health and the environment. Recommendations include implementing stricter regulatory measures, investing in research and development of cleaner technologies, providing incentives for sustainable practices, and fostering collaboration among stakeholders. Addressing these challenges requires a multifaceted approach and concerted efforts from government agencies, non-governmental organizations, academia, and the private sector. By prioritizing environmental stewardship and adopting sustainable practices, we can work towards a healthier, more resilient future for communities affected by pollution from cattle processing.

Keywords: Pollution, Cattle Processing, Air Quality, Suspended Particulate Matter, Environmental Implications

Introduction

Environmental pollution encompasses any release of material or energy into water, land, or air that disrupts Earth's ecological balance or diminishes the quality of life. Pollutants may cause direct harm or minor disturbances in biological systems over time (Bello et al., 2011). Air pollution involves the introduction of substances or energy not normally present in the atmosphere or present in abnormal concentrations. It includes chemicals, particulate matter, or biological materials that harm humans, living organisms, or the environment (Boardi et al., 2013). More than 3,000 substances can be considered air pollutants, whether from human activities or natural sources like volcanic eruptions, forest fires, or desert dust (Etalla et al., 2016). Human activities are significant contributors to air pollution, particularly through emissions from internal combustion engines, industrial processes, and waste disposal. Locations like Okrika Kingdom in Rivers State exemplify severe air pollution due to emissions from refineries and industrial activities (Dockery et al., 2014). Common air pollutants include carbon monoxide, sulphur oxides, nitrogen oxides, hydrocarbons, and photochemical oxidants (Dockery et al., 2014). Fossil fuel combustion, prevalent in industries and transportation, remains a primary source of air pollution. Industrialization and fossil fuel consumption have led to widespread air pollution, with effects ranging from urban areas to global scales (Dockery et al., 2014). Environmental challenges have escalated, notably in aquatic environments, due to improper waste management. Slaughterhouses, ubiquitous worldwide, are significant contributors to pollution through wastewater discharge, deoxygenating rivers and contaminating groundwater (Brash, 2006). Slaughterhouse effluents, rich in organic matter, pose challenges for water quality management (Hammond-Aryee, 2010). Livestock production, while vital for food supply, generates organic waste and pollutants. Slaughterhouse operations produce highly organic waste with suspended solids and fats, contributing to water pollution (Bello 2011). As urbanization increases, demands on water resources intensify, exacerbating pollution challenges (Fobil, 2012).

Moreover, it is crucial to consider the socio-economic impacts of pollution from cattle processing. Communities living near these facilities may experience adverse health effects and reduced quality of life due to pollution. Additionally, environmental degradation can harm local ecosystems, affecting biodiversity and ecosystem services. Therefore, the study will explore the socio-economic implications of pollution from cattle processing and propose measures to mitigate these impacts. Furthermore, it is essential to recognize the interconnected nature of environmental pollution with broader global challenges such as climate change and biodiversity loss. Pollution from cattle processing contributes to greenhouse gas emissions, exacerbating climate change impacts. Additionally, pollution can degrade habitats and threaten biodiversity, further compromising ecosystem resilience. Addressing pollution from cattle processing requires collaboration across sectors and disciplines. Government agencies, non-governmental organizations, academia, and the private sector all have roles to play in implementing solutions. Regulatory frameworks must be strengthened to ensure compliance with environmental standards, while incentives can encourage the adoption of cleaner technologies and practices. Moreover, investing in research and innovation is critical to developing sustainable solutions for pollution prevention and mitigation. This includes exploring alternative waste management strategies, improving waste treatment technologies, and promoting circular economy approaches to minimize resource use and waste generation. Education and capacity-building efforts are also vital to empower stakeholders with the knowledge and skills needed to address pollution effectively. By fostering a culture of environmental stewardship and promoting responsible consumption and production patterns, we can create a more sustainable future for both people and the planet. The study focuses on assessing airborne particles during cattle processing, recognizing the need to understand pollution dynamics in this context. It aims to evaluate the types and concentrations of airborne pollutants, shedding light on potential environmental and health impacts. By addressing pollution in cattle processing, it aims to contribute to sustainable practices that minimize adverse effects on the environment and public health.

Methodology

In Port Harcourt, which is in the South-South region of Nigeria, the study was conducted. For the study, five slaughterhouse locations—Trans-Amadi, Eleme, Rumuokoro, Eagle-Island, and Okuru—were chosen. The fully randomized block design, which is based on replication and randomization, is the experimental strategy used in this study. When experimental areas are homogeneous, this approach can be used. Study locations, however, are picked on purpose. It divides the experimental units into equal-sized groups or blocks and then randomly allocates a treatment to each group. This ensures that external circumstances have no impact on the data. Suspended particulate matters ($SPM_{2.5}$ and SPM_{10}) were determined using handheld air quality monitoring equipment. $SPM_{2.5}$ and SPM_{10} samples were collected from the Trans-Amadi slaughterhouse (04°48'53"N, 07°02'42"E). The same procedures were also carried out in the Eleme (04°95'43.92"N, 07°01'26.25"E), Rumuokoro (04°65'43.69"N, 07°01'31.70"E), Eagle-Island (04°47'39"N, 06°58'25"E) and Okuru (04°47'39"N, 07°58'45"E) slaughterhouses respectively. The data on the concentration of $SPM_{2.5}$ and SPM_{10} were collected in the morning and evening periods at the five slaughterhouses. These parameters were collected for a period of twelve months (February, 2020 to January 2021). The AeroQual Air Analyzer, Series 500, was used in slaughterhouses to measure various air parameters and suspended particulates' concentration. Inference on the overall concentration of the particulate parameters was done using the SPSS (version 27.0) for the Windows software package. Mean concentrations and standard deviations were calculated for each parameter. The results were also subjected to analysis of variance (ANOVA) and means were compared using Duncan Multiple Range Test. The means of the particulates were compared with standards established for particulates procedure adopted by Rivers State Government, NAAQS, WHO and FMENV.

Results

Air Quality for Suspended Particulate Analysis

The findings from the slaughterhouses regarding Suspended Particulate Matter parameters ($SPM_{2.5}$ and SPM_{10}) displayed in Tables 1 & 2 revealed higher morning concentrations compared to evening levels, surpassing WHO standards. Bar charts illustrating mean±SD concentrations of air pollutant gases at the five research sites (Trans Amadi, Eleme, Rumuokoro, Eagle Island, and Okuru slaughterhouses) during morning and evening are presented in Figures 1 to 2 in the Appendix.

Table.1: Mean ± SD concentrations of $SPM_{2.5}$ ($\mu g/m^3$) in the various slaughterhouses in the morning and evening.

Location (Study Area)	Mean Morning	Mean Evening	Standard Deviation Morning	Standard Deviation Evening	Coefficient Of Variation Morning	Coefficient Of Variation Evening	Standard Error Morning	Standard Error Evening
TRANS AMADI	69.902	39.204	9.885	9.815	14.14	14.14	32.573	12.171
ELEME	65.074	35.011	8.292	8.212	12.74	12.74	22.917	12.213
RUMUOKORO	64.714	34.715	8.925	8.305	13.79	13.19	26.551	16.252
EAGLE ISLAND	68.111	38.106	8.311	8.301	12.20	12.20	23.024	13.010
OKURU	51.302	21.311	6.419	6.409	8.32	2.32	18.452	12.414

Table.2: Mean±SD concentrations of SPM_{10} ($\mu g/m^3$) in the various slaughterhouses in the morning and evening.

Location (Study Area)	Mean Morning	Mean Evening	Standard Deviation Morning	Standard Deviation Evening	Coefficient Of Variation Morning	Coefficient Of Variation Evening	Standar d Error Morning	Standard Error Evening
TRANS AMADI	60.118	30.104	7.675	4.615	13.22	11.24	30.341	20.120
ELEME	57.202	37.105	6.908	4.308	10.09	10.03	20.212	10.114
RUMUOKORO	62.367	32.313	8.112	3.102	10.87	10.11	24.754	14.156
EAGLE ISLAND	64.865	34.812	7.541	4.511	11.18	11.09	22.033	12.031
OKURU	45.233	25.211	5.455	3.415	8.11	4.15	19.311	13.315

Discussion

Suspended particulate matter (SPM) consists of dust particles comprising organic compounds and minerals, originating from natural sources like volcanoes or human activities such as industrial processes and traffic. Classified by size, smaller particles pose respiratory risks by transporting toxins. Inhalation primarily affects human health, though ingestion can also occur, especially among children, with potential implications for toxic compounds like lead. Table 1 illustrates $SPM_{2.5}$ concentrations (mean±SD) at various slaughterhouses: Trans Amadi, Eleme, Rumuokoro, Eagle Island, and Okuru. Morning and evening concentrations in µg/m3 respectively: Trans Amadi (69.902±9.885 and 39.202±9.815), Eleme (65.074±8.292 and 35.014±8.212), Rumuokoro (64.714±8.925 and 34.714±8.305), Eagle Island (68.111±8.311 and 38.101±8.301), and Okuru (51.302±6.419 and 21.312±6.40). Trans Amadi showed the highest $SPM_{2.5}$ levels, while Okuru had the lowest. All slaughterhouses exceeded WHO guidance (15.0 $\mu g/m^3$). The study indicates increased SPM levels across slaughterhouses, exceeding WHO standards. SPM, though chemically inert, can absorb harmful materials, causing respiratory issues, cardiovascular diseases, and premature mortality. It also impacts the environment aesthetically, with visible effects like dust settling on surfaces and contributing to greenhouse gases. Tyre burning emits significant SPM, including carcinogens, affecting both health and environment.

Suspended particulate matter poses health risks through direct irritation, systemic toxicity, and as carriers of toxins. Exposure leads to pulmonary and cardiovascular issues, increased susceptibility to infections, morphological respiratory changes, and mortality. Asthmatics and those with COPD are particularly vulnerable.

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Table 2 displays SPM_{10} concentrations at the mentioned slaughterhouses. Morning and evening concentrations respectively: Trans Amadi (60.118±7.675 and 30.108±7.615), Eleme (57.202±6.90 and 37.102±6.308), Rumuokoro (62.367±8.112 and 32.317±8.102), Eagle Island (64.865±7.541 and 34.815±7.51), and Okuru (45.233±5.455 and 25.213±5.415). SPM_{10} levels were highest in Eagle Island and lowest in Okuru, with all sites exceeding WHO standards (13.0 $\mu g/m^3$).

Soot pollution from burning fossil fuels and organic matter, including tyre combustion, contributes significantly to SPM levels. Continuous emission not only impacts health but also environmental aesthetics, with visible soot settling on surfaces. The chemical composition of tyres contributes to the emission of harmful substances like SO_2. Suspended particulate matter in slaughterhouses poses significant health risks and environmental concerns. Mitigating strategies are crucial to safeguard both human health and environmental sustainability.

Conclusion

This study sheds light on the critical issue of environmental pollution, particularly focusing on air pollution and its impact on public health and the environment, with a specific emphasis on cattle processing facilities in Port Harcourt, Nigeria. The findings underscore the alarming levels of suspended particulate matter ($SPM_{2.5}$ and SPM_{10}) in the vicinity of slaughterhouses, surpassing the recommended standards set by the World Health Organization (WHO). The results indicate a clear correlation between industrial activities associated with cattle processing and heightened levels of air pollution. This pollution not only poses immediate health risks to individuals in the surrounding communities but also contributes to long-term environmental degradation. The adverse effects of suspended particulate matter on respiratory health, cardiovascular diseases, and mortality rates are particularly concerning, highlighting the urgent need for intervention measures. Moreover, the study underscores the interconnectedness of environmental pollution with broader global challenges such as climate change and biodiversity loss. Pollution from cattle processing facilities not only exacerbates climate change through the emission of greenhouse gases but also threatens biodiversity and ecosystem resilience, further underscoring the urgency of addressing this issue. To mitigate the adverse impacts of pollution from cattle processing, a multifaceted approach is necessary. Strengthening regulatory frameworks to ensure compliance with environmental standards, incentivizing the adoption of cleaner technologies and practices, and investing in research and innovation are crucial steps towards sustainable pollution prevention and mitigation. Furthermore, collaboration among government agencies, non-governmental organizations, academia, and the private sector is essential to effectively implement solutions and address the socio-economic implications of pollution from cattle processing. By fostering a culture of environmental stewardship and promoting responsible consumption and production patterns, we can work towards creating a more sustainable future for both people and the planet. This study underscores the urgent need for concerted action to mitigate the adverse impacts of pollution from cattle processing on public health and the environment. By addressing this issue comprehensively and collaboratively, we can strive towards a healthier, more sustainable future for all.

Recommendations

1. Implement stricter regulatory measures to enforce compliance with environmental standards in cattle processing facilities.
2. Invest in research and development of cleaner technologies and practices for waste management in the livestock industry.
3. Provide incentives for businesses to adopt sustainable practices and reduce emissions associated with cattle processing.
4. Collaborate across sectors and disciplines to develop comprehensive strategies for mitigating the socio-economic and environmental impacts of pollution from cattle processing.

References

Bello, M. O., & Bello, V. A., (2011). Willingness to pay for better environmental services: Evidence from the Nigerian real estate market. *Journal of African Real Estate Research, 1*(1), 19-27.

Boardi, K., & Collins, M., (2013). Environmental and health impacts of air pollutants in the third world cities: The case of Accra Metropolitan Area, Ghana. Journal of Environmental Health, 68(4), 34-36.

Dockery, D. W., & Pope, C. A., (2014). Acute respiratory effects of particulate air pollution. *Annual Review of Public Health, 15*(2), 107-132. https://doi.org/10.1146/annurev.pu.15.050194.000543

Ettala, M. T., Rahkonen, P. O. Rossi, E. P., Mangs, J. D., & Keski-Rahkonen, O., (2016). Air.

Quality of the Atmosphere 38(2), 126–147.
Brash, D., (2006). New Zealand pollution. Where to now? Paper presented at the 8th Annual Conference Proceedings Air Pollutant Emissions Management Institute.
Fobil, J. N., Carboo, D., & Clement, C., (2012). Defining options for integrated management of pollutants in large cities in low income economies: The case of the Accra metropolis in Ghana. 28(2), 106–117.
Hammond-Aryee, A. O., (2010). Investigation of cattle skin processing techniques and its lead, zinc, cadmium, manganese and iron content. *A journal submitted to the Department of Chemistry*, *Faculty of Science*, KNUST, Kumasi. 22(11), 9-14

Appendix

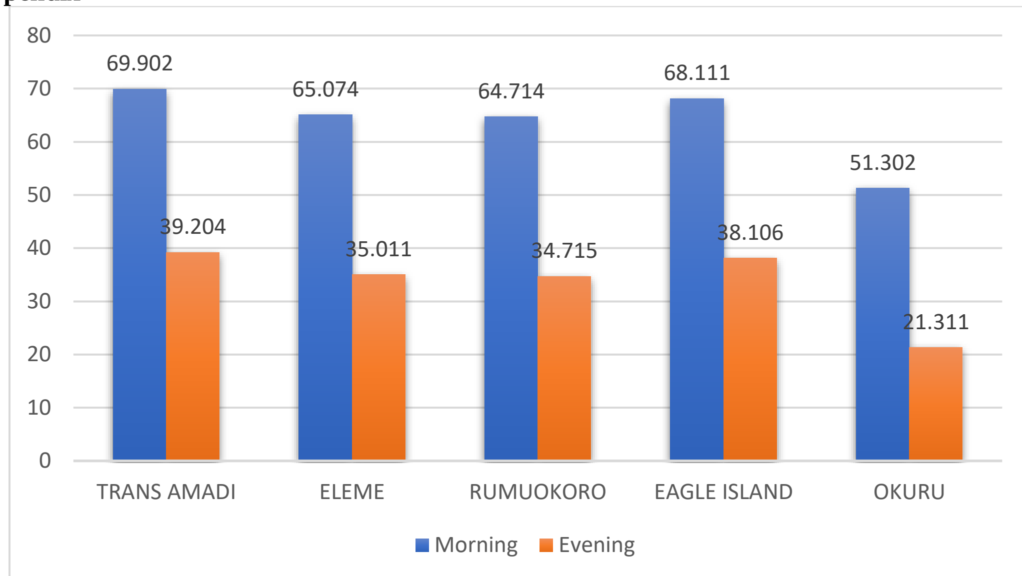

Fig.1: Mean±SD concentrations of $SPM_{2.5}$ ($\mu g/m^3$) in the various slaughterhouses in the morning.

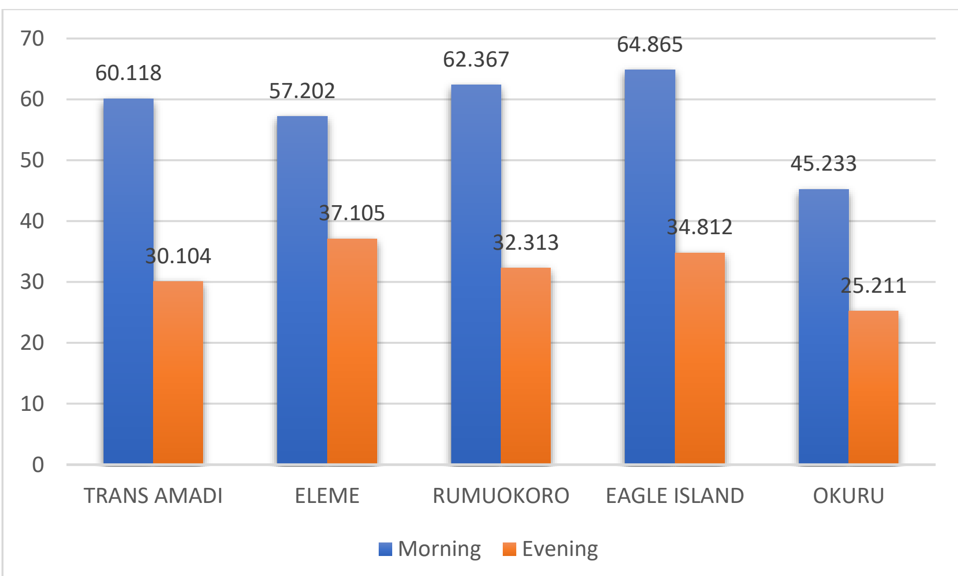

Fig.2: Mean concentrations of SPM_{10} ($\mu g/m^3$) in the various slaughterhouses in the morning and evening.