Assessment of Land Pollution and Its Effects on Environmental Quality and Residents' Health across Residential Density Areas in Akure, Ondo State, Nigeria

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ABSTRACT

The persistent impacts of land pollution on the environment and human health have received limited empirical attention in many Nigerian cities. This study assessed land pollution and its health implications across residential density areas in Akure, Ondo State, Nigeria. Six localities were randomly selected from high-, medium- and low-density neighbourhoods in a ratio of 3:2:1. A total of 384 questionnaires were administered to household heads to obtain information on pollution and its perceived health effects. Soil samples were analysed for pH, organic carbon, lead (Pb), cadmium (Cd), iron (Fe) and zinc (Zn), with results compared against applicable Federal Environmental Protection Agency (FEPA) standards. Descriptive statistics, chi-square tests and analysis of variance (ANOVA) were employed. Findings showed that high-density areas recorded the highest refuse-site occurrence score (17.6), compared with medium-density (12.3) and low-density areas (2.0). Environmental assessments also recorded the highest scores for declining property values (640) and reduced housing patronage (615) in high-density areas. ANOVA revealed significant differences in reported health effects, including respiratory diseases ($F = 6.203$, $p = 0.002$) and cholera ($F = 66.710$, $p < 0.001$). The study recommends improved waste management, regular soil monitoring and targeted environmental planning interventions.

Keywords: Land pollution, residential density, soil quality, health impacts, Akure.

1. INTRODUCTION

Land is an important natural resource that supports human activities and the development of urban areas. It provides space for residential buildings, commercial activities, roads, public facilities, recreation and other land uses. The quality of land is therefore important to the health, comfort and general well-being of residents. However, increasing human activities, urban expansion and inadequate waste-management practices have contributed to the degradation of land in many urban centres. Where refuse and other waste materials are indiscriminately dumped, the quality of the environment may deteriorate, thereby reducing the usefulness of land for residential, commercial and other purposes.

Land pollution refers to the degradation of the land surface and soil through the disposal, accumulation or release of waste materials and harmful substances. Such materials include household refuse, plastics, food waste, construction debris, industrial waste, used oils, electronic waste and agricultural chemicals. When these materials are not properly managed, they may affect soil quality, create unpleasant surroundings and expose residents to environmental hazards. Land pollution is therefore not limited to the physical appearance of an area; it may also involve changes in soil properties and the introduction of potentially harmful substances into the environment.

The sources of land pollution are closely related to the activities carried out within urban areas. Households generate domestic waste, while markets, shops, restaurants, construction sites and vehicle-repair workshops produce different types of refuse and residual materials. Where waste collection services are inadequate or irregular, some of these materials may be deposited on vacant plots, roadsides, drainage channels and other open spaces. According to the United Nations Environment Programme (UNEP, 2012), improper waste disposal remains an important environmental concern in Nigeria, with uncontrolled dumping contributing to soil degradation and other environmental problems.

In developing countries, land pollution is often associated with the challenges of providing adequate environmental services to growing urban populations. Increasing population and commercial activities can raise the volume of waste generated, while inadequate facilities and weak enforcement may encourage indiscriminate disposal. However, population growth alone does not necessarily cause land pollution. The problem becomes more pronounced where waste-management arrangements, public awareness and environmental control measures are insufficient to deal with the waste produced. Effective management therefore requires an understanding of the sources of pollution, the disposal practices of residents and businesses, and the capacity of relevant authorities to provide appropriate services.

Land pollution has several environmental and social implications. The accumulation of refuse may obstruct drainage channels, contribute to local flooding, create unpleasant odours and provide breeding or feeding sites for rodents and insects. It may also reduce the attractiveness of neighbourhoods and interfere with the use of open spaces. The World Bank (2024) notes that the improper management of solid waste in Nigeria contributes to land degradation, obstruction of drainage systems and other environmental problems. These effects show that waste disposal is not merely a sanitation issue but also an important concern for urban planning and environmental management. The problem of land pollution becomes more serious when waste generation is not matched by effective collection, transportation and disposal services.

In Nigeria, some studies (Ugochukwu, 2013; Ashton-Jones, 2018; and Udoudo, 2016) have shown that accumulation of solid wastes is an aesthetic disaster, if they are burned, they contribute to air pollution and when rain falls percolate into the soil. Adimekwe (2013) also concluded that dumping of refuse enables rats, flies, cockroaches and other insects which can cause varying degree of diseases. All these reduce the quality of the environment which in turn affects human health.

Existing studies on land pollution have largely focused on major urban centres or specific sources of pollution, with limited attention given to spatial variations in pollution within individual cities (Ajibade et al., 2019; Ogungbade et al., 2020). For instance, studies on solid-waste disposal and landfill suitability have examined the environmental challenges associated with waste generation, indiscriminate dumping and the location of disposal facilities. Similarly, research on soil contamination around waste-management sites has highlighted the potential effects of improperly managed waste on soil quality (Olanipekun et al., 2024). However, land pollution does not occur uniformly across urban areas. Its occurrence and severity may vary according to land-use patterns, population concentration, commercial activities, waste-disposal practices, drainage conditions and the availability of waste-collection services. Treating an urban area as a single unit may therefore overlook differences between residential neighbourhoods, markets, commercial centres, construction sites and other locations where waste is generated or deposited. These spatial variations are important because they influence the accumulation of waste, the condition of affected land and the environmental problems experienced by nearby residents. In Akure, existing research on solid-waste management provides useful background, but there remains a need for a focused assessment of how land pollution varies across selected neighbourhoods and the factors associated with these variations. This study addresses this gap by examining the sources, spatial distribution and environmental implications of land pollution in Akure, Ondo State, to provide evidence for more targeted urban environmental planning and waste-management interventions.

1.1 Aim and Objectives of the Study

The aim of this study is to assess the spatial distribution and environmental implications of land pollution across selected residential density areas in Akure, Ondo State, Nigeria, with a view to recommending appropriate planning and waste-management strategies for improving urban environmental quality.

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The specific objectives are to:

1. Identify the major sources of land pollution and examine the waste disposal practices contributing to land pollution across selected residential neighbourhoods in Akure.

2. Examine the spatial variations in the occurrence and severity of land pollution across high-, medium- and low-density residential neighbourhoods, including their effects on soil quality, environmental conditions and reported health problems.

3. Assess the existing waste-management practices and their effectiveness in controlling land pollution across the selected residential neighbourhoods.

1.2 Justification of the Study

This study is justified by the need to assess the sources, spatial distribution and environmental implications of land pollution in Akure, Ondo State. Land is an important urban resource that supports residential, commercial and infrastructural activities. However, indiscriminate waste disposal and poor waste-management practices can reduce the quality and usefulness of land. The study will therefore identify the major sources of land pollution and the disposal practices contributing to the problem.

The study is also important to urban and regional planning because land pollution may vary across neighbourhoods due to differences in land use, commercial activities and access to waste-collection services. Examining these variations will help identify affected areas and the environmental problems associated with land pollution. Furthermore, the study will assess the effectiveness of existing waste-management measures in controlling land pollution in Akure. This will help reveal weaknesses in current practices and identify areas requiring improvement.

The findings will be useful to urban planners, environmental authorities, waste-management agencies and community leaders. They may support improved waste collection, monitoring of illegal dumping, enforcement of environmental regulations and better land-use planning. Ultimately, the study is expected to provide practical recommendations for controlling land pollution and improving environmental quality across selected neighbourhoods of Akure.

2. THE STUDY AREA

Akure is the administrative and political capital of Ondo State in southwestern Nigeria. The city developed from a traditional Yoruba settlement into a major urban centre following the creation of Ondo State in 1976. Its functions as a centre of government, commerce, education and residential development have contributed to the expansion of urban activities and increased demand for land and environmental services.

Akure experiences a tropical climate characterised by wet and dry seasons. Its terrain and drainage conditions are relevant to the movement of surface runoff and the possible transportation of waste materials from disposal locations. The 2006 National Population Census recorded 484,798 people in Akure, reflecting its importance as an urban centre (National Population Commission [NPC], 2009).

The city contains residential neighbourhoods, markets, commercial areas, institutional facilities and construction sites, which generate different categories of waste. Where waste collection and disposal are inadequate, refuse may accumulate on vacant plots, roadsides and other open spaces. Previous studies have examined solid-waste management and disposal-site suitability in Akure, highlighting the importance of effective waste management and environmental planning (Ajibade et al., 2019; Ogungbade et al., 2020).

This study therefore examines land pollution across selected neighbourhoods of Akure, focusing on its sources, distribution and environmental implications.

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3. RESEARCH METHODOLOGY

3.1 Research Design

The study adopted a cross-sectional research design involving household surveys, field observations and laboratory analysis of soil samples. The approach enabled the collection of information on the sources, distribution and environmental implications of land pollution across selected residential density areas in Akure, Ondo State.

The household survey provided information on residents' waste disposal practices, perceptions of environmental conditions and reported health problems. Direct field observations were used to identify refuse disposal locations and other potential sources of land pollution, while laboratory analysis was conducted to determine selected physicochemical characteristics and heavy-metal concentrations in soil samples.

3.2 Sampling Frame and Sample Size

The study area was stratified into three residential density categories: high-, medium- and low-density neighbourhoods.

The stratification was based on the prevailing residential development characteristics, including building concentration, neighbourhood layout and intensity of residential activities.

Six neighbourhoods were subsequently selected through random sampling, using a proportional allocation ratio of 3:2:1 for high-, medium- and low-density areas, respectively.

This resulted in the selection of three high-density neighbourhoods, two medium-density neighbourhoods and one low-density neighbourhood.

A total of 384 questionnaires were administered to household respondents across the selected neighbourhoods.

Table 1: Residential Densities and Identified Streets in Akure, Ondo State

Residential density	**Urban Localities**	**Localities Randomly Sampled**	**Population of selected localities**	**Number of questionnaire scheduled (0.5%)**
High density	Owode, Okearo, Okearodanjuma, Aule, Okeijebu, Gbogi, Odofin, Ayetutu, Igbeyinadun	Okearo, Owode, Ayetutu,	18,747	**93**
			14,770	**74**
			10,740	**53**
Medium density	Gbadareondo Bye Pass, Ijomu, Obas Palace, Nipost Headquarter, High Court, Osinlesijuade Estate, Olukayode Street, Adinlewa Street, Afonbiowo, Arakale, Ayegunle, Oguntoye Layout, Mojere And Akad	Ondo bye pass, Gbadare,	15,564	**77**
			12,110	**67**
Low density	Alagbaka, Ijapo Estate, Fanimi Estate, Bishop court, GRA	Alagbaka	4,078	**20**
Total				**384**

Source: National Population Census (2006), Author's fieldwork 2026

The household constituted the basic sampling unit, while the household head or an adult representative was selected as the respondent.

Within each selected neighbourhood, residential buildings were identified, and households were selected systematically to ensure adequate geographical coverage.

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Where a building contained multiple households, one eligible household was selected to avoid unnecessary concentration of respondents in a single building.

The questionnaire was administered to household heads or responsible adult representatives who had sufficient knowledge of household waste disposal practices and neighbourhood environmental conditions.

3.3 Methods of Data Collection

Questionnaire Administration

A structured questionnaire was used to obtain information from residents of the selected neighbourhoods. The questionnaire covered residential characteristics, length of stay, the occurrence of refuse sites, waste-disposal practices, environmental conditions and health problems. Respondents also assessed pollution-related effects, including declining property values, reduced environmental quality, reduced housing patronage and increased criminal activities.

Questions relating to health problems covered irritation of the eyes, throat and nose; skin disease; heavy-metal poisoning; neurological disorders; gastrointestinal diseases; cholera; respiratory disease; mental health problems; eye infections; annoyance; and cancer.

Soil Sampling and Laboratory Analysis

Soil samples were collected from selected locations representing high-, medium- and low-density residential neighbourhoods in Akure. Six soil samples were obtained from locations associated with refuse disposal activities and automobile-related activities to examine variations in selected soil characteristics.

The collected samples were labelled according to their respective sampling locations and transported to the Department of Agronomy, University of Ibadan, for laboratory analysis.

The samples were analysed for pH, organic carbon, lead (Pb), cadmium (Cd), iron (Fe) and zinc (Zn).

The determination of soil pH was undertaken to establish the acidity or alkalinity of the samples, while organic carbon was analysed to assess the organic matter characteristics of the soil.

Heavy-metal analysis was undertaken to determine the concentrations of selected potentially toxic elements associated with waste disposal and automobile-related activities.

The laboratory results were subsequently compared with relevant environmental guideline values (FEPA) to assess the potential contamination status of the sampled soils.

Scaled values were used to compare environmental and socio-economic effects, including property value decline, reduced environmental quality, reduced housing patronage and increased criminal activities. One-way analysis of variance (ANOVA) was used to test whether the mean severity scores for the percieved health problems differed significantly across high-, medium- and low-density residential areas. Statistical significance was assessed at the 5% level.

4. RESULTS AND DISCUSSION

4..1 Length of stay in the area

Research has consistently shown that the length of time individuals reside in an area significantly influences their adaptation to environmental problems and exposure to pollution (Oyedepo, 2019; Akindele *et al*., 2016; Odonkor *et al*., 2020). This study's findings support this assertion.

As illustrated in Figure 1, a significant majority (65%) of respondents have lived in the study areas for over 15 years, while 35% have resided there for less than 15 years. Further analysis reveals that a larger proportion of

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respondents in high-density residential areas have longer residential tenures, enabling them to develop a deeper understanding of their environment. Long-term residents are more likely to be knowledgeable about local pollution hazards and environmental issues, which makes them more trustworthy information sources (Wakefield *et al*., 2021).

The study's findings indicate a strong positive correlation between length of stay and exposure to pollution risks (X^2 = 0.005, Table 2). Respondents who have resided in an area for an extended period are more likely to be exposed to pollution risks. The results of the study indicate that the length of stay and exposure to pollution hazards are strongly correlated, with longer-term residents having a higher chance of being exposed to pollution (Table 2). This is in line with current research, which indicates that extended exposure to land pollution may raise health risks and have other negative consequences (Kampa and Castanas, 2018).

The results of the study emphasize how crucial it is to take into account how long a person plans to stay in a place when determining their exposure to environmental pollutants. Policymakers and public health professionals can create focused initiatives to reduce these hazards and enhance people' health and well-being by knowing the connection between length of stay and pollution exposure.

Table 2: Chi square

Length of Stay (years)	**Rate of Exposure to Pollution risks**			**X^2**
	High	Medium	Low	
5-Jan	15.31	12.27	5.34	0.358
10-Jun	18.92	16.09	6.02	0.049
15-Nov	25.58	25.33	4.1	0.005
16-20	23.05	23.8	0.04	0.004
Above 20	17.4	20.66	1.25	

Source: Author's fieldwork 2026

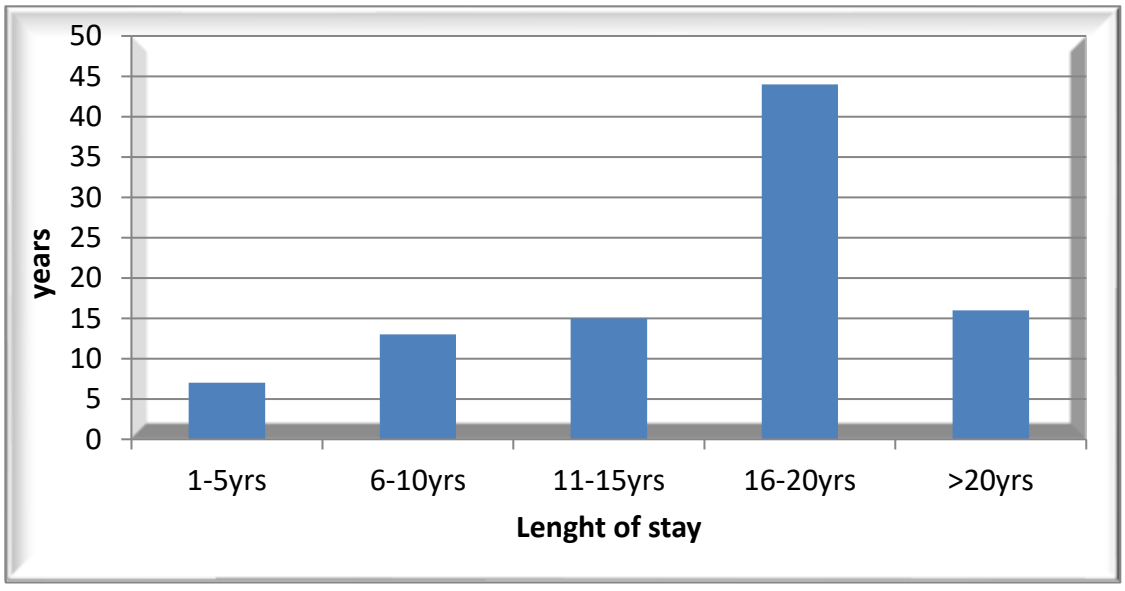

Figure 1: Length of stay of respondents

Source: Author's fieldwork 2026

4.2 Incidence of land pollution

Figure 2 shows that land pollution was more prevalent in high-density residential areas (67%) than in medium-density areas (33%). This may be attributed to the numerous refuse dumpsites in high-density areas, compared

with the fewer dumpsites in medium-density areas and the absence of designated refuse sites in low-density areas. The finding suggests that population concentration and the distribution of waste disposal facilities may influence the occurrence of land pollution in Akure. Therefore, improved waste collection and proper siting of refuse disposal facilities are necessary, particularly in high-density neighbourhoods.

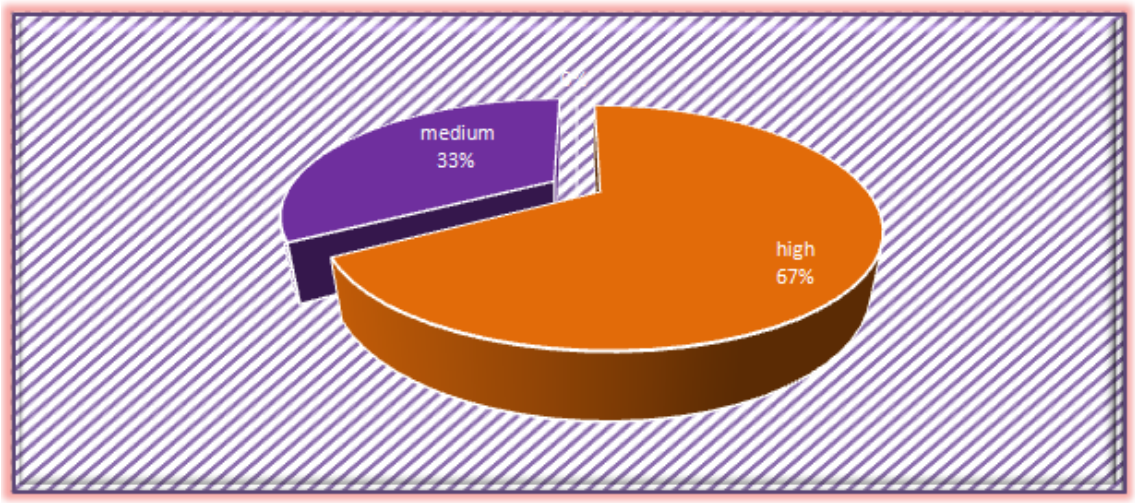

Figure 2: Prevalence of Land pollution

Source: Author's fieldwork 2026

4.3 Intra-Residential Density Variation in the Existence of Land Pollution Sources

Land pollution in urban neighbourhoods is associated with human activities, particularly improper waste disposal and automobile-related activities. In the study area, refuse sites and automobiles were identified as the two pollution sources considered in assessing variations across high-, medium- and low-density residential areas.

Table 3: Association between Residential Density and the Presence of Pollution Sources

Pollution source	High density (%)	Medium density (%)	Low density (%)	df	p-value
Refuse sites	87.6	68.6	22.6	2	<0.001
Automobile presence	93	81.6	0	2	0.448

Source: Author's fieldwork 2026

The findings indicate that refuse sites were more prevalent in high-density residential areas (87.6%) than in medium-density (68.6%) and low-density areas (22.6%).

The reported chi-square result indicates a statistically significant association between residential density and the presence of refuse sites ($p < 0.001$).

However, automobile presence did not show a statistically significant association with residential density ($p = 0.448$).

These findings suggest that the spatial distribution of refuse sites varies considerably across residential density categories, while the observed differences in automobile presence were not statistically significant.

4.4 Variation in Severity of land Pollution across Residential Neighbourhood

The ANOVA results (Table 4) indicate significant differences in the reported severity of refuse-site pollution across residential density categories, $F(2, 428) = 42.759$, $p < 0.001$.

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The effect size ($\eta^2 = 0.167$) indicates that approximately 16.7% of the observed variation in refuse-site severity scores was associated with differences between residential density groups.

Similarly, automobile-related pollution showed statistically significant differences, $F(2, 416) = 18.628$, $p < 0.001$, with an effect size of 0.082.

This suggests that approximately 8.2% of the variation in reported automobile-related pollution severity was associated with residential density differences.

These findings indicate that residential density is relevant to understanding variations in the reported severity of pollution sources in Akure.

Table 4: Differences in the Severity of Land Pollution Sources across Residential Densities

Pollution source	F-value	df	p-value	Eta squared
Refuse sites	42.759	2, 428	<0.001	0.167
Automobile activities	18.628	2, 416	<0.001	0.082

Source: Author fieldwork 2026

4.5 Physiochemical Characteristics of Soil Samples

Soil samples were analysed for pH, organic carbon, lead (Pb), cadmium (Cd), iron (Fe) and zinc (Zn), with results compared against applicable Federal Environmental Protection Agency (FEPA)

Table 5: Physicochemical Characteristics and Heavy-Metal Concentrations of Soil Samples

Parameter	Unit	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Verified guideline value
pH	pH units	7.44	6.94	6.44	6.99	7.15	7.38	6.7
Organic carbon	g/kg	3.6	6.44	3.66	7.52	8.16	8.32	< 0.2
Pb	mg/kg	403.5	408	411	430.8	424.2	435	<1
Cd	mg/kg	26,875	26,075	26,345	26,622	26,095	26,575	< 1
Fe	mg/kg	3.45	2.45	6.32	9.55	8.4	5.6	20
Zn	mg/kg	76	118.2	285	390	471.5	440.5	<1

Source: **Author fieldwork 2026**

Table 5 indicates variations in the physicochemical characteristics of the sampled soils across the selected residential density areas. The recorded pH values ranged from 6.44 to 7.44, suggesting that the sampled soils varied from slightly acidic to mildly alkaline conditions.

The organic carbon values also differed across the samples, ranging from 3.60 to 8.32 g/kg. These differences may reflect variations in soil characteristics and the accumulation of organic materials.

Soil samples 4, 5 and 6, collected from high-density residential areas, recorded the highest concentrations of lead, cadmium, iron and zinc, exceeding the reported FEPA limits. The elevated lead concentration around automobile workshops is particularly concerning because lead exposure poses serious health risks. These findings agree with Adesuyi (2019) and Vincent et al. (2022), who identified potential heavy-metal contamination around automobile workshops.

Furthermore, decomposing waste may generate leachate that transports pollutants into surrounding soil and groundwater. Although water contamination was not directly established in this study, the possibility highlights the need for proper waste disposal, safe management of automobile waste and regular environmental monitoring.

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4.6. Effects of Land Pollution

Environmental and Socio-Economic Implications of Land Pollution

Table 6 presents the scaled severity of pollution-related environmental effects across high-, medium- and low-density residential areas in Akure. High-density areas recorded the highest values for property value decline (640), reduced environmental quality (593), reduced housing patronage (615) and increased criminal activities (593). Medium-density areas recorded intermediate values, while low-density areas had the lowest values across all four indicators.

The findings suggest that pollution-related environmental problems are more pronounced in high-density areas, where intensive human activities and pressure on environmental infrastructure may contribute to declining environmental quality and residential attractiveness. The high values for property value decline and reduced housing patronage also suggest that environmental conditions may influence residents' housing choices and perceptions of property desirability. This interpretation is consistent with environmental research showing that pollution and poor neighbourhood conditions can reduce residential amenity and affect property values. However, the scaled values indicate relative severity and should not be interpreted as percentages or direct proof that pollution caused these effects.

These findings are consistent with Schütt (2021), whose meta-analysis found that proximity to severely contaminated waste sites can negatively affect residential property values. Similarly, the Lagos study on environmental sanitation found that households placed value on living farther from landfill sites, reflecting the importance of environmental quality in residential location decisions.

Table 6: **Scaled Incidence of Environmental Problems**

Environmental effect	High density	Medium density	Low density
Property value decline	640	395	111
Decrease in environmental quality	593	324	143
Reduced housing patronage	615	428	95
Increase in criminal activities	593	415	74

Source: Author's fieldwork, 2026,

Variations in the Severity of land Pollution-Related Diseases across Residential Densities

The ANOVA results in Table 7 indicate statistically significant differences in reported health-problem severity across high-, medium- and low-density residential neighbourhoods.

Annoyance recorded the highest effect size ($\eta^2 = 0.427$), followed by mental health problems ($\eta^2 = 0.351$) and cholera ($\eta^2 = 0.293$).

These results indicate that residential density groups differed substantially in their reported severity scores for these conditions.

However, these findings should not be interpreted as evidence that land pollution directly caused the reported illnesses. The study relied on household responses rather than clinical diagnoses or longitudinal health records.

Table 7: ANOVA Results and Effect Sizes of Reported Health Problems across Residential Densities

Reported health problem	F-value	df	p-value	Eta squared
Eye, throat and nose irritation	15.642	2, 366	<0.001	0.079

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Skin disease	12.165	2, 410	<0.001	0.056
Heavy-metal poisoning	44.46	2, 415	<0.001	0.176
Neurological disorders	30.414	2, 416	<0.001	0.128
Gastrointestinal diseases	3.717	2, 223	0.026	0.032
Cholera	66.71	2, 322	<0.001	0.293
Respiratory diseases	6.203	2, 336	0.002	0.036
Mental health problems	89.105	2, 330	<0.001	0.351
Eye infections	56.716	2, 510	<0.001	0.182
Annoyance	117.731	2, 316	<0.001	0.427
Cancer	47.883	2, 477	<0.001	0.167

Source: Author fieldwork 2026.

4.7 Discussion of findings

Implications of Land Pollution for Urban Environmental Planning

The findings reveal considerable differences in the occurrence and severity of land pollution across residential density areas in Akure. High-density neighbourhoods recorded the highest occurrence of refuse sites, suggesting that waste disposal problems are more pronounced in these locations.

This finding has important implications for urban environmental planning. High-density neighbourhoods generally require more intensive waste collection arrangements because of the concentration of residential buildings and human activities. Where collection facilities are inadequate, vacant plots, roadsides and drainage corridors may become informal waste disposal locations.

The findings therefore support the need for differentiated waste-management interventions rather than applying uniform waste collection arrangements across all residential areas.

For example, high-density neighbourhoods should be prioritised for strategically located communal waste collection points, more frequent evacuation schedules and accessible collection routes. Medium-density areas require regular monitoring of existing disposal locations, while low-density neighbourhoods require preventive measures to discourage the conversion of vacant plots into illegal dumpsites.

The study by Ajibade et al. (2019) demonstrated the relevance of integrating geographical information systems and multicriteria decision analysis into landfill site selection in Ogun. This provides an important planning basis for identifying environmentally suitable locations for waste disposal facilities.

Consequently, urban planning authorities should integrate waste disposal locations into neighbourhood planning and development control activities. New residential layouts should make adequate provision for accessible waste collection facilities, while existing neighbourhoods should be assessed to identify locations where additional facilities are required.

Implications for Soil Quality and Environmental Monitoring

The laboratory analysis provides preliminary evidence of variations in soil characteristics across the sampled locations.

The reported concentrations of selected heavy metals require verification before definitive conclusions can be made regarding the extent of soil contamination.

Nevertheless, the findings highlight the importance of environmental monitoring around refuse disposal sites and automobile-related activities.

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In particular, automobile workshops should be subjected to improved environmental management practices involving the proper collection and storage of used engine oil, batteries, metal scraps and other potentially hazardous materials.

Environmental authorities should also establish routine soil-monitoring programmes around identified waste disposal locations.

The findings of Olanipekun et al. (2024), which examined potentially toxic elements in soils around a solid-waste management site in Ibadan, further demonstrate the importance of monitoring soil contamination around waste disposal facilities.

The planning implication is that environmental monitoring should be incorporated into the management of existing waste disposal sites and the approval of new waste-related land uses.

Implications for Residential Property Values and Neighbourhood Quality

The study recorded higher scaled values for property value decline and reduced housing patronage in high-density residential areas.

These results suggest that residents associate poor environmental conditions with reduced residential attractiveness.

Although the study does not establish actual market depreciation through property transaction records, the findings indicate that environmental quality is an important consideration in residential location decisions.

Schütt (2021) similarly demonstrated that proximity to severely contaminated waste sites can negatively affect residential property values.

From an urban planning perspective, this suggests that effective waste management should be considered part of neighbourhood improvement and residential property protection.

Planning authorities should therefore prioritise the removal of illegal dumpsites, rehabilitation of affected open spaces and enforcement of appropriate land-use controls around waste disposal locations.

Implications for Public Health and Environmental Management

The ANOVA findings indicate significant differences in reported health problems across residential density categories.

These differences highlight the importance of environmental sanitation and improved waste management in residential neighbourhoods.

However, the questionnaire-based findings should be interpreted as reported health experiences rather than clinically confirmed pollution-related diseases.

Environmental health authorities should therefore undertake targeted health surveillance in neighbourhoods with high reported pollution exposure.

Public education should also focus on avoiding direct contact with potentially contaminated waste, improving household sanitation and preventing the use of vacant plots and drainage channels as dumping locations.

These interventions would complement physical planning measures by addressing both the environmental sources of pollution and the exposure pathways through which residents may encounter environmental hazards.

4.8 Contribution of the Findings to Knowledge

This study contributes to knowledge by providing an integrated assessment of land pollution across different residential density categories in Akure, Ondo State. Unlike assessments that examine urban waste management as a general environmental problem, the study considers variations in the occurrence and severity of pollution across high-, medium- and low-density residential neighbourhoods.

The study also contributes by combining household survey information, field observations and laboratory assessment of selected soil characteristics. This approach provides a broader understanding of the relationship between waste disposal activities, residential density and environmental conditions.

Furthermore, the findings demonstrate the importance of considering residential density when designing urban waste-management interventions. The higher occurrence of refuse sites in high-density neighbourhoods suggests that environmental management strategies should be spatially differentiated to reflect variations in waste generation, neighbourhood characteristics and environmental service requirements.

The study provides an empirical basis for incorporating environmental monitoring, improved waste collection and the control of indiscriminate dumping into neighbourhood planning and development control practices in Akure.

5. SUMMARY OF THE FINDINGS

The study assessed land pollution across selected residential density areas in Akure, Ondo State, with particular attention to pollution sources, spatial variations, soil characteristics and environmental implications.

Regarding the first objective, the findings identified refuse disposal sites and automobile-related activities as the major pollution sources examined in the study. Refuse sites were more prevalent in high-density neighbourhoods (87.6%) than in medium-density (68.6%) and low-density neighbourhoods (22.6%). The chi-square analysis indicated a statistically significant association between residential density and the presence of refuse sites ($p < 0.001$).

Regarding the second objective, the findings revealed variations in the occurrence and severity of land pollution across the selected residential density categories. High-density neighbourhoods recorded higher scaled values for property value decline (640), reduced environmental quality (593) and reduced housing patronage (615). The ANOVA results also indicated significant differences in the severity of reported health problems across residential density categories.

The laboratory analysis further revealed variations in the physicochemical characteristics of the six soil samples. However, the reported heavy-metal concentrations require verification before the extent of soil contamination can be conclusively established.

5.2 RECOMMENDATIONS AND CONCLUSION

Based on the available evidence, the following recommendations are made:

- The Ondo State Waste Management Authority and relevant local environmental authorities should introduce differentiated waste collection arrangements across residential density categories. High-density neighbourhoods should receive more frequent waste evacuation services because of the higher occurrence of refuse disposal sites recorded in these areas.
- Communal waste collection points should be provided at accessible locations within high- and medium-density neighbourhoods. Their locations should be determined through spatial assessment to minimise walking distances, prevent indiscriminate dumping and avoid obstruction of roads and drainage channels.
- The Akure urban planning authorities should incorporate waste collection facilities into residential layout approval and neighbourhood improvement programmes. Vacant plots, road setbacks and drainage corridors should be protected against unauthorised waste disposal.

- Environmental authorities should strengthen monitoring of automobile workshops, particularly regarding the disposal of used engine oil, batteries, metal scraps and other potentially hazardous materials. Workshops should provide appropriate storage facilities for these materials and comply with environmental management requirements.
- Identified illegal dumpsites should be cleared and rehabilitated. Reclaimed spaces should be converted into appropriate neighbourhood uses, including landscaped open spaces, subject to land suitability and planning approval.

The study however concludes that addressing land pollution requires a coordinated approach involving urban planning authorities, environmental agencies, waste-management organisations and residents.

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