

**ANTHROPOGENIC DRIVERS OF MICROBE–HOST DYNAMICS IN THE GLOBAL SOUTH:  
A ONE HEALTH PERSPECTIVE FROM NIGERIA****\*Dr. Christopher Ononiwu Elemuwa**

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**Abstract**

Human activities have emerged as dominant drivers of ecological transformation, profoundly influencing microbial diversity and host–microbe interactions (Elemuwa, 2026; Ullah, 2025; Jones *et al.*, 2025). In the Global South, particularly Nigeria, rapid urbanization, environmental degradation, agricultural intensification, and widespread antimicrobial misuse are accelerating microbial dysbiosis, pathogen evolution, and zoonotic spillover (WHO, 2024; FAO, 2024). This review synthesizes current evidence on anthropogenic drivers shaping microbe–host dynamics within a One Health framework, emphasizing the interconnectedness of human, animal, and environmental health systems (CDC, 2023; One Health Commission, 2022). The study highlights key pathways linking environmental disruption to antimicrobial resistance (AMR), emerging infectious diseases, and ecosystem instability (Venter *et al.*, 2023; O’neill, 2016). Furthermore, it proposes integrated public health interventions, including strengthened surveillance systems, antimicrobial stewardship, environmental management, and cross-sectoral policy harmonization. This work underscores the urgent need for context-specific, multidisciplinary strategies to mitigate microbial risks and enhance health resilience in Nigeria and similar settings.

**Keywords:** Anthropogenic Drivers, Microbe–Host Dynamics, One Health; Antimicrobial Resistance (AMR), Zoonotic Diseases, Urbanization; Environmental Pollution, Agricultural Intensification, Microbial Ecology, Nigeria, Global South, Public Health, Disease Emergence, Environmental Reservoirs, Health Systems Resilience.

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**INTRODUCTION**

Anthropogenic activities are increasingly recognized as central determinants of microbial ecosystem structure and function (Ullah, 2025; Venter *et al.*, 2023). Across the Global South, rapid socio-economic transitions characterized by urban expansion, deforestation, climate variability, and agricultural intensification are reshaping interactions between microbes and their hosts (Jones *et al.*, 2025; IPCC, 2023). Nigeria exemplifies these dynamics. Accelerated urbanization, inadequate sanitation infrastructure, environmental pollution, and unregulated antimicrobial use contribute to significant alterations in microbial communities (WHO, 2024; Okeke *et al.*, 2020). These changes facilitate the emergence and transmission of infectious diseases, disrupt host immunity, and promote antimicrobial resistance (AMR) (O’neill, 2016; CDC, 2023). Understanding these processes requires an integrated framework that transcends traditional disciplinary boundaries. The One Health approach provides such a framework by linking human, animal, and environmental health systems, enabling a holistic assessment of microbial risks in complex ecological contexts (One Health Commission, 2022; FAO, 2024).

**Problem Statement**

Infectious disease burden remains disproportionately high due to fragmented health systems, environmental degradation, and antimicrobial misuse and abuse of regulatory policies particularly in Nigeria.

**Significance of the study**

This study is significant for several reasons:

- It provides a context-specific synthesis of anthropogenic impacts on microbial ecology in Nigeria (Elemuwa, 2026).
- It bridges microbiology, environmental science, and public health, offering a multidisciplinary perspective (Ullah, 2025).
- It strengthens the application of the One Health framework in addressing emerging infectious threats (FAO, 2024).
- It highlights critical challenges, including:
  - Antimicrobial resistance (AMR) (O’neill, 2016)
  - Zoonotic disease emergence (Jones *et al.*, 2025)
  - Environmental microbial reservoirs (Venter *et al.*, 2023)
- It offers policy-relevant insights for low- and middle-income countries undergoing rapid ecological transitions (WHO, 2024).

**Rationale**

Despite growing global awareness of anthropogenic influences on microbial systems, there remains a critical gap in integrated, region-specific analyses from the Global South (Ullah, 2025; IPCC, 2023). Nigeria, with its unique ecological and socio-economic landscape, presents an important case for examining how human activities drive microbial and disease dynamics (Okeke *et al.*, 2020).

There is an urgent need for frameworks that:

- Integrate environmental, microbial, and host-level processes (Venter *et al.*, 2023)

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- Address AMR, zoonoses, and environmental reservoirs simultaneously (O'Neill, 2016; Jones *et al.*, 2025)
- Support evidence-based policy and intervention strategies (WHO, 2024)
- This study responds to that need by applying a One Health lens to anthropogenic-microbial interactions.

## Anthropogenic drivers of microbe-host dynamics

### 1. Urbanization and Sanitation Challenges

Rapid urban growth, particularly in informal settlements, is associated with poor waste management, contaminated water systems, and increased transmission of enteric pathogens (WHO, 2024; Unep, 2023). These conditions promote microbial dysbiosis and facilitate infectious disease spread (Venter *et al.*, 2023).

### 2. Agricultural Intensification

Livestock production and crop intensification contribute to increased antibiotic use, selection pressure for resistant microorganisms, and cross-species pathogen transmission (FAO, 2024; Jones *et al.*, 2025). These processes are key drivers of AMR emergence in both human and animal populations (O'Neill, 2016).

### 3. Deforestation and Environmental Change

Deforestation alters natural habitats and increases human-wildlife interactions, thereby elevating the risk of zoonotic spillover (IPCC, 2023; Jones *et al.*, 2025). Environmental disruption also destabilizes microbial ecosystems and biodiversity (Venter *et al.*, 2023).

### 4. Pollution and Environmental Contamination

Industrial discharge, pharmaceutical waste, and agricultural runoff introduce antibiotic residues into ecosystems, creating selective pressure for resistant microbial strains (Unep, 2023; WHO, 2024). This contributes to the persistence and spread of AMR in environmental reservoirs (Okeke *et al.*, 2020).

## Public health interventions

Effective responses must adopt integrated strategies:

- Strengthening surveillance systems across human, animal, and environmental sectors (CDC, 2023; FAO, 2024)
- Enhancing laboratory capacity, including molecular diagnostics and genomic surveillance (WHO, 2024)
- Improving sanitation and water systems to reduce environmental pathogen load (Unep, 2023)
- Implementing antimicrobial stewardship programs to limit inappropriate antibiotic use (O'Neill, 2016)

## One Health Framework

The One Health approach is essential for addressing complex microbial challenges. It promotes institutional integration, coordinated surveillance systems, policy harmonization, and capacity building (One Health Commission, 2022; FAO, 2024). This framework enables early detection, prevention, and control of emerging microbial threats while addressing the root causes of disease emergence (WHO, 2024).

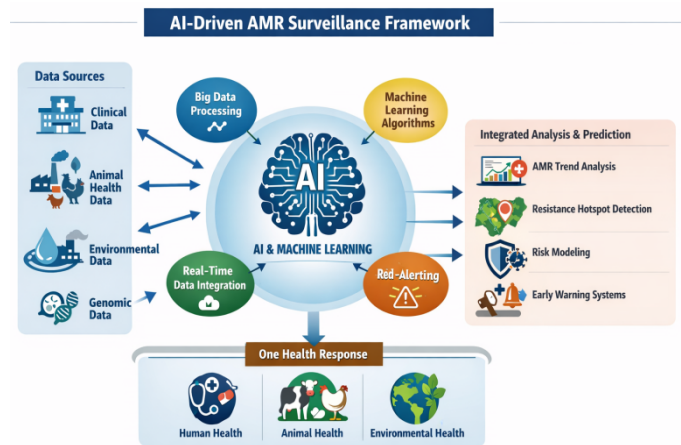


Fig.1. AMR Surveillance Framework

## Suggestions

- Strengthen antimicrobial stewardship and regulatory enforcement (O'NEILL, 2016; WHO, 2024)
- Improve environmental sanitation and waste management systems (UNEP, 2023)
- Develop integrated One Health surveillance platforms (FAO, 2024)
- Promote interdisciplinary research and local capacity building, Fig.1 (ELEMUWA, 2026)
- Enhance community awareness on hygiene and antibiotic use (CDC, 2023)

## DISCUSSION

The findings and literature synthesized in this study underscore the profound influence of anthropogenic activities on microbial ecology and host dynamics, particularly in the context of the Global South. Rapid urbanization, agricultural intensification, industrial expansion, and environmental degradation have created complex ecological pressures that reshape microbial communities and facilitate the emergence of zoonotic pathogens (Elemuwa, 2026; Jones *et al.*, 2025). In Nigeria, for instance, uncontrolled urban sprawl, poor sanitation, and high-density settlements provide ecological niches conducive to microbial dysbiosis and the transmission of infectious diseases, including measles, rubella, and emerging antimicrobial-resistant organisms (Ullah, 2025; Zhang *et al.*, 2025).

## Anthropogenic Dynamisms and Microbial Ecology

Human-induced environmental changes deforestation, wetland drainage, and intensive farming directly alter microbial habitat structures, species composition, and community resilience (DERU *et al.*, 2025). These modifications promote the proliferation of opportunistic pathogens while reducing microbial diversity, a pattern consistent with the concept of ecological simplification (Elemuwa, 2026). Microbial dysbiosis in human and animal populations is increasingly linked to altered host immunity, susceptibility to infections, and the emergence of novel pathogen strains (Zhang *et al.*, 2025). In Nigeria, the intersection of livestock farming, wildlife encroachment, and peri-urban settlements represents a hotspot for pathogen spillover events, exemplifying the interplay between anthropogenic dynamism and microbial evolution.

## Public Health Implications

The consequences of anthropogenic pressures extend beyond microbial ecology, profoundly affecting public health systems. Disease outbreaks such as periodic measles and rubella epidemics are exacerbated by gaps in vaccination coverage, poor cold-chain management, and limited disease surveillance infrastructure (Elemuwa, 2026; Ullah, 2025). Moreover, antimicrobial resistance (AMR), driven by unregulated antibiotic use in human and veterinary settings, represents a critical public health challenge linked to anthropogenic behavior (Deru *et al.*, 2025). The cumulative effect is increased disease burden, economic strain, and reduced health system resilience in Nigeria and similar Global South contexts.

## One Health Perspective

A One Health approach, which emphasizes the interconnectedness of human, animal, and environmental health, is indispensable for addressing these complex dynamics (Jones *et al.*, 2025). Coordinated surveillance across human and animal populations, integrated pathogen genomic monitoring, and ecosystem-based interventions can mitigate the risk of zoonotic spillovers. For instance, enhancing vaccination coverage in both humans and livestock, implementing sustainable agricultural practices, and improving waste management can disrupt transmission pathways and restore microbial equilibrium (Zhang *et al.*, 2025; Elemuwa, 2026).

## Implications for Policy and Future Research

This analysis highlights the need for evidence-based policies that address anthropogenic drivers at multiple levels. Urban planning, environmental regulation, and public health interventions must integrate microbial ecology insights to anticipate and prevent disease emergence. Further research is required to map microbial networks in urban and peri-urban environments, evaluate the impact of land-use change on pathogen evolution, and quantify the socioeconomic costs of anthropogenic-driven disease outbreaks. Cross-sectoral collaboration between ecologists, microbiologists, clinicians, and policymakers is critical for translating these insights into actionable strategies. In conclusion, therefore, anthropogenic dynamisms in Nigeria and similar Global South settings are reshaping microbial landscapes with profound consequences for host health and disease epidemiology. Integrating One Health perspectives with public health policy and microbial ecological understanding offers a robust framework for mitigating emerging infectious diseases and enhancing health system resilience. Addressing these challenges requires a holistic, multidisciplinary strategy that simultaneously targets environmental stewardship, microbial monitoring, and community health interventions (Elemuwa, 2026; Jones *et al.*, 2025; Zhang *et al.*, 2025).

## Conclusion

Anthropogenic activities are increasingly recognized as central drivers of microbial and host dynamics in the Global South, with Nigeria exemplifying the complex interplay between human behavior, environmental change, and pathogen emergence. Rapid urbanization, unsustainable agriculture, industrialization, and poor sanitation disrupt microbial ecology, reduce biodiversity, and create conditions conducive

to infectious disease outbreaks and antimicrobial resistance. These ecological perturbations not only threaten human and animal health but also challenge the resilience of public health systems. Adopting a One Health framework is essential to address these multifaceted challenges. Integrative strategies that combine environmental stewardship, microbial surveillance, vaccination programs, sustainable agricultural practices, and cross-sectoral collaboration are critical for mitigating disease emergence and enhancing population health. Evidence-based policies informed by microbial ecology and epidemiological insights can strengthen Nigeria's capacity to anticipate and respond to emerging infectious threats. Ultimately, this study underscores that the health of humans, animals, and ecosystems are intrinsically linked. Addressing anthropogenic drivers holistically offers a pathway toward sustainable disease prevention, improved public health outcomes, and resilient microbial ecosystems in Nigeria and the broader Global South.

## Recommendations

### Strengthen One Health Integration:

- Develop and implement coordinated surveillance systems that monitor pathogens across human, animal, and environmental interfaces.
- Promote cross-sectoral collaboration among public health authorities, veterinary services, ecologists, and environmental agencies to prevent zoonotic spillover and manage disease outbreaks.

### Enhance Public Health Infrastructure and Vaccination Programs:

- Expand routine immunization coverage for measles, rubella, and other vaccine-preventable diseases, with targeted outreach in urban slums and rural areas.
- Improve cold-chain management, disease reporting systems, and outbreak preparedness to mitigate the health impacts of microbial dysbiosis and emerging pathogens.

### Implement Sustainable Environmental and Agricultural Practices:

- Encourage agroecological methods, controlled livestock farming, and urban planning strategies that reduce environmental degradation and microbial disruption.
- Enforce regulations on industrial waste disposal, water sanitation, and deforestation to minimize pathogen emergence linked to anthropogenic activities.
- Combat Antimicrobial Resistance (AMR) aggressively,
- Promote rational use of antibiotics in human and veterinary medicine, with strict regulatory oversight to prevent misuse.
- Establish AMR surveillance networks to track resistance patterns in both clinical and environmental settings.

### Invest in Microbial Ecology and Epidemiological Research:

- Conduct longitudinal studies to map microbial community dynamics and pathogen evolution in urban, peri-urban, and rural ecosystems.

- Leverage genomic and metagenomic tools to understand the ecological drivers of emerging infectious diseases, providing data-driven guidance for policy and intervention strategies.

#### Community Engagement and Education:

- Increase public awareness of hygiene, vaccination, environmental conservation, and responsible antibiotic use to empower communities in disease prevention.
- Integrate behavioral science approaches to ensure community participation in One Health initiatives and public health programs.

#### Policy and Governance:

- Formulate evidence-based policies addressing the nexus of urbanization, environmental change, and infectious disease emergence.
- Ensure adequate funding, monitoring, and enforcement mechanisms for One Health strategies at local, state, and national levels.

These recommendations provide a practical roadmap linking anthropogenic impacts, microbial ecology, and public health interventions, reinforcing the findings in this study, their relevance for both scientific and policy audiences. The recommendations are very holistic and comprehensive and if religiously implemented will ensure a multiplier effects towards understanding the ANTHROPOGENIC DRIVERS OF MICROBE-HOST DYNAMICS IN THE GLOBAL SOUTH: A ONE HEALTH PERSPECTIVE FROM NIGERIA”

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