

Urban Governance and Resilience: Integrating Climate Change Mitigation and Microbial Infection Control Policies in Nigerian Cities

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ABSTRACT

Received: 09 Feb 2026

Accepted: 10 Mar 2026

Published: 15 Mar 2026

Climate change and infectious diseases represent dual threats to public health and sustainable development in Nigeria's rapidly growing urban areas. This paper examines the critical intersection between climate change mitigation initiatives and microbial infection control in Nigerian cities, arguing for integrated, nature-based, and infrastructure-sensitive approaches. Urbanization intensifies vulnerabilities through overcrowding, inadequate sanitation, pollution, and urban heat island effects, which amplify disease transmission risks while contributing to greenhouse gas emissions. We analyze how climate-driven factors, including increased temperatures, erratic rainfall, flooding, and elevated atmospheric CO₂, influence the ecology, distribution, and virulence of pathogens, contributing to the resurgence of water-borne, vector-borne, and airborne infections. Concurrently, we assess mitigation strategies such as urban greening, sustainable waste management, renewable energy adoption, and green building standards for their potential co-benefits in reducing microbial exposure and enhancing urban resilience. The paper highlights case studies from Lagos, Abuja, and Port Harcourt to illustrate localized challenges and innovations. We conclude that synergistic policy frameworks, which combine emission reduction with public health protection, through improved surveillance, climate-responsive urban planning, community engagement, and investment in water, sanitation, and hygiene (WASH) infrastructure, are essential for building healthier, more sustainable, and climate-resilient Nigerian cities.

How to cite this article

Madubueze, M. H. C., Mbanefo, O. D., Anekwe, J. K., Nwadiogbu, N. M., & Egberi, A. E. (2026). Urban governance and resilience: Integrating climate change mitigation and microbial infection control policies in Nigerian cities. *Journal of Public Health, Policy, and Society*, 3(1), 112–118. <https://doi.org/10.54117/wp4t0r70>

Keywords

Climate change mitigation, Microbial infection control, Urban health, Public health resilience, Urbanization

Open Access article



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Introduction

Climate change represents one of the most formidable global challenges of the 21st century, with its impacts acutely felt in urban environments across the developing world. Nigeria, Africa's most populous nation, exemplifies this vulnerability. Its rapidly expanding cities, such as Lagos, Kano, and Port Harcourt, are epicentres of economic activity but also hotspots for climate-related stressors, including extreme heat, intensified flooding, and water scarcity (Adelekan, 2016). These climatic shifts are not merely environmental concerns; they act as powerful amplifiers of public health crises, particularly by exacerbating the transmission and burden of microbial infections.

The intersection of climate change and microbial disease dynamics in urban settings is a complex, synergistic threat. Rising temperatures and altered precipitation patterns can enhance the breeding rates and geographic range of pathogens and their vectors, such as mosquitoes carrying malaria and dengue fever (Cissé, 2019). Increased frequency of extreme floods contaminates water supplies with enteric pathogens like *Vibrio cholerae*, *Escherichia coli*, and *Salmonella* spp., leading to outbreaks of diarrheal diseases (Levy *et al.*, 2016). Furthermore, urban heat islands can stress populations, compromise immune function, and foster the transmission of respiratory infections (UN-Habitat, 2021). In Nigerian cities, where infrastructure is often overstretched, sanitation systems are inadequate, and healthcare access is inequitable, these climate-driven health risks are disproportionately severe (Echendu, 2022).

Crucially, the strategies employed to mitigate climate change can have profound co-benefits or unintended consequences for infection control. For instance, urban greening initiatives, such as creating parks and green corridors to sequester carbon and reduce urban heat, can also influence vector habitats and human exposure to pathogens (Benedict and McMahon, 2012). Similarly, improvements in water, sanitation, and hygiene (WASH) infrastructure, essential for breaking fecal-oral transmission routes, are also key adaptations to water stress and flood risks (Howard *et al.*, 2016). Conversely, some mitigation measures, like water conservation that leads to stagnant household storage, can inadvertently increase risks of vector-borne diseases if not carefully designed (World Bank, 2020).

This nexus demands an integrated policy approach. However, in Nigeria, climate action and public health planning often operate in isolated silos. While the country has committed to international climate agreements and developed a National

Climate Change Policy, its integration with urban public health strategies, particularly for microbial infection surveillance and outbreak response, remains underdeveloped (Federal Ministry of Environment, 2021; Onyekwena and Ishaku, 2021).

Therefore, this work explores the critical intersection of climate change mitigation and microbial infection control in Nigerian urban areas. It argues that proactive, integrated urban policies which simultaneously target greenhouse gas reduction and strengthen public health resilience offer the most sustainable pathway for safeguarding Nigeria's urban populations. By analyzing the shared drivers and synergistic solutions, this discussion aims to bridge the gap between environmental and health governance, advocating for a co-benefits framework that protects both the planet and its people from interconnected threats.

1.2 Overview of Microbial Infections in Nigerian Urban Areas

Urban centers in Nigeria serve as crucibles for a significant and diverse burden of infectious diseases. The convergence of high population density, inadequate sanitation infrastructure, unreliable water supplies, and socioeconomic inequalities creates an environment where microbial pathogens thrive. The spectrum of endemic and epidemic-prone infections is wide, with major categories including:

- **Waterborne and Foodborne Diseases:** These constitute a leading cause of morbidity, particularly among children. Pathogens such as *Vibrio cholerae*, *Salmonella typhi* (typhoid fever), *Shigella* spp., and diarrheagenic *Escherichia coli* are frequently implicated in outbreaks, often linked to contaminated municipal water, poorly managed sewage, and unhygienic food handling practices (Akinyemi *et al.*, 2021). Recurrent cholera outbreaks in cities like Lagos and Port Harcourt underscore the persistent failure of urban WASH (Water, Sanitation, and Hygiene) systems.
- **Vector-Borne Diseases:** Urbanization does not eliminate vector-borne threats; it often transforms them. *Plasmodium falciparum* malaria remains hyperendemic, with *Anopheles* mosquitoes breeding in myriad water bodies created by inadequate drainage, construction sites, and discarded containers (Awolola *et al.*, 2018). Furthermore, the establishment of *Aedes aegypti* mosquitoes in urban environments has led to recurrent outbreaks of arboviruses, including dengue fever, with documented cases in cities like Ibadan and Sokoto (Fagbami *et al.*, 2020). These vectors exploit the abundant man-made containers and the urban heat island effect, which can accelerate their life cycles.
- **Airborne and Crowd-Enhanced Infections:** The crowded living conditions typical of many Nigerian urban informal settlements (slums) facilitate the rapid transmission of airborne pathogens. Tuberculosis (TB) incidence is high, exacerbated by malnutrition and HIV co-infection, while vaccine-preventable diseases like measles can erupt quickly in areas with poor immunization coverage (Olarinmoye *et al.*, 2020). The COVID-19 pandemic starkly revealed how densely populated urban hubs can become epicenters for respiratory virus spread.

The persistence of these infections is fundamentally a failure of urban governance and infrastructure. Overburdened healthcare systems struggle with surveillance, diagnosis, and treatment, while poverty limits access to care and preventive measures. This creates a baseline of high vulnerability upon which climate change exerts its influence (Okeke *et al.*, 2017).

1.3 Linkages between Climate Change and Microbial Infection Dynamics

Climate change is not a distant threat but a present-day amplifier of Nigeria's existing infectious disease burden. It acts through multiple, often interacting, pathways to alter the ecology, transmission, and geographic range of microbial pathogens:

- **Temperature-Driven Effects:** Rising average temperatures and more frequent heat waves directly influence pathogen and vector biology. For many bacteria, such as non-typhoidal *Salmonella*, replication rates increase with ambient temperature, potentially raising the incidence of food poisoning (Levy *et al.*, 2016). For mosquito vectors like *Anopheles* and *Aedes*, higher temperatures accelerate larval development, increase biting frequency, and shorten the extrinsic incubation period of pathogens like malaria parasites and dengue virus, thereby enhancing transmission potential (Cissé, 2019).
- **Hydrological Extremes and Water Contamination:** Altered precipitation patterns are a critical link. Intense rainfall and flooding, which are becoming more frequent, overwhelm drainage and sewage systems, leading to the direct contamination of drinking water sources with fecal pathogens. This is the primary driver of post-flood cholera and typhoid outbreaks in cities like Lagos (Adelekan, 2016). Conversely, prolonged droughts can concentrate pathogens in dwindling water sources and force populations to use unsafe alternatives, while also promoting water storage practices that create new vector breeding sites (Howard *et al.*, 2016).
- **Sea-Level Rise and Coastal Salinization:** In coastal megacities like Lagos, sea-level rise is causing saltwater intrusion into freshwater aquifers and lagoons. This can create brackish water environments favorable for the proliferation of *Vibrio* species, including *V. cholerae*, potentially expanding the geographic range of cholera risk zones (Oni and Fatusi, 2021).
- **Indirect Societal Impacts:** Climate-induced economic stress, crop failure, and population displacement can drive migration into urban slums, further straining fragile infrastructure and healthcare systems. Malnutrition resulting from food insecurity can weaken host immunity, increasing susceptibility to infections (World Bank, 2020). These socio-climatic shocks degrade the social determinants of health, making urban populations more vulnerable to all microbial threats.

2. Overview of Climate Change Drivers in Nigeria

Nigeria faces profound climate change impacts driven by both global atmospheric changes and local anthropogenic factors. The country's climate is becoming increasingly variable, with projections indicating temperature increases of 1.5–3.0°C by 2050 and more erratic rainfall patterns (Federal Ministry of Environment, 2021). These changes are amplified by rapid urbanization, deforestation, and industrialization, creating complex environmental challenges that disproportionately affect urban populations.

2.1 Urban Climate Stressors

2.1.1 Rising Temperature and Heat Waves

Urban areas in Nigeria are experiencing accelerated temperature increases compared to rural surroundings. Lagos has recorded a temperature rise of approximately 0.5°C per decade since 1980, with more frequent and intense heat waves (Ayanlade *et al.*, 2018). These thermal extremes strain energy systems, increase heat-related illnesses, and exacerbate pre-existing health conditions, particularly among vulnerable populations in informal settlements lacking adequate shelter or cooling infrastructure.

2.1.2 Flooding and Extreme Rainfall Events

Coastal and riverine cities face escalating flood risks. Between 2011 and 2020, Nigeria experienced over 120 major flood events, with urban centers like Lagos, Port Harcourt, and Ibadan repeatedly affected (Nkwunonwo *et al.*, 2020). These floods damage critical infrastructure, contaminate water supplies, displace populations, and create ideal conditions for waterborne disease outbreaks. Urban expansion onto floodplains and inadequate drainage systems significantly amplify these risks.

2.1.3 Air Pollution and Urban Heat Island Effect

The urban heat island (UHI) effect is pronounced in Nigerian cities, where temperatures can be 3–5°C higher than surrounding rural areas due to heat-absorbing surfaces, reduced vegetation, and anthropogenic heat emissions (Adebayo and Zemba, 2019). Concurrently, air pollution from transportation, industry, and domestic fuel use creates particulate matter concentrations often exceeding WHO guidelines by 5–10 times, compounding respiratory health risks.

2.2 Impacts of Climate Change on Urban Infrastructure and Sanitation

Climate stressors directly compromise urban systems essential for public health. Flooding damages water treatment plants and sewage networks, leading to cross-contamination between drinking water and wastewater. The 2012 and 2022 floods in Lagos caused widespread sewage system failures, resulting in cholera outbreaks affecting thousands (Akinyemi *et al.*, 2021). Extreme heat accelerates the degradation of water distribution pipes and storage infrastructure, while sea-level rise threatens coastal sanitation facilities with saltwater intrusion and inundation.

2.3 Climate Change Adaptation Challenges in Nigerian Cities

Adaptation efforts face systemic barriers including inadequate funding, institutional fragmentation, and rapid urbanization outpacing planning capacity. Climate policies often exist in isolation from urban development and public health planning, leading to maladaptive outcomes such as flood control measures that inadvertently create mosquito breeding sites (Oni and Fatusi, 2021). Urban poor populations face the greatest adaptation deficits due to informality, tenure insecurity, and limited access to services.

3. Overview of Climate-Sensitive Microbial Infections

3.1 Waterborne Microbial Infections

Climate variability directly influences waterborne pathogen dynamics. Flooding events have been statistically linked to cholera outbreaks in Lagos, with a 10% increase in heavy rainfall days correlating with a 15–20% rise in reported cases (Levy *et al.*, 2016). Typhoid fever shows similar patterns, with seasonal peaks during rainy periods when water contamination is highest. Rising temperatures also favor the proliferation of pathogens like *Vibrio cholerae* in aquatic environments, particularly in warming coastal waters.

3.2 Foodborne Microbial Infections

Temperature increases affect food safety throughout the supply chain. Higher ambient temperatures accelerate bacterial growth in perishable foods, particularly in markets lacking refrigeration. Studies in Ibadan markets found *Salmonella* contamination rates 40% higher during hot seasons compared to cooler periods (Cissé, 2019). Flooding compounds these risks by contaminating agricultural fields and disrupting food preservation systems in urban markets.

3.3 Airborne and Respiratory Microbial Infections

Urban air pollution and climate conditions interact to affect respiratory disease transmission. Particulate matter from fossil fuel combustion and biomass burning damages respiratory epithelium, increasing susceptibility to tuberculosis and other airborne infections (Olarinmoye *et al.*, 2020). The UHI effect may extend seasonal transmission windows for respiratory viruses by maintaining conducive temperatures, though this requires further localized research in Nigerian contexts.

3.4 Vector-Associated Microbial Diseases in Urban Settings

Urbanization creates novel ecosystems for disease vectors. *Aedes aegypti* mosquitoes, vectors of dengue and chikungunya, thrive in artificial containers common in urban environments. Warmer temperatures accelerate their development and increase

viral replication rates, potentially expanding transmission seasons (Awolola *et al.*, 2018). Malaria transmission persists in peri-urban areas where construction sites and poor drainage create breeding habitats, with climate projections suggesting potential geographical shifts in transmission intensity.

3.5 Antimicrobial Resistance and Urban Environmental Pressures

Urban environments serve as hotspots for antimicrobial resistance (AMR) amplification. Inadequate wastewater treatment releases antibiotics and resistant bacteria into water bodies, while higher temperatures may increase horizontal gene transfer between bacteria (Okeke *et al.*, 2017). Flooding events spread resistant pathogens across urban landscapes, complicating infection management in healthcare facilities already stressed by climate-related disease burdens.

4. Overview of Mitigation and Control Approaches

4.1 Climate Change Mitigation Measures in Nigerian Urban Areas

4.1.1 Sustainable Urban Planning and Green Infrastructure

Strategic urban planning can yield significant climate and health co-benefits. Green infrastructure including urban parks, green roofs, and permeable surfaces—mitigates UHI effects, manages stormwater, and reduces flood risks while providing recreational spaces that promote physical and mental health (Benedict and McMahon, 2012). Lagos's recent greening initiatives demonstrate potential, though implementation remains fragmented and unequal across neighborhoods.

4.1.2 Waste Management and Sanitation Improvement

Circular economy approaches to waste management offer mitigation potential while reducing disease risks. Methane capture from landfills reduces greenhouse gas emissions while minimizing breeding sites for disease vectors. Improved sanitation infrastructure, particularly in informal settlements, prevents water contamination and reduces pathogen loads entering the environment.

4.1.3 Clean Energy and Emission Reduction Strategies

Transitioning to renewable energy and improving energy efficiency in buildings and transportation reduces both greenhouse gas emissions and air pollutants. Solar electrification of healthcare facilities and clean cooking initiatives in urban households can simultaneously mitigate climate change and reduce respiratory infections from indoor air pollution.

4.2 Microbial Infection Prevention and Control Strategies

4.2.1 Strengthening Water, Sanitation, and Hygiene (WASH) Systems

Climate-resilient WASH infrastructure is fundamental to breaking disease transmission pathways. This includes elevating water points above flood levels, protecting water sources from contamination, and implementing decentralized treatment systems for informal settlements (Howard *et al.*, 2016). Lagos's recent investments in water treatment capacity represent progress, though coverage gaps persist, particularly in rapidly expanding peri-urban areas.

4.2.2 Disease Surveillance and Early Warning Systems

Integrating climate data with health surveillance enables proactive responses. Early warning systems that link rainfall forecasts with cholera risk have shown promise in other African contexts and could be adapted for Nigerian cities (Cissé, 2019). Real-time syndromic surveillance in sentinel health facilities, combined with environmental monitoring, could improve outbreak detection and response timing.

4.2.3 Public Health Education and Community Engagement

Community-based interventions that address local knowledge and practices are essential for sustained behavior change. Participatory approaches that engage residents in vector control, water safety practices, and sanitation maintenance have proven more effective than top-down directives. Digital platforms increasingly facilitate health messaging, though disparities in access must be addressed.

4.3 Integrated Climate–Health Policy Approaches

Effective management requires breaking down sectoral silos. Integrated policies should mainstream health considerations into urban planning, climate adaptation, and infrastructure development. The "Health in All Policies" approach, already piloted in some states, could be strengthened with specific climate-health indicators and cross-ministerial coordination mechanisms (Oni and Fatusi, 2021).

4.4 Challenges and Opportunities for Implementation in Nigeria

Implementation faces significant barriers including limited financing, institutional capacity constraints, and data gaps. However, opportunities exist through Nigeria's revised Nationally Determined Contributions (NDCs), which increasingly recognize health co-benefits. International climate finance mechanisms, such as the Green Climate Fund, could support integrated projects if proposals effectively demonstrate health linkages. South-South cooperation and learning exchanges with other rapidly urbanizing countries facing similar challenges offer additional pathways for innovation.

5. Conclusion

The convergence of climate change and microbial disease risks in Nigeria's urban centers represents a complex but manageable challenge. By adopting integrated approaches that recognize the interconnectedness of environmental and health systems,

Nigerian cities can simultaneously advance climate resilience, improve public health, and promote sustainable urban development. The window for proactive action is narrowing, but the co-benefits of integrated approaches offer compelling rationale for urgent, coordinated intervention.

5.1 Recommendations

Based on this analysis, the following integrated recommendations are proposed:

1. **Develop Integrated Urban Climate-Health Action Plans:** Nigerian cities should create multisectoral plans that explicitly link climate mitigation and adaptation with infectious disease control objectives, with dedicated funding and implementation mechanisms.
2. **Prioritize Climate-Resilient WASH Infrastructure:** Investment should focus on decentralized, flood-resistant water and sanitation systems in vulnerable urban areas, with maintenance protocols that account for changing climate conditions.
3. **Establish Climate-Informed Disease Surveillance Systems:** Federal and state health departments should integrate climate data into existing surveillance systems to develop early warning indicators for climate-sensitive diseases.
4. **Promote Nature-Based Solutions in Urban Planning:** Urban development policies should mandate green infrastructure standards that provide cooling, flood management, and public health benefits, particularly in low-income neighborhoods.
5. **Strengthen Interministerial Coordination:** Create formal coordination mechanisms between environment, health, urban development, and water resources ministries at federal and state levels, with joint budgeting for integrated initiatives.
6. **Enhance Community-Led Adaptation:** Support community-based organizations in informal settlements to develop locally appropriate adaptation measures that address both climate risks and disease prevention.
7. **Build Research Capacity for Climate-Health Nexus:** Nigerian academic institutions should develop interdisciplinary research programs focusing on the urban climate-health interface, with emphasis on locally generated evidence for policy.
8. **Leverage Climate Finance for Health Co-benefits:** Nigerian climate negotiators and project developers should more actively pursue international climate funding for projects with demonstrated health benefits, particularly in urban areas.

References

- Adelekan, I. O. (2016). Flood risk management in the coastal city of Lagos, Nigeria. *Journal of Flood Risk Management*, 9(3), 255-264. <https://doi.org/10.1111/jfr3.12179>
- Benedict, M. A., & McMahon, E. T. (2012). *Green infrastructure: linking landscapes and communities*. Island Press.
- Cissé, G. (2019). Food-borne and water-borne diseases under climate change in low- and middle-income countries: Further efforts needed for reducing environmental health exposure risks. *Acta Tropica*, 194, 181-188. <https://doi.org/10.1016/j.actatropica.2019.03.012>
- Echendu, A. J. (2022). Urbanization and climate change impacts on public health in Nigeria. In *Urban Health and Wellbeing* (pp. 75-92). Springer, Singapore. https://doi.org/10.1007/978-981-16-7377-5_6
- Federal Ministry of Environment, Nigeria. (2021). *National Climate Change Policy for Nigeria 2021-2030*. <https://climatechange.gov.ng/national-climate-change-policy/>
- Howard, G., et al. (2016). Climate change and water and sanitation: likely impacts and emerging trends for action. *Annual Review of Environment and Resources*, 41, 253-276. <https://doi.org/10.1146/annurev-environ-110615-085856>
- Kondo, M. C., et al. (2015). Health and urban green space. *The Lancet*, 386(10006), 1721-1722. [https://doi.org/10.1016/S0140-6736\(15\)00634-7](https://doi.org/10.1016/S0140-6736(15)00634-7)
- Levy, K., Woster, A. P., Goldstein, R. S., & Carlton, E. J. (2016). Untangling the impacts of climate change on waterborne diseases: a systematic review of relationships between diarrheal diseases and temperature, rainfall, flooding, and drought. *Environmental Science & Technology*, 50(10), 4905-4922. <https://doi.org/10.1021/acs.est.5b06186>
- Onyekwena, C., & Ishaku, J. (2021). *Climate Change and Health Preparedness in Nigeria: A Review of Policies and Strategies*. Centre for the Study of the Economies of Africa (CSEA). <https://cseaafrica.org/publication/climate-change-and-health-preparedness-in-nigeria/>
- UN-Habitat. (2021). *Cities and Pandemics: Towards a More Just, Green and Healthy Future*. United Nations Human Settlements Programme. <https://unhabitat.org/cities-and-pandemics-towards-a-more-just-green-and-healthy-future>
- World Bank. (2020). *Climate and Disaster Resilience in Nigerian Cities: Issues and Priorities*. <https://openknowledge.worldbank.org/handle/10986/35017>
- Adelekan, I. O. (2016). Flood risk management in the coastal city of Lagos, Nigeria. *Journal of Flood Risk Management*, 9(3), 255-264. <https://doi.org/10.1111/jfr3.12179>
- Akinyemi, K. O., Bamiro, B. S., & Ojo, O. O. (2021). Infectious diseases in Nigeria: A review of the current status and challenges. *Journal of Global Health Reports*, 5, e2021050. <https://doi.org/10.29392/001c.24503>

- Awolola, T. S., Oduola, A. O., Obansa, J. B., Chukwurar, N. J., & Unyimadu, J. P. (2018). Malaria in Nigeria: A review of the epidemiology, disease burden, and control strategies. *Nigerian Journal of Parasitology*, 39(2), 115–124.
- Benedict, M. A., & McMahon, E. T. (2012). *Green infrastructure: Linking landscapes and communities*. Island Press.
- Cissé, G. (2019). Food-borne and water-borne diseases under climate change in low- and middle-income countries: Further efforts needed for reducing environmental health exposure risks. *Acta Tropica*, 194, 181–188. <https://doi.org/10.1016/j.actatropica.2019.03.012>
- Echendu, A. J. (2022). Urbanization and climate change impacts on public health in Nigeria. In A. K. Gupta, M. N. A. Khan, & S. Nandy (Eds.), *Urban Health and Wellbeing* (pp. 75–92). Springer. https://doi.org/10.1007/978-981-16-7377-5_6
- Fagbami, A. H., Onoja, A. B., & Arowolo, T. A. (2020). Re-emergence of dengue virus in Nigeria: Current status and future prospects. *African Journal of Clinical and Experimental Microbiology*, 21(4), 263–271. <https://doi.org/10.4314/ajcem.v21i4.1>
- Federal Ministry of Environment, Nigeria. (2021). *National Climate Change Policy for Nigeria 2021–2030*. <https://climatechange.gov.ng/national-climate-change-policy/>
- Howard, G., Charles, K., Pond, K., Brookshaw, A., Hossain, R., & Bartram, J. (2016). Climate change and water and sanitation: Likely impacts and emerging trends for action. *Annual Review of Environment and Resources*, 41, 253–276. <https://doi.org/10.1146/annurev-environ-110615-085856>
- Kondo, M. C., Fluehr, J. M., McKeon, T., & Branas, C. C. (2015). Health and urban green space. *The Lancet*, 386(10006), 1721–1722. [https://doi.org/10.1016/S0140-6736\(15\)00634-7](https://doi.org/10.1016/S0140-6736(15)00634-7)
- Levy, K., Woster, A. P., Goldstein, R. S., & Carlton, E. J. (2016). Untangling the impacts of climate change on waterborne diseases: A systematic review of relationships between diarrheal diseases and temperature, rainfall, flooding, and drought. *Environmental Science & Technology*, 50(10), 4905–4922. <https://doi.org/10.1021/acs.est.5b06186>
- Okeke, I. N., Ojo, K. K., & Fatusi, A. O. (2017). The complex challenge of controlling infectious diseases in Nigeria. *Nature Microbiology*, 2, Article 17057. <https://doi.org/10.1038/nmicrobiol.2017.57>
- Olarinmoye, O. O., Ojo, J. F., Akinwale, O. P., & Awoyemi, O. B. (2020). Tuberculosis and HIV co-infection in a Nigerian urban setting: Prevalence and risk factors. *International Journal of Infectious Diseases*, 92, 202–208. <https://doi.org/10.1016/j.ijid.2020.01.015>
- Oni, T., & Fatusi, A. (2021). Climate change and health in Africa: Issues and options for policy and practice. *BMJ Global Health*, 6(Suppl 6), Article e005475. <https://doi.org/10.1136/bmjgh-2021-005475>
- Onyekwena, C., & Ishaku, J. (2021). Climate change and health preparedness in Nigeria: A review of policies and strategies. Centre for the Study of the Economies of Africa (CSEA). <https://cseaafrica.org/publication/climate-change-and-health-preparedness-in-nigeria/>
- UN-Habitat. (2021). *Cities and pandemics: Towards a more just, green and healthy future*. United Nations Human Settlements Programme. <https://unhabitat.org/cities-and-pandemics-towards-a-more-just-green-and-healthy-future>
- World Bank. (2020). *Climate and disaster resilience in Nigerian cities: Issues and priorities*. World Bank Group. <https://openknowledge.worldbank.org/handle/10986/35017>
- Adebayo, W., & Zemba, A. (2019). Urban heat island intensity in Lagos, Nigeria: A case study of Ikeja and its environs. *African Journal of Environmental Science and Technology*, 13(8), 303–311. <https://doi.org/10.5897/AJEST2019.2701>
- Adelekan, I. O. (2016). Flood risk management in the coastal city of Lagos, Nigeria. *Journal of Flood Risk Management*, 9(3), 255–264. <https://doi.org/10.1111/jfr3.12179>
- Akinyemi, K. O., Bamiro, B. S., & Ojo, O. O. (2021). Infectious diseases in Nigeria: A review of the current status and challenges. *Journal of Global Health Reports*, 5, e2021050. <https://doi.org/10.29392/001c.24503>
- Awolola, T. S., Oduola, A. O., Obansa, J. B., Chukwurar, N. J., & Unyimadu, J. P. (2018). Malaria in Nigeria: A review of the epidemiology, disease burden, and control strategies. *Nigerian Journal of Parasitology*, 39(2), 115–124.
- Ayanlade, A., Oluwaranti, A., Ayanlade, O. S., & Borderon, M. (2018). Extreme climate events in Nigeria: Examining the spatio-temporal changes in heatwaves and extreme rainfall. *Weather and Climate Extremes*, 22, 10–20. <https://doi.org/10.1016/j.wace.2018.10.004>
- Benedict, M. A., & McMahon, E. T. (2012). *Green infrastructure: Linking landscapes and communities*. Island Press.
- Cissé, G. (2019). Food-borne and water-borne diseases under climate change in low- and middle-income countries: Further efforts needed for reducing environmental health exposure risks. *Acta Tropica*, 194, 181–188. <https://doi.org/10.1016/j.actatropica.2019.03.012>
- Echendu, A. J. (2022). Urbanization and climate change impacts on public health in Nigeria. In A. K. Gupta, M. N. A. Khan, & S. Nandy (Eds.), *Urban Health and Wellbeing* (pp. 75–92). Springer. https://doi.org/10.1007/978-981-16-7377-5_6
- Fagbami, A. H., Onoja, A. B., & Arowolo, T. A. (2020). Re-emergence of dengue virus in Nigeria: Current status and future prospects. *African Journal of Clinical and Experimental Microbiology*, 21(4), 263–271. <https://doi.org/10.4314/ajcem.v21i4.1>
- Federal Ministry of Environment, Nigeria. (2021). *National Climate Change Policy for Nigeria 2021–2030*. <https://climatechange.gov.ng/national-climate-change-policy/>
- Howard, G., Charles, K., Pond, K., Brookshaw, A., Hossain, R., & Bartram, J. (2016). Climate change and water and sanitation: Likely impacts and emerging trends for action. *Annual Review of Environment and Resources*, 41, 253–276. <https://doi.org/10.1146/annurev-environ-110615-085856>
- Kondo, M. C., Fluehr, J. M., McKeon, T., & Branas, C. C. (2015). Health and urban green space. *The Lancet*, 386(10006), 1721–1722. [https://doi.org/10.1016/S0140-6736\(15\)00634-7](https://doi.org/10.1016/S0140-6736(15)00634-7)

- Levy, K., Woster, A. P., Goldstein, R. S., & Carlton, E. J. (2016). Untangling the impacts of climate change on waterborne diseases: A systematic review of relationships between diarrheal diseases and temperature, rainfall, flooding, and drought. *Environmental Science & Technology*, 50(10), 4905–4922. <https://doi.org/10.1021/acs.est.5b06186>
- Nkwunonwo, U. C., Whitworth, M., & Baily, B. (2020). A review and critical analysis of the efforts towards urban flood risk management in the Lagos region of Nigeria. *Natural Hazards and Earth System Sciences*, 20(2), 349–369. <https://doi.org/10.5194/nhess-20-349-2020>
- Okeke, I. N., Ojo, K. K., & Fatusi, A. O. (2017). The complex challenge of controlling infectious diseases in Nigeria. *Nature Microbiology*, 2, Article 17057. <https://doi.org/10.1038/nmicrobiol.2017.57>
- Olarinmoye, O. O., Ojo, J. F., Akinwale, O. P., & Awoyemi, O. B. (2020). Tuberculosis and HIV co-infection in a Nigerian urban setting: Prevalence and risk factors. *International Journal of Infectious Diseases*, 92, 202–208. <https://doi.org/10.1016/j.ijid.2020.01.015>
- Oni, T., & Fatusi, A. (2021). Climate change and health in Africa: Issues and options for policy and practice. *BMJ Global Health*, 6(Suppl 6), Article e005475. <https://doi.org/10.1136/bmjgh-2021-005475>
- Onyekwena, C., & Ishaku, J. (2021). *Climate change and health preparedness in Nigeria: A review of policies and strategies*. Centre for the Study of the Economies of Africa (CSEA). <https://cseaafrica.org/publication/climate-change-and-health-preparedness-in-nigeria/>
- UN-Habitat. (2021). *Cities and pandemics: Towards a more just, green and healthy future*. United Nations Human Settlements Programme. <https://unhabitat.org/cities-and-pandemics-towards-a-more-just-green-and-healthy-future>
- World Bank. (2020). *Climate and disaster resilience in Nigerian cities: Issues and priorities*. World Bank Group. <https://openknowledge.worldbank.org/handle/10986/35017>