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Transforming the Nigerian Water Sector Through Collaborative Research and Innovations for Public Health and Environment

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Abstract
Transformation of the Nigerian water sector and Sustainable water management solutions can be achieved through collaboration among academic institutions, government bodies, international organizations, businesses, and local communities. This paper examines how collaborative research between Government agencies, Universities, industries, businesses, and international partners can change Nigeria's water sector for the better, improving public health and protecting the environment. Employing a qualitative research methodology grounded in secondary data, policy documents, and pre-existing empirical studies, the paper examines the present condition of the Nigerian water sector, pinpoints deficiencies in research collaboration, and assesses the prospective advantages of interdisciplinary and multi-stakeholder research partnerships. The government, universities, communities, international agencies, and the private sector need to work together on research. The findings showed that poor coordination between institutions and a lack of knowledge transfer make it harder to manage water well. The connection between water quality and the ultimate outcomes on public health and the necessity of coordinated governance, the involvement of the community, and the exchange of knowledge were also outlined in the paper. The paper concludes that strengthening collaborative research frameworks and innovations is essential for evidence-based policymaking, improved water quality, development of water infrastructure, environmental protection, disease prevention, and environmental sustainability in Nigeria. These strategies are necessary in the realization of Sustainable Development Goal 6 (Clean Water and Sanitation) and the development of resilience of nations to climate change and environmental pollution.

Keywords: Sustainable development, Environmental protection, Collaborative research, Environmental sustainability, Nigerian water sector

1.0 Introduction

Water is ubiquitous and an indispensable natural resource that supports public health, economic growth, environmental integrity, and human life. Nigeria's water industry is essential to meeting the country's domestic, agricultural, industrial, and ecological needs. Millions of Nigerians still struggle with inadequate access to clean drinking water, inadequate sanitation facilities, water pollution, ineffective infrastructure, and poor institutional coordination despite the nation's abundance of water resources. The frequency of waterborne illnesses, environmental deterioration, decreased agricultural output, and social disparities in both urban and rural areas have all been greatly exacerbated by these issues. Water resources are very important for protecting the environment, promoting sustainable development, and protecting human health. Nigeria has had a hard time getting enough water, keeping it clean, and managing it, even though it has a lot of freshwater. In developing nations like Nigeria, the availability of safe, adequate, and reliable water is a significant problem, although the nation has a significant amount of surface and ground water. The water

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sector in Nigeria is an important sector not only in domestic use but also in agriculture, industry, energy generation and ecosystem conservation. Nevertheless, the lack of proper infrastructure, water pollution, inadequate sanitation, high population growth, and global warming have remained as the challenges to proper water management (Adewumi *et al*., 2019). These challenges have serious implications on the health of the population. Waterborne diseases such as cholera, typhoid fever, diarrhoea, and dysentery are significant contributors to death and morbidity in children and the vulnerable population due to unsafe drinking water and poor sanitation (WHO, 2022).

The quality of water is further worsened by environmental degradation caused by industrial effluents, agricultural runoff, oil spills, and poor disposal of waste in the rivers, lakes, and groundwater systems of the entire of Nigeria (Ojekunle *et al*., 2020). The interrelationship between these issues demonstrates the necessity of comprehensive solutions, which can be implemented to manage water supply, human health, and environmental safety. Although the water sector is subject to many national policies, reforms, and investments, progress has been poor because of poor governance structures, institutional fragmentation, inadequate funding, and a lack of scientific evidence in decision-making (FMWR, 2018). Universities, research institutes, and government agencies often conduct research efforts in isolation, which leads to duplication of efforts and a lack of translation of research findings into policy and practice (Okeke *et al.,* 2021). The lack of connection has diminished the efficacy of interventions to enhance the quality of water and service delivery.

Inadequate infrastructure, water contamination, poor institutional coordination, and pressures from climate change are just a few of the major issues Nigeria's water industry must deal with. Environmental sustainability, economic productivity, and public health have all suffered as a result of these issues. Millions of Nigerians still lack access to clean drinking water and adequate sanitation despite the country's plentiful water resources. Joint research provides a strategic avenue to such systemic challenges. Collaborative research can facilitate the pooling of different expertise, resources and views by forming partnerships between academic institutions, government agencies, stakeholders in the private sector, civil society organizations, and international development partners. This type of cooperation increases knowledge creation, innovation and evidence-based policymaking, which are key to transforming the water sector sustainably (UNESCO, 2021).

In Nigeria, water governance, protection of the population, and environmental sustainability can be enhanced through enhanced collaborative research frameworks. The Nigerians are not yet benefiting from the safe drinking water and the sources of polluted water have also multiplied spreading water borne diseases and environmental degradation among millions of Nigerians. Availability of safe and sustainable water is an important issue in Nigeria and the implications of this issue on the health of the population and environmental sustainability are huge. Although the Nigerian water sector is endowed with many policy frameworks and infrastructural investments, the problem of governance fragmentation, poor research integration, pollution, and climate variability still persists in the sector. It is on this basis that this paper will discuss how collaborative research can help in transforming the Nigerian water sector to help in enhancing the health outcomes of the people and protecting the environment. The research aims at adding to the body of knowledge by establishing the significance of interdisciplinary and multi-stakeholder research partnerships as a basis of sustainable water management in Nigeria.

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2.0 Literature Review

2.1 The Structure and Challenges of the Nigerian Water Sector

Nigeria has a lot of surface and groundwater resources, but managing them well is still a big problem. Research indicates that the Nigerian water sector is marked by institutional fragmentation, inadequate regulatory enforcement, and insufficient progress in building infrastructure. Federal, state, and local governments all have a role to play in managing water resources. This can lead to overlapping responsibilities and poor coordination. This governance structure has made it harder to deliver water services efficiently and made it harder to hold people accountable (Adeniyi and Yusuf, 2020). The existing water infrastructure is under more stress because of rapid population growth, urbanisation, and industrial growth. Many cities still use old water treatment plants, and most rural areas get their water from shallow wells or untreated surface water. Climate change, such as long periods of drought and flooding, has made water shortages and weak infrastructure even worse in many parts of the country (UNESCO, 2021). These problems show that we need new and research-based ways to make changes in the water sector.

2.2 Water Quality, Public Health, and Human Well-being

The connection between water quality and public health has been well-documented in the literature ((Erojikwe *et al.,* 2024; Ezeaka and Bartholomew, 2025). To stop diseases and improve health, it is important to have access to clean drinking water and good sanitation. In Nigeria, bad water quality is still a big part of the burden of communicable diseases, especially in rural and low-income areas. Diseases that spread through water, like cholera, diarrhea, and typhoid fever, are still very dangerous to public health, especially for kids under five (WHO and UNICEF, 2023). Several studies link these health problems to microbial contamination, chemical pollutants, and not enough water treatment. Industrial discharges, oil exploration, runoff from farms, and bad waste disposal have all made water sources in the country much worse. The literature underscores that enhancing public health outcomes in Nigeria necessitates integrated water quality monitoring systems, preventive health strategies, and evidence-based interventions underpinned by rigorous research (Okeke *et al*., 2021; Adewumi *et al*., 2011; William *et al*., 2023; Ogarekpe *et al*., 2023; Oyebode, 2024). Innovative solutions can be employed to address public health challenges in Nigeria. (Adeola and Ibrahim, 2024; Adewumi *et al*., 2026; Adewumi et al., 2019; Agusomu *et al*., 2025). We can tackle water and public Health Problems through a participatory mechanism (FMWR, 2018; Ojekunle *et al*., 2020; Okeke *et al,* 2021).

2.3 Environmental Sustainability and Water Resource Management

To manage water resources well, it's important to be environmentally friendly. Ecosystem degradation, deforestation, soil erosion, and pollution are all making Nigerian water bodies less available and less stable. Studies show that bad land-use practices and weak environmental laws have made aquatic ecosystems worse, which hurts biodiversity and long-term water security. Integrated Water Resources Management (IWRM) has been extensively advocated in the literature as a framework for reconciling social, economic, and environmental objectives in water governance. But in Nigeria, it hasn't been put into action very much because there aren't enough skilled workers, there is not enough reliable data, and agencies don't work together very well (UNESCO, 2021). Researchers say that environmental sustainability in the water sector can't be reached without strong research support to help make policy decisions, keep an eye on environmental effects, and help with adaptive management strategies. Climate change has a lot of effects on

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how Nigeria treats water and wastewater. (Amaefule *et al*., 2023; Bamidele, 2024; Canton, 2021; Creswell, 2018; Dominguez and Molina Vogelsang, 2024).

2.4 Role of Research in Water Sector Development

Research is widely recognized as a key driver of innovation and sustainability in the water sector. Through scientific investigation, research provides critical data on water availability, quality, health risks, and environmental impacts. In Nigeria, universities and research institutes have produced valuable studies on water resources, treatment technologies, and disease prevention (Okeke *et al.,* 2021). However, the literature reveals that many of these research outputs remain underutilized due to weak linkages between researchers and policymakers. The absence of effective platforms for knowledge sharing has resulted in a gap between research findings and practical implementation. As a result, water sector policies are often developed without sufficient empirical evidence, limiting their effectiveness and sustainability (Adeniyi and Yusuf, 2020). This gap underscores the importance of strengthening research–policy interfaces within the Nigerian water sector.

2.5 Collaborative Research as a Transformative Approach

Collaborative research has emerged in the literature as a powerful approach for addressing complex and interdisciplinary challenges such as water management, public health, and environmental sustainability. Collaborative research involves partnerships among academic institutions, government agencies, private sector organizations, and international development partners, enabling the pooling of expertise, resources, and perspectives (OECD, 2020). Nigeria's water sector remains critical to national development, public health, and environmental sustainability. Despite possessing abundant water resources, the country continues to face serious challenges related to access, governance, pollution, and infrastructure. Collaborative research and innovation provide effective pathways for transforming the sector. Global experiences demonstrate that collaborative research enhances data quality, fosters innovation, and improves policy relevance by integrating scientific knowledge with practical needs. In the Nigerian context, collaborative research can support coordinated water quality monitoring, strengthen public health surveillance systems, and promote environmentally sustainable practices. Despite these benefits, existing studies indicate that collaborative research in Nigeria's water sector remains limited, fragmented, and poorly institutionalized. Management of infrastructures in the water sector is a veritable tool for healthcare and sustainable development in Nigeria (Oyebode, 2018; Oyebode and Coker, 2021; Oyebode *et al*., 2025; UNESCO, 2021; WHO, 2022; WHO and UNICEF, 2023).

2.6 Identified Research Gaps

Although numerous studies have examined water governance, public health challenges, and environmental sustainability in Nigeria, limited attention has been given to the role of collaborative research as a unifying framework for sectoral transformation. Most existing studies focused on isolated issues rather than integrated solutions that connect research, policy, and practice. This gap in the literature highlights the need for further examination of how collaborative research can be strategically leveraged to transform the Nigerian water sector for improved public health and environmental outcomes.

3.0 Methodology

This study employed a qualitative descriptive research design to examine the role of collaborative research in transforming the Nigerian water sector for improved public health and environmental

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sustainability. The qualitative approach is appropriate because it allows for a comprehensive exploration of institutional structures, policy frameworks, and research practices within the water sector without relying on numerical data. Data for the study were obtained exclusively from secondary sources, including peer-reviewed journal articles, government publications, policy documents, technical reports, and publications from international organizations such as the World Health Organization (WHO), United Nations Educational, Scientific and Cultural Organization (UNESCO), and the Organization for Economic Co-operation and Development (OECD). These sources were selected based on their relevance, credibility, and alignment with the objectives of the study. A systematic content analysis technique was used to analyze the collected data. Relevant documents were carefully reviewed and coded into thematic categories such as water governance, research collaboration, public health impacts, environmental sustainability, and policy implementation. This thematic analysis identified recurring patterns, challenges, and opportunities related to collaborative research in Nigeria's water sector.

To ensure validity and reliability, data were cross-checked across multiple sources and compared with existing empirical evidence. The study also relied on widely cited and authoritative publications to minimize bias and enhance the credibility of findings. As the research is based on secondary data, ethical concerns were minimal; however, all sources were properly acknowledged in line with academic standards.

4.0 RESULTS AND DISCUSSION

This section analyses findings from the reviewed literature and secondary data, focusing on how collaborative research influences water sector performance, public health outcomes, and environmental sustainability in Nigeria. The discussion is supported with practical examples from existing collaborative initiatives within the country. Figure 1 presents a Venn diagram showing the overlap between academia (universities), government (ministries), and industry. Figure 2 also highlights sectoral influences and the fundamental reasons why this research is important and should receive adequate attention.

Figure 1: A Venn Diagram of the Overlap Between Academia (Universities), Government (Ministries), and Industry (Private Sector)

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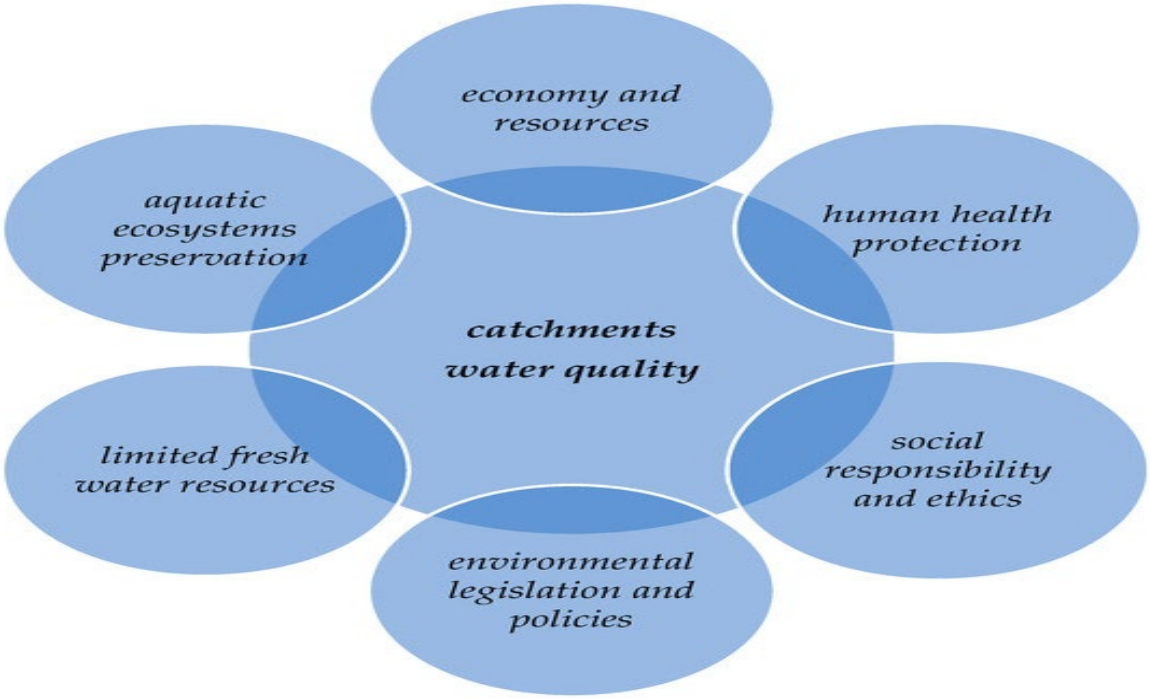

Figure 2: Sectoral Influences on Water Quality in Hydrographic Basins

Source: (Gavrilas et al, 2025)

4.1 State of Collaborative Research in Nigeria's Water Sector

The analysis reveals that collaborative research in Nigeria's water sector remains limited and poorly institutionalized. Research activities are often conducted independently by universities, government agencies, and non-governmental organizations, resulting in fragmented data and weak knowledge transfer. However, where collaboration exists, evidence suggests significant improvements in water management outcomes. For instance, collaborative research between universities such as the University of Ibadan and Obafemi Awolowo University and state water agencies in South-West Nigeria has improved groundwater and surface water quality monitoring. These joint studies identified widespread microbial contamination in shallow wells, which informed policy decisions on water treatment and public health awareness campaigns. This example demonstrates how structured collaboration can enhance the relevance and application of research findings.

4.2 Implications for Public Health

Findings indicated that weak integration between water research and public health systems contributes to the continued prevalence of waterborne diseases in Nigeria. In many cases, health authorities rely on reactive measures due to limited access to scientific data on water quality and contamination risks (WHO, 2022). Collaborative initiatives such as the UNICEF–Federal Ministry of Water Resources Water, Sanitation and Hygiene (WASH) programmes provide evidence of the benefits of research partnerships. Baseline studies conducted jointly by researchers, government agencies, and international partners informed the design of water infrastructure and sanitation facilities in rural communities. These evidence-based interventions have contributed to improved access to safe water and reductions in diarrheal diseases, highlighting the public health value of collaborative research.

Sustainable urban water management extends beyond technical infrastructure, relying on organizational capacity, effective governance and adaptive strategies that foster resilience and innovation.

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4.3 Environmental Sustainability and Ecosystem Protection

Environmental degradation remains a major challenge in Nigeria's water sector, particularly in regions affected by industrial pollution and oil exploration. The analysis shows that limited collaboration between environmental scientists, regulators, and water managers has weakened environmental monitoring and enforcement mechanisms (Ojekunle *et al.*, 2020). Collaborative research efforts in the Niger Delta region illustrate the potential of partnership-driven approaches. Joint studies involving universities, environmental NGOs, and international organizations documented hydrocarbon contamination of rivers and groundwater, providing scientific evidence for environmental remediation and policy advocacy. These initiatives strengthened environmental awareness, supported ecosystem restoration, and underscored the role of research collaboration in promoting sustainable water resource management.

4.4 Research Collaboration and Disaster Risk Management

The analysis further highlighted the role of collaborative research in addressing water-related disasters such as flooding. Partnerships between the Nigeria Hydrological Services Agency (NIHSA), academic institutions, and international research organizations have improved hydrological data collection and flood risk modelling. Enhanced flood forecasting and early warning systems have contributed to better disaster preparedness, reducing flood-related water contamination, public health risks, and environmental damage in vulnerable communities.

4.5 Community-Based Research and Sustainable Water Supply

Evidence from community-based research initiatives in northern Nigeria demonstrates the importance of involving local stakeholders in collaborative research. Studies conducted by NGOs, academic researchers, and community members identified technical and management factors responsible for borehole failure and water scarcity. Integrating scientific analysis with local knowledge led to improved water system designs and community-led maintenance strategies, enhancing sustainability and long-term public health benefits.

4.6 Discussion

The results show that collaborative research and technology advancements have the potential to significantly change Nigeria's water industry, with favorable effects on socioeconomic development, environmental sustainability, and public health. The findings show that better water resource management, improved service delivery, and better water quality outcomes are typically found in places where research institutions, government agencies, private sector groups, and local communities work well together. These kinds of partnerships enable the exchange of knowledge, the development of capacity, and the creation of context-specific solutions to problems pertaining to water.

The study shows that cutting-edge technologies can significantly increase the effectiveness and dependability of water infrastructure. These technologies include Geographic Information Systems (GIS), remote sensing, smart water metering, digital monitoring platforms, and water delivery systems driven by renewable energy. These technologies provide prompt leak detection, efficient water quality parameter monitoring, and well-informed decision-making for the planning and management of water resources. As a result, service coverage and sustainability are improved while operating expenses are decreased. The results show a strong correlation between public health outcomes and better water supply systems. The results also

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highlight the significance of innovation in tackling new issues related to population increase, fast urbanization, and climate change. Resilience to floods, droughts, and water scarcity is improved by adaptive water management techniques created through cooperative research. However, the study finds that the biggest obstacles to successful implementation include bad maintenance culture, insufficient budget, weak institutional frameworks, and a lack of technical skills.

Overall, the results demonstrated that cooperative research boosts public health protection, advances environmental sustainability, and improves evidence-based decision-making in Nigeria's water sector. The Nigerian examples presented corroborate previous research that shows cooperation is a key factor in sectoral transformation and efficient water governance (UNESCO, 2021; OECD, 2020). To optimize their influence, however, stronger policy frameworks, ongoing funding, and official research-policy platforms are required, as seen by the limited scope and institutionalization of such partnerships. All things considered, the findings highlight the need to improve stakeholder collaborations, boost research and development funding, and encourage technology adoption. Achieving sustainable water security, safeguarding the environment, enhancing public health, and quickening Nigeria's progress toward national development goals and the Sustainable Development Goals (SDGs) all depend on such actions.

5.0 CONCLUSION

This study has examined the potential of collaborative research as a transformative tool for improving the Nigerian water sector, with particular emphasis on public health protection and environmental sustainability. Based on the critical analysis of the infrastructural decay, public health crises, and environmental degradation prevalent in the Nigerian water sector, it is evident that the current disjointed approach to water management is unsustainable. Innovative technologies like smart water systems, rainwater harvesting, wastewater reuse, artificial intelligence, and community-based Water, Sanitation, and Hygiene (WASH) initiatives are highlighted in this article. Sustainable water management solutions can be produced through collaborations between academic institutions, governmental bodies, international organizations, businesses, and local communities. Smart water systems, wastewater recycling, infrastructure powered by renewable energy, and community-based WASH initiatives are examples of innovations that have the potential to increase access to clean water, lessen disease outbreaks, and save the environment. In order to achieve sustained public health, environmental protection, and economic development, the Nigerian water sector must be transformed through cooperative research and innovation. This study has demonstrated that water resource management and service delivery may be greatly enhanced by strategic collaborations between government agencies, academic institutions, corporate groups, development partners, and local communities. The ongoing problems of water scarcity, pollution, deteriorating infrastructure, and insufficient access to potable water can be effectively addressed by cutting-edge technologies like smart monitoring systems, GIS applications, remote sensing, water facilities powered by renewable energy, and sophisticated wastewater treatment techniques. Additionally, better water management directly lowers the prevalence of waterborne illnesses, improves environmental quality, and increases resistance to climate-related problems.

Nigeria must prioritize research-driven policies, technological innovation, institutional reforms, and inclusive stakeholder collaboration in order to achieve sustainable development and better public health outcomes. The study comes to the conclusion that strong collaborations, research funding, regulatory changes,

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technical innovation, and public involvement are necessary for Nigeria's water industry to undergo sustained transformation. The operations of government agencies, academic institutions, and the private sector have resulted in a significant waste of resources and a lack of data-driven interventions. The conclusion includes the following:

i. Despite Nigeria's abundant water resources, persistent challenges such as poor water quality, inadequate infrastructure, institutional fragmentation, and environmental degradation continue to limit access to safe and sustainable water.

ii. Challenges are not solely technical in nature but are deeply rooted in weak coordination, limited knowledge integration, and insufficient use of scientific evidence in policy and practice.

iii. The analysis revealed that collaborative research plays a critical role in bridging the gap between research, policy, and implementation within the water sector. Evidence from Nigerian examples shows that partnerships among academic institutions, government agencies, international organizations, and local communities have contributed to improved water quality monitoring, more effective public health interventions, enhanced environmental protection, and better disaster risk management.

iv. These collaborative initiatives illustrate how integrating multidisciplinary expertise and shared knowledge can lead to more responsive, efficient, and sustainable water management outcomes. Furthermore, the study highlights that collaborative research strengthens evidence-based decision-making by ensuring that policies and interventions are informed by reliable scientific data and contextual knowledge. When researchers and policymakers work together, water sector reforms are more likely to address real-world challenges, reduce the burden of waterborne diseases, and promote the long-term sustainability of aquatic ecosystems.

v. This approach is particularly important in Nigeria, where climate variability, population growth, and environmental pressures are increasing the complexity of water management challenges. In conclusion, transforming the Nigerian water sector requires a deliberate shift from fragmented and isolated research efforts toward institutionalized, well-funded, and interdisciplinary collaborative research frameworks. Such a shift will not only enhance public health outcomes and environmental sustainability but also support national development goals and international commitments related to water security and sustainable development.

vi. The research concludes that by enhancing collaborative research platforms, the development of water infrastructure, environmental protection, and disease prevention in Nigeria can be enhanced significantly. Strengthening collaborative research should therefore be prioritized as a strategic foundation for achieving a resilient, inclusive, and sustainable water sector in Nigeria.

5.1 Recommendations

More funding should be allocated to research and development projects centered on sustainable water management techniques and technologies in order to hasten the transformation of Nigeria's water industry. To promote knowledge sharing and technology transfer, the government should improve cooperation between academic institutions, research centers, water agencies, private sector stakeholders, and overseas development partners. Programs for capacity-building should be put in place to improve the technical

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proficiency of local communities and water experts. To increase productivity and decision-making, the use of digital technologies, including GIS, remote sensing, smart metering, and real-time water quality monitoring systems should be promoted. Infrastructure development, operation, and repair should be supported by public-private partnerships and adequate financial sources. In order to encourage innovation, environmental preservation, and accountability in the water industry, legislation and regulatory frameworks also need to be enhanced. Consequently, this study proposes the following comprehensive recommendations to operationalize collaborative research and transform the sector.

i. **Establishment of Regional Water Research Clusters (WRCs):**

The most urgent recommendation is the institutionalization of the "Triple Helix" model through the creation of Regional Water Research Clusters (WRCs). Currently, research conducted in Nigerian universities is rarely utilized by the River Basin Development Authorities (RBDAs). To bridge this gap, the Federal Ministry of Water Resources (FMWR) and the Federal Ministry of Education should jointly sign a Memorandum of Understanding (MoU) to establish a WRC in each of the six geopolitical zones.

ii. **Mandatory Independent Academic Oversight for Environmental Impact Assessments (EIA)**

A critical finding of this study is the prevalence of "copy-and-paste" Environmental Impact Assessments (EIAs) for major water projects, such as dams and irrigation schemes. These documents are often produced by non-specialist contractors to fulfill bureaucratic requirements, leading to projects that fail or cause ecological harm.

iii. **Creation of the National Water Data Repository (NWDR)**

One of the most significant impediments to sector transformation is the lack of centralized, accessible data. Research findings regarding water quality, aquifer depth, and disease vectors are currently scattered across university libraries, NGO reports, and dusty government files.

iv. **Integration of WASH Protocols into National Health Security Policy**

This study has established a direct correlation between the water crisis and public health burdens. However, the Ministries of Health and Water Resources often operate in parallel rather than in tandem.

v. **Institutionalizing Citizen Science and Community-Led Research**

Top-down approaches to water management often fail because they ignore local knowledge and lack community buy-in. To transform the sector, research must be democratized through "Citizen Science."

vi. **Curriculum Reform: From Theory to Practice**

Finally, the long-term transformation of the sector relies on the quality of human capital produced by Nigerian tertiary institutions. Current engineering and geology curricula are often heavily theoretical, with outdated textbooks and insufficient field experience.

vii. Funding for water research, innovation, and technical advancement should be increased by both public and commercial entities.

viii. Nigeria ought to use renewable energy sources, AI-based water management techniques, and digital monitoring systems.

ix. To stop pollution and safeguard aquatic ecosystems, environmental rules must be strictly enforced.

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References

Adeola, T. A., and Ibrahim, F. A. (2024). Innovative Solutions to Public Health Issues in Nigeria's Urban Areas. *Ayden Journal of Drug and Pharmaceutical Research*, *12*(2), 32-44.

Adewumi, I. K., Oyebode, O. J., Igbokwe, K. C., and Aluko, O. G. (2011). Water footprints in four selected Breweries in Nigeria. In *Towards life cycle sustainability management* (pp. 171-181). Dordrecht: Springer Netherlands.

Adewumi, I. P., Adeyemi, Q. O., Babatope, A. E., Ajisafe, D. O., and Adepoju, K. O. (2026). Intersectoral collaboration for strengthening infectious disease prevention and control in Nigeria: a narrative review. *Discover Public Health*, *23*(1), 19.

Adewumi, J., Ajayi, O. and Ojo, T. (2019) 'Water resource management and sustainability in Nigeria', *Journal of Environmental Studies*, 14(2), pp. 45–58.

Agusomu, T. D., O. Ohwo, and M. O. Raimi. "Living with the waters: perception, adaptation, and policy implications of flooding in Yenagoa metropolis, Nigeria." *Open Access Journal of Science* 8.1 (2025): 117-131.

Amaefule, E. O., Amarachi, A. S., Abuka, C. O., Nwaogazie, F. O., Nwabuko, C. N., and Divine, C. C. (2023). Water and wastewater treatment in Nigeria: advancements, challenges, climate change and socioeconomic impacts. *Traektoriâ Nauki Path of Science*, *9*(8), 2010-2031.

Bamidele, G. O. (2024). Urban Health Dilemmas and Strategies for Improvement in Nigeria. *Research Journal of Health, Medicine and Nursing*, *12*(1), 12-24.

Canton, H. (2021). Organisation for economic co-operation and development—OECD. In *The Europa directory of international organizations 2021* (pp. 677-687). Routledge.

Creswell, J.W. (2018). *Research design: Qualitative, quantitative and mixed methods approaches*. 5th Edn. London: Sage Publications.

Dominguez Lacasa, I., and Molina Vogelsang, M. (2024). Enhancing international collaboration in science, technology, and innovation to achieve sustainable development goals. *Science and Public Policy*, *51*(3), 509-525.

Erojikwe, I., Nnanna, N., Cindy, A. E., Nnamele, V. U., Eze, J., Nwaozuzu, U. C., ... and Chigor, V. (2024). Tackling Water and Public Health Problems through Participatory Theatre Methodologies: The Iheakpu-Awka Enugu State, Nigeria Example.

Ezeaka, N. B., and Bartholomew, C. E. (2025). Navigating Environmental Sanitation and Health Communication in Nigeria: Challenges and Prospects. *International journal of Research and Innovation in Socia l Science*, *9*(1), 3381-3389.

Federal Ministry of Water Resources (FMWR) (2018) *National water resources master plan*. Abuja: Federal Government of Nigeria.

Gavrilaş, S., Burescu, F. L., Chereji, B. D., and Munteanu, F. D. (2025). The impact of anthropogenic activities on the catchment's water quality parameters. *Water*, *17*(12), 1791.

Ogarekpe, N. M., Nnaji, C. C., Oyebode, O. J., Ekpenyong, M. G., Ofem, O. I., Tenebe, I. T., and Asitok, A. D. (2023). Groundwater quality index and potential human health risk assessment of heavy metals in water: A case study of Calabar metropolis, Nigeria. *Environmental Nanotechnology, Monitoring and Management*, *19*, 100780.

Ojekunle, Z.O., Ojekunle, O.V. and Adeyemi, A.A. (2020) 'Environmental pollution and water quality challenges in Nigeria', *Environmental Monitoring Review*, 6(3), pp. 110–124.

https://doi.org/10.70118/ujet.2026.sp01.01

Okeke, I., Lawal, M. and Bello, S. (2021) 'Research–policy gaps in Nigeria's water sector', *African Journal of Policy Studies*, 9(1), 72–89.

Oyebode, O. J. (2024). Promoting integrated and sustainable solid waste management system in A developing city for public health and cleaner environment. *Journal of Harbin Engineering University*, *45*(01).

Oyebode, O. J. (2018). A Comparative Assessment of Water Corporations in Nigeria with Water Management in a Typical Developed Country. *European Journal of Advances in Engineering and Technology*, *5*(8), 535-542.

Oyebode, O. J., and Coker, A. O. (2021, March). Management of infrastructures in water sector: a veritable tool for healthcare and sustainable development in Nigeria. In *IOP conference series: materials science and engineering*, 1036, 1, 012008). IOP Publishing.

Oyebode, O. J., Jegede, J. T., Apeh, S., Adetunla, A. O., Afolalu, S. A., and Ikumapayi, O. M. (2025). Wastewater Management, Use of Stormwater and Green Infrastructure Management in Nigeria: Challenges and Way Forward. *NIPES JSTR Special Issue*, *7*(2), 3788-3794.

Oyebode, O. J., Apeh, S., Afolalu, S. A., Bayode, O. A., Okokpujie, I. P., and Udeagbara, S. G. (2025). Utilization of Integrated Water Resources Management and Environmental Engineering Techniques for Sustainable Green Energy. *NIPES JSTR Special Issue*, *7*(2), 3780-3787.

Oyebode, O. J., Oyebode, F. A., Okokpujie, I. P., Ikumapayi, O. M., Jegede, J. T., Afolalu, S. A., and Coker, A. O. (2025). Real World Implementations of Green Energy Solutions and Sustainable Water Resources. *NIPES JSTR Special Issue*, *7*(2), 3773-3779.

Oyebode, O. J., Dada, J. B., Afolalu, S. A., Aliyu, S. J., Ajisegiri, E., Adediran, A. A., and Oladimeji, S. O. (2025). Development and Performance Evaluation of Pilot-Scale Model Integrated with Wastewater Treatment Plant Using STOAT. *NIPES JSTR Special Issue*, *7*(2), 2953-2962.

Oyebode, O. (2014). Life cycle assessment and management of water use in selected breweries in Nigeria. *Civil Engineering and Architecture*.

Oyebode, O. J., Iyanda, O. J., Adeola, R. S., Apeh, S., Aforolagba-Balogun, O. T., Bayode, O. A., and Egbiki, S. (2026). Urban water management for public health in Nigeria: Effective Governance and Sustainability Perspectives. *FUTA journal of engineering and engineering technology*, *20*(Special), 8-24.

United Nations Educational, Scientific and Cultural Organization - UNESCO (2021) *Water Research and Innovation for Sustainable Development*. Paris: United Nations Educational, Scientific, and Cultural Organization.

William, P., Oyebode, O. J., Ramu, G., Gupta, M., Alzubaidi, L. H., and Srivastava, A. P. (2023). Architecture for AI-based validation of wastewater management using open data exchange technique. In the 2023 International Conference on Circuit Power and Computing Technologies (ICCPCT) (pp. 1502-1507). IEEE.

William, P., Oyebode, O. J., Ramu, G., Gupta, M., Bordoloi, D., and Shrivastava, A. (2023). Artificial intelligence-based models to support water quality prediction using machine learning approach. In *2023 International Conference on Circuit Power and Computing Technologies (ICCPCT)* (pp. 1496-1501). IEEE.

World Health Organization - WHO (2022) *Drinking-water and health*. Geneva: World Health Organization.

WHO and UNICEF (2023) *Progress on household drinking water, sanitation and hygiene: 2000–2022*. New York: UNICEF and World Health Organization.

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