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Manuscript ID:
IJWGAFES-2026-030205

DOI: 10.5281/zenodo.19246214

DOI Link:
<https://doi.org/10.5281/zenodo.19246214>

Volume: 3

Issue: 2

February

Year: 2026

E-ISSN: 3066-1552

Submitted: 06 Jan. 2026

Revised: 10 Jan. 2026

Accepted: 05 Feb. 2026

Published: 28 Feb. 2026

Senior Petroleum Officer, Ministry of
Petroleum and Energy, The Gambia,
Africa
Email: basirudarboe770@gmail.com

Address for correspondence:

Basiru K Darboe
Senior Petroleum Officer, Ministry of
Petroleum and Energy, The Gambia,
Africa
Email: basirudarboe770@gmail.com

How to cite this article:

Darboe, B. K. (2026). Geographical Perspectives on Urban Air Pollution in Brikama City. *International Journal of World Geology, Geography, Agriculture, Forestry and Environment Sciences*, 3(2), 19–24.
<https://doi.org/10.5281/zenodo.19246214>

Geographical Perspectives on Urban Air Pollution in Brikama City

Basiru K Darboe

Abstract

This study presents a geographical analysis of urban air pollution in Brikama, The Gambia. It is a rapidly growing city facing significant environmental challenges due to urbanisation and industrialisation. The research investigates the spatial distribution, sources, and impacts of air pollution, employing a mixed-methods approach that combines primary data from questionnaire surveys with secondary sources such as official reports and scientific literature. The findings reveal that vehicular emissions, industrial activities, waste burning, and the use of traditional cooking fuels are the predominant contributors to air pollution in Brikama. Spatial patterns indicate that densely populated and industrial zones experience higher pollution levels, aggravating health risks for vulnerable groups, including children and the elderly. The study also highlights varying levels of public awareness and perception regarding air quality, with many residents recognising the adverse effects on health and the environment. Based on the geographical assessment, the research paper recommends targeted interventions such as improved public transportation, stricter emission controls, enhanced waste management, and community education programs. These geographically informed strategies are essential for mitigating air pollution and promoting sustainable urban development in Brikama.

Keywords: Brikama, Air Pollution, Air Quality Index, Perception, Effects of Air Pollution, Public Perception, Environmental Health, Urbanisation, Pollution Sources

Introduction

Air pollution is a critical environmental and public health issue, particularly in rapidly urbanising regions of West Africa. According to the World Health Organisation (WHO), nearly 99% of the global population breathes air that exceeds WHO guideline limits, with low- and middle-income countries—including those in Africa—experiencing the highest exposures and associated health risks (World Health Organisation, 2023). In West Africa, air pollution is now recognised as a threat to life expectancy on par with communicable diseases, with fine particulate matter (PM_{2.5}) levels often several times higher than recommended standards (EPIC, 2023).

Urban centres such as Brikama, The Gambia, are experiencing increased air quality challenges due to population growth, industrialisation, and changing land use patterns. Recent studies highlight that air pollution in African cities is driven by a complex mix of sources, including vehicular emissions, industrial activities, waste burning, and household energy use, all of which are exacerbated by rapid urbanisation and limited regulatory oversight (UN-Habitat, 2023). In The Gambia, the National Environment Agency's recent air quality monitoring initiatives have revealed that urban areas like Brikama consistently record PM_{2.5} concentrations far above WHO guidelines, with significant seasonal variation and health impacts (The Gambia National Environment Agency, 2025).

Geographical factors further influence the spatial distribution and intensity of air pollution. Features such as low-lying plains, proximity to the Atlantic Ocean, and prevailing wind patterns can either disperse or concentrate pollutants, affecting both urban and peri-urban populations (Green Packs, 2023). The interplay of these geographical and socio-economic factors underscores the need for localised, data-driven research to inform effective policy and urban planning.

This paper provides a comprehensive geographical analysis of air pollution in Brikama, The Gambia, drawing on both primary and secondary data to examine sources, spatial patterns, health impacts, and community perceptions. The findings aim to support evidence-based interventions for sustainable urban management and improved public health outcomes in the region.

Air pollution is a major public health and environmental challenge in Africa, with urban centres experiencing particularly high levels of exposure due to rapid population growth, industrialisation, and increased energy consumption (Mir Alvarez et al., 2020; Takal et al., 2025). In West Africa, ambient air pollution is responsible for severe mortality and morbidity, especially from respiratory and cardiovascular diseases (Mir Alvarez et al., 2020).

The Economic Community of West African States (ECOWAS) region faces significant gaps in air quality monitoring and policy enforcement, with only a few countries maintaining systematic surveillance (Mir Alvarez et al., 2020).

Recent systematic reviews highlight that mean annual PM_{2.5} concentrations in African cities range widely, from 19.3 µg/m³ in Bamako to 63.5 µg/m³ in Kano, far exceeding the World Health Organisation's recommended threshold of 5 µg/m³ (Takal et al., 2025; Safo-Adu et al., 2023). Sources of air pollution include household fuels, industrial emissions, vehicular traffic, bush burning, and natural phenomena such as Harmattan dust (David et al., 2025; Njie, 2024). In The Gambia, urban areas like Brikama are particularly affected, with seasonal variations in PM_{2.5} levels and pollution hotspots linked to activities such as fish processing and waste burning (National Environment Agency, 2024; ODI, 2023).

The health impacts of air pollution in Africa are profound, disproportionately affecting vulnerable populations such as children, women, and low-income communities (Frazenburg et al., 2025; Safo-Adu et al., 2023). Chronic exposure to particulate matter increases the risk of respiratory infections, pulmonary illnesses, cardiovascular diseases, and non-communicable diseases (Kabuya et al., 2025; Atuyambe et al., 2024). Urban form, geography, and meteorological conditions further influence the distribution and severity of air pollution, with valleys, coastal regions, and densely populated areas experiencing higher concentrations due to limited air circulation and temperature inversions (Green Packs, 2023; Katsouyanni, 2003).

Despite the growing body of research, significant gaps remain in air quality monitoring, public health surveillance, and policy implementation in Africa (Mir Alvarez et al., 2020; Ihedike et al., 2024). Integrated, context-specific strategies—including renewable energy adoption, improved monitoring infrastructure, and targeted interventions for vulnerable groups—are recommended to mitigate the health and environmental impacts of air pollution (Atuyambe et al., 2024; Takal et al., 2025).

Research Methodology:

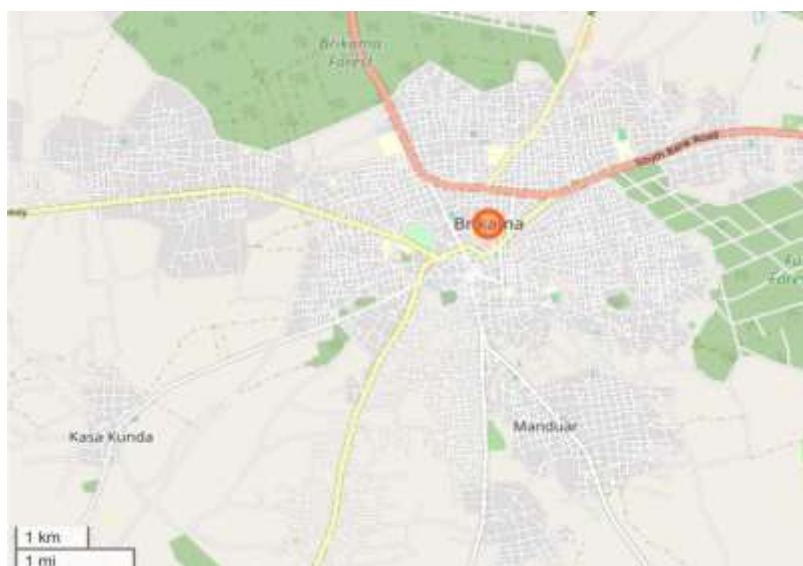
This research adopts a mixed-methods approach to analyse the geographical patterns and impacts of air pollution in Brikama. The study is based on both primary and secondary data sources. Primary data were collected through a structured questionnaire survey administered to 150 residents of Brikama, selected to represent diverse social, economic, and cultural backgrounds. The survey gathered information on respondents' perceptions of air pollution, health impacts, and socio-economic characteristics.

Secondary data were obtained from books, journals, research papers, and official reports, providing context on the physical and non-physical environment of Brikama, as well as historical air quality data. Quantitative methods, including statistical tools such as tables, pie charts, and bar diagrams, were used to analyse the data. The study area was geographically profiled, and the research period spanned January to May 2023.

Study Area:

Brikama is a major urban centre located in the Western Region of The Gambia, West Africa. Geographically, it lies at approximately 13.2772° N latitude and 16.6597° W longitude, about 35 kilometres southwest of the capital city, Banjul. Brikama serves as the capital of the West Coast Region and is the headquarters of the Brikama Regional Council, making it the most populous local government area in the country. The city is situated within a low-lying coastal plain characterised by flat to gently undulating terrain, with an average elevation of about 30 meters above sea level.

Brikama's population has grown rapidly in recent decades, driven by urbanisation, migration, and high fertility rates. As of 2015, the city's population was estimated at over 877,000, with a youthful demographic profile—over 60% of residents are under the age of 30. The city is ethnically diverse, with Mandinka as the largest group, followed by Fula, Wolof, Jola, Serahule, and non-Gambians from neighbouring countries. Economically, Brikama is a vibrant market town and trading centre, with activities ranging from retail trade and agriculture to small-scale industries such as metalwork, woodworking, and food processing.



Source: Open Street Map, 2026

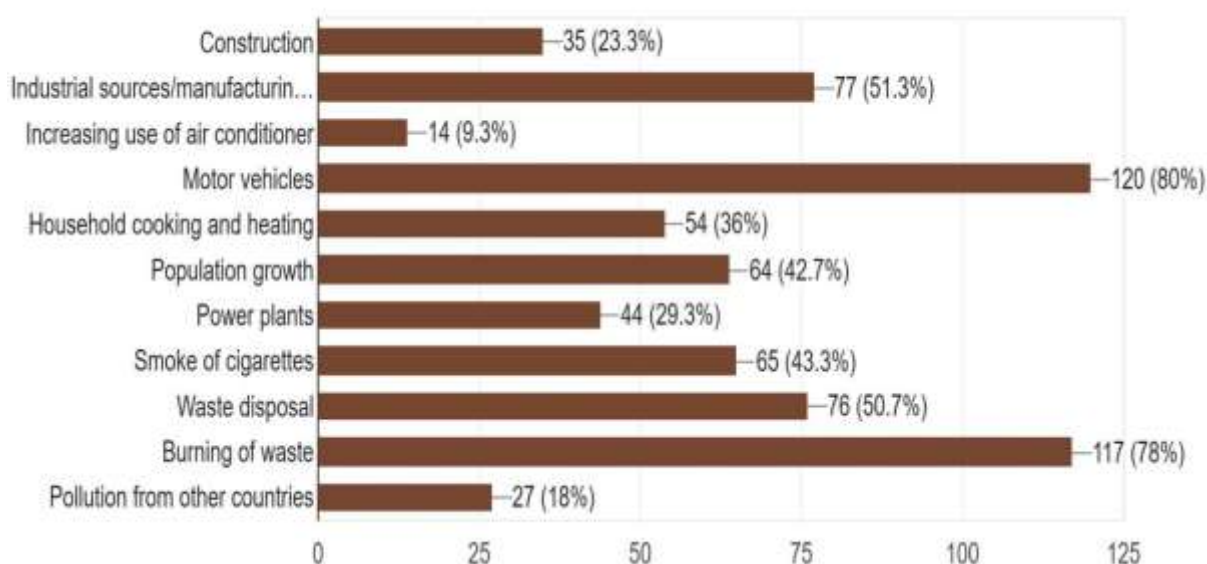
Results and Findings:

Major Sources of Air Pollution

The study identified several primary sources of air pollution in Brikama, with both human-made and natural contributors. The most significant sources include:

- **Vehicular emissions:** 80% of survey respondents indicated motor vehicles as the main source of air pollution. The rapid increase in vehicle numbers, especially older and poorly maintained vehicles, has led to elevated emissions of carbon monoxide, nitrogen oxides, and particulate matter.
- **Industrial activities:** 52.3% of respondents cited industrial sources and manufacturing as major contributors. Small-scale industries such as metalwork, woodworking, and food processing, along with larger facilities on the city's outskirts, emit dust, smoke, and chemical fumes.
- **Waste burning and disposal:** 78% of respondents identified burning of waste as a significant source. The lack of proper waste management leads to open burning, releasing harmful pollutants, including dioxins and furans.
- **Household energy use:** 36% of respondents pointed to the burning of wood and traditional fuels for cooking and heating as a major source, contributing to indoor and outdoor air pollution.

Fig 1. Perception of Respondents Regarding Major Air Pollution Sources



Source: Based on Survey

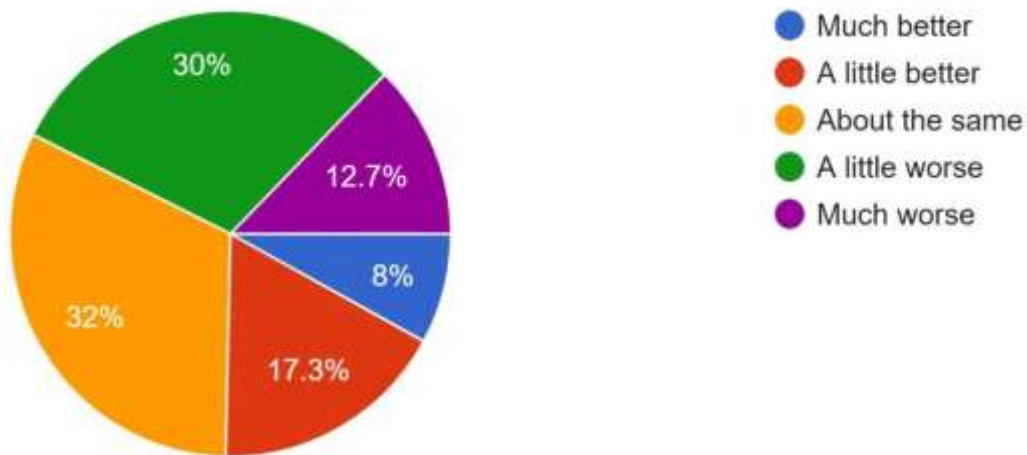
Spatial Patterns and Air Quality Index

Spatial analysis revealed that pollution levels are highest in densely populated and industrial zones. The average annual Air Quality Index (AQI) for Brikama in 2022 was 76, with current readings in May 2023 reaching 119 (classified as "unhealthy for sensitive groups"). The main pollutant is PM_{2.5}, with concentrations 8.6 times higher than the WHO annual guideline values.

Public Perception and Awareness

- **Awareness:** 99% of survey respondents reported being aware of air pollution and its changing quality in Brikama.
- **Perception of air quality:** 32% felt air quality was unchanged compared to the previous year, 30% believed it was a little worse, and 12.7% thought it was much worse.

Fig 2. Perception about Overall Air Quality

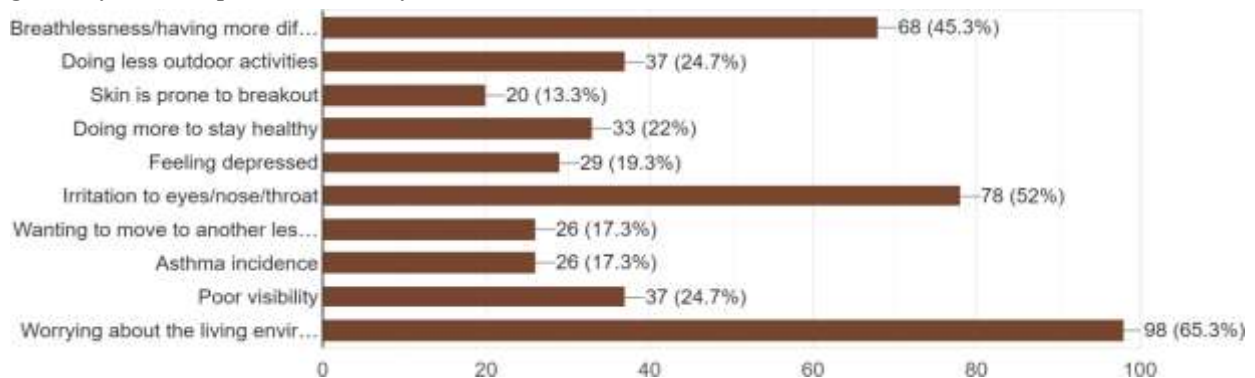


- **Transport choices:** 50% of respondents use individual transport, while the other half prefer public transportation to help reduce emissions.

Health and Environmental Impacts

- **Health effects:** 41.3% of respondents reported being very much affected by air pollution, while 54.7% were affected a little. Only 4% felt unaffected.
- **Symptoms and conditions:** Common effects include breathlessness (45.3%), irritation to eyes/nose/throat (52%), asthma incidence (17.3%), and worrying about children's living environment (65.3%).
- **Disease prevalence:** 18.7% reported suffering from diseases related to air pollution, mainly respiratory and cardiovascular conditions.
- **Environmental impacts:** Air pollution contributes to poor visibility, damage to vegetation, soil, and water bodies, and exacerbates climate change.

Fig 3. Ways that Respondents feel they are Affected



Quantitative Highlights

- **AQI (May 2023):** 119 (Unhealthy for sensitive groups)
- **PM2.5 concentration:** 43 $\mu\text{g}/\text{m}^3$ (8.6 times WHO guideline)
- **Population affected:** 96% report some level of impact
- **Main sources (survey):** Motor vehicles (80%), waste burning (78%), industrial activities (52.3%), household cooking (36%).

Table 1. Gambia Air Quality City Ranking

#	City	AQI
1	Brikama, Western	119
2	Basse Santa Su, Upper River	76
3	Bakau, Banjul	74
4	Keneba, Lower River	74

Source: IQAir, 2023

Table 2. Seasonal Differences in Air Quality Index (2023-24)

Brikama	Annual Mean	Dry Season	Rainy Season
PM 2.5	35.6	42.5	25.9
US Air Quality Index	102	115	84

Source: The Gambia National Environment Agency, 2025

Significance:

These findings underscore the urgent need for targeted interventions in Brikama, including improved public transportation, stricter emission controls, enhanced waste management, and public education campaigns. The spatial and demographic analysis highlights vulnerable groups and pollution hotspots, providing a foundation for evidence-based policy and urban planning.

Conclusion

This research has provided a comprehensive geographical analysis of urban air pollution in Brikama, The Gambia. It demonstrates the complex nature of this issue and its severe effects on public health and the environment. The sources of air pollution were found to be emissions from vehicles, industries, waste burning, and domestic energy consumption, and the spatial analysis showed that air pollution is more severe in densely populated and industrial areas. The Air Quality Index (AQI) and PM2.5 values were found to be above the recommended levels, which is a serious health concern, especially for sensitive populations like children and the elderly.

The survey findings showed that public knowledge of air pollution is high, and most people have experienced health problems, including respiratory and cardiovascular diseases. The results also emphasised the need for interventions such as stricter emission standards, better public transportation, better waste management, and community education campaigns.

To address air pollution in Brikama, it is important to adopt a multi-faceted strategy involving the government and the people. By adopting effective policies and encouraging public participation, it is possible to reduce the negative impacts of air pollution and create a healthier environment. The results of this study not only provide information on the need to address air pollution in Brikama but also shed light on the challenges posed by air pollution in rapidly developing areas of West Africa.

Acknowledgment

I would like to express my sincere gratitude to all those who contributed to the successful completion of this research on Geographical Perspectives on Urban Air Pollution in Brikama City. My appreciation goes to the residents of Brikama who willingly participated in the questionnaire survey and shared valuable insights regarding air pollution and its impacts on their daily lives.

Financial support and sponsorship

Nil.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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