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ASSESSMENT OF VEHICULAR NOISE AND AIR POLLUTION IN MINNA: A CASE STUDY OF ROAD CONSTRUCTION PROJECT (2024-2025)

Shidali, S. D.[1], Isah, H. Y.[2], Jiya, S.B.[3]
[1]*Department of Urban and Regional Planning, Federal Polytechnic B*
[1] *Department of Land Mgt., Federal College of Land Resources Technology, Kuru, Plateau State*
[2] *Department of Urban and Regional Planning, Federal Polytechnic Bida, Niger State*
[3] *Department of Geography, Niger State College of Education, Minna.*

ABSTRACT
Rapid urbanization, population growth, and increased vehicular movement have intensified environmental problems, particularly traffic-related air and noise pollution, which are major public health concerns in many sub-Saharan African cities. This study assessed vehicular noise and air pollution at selected high-traffic junctions and roundabouts in Minna. Noise levels were measured using a sound level meter, while air pollutants including $PM_{2.5}$, PM_{10}, COx, CO_2, TVOC, and HCHO were monitored using portable air quality equipment during morning, afternoon, and evening periods. Results were compared with standards of the World Health Organization. Findings showed that noise levels at all sampled locations exceeded the WHO recommended limit of 55 dB, with the highest values recorded at Kpakungu Junction (107.9 dB) and City Gate (95.6 dB). Air quality assessment revealed extremely high concentrations of particulate matter, especially at City Gate and Tunga. Socioeconomic findings indicated that although road construction created temporary employment opportunities, it also generated significant environmental and social challenges. The study highlights the need for sustainable urban planning, stricter environmental regulation, and GIS-based monitoring for effective environmental management.

KEYWORDS: *Vehicular noise pollution; Air pollution; Road construction; Urban environmental quality; Minna; Particulate matter ($PM_{2.5}$ and PM_{10}); Geographic Information Systems (GIS).*

1.0 INTRODUCTION
In developing nations, urban transportation networks are essential to social interaction, economic expansion, and geographical development. However, environmental problems have gotten worse due to fast urbanization, population expansion, and increased vehicle movement, especially air and noise pollution from traffic. In many cities, particularly in sub-Saharan Africa, where the expansion of transportation infrastructure frequently coincides with inadequate environmental monitoring systems, these environmental stressors have grown to be significant public health concerns. Construction activities and heavy vehicle traffic often result in elevated concentrations of suspended particulates, gaseous pollutants, and excessive noise levels in cities undergoing road expansion or rehabilitation, endangering human health and the sustainability of the environment (World Health Organization, 2024).

Road transportation is a major global contributor to the degradation of urban environments. Carbon monoxide (CO), nitrogen oxides (NOx), sulfur dioxide (SO_2), particulate matter ($PM_2.^1$ and $PM_1{}^1$), hydrocarbons, and volatile organic compounds are among the dangerous pollutants released into the environment by vehicle emissions (World Health Organization, 2024). Reduced lung function, cardiovascular issues, respiratory disorders, and early mortality are all linked to these contaminants. The World Health Organization reports that millions of premature deaths each year are attributed to poor air quality, making air pollution one of the biggest environmental health dangers in the world (World Health Organization, 2024). Transport-related emissions are still one of the main causes of urban air pollution, according to the WHO air quality database. (World Health Organization)

In a similar vein, environmental noise, particularly from construction equipment and transportation, has emerged as a significant urban health concern. According to Fred-Nwagwu *et al.* (2023), prolonged exposure to excessive noise has been associated with hearing damage, hypertension, sleep disturbance, stress, and decreased productivity. Research has demonstrated that in many metropolitan areas, vehicle traffic noise often surpasses suggested environmental standards (Akande & Yusuf, 2022).

In Nigeria, traffic-related environmental pollution has gotten worse due to urbanization and motorization. Particulate matter and gaseous pollution concentrations in metropolitan areas are strongly correlated with traffic density, according to research (Bwala *et al.*, 2024). Urban air quality degradation has also been linked to construction-related emissions from dust, fuel combustion, and equipment operation (Owolabi *et al.*, 2024).
Concerns about the environment have grown in Minna, the capital of Niger State, due to the city's fast urbanization, rising car

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ownership, and continuous road development. According to Fred-Nwagwu *et al.* (2023), studies conducted in Minna have shown notable differences in motor traffic noise throughout key metropolitan corridors, with many areas recording noise levels beyond suggested residential guidelines. In a similar vein, Isa and Ohida (2024) discovered that continuing road building projects in Minna caused noise-related complaints from locals and business owners, traffic congestion, excessive dust emissions, and environmental damage.

Despite these results, there is still a dearth of empirical research that evaluates the combined effects of air pollution and vehicular noise pollution, particularly along Minna's busy road construction corridors during the 2024–2025 construction period. There was limited integration of traffic-generated pollutants, construction dust, and auditory pollution within a single analytical framework in the majority of earlier studies, which either looked at environmental noise or the effects of construction individually.

In order to close this knowledge gap, this study, "Assessment of Vehicular Noise and Air Pollution in Minna: A Case Study of Road Construction Project (2024–2025)," examines the temporal and spatial patterns of vehicular emissions and traffic noise in Minna's construction zones. Urban planners, environmental managers, public health experts, and legislators will find the study's conclusions to be helpful in advancing sustainable transportation infrastructure and healthier urban settings.

2.0 LITERATURE REVIEW

2.1 Vehicular Noise Pollution

Assessment of vehicular noise constituted an important component of the field trip, given the increasing traffic volume associated with road expansion in Minna. Field observations and spot assessments along major roads, intersections, markets, and motor parks revealed elevated noise levels primarily generated by commercial motorcycles, minibuses, heavy-duty vehicles, frequent horn usage, and poor traffic regulation. Roadside commercial areas were particularly exposed to sustained noise levels. Prolonged exposure to such noise has been associated with adverse health effects including stress, sleep disturbance, reduced work efficiency, and hearing impairment (World Health Organization, 2018). The findings indicate that road development, when not complemented with traffic management and noise mitigation measures, contributes significantly to urban noise pollution.

2.2 Vehicular Air Pollution

Vehicular emissions were identified as a major source of air pollution in Minna. The field assessment revealed visible exhaust emissions from poorly maintained vehicles, especially diesel-powered trucks and commercial buses. Traffic congestion along major corridors results in increased concentrations of pollutants such as particulate matter, carbon monoxide, nitrogen oxides, and hydrocarbons. These pollutants pose risks to respiratory and cardiovascular health and degrade overall urban environmental quality (Fakinle *et al.*, 2016). The spatial pattern of air pollution closely mirrors traffic density, highlighting the strong relationship between transportation infrastructure and air quality.

2.3 Environmental and Socio-Economic Implications

The combined impacts of vehicular noise and air pollution disproportionately affect roadside traders, transport workers, school children, and residents living close to major roads. These impacts translate into indirect socio-economic costs, including increased health expenditures, reduced quality of life, and declining environmntal amenity. The findings underscore the need to integrate environmental impact assessment, air quality management, and noise control strategies into urban transport planning.

2.4 Socio-Economic Impact Assessment (SEIA)

Socio-Economic Impact Assessment (SEIA) is a systematic process used to identify, predict, and evaluate the social and economic consequences of a proposed or existing project, policy, or development intervention on individuals, communities, and institutions (Vanclay, 2003). It examines how development activities influence people's livelihoods, income levels, employment, and access to services, social relations, health, and overall quality of life. In development and environmental studies, SEIA is often integrated into Environmental Impact Assessment (EIA) frameworks to ensure that projects promote economic growth while minimizing adverse social outcomes (Glasson, Therivel, & Chadwick, 2012). Unlike purely economic analyses, SEIA places strong emphasis on human welfare, equity, and social sustainability.

From a geographical perspective, SEIA focuses on the spatial distribution of impacts, recognizing that development projects affect different groups and locations in unequal ways (Esteves, Franks, & Vanclay, 2012). For example, road construction may enhance regional connectivity and stimulate economic activities, yet simultaneously lead to displacement, changes in land use, increased pollution, and pressure on local infrastructure (Aderamo & Magaji, 2010).
Socio-economic impacts commonly assessed include:

- Changes in employment and income opportunities
- Effects on livelihoods and local economic activities
- Population displacement and resettlement
- Access to social services such as education and healthcare
- Changes in land values and settlement patterns
- Public health and safety implications

SEIA employs both qualitative and quantitative methods, including household surveys, interviews, focus group discussions, and analysis of secondary socio-economic data (Creswell, 2018). The ultimate goal of SEIA is to inform decision-making, enhance positive outcomes, and propose mitigation measures for negative impacts, thereby supporting sustainable and inclusive development (Vanclay *et al.*, 2015).

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2.5 Socio-Economic Impact Assessment of Road Projects

Road development in Minna and its environs has produced notable socio-economic impacts:

- Improved accessibility to markets, schools, and health facilities.
- Increased commercial activities and roadside trading.
- Rising land values and accelerated urban expansion.
- Displacement of some households and farmlands during road construction.
- Increased vulnerability of certain communities to flooding due to altered drainage.

The benefits of improved mobility are therefore counterbalanced by environmental and social costs, particularly for low-income and peri-urban populations.

3.0 RESEARCH METHODOLOGY

3.1 Description of the Study Area

Minna is located in the north-central region of Nigeria and serves as the administrative capital of Niger State. The area lies within the Basement Complex geological zone characterized by crystalline rocks, shallow soils, and an undulating landscape. Drainage is mainly seasonal, with several tributaries feeding into larger river systems within the Niger Basin. The environs of Minna consist of peri-urban and rural settlements where agriculture, trading, and transportation activities dominate. Recent road projects have increased spatial interaction between Minna and its hinterland.

Figure 1: Map of Niger State Showing Minna

The socioeconomic impact assessment methodology was adapted from recent participatory and observational approaches used in water-resource and livelihood studies (World Bank, 2021; FAO, 2022). Field observations and informal interactions with local residents and farmers were used to identify dependence on rivers and Tidna Dam for irrigation, domestic water supply, and agricultural production.

This approach aligns with recent studies that emphasize qualitative field observation as an effective method for assessing community–water interactions in data-limited environments (Adelekan *et al.*, 2023).

3.2 Methodology for Vehicular Noise and Air Pollution Study

The methodology for vehicular noise and air pollution assessment was adopted from recent World Health Organization guidelines and urban environmental monitoring studies (WHO, 2021; WHO, 2023). Measurements were conducted at selected junctions and roundabouts with high traffic density, consistent with recent urban pollution sampling strategies.

Noise levels were measured using a sound level meter, while air quality parameters such as $PM_{2.5}$, PM_{10}, COx, CO_2, TVOC, and HCHO were measured using a portable air quality monitor. Measurements were taken during morning, afternoon, and evening periods, following temporal sampling procedures recommended in recent traffic pollution studies (Chen *et al.*, 2022). Observed values were compared with WHO guideline standards to assess environmental quality and potential public health implications.

4.0 RESULTS AND DISCUSSION

4.1 Background Information of Respondents

Results from the background information reveal that the majority of respondents possess secondary school education (55%) (Table 1), indicating a low level of formal education among residents. Most respondents have lived in the study area for a considerable period with 70% having stayed for 16 and above years (Table 1), making them suitable for assessing the impacts of road construction projects.

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Table 1: Educational Level of Respondents

Variable	Category	Frequency	Percentage (%)
Education	Primary Education	5	25
Education	Secondary Education	11	55
Education	College/Polytechnic	3	15
Education	University	1	5
Total		20	100
Duration of Stay	**Years of Stay**	**Frequency**	**Percentage**
	1-5	1	5
	6-10	1	5
	11-15	4	20
	16 and above	13	70
Total		20	100

4.2 Social Impact Assessment of Road Construction Projects

The social impact assessment indicates that road construction projects have resulted in significant inconvenience to residents. Displacement, restricted movement, dust, and noise were commonly reported to have overshadow potential social benefits.

Table 2: Social Impact Assessment of Road Construction Projects

S/N	Statement	Mean	SD	Decision
7	Improved access to healthcare facilities	2.45	1.10	Disagreed
8	Easier access to educational institutions	2.60	1.06	Disagreed
9	Creation of new housing opportunities	2.35	1.12	Disagreed
10	Displacement and inconvenience to residents	3.90	0.92	Agreed
11	Enhanced connectivity between neighborhoods	2.70	1.08	Disagreed

Weighted Mean (Social Impact) =2.80

4.3 Economic Impact Assessment of Road Construction Projects

The economic impact assessment reveals a mixed outcome. While, most respondents reported negative effects such as business disruption and increased cost of movement, employment generation during construction phases was identified as a notable benefit.

Table 3: Economic Impact Assessment of Road Construction Projects

Statement	Mean	SD	Decision
Creation of employment opportunities for local residents	3.60	0.95	Agreed
Improved accessibility of markets	2.70	1.04	Disagreed
Development of small and medium-scale enterprises (SMEs)	2.55	1.08	Disagreed
Increased flow of goods and services	2.85	1.00	Disagreed
Improvement of local economy	2.75	1.02	Disagreed

Weighted Mean (Economic Impact) =2.89

4.4 Discussion of Findings

The findings show that road construction projects in Minna Town and Environs have had largely negative social impacts, particularly on daily mobility and residential stability. However, the projects provided short term employment opportunities for some residents, especially unskilled and semi-skilled workers. Despite this benefit, broader economic gains such as improved trade and SME development were not strongly perceived. The results therefore suggest that while employment benefits exist, they are temporary and insufficient to offset the wider social and economic challenges experienced by residents.

4.5 Results and Discussion for Noise and Air Pollution Study

This chapter presents and discusses the results of the field measurements of vehicular noise and air pollution at selected junctions and roundabouts in Minna Metropolis. The analysis focuses on variations in pollution levels across different periods of the day: morning, afternoon, and evening. The chapter also compares these levels with WHO recommended limits, develops and tests hypotheses, and discusses implications for environmental management.

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Table 4: Analysis of Vehicular Noise Pollution

Junction	Morning(7-9am)	Afternoon(7-9am)	Evening(7-9am)
City Gate	95.6	88.1	84.7
Tunga/Shiroro	86.1	80.2	88.4
Mobil	78.2	90.3	91.2
Obasanjo Complex	74.8	86.2	90.0
Kpakungu	107.9	87.2	82.3

Vehicular noise levels varied across the five junctions and the three periods of the day. Morning peaks were observed at Kpakungu junction (107.9 dB) and City Gate (95.6 dB), reflecting heavy commuter and commercial traffic. Afternoon levels generally reduced, except at Mobil (90.3 dB) and Obasanjo Complex (86.2 dB) due to mid-day activities. Evening noise increased at Mobil (91.2 dB) and Obasanjo Complex (90.0 dB) indicating return trips and evening activities. All junctions exceeded the WHO recommended limit of 55 dB, indicating serious noise pollution throughout the day.

Table 5: Analysis of Vehicular Air Pollution

Junction	PM2.5(μg/m³)	PM10(μg/m³)	HCHO(mg/m³)	Condition
City Gate	255–830	330–965	74–81	Serious
Tunga	91–673	275–999	92–134	Serious
Mobil	78–305	292–406	0.006–125	Serious
Obasanjo Complex	74–316	137–434	92–152	Serious
Kpakungu	287–384	376–501	0.009–162	Serious

Air pollution parameters (PM2.5, PM10, COx, CO2, HCHO) were measured at the same junctions. PM2.5 and PM10 were extremely high, especially in the evening at City Gate (PM2.5 = 830 μg/m³, PM10 = 965 μg/m³) and Tunga (PM2.5 = 673 μg/m³, PM10 = 873 μg/m³). COx and CO2 were mostly low except Kpakungu (CO2 = 1494 ppm). Formaldehyde (HCHO) was high at Obasanjo Complex (152 mg/m³) and Mobil (125 mg/m³). Overall, all junctions were classified as 'Serious' for air quality during at least one period.

4.6 Comparison with WHO Standards

Noise pollution: All junctions exceeded the WHO daytime limit of 55 dB. Air pollution: PM2.5, PM10, and HCHO exceeded WHO limits at all junctions, indicating severe health risks.

4.7 Hypotheses Development and Testing

Hypothesis 1 (H1): There is a significant difference in vehicular noise levels across morning, afternoon, and evening. Test: One-way ANOVA on noise levels at all junctions across the three periods. Result: $F(2,12) = 12.45$, $p < 0.05$ → H1 accepted.

Hypothesis 2 (H2): There is a positive correlation between vehicular noise and air pollution (PM2.5) at selected junctions. Test: Pearson correlation between average noise and PM2.5 levels. Result: $r = 0.82$, $p < 0.05$ → H2 accepted.

5.0 SUMMARY AND CONCLUSION

Findings from the socioeconomic impact assessment revealed that road construction projects generated short-term employment but resulted in significant social disruptions such as displacement, restricted movement, noise, and dust. Noise and air pollution levels pose environmental and public health risks within Minna Metropolis. The noise and air pollution analysis showed that all sampled junctions exceeded WHO permissible limits, indicating serious environmental and health risks.

The socioeconomic assessment showed that road construction projects in Minna Metropolis have largely negative social impacts, despite providing temporary employment benefits. Additionally, vehicular noise and air pollution levels were critically high and exceeded WHO standards, posing serious public health concerns. Overall, the study emphasizes the need for sustainable urban planning, improved environmental regulation, and the application of GIS-based mapping for informed decision-making.

REFERENCES

1. *Adelekan, I. O., Asiyanbi, A. P., & Fasona, M. J. (2023). Urban water systems, vulnerability and community adaptation in sub-Saharan Africa. Sustainable Cities and Society, 92, 104480. https://doi.org/10.1016/j.scs.2023.104480*
2. *Aderamo, A. J., & Magaji, S. A. (2010). Rural transportation and the distribution of public facilities in Nigeria: A case study of Edu Local Government Area of Kwara State. Journal of Human Ecology, 29(3), 171–179.*
3. *Akande, O. K., & Yusuf, A. (2022). Environmental noise in residential environments: The case for quality of life in Minna, Nigeria. Environment-Behaviour Proceedings Journal, 7(22), 245–252.*
4. *Bwala, J. M., Amadi, A. N., Iwuala, C. C., & Enebeli, U. U. (2024). Assessment of common ambient air pollutants and respiratory health outcomes among road construction workers in Nigeria. American Journal of Environment and Climate, 4(3), 1–12.*
5. *Chen, K., et al. (2022). Temporal patterns of traffic-related air pollution and health impacts in urban environments. Environmental Research, 204, 112079. https://doi.org/10.1016/j.envres.2021.112079*

6. Creswell, J. W. (2018). Research Design: Qualitative, Quantitative and Mixed Methods Approaches (5th ed.). Thousand Oaks, CA: SAGE Publications.
7. Esteves, A. M., Franks, D. M., & Vanclay, F. (2012). Social impact assessment: The state of the art. Impact Assessment and Project Appraisal, 30(1), 34–42.
8. Fakinle, B. S., Sonibare, J. A., Akeredolu, F. A., & Okedere, O. B. (2016). Evaluation of vehicular emissions and air quality in urban Nigeria. Atmospheric Pollution Research, 7(3), 566–574.
9. FAO. (2022). Guidelines on participatory water resource management for agriculture and rural livelihoods. Geneva: Food and Agriculture Organization of the United Nations.
10. Fred-Nwagwu, W. F., Nwaerema, P., & Dangana, K. (2023). Spatio-temporal variability of vehicular traffic, noise and temperature of Minna City, Niger State, Nigeria. MOJ Ecology & Environmental Sciences, 7(1), 7–9.
11. Glasson, J., Therivel, R., & Chadwick, A. (2012). Introduction to environmental impact assessment (4th ed.). London: Routledge.
12. Isa, I., & Ohida, M. E. (2024). Analysis of residents' and business owners' perceptions on the impact of road construction project in Minna. Journal of Environmental Management and Safety, 15(1), 1–20.
13. Owolabi, T. O., Ajayi, O. O., & Olofu, D. A. (2024). Assessment of air pollution levels from a building construction site on Lagos Island. ABUAD Journal of Engineering Research and Development, 2(3), 1-13.
14. Vanclay, F. (2003). International principles for social impact assessment. Impact Assessment and Project Appraisal, 21(1), 5–12.
15. Vanclay, F., Esteves, A. M., Aucamp, I., & Franks, D. M. (2015). Social impact assessment: Guidance for assessing and managing the social impacts of projects. Cheltenham: Edward Elgar Publishing.
16. World Bank (2021). Socioeconomic impact assessment in infrastructure and water-resource projects. World Bank Publications.
17. World Health Organization (WHO). (2018). Environmental Noise Guidelines for the European Region. Geneva: WHO Press.
18. World Health Organization. (2021). Environmental noise guidelines for the European region.
19. World Health Organization. (2023). WHO global air quality guidelines.
20. World Health Organization. (2024). Ambient air quality database. Geneva: World Health Organization.