Assessment of Environmental Impacts of Urbanization in Port Harcourt Metropolis, Nigeria

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(Received: 14.04.2026; Accepted: 01.05.2026)

Abstract

Urbanization in Port Harcourt Metropolis has brought about significant environmental and social challenges. Rapid and poorly unregulated urban growth has intensified pollution, depleted natural resources, and overstretched infrastructure. This study aimed to investigate the impact of urbanization on the livability of Port Harcourt Metropolis. The objectives of the study are to ascertain the impact of urbanization on the environment as well as the social-economic life of the citizens in the Port-Harcourt Metropolis. The research instrument used was the questionnaire, which was designed using the 4-point Likert scale method. A total of 384 questionnaires were distributed, of which 267 were completed and retrieved, representing a response rate of approximately 70%. Data collection was conducted using a well-tailored questionnaire, and the data analysis was performed using descriptive statistics. Hypotheses were tested using the Chi-square test, which indicated that all three hypotheses were rejected at a 5% level of significance. Key findings revealed significant environmental concerns among respondents, including air pollution (33.70% strongly agree; 48.70% agree), water contamination (31.80% strongly agree; 50.60% agree), and noise pollution (30.00% strongly agree; 52.40% agree). The study concludes that urbanization in Port Harcourt has led to notable environmental and social challenges, underscoring the urgent need for effective urban planning and community engagement to mitigate these impacts. The recommendation is to adopt innovative environmental mitigation strategies; to effectively tackle the environmental as well as socio - economic challenges posed by urbanization, local governments and stakeholders should invest in innovative technologies and practices that promote sustainability.

Keywords: *Assessment; Environmental impact; Urbanization; Port Harcourt Metropolis*

INTRODUCTION

Urbanization is the population growth in urban areas instead of rural ones. It is predominantly the process by which towns and cities are formed and become larger as more people begin living and working in central areas (NG, 2023). Urbanization is often responsible for the modern problems facing humanity. Rapid urbanization has given rise to "urban disease", causing many social and environmental problems, such as the disorderly development of urban space, excessive population aggregation, overemphasis on economic development, ignoring environmental protection, severe traffic congestion, shortage of energy resources, and deterioration of the ecological environment (Jarica, 2026; Nyagwaya *et al.*, 2026; Singh and Garg, 2026).

Urbanization can be seen as a specific condition at a set time (e.g. the proportion of total population or area in cities or towns), or as an increase in that condition over time. Therefore, urbanization can be quantified either in terms of the level of urban development relative to the overall population, or as the rate at which the urban proportion of the population is increasing. Moreover, the rapid influx of people into urban areas has strained existing environmental resources, leading to increased pollution levels, particularly air and water pollution, which pose significant risks to both human health and ecosystem integrity (Adebowale *et al.*, 2026; Meena and Kumar, 2025; Okoro *et al.*, 2018).

Additionally, industrial pollution, vehicular emissions, and poor waste management practices have contributed to elevated levels of air and water-borne pollutants increasing

the risks of respiratory illnesses, water-borne diseases and other environmental problems among urban dwellers (Deepanshu, 2025; Meena and Kumar, 2025; Praveen, 2025; WHO, 2016). Urbanization has led to indiscriminate waste disposal, accompanied by its foul odour, which changes the aesthetic nature of the environment. Most urban centers are known for large traffic congestion, and the fumes from the exhaust pollute the atmosphere badly (Deswal *et al.*, 2026; Idowu, 2013), causing diseases in plants and animals. The environmental effect of Green House Gases (GHG) emissions has adverse effects of climate change like increased temperature, rise in Sea levels, flooding, desertification of fertile areas and hurricanes (Garba and Abdullahi, 2026; Deswal and Deswal, 2025).

Urbanization creates enormous social, economic and environmental challenges, which provide an opportunity for sustainability with the "potential to use resources much less or more efficiently, to create more sustainable land use and to protect the biodiversity of natural ecosystems." However, current urbanization trends have shown that massive urbanization has led to unsustainable ways of living. Developing urban resilience and urban sustainability in the face of increased urbanization is at the center of international policy in Sustainable Development Goals (SDGs), particularly SDG 11 "Sustainable cities and communities" (Ezeanyim *et al.*, 2026; Garba and Abdullahi, 2026; Singh and Garg, 2026).

The rapid expansion of Port Harcourt has led to increased pressure on the natural environment. The expansion of urban infrastructure, industrial activities and transportation networks has resulted in extensive land use change and habitat fragmentation (Pandey, 2025; Raj and Deswal, 2025). This has contributed to the degradation of natural ecosystems, loss of biodiversity and disruption of ecological processes (Ochiha 2017). Urbanization in Port Harcourt has significantly transformed the city's landscape, bringing both development opportunities and environmental challenges. Rapid urban growth has led to increased deforestation and the conversion of green spaces into residential and industrial areas, contributing to a rise in pollution levels. The Port Harcourt metropolis has experienced severe air and water pollution due to industrial emissions and inadequate waste management practices. Studies have shown that the particulate matter concentration in Port Harcourt's air far exceeds the World Health Organization's recommended limits, posing serious health risks to the inhabitants (Chinedu *et al.*, 2022). Additionally, the Niger Delta region, where Port Harcourt is located, suffers from extensive oil spillage, contaminating water sources and harming aquatic life.

Aim of the Study

The study aims to assess the environmental impact of urbanization on the livability of Port Harcourt Metropolis.

Objectives of the Study

- Ascertain the impact of urbanization on the environment in Port Harcourt Metropolis.
- Ascertain the impact of urbanization on the social - economic life of the citizens of Port Harcourt Metropolis.

MATERIALS AND METHODS

Study Area

Port Harcourt is the capital and largest city of Rivers State in Nigeria. It is the fifth most populous city in Nigeria after Lagos, Kano, Ibadan and Benin. It lies along the Bonny River and is located in the Niger Delta. As of 2023, Port Harcourt's urban population is estimated at 3.5 million. The population of the metropolitan area of Port Harcourt is almost twice its urban area population, with a 2015 United Nations estimate of 2,344,000 (UNDP, 2015).

According to Macrotrends.net, the population of Port Harcourt in 1950 was 60,000. Port Harcourt has grown by 150,844 since 2015, which represents a 4.99% annual change. Historically, it has been known as "Ígwúóchá" in the Ikwerre language, also Obomuotu Country, within which a few other smaller areas were called Diobu.

The area that became Port Harcourt in 1912 was previously a farmland of the people of Rebisi (Ikwerre). The colonial administration of Nigeria created the port to export coal from the collieries of Enugu, located 243 kilometres (151 mi) north of Port Harcourt, to which it was linked by a railway called the Eastern Line, also built by the British (Nwokaeze and Dawaye, 2020)

Port Harcourt's economy turned to petroleum when the first shipment of Nigerian crude oil was exported through the city in 1958. Through the benefits of the Nigerian petroleum industry, Port Harcourt was further developed, with aspects of modernization such as overpasses, city blocks, and taller and more substantial buildings. Oil firms that currently have offices in the city include Shell and Chevron (Okorobia and Olali, 2018).

Research Design

The researcher employed a cross-sectional survey research design, which involves collecting data from a representative sample of the selected population at a single point in time. This approach enabled the researcher to gather comprehensive information and draw inferences that could be generalized to the broader target population. Using this design was particularly suitable for capturing the current state of urbanization's impact on the environment in Port Harcourt Metropolis, providing a snapshot that reflects the experiences and perceptions of the community as a whole.

Sources of Data

Data for this study was gathered from primary and secondary sources using the following approaches:

- Interviews: Personal interviews conducted with selected communities in the study area.
- Questionnaire: The researcher administered questionnaires to the targeted communities
- Journals

Sample and Sampling Techniques

In conducting a socio-economic study within Port Harcourt Metropolis, a robust and thoughtful sampling strategy is essential to ensure accurate and representative data

Fig. 1: Port Harcourt Metropolis showing Port Harcourt City and Obio-Akpor LGAs.

collection. This study employs a stratified random sampling technique, treating each Local Government Area (LGA) within Port Harcourt Metropolis as an individual stratum. The LGAs comprising Port Harcourt Metropolis are Port Harcourt City and Obio-Akpor (Fig. 1). The choice of a simple random sampling technique is rooted in the diversity of the LGAs within Port Harcourt Metropolis. This method enables a systematic and comprehensive representation of the entire population by categorizing it into distinct strata based on geographic location (LGAs, in this case). Each LGA is treated as a separate stratum, acknowledging the unique characteristics and variations that may exist across different areas within the city.

Cochran's formula was applied to determine the sample size, a pivotal tool in statistics for calculating sample sizes in survey research. This formula provides a systematic approach to determining the number of observations needed to estimate a population parameter with a specified level of confidence and precision, incorporating factors such as the desired level of confidence, estimated population proportion, and margin of error (Cochran, 1977).

$$n = \frac{z^2 pq}{d^2} \quad (1)$$

where,

n = sample size

Z = standard normal deviation corresponding to 95% level of significance.

p = Proportion of the population

q = (1-p)

d = Desired margin of error (5%)

Now, computing the sample size, let 'p' be the proportion of the population under study – Port Harcourt metropolis, which is estimated to be 0.5, with a confidence level of 95% and a margin of error of 5%. In this case, the Z-score would be 1.96 (corresponding to a 95% confidence level).

Assuming an estimated proportion (p) of Informal Waste pickers in Port Harcourt metropolis based on prior knowledge is 0.05 (which is taken by default). We can apply Cochran's formula (Eq. 1) above:

$$n = \frac{(1.96)^2.0.5(1-0.50)}{(0.05)^2}; \; n \approx 384 \quad (2)$$

The sample size for the study is 384. This was distributed across the two LGAs within the Port Harcourt metropolis of Rivers State.

Instrument for Data Collection

The study researcher used primary data. A researcher-designed questionnaire was used for data collection. The instrument was administered, and data were collected by the study researcher with the help of two research assistants.

Three hundred and eighty-four (384) copies of the questionnaire were administered to the study respondents.

Since the research instrument used was the questionnaire, it was designed using the 4-point Likert scale method. The questionnaire was designed in the following ways:

i. Strongly Disagree - 1
ii. Disagree - 2
iii. Agree - 3
iv. Strongly Agree - 4

Reliability of the Instrument

In assessing the reliability of the instrument, the study deployed the Kuder-Richardson-20 (KR-20) method to measure the internal consistency of the items comprising the research instrument. This will involve applying the KR-20 formula to determine the extent to which the items within the instrument consistently measure the same construct or concept. By utilizing this method, the study ascertained the reliability of the instrument in yielding consistent results over multiple administrations, thereby enhancing the credibility and validity of the research findings.

The formula is:

$$\propto= (\frac{K}{K-1}\ 1 - \frac{\sum Vi}{Vt}) \quad (3)$$

where,
$K = No.of\ items$
$\sum Vi = sum\ of\ variance\ of\ items$
$Vt = Variance\ of\ total\ items$
$\propto= Cronbach's\ Alpha = 0.76$ was obtained with a sample of 5 responses, which was tested using SPSS software, indicating that the instrument is very reliable.

Methods of Data Analysis

Statistical Analysis

The data that was collated through the survey underwent numerical data presentation and analysis. These include descriptive statistical methods such as frequency and percentage calculations to analyze the demographics and responses. The findings were presented using tables, charts, and graphs to provide a comprehensive overview. Additionally, inferential conclusions based on the research hypotheses were derived using the chi-square statistic.

Chi-Square Statistic

The Chi-square statistic is commonly used for testing relationships between categorical variables in order to draw inferential conclusions.

The general form of the Chi-square test statistic is given by:

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i} \quad (4)$$

where,

χ^2 = Chi-square test statistic
O_i = Observed frequency
E_i = Expected frequency
n = number of observations

Decision Rule for Chi-square Statistic –

- We will reject $H_o\ at the critical value\ \alpha = 0.05$ if the χ^2 Calculated > χ^2 Critical and do not reject Ho, otherwise.
- Also, we will reject H0 if the probability (p-value) for the test is less than the critical value of 0.05. That is, if p<0.05, otherwise we will not reject H0.

Numerical analysis was done using two statistical packages: Statistical Package for Social Sciences (SPSS), version 25 and Minitab 15.

RESULT

Research Hypothesis HO: There is no Significant Impact of Urbanization on the Environment in Port Harcourt Metropolis

The chi-square test was conducted to evaluate the impact of urbanization on the environment in Port Harcourt Metropolis, with the null hypothesis (H_{01}) stating that there is no significant impact of urbanization on environmental factors. The test results, summarized in Table 2, show observed frequencies for responses regarding air pollution, water quality, noise pollution, flooding, waste management, green spaces, quality of life, and vehicular traffic. The computed chi-square value was 237.41, accompanied by a p-value of 0.005. Given that this p-value is significantly lower than the typical significance level of 0.05, the null hypothesis is rejected. This indicates that urbanization has a statistically significant impact on the environment in Port-Harcourt Metropolis. The significant chi-square value suggests that urbanization has led to notable changes across various environmental factors, including increased air pollution, negative effects on water quality, heightened noise pollution, increased frequency of flooding, exacerbated waste management challenges, loss of green spaces, and a decline in overall quality of life. Therefore, the findings underscore the urgent need for effective urban planning and management strategies to mitigate the adverse environmental consequences associated with urbanization in the region.

DISCUSSION

Investigating the Impacts of Urbanization on the Environment in Port-Harcourt Metropolis

The findings presented in Table 2 align with recent studies examining the environmental impacts of urbanization in rapidly expanding urban centers. The findings indicate a consensus among respondents that urbanization in Port Harcourt Metropolis has significantly impacted the environment, particularly concerning air and noise pollution, water quality, and waste management. A combined 82.4% of participants strongly agreed (SA) or agreed (A) that urbanization has increased air pollution levels. This aligns with prior studies that have highlighted the effects of rapid urbanization in Nigerian cities, including worsening air quality and noise pollution due to increased vehicular traffic

Table 1: Distribution of responses on impacts of urbanization on the environment in Port-Harcourt Metropolis.

Question	Category	Number of Responses (N = 267)	Percentage
Urbanization in Port-Harcourt metropolis has significantly increased air pollution levels.	SA	90	33.70%
	A	130	48.70%
	D	27	10.10%
	SD	20	7.50%
Urbanization has negatively affected water quality in Port-Harcourt Metropolis.	SA	85	31.80%
	A	135	50.60%
	D	25	9.40%
	SD	22	8.20%
The increase in urban infrastructure has contributed to higher levels of noise pollution in Port-Harcourt metropolis.	SA	80	30.00%
	A	140	52.40%
	D	25	9.40%
	SD	22	8.20%
The expansion of Port-Harcourt metropolis has caused an increase in the frequency and severity of flooding.	SA	95	35.60%
	A	125	46.80%
	D	25	9.40%
	SD	22	8.20%
Waste management issues have worsened in Port-Harcourt due to urbanisation.	SA	88	33.00%
	A	130	48.70%
	D	27	10.10%
	SD	22	8.20%
Urbanization has resulted in the loss of green spaces in Port-Harcourt.	SA	85	31.80%
	A	132	49.40%
	D	28	10.50%
	SD	22	8.20%
The quality of life in Port-Harcourt has been negatively impacted by the environmental changes caused by urbanization.	SA	92	34.50%
	A	128	47.90%
	D	25	9.40%
	SD	22	8.20%
The increase in vehicular traffic due to urbanization has contributed to greater air and noise pollution in Port-Harcourt.	SA	90	33.70%
	A	130	48.70%
	D	27	10.10%
	SD	20	7.50%

and industrial activities (Albert and Charles 2015; Bodo, 2019; Ngele *et al.*, 2020). Similarly, the assertion that water quality has deteriorated due to urban growth garnered 82.4% agreement (SA + A), corroborating findings from Nwankwo and Adebayo (2020), who noted contamination risks from unregulated industrial discharge and inadequate drainage systems in Port Harcourt.

Moreover, 82% of respondents agreed that urban infrastructure development has exacerbated noise pollution, while 82.4% linked the city's expansion to heightened flooding frequency and severity. These figures mirror observations from Okafor *et al.* (2023), who emphasized the link between poor drainage, reduced green spaces, and increased flood risks in urbanized Nigerian regions. The reported 81.7% agreement regarding worsening waste management due to urbanization echoes previous research identifying ineffective waste disposal systems as a growing environmental challenge (Eke and Osuji, 2022). Overall, the findings reveal a strong pattern of environmental degradation associated with urbanization, underscoring a need for strategic urban planning and environmental protection measures.

Noise pollution, another common consequence of urban infrastructure expansion, was also a concern, with 30.00% of respondents strongly agreeing and 52.40% agreeing on its adverse effects. This perception mirrors observations in urban studies across other Nigerian cities, where increased construction and traffic are cited as primary contributors to noise pollution (Nwogu and Okafor, 2023). Similarly, flooding due to urban expansion was acknowledged by respondents, with 35.60% strongly agreeing and 46.80% agreeing on the issue. This finding supports research indicating that inadequate drainage systems and impermeable surfaces in urban areas amplify flood risks, as shown in recent analyses by Nwogu and Okafor (2023).

Waste management remains a major challenge, as highlighted by 33.00% of respondents strongly agreeing and 48.70% agreeing on its deterioration due to urbanisation. These findings align with national studies that attribute increased waste production and insufficient disposal systems to rapid urban growth (Nwogu and Okafor, 2023). Additionally, the loss of green spaces due to urban expansion, as perceived by 31.80% strongly agreeing and 49.40% agreeing, is consistent with literature indicating that urban sprawl frequently displaces natural habitats, impacting

Table 2: Chi-square test for hypotheses.

Variable	SA	A	D	SD	All
Urbanization in Port-Harcourt metropolis has significantly increased air pollution levels.	90.00	130.00	27.00	20.00	267
	88.13	131.25	26.13	21.50	
Urbanization has negatively affected water quality in Port-Harcourt Metropolis.	85.00	135.00	25.00	22.00	267
	88.13	131.25	26.13	21.50	
The increase in urban infrastructure has contributed to higher levels of noise pollution in Port-Harcourt metropolis.	80.00	140	25.00	22.00	267
	88.13	131.25	26.13	21.50	
The expansion of Port-Harcourt metropolis has caused an increase in the frequency and severity of flooding.	95.00	125.00	25.00	22.00	267
	88.13	131.25	26.13	21.50	
Waste management issues have worsened in Port-Harcourt due to urbanisation.	88.00	130.00	27.00	22.00	267
	88.13	131.25	26.13	21.50	
Urbanization has resulted in the loss of green spaces in Port-Harcourt.	85.00	132.00	28.00	22.00	267
	88.13	131.25	26.13	21.50	
The quality of life in Port-Harcourt has been negatively impacted by the environmental changes caused by urbanization.	92.00	128.00	25.00	22.00	267
	88.13	131.25	26.13	21.50	
The increase in vehicular traffic due to urbanization has contributed to greater air and noise pollution in Port-Harcourt.	90.00	130.00	27.00	20.00	267
	88.13	131.25	26.13	21.50	
All	**705**	**1050**	**209**	**172**	**2136**
Chi-square					**237.41**
p-value					**0.005**

biodiversity and environmental quality (Adewale *et al.*, 2023).

Furthermore, the perception of deteriorated overall quality of life and increased vehicular traffic aligns with studies demonstrating the complex relationship between urbanization, quality of life, and environmental strain (Okoro *et al.*, 2018). The insights gathered from Table 1, visually reinforced in Fig. 2, illustrate a heightened awareness among residents of the pressing environmental issues associated with urban growth in Port Harcourt. These findings underscore the urgent need for effective urban planning and sustainable development policies to mitigate the adverse environmental impacts of urbanization in the metropolis.

CONCLUSION

The research showed that urbanization in Port Harcourt Metropolis has brought about significant environmental and social challenges. This study has contributed to knowledge by providing a comprehensive analysis of the multifaceted impacts of urbanization on the environment and social life of residents in Port Harcourt Metropolis. By employing a robust sample size and statistical methods, the chi-square test showed a significant relationship between urbanization and environmental concerns, reinforcing the importance of collaborative efforts among residents, policymakers, and stakeholders to address pressing urban environmental issues effectively.

The study revealed a strong consensus among respondents regarding the negative environmental impacts of urbanization, notably air pollution, water contamination, noise pollution, flooding, waste management challenges, loss of green spaces, and increased vehicular traffic, highlighting the urgent need for effective urban planning and sustainable development policies, as demonstrated by the chi-square test that rejected the null hypothesis of no significant impact.

The study not only highlights specific environmental concerns such as air and water pollution, noise pollution, and waste management challenges but also reveals significant health implications, including increased respiratory issues and waterborne diseases among citizens. Additionally, it underscores the nuanced social consequences of urbanization, demonstrating the delicate balance between enhanced social cohesion and cultural preservation. These findings fill a critical gap in the existing literature on urbanization in Nigeria, offering valuable insights for policymakers and urban planners aiming to foster sustainable urban development and improve the quality of life for residents in rapidly urbanizing regions.

Support for innovative strategies and improved urban planning was evident, alongside a call for local community involvement. and sustainable development policies, as demonstrated by the chi-square test that rejected the null hypothesis of no significant impact. The social consequences presented a complex picture, with both positive and negative impacts on social cohesion and cultural preservation,

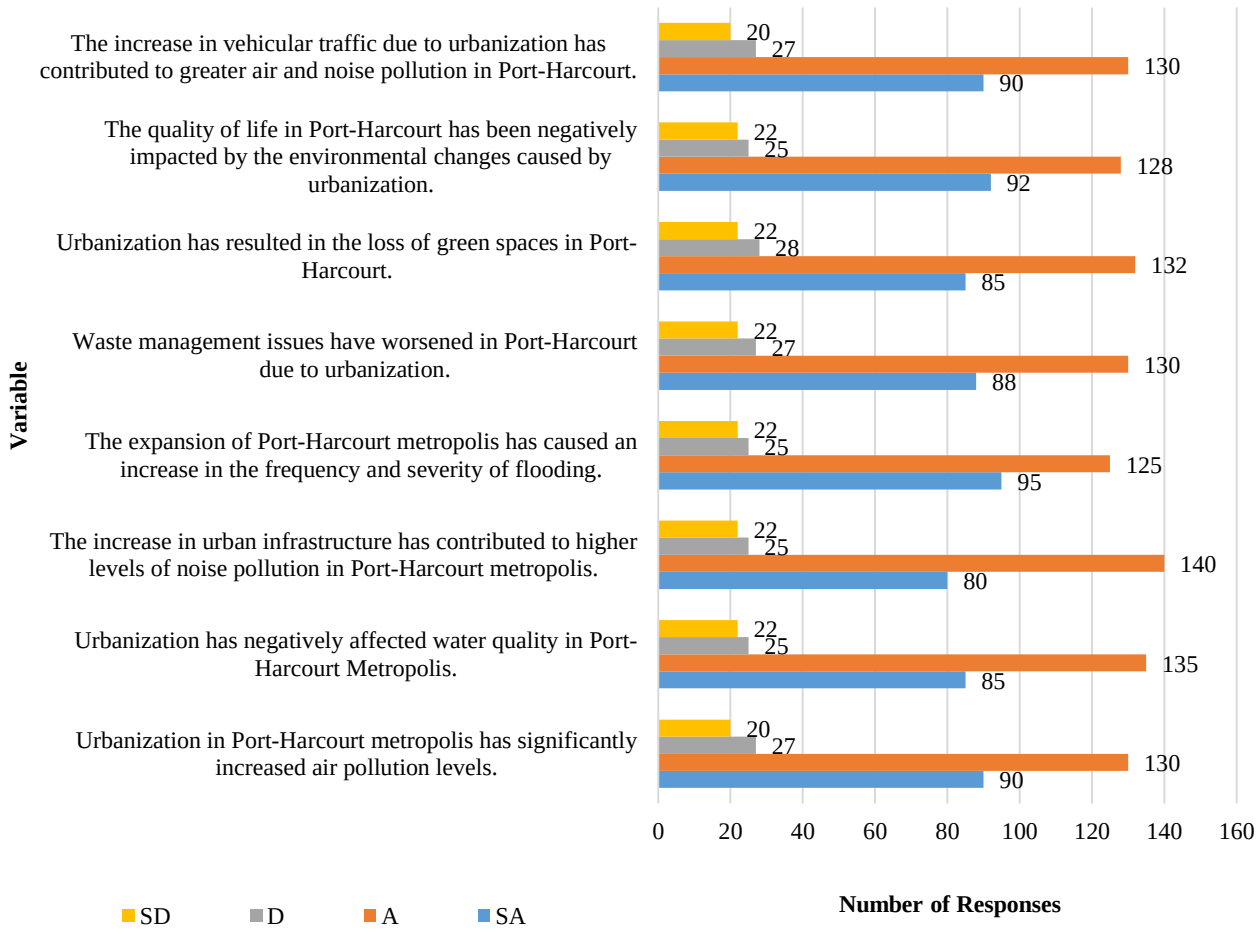

Fig. 2: Spatial distribution of responses on impacts of urbanization on the environment in Port-Harcourt Metropolis.

necessitating inclusive urban development policies. Finally, the findings pointed to an urgent need for effective mitigation and control measures, with a significant majority of respondents recognizing the necessity for innovative strategies, improved urban planning, and active community involvement. The significant relationship established through the chi-square test reinforces the critical role of collaborative efforts among residents, policymakers, and stakeholders in addressing the pressing environmental, health, and social issues arising from urbanization in Port Harcourt Metropolis, underscoring the importance of comprehensive approaches that prioritize citizen well-being and environmental sustainability in accordance with the objectives and/or targets of MDGs, SDGs and the Paris Agreement (Deswal, 2025; Nguyen *et al.*, 2026).

RECOMMENDATIONS

Implement Comprehensive Urban Planning and Sustainable Development Policies

To mitigate the adverse environmental effects identified in the study, local government authorities should develop and enforce comprehensive urban planning strategies that incorporate sustainable development principles. This includes creating green spaces, enhancing waste management systems, and improving drainage infrastructure to address flooding and water contamination issues.

Promote Community Engagement in Urban Development

The research highlighted the need for community involvement in urban planning processes. Local authorities should establish platforms for citizen participation to ensure that the voices of residents are considered in decision-making. This engagement can help address cultural preservation concerns and enhance social cohesion within diverse urban communities.

Adopt Innovative Environmental Mitigation Strategies

To effectively tackle the environmental challenges posed by urbanization, local governments and stakeholders should invest in innovative technologies and practices that promote sustainability. This may include adopting smart city solutions, utilizing green infrastructure, and implementing recycling initiatives to reduce waste and enhance resource management in the metropolis.

Grant Support Details

The present research did not receive any financial support to conduct the research.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/ or falsification, double publication and/or submission, and redundancy has been completely observed by the authors.

Life Science Reporting

No life science threat was practised in this research.

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