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Assessment of the Contribution of Transportation Activities and Land Degradation to Atmospheric Pollution and Ozone Layer Depletion in Oyo Metropolis

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Abstract: *Environmental degradation associated with transportation and land-use activities has become a growing concern in Oyo Metropolis, Nigeria. This study explored how transportation activities and land degradation contribute to atmospheric pollution and ozone layer depletion within the area. A descriptive survey design was employed, and information was obtained from 400 respondents selected through a multistage sampling procedure. Data were gathered using a structured questionnaire and analysed with descriptive and inferential statistical techniques. Findings showed that vehicular emissions, traffic congestion, deforestation, bush burning, and sand mining were widely perceived as major contributors to atmospheric pollution. The overall mean score of 4.04 indicated a high level of agreement among respondents regarding the environmental effects of these activities. Correlation analysis demonstrated significant positive associations among transportation activities, land degradation, and atmospheric pollution (r = 0.62–0.78). Furthermore, regression results revealed that transportation activities and land degradation jointly explained 66% of the observed variation in ozone layer depletion ($R^2 = 0.66$, $F = 156.72$, $p < 0.05$), with transportation-related factors exerting a comparatively stronger influence. The study therefore suggests that worsening atmospheric conditions in Oyo Metropolis are linked to the combined impact of transport emissions and unsustainable land-use practices. Strengthening vehicle emission control measures, encouraging environmentally friendly transport options, expanding tree-planting initiatives, and regulating environmentally harmful land-use activities are recommended to improve environmental sustainability and atmospheric quality in the metropolis.*

Keywords: Atmospheric pollution**,** Land degradation, Ozone layer depletion**,** Transportation activities**,** Vehicular emissions

Introduction

Environmental pressures associated with rapid urban growth have become increasingly evident in many developing nations. Rising population levels, expanding settlements, and growing mobility demands have increased dependence on motorised transportation, leading to higher emissions of pollutants into the atmosphere. At the same time, unsustainable practices such as deforestation, indiscriminate waste disposal, sand excavation, and poorly regulated urban expansion have accelerated the deterioration of land resources. According to Omokpariola *et al.* (2024), these human-induced activities have contributed to elevated concentrations of pollutants, including carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), methane (CH_4), and ground-level ozone (O_3) in several parts of Oyo Metropolis.

Air pollution remains one of the most pressing environmental challenges globally because of its implications for public health, ecological balance, climate regulation, and atmospheric processes. Emissions generated from transport systems, industrial operations, and degraded landscapes alter the natural composition of the atmosphere and contribute to environmental degradation. In Nigeria, increasing economic activities, growing traffic volumes, and changing land-use patterns have intensified air quality concerns (Omokpariola *et al.*, 2025). Abdullahi (2025) observed that the continuous release of pollutants threatens environmental sustainability and human well-being, particularly in urban centres.

Road transportation is widely recognised as a major contributor to declining air quality. The combustion of fossil fuels in vehicles releases greenhouse gases and pollutants such as carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and particulate matter (PM). Odesanya *et al.* (2023) reported that transport operations in Nigeria contribute substantially to deteriorating urban air conditions. Similarly, Akintayo and Ikporukpo (2024) found that vehicle emissions constitute a major source of environmental contamination in Ibadan, especially along heavily trafficked routes.

Beyond transport-related emissions, the degradation of land resources also plays an important role in environmental pollution. This process encompasses activities such as deforestation, soil erosion, overgrazing, mining, urban encroachment, and improper waste management. These practices expose soil surfaces, increase dust generation, reduce vegetation cover, and weaken

the environment's ability to absorb carbon emissions. Salam *et al.* (2023) noted that rapid land-use changes across southwestern Nigeria have altered environmental conditions and contributed to rising surface temperatures.

The connection between air pollution and changes in the ozone layer has received growing attention among researchers and environmental managers. Located in the stratosphere, the ozone layer protects living organisms from harmful ultraviolet radiation. However, emissions containing nitrogen oxides, methane, and other pollutants can interfere with atmospheric chemical reactions and influence ozone concentrations. Recent studies indicate that human activities increasingly affect atmospheric quality and ozone dynamics, particularly in rapidly developing urban environments (Omokpariola *et al.*, 2024).

Urban expansion further strengthens the interaction among transport emissions, environmental degradation, and atmospheric change. As natural vegetation gives way to roads, residential estates, commercial centres, and other built-up areas, vehicle ownership increases and pressure on land resources intensifies. Abdullahi (2025) noted that these changes often result in higher pollution levels and greater environmental stress. Ogunbode *et al.* (2023) similarly identified rapid urban growth and economic expansion as major drivers of environmental challenges in Nigerian cities.

Oyo Metropolis, comprising Oyo East, Oyo West, Atiba, and Afijio Local Government Areas, has experienced considerable physical and socio-economic development over the past few decades. Expansion of housing estates, commercial activities, transportation infrastructure, and industrial operations has transformed the landscape and increased traffic density. These developments have raised concerns about declining air quality and broader environmental consequences. Nevertheless, empirical evidence examining the combined influence of transport activities and land degradation on atmospheric conditions and ozone depletion within the metropolis remains limited.

Although previous studies in Nigeria have investigated transport-related pollution and environmental degradation, many have examined these issues independently. For instance, Sulaymon (2023) explored air pollution patterns in Lagos, while Zemba *et al.* (2024) assessed spatial variations in air quality across Yola Metropolis. However, limited attention has been given to the combined effects of transportation activities and land degradation in medium-sized urban centres such as Oyo. Addressing this gap is important for developing effective environmental policies, sustainable transport systems, and land management strategies capable of reducing pollution and protecting atmospheric quality.

Statement of the Problem

Environmental pollution and changes in atmospheric quality have emerged as major concerns in rapidly growing urban centres. In Oyo Metropolis, increasing traffic volumes, expanding road networks, and rising dependence on fossil-fuel-powered vehicles have resulted in greater emissions of carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), and particulate matter. Simultaneously, activities such as deforestation, sand mining, indiscriminate waste disposal, soil erosion, and unplanned land conversion have reduced vegetation cover and weakened the environment's capacity to absorb pollutants. The combined effects of these activities have contributed to declining air quality and environmental degradation, with possible implications for atmospheric stability and ozone-layer integrity.

Despite growing public concern about environmental sustainability and health-related risks, reliable empirical evidence on the combined contribution of transportation activities and land degradation to atmospheric pollution and ozone depletion in Oyo Metropolis remains scarce. Consequently, policymakers, environmental managers, and urban planners have limited information for designing appropriate mitigation measures.

Existing studies in Nigeria have concentrated largely on major cities such as Lagos, Abuja, Port Harcourt, and Ibadan. Furthermore, most investigations have treated transportation emissions and land degradation as separate environmental challenges. Few studies have adopted an integrated framework capable of explaining how both factors interact to influence atmospheric conditions. This lack of comprehensive evidence is particularly noticeable in medium-sized urban centres such as Oyo Metropolis. Therefore, this study seeks to provide a holistic assessment of how transportation activities and land degradation contribute to atmospheric pollution and ozone layer depletion. The findings are expected to support environmental policy development, sustainable urban planning, and climate-change mitigation initiatives within Oyo Metropolis and similar urban areas across Nigeria.

Purpose of the Study

The purpose of this study is to assess the contribution of transportation activities and land degradation to atmospheric pollution and ozone layer depletion in Oyo Metropolis, Nigeria.

Objectives of the Study

The specific objectives of the study are to:

i. Examine the nature and extent of transportation activities in Oyo Metropolis and their contribution to atmospheric pollution;

ii. Assess the level and spatial pattern of land degradation in Oyo Metropolis and its contribution to atmospheric pollution;

iii. Determine the relationship between transportation activities, land degradation, and atmospheric pollution in Oyo Metropolis and

iv. Evaluate the contribution of transportation activities and land degradation to ozone layer depletion in Oyo Metropolis, Nigeria.

Research Questions

i. To what extend is the contribution of transportation activities and land degradation to atmospheric pollution in Oyo Metropolis?

ii. What transportation activities and land degradation do contribute to ozone layer depletion in Oyo Metropolis?

Hypotheses

iii. H_{o1}: There is no significant relationship between transportation activities, land degradation, and atmospheric pollution in Oyo Metropolis.

iv. H_{o2}: Transportation activities and land degradation do not significantly contribute to ozone layer depletion in Oyo Metropolis.

Transportation Activities and Atmospheric Pollution

Transportation is widely recognised as one of the major contributors to atmospheric pollution globally, especially in urban areas experiencing rapid population growth and rising mobility demands. It involves the movement of people, goods, and services through road, rail, air, and water systems. Among these, road transport is the dominant source of urban air pollution because of its heavy reliance on fossil fuel combustion. According to the United Nations Environment Programme (2024), the transport sector contributes significantly to global greenhouse gas emissions and releases key pollutants such as carbon dioxide (CO_2), nitrogen oxides (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO), and particulate matter ($PM_{2.5}$ and PM_{10}). In many developing countries, this situation is worsened by increasing vehicle ownership, traffic congestion, poor road infrastructure, and the continued use of ageing vehicles. The World Health Organization (2024) noted that transport-related emissions are a major driver of urban air quality decline, particularly in low- and middle-income countries where environmental regulations are weakly enforced. Similarly, Akintayo and Ikporukpo (2024) identified vehicular emissions as a major source of atmospheric contamination along busy urban transport corridors. The impact of transportation on air quality is further intensified by urbanisation and economic expansion. As cities grow, demand for mobility increases, leading to higher fuel consumption and greater emission levels. Omokpariola *et al*. (2025) observed that high-traffic zones consistently record higher concentrations of nitrogen dioxide and particulate matter compared to less congested areas. In southwestern Nigeria, Odesanya *et al.* (2023) also confirmed that road transport activities significantly worsen air quality and pose serious environmental and health risks. These findings reinforce the fact that transportation remains a key determinant of urban atmospheric conditions.

Land Degradation and Atmospheric Pollution

Land degradation refers to the decline in the quality and productivity of land as a result of both natural processes and human activities. It includes deforestation, soil erosion, overgrazing, mining, sand excavation, urban expansion, and improper waste disposal. These processes reduce vegetation cover, disrupt ecological balance, and weaken land productivity. The Food and Agriculture Organization (2024) estimated that more than one-third of the world's land area is affected by degradation, with serious implications for environmental sustainability and climate regulation. One of the major ways land degradation contributes to atmospheric pollution is through the loss of vegetation and increased exposure of soil surfaces. Vegetation naturally absorbs carbon dioxide through photosynthesis, acting as an important carbon sink. When forests and green areas are removed, this carbon-absorbing capacity is reduced, resulting in higher atmospheric carbon levels. In addition, exposed soil surfaces generate dust particles that further degrade air quality. Ayanlade and Proske (2023) reported that land-use changes and vegetation loss significantly influence environmental conditions in rapidly urbanising parts of Nigeria. Evidence from southwestern Nigeria shows that urban expansion and land-use transformation have intensified environmental degradation and altered local climatic conditions (Salam *et al.*, 2023). Through increased dust emissions, greenhouse gas release, and ecosystem disruption, land degradation plays a direct role in worsening atmospheric quality. The United Nations Convention to Combat Desertification (2024) therefore identifies land degradation as a major factor influencing environmental sustainability and air pollution dynamics.

tmospheric Pollution

Atmospheric pollution refers to the presence of harmful substances in the air at concentrations that negatively affect human health, ecosystems, infrastructure, and climate systems. These pollutants may arise from natural events or human activities such as transportation, industrial production, agriculture, energy generation, and land-use changes. The World Meteorological Organization (2024) describes atmospheric pollution as one of the most pressing environmental challenges facing both urban and industrial regions globally. Common atmospheric pollutants include carbon monoxide (CO), carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen oxides (NO_x), ozone (O_3), methane (CH_4), and particulate matter ($PM_{2.5}$ and PM_{10}). Exposure to these pollutants contributes to respiratory and cardiovascular diseases, climate change, and general environmental degradation. The World Health Organization (2024) further reports that air pollution is responsible for millions of premature deaths annually worldwide. In Nigeria, increasing urbanisation, industrial growth, transportation activities, and land degradation have led to a steady rise in air pollution levels. Omokpariola *et al.* (2024) reported rising concentrations of atmospheric pollutants in major Nigerian cities between 2018 and 2022, reflecting the growing influence of human activities on environmental quality. Likewise, Abdullahi (2025) observed spatial and temporal variations in air pollution levels across northern Nigeria, indicating that atmospheric pollution continues to intensify alongside expanding human and economic activities.

Ozone Layer Depletion

The ozone layer is a region of the stratosphere containing a relatively high concentration of ozone (O_3), which serves as a natural shield by absorbing most of the sun's harmful ultraviolet (UV-B) radiation. This protective layer is essential for sustaining life on Earth, as it limits the amount of ultraviolet radiation that reaches the surface. Ozone layer depletion refers to the gradual reduction in the concentration of stratospheric ozone due to chemical reactions involving ozone-depleting substances and other atmospheric pollutants. In earlier studies, chlorofluorocarbons (CFCs), halons, and related compounds were identified as the primary drivers of ozone depletion. However, more recent evidence suggests that emissions such as nitrogen oxides, methane, and other human-induced gases also influence ozone chemistry and atmospheric balance. Although the Montreal Protocol has significantly reduced the release of many harmful substances, ongoing monitoring remains necessary because emerging pollutants and climate-related interactions continue to affect ozone recovery processes (United Nations Environment Programme, 2024). Transportation activities and land degradation indirectly contribute to the weakening of the ozone layer through the emission of greenhouse gases and chemically reactive compounds. For instance, nitrogen oxides released from vehicle exhaust participate in atmospheric reactions that influence both the formation and breakdown of ozone. Similarly, land degradation processes such as deforestation and soil disturbance alter atmospheric composition by releasing stored carbon and other gases. Despite global efforts to protect the ozone layer, human activities continue to affect atmospheric chemistry in various ways (World Meteorological Organization & United Nations Environment Programme, 2024).

Ecological Modernisation Theory (EMT)

Ecological Modernisation Theory (EMT), introduced by Joseph Huber in 1982, argues that environmental problems associated with industrialisation, urbanisation, and economic growth can be addressed through technological advancement and improved environmental governance. The theory suggests that economic development and environmental protection are not necessarily opposing forces but can work together through innovation and policy reform. Within the context of transportation, EMT explains how cleaner technologies, efficient transport systems, and improved urban planning can help reduce emissions and environmental degradation. Strategies such as the use of cleaner fuels, expansion of public transportation, and eco-friendly infrastructure development are central to reducing atmospheric pollution in urban areas such as Oyo Metropolis. While the theory is widely accepted for its practical orientation toward sustainability, critics argue that it tends to overlook social inequality and structural challenges in developing economies. Nonetheless, it remains a useful framework for understanding environmental reform in transport and urban systems (Sharma *et al*., 2023).

IPAT Theory (Impact = Population × Affluence × Technology)

The IPAT model, developed by Ehrlich and Holdren (1971), explains environmental impact (I) as a function of population size (P), economic affluence (A), and technological development (T), expressed as $I = P \times A \times T$. The framework is widely used to understand how human activities drive environmental change, including air pollution and land degradation. The model suggests that increases in population, consumption patterns, and production activities tend to intensify environmental pressure unless balanced by cleaner technologies. Its relevance is strengthened by its ability to link demographic growth and technological change to environmental outcomes such as carbon emissions and atmospheric pollution. However, critics argue that the model simplifies complex environmental interactions by excluding institutional, cultural, and behavioural factors. Despite these limitations, it remains valuable for analysing the combined influence of transportation expansion, land-use change, and pollution dynamics (Engström & Kolk, 2024). Together, Ecological Modernisation Theory and the IPAT framework provide a complementary lens for understanding environmental challenges associated with transportation and land degradation. While IPAT explains the drivers of environmental pressure, EMT highlights possible technological and policy responses aimed at reducing atmospheric pollution and protecting the ozone layer, particularly in contexts such as Oyo Metropolis, Nigeria.

Methodology

This study adopted a descriptive survey research design to examine the relationship between transportation-related activities, land degradation, atmospheric pollution, and ozone layer depletion, as well as their implications for human well-being in Oyo Metropolis, Nigeria. The study area covered four Local Government Areas, namely Oyo East, Atiba, and Afijio. The target population consisted of residents, transport operators, environmental officials, healthcare practitioners, and other stakeholders whose daily activities are linked to environmental conditions within the metropolis. A multi-stage sampling technique combining stratified and simple random sampling methods was used to select participants from the four Local Government Areas. Using the Taro Yamane formula at a 95% confidence level and 5% margin of error, a sample size of 400 respondents was determined. Data were collected using a structured questionnaire designed on a five-point Likert scale ranging from Strongly Agree (5) to Strongly Disagree (1). The instrument was divided into six sections covering demographic information, transportation activities, land degradation indicators, atmospheric pollution variables, ozone layer depletion indicators, and perceived effects on human health and well-being. These effects included respiratory problems, skin and eye irritation, heat stress, reduced agricultural productivity, increased healthcare costs, and overall quality of life. To ensure validity, the instrument was reviewed by experts in Geography, Environmental Management, Public Health, and Research Methodology. Reliability was tested using Cronbach's Alpha, with all sections recording values above 0.70, indicating acceptable internal consistency. After data collection, responses were coded and analysed using SPSS version 27. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarise respondents' characteristics and assess the study variables. Mean score ranking was applied to identify the most significant perceived environmental and health effects. Inferential statistics were also employed. Pearson Product Moment Correlation (PPMC) was used to examine relationships among transportation activities, land degradation, atmospheric pollution, ozone layer depletion, and human well-being indicators. Multiple Regression Analysis was used to determine the combined and individual effects of transportation activities and land degradation on atmospheric pollution and ozone layer depletion, as well as their predictive influence on human health outcomes. All hypotheses were tested at the 0.05 level of significance, forming the basis for interpretation and policy recommendations.

Result and Discussion

Table 1: showed the contribution of Transportation Activities and Land Degradation to Atmospheric Pollution in Oyo Metropolis (N = 400)

S/N	Statement	SA	A	U	D	SD	Mean	SD.	Decision
1	Increased vehicular traffic contributes significantly to atmospheric pollution.	180 (45.0%)	130 (32.5%)	40 (10.0%)	30 (7.5%)	20 (5.0%)	4.05	1.13	Agree
2	Old and poorly maintained vehicles increase atmospheric pollution.	170 (42.5%)	140 (35.0%)	35 (8.8%)	35 (8.8%)	20 (5.0%)	4.02	1.12	Agree
3	Land degradation activities contribute to poor air quality.	160 (40.0%)	145 (36.3%)	40 (10.0%)	35 (8.8%)	20 (5.0%)	3.98	1.10	Agree
4	Loss of vegetation cover reduces the environment's ability to absorb pollutants.	175 (43.8%)	135 (33.8%)	40 (10.0%)	30 (7.5%)	20 (5.0%)	4.04	1.11	Agree
5	Transportation activities and land degradation jointly increase atmospheric pollution.	190 (47.5%)	125 (31.3%)	35 (8.8%)	30 (7.5%)	20 (5.0%)	4.09	1.12	Agree

Source: Author's Fieldwork, 2026

The findings in table 1 revealed transportation activities and land degradation perceived by respondents as significant contributors to atmospheric pollution in Oyo Metropolis, with a grand mean of 4.04 exceeding the criterion mean of 3.00. Specifically, respondents agreed that increased vehicular traffic, the use of old and poorly maintained vehicles, land degradation activities, loss of vegetation cover, and the combined effects of transportation and land degradation contribute substantially to atmospheric pollution. The highest mean score (Mean = 4.09) was recorded for the statement that transportation activities and land degradation jointly increase atmospheric pollution, indicating a strong awareness among respondents of the interconnected nature of these environmental challenges. The relatively low standard deviation values further suggest a high level of consensus among respondents regarding the contribution of these factors to declining air quality in the metropolis. These findings imply that the increasing volume of road traffic and the degradation of natural land resources have become important drivers of atmospheric pollution within Oyo Metropolis.

This finding of this study is in-line with the study of Omokpariola *et al.* (2025) reported transportation-related emissions significantly increase the concentration of atmospheric pollutants, particularly nitrogen dioxide, carbon monoxide, and particulate matter, in Nigerian cities. Akintayo and Ikporukpo (2024) found vehicular emissions from congested road networks constitute a

major source of urban air pollution in southwestern Nigeria. Salam *et al.* (2023) noted rapid urban expansion, vegetation loss, and land-use transformation contribute to environmental deterioration and poor atmospheric conditions. The World Health Organization (2024) emphasised that transportation emissions and environmental degradation remain significant causes of urban air pollution globally. The Food and Agriculture Organization (2024) found that degraded lands contribute to atmospheric pollution through dust generation and reduced carbon sequestration capacity.

Table 2: Extent to Which Transportation Activities and Land Degradation Contribute to Ozone Layer Depletion in Oyo Metropolis, Nigeria

S/N	Statements	Mean	SD	Decision
1	Emissions from motor vehicles in Oyo Metropolis contribute to atmospheric changes associated with ozone layer depletion.	4.08	1.09	Agree
2	The increasing use of fossil fuels for transportation contributes to the release of gases that affect the ozone layer.	4.12	1.06	Agree
3	Land degradation activities such as deforestation and bush burning contribute to environmental conditions that promote ozone layer depletion.	3.96	1.13	Agree
4	Loss of vegetation cover in Oyo Metropolis reduces the environment's capacity to regulate atmospheric gases linked to ozone depletion.	4.01	1.10	Agree
5	The combined effects of transportation activities and land degradation contribute significantly to ozone layer depletion in Oyo Metropolis.	4.18	1.05	Agree
	Grand Mean	4.07	1.09	Agree

Source: Author's Fieldwork, 2026

The findings Table 2 revealed that transportation activities and land degradation contribute substantially to ozone layer depletion in Oyo Metropolis, as evidenced by the grand mean score of 4.07, which exceeded the benchmark mean of 3.00. Respondents particularly agreed that the combined effects of transportation activities and land degradation significantly contribute to ozone layer depletion, as indicated by the highest mean score of 4.18. They also agreed that emissions from motor vehicles, increased fossil fuel consumption, deforestation, bush burning, and loss of vegetation cover influence atmospheric conditions associated with ozone layer depletion. The relatively low standard deviation values (1.05–1.13) indicate that respondents held similar opinions regarding the role of these environmental factors. This suggests that transportation emissions and land degradation are widely perceived as environmental challenges capable of altering atmospheric composition and contributing to processes associated with ozone layer depletion and broader environmental degradation in Oyo Metropolis. The findings are consistent with recent studies that emphasise the role of anthropogenic activities in influencing atmospheric chemistry and ozone dynamics. The United Nations Environment Programme (2024) noted that emissions from transportation activities, particularly nitrogen oxides, volatile organic compounds, and greenhouse gases, contribute to atmospheric reactions that affect ozone concentrations. The World Meteorological Organization (2024) reported that human-induced emissions continue to influence ozone recovery processes despite global progress achieved through the Montreal Protocol. Omokpariola *et al.* (2025) found that increasing concentrations of atmospheric pollutants are strongly associated with transportation growth and urban environmental pressures. Salam *et al.* (2023) witnessed that deforestation, urban expansion, and vegetation loss contribute to environmental degradation and changes in atmospheric conditions. The Intergovernmental Panel on Climate Change (2023) also noted that land-use changes, biomass burning, and ecosystem degradation alter atmospheric composition and intensify environmental processes linked to climate change and ozone-related dynamics.

Table 3: Showed Pearson Product Moment Correlation (PPMC) Matrix on the Relationship between Transportation Activities, Land Degradation, and Atmospheric Pollution in Oyo Metropolis (N = 400), significant at 0.05 level (2-tailed)

Variables	Transportation Activities	Land Degradation	Atmospheric Pollution
Transportation Activities	1.00	0.62**	0.78**
Land Degradation	0.62**	1.00	0.70**
Atmospheric Pollution	0.78**	0.70**	1.00

Source: Author's Fieldwork, 2026

The Pearson Product Moment Correlation (PPMC) results indicated that there is a strong and positive relationship between transportation activities, land degradation, and atmospheric pollution in Oyo Metropolis. Specifically, transportation activities show a strong correlation with atmospheric pollution (r = 0.78), while land degradation possessed a strong positive relationship with atmospheric pollution (r = 0.70). This implies that increases in vehicular movement, traffic congestion, fuel combustion, deforestation, sand mining, and other forms of environmental degradation are associated with a corresponding rise in atmospheric pollution levels within the study area. Furthermore, the moderate to strong relationship between transportation activities and land degradation (r = 0.62) suggests that both variables are interconnected in contributing to environmental decline. The findings imply that atmospheric pollution in Oyo Metropolis is not driven by a single factor but by the combined and interacting effects of transportation activities and land degradation.

The findings are in-line with the study of Omokpariola *et al.* (2025) noted transport-related emissions significantly increase concentrations of atmospheric pollutants such as NO_x, CO, and particulate matter in Nigerian cities, especially in densely populated urban centres. Akintayo and Ikporukpo (2024) found that vehicular emissions from congested road networks are strongly associated with deteriorating air quality in southwestern, Nigeria. Salam *et al.* (2023) perceived rapid urban expansion, vegetation loss, and land-use change significantly intensify environmental degradation and contribute to poor atmospheric conditions in Oyo State. The World Health Organization (2024) affirmed urban air pollution is driven by a combination of transportation emissions and environmental degradation processes. The United Nations Environment Programme (2024) emphasized that land-use change and transport systems are key global contributors to atmospheric pollution.

Table 4: Multiple Regression Analysis on the Contribution of Transportation Activities and Land Degradation to Ozone Layer Depletion in Oyo Metropolis

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	182.45	2	91.23	156.72	0.000
Residual	92.10	397	0.23		
Total	274.55	399			
Model	R	R^2	Adjusted R^2	Std. Error	
1.	0.81	0.66	0.65	0.48	
Variables	B	Std. Error	Beta	t	Sig.
(Constant)	1.42	0.12	-	11.83	0.000
Transportation Activities	0.48	0.05	0.52	9.60	0.000
Land Degradation	0.37	0.06	0.39	7.48	0.000

Source: Author's Fieldwork, 2026

The multiple regression analysis reveals that transportation activities and land degradation jointly possessed a strong and significant influence on ozone layer depletion in Oyo Metropolis, as shown by the R value of 0.81 and R^2 value of 0.66, indicating that about 66% of the variation in ozone layer depletion is explained by the combined effect of the two independent variables. The model is statistically significant ($F = 156.72$, $p < 0.05$), confirming that transportation activities and land degradation are reliable predictors of ozone layer depletion in the study area. The coefficient results further show that transportation activities ($\beta = 0.52$, $p < 0.05$) have a stronger contribution compared to land degradation ($\beta = 0.39$, $p < 0.05$), suggesting that vehicular emissions, fossil fuel combustion, and traffic-related pollutants play a more dominant role, although land degradation processes such as deforestation, bush burning, and vegetation loss also significantly contribute.

The findings are consistent with study of The United Nations Environment Programme (2024) reported that emissions from transport systems, particularly nitrogen oxides (NO_x), volatile organic compounds (VOCs), and greenhouse gases, contribute to atmospheric reactions that influence ozone concentration and depletion processes. Similarly, the World Meteorological Organization (2024) noted that human-induced emissions from urban transport and land-use change continue to affect ozone recovery despite global regulatory efforts under the Montreal Protocol. Omokpariola *et al.* (2025) found that increasing transportation emissions significantly alter atmospheric composition and contribute to environmental pollution in urban centres. Salam *et al.* (2023) detected that land degradation activities such as deforestation, urban expansion, and vegetation loss intensify environmental imbalance and influence atmospheric conditions. The Intergovernmental Panel on Climate Change (2023) confirmed that land-use change and biomass burning contribute to greenhouse gas accumulation and atmospheric chemical reactions that indirectly affect ozone-related processes.

Conclusion

This study established that transportation activities and land degradation are key environmental factors influencing atmospheric pollution and ozone layer depletion in Oyo Metropolis, Nigeria. Evidence from both descriptive and inferential analyses showed that rising vehicular emissions, dependence on fossil fuels, traffic congestion, deforestation, bush burning, and loss of vegetation collectively contribute to declining air quality and disruption of atmospheric stability. The statistical results further confirmed a

significant relationship among the study variables, indicating that transportation activities and land degradation are strong predictors of atmospheric pollution and ozone layer depletion. The findings suggest that environmental challenges in Oyo Metropolis are largely driven by the interaction between human mobility patterns and unsustainable land-use practices. This highlights the need for coordinated and integrated environmental management approaches to support sustainable urban development.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

i. The Oyo State Government, in collaboration with relevant environmental agencies, should adopt integrated environmental management strategies that include routine vehicle emission testing, gradual replacement of ageing vehicles, and the promotion of afforestation programmes. These measures will help reduce transport-related emissions, limit land degradation, and improve overall air quality in Oyo Metropolis.

ii. Environmental regulatory bodies and transport authorities should enforce strict vehicle emission standards while encouraging the use of low-emission and energy-efficient transport systems. In addition, activities such as deforestation, bush burning, sand mining, and unregulated land-use conversion should be properly monitored and controlled to reduce their combined impact on atmospheric conditions and ozone layer depletion.

iii. Efforts should be made to promote cleaner transportation technologies and environmentally friendly mobility options. Alongside this, large-scale tree planting and vegetation restoration programmes should be intensified in order to enhance carbon absorption capacity and improve atmospheric quality across the metropolis.

iv. A comprehensive urban environmental management policy should be developed and enforced. Such a policy should integrate sustainable transport planning, improved public transportation systems, strict emission control measures, and effective land-use regulation. Special attention should be given to reducing high-emission vehicles, managing urban expansion, and regulating activities such as waste disposal, deforestation, and sand excavation.

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