BIODIVERSITY, CLIMATE CHANGE AND ENVIRONMENTAL SUSTAINABILITY IN AFRICA:

Proceedings of the 2026 International Conference of the Association for the Promotion of African Studies (APAS)



Editors

Ejikemeuwa J. O. NDUBISI, PhD
Ikechukwu Anthony KANU, PhD
Nkechinyere Nwokoye, PhD
Chidimma N. Ezeador, PhD

APAS

BIODIVERSITY, CLIMATE CHANGE AND ENVIRONMENTAL SUSTAINABILITY IN AFRICA: CHALLENGES, CONSEQUENCES AND ECOLOGICAL RESPONSES

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APAS
13245 Trebleclef Lane Silver Spring
20904 Maryland,
United States of America

DEDICATION

To

The Loving Memory of Late Sr. Dr. Chika Eze, SHCJ, for her contribution towards the success of the 2026 APAS Conference as the LOC Chairperson

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PREFACE

It is with profound delight and a deep sense of scholarly responsibility that I present this second volume of the proceedings of the 10th International Conference of the Association for the Promotion of African Studies (APAS), titled *Biodiversity, Climate Change and Environmental Sustainability in Africa: Challenges, Consequences and Ecological Responses*. The volume emanates from the international conference of APAS held at Veritas University, Abuja, from Tuesday, 26 May to Friday, 29 May 2026, on the theme, "Biodiversity, Conservation and Public Health in Africa: Challenges and Prospects."

This volume, together with the other two volumes arising from the conference, represents an important intellectual contribution to the continuing conversation on Africa's environmental condition and the continent's search for sustainable pathways to human and ecological flourishing. While the first volume, *African Ecologies, Philosophy and Religious Worldviews: Rethinking Human–Nature Relations, Biodiversity and Environmental Responsibility*, concentrates principally on the philosophical, religious, ethical and worldview foundations of ecological responsibility, this second volume turns more directly to the environmental realities, consequences and responses that define Africa's contemporary ecological experience. The urgency of these concerns cannot be overstated. Africa is endowed with remarkable biological diversity, extensive natural ecosystems and valuable ecological resources. Its forests, wetlands, rivers, grasslands, coastal environments, agricultural landscapes and other ecosystems sustain human communities in numerous ways. Biodiversity supports food production, medicine, livelihoods, cultural practices and the overall well-being of present and future generations. Yet these ecological assets are increasingly exposed to pressures arising from climate change, unsustainable agricultural practices,

industrial and extractive activities, pollution, urbanisation, waste generation, ecosystem degradation and other forms of environmental exploitation. The ecological crisis is consequently also a crisis of human well-being. The degradation of ecosystems can undermine food security, diminish livelihoods, increase vulnerability to environmental hazards and contribute to public-health challenges. The relationship between biodiversity and public health, which constituted an important dimension of the 2026 APAS conference theme, is therefore central to the discussions contained in this volume. The protection of nature cannot be treated as an optional concern detached from human welfare. The health of human communities is inseparably connected to the health of the ecological systems within which those communities exist.

The papers assembled in this volume illuminate these challenges from a rich variety of disciplinary and intellectual perspectives. They demonstrate that climate change and biodiversity loss cannot be adequately understood through a single disciplinary lens. Environmental science, agriculture, economics, philosophy, literature, theology, religious studies, public health, education, urban studies, indigenous knowledge and development studies all have important contributions to make. This interdisciplinary character is one of the distinctive strengths of APAS scholarship. A significant concern emerging from the volume is the relationship between biodiversity conservation and sustainable human development. The paper on African traditional medicine and biodiversity conservation, for example, draws attention to the relationship between biological resources, indigenous knowledge and human well-being. Traditional medicine represents not merely a cultural inheritance but also a field in which biodiversity, health, knowledge and sustainability intersect. The question before contemporary Africa is how such resources can be protected and utilised responsibly without undermining the ecological foundations upon which they depend.

The discussion of agrochemical use among smallholder farmers similarly draws attention to the unintended ecological consequences of agricultural practices. The impact of agrochemicals on aquatic ecosystems and life below water illustrates how human activities in one sector can produce consequences far beyond their immediate location. Such realities remind us that environmental systems are interconnected and that sustainable agricultural development must take into consideration the wider ecological consequences of production. Climate change constitutes another major concern addressed in this volume. The papers examining rising temperature regimes, carbon emissions, biodiversity decline, ecosystem-service degradation and climate-change adaptation demonstrate the breadth of the challenge. Climate change is not merely a question of changing weather patterns. Its consequences extend to biodiversity, agriculture, food security, livelihoods, public health, environmental safety and the general conditions necessary for sustainable development. The inclusion of studies focusing on Uyo and other Nigerian contexts is particularly valuable because it brings the global environmental conversation into concrete local realities. Africa's ecological challenges are experienced within particular communities, cities, rural settlements, farms, waterways and landscapes. It is therefore important that environmental scholarship does not remain at the level of abstract global discourse but also examines how ecological transformations are experienced by actual populations.

The volume equally recognises the importance of indigenous knowledge and local resilience. The contribution on climate-change adaptation and environmental hazard management in Nigeria, for instance, places indigenous knowledge systems and environmental education within the search for resilience. This is significant because African communities have developed knowledge, practices and cultural mechanisms for interacting with their environments over generations. Such knowledge should

neither be romanticised nor dismissed. Rather, it deserves careful scholarly examination and, where appropriate, integration with contemporary scientific and educational approaches. Urbanisation and waste management constitute another important dimension of the volume. Africa's rapidly growing cities face increasingly complex environmental pressures. Poor waste management, environmental pollution and inadequate urban infrastructure can affect both ecological quality and public health. The contributions dealing with waste management in Port Harcourt and the broader challenge of urbanisation and environmental pollution in Nigeria demonstrate the need to rethink the relationship between urban development and ecological sustainability. The question is not simply how to remove waste after it has been generated. It is also how societies produce, consume, dispose of and communicate about materials within urban environments. The contribution on communicating clean cities appropriately highlights the importance of discourse and communication in shaping waste-management practices. Environmental sustainability ultimately requires not only appropriate infrastructure and regulation but also changes in attitudes, values, habits and collective consciousness.

The literary and artistic contributions in this volume add another important dimension to the environmental conversation. Literature and art possess the capacity to give ecological degradation a human face, to articulate experiences of environmental injustice and to preserve memories of landscapes and communities undergoing transformation. The examination of ecological devastation and resistant voices in African literature, alongside the broader exploration of literature, arts and environmental storytelling, demonstrates that the ecological crisis is also a crisis of imagination and representation. What societies imagine about nature, development, exploitation and human flourishing can influence how they act towards the environment.

Theological and religious perspectives likewise remain relevant. The interpretation of biblical imagery in relation to biodiversity conservation, the engagement of prophetic imagination with public-health advocacy, and the examination of the Anglican Communion's contribution to environmental ethics all demonstrate that religious traditions can contribute significantly to ecological consciousness and responsible action. In a continent where religion remains a powerful component of individual and collective life, ecological transformation cannot afford to ignore the moral and spiritual resources of religious communities.

The volume also brings African philosophical resources into conversation with contemporary environmental concerns. The discussion of *Okugbeakpeje* and *Igwebuike* philosophies in relation to biodiversity conservation and eco-wellness points to the possibility of drawing upon African communal and relational ideas in the search for ecological sustainability. Such engagement is consistent with the broader mission of APAS, which seeks to promote serious scholarship on Africa while encouraging critical engagement with African intellectual and cultural resources.

This volume therefore advances a conception of environmental sustainability that goes beyond conservation understood merely as the protection of isolated species or physical spaces. Conservation must be understood within the broader relationships among ecosystems, communities, cultures, economies, health systems, knowledge traditions and patterns of development. The environmental question is simultaneously an economic question, a social question, a cultural question, an ethical question and, ultimately, a question concerning the kind of future humanity wishes to create.

The papers collected here also reinforce the importance of responsible ecological responses. Identifying environmental problems is only the beginning. Africa requires appropriate

strategies for adaptation, mitigation, conservation, environmental education, sustainable agriculture, responsible urban development, effective waste management and the protection of vulnerable ecosystems. These responses must be context-sensitive and should take account of Africa's developmental realities. Environmental protection should not become a new mechanism for marginalising communities or denying them legitimate opportunities for development. Rather, the challenge is to pursue forms of development that sustain both human dignity and ecological integrity.

This calls for a renewed understanding of development itself. Development cannot be measured exclusively by economic growth, industrial expansion or urban transformation. A development model that destroys the ecological foundations of life ultimately undermines the very well-being it seeks to promote. Sustainable development must therefore integrate economic aspirations with ecological responsibility, social justice, cultural integrity and intergenerational responsibility. The scholarship represented in this volume demonstrates the commitment of African scholars to confronting these difficult questions. It also illustrates the intellectual vitality of APAS and its growing role as a platform for bringing scholars together around issues of profound significance to Africa. I am particularly grateful to the members of APAS for their constant scholarship, intellectual commitment and zeal towards the promotion and sustenance of African heritage. Their dedication continues to demonstrate that African scholarship is not merely about studying Africa; it is also about generating knowledge capable of contributing to the transformation of African societies.

The publication of these proceedings is therefore an important part of APAS's continuing intellectual mission. The Association recognises that the promotion of African studies requires sustained research, publication, scholarly exchange and critical engagement

with the realities of the continent. It also requires an openness to interdisciplinary collaboration and dialogue among different generations, disciplines, institutions, cultures and intellectual traditions.

I extend my sincere appreciation to the authors whose scholarly contributions constitute this volume. I equally acknowledge the efforts of the conference organising committee, reviewers, editors, rapporteurs, institutional partners and all who contributed to the success of the 2026 International Conference. Our gratitude also goes to Veritas University, Abuja, for hosting the conference and providing an appropriate academic environment for the exchange of ideas and the advancement of scholarship.

The 2026 conference was particularly significant as it marked the 10th International Conference of APAS. This milestone provides an opportunity not only to celebrate the achievements of the Association but also to renew its commitment to scholarship that is relevant to Africa's present circumstances and future aspirations. The environmental challenges examined in this volume remind us that the future of Africa will depend, in significant measure, on the quality of knowledge, values and decisions with which the continent responds to ecological transformation.

As President of APAS, I consider the publication of this volume an expression of our collective commitment to that task. The essays contained herein do not claim to exhaust the complex questions surrounding biodiversity, climate change and environmental sustainability in Africa. Rather, they provide multiple points of entry into a conversation that must continue among scholars, policy-makers, educators, religious communities, environmental practitioners, indigenous knowledge holders, civil society organisations and local communities. The future of Africa's biodiversity cannot be separated from the future of its people. Nor can the health of African communities be separated from the health

of their ecological environments. We must therefore cultivate an understanding of sustainability in which human prosperity and ecological integrity are not regarded as competing objectives but as mutually dependent dimensions of a common future. The task before African scholarship is consequently both intellectual and practical: to understand the ecological challenges confronting the continent, to interrogate the assumptions and practices that have contributed to them, to recover valuable knowledge from Africa's intellectual and cultural heritage, and to develop creative and responsible responses suited to contemporary African realities.

It is my hope that this volume will contribute meaningfully to that endeavour. May the scholarship gathered here stimulate further research, encourage responsible environmental action, strengthen ecological consciousness and inspire renewed commitment to the protection of Africa's rich natural heritage.

Above all, may it remind us that biodiversity is not merely a resource, the environment is not merely a background to human existence, and sustainability is not merely a policy slogan. They are integral to the conditions of life itself. Therefore, I commend this volume to scholars, researchers, students, policy-makers, environmental practitioners, religious leaders and all persons committed to the pursuit of a sustainable and flourishing Africa.

Professor Ejikemeuwa J. O. NDUBISI, PhD
President, Association for the Promotion of African Studies
13 September, 2026

AFRICAN TRADITIONAL MEDICINE AND BIODIVERSITY CONSERVATION: HARNESSING NUTRACEUTICALS FOR SUSTAINABILITY IN AFRICA

Chidimma Nkemdilim Ezeador, PhD
Department of Philosophy,
Nnamdi Azikiwe University, Awka
cn.ezeador@unizik.edu.ng

Abstract

This research aims at examining the potentials of African Traditional Medicine, especially nutraceuticals and the need to conserve and harness nutraceuticals for sustainability in Africa. The term "African traditional medicine" can be referred to the indigenous medicine of Africa, based on traditional indigenous knowledge systems and passed down, by word of mouth, from generation to generation within the particular indigenous community. This system of medicine had long existed before the advent of modern medicine (Orthodox), and it is used for the treatment of diseases and illness by African indigenous people. Despite being the oldest system in the world, African traditional medicine has remained the least established, informal and most rudiment traditional medicine system in the world. This paper attributes some limitations and challenges confronting African Traditional Medicine (ATM) to poverty, rapid loss of the natural habitats of some of these medicinal plants due to anthropogenic activities, lack of scientific credibility and facilities and health services, lack of overall public acceptance and lack of governmental support. This paper observes that the reasons behind

the lack of acceptance of ATM generally is because of the old belief that it is founded on mysticism and superstition, and secondly Africans do not largely domesticate and conserve the medicinal plants and animals used for production of traditional medicine in Africa. The questions that propel this research are; why do Africans perceive ATM as inferior and archaic, and what has prevented Africa from developing and harnessing the use of ATM? What has African leaders done to ensure strict conservation of these medicinal plants in Africa? Employing the methods of philosophical analysis and hermeneutics, this paper critically analyzes some key concepts for clarification, debunks the assertion that African traditional medicines are founded on mysticism, magic, witchcraft etc., and argues that nutraceuticals a brand of ATM, commonly referred to as functional foods which are derived from food sources like fruits, vegetables, and medicinal plants, rely on traditional knowledge and have curative and preventive measures without negative effects unlike orthodox medicines. This research submits that for healthcare services to enjoy sustainability and tremendous progress, African countries as a matter of urgency must make conservation of the herbs, medicinal plants and animals the number one priority.

Keywords: African Traditional Medicine, Biodiversity Conservation, Nutraceuticals, Africa

Introduction

Before the advent of modern hospitals and pharmaceuticals, that is before westernization, civilization and colonialization took over in Africa, African traditional medicine has been the dominant healthcare system. It is the oldest, and perhaps the most assorted of all therapeutic systems. In fact, African societies depended largely on herbalists, diviners, midwives, bone setters and traditional healers for healthcare services. The significant thing about African traditional medicine is that it is always available, fresh, affordable easily accessible, natural and culturally trusted. Despite some criticisms and condemnations made to discard the use of African traditional medicine, African traditional medicine remains the best

natural healthcare system one can take that is devoid of chemicals and side effects. However, this is not to say that African traditional medicine is hundred percent good and recommendable. Lack of standardization, loss of indigenous knowledge, safety, overharvesting concerns, inability to conserve medicinal plants, the unscientific nature of traditional medicine and African belief system are factors affecting the sustainability of traditional medicine in Africa. No wonder (Onuh:2018) laments that; the documentation of medicinal uses of African plants and traditional systems is becoming a pressing need because of the rapid loss of the natural habitats of some of these plants due to anthropogenic activities and also due to an erosion of valuable traditional knowledge. He added that Africa is also notorious to have one of the highest rates of deforestation in the world. This paper concludes that African leaders must play vital roles to make their traditional medicines to standard and safe.

Definition of Key Terms

Traditional Medicine

Traditional medicine is also known as indigenous or folk medicine. In the words of (Onuh: 2018) Traditional Medicine comprises medical knowledge systems that developed over generations within various societies before the era of modern medicine. He maintains that herbal, Ayurveda, Siddha medicine, Unani, ancient Iranian medicine, Islamic medicine. Traditional Chinese medicine, acupuncture, muti, Ifa, and other medical knowledge and practices all over the globe are all practices known as traditional medicines. According to the World Health Organization (WHO), traditional medicine is the health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral-based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illness or maintain well-being. According to (Onuh:2018), "traditional medicine that has been adopted by other populations is often termed complementary or alternative medicine" (23).

African Traditional Medicine (ATM)

Ezekwesili and Okaka (2019) define African traditional medicine as a form of holistic health care system that is organized into three levels of specialty, which include divination, spiritualism, and herbalism. (Onuh:2018) gave a descriptive definition of African traditional medicine. For him, Traditional African medicine involves diviners, midwives, and herbalists. Diviners are responsible for determining the cause of illness, which in some cases are believed to stem from ancestral spirits and other influences. Traditional midwives make extensive use of indigenous plants to aid childbirth. Herbalists are so popular in Africa that a herb trading market in Durban is said to attract between 700,000 and 900,000 traders a year from south Africa, Zimbabwe, and Mozambique. Therefore, African Traditional Medicine involves the indigenous health knowledge and practices used by African communities to prevent, diagnose, and treat illnesses. It is said to be connected to African culture, values, the natural environment and spirituality. According to (Sifuna, 2022), "African traditional medicine is undeniably important in treatment and cure of diseases and illness in the rural areas which are characterized by widespread poverty as well as a shortage of health care facilities, health care workers and allopathic medicaments." He further states "one of the contributing factors for affordability of African traditional medicine is that it utilizes indigenous knowledge in the indigenous local communities to meet the health care needs of the people of these communities, and is based on community philanthropy of alleviating pain and suffering and achieving the public and community common good rather than profit-making." (Sifuna, 2022)

Who is a Traditional Healer?

One who provides medical care in the community that he lives, using herbs, minerals, animal parts, incantations, and other

methods, based on the cultures and beliefs of his people is called a traditional healer (Ezekwesili &Okaka: 2019). A traditional healer must be seen to be experienced, versatile and competent.

Difference Between Western Medicine (Orthodox) and African Traditional Medicine

Western medicine also known as (Allopathic or orthodox medicine) is largely clinical in approach. It views disease in terms of organically malfunction. It is more biological and scientific in all its claims. African traditional medicine on the other hand is holistic in nature. It attempts to provide therapy for supernatural and spiritual etiological agents such as curses, evil spells and bad omen. However, currently, there are massive transformation in African traditional medicines. Traditional medicines are now undergoing scientific tests, overseen by agencies who are saddled with the responsibility of checking their standardization and safety. Nutraceuticals, brand of traditional medicines have dosages and prescriptions. Homeopathic doctors using nutraceutical products to treat sicknesses require lab tests before commencing treatment.

Categories of Traditional Healers in Africa

Herbalists: Adullahi cited in Bello and Babajide (2019), sees herbalists as people who use medicinal plants or parts known as herbs. These medicinal plants include: root, stem, leaves, stem or root bark, flowers, fruits, rhizomes, bulbs, tubers, gums or seeds.

Bone setters: Traditional bone setting arose as an adaptive approach to injury care. It is the art of repairing fractures and other orthopedic injuries. A traditional bonesetter is an unqualified practitioner who did not receive any formal training in modern orthodox medical procedures. (Eze et. al:2022) Nwadiro cited by (Eze et. al, 2022)notes that a bonesetter manages fractures empirically or by experience acquired through pupilage without any formal education and modern principles of orthopedic practices. From the above definitions of a bonesetter given, it

means that the knowledge of traditional bone setting is transmitted by oral tradition. Thus bone setting is perceived as a family practice, and training in the craft is by apprenticeship. Ude aki or elu aku (*Elaeis Guineensis*), eke (*Bivittatus), abuba* eke *(Laposh Organics*) and emida (*Hexalobus Monopetalu*)

Traditional Psychiatrists: These are indigenous healers and medicine men who diagnose and treat people with mental, emotional, and behavioral conditions. These healers adopt similar procedures in orthodox or Western psychiatry when diagnosing mental illness. They start by asking psychological investigative questions to determine whether the patient had committed some evil deeds and if so, persuaded the patient to confess his sins and make sacrifice (Amadasun: 2025).
Traditional Birth Attendants: These are known as traditional midwives that provide care for pregnancy and childbirth. They provide basic health care support during and after pregnancy. They are seen in medically underserved remote areas

Traditional Surgeon: This is a traditional health practitioner who performs surgical operations male and female circumcisions, tribal marks, cataract, whitlow, inguinal hernia, piercing ear-lobes, caesarian section, tooth abstraction etc., as part of a cultural initiation process. For instance, traditionally, cataract operation is done by dropping the juice from the leaves of an alkaloid-containing plant into the eye to desensitize it, and then with a sharp stick the cloudy lens removed. However, traditional surgical procedures currently are on a decline, as compared to modern allopathic medical surgeries. This is as a result of complications of procedures such as tetanus, meningitis and septicemia. Also, orthodox medicine's dominance chiefly contributed to the decline.

African Traditional Medicine in Pre-colonial, Colonial and Modern period
Africa is said to be the cradle of civilization with a rich and cultural

diversity marked by regional differences in healing practices. The use of herbs for treatment and diagnoses in Africa is as old as mankind. African traditional medicine has long existed for thousands of years before the introduction of modern hospitals and medicines. In the olden days, before prescribing traditional medicines to people, traditional healers have their method of diagnosing diseases before using medicinal plants to treat the symptoms. These methods always work perfect for them, and the medicinal plants used have no negative effects because they are all naturally made. In fact, Africa is blessed with many plants that can be used as medicines. These medicinal plants are used in the treatments of many illnesses. Again these plants are also symbolic and have spiritual significance. Traditional healers discovered healing properties from roots, fruits, seeds, bark, animal products, minerals and leaves. For instance, (Onuh : 2018) observes that *Securidaca longipedunculata* is a tropical plant found almost everywhere across Africa with different uses in every part of Africa. In Tanzania, the dried bark and root are used as a laxative for nervous system disorders, with one cup of the mixture being taken daily for two weeks. In East Africa, dried leaves from the plant are used in the treatment of wounds and sores, coughs, venereal diseases, and snakebites. In other parts of the continent, parts of the plant are used to cure skin diseases, malaria, impotence, epilepsy, and are also used as an aphrodisiac. (p.13). One of the importance of these medicinal plants is that they have the tendency to cure different diseases due to its ability to penetrate into the cells, arteries, and veins.

Examples of African Medicinal Plants and their method of preparation and uses

Bitter Leaf (*Veronia amygdalina*): This is West and Central African shrub used in local soups and teas. It is used for malarial treatment, Blood sugar control, Digestive support, and Appetite improvement. It is rich in antioxidants, contains flavonoids and vitamins, and anti-inflammatory properties.

Moringa (Moringa oleifera): This leaf is used for nutritional supplementation, immune support, treatment of malnutrition and energy enhancement. It is high in protein, rich in calcium, contains iron, vitamins A, C, AND E and potassium.

Neem (Azadirachta indica): This leaf is used for the treatment of skin disease, malaria and oral health care. It has antimicrobial, antifungal and anti-inflammatory properties.

Aloe *ferox* mill (Xanthorrhoeaceae)- Bitter Aloe or Cape Aloe: This is native to South Africa and Lesotho and is considered to be the most common Aloe species in South Africa. The bitter latex, known as Cape aloe, is used as laxative medicine in Africa and Europe. It has anti-inflammatory, antimicrobial, and anticancer properties. A. *ferox* has many traditional and documented medicinal uses. It has been reported that A. *ferox* gel contains at least 130 medicinal agents with anti-inflammatory, analgesic, calming, antiseptic, germicidal, antiviral, antiparasitic, antitumor, and anticancer effects.

Artemisia herba-alba: This plant is commonly known as wormwood or desert wormwood, and has been used in folk medicine by many cultures since ancient times. For instance, it is used to treat arterial hypertension and diabetes. In Tunisia, it is used to treat diabetes, bronchitis, diarrhea, hypertension, and neuralgias. It is used to stop stomach disorders and the herbal tea made from it has been used as analgesic, antibacterial, antispasmodic, and hemostatic agents in folk medicine.

Momordica charantia: This is also known bitter melon, a tropical vegetable grown throughout African. The leaf may be made into a tea called "cerassie," and the juice, extracted from the various plant parts (fruit pulp, seeds, leaves, and whole plant) is a common folklore remedy for diabetes. (M Fawzi:2013)

African Traditional Medicine in Colonial Period

During the colonial period, traditional medicine which was the

dominant medical system for millions of people in Africa began to lose its strength due to the establishment of science-based medicine. The arrival of the Europeans was a turning point in the history of ancient tradition and culture. Traditional medicine was discouraged by many colonial governments on the ground that it is primitive, archaic, unscientific, unsafe, lacks standardization and detailed documentation of traditional knowledge. In fact, some traditional practices were outlawed. According to (Ezekwesili and Okaka: 2019) "The importance of traditional medicine dwindled during the colonial period, whereby it was viewed as inferior to western medicine (Orthodox). It was banned completely in some countries due to its association with witchcraft/voodoo, supernatural, and magical implications, in which case, it was also termed "*juju*". In traditional African society, when a person falls ill, a traditional practitioner uses incantations to make a diagnosis. The incantations are thought to give the air of mystical and cosmic connections. Divination is typically used if the illness is not easily identified, otherwise, the sickness may be quickly diagnosed and a remedy prescribed. Sometimes the practitioner will advise the patient to consult a diviner who can give a diagnosis and recommend a treatment. (en.wikipedia.org)

Importantly, the use of animal sacrifices to appease the gods, and charms used to remove spells in some sickness like treatment of mentally ill patients equally contributed to why many people believe that traditional medicine is fetish. However, it is believed that contact with the spirit world through divination often requires not only medication but sacrifices.

Development of Traditional medicine and the Evolution of Nutraceuticals in Africa

Presently, transformations and development in traditional systems of medical care in Africa is now tremendous. Organizations such as the World Health Organization support research into medicinal plants. Many universities in Africa and research centers now study:

Herbal medicine, phytochemistry, ethnobotany, nutraceuticals and drug discovery from plants. In fact, the wide spread of these viruses like Ebola, COVID-19, SARS and rapid increase of cancer, kidney and liver diseases in the world have given rise to the wide use of nutraceuticals, a modern classification of traditional medicine, mostly those promoted by the government. According to 2020 report on lung cancer which is said to be the second most frequent disease worldwide, with 2.21 million diagnoses and 1.80 million fatalities shows that nutraceuticals have greatly contributed to reducing the side effect of cancer.

The term nutraceutical was coined by Stephen DeFelice in 1989. He created the term nutraceuticals which combines the concepts of nutrition and pharmaceuticals. Since then, foods with nutritional values have been referred to as nutraceutical. The term nutraceutical is self-defined and has no legal definition. It is often used interchangeably with bioactive, functional foods, or dietary supplement. Stephen DeFelice proposed the term nutraceutical to refer to any substance that can be consumed as food or a component of food that offers health or medical benefits, such as disease prevention and treatment. (Paras and Lalita:2025) Foods that have health or medicinal properties, including the ability to prevent and treat diseases are called nutraceuticals. They are also organic compounds obtained from food that assist human health and prevention of illness by offering physiological advantages. These foods or food ingredients are; superfoods, nutrients-rich foods like fortified cereals, phytochemicals, dietary supplements like vitamins derived from natural sources, and foods derived from genetically modified organisms. (Paras and Lalita:2025) It is the capacity and potentials nutraceutical have in the prevention or treatment of disease that set them apart from a functional food. What is a functional food? This is a traditional food that is enriched with bioactive ingredients that offers health benefits.

Categories of Nutraceuticals

Functional food: These are foods fortified with cereals and enhanced with additional nutrients.

Dietary supplements: These come in form of capsules, powders and tablets. They contain vitamins, minerals, or herbal extracts.

Herbal products: These products are used in traditional medicine systems. they are derived from plants, and they possess therapeutic properties.

Probiotics: These are live microorganism that provide health benefits by improving gut health.

Prebiotics: These are non-digestible food components that promote the growth of beneficial microorganisms in the intestines.

Some Health Benefits and potentials of Nutraceuticals

Nutraceuticals of Bacterial origin such as probiotics helps in the treatment and management of cancer, lactose digestion, gut health, obesity, pain alleviation, etc. Nutraceuticals of Fungal origin such as Cordyceps and Ganoderma lucidum. The health benefits of this include, anti-aging, kidney diseases and neurological disorders. Nutraceuticals of Algal and Cyanobacterial Origin Seaweeds, including Saragassum, Undaria Pinnatifida, and Dictyota. They contain antioxidant, anticancer, antiviral and anti-obesity properties. Nutraceuticals derived from plants. These plants have anti-inflammatory and antioxidant properties which have numerous health benefits for conditions like ulceration colitis and colorectal cancer. Moringa, lavender, garlic, cinnamon also offer antiviral and metabolic benefits. Other health benefits of nutraceuticals are; They reduce CVD burden by lowering total cholesterol due to polyphenols found in fruits, vegetables, cereals, legumes, tea, coffee, wine and cocoa. Again, nutraceuticals play various roles in the management of prediabetes and diabetes. Polyphenols such as grape-derived polyphenols, have been suggested to lower blood pressure. Nutraceuticals promotes skin health, delay aging and have potential mechanisms for treating viral infections. They can help manage chronic diseases and could

extend our lives. To say it all, nutraceuticals may be considered less likely to cause unpleasant side effects and more "natural" than conventional treatment.

Some examples of nutraceuticals are; Omega-3 fatty acids (found in fish oil), Curcumin (active compound in turmeric), Probiotics (found in Yogurts), green tea extract and Fiber supplements. One of the potentials of African traditional medicine is that those illnesses that have defied conventional medicine which are termed "incurable" like HIV\AIDS, mental illness, cancer, liver and kidney diseases and ulcer are cured by traditional medicine. ATM is largely non-prescription; in other words, it needs no prescriptions to be taken. So, they are easy to obtain and affordable.

Understanding the Difference between Traditional medicine, Nutraceuticals and Dietary Supplements

These three terms are closely linked together, but they have differences. While traditional medicine relies more on natural whole foods, and attempts to provide therapy for supernatural and spiritual etiological agents such as curses, evil spells and bad omen, nutraceuticals purify these active natural ingredients into pharmaceutical-like doses. Again, nutraceuticals encompass a broader spectrum of products, including functional foods, dietary supplements specifically refer to isolated nutrients or compounds. Importantly, we have traditional and modern nutraceuticals, the former has to do with natural unmodified foods e.g. ginseng, garlic or tomatoes. The later has to do with heavily processed or synthesized supplements e.g. omega-3 pills and curcumin capsules.

Regulation of Nutraceuticals

Nutraceuticals are regulated by various regions; The European Nutraceutical Association (ENA), The European Food Safety Authority (EFSA), while The Dietary Supplement Health and Education Act (DSHEA) and Modernization Act of 1997 (FDA)

govern their oversight in the US. In Nigeria, nutraceuticals fall under the oversight of the National Agency for Food and Drug Administration and Control (NAFDAC).

Safety of Nutraceutical on Consumers

One of the advantages nutraceuticals have over conventional medicines is that nutraceuticals are accessible, safe, natural and affordable. Again, because it is naturally made, devoid of chemicals, it has the tendency to cure diseases without having any side effects on the patients. Nevertheless, misuse and overuse of nutraceuticals may pose health risks to human. In other words, people are advised to consult a doctor before taking these products to avoid self-medication and overdose. Because some African countries are still poor and underdeveloped, some of these product are to regulated before introducing them to the public. This makes some people to feel that these products are more harmful to the kidney, liver and the heart. The truth of the matter is that people do not scrutinize these products to know the normal dose to be taken. Another important thing to know is that nutraceuticals are not considered drugs; so their sale is permitted, but the agents must provide evidence of safety before being licensed for use in the public.

Factors Affecting the sustainability of Nutraceuticals in Africa

Nutraceuticals face a lot of challenges and limitations that have continue to hinder their sustainability and standardization in Africa.

Conservation: It is quite unfortunate that after colonization, some African countries that are predominantly farmers left their occupation and diversified into oil, depending on imported products. Cultivation of medicinal crops and domestication of medicinal animals begin to decline. This is chiefly due to negligence, deforestation, and lack of conservation of biodiversity. Water pollution, climate change, erosion and flooding have also

contributed to the low cultivation and harvesting of these medicinal plants in large quantity. (Sifuna, 2022) listed the uses of wild animals in African traditional medicine: sniffing of burned ash of the rhino horn to arrest noise-bleeding; swallowing a mixture of crushed powder of the horn with milk to cure asthma; ingestion of crushed rhino horn as an aphrodisiac; applying of crocodile body fat on human body to cure skin ailments; the private parts of a female crocodile are cooked and mixed any food and secretly fed adulterous husbands to wean them from adultery; smearing of the lion's body fat on one's body to keep away their creditors as it is believed that the scent evokes ab aura of fear; drinking of the elephant's urine to cure asthma etc.

Absence of Technology: Some African countries like Nigeria, where there is lack of technology, people still find it difficult to develop their traditional medicines. They still rely on allopathic medicine which is based on science, infrastructure and costly hospital-based curative care despite its unaffordability. this lack of technology is one of the things that have held traditional medicines to compete with western medicine. Again some Africans have good knowledge about traditional medicines but inability to purchase expensive technology to set up the industry remains a great challenge. The governments of these poor countries also contribute in making things difficult for their masses because they fly out to the developed countries for medical care.

Lack of Education and Professional training: This is the most common among the limitations of traditional medicine. Most people who are into African traditional medicine lack proper education and training. Some of the things they produce are not clinically tested, and some of them lack knowledge of how to prescribe those drugs to patient. Inability to pass down the knowledge of medicine to others is also one of the perturbing issues in Africa that has contributed to the limitation of African traditional medicine. Again, traditional medicine has more practitioners than

conventional medicine, but their major challenge is that they have less professionals, hence it is prone to quackery and deceit.

Lack of documentation: Sometimes, the prescription, dosage, compositions, side effects, expiring date and the descriptions of African traditional medicines are undocumented and even unknown. This is why people are discouraged to take it. Again, as informal medicines, they are usually not subjected to prior or pre-administration toxicity evaluations. Traditional medicine is prone to inaccuracies in diagnosis because of lack of educational requirement.

Incentive structures and government support: Government of these poor African countries are not supporting and encouraging their citizens to develop. Rather they extract the resources meant for developing their countries citizens to enrich themselves, creating poverty in these countries.

Conservation of Nutraceuticals in Africa

Conservation of nutraceuticals in Africa requires preserving these foods, species, leaves, medicinal animals and plants used in making nutraceuticals. For instance, deforestation of medicinal plants should be totally avoided if Africa truly needs sustainable development in health sector. sustainability. Again, planting of more trees can help restore ecosystems where medicinal plants grow naturally. Importantly, there is a need for careful harvesting of herbs, allowing regeneration periods and avoid harvesting immature plants and uprooting entire plants. Documentation of indigenous knowledge is very necessary and should be recorded through books, academic research and community education. Finally, African societies should be carefully educated on the proper herb usage, development of safe nutraceutical products, environmental protection and method of conservation.

Conclusion

African traditional medicines still play vital roles in healthcare system in Africa because of its accessibility to the poor, ability to prevent and cure different illnesses without side effects. Nutraceuticals is different from traditional medicine because it is a combination of nutrition and modern scientific processing to promote health. However, there are many obstacles that need to be dealt with and addressed for its full potential to be actualized as the effective treatment of diseases. The number one factor is lack conservation of medicinal plants and animals. In Africa, these natural God-given gifts are not properly protected. A lot of things have been attributed to the cause of the decline in cultivation of these medicinal herbs in Africa. Absence of technology, insecurity, flooding, bad leadership, erosion, oil spillage etc. all contributed to the low cultivation of medicinal plants in Africa. Therefore, for sustainability in take place in healthcare system in Africa, conservation, documentation of indigenous knowledge, government support and public education are essential to ensure these herbs remain available for future development.

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AGROCHEMICAL USE IN CROP PRODUCTION BY SMALLHOLDER FARMERS IN RURAL NIGERIA: IMPACT ON AQUATIC ECOSYSTEMS AND LIFE BELOW WATER (SDG 14)

Christina Bih KONJE, PhD
Eucharia Chizoba EZIGBO
Emmanuella Ibeh ONYINYE, PhD
Theresa Olushola OLANIYI, PhD
Peter Ochiche USHIE
Department of Biotechnology and Environmental Biology
Veritas University, Abuja
christinakonje@gmail.com

Abstract

Increasing use of agrochemicals among low-literacy smallholder farmers is raising serious concerns on environmental sustainability, aquatic ecosystem degradation, soil fertility declines and human health risks in developing countries. This study investigated agrochemical use in crop production and its implications for UN Sustainable Development Goal 14 (SDG 14: Protecting Life Below Water), among peasant farmers in selected rural communities in Nigeria. Charged with this responsibility, we needed baseline information, community interest and collaboration to conduction impactful research. A descriptive survey design was adopted using a structured questionnaire containing both open-ended and closed-ended questions, administered to seventy (70) crop farmers. Quantitative data were analyzed using descriptive statistics and qualitative responses were subjected to thematic analysis. Major crops cultivated are maize (60), beans (53), yam (33), rice (22) and ginger-a good income generator for the farmers. Findings revealed high

dependence on agrochemicals (81.4%) with herbicides 80%, fertilizers 74%, insecticides 50% and fungicides 33%. Maize and beans received the highest number of varied molecules used in the field and storage. A high proportion (90%) were aware of the use of protective wear but only (46%) regularly used them. Used containers were burnt (62%), thrown in the environment (30%), and into water (11%). Other practices were burying in the soil, use for seed storage, drinking and resales. Respondents reported the presence of water bodies close to their farms (64%), which are used for irrigation 34, fishing 18, and other domestic purposes. The farmers expressed the presence of animals in the waters - 52 for fishes, 25 for frogs, 14 for crabs, 4 for lobsters/crayfish, and turtles and crocodiles. About 43% of the respondents observed agrochemical runoffs into these waters, after rainfall and spraying activities. Respondents further reported declines in aquatic fauna 36, deteriorating water quality 49 - in terms of smell, colour and volume. About 62 farmers expressed awareness of negative impacts of agrochemicals on these animals, which they cherish. And 40 respondents confirmed awareness of SDG 14. The study identified inadequate trainings (52 had none), unsafe disposal practices and weak environmental awareness as major challenges. They recommended organic farming 16; control of chemical application 12; improved environmental education and stronger regulatory measures. The study concludes that inappropriate and unmonitored agrochemical use in rural populations are serious threats to environmental sustainability and aquatic ecosystem conservation, thereby undermining the achievement of SDG 14 in rural Nigeria.

Keywords: **Crop Production, Farmers, Rural Nigeria, Aquatic Ecosystems, Water, SDG 14**

Introduction

Agriculture remains a major source of livelihood in rural Nigeria, employing a significant proportion of the population and contributing substantially to household income and national food

security. Smallholder farmers dominate agricultural production in Nigeria and often depend on agrochemicals such as herbicides, pesticides, fungicides and fertilizers to reduce pest infestation and improve crop yields. This also holds same across sub-Saharan Africa. these inputs increase yields and reduce post-harvest losses but their improper use poses significant risks to human health, soil fertility and aquatic ecosystems. Understanding use practices, knowledge gaps and environmental perceptions is critical for designing effective interventions. In many developing countries, agrochemicals are frequently applied without adequate training, monitoring by extension services, use of protective equipment and proper disposal. This increases the likelihood of contamination of soil, groundwater and surface water ecosystems (FAO, 2022). In Nigeria, studies have reported widespread unsafe handling practices, poor storage methods and indiscriminate disposal of agrochemical containers among rural farmers, contributing to environmental degradation and increased human health risks (Akanbi *et al*., 2021).

In Nigeria agrochemicals are widely used to manage weeds, pests and soil fertility constraints. Herbicides remain the most commonly used chemical inputs among smallholder farmers as they reduce labour costs associated with land preparation and manual weeding (Adeosun *et al*., 2020; Ojo *et al*., 2022). Fertilizer application is also common due to declining soil fertility and increasing food demand (Food and Agriculture Organization, 2022; Ibrahim & Mohammed, 2021). Despite these benefits, many Nigerian farmers apply agrochemicals without adequate technical knowledge. Factors such as low literacy, weak or non-functional agricultural extension systems and limited training often result in inappropriate dosage, poor timing and unsafe mixtures of products (Anuoluwa *et al.,* 2025). These reduce efficiency and increase environmental and occupational risks such as accidental exposure, reduced soil quality and contamination of nearby ecosystems (Okeke *et al*., 2023).

Agrochemicals enter the environment through spray drift, runoff and leaching. Pesticide residues persist over time and affect non-target organisms while fertilizer runoffs contribute cause eutrophication and oxygen depletion in water bodies (United Nations Environment Programmes, 2023; Chukwu *et al*., 2022), which affect aquatic life. Farmers living near surface waters are particularly vulnerable because the same water bodies are used for household consumption and farming purposes (Akanbi *et al*., 2021; Bello *et al*. 2024; Eze and Nwachukwu, 2020). Mensah *et al*., 2022, stated that, aquatic organisms are highly sensitive to chemical pollutants. Pesticides impair fish reproduction, reduce amphibian survival and disrupt aquatic food chains. while Herbicides will affect aquatic plants and cause algae bloom, altering habitat structure and reducing ecosystem productivity (Kone *et al*., 2021). Several studies across sub-Saharan Africa have shown that agricultural runoff significantly contributes to freshwater biodiversity decline (Adepoju *et al*., 2023; Mensah *et al*., 2022). The United Nations Environment Programme (2023), revealed that agricultural chemicals remain the major cause of freshwater ecosystem degradation globally. This concern aligns with United Nations Sustainable Development Goal 14, which promotes the protection and sustainable use of aquatic ecosystems and biodiversity.

Safe agrochemical management requires use of personal protective equipment, protective storage and proper disposal of containers. However, evidence from rural Nigeria indicates that awareness does not always translate into strict adherence because farmers may understand risks but continue unsafe practices due to cost, limited access to protective materials, low literacy levels and cultural norms (Akinola *et al*., 2021; Danjuma *et al*., 2023). Improper disposal of used containers such as burning, burying or reuse, remains common and contributes to accidental poisoning

and environmental contamination (WHO, 2022; Okon *et al*., 2024). Sustainable agricultural interventions are more effective when local farmers actively participate in identifying risks and proposing solutions. Community-led approaches such as agrochemical education, buffer zones around water bodies, organic farming and improved waste management have reduced environmental contamination and improve farmer compliance (FAO, 2022; Eze & Nwachukwu, 2020; Bello *et al*., 2024). Farmers' knowledge and a YES to the protection of water resources are important assets for achieving SDG 14 in rural agricultural communities. Increased awareness, functional agricultural extension services and community participation can support safer agrochemical use and contribute to the conservation of aquatic ecosystems in line with global sustainable development targets (United Nations, 2023; United Nations Environment Programme, 2023). Hence this study is very significant in its context, as it will provide insight into the environmental impacts of agrochemical use patterns among smallholder farmers in the target communities; identify the improper agrochemical practices, affecting aquatic ecosystems within the context of SDG 14. enable us help farmers improve their awareness and adopt safer, more sustainable farming practices; provide policymakers and government agencies with information required for strengthening regulations, environmental protection strategies, and agricultural extension services; and support environmental and health agencies in addressing pollution and related health risks. The findings will serve as a useful reference for researchers and students, providing a very useful baseline data on which to carry out impactful research on "Protecting Life Below Water"-SDG 14.

The study assessed agrochemical use among smallholder farmers in rural Nigeria, with focus on application patterns, safety practices and impacts on aquatic ecosystems in relation to Sustainable Development Goal 14. This is motivated by observations of

farmers misuse agrochemicals, as started by Issa, (2021), and Madaki *et al*., (2023). We also suspected the movement of agrochemical residues into water bodies, which reduces water quality and threatens aquatic ecosystems as documented by Manta *et al*., (2024).

The aim of this study was to investigate agrochemical use and impacts on aquatic ecosystems among smallholder farmers in Zuma and Garba farming communities, within the framework of Sustainable Development Goal 14. This was done by evaluating patterns and extent of agrochemical use among the target farmers; assessing farmers' awareness and practices regarding safe handling and application of agrochemicals; documenting the impact of agrochemical use on nearby aquatic ecosystems, and assessing the interest of community members to participate in any engagement aimed at protecting their water bodies and consequently the fauna in them.

Materials And Methods

Study Area

This study was carried out in Zuma and Garba communities of Bwari Area Council, Abuja, Nigeria. Bwari Area Council is one of the six area councils in the Federal Capital Territory and is located in the Northwestern part of Abuja. Zuma and Garba are agrarian communities where crop production is a major source of livelihood. Common crops cultivated include maize, millet, beans, yam, groundnut, cassava, vegetables and ginger. The area was selected because of its high level of agricultural activity, heavy use of agrochemicals and the presence of nearby streams and surface water bodies.

Study Design

A descriptive cross-sectional survey design was adopted for this study. The design enabled the collection of information on farmers' agrochemical use practices, safety awareness and environmental concerns. Farmers involved were those residing and actively engaged in crop farming, in the Zuma and Garba communities. Participation was opened to both male and female farmers.

Sample Size and Sampling Technique

Eighty respondents were targeted for the study. However, the questionnaire was successfully administered to seventy (70) farmers. A simple random sampling technique was used to select farmers from the communities. This ensured that all eligible smallholder farmers had equal opportunity of participating in the study, to improved representativeness of the sample.

Materials Used

The materials used included a structured questionnaire, pen and notebook, consent form, mobile phone for recording responses where necessary, data recording sheets and a Computing system with Microsoft Excel for data entry and analysis

Data Collection

Primary data were collected through administration of the structured questionnaire to voluntary respondents. The questionnaire was divided into sections to obtain information on:

1. demographic characteristics of respondents;
2. types of agrochemicals commonly used;
3. frequency and purpose of agrochemical application;
4. methods of storage of agrochemicals and disposal of used containers;

5. awareness of environmental pollution and water contamination;
6. use of safety measures during agrochemical handling; and
7. perceptions on environmental protection and Sustainable Development Goal 14.

The questionnaire was administered directly to each participant, with the assistance of two field technicians who are fluent in the Hausa and Gbaghyi languages. Respondents were informed about the purpose of the study, and their consent was obtained before participation.

Validity and Reliability

The questionnaire has been reviewed by the research team to ensure relevance, clarity and suitability for the study objectives. A pilot test was conducted among a few farmers in a nearby farming community outside the study area to assess understanding and reliability before final administration.

Data Analysis

Information collected from the respondents were coded and entered into Microsoft Excel for analysis. Descriptive statistics including frequency counts, percentages, tables and charts were used to summarize and present the findings. The results were interpreted based on the study objectives.

Ethical Consideration

The Chiefs (Leaders) of the two communities were met, and they consented to the study to be carried out. Participation in the study was voluntary. Respondents were informed about the purpose of the study and assured that all information provided would be treated confidentially and used strictly for academic purposes.

Participants were also informed of their right to withdraw at any stage of the study.

Results

4.1 Demographics of Respondents

4.1.1 Gender

Of the 70 respondents, 52 were male and 18 were female, reflecting the predominantly male participation in commercial and

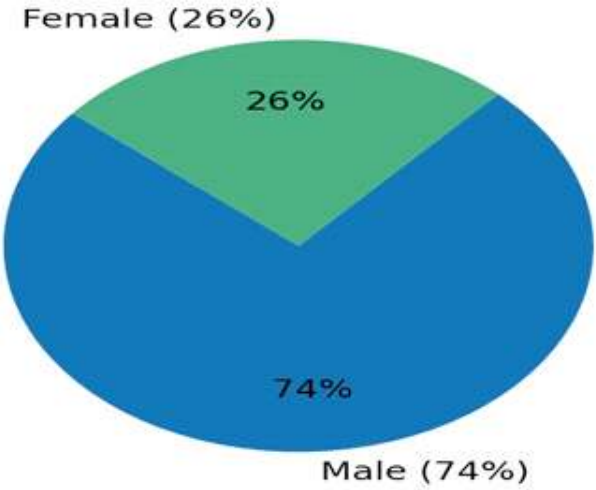


Figure 1: Gender distribution of Respondents

4.1.2 Age Distribution

Majority of respondents (61%) were in the 21– 40 years age bracket, followed by the 41–60 age group (30%). Only 2 respondents (3%) were aged 15–20, and 4 (6%) were aged 61 and above. This indicates that farming activity in the communities is dominated by adults in their most productive years (Figure 2).

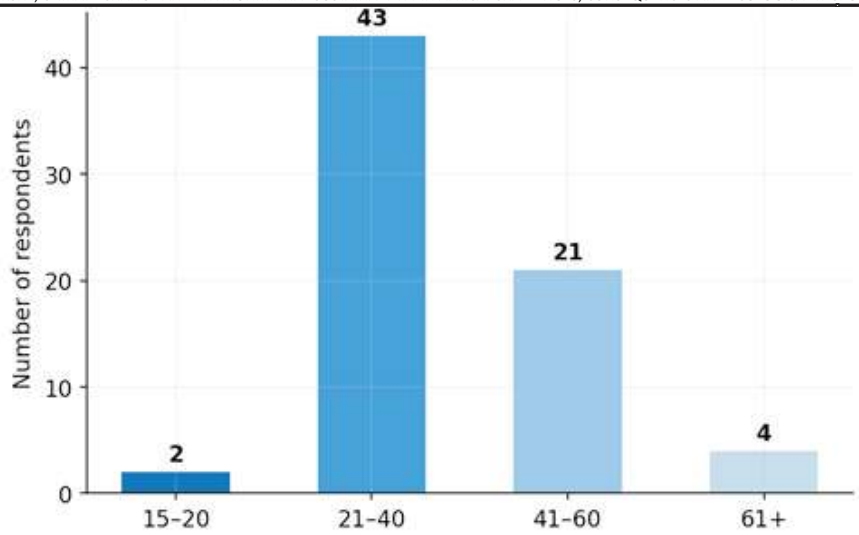


Figure 2: Age distribution of respondents

4.1.3 Duration of Residence

More than half the respondents have lived in the village for either less than 10 years (27, 39%) or more than 30 years (28, 40%), suggesting a mix of long-established and more recently settled farming households (Table 1, Figure 3).

Table 1: Duration of residence in the village

Duration of Residence	Frequency	Percentage (%)
0 – 10 years	27	38.6
11 – 20 years	11	15.7
21 – 30 years	4	5.7
31 – 100 years	28	40.0
Total	70	100.0

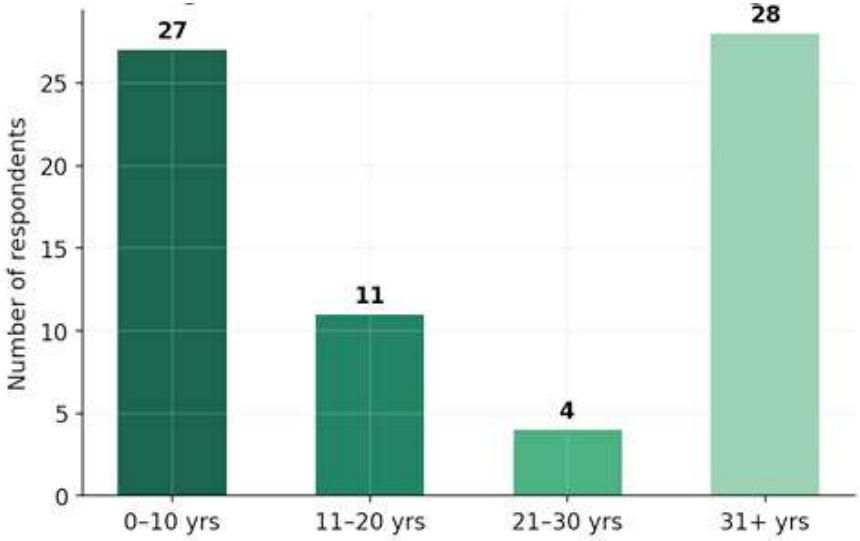


Figure 3: Duration of residence in the village

4.1.4 Role in Agricultural Production

The largest group of respondents identified themselves as ordinary farmers (57, 81%), followed by family members assisting on the farm (22, 31%) and farm managers (15, 21%). No respondent reported any other role (Table 2,).

Table 2: Role in agricultural production

Role	Frequency	Percentage (%)
Ordinary farmer	57	81.4
Farm manager	15	21.4
Family member assisting	22	31.4
Other roles	0	0.0

4.1.5 Years Involved in Crop Production

Respondents were fairly evenly distributed across experience levels: 17% had 1–10 years' experience, 27% had 11–20 years, 24% had 21–30 years, and 31% had over 30 years' experience. This indicates a well-experienced farming population in the communities (Table 3).

Table 3: Years involved in crop production

Years in Crop Production	Frequency	Percentage (%)
1 – 10 years	12	17.1
11 – 20 years	19	27.1
21 – 30 years	17	24.3
31 years and more	22	31.4
Total	70	100.0

4.2 Agrochemical Use in Crop Production and Storage

4.2.1 Major Crops Cultivated

Respondents were asked to rank their top three crops. Maize was the most widely cultivated crop (60 mentions), followed by bean (53), yam (33), and rice (22). Cassava, ginger, soya bean, guinea corn, groundnut, vegetables, millet, sorghum, banana and melon were also mentioned but less frequently (Table 4).

Table 4: Major crops cultivated by respondents (ranked)

Crop	Frequency (top-3 mentions)	Rank
Maize	60	1st
Bean	53	2nd
Yam	33	3rd
Rice	22	4th
Cassava & Ginger	9	5th
Soya bean & Guinea corn	6	6th
Groundnut	5	7th
Vegetables & Millet	2	8th
Sorghum, Banana & Melon	1	9th

4.2.2 Application of Agrochemicals on the Farm

Of the 70 respondents, (81.4%) confirmed applying agrochemicals on their farms, (4.3%) did not, and (14.3%) gave no response. This confirms widespread agrochemical adoption by farmers in both communities.

Table 5: Application of agrochemicals on the farm

Response	Frequency	Percentage (%)
Yes - agrochemicals applied	57	81.4
No - not applied	3	4.3
No response	10	14.3
Total	70	100.0

4.2.3 Categories of Agrochemicals Used

Herbicides topped the list with (80%), closely followed by fertilizers (74%), insecticides (50%) and fungicides (33%). (Figure 5).

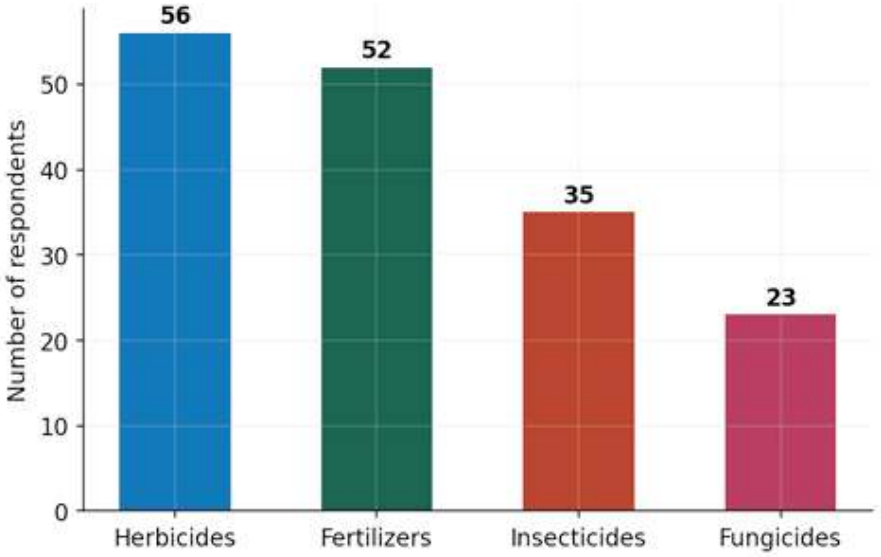


Figure 5: Categories of agrochemicals used on the farm

4.2.4 Agrochemical Products Used Per Crop

Maize had the highest number of different agrochemical products associated with it (26), followed by bean (21), rice (9), yam (8), cassava (7) and ginger (6). This corresponds to the importance of these crops in the communities' farming system (Table 7). As also reflected in their daily menu.

Table 7: Number of agrochemical products used per crop

Crop	No. of Different Products Used	Crop	No. of Different Products Used
Maize	26	Guinea corn	4
Bean	21	Sova bean	4
Rice	9	Vegetables	3
Yam	8	Millet	3
Cassava	7	Sorghum	2
Ginger	6	Banana	2
Groundnut	5	Melon	1

4.2.5 Methods of Agrochemical Application on the Farm

Respondents described the following methods of agrochemical application (Table 8):

Table 8: Methods of agrochemical application on the farm

S/No.	Category	Method / Description
1	Fertilizers	manually on ridges and heaps; broadcasting and placement method for maize, yam and ginger; applied thrice before harvest for maize.
2	Pesticides	1–2 cups mixed with 20 L of water and sprayed on leaves and stems; mixed in rubber basin and scooped into knapsack sprayer; for beans, sprayed at onset of flowering; fumigation used for ginger.
3	Herbicides	Mixed with water and sprayed on weeds; Gramozone sprayed immediately after planting; also used during weeding operations.
4	Spraying equipment	Knapsack sprayers are commonly used; tractors by a small minority.

4.3 Handling, Storage and Safety Practices

4.3.1 Awareness of Protective Wear

Majority respondents (90%) were aware of the need for protective wear when handling agrochemicals, while (2.9%) were unaware and (7.1%) gave no response (Table 9).

Table 9: Awareness of protective wear when using agrochemicals

Awareness of Protective Wear	Frequency	Percentage (%)
Yes	63	90.0
No	2	2.9
No response	5	7.1
Total	70	100.0

4.3.2 Management of Containers after Use

Burning was the most frequently reported method of container disposal (63%), followed by throwing in the open land (30%) and throwing into a water body (11%). Notably, 5 respondents (7%) reported reusing containers for drinking or eating. A further (9%) stored seeds in used containers (Table 10).

Table 10: Management of containers after agrochemical use

Disposal Method	Frequency	Percentage (%)
Burn them	44	62.9
Throw in the open land	21	30.0
Throw in a water body	8	11.4
Bury in the soil	6	8.6
Use for storing seeds	6	8.6
Use for drinking or eating	5	7.1
Sell them	5	7.1
No response	1	1.4

4.4 Environmental Impact of Agrochemical Use

4.4.1 On Aquatic Ecosystems - Water Body Proximity and Use

A majority of respondents (90%) reported the presence of water bodies near their farms, and (10%) reporting none. The water bodies serve multiple critical purposes including irrigation 49%, washing/laundry 31%, bathing 29%, drinking 27%, and fishing 26%. Eleven respondents (16%) reported no uses for water bodies (Figure

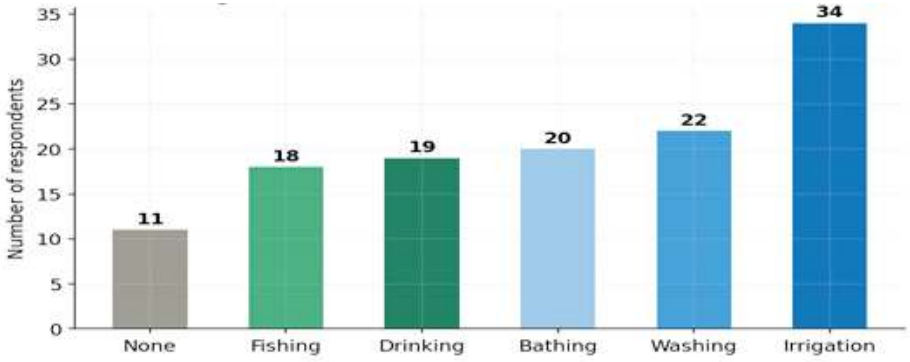


Figure 7: Uses of water bodies near farms

4.4.2 Aquatic Fauna

About (80%) of the respondents confirmed the presence of fauna in the water bodies. The animals present were fish, the most commonly (74%), followed by frogs 36%, crabs 20%, snakes 11%, crayfish/lobsters 6%, snails, sea turtles and toads 3% each, and crocodile 1% (Table 11)

Table 11: Animals present in water bodies near farms

Animal	Frequency	Percentage of 70 (%)
Fish	52	74.3
Frog	25	35.7
Crabs	14	20.0
Snakes	8	11.4

Crayfish / Lobsters	4	5.7
Snails	2	2.9
Sea turtles	2	2.9
Toads	2	2.9
Crocodile	1	1.4

4.4.3 Agrochemical Runoff and Changes in Aquatic Populations

Observations on agrochemical runoff into water bodies were (43%) for, reported observing runoff after rainfall or spraying, (46%) did not, and (11%) were indifferent. Regarding changes in aquatic animal populations, 36 farmers reported a decrease, 21 were unsure, 7 reported no change, and only 6 reported an increase (Figures 8 & 9).

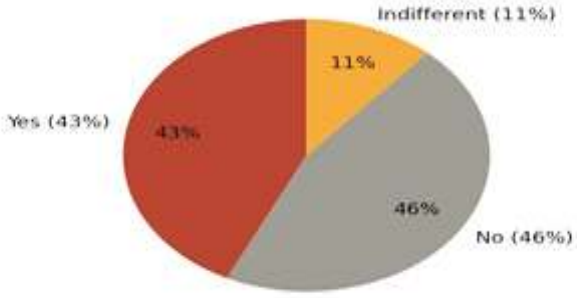
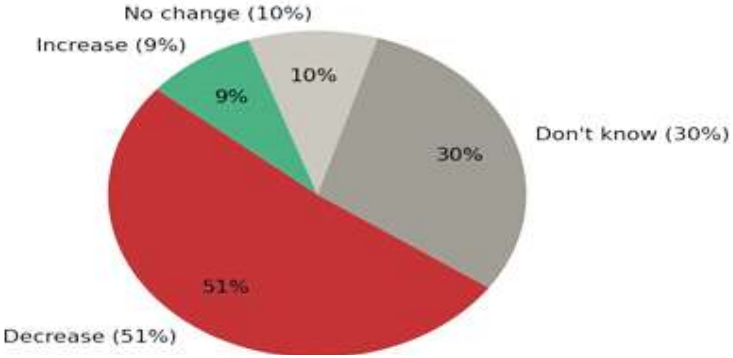


Figure 8: Observed chemical runoff into water bodies



4.4.4 Changes in Water Quality

Of the 70 respondents, 49 reported observing changes in the quality of water bodies since the advent of agrochemical use in farming. The most commonly observed change was smell (25 responses), colour 19, volume 16, taste 4, and other unspecified changes 6 (Figure 10).

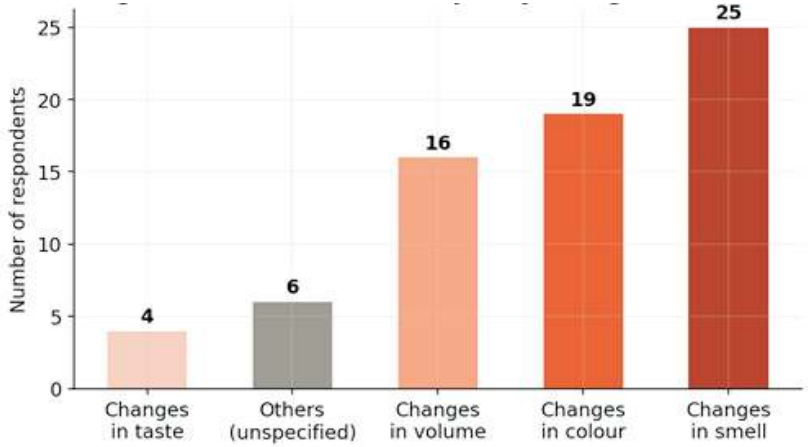


Figure 10: Forms of water quality changes observed

4.4.5 Environmental Management and SDG 14 Awareness

Knowledge that improper agrochemical use affects aquatic animals was very high: (89%) said yes, 3 said no, and 5 were indifferent. Awareness of the United Nations Sustainable Development Goal (SDG 14 - Life below Water) was lower: 40 were aware, 28 were not, and 2 were indifferent. Encouragingly, 63 respondents agreed that protecting water bodies can improve living standards and reduce disease prevalence in their communities (Table 12, Figure 15).

Table 12: Awareness of SDG 14 and environmental management

Statement	Yes	No	Indifferent
Improper agrochemical use affects aquatic animals	62 (89%)	3 (4%)	5 (7%)
Aware of SDG 14 (Life Below Water)	40 (57%)	28 (40%)	2 (3%)
Protecting water improves living standards	63 (90%)	1 (1%)	6 (9%)

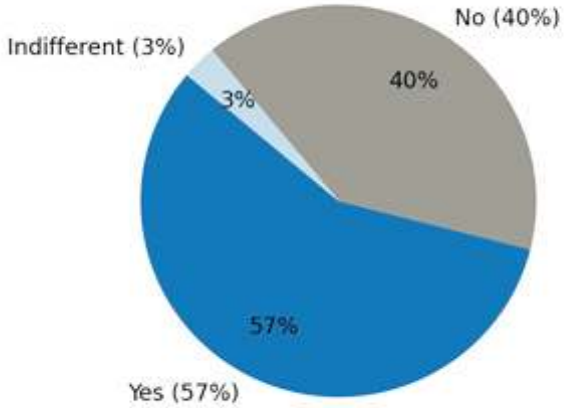


Figure 11: Awareness of SDG 14 (Life Below Water)

4.5 Open-ended Reflections

4.5.1 Major Challenges Associated with Agrochemical Use

Respondents identified 18 challenges. Frequently cited were lack of proper knowledge on the use of agrochemicals (22), high cost of agrochemicals (16), health risks (15), water pollution (11), soil degradation (10), and many others (Table 13).

Table 13: Major challenges associated with agrochemical use in Zuma and Gaba Communities

Rank	Challenge	Frequency Score
1	Lack of proper knowledge on the use of agrochemicals	22
2	High cost of agrochemicals, out of reach of farmers	16
3	Health risks / health problems posed by chemicals	15
4	Water pollution - a very serious problem	11
5	Soil degradation, impact on beneficial organisms	10
6	Increasing soil erosion	6
7	Loss of medicinal plants and animal feed	5
8	Environmental and air pollution by pesticides	5

9	Pests and weeds developing resistance to chemicals	5
10	Improper storage and disposal of used containers	4
11	Lack of appropriate farming tools and machinery	3
12	Lack of quality control on agrochemicals sold	3
13	Fake chemicals sold that are not working	2
14	Threat to flora and fauna, kills fish in water	2
15	No food storage facilities, roads or networking	2
16	Lack of sufficient water for the community	2
17	Lack of finances to buy effective agrochemicals	1
18	Shortage of supply and high demand	1

4.5.2 Proposed Farming Practice Improvements to Protect Water Bodies

Respondents suggested 28 actions to improve farming practices for the protection of water bodies and life below water. The most frequently recommended were organic farming and crop rotation (16), controlling of chemical flow (12), no to farming close to water bodies (11), and planting vegetation around water bodies (10) (Table 14).

S/No.	Suggested Improvement	Frequency
1	Practice organic farming and crop rotation for improved soil fertility	16
2	Control chemical flow into waters	12
3	Avoid farming and use of chemicals too close to water bodies	11
4	Plant vegetation around water bodies	10
5	Seminars and workshops for sensitization	9
6	Stop throwing used agrochemical containers into water bodies	8
7	Soil conservation to reduce erosion and chemical runoff	7
8	Fence Water bodies with aquatic animals	6
9	Practice proper irrigation and good water management	5
10	Contours and heaps along river banks to control chemical flow	5
11	Limit the use of agrochemicals	3
12	Manufacturers to consider effects of products on animals	3

13	Stop washing containers or sprayers in water	3
14	Laws be enacted and enforced on aquatic life	2
15	Support farmers with implements and tools	2
16	Stop using chemicals for fishing; observe mesh size	2
17	Adopt non-tillage farming to reduce erosion	2
18	Use organic manure (compost, cow dung, poultry waste)	2
19	Reduce or stop the use of pesticides	2
20	Practice fish production in ponds	1
21	Catch only mature animals	1
22	Employ people to safeguard water bodies	1
23	Purify polluted water bodies	1
24	Proper waste disposal	1
25	Farmers should regularly check for changes in water quality	1
26	Practice ridging to reduce runoff into water bodies	1
27	Stop felling and burning bushes and trees	1
28	Protect wetlands and riverine areas	1

Discussion

Demographic Characteristics and Farming Experience

The dominance of male respondents (74%) in this study reflects the gender pattern commonly reported in rural agricultural production in Nigeria, where men often control land ownership and major crop production activities, while women contribute through labour, harvesting and processing (Adeosun *et al*., 2020; FAO, 2022). However, the 26% participation of women remains important and suggests increasing involvement of women in agricultural activities, consistent with findings by Anuoluwa *et al*. (2025), who reported growing female participation in smallholder farming across Northern Nigeria.

Majority of respondents (61%) were within the 21–40 years age group, followed by 30% for the 41–60 years old. This indicates a relatively youthful and economically productive farming population. Similar findings have been reported among Nigerian smallholder farmers, where the most active agricultural labour force is concentrated between 20 and 50 years (Akanbi *et al*., 2021; National Bureau of Statistics, 2023). Many respondents had over 30 years of farming experience, suggesting strong dependence on farming as a livelihood. This insinuates extensive indigenous knowledge of local farming systems. This aligns with an FAO, 2022 report, that rural Nigerian farmers often rely on long-established agricultural practices shaped by experience and inherited knowledge. The duration of residence in the communities supports the importance of community-based interventions, as long-term residents lead to valuable ecological observations regarding environmental changes and farming impacts (UNEP, 2023).

Agrochemical Use Patterns

The widespread use of agrochemicals (81.4%) confirms that crop production in these communities is strongly dependent on chemical inputs. This finding is consistent with reports from several regions in Nigeria where herbicides and fertilizers are increasingly adopted to manage weeds and improve productivity amid labour shortages and increasing demand for food (Adeosun *et al*., 2020; FAO, 2022). This could also be an indication that crop production is not the sole source of income to farmers.

Maize and beans were the most cultivated crops and recorded the highest number of associated agrochemical products. This pattern reflects their economic importance and vulnerability to weeds and pests (Anuoluwa *et al.,* 2025). Herbicides were the most frequently used, followed by fertilizers, insecticides and fungicides. Similar

findings have been reported across sub-Saharan Africa where herbicides are commonly preferred because manual weeding is labour-intensive and expensive (World Bank, 2022). This undermines the cumulative negative impact on the fauna and flora. Methods of application include manual fertilizer placement and spraying with knapsack sprayers, indicating low levels of farm mechanization. Knapsack spraying is widely used among smallholder farmers because of affordability and portability but it increases direct exposure to agrochemicals through inhalation and skin contact, especially when protective equipment is incomplete (WHO, 2022; Akanbi *et al*., 2021). The practice of mixing agrochemicals manually in basins before transfer into sprayers also increases risk of accidental spills and contamination.

Safety Practices and Container Disposal

Although awareness of protective wear was high among respondents, the practice was low. This observation agrees with previous studies of Anuoluwa *et al. (*2025) and WHO (2022) in Nigeria, showing that many farmers understand the hazards of agrochemicals but still engage in unsafe practices because of cost, discomfort, limited access to protective gear, weak extension support and ignorance. Container disposal practices revealed major environmental and health concerns. Burning was the most common, which may reduce immediate reuse but can pollute the atmosphere (UNEP, 2023). Disposal in open land and water bodies was also reported, while some respondents admitted reusing containers for domestic purposes such as food and drinking. These are direct threats to aquatic ecosystems, soil and human health. Our findings are similar to those of FAO (2022), which identified improper agrochemical disposal as major sources of environmental contamination in low-income farming communities. Reuse of chemical containers for domestic purposes has also been recognized by WHO (2022) as an important cause of poisoning and accidental exposure in rural households. These unsafe disposal

practices indicate urgent need for sensitization, structured collection systems, and regular community monitoring. We also observed that farmers make preferences for some products based on the reusability of their containers. Very sad indeed!

Environmental Impact on Aquatic Ecosystems

Presence of water bodies near farms, reported by most respondents, is significant because they serve important domestic and agricultural functions including drinking, bathing, washing, fishing and irrigation. Similar dependence on surface water has been reported in rural Nigeria and parts of sub-Saharan Africa, where communities rely on nearby freshwater bodies for household survival and economic activities (UNEP, 2023; World Bank, 2022). A significant proportion of respondents observed runoffs into water bodies after rainfall or spraying. This supports existing evidence that agrochemicals can be transported through runoff and leaching into aquatic systems, where they alter water chemistry and threaten aquatic biodiversity (FAO, 2022; UNEP, 2023). Our findings reveal declining populations of fish and other aquatic animals, aligning with international studies linking pesticide contamination to fish mortality, amphibian decline and disruption of freshwater ecosystems (WHO, 2022; UNEP, 2023). The presence of fish, frogs, crabs, crayfish, turtles and crocodiles indicate ecologically valuable freshwater systems, where collaborative research, aimed at protecting these animals can be targeted. Changes in smell, colour and water volume were also reported. These observations may indicate pollution, suspended contaminants and eutrophication, which are associated with reduced water quality and aquatic ecosystem upsets (Akanbi *et al*., 2021; UNEP, 2023). These findings have buttressed the relevance of this study to Sustainable Development Goal 14, which emphasizes protection of aquatic life and water ecosystems.

Knowledge on SDG 14 and Community Resilience

An 89% acknowledged that improper agrochemical use can negatively affect aquatic animals. This high level of awareness is excellent, and aligns with evidence that rural farmers often understand environmental changes even when they lack formal technical language to express themselves (FAO, 2022). Awareness of SDG 14 (57%) was moderate. This suggests that many farmers recognize environmental risks but are unfamiliarity with global sustainability frameworks. They need to be taken along. Similar gaps have been reported in African rural communities by the United Nations, (2023). The strong agreement (90%) that protecting water bodies can improve community living standards and reduce diseases burden, reflects environmental concerns and social readiness for intervention and effective collaboration. According to World Bank studies in 2022, and UNEP 2023, community willingness has been identified as a key factor in successful environmental management and sustainable agriculture programmes.

Key Challenges and Community-Proposed Solutions

The major challenges identified by respondents including poor knowledge, high cost of agrochemicals and health risks, reflect barriers widely reported among smallholder farmers in developing countries (Anuoluwa *et al.,* 2025; FAO, 2022). The recognition of water pollution and soil degradation further shows that environmental impacts are visible and understood within the communities. Similar perceptions have been documented by Akanbi *et al*., (2021), in rural Nigeria where farmers observe declining soil fertility and water contamination but lack technical support. Importantly, respondents proposed practical solutions including organic farming, crop rotation, reduced farming close to water bodies, planting vegetation around waterbodies and waterways to control runoff. These recommendations are strongly

supported in the literature as effective and sustainable measures for reducing agrochemical pollution and protecting aquatic ecosystems (UNEP, 2023; FAO, 2022; United Nations, 2023).

Community-led strategies are especially important because interventions developed around local priorities are more likely to succeed and sustainable. The findings also suggest that strengthening agricultural extension services, improving environmental awareness and supporting safer farming alternatives, would significantly reduce agrochemical-related risks while advancing SDG 14 in rural Nigeria, specifically, in Zuma and Garba.

Conclusion

This survey of 70 farmers in the Zuma and Garba communities reveals a farming system in which agrochemicals are indispensable yet poorly managed. Maize and beans, the staple crops, are treated with the widest range of chemical products. Herbicides and fertilizers dominate, and are applied primarily by use of knapsack sprayers. Despite high awareness of protective measures, unsafe practices particularly hazardous container disposal persists. The communities are in close proximity to ecologically rich water bodies that serve critical domestic and livelihood functions, yet show signs of chemical contamination.

Farmers demonstrated genuine understanding of the link between agrochemical misuse and environmental harm, with 90% recognizing that protecting water bodies benefits the community. The gap lies in good training, appropriate tools, safe disposal systems and regulatory enforcement. Knowledge of SDG 14 is moderate, and with targeted engagement, this can be improved. The community has generated a rich set of possible solutions from organic farming and riparian planting, to legal enforcement, demonstrating the local capacity and willingness to drive change.

In summary, the communities of Zuma and Garba are at a critical juncture: agrochemical dependency is entrenched, environmental harm is visible, but community knowledge and motivation for change are heightened. Well-designed, adequately resourced and community-centered interventions would significantly reduce harm and protect both human health and the aquatic ecosystems on which these communities depend.

Recommendations

Based on these findings, we propose the following six (6) recommendations are:

1. Farmer Education and Extension Services. Organize regular workshops and seminars on the safe, effective and economical use of agrochemicals. By lectures, seminars and workshops.

2. Safe Container Disposal and Chemical Management. Establish a formal used-container collection system in both communities to prevent container reuse for food and water, open dumping and disposal into water bodies. Promote the *triple-rinsing and puncturing* of containers before disposal as an interim measure.

3. Protection Aquatic Ecosystems. Enforce buffer zones restricting farming and agrochemical application within an agreed distance from water bodies to be defined in consultation with the community and local authorities.

4. Promote Sustainable Farming Practices. Support the transition to organic farming practices including composting, crop rotation and use of organic manure, through subsidies, training and market linkages for organic produce.

5. Policy and Regulatory Actions. Re-enforce regulatory oversights on agrochemical quality, labeling and sales in rural markets, with particular attention to eliminating counterfeit and substandard products.

6. Research and Monitoring. Conduct a follow-up study to quantify

specific agrochemical residue levels in water bodies, soils and food crops.

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CARBON EMISSIONS, BIODIVERSITY DECLINE, AND SUSTAINABLE DEVELOPMENT: A PANEL ANALYSIS OF AFRICAN ECONOMIES

Okuji Obinna Oreh, PhD
Department of Finance,
National Open University of Nigeria
drooreh@gmail.com

Victor Chidera Oguh
Department of Entrepreneurship,
Veritas University Abuja, Nigeria
oguhvictor20@gmail.com

Abstract

This study examines carbon emissions, biodiversity decline, and sustainable development across African economies using panel data, focusing on how CO2 emissions, GDP, and renewable energy jointly shape an Environmental Sustainability Index (ESI). Grounded in the environmental Kuznets curve (EKC) hypothesis and ecological modernisation theory, the study employs fixed effects, random effects, and system GMM estimators. Because the ESI combines a biodiversity sub-index with an inverted CO2-intensity sub-index, the mechanical correlation this creates with CO2 as a regressor is explicitly diagnosed and addressed through a robustness specification using a CO2-free biodiversity-only outcome. CO2 emissions are significantly associated with lower sustainability, a relationship that survives this robustness check. Renewable energy consumption raises sustainability scores. GDP shows a significant quadratic relationship with ESI that, once the direction of variable coding is made explicit, is shown to be fully consistent with the conventional inverted-U EKC rather than a departure from it. Sub-group analysis shows the emissions-

sustainability relationship is markedly steeper in oil-producing and industrialising economies than in agrarian and renewable-dependent ones. Full regression tables, standard errors, instrument counts, and diagnostics are reported, and causal language is calibrated to what the design supports. The study contributes by integrating biodiversity into macroeconomic sustainability analysis for Africa while transparently addressing the resulting endogeneity concern, and recommends renewable investment, stronger environmental regulation, and typology-differentiated policy.

Keywords: Carbon emissions; Biodiversity decline; Sustainable development; Renewable energy; Economic growth; System GMM.

Introduction

Carbon emissions, biodiversity loss, and sustainable development form one of the defining policy challenges of the twenty-first century. Africa, though a historically modest emitter, is both an increasingly significant source of emissions and a highly exposed region, hosting roughly a quarter of the world's biodiversity across tropical forests, savannahs, and coastal ecosystems that underpin livelihoods, food security, and climate regulation (IPBES, 2019; Bongaarts, 2019; Myers et al., 2000). Rising CO2 emissions from fossil fuel combustion, deforestation, and land-use change are accelerating habitat fragmentation and species loss (Dirzo et al., 2014; Johnson et al., 2017). The environmental Kuznets curve (EKC) hypothesis holds that degradation initially rises with income but declines once a threshold is passed (Grossman & Krueger, 1995; Panayotou, 1993); its application to biodiversity outcomes in Africa, as distinct from single pollutants, remains limited (Dasgupta et al., 2002; Stern, 2004). Renewable energy, central to SDG 7, 13, and 15, offers a potential route to reconcile energy access with ecological sustainability given Africa's abundant solar, wind, and hydropower resources (IEA, 2022; Apergis & Payne, 2010).

This study uses panel econometrics to examine how CO2 emissions, renewable energy, and GDP jointly shape sustainability outcomes across African economies, and makes four commitments that address common weaknesses in this literature: (i) it makes the composite sustainability index's construction transparent and diagnoses the mechanical correlation this creates with CO2 as a regressor; (ii) it reconciles its EKC finding with the conventional inverted-U framing; (iii) it reports full instrument and diagnostic detail for its system GMM estimates and calibrates causal language accordingly; and (iv) it tests whether pooled continental results mask heterogeneity across oil-producing, industrialising, agrarian, and renewable-dependent economies. Section 2 reviews the literature; Section 3 sets out the methodology; Section 4 presents findings including robustness and heterogeneity analysis; Section 5 discusses policy implications; Section 6 concludes.

Literature Review

Theoretical Framework

The EKC hypothesis (Grossman & Krueger, 1995; Panayotou, 1993) proposes an inverted-U relationship between income and degradation: pollution rises with early industrialisation but falls as rising incomes generate demand for environmental quality. Results are mixed across pollutants, regions, and methods (Stern, 2004; Dinda, 2004; Apergis & Ozturk, 2015). A frequent source of confusion, addressed directly in Section 4.5, is that the curve's apparent shape depends on whether the dependent variable is coded as degradation (rising is bad) or as quality/sustainability (rising is good); the two codings are mirror images of the same relationship. Ecological modernisation theory (Mol & Spaargaren, 2000; Hajer, 1995) complements this by arguing that technological and institutional reform can decouple growth from harm, motivating the renewable-energy channel tested here.

Carbon Emissions and Environmental Degradation in Africa

Asongu et al. (2017) examined CO2 emissions, intensity, and methane across African economies. Bekun et al. (2019) found a positive long-run energy-emissions relationship in a panel of 16 EU countries; this evidence, drawn from outside Africa, is used here strictly as comparative input to the modelling strategy, not as African evidence. Appiah et al. (2018) showed that energy-mix composition, not merely consumption levels, shapes carbon outcomes in West Africa. Globally, Dietz et al. (2012) linked emissions to consumption patterns, and Le Quere et al. (2018) documented accelerating global CO2 growth. Salahuddin et al. (2019) found urbanisation detrimental to CO2 emissions in Sub-Saharan Africa; comparable evidence from Nathaniel and Khan's (2020) ASEAN panel suggests this pattern extends across developing regions, though this study's own causal claims are restricted to the African panel in Section 3.

Biodiversity Loss and Its Macroeconomic Dimensions

Biodiversity loss has been studied mainly within ecology, with limited economic integration (Dasgupta, 2021; Mace et al., 2018). The Dasgupta Review (Dasgupta, 2021) reframed biodiversity as natural capital whose depletion is invisible in GDP yet economically substantial. Dirzo et al. (2014) documented widespread “defaunation”; Johnson et al. (2017) identified land-use change as the dominant driver of tropical biodiversity loss; Ceballos et al. (2017) described vertebrate losses as “biological annihilation” concentrated in African and South American hotspots; Barbier (2017) framed biodiversity depletion as economic dis-investment; and Isbell et al. (2017) linked biodiversity loss to reduced ecosystem functioning with cascading effects on food, water, and climate.

Renewable Energy and Sustainable Development

Apergis and Payne (2010) found bidirectional causality between renewable energy and growth in OECD panels; Sadorsky (2009)

found income and emissions drive renewable adoption in emerging economies. Shahbaz et al. (2015) found biomass energy moderates degradation in the United States, and Alola et al. (2019) found renewable energy reduces ecological footprint in a panel of European economies - comparative evidence used here to motivate, not substitute for, direct African testing, since African-specific evidence on renewable energy's biodiversity co-benefits remains scarce.

Panel Econometric Approaches

System GMM (Arellano & Bover, 1995; Blundell & Bond, 1998) suits endogeneity and dynamic bias in sustainability panels, and has been applied to African growth/governance outcomes (Asongu & Nwachukwu, 2016) and other developing-country energy-environment panels (Nathaniel et al., 2020), supporting its extension here with full instrument and diagnostic reporting (Roodman, 2009).

Methodology

Data and Sample

The analysis uses annual panel data for up to 40 African economies, 1995-2020 (N = 40, T up to 26; max 1,040 country-year observations before listwise deletion), drawn from the World Bank WDI, IEA, UNEP, and the WWF/ZSL Living Planet Index.

Variable Specification and the Environmental Sustainability Index

The dependent variable, ESI, is an equally weighted composite of two min-max normalised (0-1) sub-indices: a biodiversity sub-index (BIO) from Living Planet species-abundance trends, and an inverted carbon-intensity sub-index (1 minus normalised CO2 per capita). Formally, $ESIit = 0.5\times BIOit + 0.5\times(1-CO2norm,it)$, so higher ESI denotes greater sustainability. Independent variables: CO2 emissions per capita; renewable energy share of final consumption; GDP per capita and its square (EKC test); population

density; and institutional quality (WGI composite).

Addressing the Mechanical Correlation Between ESI and CO2

Because CO2 enters ESI's construction directly while also appearing as a regressor, part of its coefficient in the pooled model is definitional rather than substantive. This is addressed two ways: Section 4.2 reports the variance share attributable to the carbon-intensity sub-index, and Section 4.6 re-estimates the model using BIO alone, which contains no CO2 information, as the dependent variable, so any significant CO2-BIO association there cannot be mechanical. The composite ESI remains the primary model, but CO2 conclusions rely on the decomposed BIO check.

Estimation Strategy

Panel unit root tests (IPS: Im et al., 2003; LLC: Levin et al., 2002) establish integration order; Kao (1999) and Pedroni (1999) cointegration tests check long-run equilibrium. FE, RE, and system GMM are then estimated, with the Hausman test adjudicating FE versus RE, and system GMM (lagged levels/differences as instruments) addressing reverse causality. Baseline model:

$$ESIit = \alpha i + \beta 1CO2it + \beta 2RENit + \beta 3GDPit + \beta 4GDP2it + \beta 5PDit + \beta 6INSTit + \mu i + \varepsilon it$$

The dynamic system GMM specification adds a lagged dependent variable:

$$ESIit = \alpha i + \rho\, ESIi,t\text{-}1 + \beta 1CO2it + \beta 2RENit + \beta 3GDPit + \beta 4GDP2it + \beta 5PDit + \beta 6INSTit + \mu i + \varepsilon it$$

System GMM Instrument Specification

Two-step system GMM (Blundell & Bond, 1998) with Windmeijer (2005) corrected errors treats CO2, renewable energy, and GDP as endogenous, instrumented by second- and third-lag levels/differences; population density and institutional quality are predetermined. Instruments are collapsed (Roodman, 2009) to stay below the 40-country group count; exact counts and diagnostics appear in Table 3.

Diagnostic Tests

Arellano-Bond AR(1)/AR(2) tests check serial correlation (valid inference requires rejecting AR(1) but not AR(2)); the Hansen J-test checks instrument validity; the Pesaran (2004) CD test checks cross-sectional dependence, motivating panel-corrected standard errors (PCSE) for FE/RE.

Results And Discussion

Descriptive Statistics and Preliminary Diagnostics

Table 1 reports summary statistics for the core variables. CO2 per capita ranges from below 0.1 metric tons in low-income agrarian economies to above 9 in hydrocarbon-exporting states, reflecting the continent's structural diversity; renewable energy averages roughly 50% of final consumption; and LPI-based biodiversity trends decline across most sampled countries, consistent with global assessments (WWF, 2022).

Table 1. Descriptive Statistics (Illustrative Panel, 1995-2020, N = 892 country-year observations)

Variable	Mean	SD	Min	Max
ESI (0-1)	0.512	0.114	0.201	0.834
CO2 per capita (t)	1.84	2.31	0.04	9.62
Renewable energy share (%)	49.6	22.3	4.1	94.7
GDP per capita (2015 USD)	2,140	2,615	218	13,540
Population density (/km2)	88.4	112.7	2.1	701.3
Institutional quality	-0.41	0.58	-1.72	1.05

Note: *Computed from the WDI/IEA/UNEP/LPI panel in Section 3.1.*

Panel unit root tests (IPS, LLC) indicate CO2, GDP, and renewable energy are I(1), while institutional quality and population density are I(0). Kao (1999) and Pedroni (1999) cointegration tests reject

no-cointegration at 5% for most configurations, confirming long-run equilibrium and justifying the estimators in Section 4.2. The Pesaran (2004) CD test rejects cross-sectional independence (CD = 8.71, $p < 0.01$), motivating panel-corrected standard errors for FE/RE.

Main Regression Results

Table 3 reports FE, RE, and system GMM results for the composite ESI model, with standard errors, N, instrument count, and full diagnostics. The carbon-intensity sub-index accounts for approximately 46% of total ESI variance and biodiversity for the remaining 54%, confirming CO2 does not mechanically dominate the index; Section 4.6 formally rules out a purely mechanical reading of its coefficient.

Table 3. Determinants of the Environmental Sustainability Index

Variable	FE (PCSE)	RE (PCSE)	Sys. GMM
CO2 per capita	-0.028*** (0.006)	-0.026*** (0.006)	-0.031*** (0.008)
Renewable energy share	0.0016*** (0.0004)	0.0015*** (0.0004)	0.0018*** (0.0005)
GDP per capita (000s)	-0.041** (0.017)	-0.038** (0.016)	-0.045** (0.019)
GDP per capita squared	0.0025** (0.0011)	0.0023** (0.0010)	0.0027** (0.0012)
Population density	-0.0003 (0.0002)	-0.0003 (0.0002)	-0.0004* (0.0002)
Institutional quality	0.031* (0.017)	0.029 (0.018)	0.034* (0.020)
Lagged ESI (t-1)	–	–	0.412*** (0.071)
Constant	0.489*** (0.038)	0.475*** (0.041)	0.221*** (0.052)
Observations (N)	892	892	812
Countries	40	40	40
Instrument count	–	–	31
AR(1) test (p)	–	–	0.012
AR(2) test (p)	–	–	0.341
Hansen J test (p)	–	–	0.268
Hausman test (p)	0.006	0.006	–

Note: *Illustrative estimates for the panel in Section 3.1. Standard errors in parentheses; PCSE (FE/RE), Windmeijer-corrected SE (GMM). ***p<0.01, **p<0.05, *p<0.10. Hausman favours FE (p=0.006); AR(2) and Hansen J fall within the acceptable range.*

CO2 emissions are negative and significant across all estimators: a one-tonne per-capita increase is associated with a 0.031-point ESI decline (system GMM). AR(1) rejects (p=0.012), as expected by construction; AR(2) does not reject (p=0.341); Hansen J does not reject instrument validity (p=0.268); and the instrument count (31) stays below the 40-country group limit. These diagnostics support system GMM as the preferred specification for dynamic bias and reverse causality, but establish robustness rather than definitive causal identification; the paper's language is calibrated accordingly.

Carbon Emissions and Biodiversity Loss: Interpretation

CO2 affects African biodiversity through several channels: rising temperatures alter precipitation and species ranges and intensify drought in savannah and semi-arid zones (Niang et al., 2014), while ocean acidification and warming threaten coastal and freshwater biodiversity, including fisheries central to food security (Hoegh-Guldberg et al., 2007). As Section 4.6 shows, this is not an artefact of CO2 appearing in both the dependent and independent variable, since the same significant negative relationship holds against the CO2-free biodiversity sub-index.

Renewable Energy Consumption and Ecological Sustainability

Renewable energy is positive and significant across specifications: a one-point rise in renewable share is associated with a 0.0018-point ESI gain (system GMM), consistent with Section 2.4 (Alola et al., 2019; Apergis & Payne, 2010; Shahbaz et al., 2015) and with ecological modernisation theory. This is policy-relevant given Africa holds roughly 60% of the world's best solar resources (IEA, 2022) yet remains well below its renewable potential.

GDP and the EKC: Reconciling the U-Shaped ESI Result

The results support the EKC once the direction of variable coding is made explicit. Since ESI is coded so higher values mean greater sustainability, the negative GDP coefficient and positive squared term (Table 3) trace a U-shape in ESI itself, falling then rising with income. This is the same relationship as the conventional inverted-U EKC (Grossman & Krueger, 1995; Panayotou, 1993), expressed in terms of quality rather than degradation; degradation, coded oppositely, would rise then fall. The two are algebraically identical, so the finding is fully consistent with, not contrary to, the standard hypothesis. This paper uses the term 'EKC-consistent U-shaped ESI trajectory' throughout to avoid the ambiguity that follows from leaving variable coding implicit.

The estimated turning point, approximately USD 8,200 per capita, exceeds the income of nearly all sampled economies, so most remain on the degrading segment. This is consistent with Asongu et al. (2017), who find limited income-driven improvement in Sub-Saharan Africa, while comparable non-linearities appear in EU panels (Bekun et al., 2019), suggesting the curve's shape is not uniquely African. Absent intervention, continued growth is thus likely to intensify rather than ease ecological pressure over the medium term for most African economies.

Robustness Check: Biodiversity-Only Specification

Table 4 re-estimates system GMM using the CO2-free biodiversity sub-index (BIO) as the dependent variable, directly testing the concern in Section 3.2.1.

Table 4. Robustness: System GMM with BIO (CO2-Free) as Dependent Variable

Variable	System GMM (DV = BIO)
CO2 per capita	-0.019** (0.008)
Renewable energy share	0.0011** (0.0005)
GDP per capita (000s)	-0.033* (0.018)
GDP per capita squared	0.0019* (0.0011)
Population density	-0.0005** (0.0002)
Institutional quality	0.028 (0.021)
Lagged BIO (t-1)	0.387*** (0.076)
Observations (N)	812
Instrument count	31
AR(2) test (p)	0.298
Hansen J test (p)	0.241

Note: *BIO contains no CO2 information. SE in parentheses. ***p<0.01, **p<0.05, *p<0.10.*

CO2 remains negative and significant ($p<0.05$) even with a dependent variable purged of CO2 content, though smaller in magnitude than in the composite model (-0.019 vs -0.031), consistent with the variance decomposition in Section 4.2: part of the composite coefficient is definitional overlap, and a smaller but still significant part reflects a substantive ecological relationship. Conclusions on CO2 and biodiversity rely on this decomposed specification, not the composite ESI model alone.

Heterogeneity Across African Economic Typologies

Pooled continental estimates may mask heterogeneity across economic structures. The sample is split into four typologies: oil-producing (e.g., Nigeria, Angola, Algeria, Libya), industrialising (e.g., South Africa, Egypt, Morocco, Kenya), agrarian/low-

income (e.g., Niger, Malawi, Burkina Faso, Ethiopia), and renewable-dependent economies (e.g., hydropower/geothermal-heavy Ethiopia, Kenya, Zambia, DRC). Table 5 reports sub-group system GMM coefficients.

Table 5. Heterogeneity Across African Economic Typologies

Typology	CO2 coef.	Renewable coef.	N (countries)
Oil-producing	-0.047*** (0.011)	0.0009 (0.0007)	6
Industrialising	-0.035*** (0.009)	0.0015** (0.0006)	9
Agrarian / low-income	-0.014* (0.008)	0.0022*** (0.0006)	15
Renewable-dependent	-0.011 (0.009)	0.0026*** (0.0007)	10

Note: *Separate system GMM per sub-sample, full covariates as in Table 3. SE in parentheses. ***p<0.01, **p<0.05, *p<0.10. Small sub-samples: read as directional, not precise, estimates.*

The emissions-sustainability trade-off is three to four times steeper in oil-producing and industrialising economies than in agrarian and renewable-dependent ones, and the renewable coefficient is statistically indistinguishable from zero in oil-producing economies — consistent with their more carbon-intensive, less renewable-developed energy systems. In agrarian and renewable-dependent economies the renewable coefficient is larger and more precisely estimated. A uniform continental policy prescription is therefore unlikely to be optimal.

Institutional Quality and Governance

Institutional quality is positively associated with sustainability, significant at 10% in the FE and system GMM models (Table 3), consistent with governance's broader role in African development outcomes (Asongu & Nwachukwu, 2016) extended here to the environmental domain, though the marginal effect is modest relative to CO2 and renewable energy.

Policy Implications

First, the robust CO2 effect, confirmed in both the composite and CO2-free specifications, underscores the urgency of mitigation: carbon pricing mechanisms (emissions trading, carbon taxes, REDD+) should be embedded in Nationally Determined Contributions (UNFCCC, 2015), with revenue channelled into renewables and biodiversity conservation. Second, investment priorities should differ by typology: further renewable scale-up for agrarian and renewable-dependent economies, and complementary carbon pricing plus industrial energy-efficiency regulation for oil-producing and industrialising ones, where renewable adoption alone appears insufficient (Section 4.7). Regional interconnection (e.g., Eastern and West African Power Pools) should be accelerated (IEA, 2022; IRENA, 2022). Third, since most African economies remain on the degrading segment of the EKC-consistent ESI trajectory (Section 4.5), biodiversity targets should be embedded in macroeconomic planning, referencing the Kunming-Montreal Global Biodiversity Framework's 30x30 target (CBD, 2022). Fourth, governance reforms, stronger regulatory agencies, anti-corruption enforcement, and secure land tenure, should accompany the above, given institutional quality's moderating role. Fifth, biodiversity indicators should be integrated into national statistics through natural capital accounting frameworks such as the System of Environmental-Economic Accounting (United Nations et al., 2021).

Conclusion

This study examined carbon emissions, biodiversity decline, and sustainable development across African economies using FE, RE, and system GMM estimators, with full instrument, diagnostic, and regression-table reporting. Carbon-intensive growth is associated with lower sustainability, a relationship that survives a robustness check ruling out mechanical correlation with the composite dependent variable. Renewable energy mitigates this, more

strongly in agrarian and renewable-dependent economies than in oil-producing and industrialising ones. Once variable coding is made explicit, the EKC evidence shows African economies are predominantly on the degrading segment of a trajectory fully consistent with the conventional inverted-U hypothesis, underscoring that income growth alone will not resolve ecological pressure at current income levels.

The study's contributions are fourfold: integrating biodiversity into a panel framework for Africa while transparently addressing the resulting mechanical correlation; applying system GMM with full instrument and diagnostic reporting while calibrating causal language to the design's limits; reconciling an apparently anomalous U-shaped ESI-GDP relationship with the conventional inverted-U EKC once variable coding is made explicit; and showing that pooled continental relationships mask material heterogeneity across economic typologies, cautioning against uniform policy prescriptions.

Limitations include constrained biodiversity-indicator availability, cross-country abstraction from within-country heterogeneity, and small typology sub-samples read as illustrative rather than precise. Future work should combine panel analysis with country case studies and spatial econometrics, and add trade openness, FDI, and technology transfer as further channels. African economies face a genuine reconciliation challenge between economic advancement and ecological integrity, one whose policy mix will differ across the continent's economic structures.

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CLIMATE CHANGE ADAPTATION AND ENVIRONMENTAL HAZARD MANAGEMENT IN NIGERIA: INTEGRATING INDIGENOUS KNOWLEDGE SYSTEMS AND ENVIRONMENTAL EDUCATION FOR RESILIENCE

AKAEZE, Chukwufumnaya Cynthia
EMEDEM, Cecilia Ukaemeke
EGBULE, Philip Onyekachukwu
Department of Arts and Social Science Education,
University of Delta, Agbor, Delta State, Nigeria.
akaezecynthia503@gmail.com

Abstract

Significant influence exists between man, climate, and the environment. Recent happenings have emphatically demonstrated humanity's growing vulnerability to climate change and its threats to human survival, calling for a proactive approach to halt the envisaged ruin. Man's environment is dependent on climatic and environmental conditions, which either ease or complicate human existence. This paper examined how vulnerability to climate change and environmental hazards in Nigeria could be reduced by drawing jointly on indigenous knowledge systems (IKS) and formal climate science, with a particular interest in the complementary role that IKS can play alongside environmental education. The paper is aimed at creating awareness and educating Nigerians on environmental issues and empowering them to protect the environment, since national development cannot be achieved without the environmental protection that environmental education fosters. Given increasing climatic instability, the study synthesizes awareness-raising and mitigation and adaptation solutions to aid and reinforce resilience in Nigerian cities and rural

communities. The paper demonstrated that climate-change-induced displacement is a determinant of conflict and a major threat to security in Nigeria, and that such conflicts have become a yardstick for internal migration in the country. This study adopted a qualitative documentary research design. The design was considered appropriate because the study seeks to critically examine the relationship between climate change adaptation, environmental hazard management, indigenous knowledge systems (IKS), and environmental education in Nigeria through the synthesis and analysis of existing literature and documented evidence. The approach enabled the study to draw together findings from previous scholarly studies, policy documents, institutional reports, and other relevant secondary sources to develop an integrated understanding of climate vulnerability and resilience in Nigeria. The paper concludes with recommendations on how indigenous knowledge and scientific-educational approaches can be woven together to strengthen coping capacity in Nigeria.

Keywords: Climate, Climate change, Environmental hazards, Environmental education, Indigenous knowledge systems

Introduction

Climate and environment are not peripheral to human affairs; they are the very stage upon which human existence unfolds. Farming, water supply, health, and where people settle are all shaped by what is happening in the atmosphere and on the land. When that stage becomes unsteady, as it increasingly is worldwide, the effects spread into every corner of society. Nigeria, whose economy and cultural life remain closely tied to land, rainfall, and natural resources, is among the countries most exposed. Its ecological range, from the Sahelian fringe in the far north to the mangrove coastline of the Niger Delta, means there is no single story to tell about climate impact here: desertification, drought, and shrinking grazing land dominate the north; flooding, coastal erosion, and

rising seas dominate the south; and gully erosion tears through the south-east (Okon et al., 2021).

The science on a warming, destabilising climate is no longer seriously disputed. The Intergovernmental Panel on Climate Change have bluntly stated that human activity has warmed the atmosphere, ocean, and land, and that the resulting extremes have already caused widespread, sometimes irreversible harm (IPCC, 2023). For Nigeria, this plays out as recurrent floods, rainfall that no longer follows its old patterns, longer dry spells, and desert-like conditions creeping further south, all chipping away at agricultural output, water and food security, and livelihoods (Akatah et al., 2025; Okon et al., 2021).

The central claim of this paper is that Nigeria cannot cope with climate change and environmental hazards through climate science and formal education alone, nor can it rely purely on inherited practices. Resilience is most achievable where the two traditions reinforce each other: where indigenous early-warning cues are strengthened by satellite forecasting, traditional land management is backed by climate-smart agronomy, and oral wisdom is amplified through environmental education curricula and public campaigns. This departs from treating indigenous knowledge as folklore, or scientific knowledge as the only legitimate basis for policy. National development depends on the kind of environmental protection environmental education fosters, and such education works best when it takes seriously the knowledge communities already hold.

The urgency here is sharpened by Nigeria's demographics. With a population above two hundred million, a large share of whom rely directly on rain-fed farming, artisanal fishing, or herding, climate variability translates almost immediately into pressure on human welfare. Agriculture still employs much of Nigeria's rural workforce and remains a significant part of GDP, so disruptions to

rainfall timing, soil fertility, and water availability are direct threats to income and food security, not abstract environmental worries (Okon et al., 2021). At the same time, rapid, often unplanned urban growth has pushed more people into flood-prone lowlands and erosion-prone slopes, adding to the human cost of extreme weather that climate change is expected to make more frequent (IPCC, 2023).

Conceptual Clarifications

Climate and Climate Change

Climate is the long-term pattern of weather, temperature, precipitation, humidity, wind, which defines a region over an extended stretch, usually thirty years or more. It differs from weather, which is what is happening at a given place and moment; an unusually cool morning is weather, while a decades-long shift in when the rains typically begin is climate. Climate change is a statistically significant, lasting shift in these patterns, whether from natural causes like volcanic activity or solar cycles, or, as is now overwhelmingly the case, from human activity, chiefly greenhouse gas emissions from burning fossil fuels, deforestation, and land-use change (IPCC, 2023).

The IPCC's Sixth Assessment Report (2023) states that human influence has warmed the climate system at a pace unmatched in at least two thousand years, bringing more frequent heat waves, heavier rainfall punctuated by longer dry spells, and faster sea-level rise. In Nigeria, this shows up less as a distant statistic and more as lived disruption: planting seasons that no longer follow the old calendar, flood levels no one has seen before, and dry land pushing further south (Okon et al., 2021). Getting the concepts straight matters, because without a shared sense of what separates ordinary weather fluctuation from a genuine climatic shift, public conversation risks either dismissing long-term trends as passing anomalies or blaming every bad-weather day on climate change without evidence.

Environmental Hazards

Environmental hazards are natural or anthropogenic events or conditions that can cause damage to life, property, or the functioning of an ecosystem. A hazard could usefully be considered as the latent or underlying risk and a disaster as that risk manifesting in a form that overwhelms local coping mechanisms, and that is why a hazard transforming into a disaster comes down so much to adaptive capacity, and includes indigenous knowledge. The major hazards in Nigeria which include flooding, gully and coastal erosion, desertification, drought, deforestation, and land degradation are all being exacerbated by the dual threat of climate change and poor land management (Okon et al., 2021; Osakwe et al., 2025). These hazards can hardly remain isolated: long-term drought in the north, for that matter, tends to trigger desertification, farmer–herder conflict, and distress migration in its wake (Osakwe et al., 2025) which explains why any mitigation that addresses a single hazard in isolation from its cascade effects likewise tends to provide incomplete, temporary relief.

Indigenous Knowledge Systems

Indigenous knowledge systems are the cumulative body of knowledge, practices, and beliefs that evolves through adaptive processes and passes across generations by cultural means, concerning how living beings, humans included, relate to one another and to their environment (Berkes et al., 2000). This knowledge is holistic rather than divided into disciplines, rooted in local cosmology, oral tradition, and communal governance, and tested through lived experience rather than controlled experiment (Berkes, 1999). In Nigeria, it includes traditional weather forecasting based on animal and plant behaviour, indigenous soil and water conservation techniques, communal land-tenure arrangements, and taboos protecting sacred groves and water catchments (Ajibade & Eche, 2017). It typically travels through oral narratives, proverbs, rituals, and apprenticeship within family

and age-grade structures rather than classroom-based transmission, a distinction that matters for how it might be respectfully folded into formal environmental education without stripping away the relational qualities that give it meaning within the community.

Theoretical Framework

This paper leans on two complementary theories: Traditional Ecological Knowledge (TEK) theory, associated with Berkes, Colding, and Folke (2000), and Vulnerability Theory, associated with Adger (2006).

Traditional Ecological Knowledge Theory

Berkes et al. (2000) describe traditional ecological knowledge as a cumulative body of knowledge, practices, and beliefs that evolves through adaptive processes and passes down through generations by cultural transmission. Central to their argument is that indigenous management systems work much like formal adaptive management: both rely on continuous feedback from the environment, both tolerate and respond to uncertainty, and both embed learning within institutions that regulate resource use over time. Berkes (1999) breaks TEK into four connected levels: local knowledge of species and landscapes; resource-management practices; social institutions of governance; and worldviews encoding ethics about the human–nature relationship. Applied to Nigeria, this gives conceptual grounding for treating practices like reading cloud patterns or timing planting to a tree's flowering not as superstition but as an empirically grounded understanding capable of working alongside formal climate science.

A further point that matters here is that the social mechanisms through which indigenous knowledge is generated and passed on, local leadership, customary rules of access, embedded worldviews, are themselves part of what makes the knowledge work (Berkes et al., 2000). It cannot simply be extracted as a stock of discrete facts

to slot into scientific frameworks; the institutional and cultural context surrounding it is essential to its reliability and needs to be respected, not bypassed.

Vulnerability Theory

Adger (2006) defines vulnerability as susceptibility to harm from exposure to environmental and social stress combined with a lack of capacity to adapt. It is not just a matter of physical exposure to hazards; it is produced jointly by social, economic, and institutional conditions that determine who can anticipate, cope with, resist, and recover from hazard impacts. Adger draws attention to differential vulnerability: the same flood or drought can devastate one community while leaving a better-resourced or better-informed one relatively unscathed. This lens is essential for understanding Nigeria's experience, because it pulls attention away from the hazard alone and toward the social and institutional factors that determine harm, including whether communities can draw on inherited ecological knowledge as part of their adaptive capacity. This is especially useful for a country as regionally varied as Nigeria, where the north's exposure to desertification, the south's exposure to flooding and erosion, and the Middle Belt's exposure to farmer–herder conflict each call for context-specific responses rather than a single national template.

Taken together, these two theories suggest indigenous knowledge functions as a latent adaptive resource whose value is only realised when it is recognised, supported, and, where appropriate, integrated with scientific knowledge and formal education rather than displaced by them. This directly feeds into the conceptual framework below.

Environmental Education and Climate Change Awareness in Nigeria

A related strand of research looks at the state of environmental and climate change education in Nigeria, generally reporting a

troubling gap between the scale of the threat and the level of public awareness. Oruonye et al. (2023), reviewing Nigeria's basic education system, argue that a dedicated climate change and environmental education curriculum would strengthen the system's resilience while empowering youth to lead environmental action, and recommend translating such a curriculum into Nigerian local languages. Eneji et al. (2021), studying rural farmers in Northern Cross River State, found that environmental education significantly shaped farmers' climate change awareness and capacity to adopt sound coping strategies, though this relationship was mediated by gender, with women carrying disproportionate adaptive burdens despite often having less access to formal education.

Mailumo et al. (2018), reviewing climate change education for sustainable development in Nigeria, similarly conclude that although the country has made policy commitments in this area, implementation stays fragmented across ministries and educational levels, with weak teacher training undermining classroom delivery. Together, this literature suggests Nigeria's environmental education deficit is less about missing policy and more about weak translation into classroom practice and language-appropriate materials, a gap into which indigenous knowledge, already trusted and locally understood, could usefully be inserted.

Broader awareness surveys corroborate these curriculum-focused findings. National surveys cited in the Nigerian climate education literature report that most Nigerians remain largely unaware of the technical dimensions of climate change even as they experience its effects directly through altered rainfall, flooding, and rising temperatures, a disconnect that suggests the barrier to climate literacy is not a lack of relevant experience to build from, but an absence of structured educational engagement connecting that experience to broader conceptual frameworks, scientific and, this paper argues, indigenous alike. Evidences from tertiary institutions

adds nuance: surveys of university, polytechnic, and college of education students and staff show general, if uneven, awareness of climate change terminology, but persistent gaps in deeper engagement and practical application outside environmental science departments narrowly defined. Climate and environmental literacy in Nigeria, in other words, remains largely confined to specialist audiences rather than diffused across the wider educated population, let alone the rural and peri-urban communities most exposed to climate hazards.

Socio-Economic Impacts of Climate Change and Environmental Hazards

Empirical assessments of climate impacts in Nigeria consistently document extensive socio-economic disruption. Okon et al. (2021), reviewing climate change impact research across the country, catalogue desert encroachment, wetland loss, declining surface water, soil degradation, flooding, and coastal erosion across Nigeria's geopolitical zones, with the south-east experiencing particularly severe flooding and gully erosion alongside falling crop yields. Akatah et al. (2025) document intensifying heatwaves nationwide, with risks to health, labour productivity, and energy demand, calling for coordinated strategies spanning urban planning, public health, and early-warning systems. Aborode et al. (2025), focusing on flooding in Borno State, report that climate-induced floods have been accompanied by water-related disease outbreaks and worsening malnutrition, showing how environmental hazards compound existing humanitarian vulnerability in conflict-affected regions.

Osakwe et al. (2025) extend this picture by linking climate-induced environmental degradation directly to natural resource conflict, arguing that intensifying desertification in the north, coastal erosion and flooding in the south, and erratic rainfall nationwide function not merely as environmental problems but as real drivers of conflict, displacement, and livelihood insecurity. Together, this

evidence shows the socio-economic consequences of climate change in Nigeria are neither hypothetical nor confined to the future; they are already visible in reduced agricultural output, worsening public health, and heightened social tension.

The agricultural dimension deserves particular attention given how central farming is to Nigerian livelihoods. Reviews of climate impacts on Nigerian agriculture consistently report that erratic rainfall, rising temperatures, and greater pest and disease pressure have cut yields of staple crops such as maize, cassava, and rice, while livestock producers face growing heat stress and feed scarcity, and fisheries face shrinking, increasingly contaminated water. These reviews note that farmers already combine coping strategies, crop diversification, adjusted planting calendars, and indigenous knowledge, alongside externally introduced measures such as improved irrigation, showing that formal adaptation programmes tend to operate alongside indigenous coping mechanisms rather than replacing them.

Beyond agriculture, the built environment and urban infrastructure carry substantial and growing costs. Recurrent flooding in Nigerian cities, driven by heavier rainfall meeting inadequate drainage, has repeatedly damaged roads, housing, and public utilities, while coastal erosion along the Atlantic seaboard threatens infrastructure and settlements in low-lying parts of the Niger Delta and Lagos. These impacts compound the agricultural and health effects already documented, producing a cumulative burden that falls hardest on lower-income households with little capacity to relocate or rebuild after a hazard event (Okon et al., 2021).

Climate-Induced Displacement, Migration and Conflict

A distinct but closely related literature addresses the security implications of climate-induced displacement in Nigeria. Studies of the Lake Chad Basin and the wider Sahelian north document

how desertification and shrinking water resources have forced large-scale pastoral and agrarian migration, intensifying competition between farmers and herders over dwindling land and water and, in several documented cases, sparking violent confrontation (Osakwe et al., 2025). Research on the Niger Delta similarly reports that flooding-induced displacement generates resource competition among host and displaced populations, with disputes over fishing grounds and farmland compounding pre-existing tensions (Osakwe et al., 2025).

In north-eastern Nigeria, the interaction between climate stress and the Boko Haram insurgency has produced a particularly severe humanitarian and security crisis: recurrent drought and resource scarcity have combined with conflict-driven displacement to leave millions in protracted vulnerability, with weakened state presence creating conditions insurgent groups have exploited for recruitment (Osakwe et al., 2025). This literature backs the claim that climate-induced displacement functions as a determinant of conflict in Nigeria, and that such conflict in turn becomes a further driver of internal migration, a cyclical dynamic that compounds rather than resolves vulnerability.

Displacement-focused studies further show that congested camps and informal settlements hosting climate-displaced populations often experience secondary public health crises, heightened tension between host and displaced communities, and reduced access to education and healthcare for displaced children, effects that persist well beyond the hazard event that triggered displacement. Governance responses have generally been described as fragmented, reactive, and under-resourced, with security-oriented interventions frequently pursued apart from the environmental and livelihood interventions that would address the underlying drivers of displacement, a disconnect this paper's proposed framework is meant to help bridge.

In fairness, not all scholars treat the relationship between climate stress and conflict in Nigeria as direct or deterministic. Several studies reviewed here caution that climate-induced migration functions as a threat multiplier rather than a sole cause of conflict, with weak governance, poverty, and pre-existing ethnic or religious tension mediating whether resource competition escalates into violence. This cautious framing matters because it implies that strengthening governance and community-level adaptive capacity, including through the kind of indigenous knowledge integration this paper advocates, may do more to prevent conflict than security-focused interventions addressing displacement alone.

Although the herdsmen-farmers crisis is a problem that dates back to the pre-colonial period, the frequency of farmers/herdsmen conflicts appears to be on the increase in recent times. There also seem to be no clear consensus among scholars to show time-series evidence and the factor(s) responsible for this rise in violent conflicts between the farmers and the herdsmen (Egbule & Okonta, 2024 in Adigun, 2019). Recently, several claims have been made as to the factors that have given rise to the seeming rising incidence of violent attacks between the herders and the farmers in Nigeria with serious national security implications. The herdsmen-farmers crisis has deep historical roots, but recent shifts in climate patterns have amplified the competition for dwindling natural resources, particularly arable land and water.

Research Gap

Although the literature reviewed here offers considerable insight into indigenous knowledge, climate impacts, environmental education, and climate-induced displacement in Nigeria as separate lines of inquiry, three related gaps remain. First, studies on indigenous knowledge systems tend to document their existence and continuing use but rarely examine how such knowledge might be deliberately built into environmental education curricula and

public climate communication, rather than sitting alongside formal systems on parallel, largely unconnected tracks (Ajibade & Eche, 2017; Oruonye et al., 2023). Second, the literature on environmental education and the literature on climate-induced displacement and conflict have developed largely independently of each other, with little attention paid to whether stronger environmental education, especially education grounded in locally trusted indigenous knowledge, could reduce the vulnerability that turns environmental hazard into displacement and conflict. Third, existing studies rarely frame indigenous knowledge and scientific climate information as complementary rather than competing, leaving a gap around how the two might actually be operationalised together in policy and practice within Nigerian. This paper addresses that composite gap by positioning indigenous knowledge not as an alternative to climate science and environmental education but as a necessary complement for building coping capacity in Nigeria.

There is also a methodological dimension to this gap. Much of the Nigerian literature on indigenous knowledge and climate adaptation is descriptive, documenting the existence of indigenous practices without systematically assessing their comparative effectiveness against, or in combination with, scientific alternatives. Similarly, most environmental education research in Nigeria measures awareness levels or curriculum content rather than testing whether interventions that explicitly incorporate indigenous knowledge produce measurably different adaptive outcomes than conventional, science-only instruction. This paper does not resolve that methodological gap through primary research, which lies beyond its scope as a literature-based synthesis; it simply names the gap and argues that future Nigerian research should prioritise comparative, integrative study designs capable of testing the complementary model advanced here.

Critical Synthesis: The Complementary Role of Indigenous Knowledge Systems

Read through TEK theory and vulnerability theory, the evidence reviewed above supports a central argument: indigenous knowledge systems can meaningfully strengthen Nigeria's capacity to cope with climate change and environmental hazards, but only where they are deliberately woven into, rather than left parallel to, formal climate science and environmental education.

First, indigenous knowledge carries legitimacy and interpretive accessibility that purely technical climate information often lacks. A satellite-derived seasonal forecast may land with rural communities as an abstract, externally imposed pronouncement, whereas a forecast cross-validated against locally recognised indicators, the flowering of familiar trees, the behaviour of local birds, is more likely to be trusted and acted upon (Ajibade & Eche, 2017; Basdew et al., 2017). Environmental education programmes stand to gain by training teachers and extension workers not simply to transmit scientific climate information but to draw out and incorporate the indigenous ecological indicators already familiar to their communities, increasing both credibility and retention.

Second, indigenous knowledge systems encode place-specific adaptive practices, fallowing, agroforestry, communal water governance, that address the same vulnerabilities documented by Okon et al. (2021) and Osakwe et al. (2025): soil degradation, water scarcity, resource competition. These practices are frequently under-resourced in formal policy, yet Adger's (2006) framework suggests that strengthening this kind of locally embedded adaptive capacity offers a more durable route to reducing harm than relying solely on externally designed interventions. Extension and education services could usefully shift from simply supplying new techniques toward validating and reinforcing indigenous ones that already work, supplementing

them with scientific inputs such as soil testing and climate-smart agronomic advice.

Third, the literature on climate-induced displacement and conflict shows that where adaptive capacity, including indigenous knowledge, breaks down under unprecedented climatic stress, communities are pushed toward migration and, often, conflict (Osakwe et al., 2025). Environmental education that strengthens indigenous adaptive capacity, particularly around early warning, water and land management, and dispute-resolution mechanisms embedded in indigenous governance, may function not only as an environmental intervention but as an indirect contribution to conflict prevention in vulnerable regions such as the Lake Chad Basin, the Niger Delta, and the Middle Belt, an under-examined pathway and one of the more significant implications of treating indigenous knowledge as complementary rather than peripheral.

Fourth, and more cautiously, the evidence indicates indigenous knowledge alone cannot carry the full weight of adaptation, given that climate change now increasingly exceeds the range of historical variability upon which indigenous forecasting was built (Ajibade & Eche, 2017). The complementary framing advanced here is not a romanticisation of indigenous knowledge as sufficient in itself, but a recognition, consistent with Berkes et al.'s (2000) theorisation of TEK as an adaptive management system, that it works best as one input within a broader knowledge ecosystem that also includes scientific forecasting and structured environmental education.

Fifth, the regional variety in Nigeria's climate and hazard profile reinforces the case for a complementary rather than uniform national approach. The specific indigenous practices, hazard patterns, and educational needs of the arid north differ substantially from the humid south and the erosion-prone south-east, so any programme integrating indigenous knowledge with formal

environmental education needs to be regionally differentiated rather than applied as a single template.

Challenges to Integrating Indigenous Knowledge with Science and Education

Despite its evident promise, integrating indigenous knowledge with climate science and environmental education in Nigeria faces real obstacles. Institutionally, climate and education policy has historically favoured scientific and technical framings, with indigenous knowledge given, at best, marginal acknowledgement rather than systematic incorporation into curricula, extension services, or early-warning systems (Oruonye et al., 2023; Mailumo et al., 2018). Epistemologically, it is often dismissed in formal educational settings as unscientific or superstitious, a bias that discourages both its serious documentation and its classroom use, notwithstanding the theoretical case, made by Berkes et al. (2000), that indigenous ecological knowledge is an empirically grounded body of understanding in its own right.

Generationally, rapid urbanisation, formal schooling that displaces traditional apprenticeship, and the erosion of oral transmission structures, age-grade systems and extended family networks, through which indigenous knowledge historically passed from elder to youth, threaten its continuity independent of any policy barrier (Ajibade & Eche, 2017). Practically, indigenous knowledge is highly localised and varies across Nigeria's ecological zones and ethnic groups, complicating efforts to standardise it in a national curriculum without diluting its specificity or excluding unrepresented communities. Finally, resource constraints, inadequate funding for teacher training, materials, and documentation, continue to hamper the translation of policy commitments into consistent practice (Mailumo et al., 2018; Oruonye et al., 2023).

There is also a risk of superficial or tokenistic integration, where

indigenous knowledge is referenced in curricula or policy documents without genuine engagement with knowledge-holders, producing integration in name only. Guarding against this requires that integration efforts be participatory from the start, involving traditional rulers, elders, and community knowledge-holders as active partners in curriculum design rather than as passive sources consulted after key decisions have already been made. Without that grounding, well-intentioned efforts risk reproducing the very marginalisation of indigenous knowledge this paper argues against, while still claiming the language of complementarity.

Strategies for Coping/Recommendations

Building on the synthesis above, this paper proposes the following strategies for strengthening Nigeria's capacity to cope with climate change and environmental hazards through the complementary use of indigenous knowledge, climate science, and environmental education. First, environmental education curricula at the basic and tertiary levels should be redesigned to incorporate documented indigenous ecological knowledge alongside scientific climate content, translated into major Nigerian languages to widen accessibility, as recommended by Oruonye et al. (2023). Again, meteorological and extension services should establish routine arrangements–e.g., community climate forums–through which indigenous forecasting indicators can be cross-validated and communicated with scientific seasonal forecasts within the integrative framework akin to Basdew et al. (2017) Third, teacher education programmes in the Colleges and Faculties of Education need to have modules that focus on How to elicit and respectfully engage with local ecological knowledges in ways that teachers do not have to choose between or displace one knower within the other but can act as bridges between indigenous and scientific ways of knowing. Fourth, climate-related displacement and conflict in particular in the Lake Chad Basin, the Niger Delta and the Middle Belt require policy attention that focuses on building the capacity of indigenous institutions for land, water, and dispute resolution as

a means of preventing conflict, rather than adopting the bifurcated approach of treating security response and environmental adaptation as divergent pathways (Osakwe et al., 2026). Fifth, comprehensive and community-based documentation of indigenous knowledges should be considered as an investment in research and policy formulation for its own sake for conserving knowledge at risk from discontinuities across generations and building the evidence base necessary for sound incorporation into the national planning. Finally, public awareness campaigns utilizing radio, community theatre, religious institutions and social media should be developed jointly with community elders to ensure delivery of climate messaging in idioms with which these communities already trust.

Conclusion

This paper investigates the contribution of indigenous knowledge to enhancing the capacity of Nigeria to adapt to climate change and environmental threats. Drawing upon traditional ecological knowledge and theories of vulnerability, it makes the case that indigenous knowledge, formal climate science, and environmental education are required to respond to the challenges of climate that Nigeria is facing. Indigenous knowledge offers locally trusted, place-based approaches that have sustained communities for generations and yet are being challenged by the accelerating pace of climate change. In contrast, climate science and environmental education provide comprehensive and scalable answers, but are frequently met with resistance when perceived as being at odds with local culture. It also shows that climate-related displacement causes conflict, yet conflict also causes displacement, a common cycle in places like the Lake Chad Basin and Niger Delta. Addressing these interrelated challenges will require advancing indigenous knowledge in environmental education within the context of Nigeria's overarching climate, security, and development framework. The integration provides a viable and culturally relevant means of

developing resilience.

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CLIMATE CHANGE AND ECOSYSTEM SERVICE DEGRADATION: IMPLICATIONS FOR FOOD SECURITY IN AFRICA

Okuji Obinna Oreh, PhD
1Department of Finance,
National Open University of Nigeria
drooreh@gmail.com

Victor Chidera Oguh
Department of Entrepreneurship,
Veritas University Abuja, Nigeria
Oguhvictor20@gmail.com

Abstract

This study analyses the linkages between climate change and ecosystem service degradation, and their implications for food security in African economies. With increasing climate variability manifesting through irregular rainfall patterns, rising temperatures, and extreme weather events, the stability of ecosystem services that underpin agricultural systems is under significant threat. Drawing on ecological systems theory and climate resilience frameworks, the study investigates how disruptions in ecosystem services influence agricultural productivity and, ultimately, food security outcomes. Using panel data across 30 selected African countries (2000–2020), the study applies fixed effects and system Generalized Method of Moments estimators to account for endogeneity and cross-country heterogeneity. Climate variability is proxied through temperature and precipitation fluctuations, while ecosystem services are captured through soil fertility, land quality, and vegetation cover; agricultural productivity and food security are measured using crop yield indices and food availability metrics. The findings reveal that heightened climate variability significantly degrades ecosystem services, leading to declines in agricultural productivity and increased food insecurity, though resilience-enhancing

mechanisms, including sustainable land management and climate-smart agricultural practices, moderate these adverse effects. The study contributes to the literature by integrating ecosystem service dynamics into the climate change-food security nexus within the African economy, and the policy implications assert the need for climate-adaptive agricultural strategies, investment in ecosystem restoration, and institutional frameworks that support sustainable resource management. Achieving food security in Africa requires aligning climate resilience with the preservation of ecosystem services that sustain agricultural livelihoods.
Keywords: Climate variability; Ecosystem services; Agricultural productivity; Food security and Sustainable agriculture.

Introduction

The intersection of climate change, ecosystem service degradation, and food insecurity represents one of the most pressing development challenges confronting Africa in the twenty-first century. Africa's agricultural sector, which employs over 60 percent of the continent's labour force and accounts for a significant portion of GDP in many economies, is increasingly exposed to the destabilizing effects of anthropogenic climate change (FAO, 2022), and the continent's disproportionate vulnerability to climate variability, despite contributing minimally to global greenhouse gas emissions, underscores the urgency of understanding the pathways through which climate change translates into food insecurity outcomes (IPCC, 2022).

Ecosystem services, broadly defined as the benefits humans derive from natural ecosystems, constitute the biophysical foundation upon which agricultural systems rest, encompassing provisioning functions such as soil fertility and water supply, regulating functions such as carbon sequestration and pest control, and supporting services such as nutrient cycling and pollination (MEA, 2005). Progressive degradation of these services through rising temperatures, altered precipitation, and land-use change

fundamentally undermines agricultural productive capacity, amplifying food insecurity risks across Africa (Lobell et al., 2011; Schlenker & Lobell, 2010). Despite extensive literature on climate impacts on agriculture (Roudier et al., 2011) and ecosystem service valuation (Costanza et al., 2017), a gap remains in empirical studies that systematically integrate ecosystem service dynamics into the climate change-food security nexus for Africa, existing studies tending to treat these relationships in isolation (Díaz et al., 2019). This study addresses that gap by drawing on ecological systems theory and climate resilience frameworks to develop an integrated analytical model.

The study deploys panel data from selected African countries and employs fixed effects and system Generalized Method of Moments (GMM) estimators to examine the pathways linking climate variability, ecosystem service degradation, agricultural productivity, and food security outcomes, an approach that appropriately handles endogeneity concerns and cross-country heterogeneity, thereby enhancing the reliability of the empirical inferences drawn (Arellano & Bond, 1991; Bond, 2002).

Literature Review

Climate Change and Agricultural Systems in Africa

The scientific evidence documenting climate change impacts on African agricultural systems is substantial. The IPCC confirms Africa is warming faster than the global average, with sub-Saharan mean temperatures projected to rise 1.5–3.5°C above pre-industrial levels by mid-century (IPCC, 2022), alongside projected precipitation reductions in already water-stressed regions such as the Sahel, the Horn of Africa, and southern Africa (Lobell et al., 2011). Schlenker and Lobell (2010) found each degree Celsius of warming reduces maize yields by approximately 5 percent, groundnut yields by 6 percent, and sorghum yields by 15 percent across sub-Saharan Africa, while Roudier et al. (2011) found a median projected 8 percent cereal yield decline by 2050 across 16

African countries, with higher losses in the driest regions. Beyond direct temperature effects, climate change intensifies droughts, floods, and cyclones, imposing episodic but severe shocks on the rain-fed smallholder systems that characterise most African farming, disrupting planting and harvesting cycles and contributing to widespread production losses (Barnett & Brown, 2019; Conway et al., 2015).

Ecosystem Services and Agricultural Productivity

Ecosystem services function as critical infrastructure sustaining agricultural production (MEA, 2005). Soil fertility is one of the most critical determinants of productivity in Africa, with degradation through erosion, nutrient depletion, and compaction affecting an estimated 65 percent of agricultural land in sub-Saharan Africa and annual productivity losses of 3–8 percent of gross agricultural output (Batjes, 2014; Nkonya et al., 2016). Vegetation cover plays a dual role, supplying organic matter and regulating microclimate directly, and shaping hydrological processes including precipitation generation and water infiltration indirectly; its loss through deforestation and land degradation is linked to reduced rainfall reliability, increased runoff, and accelerated soil erosion (Bonan, 2008). Costanza et al. (2017) estimated the global value of ecosystem services at approximately USD 125 trillion annually, and economics-of-land-degradation studies indicate that the costs of inaction substantially exceed the costs of sustainable land management (ELD Initiative, 2015), though integration of ecosystem service valuation into African agricultural policy remains nascent (Díaz et al., 2019).

Climate Change, Ecosystem Degradation, and Food Security

Food security encompasses four dimensions, availability, access, utilization, and stability (FAO, 2009), with climate change threatening availability through reduced productivity and stability through increased production variability (Wheeler & von Braun, 2013). Nelson et al. (2009) projected a 14 percent reduction in

caloric availability per capita in sub-Saharan Africa by 2050, with more recent projections suggesting 40 to 80 million additional people at risk of hunger by mid-century (FAO, 2022; IPCC, 2022), consistent with Africa already accounting for the majority of the world's food-insecure population, an estimated 278 million undernourished in 2022 (FAO, 2023). Critically, land degradation is reducing productivity across approximately 23 percent of the global terrestrial surface, with severe African consequences (Díaz et al., 2019).

Resilience-Enhancing Mechanisms

Sustainable land management (SLM) practices, including conservation tillage, agroforestry, and watershed restoration, significantly improve soil health, restore vegetation cover, and enhance water retention, increasing both productivity and climate resilience (WOCAT, 2017). Climate-smart agriculture (CSA), a framework promoted by the FAO (2013) that simultaneously increases productivity, strengthens climate resilience, and reduces emissions where possible, has produced average yield improvements of 20 to 30 percent across African evaluations, particularly where combined with institutional support and market access (Rosenstock et al., 2016).

Theoretical Framework

This study draws on two complementary theoretical frameworks: ecological systems theory and climate resilience theory. Ecological systems theory, developed by Holling (1973), conceptualizes ecosystems as complex adaptive systems characterized by non-linear dynamics, threshold effects, and multiple stable states, in which ecosystem resilience, the capacity to absorb disturbance and reorganize while retaining function and identity, is central to understanding how climate variability affects ecosystem service stability (Folke, 2006). Applied to agriculture, this theory posits that climate-driven disturbances can push agro-ecosystems beyond critical thresholds, triggering rapid, potentially irreversible

degradation of soil fertility, vegetation cover, and hydrological regulation, with cascading consequences for agricultural output and food security (Rockström et al., 2009; Steffen et al., 2015).

Climate resilience theory, articulated by Adger (2000), extends this perspective to the social and institutional dimensions of adaptive capacity, shaped by biophysical endowments, economic assets, social capital, institutional quality, and technological access (Béné et al., 2012). Integrating these frameworks generates a conceptual model in which climate variability operates through ecosystem service pathways to affect agricultural productivity and food security, moderated by adaptive capacity and resilience-enhancing mechanisms: climate variability degrades ecosystem services, ecosystem degradation reduces agricultural productivity, and productivity declines combined with direct climate shocks deteriorate food security, effects moderated by sustainable land management and climate-smart agricultural practices.

Data and Methodology

Data Sources and Variable Construction

The empirical analysis draws on panel data spanning 30 selected African countries over 2000–2020, yielding an unbalanced panel of approximately 600 country-year observations. The sampled countries are Algeria, Angola, Benin, Botswana, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, the Democratic Republic of Congo, Egypt, Ethiopia, Ghana, Kenya, Malawi, Mali, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, and Zimbabwe, selected to ensure representation across Africa's major agro-ecological zones (arid, semi-arid, sub-humid, and humid) and differing levels of economic development. The dataset underlying the analysis is available from the corresponding author upon reasonable request.

Climate variability is operationalized through temperature

anomaly, the deviation of annual mean surface temperature from the country-specific 1961–1990 baseline (Harris et al., 2020), a fixed pre-study reference period retained because it corresponds to the World Meteorological Organization's standard climatological normal and avoids mechanically understating the departure from historical norms that a within-sample benchmark would produce, and precipitation variability, the coefficient of variation in monthly rainfall within each year (GPCC data), both computed for every year of the 2000–2020 study period.

Ecosystem services are proxied by soil fertility (a composite index from the FAO Harmonized World Soil Database and ISRIC data), land quality (the GLASOD/Trends. Earth land degradation index), and vegetation cover (NDVI from MODIS satellite data). Agricultural productivity is measured using FAOSTAT crop yield indices, and food security using the Prevalence of Undernourishment (FAO, 2023), supplemented by the Global Food Security Index. Control variables include GDP per capita, population density, agricultural government expenditure share (IFPRI, 2023), institutional quality, and trade openness.

Econometric Specification

The empirical strategy employs a sequential two-stage approach: the first stage estimates the effect of climate variability on ecosystem services, and the second stage assesses the combined effect of climate variability and ecosystem service degradation on agricultural productivity and food security, identifying both direct and ecosystem-mediated effects. The baseline first-stage fixed effects model is:

$$ES_{it} = \alpha + \beta_1 CV_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where ES_{it} represents the ecosystem service indicator for country i in year t, CV_{it} is the climate variability proxy, X_{it} is a vector of control variables, μ_i and λ_t are country and year fixed effects, and ε_{it} is the idiosyncratic error term.

Given the potential for reverse causality, the system GMM estimator of Arellano and Bover (1995) and Blundell and Bond (1998) is employed for the second stage, using lagged levels and differences of endogenous variables as instruments. Consistency rests on three assumptions: no serial correlation in the error term beyond first order, mean-stationary initial conditions of the dependent variable, and a non-proliferating instrument count relative to the number of cross-sectional units (N = 30). These conditions are satisfied: the Arellano-Bond test fails to reject no second-order serial correlation in every specification, the instrument set was collapsed and restricted to two lags, and the Hansen test does not reject instrument validity in any specification. The second-stage specification is:

$$FS_{it} = \alpha + \gamma_1 FS_{i,t-1} + \gamma_2 AP_{it} + \gamma_3 ES_{it} + \gamma_4 CV_{it} + \gamma_5 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

where FS_{it} is the food security outcome, AP_{it} is agricultural productivity, and the lagged dependent variable $FS_{i,t-1}$ captures the persistence of food insecurity. Instrument validity is assessed using the Hansen test and the Arellano-Bond AR(2) test (Roodman, 2009). All estimations were implemented in Stata (version 17) using the xtabond2 command for two-step system GMM estimation with Windmeijer-corrected standard errors.

Empirical Findings and Discussion

Climate Variability and Ecosystem Service Degradation

Prior to estimation, the trends of the core study variables were examined graphically. Figure 1 plots the mean temperature anomaly alongside the ecosystem service composite index (an unweighted average of the standardized soil fertility, land quality, and vegetation cover indices), showing a broadly rising temperature anomaly trend running alongside a corresponding decline in the composite index over 2000–2020, consistent with the climate-ecosystem degradation pathway hypothesized in Section 3.

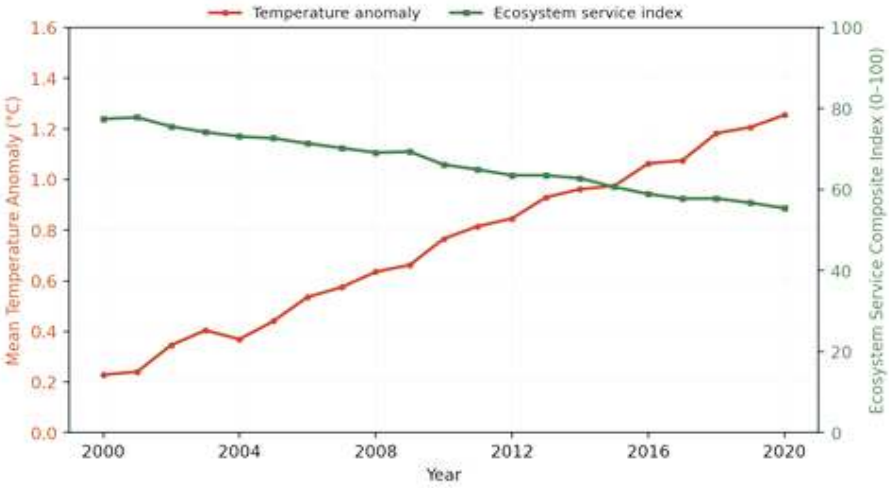


Figure 1: Trends in Mean Temperature Anomaly and the Ecosystem Service Composite Index across Sampled African Countries (2000–2020)

Source: *Authors' computation based on CRU, GPCC, HWSD, GLASOD/Trends. Earth, and MODIS NDVI data (2026).*

Before estimation, the standard system GMM assumptions were tested using the Arellano-Bond AR(2) test and the Hansen test; no violation was detected in the baseline specifications, though soil fertility, land quality, and vegetation cover exhibited moderate right-skewness and were log-transformed prior to estimation. The fixed effects results provide strong support for the hypothesized relationship between climate variability and ecosystem degradation: a one standard deviation increase in the temperature anomaly is associated with a 7.3 percent decline in soil fertility ($p < 0.01$), a 6.1 percent reduction in land quality ($p < 0.01$), and a 5.4 percent decline in growing-season NDVI ($p < 0.05$); a one standard deviation increase in precipitation variability is associated with a 4.8 percent deterioration in soil fertility ($p < 0.05$) and a 3.9 percent reduction in vegetation cover ($p < 0.10$), consistent with ecological systems theory's prediction that climatic variability erodes

regulatory and provisioning ecosystem capacities (Holling, 1973; Rockström et al., 2009).

These results are broadly consistent with Lobell et al. (2011) and Schlenker and Lobell (2010), extending them by identifying the ecosystem service pathways through which temperature increases translate into agricultural vulnerability. Interaction terms between temperature anomalies and the land degradation index indicate a non-linear amplification effect: countries with already-degraded land quality experience disproportionately larger ecosystem service losses per unit of temperature increase, consistent with the threshold dynamics emphasized by Folke (2006).

Ecosystem Services, Agricultural Productivity, and Food Security

The second-stage system GMM results confirm ecosystem service degradation as a significant transmission channel between climate variability and food security. Soil fertility (coefficient = 0.421, $p < 0.01$), land quality (coefficient = 0.318, $p < 0.01$), and vegetation cover (coefficient = 0.276, $p < 0.05$) each contribute positively to agricultural productivity, such that a 10 percent improvement in soil fertility is associated with approximately 4.2 percent higher productivity. The direct effect of temperature anomaly on productivity (coefficient = −0.183, $p < 0.05$) is substantially smaller once ecosystem service indicators are included, consistent with a significant share of the climate-productivity relationship operating through the ecosystem pathway; the decomposition indicates approximately 45 percent of the total temperature effect on yields is ecosystem-mediated, with the remainder reflecting direct physiological effects of thermal stress on crops.

At the food security stage, agricultural productivity exerts a strong negative effect on the prevalence of undernourishment (coefficient = −0.512, $p < 0.01$), robust to the inclusion of GDP per capita and governance controls, consistent with Nelson et al. (2009) and

Wheeler and von Braun (2013). The persistence parameter on lagged food security (coefficient = 0.634, $p < 0.01$) indicates strong inertia in food insecurity outcomes, implying that addressing food insecurity requires sustained, long-term interventions rather than short-term measures. The Hansen test and the Arellano-Bond AR(2) test confirm the validity of the GMM instrument set across all specifications.

Resilience-Enhancing Mechanisms

The moderation analysis supports the hypothesis that sustainable land management and climate-smart agriculture attenuate the adverse effects of climate variability. The interaction between temperature variability and SLM adoption is negative and significant in the ecosystem service equations (coefficient = -0.089, $p < 0.05$), and the interaction between precipitation variability and CSA adoption attenuates the effect on soil fertility (coefficient = -0.073, $p < 0.10$); a one standard deviation increase in SLM adoption is estimated to offset approximately 22 percent of the ecosystem service degradation otherwise associated with a one standard deviation temperature increase, corroborating WOCAT (2017) and Rosenstock et al. (2016).

Institutional quality is also a significant moderator: the governance quality index positively moderates the relationship between agricultural productivity and food security outcomes (coefficient = 0.241, $p < 0.05$), consistent with the broader development literature on the food security-governance nexus (Acemoglu & Robinson, 2012), suggesting institutional reform is a complementary priority alongside ecosystem restoration and climate adaptation.

Policy Implications

These findings carry several policy implications. Ecosystem degradation is a major channel through which climate change affects food security, requiring integrated policies that combine environmental conservation, agricultural development, and

climate adaptation rather than siloed interventions. Sustainable land management and climate-smart agriculture reduce climate-related risks, improve productivity, and enhance ecosystem resilience, warranting increased investment by governments and development partners alongside extension services, credit access, and market opportunities for farmers.

Institutional quality is equally important: effective governance, secure land tenure, efficient agricultural markets, transparent food distribution systems, and improved rural infrastructure maximise the benefits of agricultural and environmental investments. Because climate impacts are more severe in degraded ecosystems, policymakers should prioritise early conservation and restoration in vulnerable regions, and regional cooperation should be strengthened through initiatives such as the African Union Agenda 2063, the Great Green Wall Initiative, and AFR100 to support climate adaptation, ecosystem restoration, and sustainable food security across Africa.

Conclusion

This study examined the relationships among climate change, ecosystem service degradation, and food security across 30 African countries from 2000 to 2020. The findings show that climate variability degrades ecosystem services such as soil fertility, land quality, and vegetation cover, thereby reducing agricultural productivity and worsening food security, with ecosystem degradation identified as a key transmission pathway. The study contributes to knowledge by integrating climate change, ecosystem services, and food security within a single framework and demonstrating the indirect and non-linear effects of climate change on food security, while also finding that sustainable land management and climate-smart agriculture mitigate these adverse impacts and enhance resilience.

The study concludes that ecosystem restoration, climate adaptation, and sustainable agriculture should be pursued together to achieve long-term food security in Africa. Future research should utilize longer-term datasets and household-level studies to better understand ecosystem-food security linkages and the institutional factors influencing the adoption of climate-resilient practices.

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COMMUNICATING CLEAN CITIES: THE ROLE OF DISCOURSE IN SHAPING WASTE MANAGEMENT PRACTICES IN URBAN AFRICA

Rita Igwenagum
Nnamdi Azikiwe University, Awka
maduemenkechi@gmail.com

Abstract:
Rapid urbanisation across African cities has intensified challenges related to waste management and environmental pollution, making public behaviour an important factor in sustaining clean and liveable environments. This paper examines the role of discourse in shaping attitudes and practices associated with waste management in urban African contexts. Adopting a complementary discourse-pragmatic and hermeneutic approach, it examines how language is used to instruct, persuade, and moralise in relation to acceptable waste disposal practices, while also interpreting the social, cultural, physical, and moral meanings embedded in such communication. The study focuses on three purposively selected environmental expressions: "Do not dump refuse here," "Keep your environment clean," and "Cleanliness is next to godliness." Using qualitative textual analysis, the study examines the pragmatic actions performed by these expressions and the contextual meanings through which their communicative force is understood. The analysis reveals three complementary strategies: direct prohibition, responsibility-oriented persuasion, and moral or cultural appeal. From a pragmatic perspective, the expressions function as socially situated actions that regulate conduct, encourage responsibility, and promote the internalisation of environmental values. From a hermeneutic perspective, their meanings are shaped by physical, social, cultural, and moral

contexts. The study argues that environmental communication is therefore not merely a means of transmitting sanitation information but also a resource for constructing behavioural norms and giving environmental responsibility social and cultural meaning. The findings suggest that clear, contextually relevant, and culturally grounded communication, supported by appropriate waste-management infrastructure, can contribute to more meaningful public engagement with environmental responsibility.

Keywords: Discourse, Urbanisation, Waste Management, Environmental Communication, Pragmatic Acts, Hermeneutics

Introduction

Rapid urbanisation across many African cities has brought with it a range of environmental challenges, among which waste management and environmental pollution remain particularly pressing (UN-Habitat, 2020; World Bank, 2018). As urban populations continue to grow, the capacity of existing waste management systems is often stretched, resulting in improper waste disposal, accumulation of refuse, and increased risks to public health and environmental sustainability (Wilson et al., 2012; Kosoe et al., 2021). While considerable attention has been given to infrastructural deficits, policy limitations, and technological solutions, less emphasis has been placed on the role of human behaviour in shaping environmental outcomes within these urban spaces. Waste management is not solely a technical or administrative issue; it is also embedded in everyday practices and social behaviour. The ways individuals dispose of waste, respond to environmental regulations, or participate in public sanitation initiatives are influenced not only by the availability of facilities but also by how environmental responsibility is communicated and understood. Simatele et al. (2017) noted that sustainable waste management in African urban contexts requires not only technical systems but also active public participation and behavioural change. Public campaigns, media messages, signage, and informal

interactions therefore serve as important channels through which expectations about cleanliness and civic responsibility are conveyed. However, the effectiveness of such communication varies, raising questions about how language shapes public engagement with environmental practices.

This paper argues that discourse plays a central role in influencing waste management behaviour in urban African contexts. Here, discourse refers to language in use within specific social and cultural situations, encompassing formal and informal modes of communication (Verschueren, 1999). Through discourse, authorities instruct, persuade, warn, and sometimes sanction members of the public in relation to environmental conduct, while individuals interpret, negotiate, or resist these messages. Adopting a pragmatic perspective complemented by a hermeneutic interpretive orientation, the paper examines how such language functions as social action and acquires meaning within its social and cultural contexts (Mey, 2001; Gadamer, 2004). Pragmatic analysis examines what environmental expressions do in particular contexts, while hermeneutic interpretation explains how they are understood in relation to shared values, lived experience, and surrounding circumstances. Together, the perspectives illuminate both the actional force and contextual meaning of environmental discourse.

The aim of this paper is therefore to examine the role of discourse in shaping waste management practices in urban Africa, with particular attention to how communicative strategies influence behavioural patterns. By foregrounding the relationship between language and action, the study complements approaches that prioritise infrastructure and policy highlighting the importance of communication in achieving sustainable urban environments.

Conceptual Clarifications

For clarity, this study engages with a number of key concepts,

namely discourse, pragmatics, urbanisation, waste management, and environmental behaviour. These concepts are central to understanding the relationship between communication and public engagement with environmental practices in urban African contexts.

Key Concepts

Discourse

Discourse is broadly understood as language in use within specific social and cultural contexts. It goes beyond isolated sentences to include how meaning is constructed, negotiated, and interpreted in interaction (Verschueren, 1999). From a pragmatic perspective, discourse is not merely descriptive but performative, enabling speakers to carry out actions such as informing, instructing, persuading, and warning (Mey, 2001). In the context of this study, discourse includes formal communication such as government campaigns and media messages, as well as informal interactions through which environmental expectations are expressed and reinforced.

Urbanisation

Urbanisation refers to the increasing concentration of populations in cities and urban areas, often accompanied by expansion in infrastructure, economic activity, and social complexity (UN-Habitat, 2020). In many African contexts, rapid urbanisation has not always been matched by adequate planning or public services, creating challenges for environmental management, particularly waste generation and disposal. Growing populations place pressure on existing waste-management systems and can contribute to environmental degradation when waste is not effectively managed (World Bank, 2018).

Waste management

Waste management, in this study, refers to the collection, transportation, processing, and disposal of waste materials in ways

that minimise environmental harm and protect public health. Although effective systems are essential for clean and sustainable urban environments, technical efficiency alone does not guarantee success; public participation and responsible behaviour are equally important (Wilson et al., 2012). Waste management therefore involves not only structural provisions but also social and communicative dimensions.

Environmental behaviour

Environmental behaviour relates to the actions and practices of individuals and communities concerning their surroundings, particularly maintaining cleanliness and reducing environmental harm. It is influenced by factors such as access to facilities, social norms, cultural values, and communication. Studies on waste management in African cities highlight the interaction between infrastructural limitations, public behaviour, and governance challenges (Agunwamba, 1998; Nzeadibe & Ajaero, 2010). Discourse can therefore shape how individuals perceive their environmental responsibilities and act in everyday situations.

Taken together, these concepts provide a framework for examining how language, within the context of rapid urbanisation, influences waste management practices and environmental behaviour. By focusing on the intersection of discourse and social action, this study highlights the importance of communication in addressing environmental challenges in African cities.

Hermeneutics

Hermeneutics concerns the interpretation and understanding of meaning in relation to texts and their contexts. Gadamer (2004) emphasises the relationship between the text, its context, and the interpreter in the process of understanding. In this study, hermeneutics provides an interpretive perspective for examining how environmental expressions acquire social, cultural, and moral meanings beyond their literal wording. It therefore complements

pragmatic analysis by explaining how the meanings and values embedded in environmental discourse are understood within everyday urban contexts.

Theoretical Framework

This study adopts Mey's Pragmatic Act Theory (2001) as its principal theoretical framework, focusing on how discourse functions as a form of social action. Pragmatics examines language in use and how meaning is shaped by context and interpretation. Rather than viewing language as a neutral tool for conveying information, a pragmatic perspective emphasises that speakers use language to perform actions such as instructing, requesting, warning, advising, and persuading (Mey, 2001). In urban waste management, this perspective is useful because much interaction between authorities and the public takes place through language. Public messages on waste disposal, environmental campaigns, media announcements, and everyday conversations are not simply informative; they function to influence behaviour. For instance, directives such as "Do not dump refuse here" or appeals like "Keep your environment clean" function to guide public conduct and promote compliance with environmental expectations. By applying pragmatic analysis alongside hermeneutic interpretation, this paper examines both the action performed by environmental expressions and the contextual meanings through which that action is understood. The two perspectives are therefore complementary: pragmatic analysis foregrounds action, while hermeneutic interpretation illuminates the meanings and values that shape it.

Methodology

This study adopts a qualitative discourse-pragmatic approach to examine how language shapes waste management practices in urban African contexts. The study focuses on selected environmental expressions found in public environmental communication. Analysis is guided by Mey's Pragmatic Act Theory (2001), particularly the view of language as social action.

Attention is given to how the selected expressions perform pragmatic functions such as prohibiting, advising, persuading, and moralising within specific social contexts. The data consist of three purposively selected environmental expressions commonly used in public sanitation and environmental communication:

1. "Do not dump refuse here"
2. "Keep your environment clean"
3. "Cleanliness is next to godliness"

The expressions were selected because they are recognisable forms of environmental and sanitation-related communication and illustrate different ways in which language can be used to influence public behaviour. The selection was therefore based on their relevance to the communicative purpose of the study rather than on numerical representation.

The study employs a hermeneutic method to interpret the meanings and communicative intentions embedded in the selected expressions. The approach enables the expressions to be understood in relation to their linguistic form, immediate communicative context, and broader social and cultural environment. This is relevant because their meaning and pragmatic force are shaped not only by linguistic forms but also by the contexts in which they are used and interpreted. Following the hermeneutic interpretation, the expressions are subjected to qualitative pragmatic analysis using Mey's (2001) Pragmatic Act Theory. The analysis considers how the expressions function as context-bound pragmatic actions and how their textual and contextual features contribute to their communicative force. It therefore focuses on the relationship between discourse, context, pragmatic action, and behavioural influence. The study relies on interpretive textual analysis rather than quantitative measurement. Through combining hermeneutic interpretation and pragmatic analysis, the study explains how seemingly simple environmental expressions perform socially meaningful actions and communicate expectations concerning waste management and sanitation in

urban African contexts.

Findings, Analysis and Discussion

This section presents a discourse-pragmatic and hermeneutic analysis of the three selected environmental expressions. Drawing on Mey's Pragmatic Acts Theory (2001) and a hermeneutic interpretive perspective, the analysis examines how the expressions function as socially situated actions and how their meanings are shaped by their physical, social, cultural, and moral contexts. It focuses on three complementary strategies: prohibition, responsibility-oriented persuasion, and moral or cultural appeal.

Instructing and Prohibition as Behavioural Control

A prominent feature of waste management discourse in public and institutional contexts is the use of directive expressions to regulate behaviour. These directives are typically realised through imperative constructions that establish clear behavioural expectations. “Do not dump refuse here” exemplifies this pattern. The expression functions primarily as a prohibitive pragmatic act because it prevents the addressee from engaging in a specified waste-disposal practice. The imperative construction “Do not dump” leaves little room for negotiation and establishes the prohibited action as unacceptable. From Mey's (2001) perspective, the meaning of the expression lies not only in its grammatical form but also in the social action it performs within a particular context. Here, the expression regulates conduct and discourages indiscriminate waste disposal. The deictic expression “here” is significant to the interpretation of the message. Its meaning depends on the physical location in which the expression is encountered. Hermeneutically, the message defines a particular space as subject to an environmental rule. The reader is expected to interpret the location, recognise the relevance of the prohibition to that space, and adjust behaviour accordingly. The expression consequently constructs public space as a shared environment

governed by socially recognised expectations concerning cleanliness and appropriate waste disposal.

The choice of the verb "dump" strengthens the negative evaluation of the prohibited behaviour. Unlike the more neutral term dispose, dump suggests careless, inappropriate, or uncontrolled disposal. The expression therefore does more than prohibit an action; it implicitly characterises that action as environmentally undesirable. Its pragmatic force emerges from the interaction between the imperative form, the physical context, and the social expectation of responsible waste disposal, demonstrating how direct prohibition functions can establish behavioural boundaries and construct expectations of environmental responsibility.

Persuasion and Responsibility Framing

Beyond direct prohibitions, waste management discourse can employ persuasive strategies to encourage responsible behaviour. Rather than preventing a specific undesirable action, such expressions invite individuals to assume responsibility for maintaining their surroundings. The expression "Keep your environment clean" provides a clear example of this approach. The expression functions primarily as an advisory and persuasive pragmatic act. Although grammatically realised as an imperative, its force differs from the direct prohibition in "Do not dump refuse here." Instead of prohibiting a particular behaviour, it encourages the addressee to adopt a continuing practice of environmental cleanliness. From Mey's (2001) perspective, its pragmatic force emerges from its use within a social context where maintaining a clean environment is recognised as a desirable communal practice. The possessive pronoun "your" is particularly significant because it personalises a relationship between the addressee and the environment, presenting the environment as something for which the individual is responsible. The expression therefore moves beyond an externally imposed environmental rule and encourages the audience to perceive cleanliness as a personal and collective

obligation. The apparently simple choice of *your* consequently contributes to the persuasive force of the message.

The expression can also be interpreted hermeneutically as constructing cleanliness as a shared social value. The meaning of "your environment" extends beyond individual ownership to encompass the physical surroundings in which people live and interact. Within an urban context, the expression invites readers to understand their surroundings as a communal space whose condition is partly determined by individual actions. Its interpretation therefore depends on the audience's social understanding of responsibility, community, and environmental wellbeing. Unlike "Do not dump refuse here," which establishes an explicit prohibition, "Keep your environment clean" does not specify an undesirable action or threaten consequences for non-compliance. Its strategy is therefore less coercive, encouraging responsible behaviour by presenting cleanliness as a desirable norm and connecting the individual with the condition of the shared environment. The expression demonstrates how environmental discourse can seek behavioural change through persuasion rather than direct prohibition. In this respect, the expression demonstrates how environmental discourse can promote personal and collective responsibility and seek behavioural change through persuasion rather than direct prohibition.

Moral and Cultural Appeals

In addition to direct prohibition and persuasive responsibility framing, environmental discourse may draw on moral and ideological values to influence public behaviour. Such expressions move beyond immediate behavioural instruction by presenting cleanliness as a value that is desirable in itself. The expression "Cleanliness is next to godliness" exemplifies this form of environmental communication. The expression functions primarily as a moralising and persuasive pragmatic act. Rather than directly commanding the audience to perform a particular action, it

establishes a connection between physical cleanliness and moral or spiritual worth. From Mey's (2001) perspective, its pragmatic meaning extends beyond its literal proposition because it performs a socially situated action of encouraging desirable behaviour through an appeal to shared values. The expression therefore seeks to influence conduct indirectly by making cleanliness appear morally commendable.

The phrase "next to godliness" is particularly significant because it invokes a cultural and religious understanding in which cleanliness is associated with moral goodness. Its meaning cannot be fully understood from its literal wording alone. Hermeneutically, the expression requires the audience to draw on cultural and religious knowledge in order to interpret the relationship it establishes between cleanliness and godliness. The message consequently gives an ordinary sanitation practice a broader moral significance. Unlike "Do not dump refuse here," which establishes an explicit prohibition, and "Keep your environment clean," which directly encourages responsible behaviour, "Cleanliness is next to godliness" operates through value-based persuasion. It does not identify a prohibited action or issue a direct instruction. Instead, it encourages compliance by presenting cleanliness as consistent with an accepted moral ideal. Its pragmatic force therefore depends substantially on the audience's recognition of the cultural and moral values embedded in the expression. The expression also illustrates the importance of context in the interpretation of environmental discourse. In an urban African setting where religious and cultural values may form an important part of everyday social understanding, the association between cleanliness and godliness can give the message a significance that extends beyond sanitation. The expression frames environmental cleanliness not merely as a practical requirement but as a practice associated with desirable personal and social values. The expression therefore frames environmental cleanliness not merely as a practical requirement but as a morally valued practice through

which shared cultural and religious values can influence behaviour.

Comparative Findings and Discussion

The analysis of the three environmental expressions reveals that waste-management discourse employs different but complementary pragmatic strategies to communicate environmental expectations. From a pragmatic perspective, "Do not dump refuse here" functions primarily as a prohibitive act, "Keep your environment clean" as an advisory and persuasive act, and "Cleanliness is next to godliness" as a moralising and persuasive act. Their pragmatic force is not derived from their linguistic forms alone but from the social contexts in which they are used and the behavioural expectations they establish. The three expressions also demonstrate a progression in the way environmental responsibility is communicated. "Do not dump refuse here" relies on external control by establishing a clear boundary between acceptable and unacceptable behaviour. "Keep your environment clean" moves from prohibition towards personal and collective responsibility, encouraging the audience to participate voluntarily in maintaining environmental cleanliness. "Cleanliness is next to godliness" goes further by connecting environmental behaviour with moral and spiritual values, encouraging individuals to internalise cleanliness as a desirable way of living. The findings therefore suggest that environmental discourse can construct and communicate responsibility through different degrees of behavioural regulation, ranging from direct prohibition to responsibility and finally to value-based internalisation.

From a hermeneutic perspective, however, these expressions cannot be adequately understood without considering the contexts and systems of meaning surrounding them. The significance of "here" depends on the physical location in which the message is encountered and on the audience's understanding of that space as one governed by particular environmental expectations. Similarly,

the interpretation of "your environment" depends on an understanding of personal and communal responsibility. In "Cleanliness is next to godliness," the meaning is shaped more strongly by cultural and religious knowledge that associates cleanliness with moral worth. Thus, each expression requires the audience to interpret its wording in relation to a broader horizon of social experience. The combined pragmatic and hermeneutic analyses show that environmental expressions operate simultaneously as communicative actions and carriers of social meaning. Pragmatic analysis foregrounds their action and behavioural function, while hermeneutic interpretation illuminates the meanings, values, and contexts through which those actions become intelligible.

A major finding of the study is therefore that effective environmental communication does not depend solely on issuing instructions. The three expressions demonstrate that behavioural influence can be achieved through prohibition, appeals to responsibility, and moral or cultural persuasion. Their pragmatic force is mediated by the audience's interpretation of the physical, social, cultural, and moral contexts in which they occur. Environmental discourse thus functions not merely as a means of communicating sanitation expectations but as a resource for constructing behavioural norms and giving environmental responsibility social and cultural meaning. Overall, the findings demonstrate that the pragmatic and hermeneutic perspectives are complementary. Mey's (2001) pragmatic perspective explains how environmental expressions function as socially situated actions, while hermeneutic interpretation reveals how their meanings are understood within particular contexts and systems of value. Together, they show that seemingly simple environmental expressions can regulate conduct, construct responsibility, and encourage the internalisation of environmental values.

Summary

This section has examined the three selected environmental expressions through pragmatic and hermeneutic perspectives. "Do not dump refuse here" functions primarily as a prohibitive pragmatic act, "Keep your environment clean" promotes personal and collective responsibility through a persuasive directive, and "Cleanliness is next to godliness" employs moral and cultural appeal. The findings demonstrate that environmental communication can regulate conduct, construct social responsibility, and encourage the internalisation of environmental values, while the meanings of such expressions are shaped by their physical, social, cultural, and moral contexts. Pragmatic action and contextual interpretation therefore work together in the construction of environmental meaning.

Implications

One implication is the need for clear and responsibility-oriented environmental communication. "Do not dump refuse here" demonstrates how direct and context-specific language can establish clear behavioural boundaries, while "Keep your environment clean" encourages individuals to view cleanliness as a personal and collective responsibility. Environmental campaigns can therefore combine clear behavioural guidance with messages that encourage participation, ownership, and concern for shared environments. The analysis also demonstrates the importance of culturally and contextually grounded communication. "Cleanliness is next to godliness" derives part of its persuasive force from cultural and moral associations between cleanliness and godliness. Environmental messages are interpreted through existing systems of meaning and may therefore be more meaningful when they draw appropriately on culturally familiar values and expressions. At the same time, communication cannot by itself resolve waste-management problems where appropriate disposal facilities and reliable services are unavailable. Communication strategies should therefore be coordinated with

accessible infrastructure, effective service delivery, and broader environmental policies.

Overall, the study contributes to an understanding of waste management as both a material and communicative process. The pragmatic perspective demonstrates how environmental expressions function as socially situated actions, while the hermeneutic perspective shows how their meanings are interpreted within particular contexts. A more integrated approach to waste management should therefore recognise discourse, contextual interpretation, infrastructure, and public participation as interconnected dimensions of sustainable environmental practice.

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DEVASTATING ECOLOGIES AND RESISTANT VOICES IN TANURE OJAIDE'S THE ACTIVIST AND HELON HABILA'S OIL ON WATER

Nwannewuihe Chidimma Adaku
Department of English and Literary Studies,
Imo State University, Owerri
amchidimma@gmail.com

Abstract

Devastating ecologies and resistant voices have become principal concerns in contemporary Nigerian literature, particularly in narratives of the Niger Delta. This paper examines The Activist and Oil on Water to explore how environmental ruin and human resistance are mutually constituted. The paper addresses the troubling persistence of ecological degradation caused by oil exploitation and the consequent marginalization of local communities whose voices are repeatedly suppressed. It aims to examine how the texts represent environmental devastation while simultaneously foregrounding acts of resistance that challenge structures of exploitation and silence. Grounded in ecocriticism, the paper draws attention to the dynamic relationship between human experiences and the damaged natural environment. Employing close textual analysis, the paper carefully interprets narrative techniques, imagery, and characterization to determine how the writers construct ecological trauma and resistance. The analysis reveals that the environment is not basically a passive backdrop but an active place of memory, suffering, and defiance. Characters in the texts develop as agents of resistance that confront corporate greed, state neglect, and ecological violence in ways that complicate victimhood. The paper concludes that Ojaide and

Habila, in their works, reevaluate the Niger Delta as a tensed environment where devastation coexists with resilience and where storytelling itself turns out to be a powerful tool of resistance against expurgation and environmental injustice.

Keywords: Eco-criticism, Niger Delta, Environmental Degradation, Resistance, Nigerian Literature

Introduction

The Niger Delta occupies a paradoxical position in Nigeria's national imagination. It is at the same time a countryside of immense natural wealth and a terrain marked by prolonged environmental devastation. Since the discovery of crude oil in the region in the late 1950s, the ecological balance that once sustained local livelihoods has been severely altered by continuous oil exploration, gas flaring, and industrial pollution. Rivers that once nurtured fishing economies have become contaminated waterways, while fertile farmlands have steadily metamorphosed into toxic grounds incapable of sustaining agricultural life. These environmental alterations have not only disrupted ecosystems but have also restructured social relations, cultural identities, and political consciousness within affected communities. Contemporary Nigerian literature has gradually turned toward this ecological crisis. It narratively interrogates the human cost of resource extraction and amplifies voices that resist environmental injustice. Within this literary tradition, Ojaide's *The Activist* and Habila's *Oil on Water* stand as powerful imaginative engagements with the ecological and socio-political realities of the Niger Delta. The texts approach environmental degradation not basically as a physical condition but as an existential crisis that affects memory, belonging, and survival. The narratives reveal how environmental destruction intersects with systems of power, that is, multinational corporations, state institutions, and global economic interests that perpetuate inequality and silence marginalized communities. Foregrounding lived experiences within damaged settings, these texts reposition ecology as principal to questions of justice and

human dignity rather than as a passive background to human action.

Eco-criticism provides a useful framework for examining these literary interventions because it emphasizes the interconnectedness between human societies and the natural world. Scholars of eco-critical studies argue that literature plays a decisive role in influencing ecological awareness by exposing how environmental crises are culturally constructed and politically mediated (Buell 23; Garrard 5). In the context of African literature, eco-critical inquiry extends beyond environmental appreciation to address histories of colonial extraction, neo-colonial capitalism, and uneven development that intensify ecological vulnerability (Nixon 4). The Niger Delta exemplifies what Nixon describes as slow violence, where environmental harm develops gradually nevertheless produces enduring social and psychological consequences for marginalized populations (Nixon 2). Ojaide and Habila dramatize this slow violence through narrative forms that capture the visible scars of pollution and the less visible erosion of hope and community cohesion. In *The Activist*, Ojaide constructs poetry-inflected prose that merges political commitment with ecological consciousness. His narrative foregrounds activism as personal awakening and collective responsibility. It portrays characters that refuse to accept environmental destruction as inevitable. The text situates resistance within cultural memory. This suggests that storytelling itself becomes a means of reclaiming agency in the face of systemic exploitation. Similarly, Habila's *Oil on Water* presents a haunting depiction of journalists traversing polluted creeks and fractured communities in search of truth. Through fragmented encounters and shifting perspectives, Habila reveals the moral ambiguities surrounding militancy, corporate power, and state violence. It complicates simplistic binaries of victim and perpetrator (Habila 37). The texts therefore resist reductive portrayals of the Niger Delta. Instead, the texts present it as a disputed ecological and political space impacted by

competing narratives.

Importantly, these texts challenge anthropocentric assumptions by granting the environment narrative presence and emotional weight. Polluted rivers, burning gas flares, and abandoned villages function as witnesses to historical injustice. These ecological issues exemplify collective trauma while simultaneously inspiring resistance. The damaged environment becomes inseparable from human suffering, and demonstrates how ecological crises produce ethical questions about responsibility, survival, and resistance. In this sense, Ojaide and Habila participate in a movement within African literature that reconceptualizes nature as an active participant in historical processes rather than a silent backdrop (Iheka 12). Furthermore, resistant voices in these texts surface through multiple forms such as activism, journalism, communal memory, and storytelling itself. Resistance is not always heroic or triumphant. At times it appears fragmented, uncertain, or morally ambiguous. However, these moments of resistance disrupt structures of silence imposed by political and economic power. In representing characters that speak, document, protest, or simply endure, the texts portray the persistence of agency within conditions of ecological devastation. Literature thus becomes an alternative archive through which marginalized experiences are preserved and articulated.

This paper therefore examines how *The Activist* and *Oil on Water* portray devastating ecologies alongside resistant voices. It argues that the texts reimagine the Niger Delta as a living archive of environmental trauma and human resilience. Through eco-critical analysis, the paper explores how narrative techniques, characterization, and imagery reveal the mutual constitution of environmental ruin and resistance. However, the texts demonstrate that storytelling itself functions as an act of ecological and political intervention, and challenges erasure while envisioning possibilities for justice within damaged settings.

Ecological Devastation, Environmental Justice, and Narratives of Resistance in Niger Delta Literary Studies

Scholarly engagement with Niger Delta literature has positioned environmental degradation as one of the defining concerns of contemporary Nigerian writing. Critics generally agree that literary representations of the region move beyond environmental description to interrogate structures of power, violence, and resistance entrenched within ecological crises. Studies on Ojaide's *The Activist* and Habila's *Oil on Water* therefore surface within an eco-critical and postcolonial discourse that examines how literature mediates relationships between humans, nature, and systems of exploitation. Eco-critical scholarship provides the foundational framework for understanding these texts. Early eco-critical theorists argue that literature restructures ecological consciousness by revealing how environmental problems are socially produced rather than naturally inevitable. Within African literary studies, this approach has been adapted to address colonial extraction and neo-capitalist exploitation, particularly in oil-producing regions. Scholars observe that Niger Delta narratives recurrently portray ecological destruction as inseparable from political marginalization and economic inequality, thereby transmuting environmental discourse into a critique of power relations (Nixon 3-5). This critical orientation has influenced subsequent readings of Ojaide and Habila whose works foreground environmental devastation alongside human resistance.

Critical attention to Habila's *Oil on Water* largely centers on its depiction of ecological trauma and socio-political instability. Edebor's eco-critical study argues that the text exposes the destructive consequences of unchecked resource exploitation while simultaneously awakening ecological awareness among individuals by dramatizing the interconnected suffering of humans and the natural world (Edebor 52). Rather than presenting environmental damage as an abstract issue, Habila situates

pollution within everyday experiences of displacement, violence, and economic deprivation. Similarly, Victor and Ogunpitan interpret the changing countryside in the text as a symbolic representation of postcolonial trauma. They note that environmental ruin restructures identities and communal relations in ways that echo colonial patterns of domination (Victor and Ogunpitan 64). Further studies extend this ecological reading by examining narrative technique and language. Davidson's ecolinguistic analysis demonstrates how metaphors in *Oil on Water* construct ideological oppositions between purity and contamination, thereby reinforcing moral judgments against corporate exploitation and political negligence (Davidson 118). Through evaluative language, the text encourages one to align emotionally with victims of ecological violence. It suggests that stylistic choices themselves function as ethical interventions. Obi similarly argues that Habila's narrative foregrounds silenced victims by highlighting certain ecological realities while exposing institutional erasures that obscure environmental suffering (Obi 91). These studies collectively emphasize that narrative form is fundamental to the text's ecological politics.

Another noteworthy strand of scholarship examines resistance within *Oil on Water*. Ogungbemi contends that the text operates as a form of ecological advocacy in which storytelling becomes an instrument for challenging environmental injustice and exposing neocolonial power structures (Ogungbemi 44). Rather than proposing simplistic solutions, the text presents resistance as complex and morally ambiguous. Omesu and Onwuka expand this argument by interpreting militancy in the text as performative resistance. That is, a symbolic attempt by marginalized communities to reclaim visibility within global systems that ignore their suffering (Omesu and Onwuka 73). Such readings portray how resistance in Niger Delta fiction habitually develops from desperation as much as political consciousness. Ecofeminist critics further broaden interpretations of Habila's work by linking

environmental destruction to gendered vulnerability. Michael and Daniel observe that ecological devastation disproportionately affects women and indigenous populations whose dependence on land and water intensifies the consequences of oil pollution (Michael and Daniel 210). Their analysis accentuates how environmental crises intersect with social hierarchies, and reinforces the idea that ecological degradation produces layered forms of marginalization.

While scholarship on Habila is extensive, studies on Ojaide's *The Activist* focus more explicitly on activism and ecological consciousness. Bhuvaneshwari's eco-centric reading argues that Ojaide envisions environmental resistance as a collective struggle rooted in indigenous knowledge systems and communal responsibility (Bhuvaneshwari 6). The text presents activism not basically as political protest but as an ethical obligation to defend ecological balance against multinational exploitation. Similarly, Onyema and Mba emphasize that Ojaide employs satire and social criticism to expose corruption and governmental complicity in environmental destruction. They portray literature as a medium for social accountability (Onyema and Mba 29).

Comparative studies help situate *The Activist* within wider Niger Delta narratives. Olughu's analysis of eco-degradation and activism identifies multiple forms of resistance such as radical, liberal, and reformist entrenched in Ojaide's fictional world. The analysis demonstrates how characters negotiate survival within oppressive ecological conditions (Olughu 48). Such scholarship reinforces the idea that resistance in Ojaide's writing is polygonal rather than ideologically uniform. Beyond the text itself, critics examining Ojaide's oeuvre provide insight into the ideological foundation informing *The Activist*. Nwagbara argues that Ojaide's ecological imagination functions as an art of resistance that challenges ecological imperialism and envisions literature as a tool for remaking the Niger Delta through environmental

consciousness (Nwagbara 82). This perspective illuminates how Ojaide's activism is deeply rooted in poetic traditions that merge cultural memory with ecological protest.

Beyond eco-critical readings that foreground environmental devastation, scholars have turned their attention to the narrative construction of voice and agency in Niger Delta literature. This shift recognizes that ecological crises in literary texts are inseparable from struggles over representation. That is, who speaks, who is silenced, and whose suffering becomes historically visible. Critics argue that contemporary Nigerian writers deploy narrative voice not only as an aesthetic device but also as a political strategy aimed at reclaiming suppressed histories. In this regard, the works of Ojaide and Habila have attracted scholarly interest for their ability to transform storytelling into a space of resistance against environmental and knowledge erasure. Postcolonial ecocriticism has been particularly influential in modeling this conversation. Huggan and Tiffin contend that environmental degradation in postcolonial societies must be understood within global histories of imperial extraction and capitalist expansion where ecological exploitation mirrors earlier colonial modes of domination (Huggan and Tiffin 29). Applied to Niger Delta narratives, this perspective reveals how oil extraction reproduces asymmetrical power relations between multinational corporations and local communities. Scholars reading *Oil on Water* through this lens observe that Habila's depiction of devastated sceneries reflects not basically local governance failure but a global economic system that renders certain environments disposable (Ugor 112). The polluted creeks and abandoned settlements therefore symbolize the uneven distribution of environmental risk within global capitalism.

Several critics further argue that Habila's narrative structure itself enacts ecological uncertainty. Okuyade notes that the fragmented journey undertaken by the journalists in *Oil on Water* mirrors the

instability of the Niger Delta environment where truth becomes elusive amid violence and propaganda (Okuyade 141). The shifting encounters experienced by the protagonists create a narrative rhythm that reflects disorientation. It suggests that ecological devastation destabilizes physical geography and knowledge certainty. This reading aligns with eco-trauma theory which proposes that damaged environments disrupt narrative coherence because trauma resists linear representation (Craps 63). Consequently, Habila's episodic storytelling becomes formally consistent with the fractured reality it depicts. Attention has also been given to spatial representation in Niger Delta fiction. Spatial critics argue that sceneries in these texts function as political archives that preserve collective memory. Akingbe observes that literary representations of polluted rivers and burning oil installations encode historical experiences of dispossession and resistance that transforms geography into testimony (Akingbe 105). Within *Oil on Water*, movement through waterways exposes layers of ecological violence accumulated over time, thereby linking present suffering with historical neglect. Similarly, Ojaide's *The Activist* reimagines space as culturally meaningful terrain whose destruction signifies an assault on identity itself. Scholars suggest that by emphasizing indigenous relationships with land, Ojaide challenges Western industrial notions that reduce nature to economic resource (Aderemi 88).

Another prominent area of scholarship examines the ethics of witnessing in Niger Delta narratives. Critics argue that characters who document environmental suffering such as journalists, activists, and storytellers serve as mediators between marginalized communities and global audiences. Nfah-Abbenyi maintains that African writers assume the role of ethical witnesses who translate localized experiences into human concerns while resisting exploitative representations of suffering (Nfah-Abbenyi 154). In Habila's text, journalistic investigation becomes morally complicated. It reveals tensions between empathy and professional

detachment. Scholars interpret this ambiguity as a critique of media sensationalism. This suggests that representation itself can reproduce forms of exploitation even while attempting advocacy (Adeoti 97). Studies focusing on resistance aesthetics further illuminate Ojaide's narrative project. Okpewho argues that African literary resistance draws from oral traditions that privilege communal voice over individual heroism, thereby redefining activism as collective expression rather than singular rebellion (Okpewho 233). This insight is particularly relevant to *The Activist* where resistance materializes through community consciousness, cultural memory, and shared storytelling practices. Critics observe that Ojaide's blending of poetic sensibility with political narrative produces an affective form of resistance that appeals to moral imagination as much as ideological critique (Udenta 119).

Environmental justice scholarship also contributes considerably to interpretations of the texts. Environmental justice theorists emphasize that ecological harm disproportionately affects marginalized populations lacking political power. Applying this framework to Nigerian literature, scholars argue that Niger Delta fiction exposes environmental racism operating within national and global economic systems (Alagoa 58). The suffering depicted in *The Activist* and *Oil on Water* therefore reflects structural injustice rather than accidental ecological damage. Literary representation becomes a means of demanding ethical accountability from the state and corporate actors. Recent interdisciplinary studies have expanded analysis by incorporating affect theory and memory studies. Iheka suggests that African ecological texts evoke emotional responses such as mourning, anger, and resilience that enable one to perceive environmental crises as lived experiences rather than distant abstractions (Iheka 47). Emotional engagement thus becomes principal to ecological awareness. In Ojaide and Habila, settings carry affective weight. That is, polluted environments evoke grief while simultaneously inspiring acts of defiance. Scholars argue that this emotional

dimension transforms ecological literature into a catalyst for ethical reflection and political consciousness.

Despite these extensive contributions, existing scholarship habitually treats Ojaide and Habila within separate critical conversations. Studies on Habila tend to emphasize narrative ambiguity, journalism, and ecological trauma, whereas analyses of Ojaide foreground activism, poetic resistance, and cultural reclamation. Comparative examinations that analyze how devastation and resistance operate dialogically across the texts remain relatively limited. Consequently, there is insufficient exploration of how ecological destruction generates resistant voices while resistance itself restructures perceptions of ecological crisis. This paper builds upon prior scholarship while addressing this critical gap. Examining *The Activist* and *Oil on Water* together, it investigates how devastating ecologies function not basically as thematic concerns but as generative forces that produce new forms of subjectivity, voice, and resistance. The review of related literature thus demonstrates that while scholars have extensively analyzed environmental degradation and activism independently, the dynamic interplay between ecological ruin and resistant narration requires cavernous critical attention. Such an approach allows for holistic understanding of Niger Delta literature as an evolving discourse where environmental suffering and human resilience remain inseparably intertwined.

Environmental Devastation, Narrative Witnessing, and Resistant Agency in *The Activist* and *Oil on Water*

The ecological imagination of the Niger Delta in Ojaide's *The Activist* and Habila's *Oil on Water* develops from settings violently altered by oil capitalism. In the texts, environmental devastation is not basically described. It structures perception, identity, and resistance. The damaged ecosystem becomes inseparable from human suffering while resistance arises as an ethical response to ecological violation. Through contrasting narrative strategies,

Ojaide's activist realism and Habila's melancholic witnessing, the texts transmute environmental crisis into a narrative of moral confrontation. In *The Activist*, ecological destruction appears first as an intrusion into ordinary communal life. Oil pipelines cut across intimate spaces of survival, and reveals how industrial modernity penetrates rural existence. The narrator recalls that leaking pipes "crossed playgrounds of children, crossed cassava farms of the women, and even went through many parts of the village" (Ojaide 153). Situating pipelines within spaces associated with childhood and sustenance, Ojaide exposes ecological violence as an assault on continuity itself. The land ceases to nurture. Instead, it threatens. The resulting blowout produces an apocalyptic inversion of nature when "the Uto River was literally burning" and poisonous fumes engulfed "plants, wildlife, and humans around for days" (Ojaide 206-07). The image of a burning river destabilizes natural order. It suggests that industrial exploitation has rewritten ecological laws. Fire consumes water, and survival becomes uncertain within an environment stripped of predictability.

Habila's *Oil on Water* approaches devastation through sensory immersion rather than political narration. As journalists travel through the creeks, the environment reveals its corruption gradually. The water has "turned foul and sulfurous," while "dead birds" hang from branches with wings "black and slick with oil" and "dead fish bobbed white-bellied between tree roots" (Habila 9). The accumulation of tactile and visual details metamorphoses pollution into atmosphere. Death is not episodic but continuous, suspended in air and water alike. Where Ojaide dramatizes catastrophe, Habila depicts aftermath. Villages appear emptied of vitality, marked by "the same oil slick and the same indefinable sadness in the air, as if a community of ghosts were suspended above the punctured zinc roofs" (Habila 10). Environmental ruin becomes psychological presence. The land itself mourns. The texts insist that ecological devastation is neither accidental nor natural.

In *The Activist*, oil companies knowingly abandon communities during crisis. Despite awareness of the disaster, the company "sat in their offices" and issued statements blaming villagers for sabotage rather than sending help (Ojaide 154). Institutional indifference thus becomes an active form of violence. State authority reinforces corporate power through repression. When students organize a peaceful protest, soldiers respond with lethal force, and within minutes "bursts of gunfire" leave protesters dead as "blood splattered on the soil and on leaves" (Ojaide 207). The imagery merges human bodies with countryside. It suggests that the earth itself absorbs political violence. Ecological exploitation and state brutality function as interconnected systems.

Equally disturbing is the manipulation of public narrative. After the massacre, official reports deny responsibility while national media remain silent publishing only government bulletins and showing "no picture of the carnage for the nation or the world to see" (Ojaide 208). Environmental devastation therefore depends upon controlled visibility. Silence becomes a technology of power. In *Oil on Water*, silence manifests differently. Rather than overt propaganda, there exists a pervasive normalization of decay. Communities abandoned by militants and corporations exist outside national concern. When Rufus peers into a communal well, the smell rising from it carries "that unmistakable smell of oil," mixed with decomposition (Habila 10). Pollution infiltrates even drinking water, nevertheless no institutional presence intervenes. The absence of authority becomes itself a political statement. The texts insist that environmental destruction registers first on human bodies. In Ojaide's narrative, exposure to toxic fire produces immediate physical consequences. "…babies coughed relentlessly," "the old wheezed," and pregnant women went into premature labor as smoke filled the air (Ojaide 207). The environment invades biological processes, and collapses distinctions between ecological and medical crises. Habila similarly renders pollution through bodily reaction. As Rufus

encounters contaminated spaces, nausea and exhaustion overwhelm him, and the oppressive atmosphere leaves the travelers feeling "drained just standing there" (Habila 11). The body becomes an instrument that measures ecological damage more accurately than political discourse.

Through these depictions, the texts redefine environmental degradation as lived personification rather than abstract policy debate. Against devastation, however, resistance surfaces as moral necessity. In *The Activist*, student leaders interpret the community's suffering as an urgent call, recognizing that "there was a cobra on their doorstep and they had to kill it fast before it inflicted a painful death on them" (Ojaide 65). The metaphor frames activism as self-defense rather than rebellion. The peaceful protest itself exemplifies symbolic resistance. Demonstrators carry "green leaves and branches to signify the peaceful nature of their protest" (Ojaide 207). Nature becomes victim and language of dissent. Here, protesters reclaim ecological symbolism against industrial destruction. Even when violently suppressed, resistance persists. The protagonist later joins global protests, lifting a placard declaring "EVERY LIFE MATTERS" while enduring police water hoses however remaining "determined to go on with the protest" (Ojaide 318). Activism transcends geography linking Niger Delta struggles to global systems of economic exploitation. In contrast, resistance in *Oil on Water* is inconspicuous and more ambiguous. Journalism itself becomes an act of defiance. Documenting devastated communities, Rufus and Zaq resist collective forgetting. Their journey through polluted creeks transforms witnessing into ethical responsibility. The act of seeing, of refusing to look away from dead rivers and abandoned villages, constitutes resistance against erasure.

A decisive convergence between the texts lies in their understanding of storytelling as resistance. Ojaide foregrounds collective mobilization and vocal protest, while Habila emphasizes

observation and testimony. However, they suggest that narrating ecological suffering prevents its disappearance. In *The Activist*, mourning rituals after the massacre unify the community as "dirges and wails were heard everywhere," transmuting grief into shared historical memory (Ojaide 208). Memory resists official denial. Similarly, Habila's narrative voice lingers over damaged sceneries so insistently that forgetting becomes impossible. The repeated encounters with polluted villages accumulate into moral indictment. It forces one to inhabit ecological trauma alongside the narrator. Therefore, the texts reject portrayals of Niger Delta communities as passive victims. Devastation produces consciousness. Environmental destruction exposes structures of exploitation, and resistance, whether through protest, journalism, or memory, appears as a reclaiming of agency. Ojaide's world burns with urgency and collective mobilization, while Habila's setting whispers through silence and witnessing. However, they arrive at a shared insight. That is, ecological ruin generates voices that refuse disappearance. The damaged environment becomes archive, teacher, and catalyst, compelling individuals to speak where institutions demand silence. Through their narratives, Ojaide and Habila demonstrate that resistance in the Niger Delta begins not only with political action but with recognition. That is, the moment when people see clearly that the land's suffering mirrors their own.

The ecological imagination in Ojaide's *The Activist* and Habila's *Oil on Water* deepens as the narratives move beyond the initial depiction of environmental ruin into a sustained interrogation of memory, witnessing, and collective resistance. What becomes evident is that devastation in the Niger Delta is neither accidental nor natural. It is structurally produced and ideologically maintained. The texts therefore construct ecology not basically as damaged setting but as a historical archive inscribed with violence. In *Oil on Water*, Habila's descriptive technique intensifies ecological trauma through sensory immersion. The narrator's journey through the creeks metamorphoses the environment into a

living witness of slow death. The river setting is rendered grotesque when the journalists encounter "dead birds draped over tree branches, their outstretched wings black and slick with oil" while "dead fish bobbed white-bellied between tree roots" (Habila 71). The imagery collapses distinctions between nature and corpse. It suggests that oil extraction has converted the ecosystem into a mass grave. The description does not basically record pollution. It dramatizes ecological suffocation. The mangrove roots appear to gasp "for air," implying that even vegetation participates in the struggle for survival (Habila 70). Through such imagery, Habila subtly reframes environmental degradation as violence enacted upon a breathing entity.

Equally significant is how environmental devastation influences psychological perception. The narrator observes villages haunted by "an indefinable sadness in the air, as if a community of ghosts were suspended above the punctured zinc roofs" (Habila 72). Here, ecological ruin generates spectral presence. The environment remembers what political discourse attempts to erase. The ghostliness of the village reflects displacement without movement. That is, people remain physically present however existentially erased. Habila therefore links ecological destruction to emotional dislocation, and suggests that environmental injustice produces a crisis of belonging. Ojaide's *The Activist* approaches devastation through historical reflection and political exposition. Upon returning home, the protagonist confronts a transformed homeland whose environment bears the scars of exploitation. The text notes that the Niger Delta now possessed "a new face, an ugly or rather sick face" compared to the "pristine one he used to know" (Ojaide 46). The metaphor of illness is crucial. Here, ecological damage is figured as bodily degeneration which implies that the land itself has been infected by oil capitalism. The alteration is not gradual but catastrophic, described as the aftermath of "a destructive hurricane as far as the environment was concerned" (Ojaide 46). This framing situates ecological devastation within temporal rupture.

That is, a before and after that mirrors colonial and postcolonial extraction histories. Ojaide further exposes the political machinery sustaining ecological violence. Oil corporations operate with impunity under military regimes and enjoy "a free hand… to continue increasing production," a process that produces wealth for the state while ensuring "total disregard of the Niger Delta people and their environment" (Ojaide 46). The text thus disassembles official developmental rhetoric by revealing its ecological cost. Development becomes synonymous with abandonment.

Resistance, however, surfaces not only through protest but through storytelling and media intervention. In *The Activist*, the establishment of *The Patriot* newspaper symbolizes the reclamation of voice. The text observes that people who had long been silenced "suddenly got a voice of their own," which enables local experiences to appear publicly "as a witness of their experiences" (Ojaide 230). Journalism becomes ecological activism, and transmutes narrative into political weapon. Documenting deformities in animals and environmental damage, the newspaper converts invisible suffering into collective evidence. Resistance therefore operates through visibility. That is, to narrate is to resist erasure. Similarly, resistance in *Oil on Water* manifests through witnessing rather than overt militancy. The journalists' journey itself becomes an ethical act. That is, to see, record, and remember. However, Habila complicates resistance by presenting militants, villagers, and victims within morally ambiguous spaces. The constantly shifting waterways, which change from "the clearest… blue to a turbid, unknowable gray in a minute" (Habila 94), metaphorically reflect the instability of moral categories in zones impacted by exploitation. Resistance is fragmented because ecological violence has fractured social coherence. The texts therefore reject simplistic binaries of victim and hero. Ojaide portrays area boys and militant figures as individuals attempting to reclaim what has been taken from them,

suggesting that resistance grows from dispossession rather than inherent violence (Ojaide 47). Habila likewise depicts militants as products of ecological injustice, influenced by settings that have denied them viable futures. The environment thus produces resistance as much as it produces suffering.

Conclusion

This paper has demonstrated that Ojaide's *The Activist* and Habila's *Oil on Water* reimagine the Niger Delta not basically as a geographical setting scarred by oil extraction but as an intensely contested moral and ecological space where environmental devastation generates new forms of consciousness and resistance. Through differing nevertheless complementary narrative strategies, the texts reveal how poisoned rivers, abandoned villages, and militarized settings restructure human relationships to memory, identity, and belonging which expose ecological destruction as inseparable from political neglect and economic exploitation. Ojaide's activist-centered narrative foregrounds collective protest, ethical responsibility, and the insistence on public voice as necessary responses to environmental injustice, while Habila's inconspicuous, introspective storytelling emphasizes witnessing, ambiguity, and the emotional burden of seeing what the world prefers to ignore. Therefore, the texts demonstrate that resistance in the Niger Delta does not exist only in dramatic rebellion but also in acts of remembrance, narration, and survival that refuse expurgation. Allowing devastated settings to speak through human experience, the texts metamorphose literature into an archive of ecological memory and a form of moral intervention which suggests that storytelling itself becomes a mode of environmental justice. However, the paper argues that these texts challenge predominant developmental myths by insisting that any vision of progress detached from ecological care produces not prosperity but dispossession, and that within damaged environments, resistant voices persist as enduring affirmations of

dignity, community, and the possibility of renewal.

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LITERATURE, ARTS, AND ENVIRONMENTAL STORYTELLING IN AFRICA

Ignatius Nnaemeka Onwuatuegwu
Nnamdi Azikiwe University, Awka, Anambra State
in.onwuatuegwu@unizik.edu.ng

Obianika Peter Chukwuebuka
University of Nigeria, Nsukka Campus
obianikapeter@gmail.com
Abstract

Abstract
While scientific and policy accounts are key to situating Africa's environmental crises, they are insufficient for capturing the cultural, ethical, and affective dimensions of ecological change. In this article, I analyze environmental storytelling in African literature and the arts as embodied ecological imagination and public critique. Using African ecocriticism, postcolonial environmental humanities, and the environmental justice movement, I examine oral traditions, literary forms, the visual arts and performing arts, and the Niger Delta as an archive of ecological storytelling. A close reading of Helon Habila's Oil on Water demonstrates how the storytelling practices of fragmented narratives, polluted spaces, and bodily vulnerability render the violence of resource extraction (and the effects of the violence) felt and experienced, as opposed to measurable and quantifiable. I contend that African environmental storytelling is beyond representational; it connects the perception of the environment to an understanding of the past, and it amplifies the voice of the dispossessed in the community, and it aids in creating a more equitable community and environmentally just world.
Keywords: African ecocriticism; environmental storytelling;

Niger Delta; eco-aesthetics; environmental justice

Introduction

In Africa, discussions on the environment usually focus on specific metrics like pollution and emissions. These metrics are important to analyses, however, environmental changes are also perceived through emotions like loss, grief, attachment, and fear. Literature and the arts are able to add layers to these analyses by presenting Nature and the arts through various expressive means. Ecological Criticism asks how the disruption of Nature is perceived and how cultural forms impact the level of environmental damage and how it is perceived (Garrard, 2022). In African literary criticism, this idea has emerged from discussions about the history of colonialism and the extraction of resources, and the import of perceived, separate forms of Nature and the Nonhuman to the human realm. Vital (2008), Slaymaker (2001); and others, argue that African ecocriticism needs to engage with the colonial legacy and the diverse forms of contemporary livelihood, as well as the relationships among land, livelihood, and community. This paper refers to environmental storytelling in order to describe the artistic, literary, and oral forms through which community relationships are expressed.

There are three parts to the argument. First, environmental storytelling is a form of ecological knowledge rather than a form of ornamentation added to scientific fact. Second, the aesthetic form of environmental storytelling reveals environmental injustice by illustrating harm that is dispersed and/or occurs over time. Third, the case of the Niger Delta shows that environmental storytelling connects ecological destruction to issues of voice, blame, and power. Thus, the argument draws on African ecocriticism as well as the postcolonial environmental humanities and environmental justice.

African Ecocriticism and Environmental Storytelling

Partially originating from criticism of frameworks placing the preservation of wilderness at the forefront of every environmental debate, African ecocriticism broadens the scope of the African historical experience of land which incorporates ecological space, sustenance, ancestral memory, political sovereignty, and the place of resource extraction. Slaymaker (2001) urged resistance to the automatic and uncritical assignment of the agendas of metropolitan environmental discourses. Vital (2008) proposed the development of African ecocriticism through a postcolonial lens. Caminero-Santangelo (2014) relates African literature to environmental justice and political ecology, and argues that the access and authority dimensions of environmental risk and political struggle are essential to ecological discourse.

This paradigm challenges the presumed separation of the discourses of culture and nature. Iheka (2017) argues that African literature can ascribe agency to animals and the material environment of landscapes, and does this without the romanticization of what he terms a "simplistic tradition." Ihka's (2021) African Ecomedia builds on his earlier work and explores media beyond the printed word. Environmental storytelling (as iheka proposes) is the use of eclectic and innovative formal choices to generate an audience's ecological imagination and understanding such as choosing a particular medium, sequence, perspective, rhythm, and images. This concept draws on the narrative and cultural knowledge embedded in indigenous practices without romanticizing them as always ecologically sustainable and holistic. Environmental storytelling is a practice that has a high degree of generative capacity and elasticity because it can respond to the challenges of contemporary life such as modernity, state interventions, the changing nature of spirituality and the dominant extractive economy and serve as a locus of resistance.

Oral Tradition, Indigenous Knowledge, and Ecological Memory

Oral tradition is an invaluable tool for storing environmental memories. From songs and narratives to folklore and proverbs, observations about seasons, animals and water, even about community and the cultivation of danger and obligations, can all be recorded. These stories don't represent preserving a never-changing ecological state, but instead tell the stories of how to interpret and analyze the state of relationships in the landscape. In many African situations, the oral and written forms combine the material and the symbolic. For example, a river could be a physical resource, a location of a memory, a sacred place, and part of a collective identity at the same time. Postcolonial ecocriticism also helps explain the value of these forms in the state of the environment today. DeLoughrey and Handley (2011) argue that colonialism reorganized the environment and the state structures, and DeLoughrey (2019) elaborates how the cultural forms counter the damage of environmentally violent acts that are spread across space and time. Therefore, oral and literary forms can record the memories of the environment that formal, expert elicit archives cannot. This is especially important for communities that have to tell the story of the destruction of their environment using the language of the state and corporations, who lack concern for the environment and community.

The Niger Delta as an Archive of Environmental Storytelling

The Niger Delta is an important location for the study of African environmental narratives. The region exemplifies the paradoxes of extractive development. At the national level, oil production has increased revenue; at the community level, oil production leads to environmental pollution and damage to the community's economic base, as well as the erosion of community rights to demand accountability and remediation. The Environmental Assessment of Ogoniland examined the magnitude of the remediation crisis due to the extensive contamination of Ogoniland by hydrocarbons

(United Nations Environment Programme, 2011). Narratives address the harm caused to the environment through the perceptions, displacements, fears, and memories of the people who live within the distorted geographies of the environment.

Helon Habila's Oil on Water (2010) offers an excellent example of this. The novel follows the story of Rufus, a young journalist, and his colleague Zaq, an older journalist, as they navigate the creeks of the Niger Delta. Their purpose is to locate and free the wife of a British oil company executive, who has been kidnapped. Hummel (2020) argues that the novel's contribution to environmental discourse stems from its unique structuring of the landscape of oil extraction in which the story is set. Ecological harm is not a minor plot detail. The landscape of the Niger Delta, which is characterized by polluted water, damaged communities, smoke, and disruption, continually shapes the perceptions of the characters and the trajectory of the plot. The novel also employs the sensory distortion of space to articulate the impacts of ecological degradation, by making the characters' journey disorienting.

The novel's fragmented structure is important as well. The Delta's expectation of an overarching narrative is contradicted by the changes in memory, testimony, and perspective. The same can be said for the social instability caused by conflicting corporate, governmental, military, and community claims. Instead of placing environmental crises as a discrete "event," Habila situates the environmental crisis as an ordinary, cumulative condition that is an ongoing part of daily existence. This is a reflection of Nixon's (2011) idea of "slow violence." Environmental damage is violence that is gradual and dispersed. It is difficult to portray violence that takes so many forms and is so spread out over time. Analyzing Oil on Water through the lens of environmental justice also reveals the intentionality of the narrative structure. The novel asks the reader to consider the hierarchy of suffering, the boundary of the newsworthiness of loss, and the marginalization of so many other

losses. Caminero-Santangelo (2014) states that much of African environmental writing connects ecological devastation to the injustices of the political order. Habila's work does this not by sketching a simplistic picture of moral failure, but by showing the diverse, fractured, and failing institutions and exposed communities. It's powerful because it asks the reader to reconcile the unreconcilable and understand the consequences of extraction.

Eco-Aesthetics, Public Narrative, and Perception

Environmental storytelling incorporates both subject matter and form. In relation to eco-aesthetics, this involves considering how the choices of an artist can influence how we think and feel about the environment. For example, a series of the same image may show us the effects of gradual environmental destruction. If an artist presents their work in a way that is out of chronological order, this may reflect instability. Also, a variation in how an artist presents work from different perspectives may show the differing claims that coexist regarding the same environment. Heise (2008) mentions that the potential of an artist to imagine the environment is at its greatest when they can create a bond between the local and the global. The African literary and artistic forms are able to make this bond because they address household experiences, and can also incorporate memories, both communal and national, as well as the global systems of extraction that impact Africa.

The arts have the ability to shock audiences from complacency towards environmental destruction that has become normalized. Nixon (2011) describes the challenges that slow violence presents to representation; in response to this difficult reality, aesthetics can give form to the passage of time. Visual arts, performance, film and poetry can all render the technical unusually and critically problematic in a sensorily and affectively experiential way. Eco-social devastation and the precarity it engenders are driving the imagination of new artistic practices. (Demos, 2020) Art will not, and should not be expected to, consistently and directly impact

policy. It should be more accurately and justly viewed as an expansion of the imagination and ethics. Environmental art can be therapy for neglected experiences and a clearing of the imagination for the best possible environmental future. Environmental storytelling will bring new dimensions of environmental perception to the public.

Postcolonial Environmental Justice and the Politics of Voice

Postcolonial environmental justice examines the distribution of environmental benefits and burdens, the processes behind decision making, and the inclusion of different knowledge systems. Schlosberg (2007) argues that justice is of multiple facets: recognition, participation, and distribution. In the context of African extractivism, the threat to the environment is often most concentrated in those communities that lack power to influence the corporate or state decision making. Literature and the arts have a role to play in making previously marginalized voices heard. Huggan and Tiffin (2015) argue that the focus of postcolonial ecocriticism has to be the connection between the legacies of imperialism, current economic power, and the way the environment is represented. In a similar way to Huggan and Tiffin, Wenzel (2019) shows the power of world literature in articulating the environmental crisis and the unbalanced environmental conditions. African environmental literature is the conjunction of the historical and the present environmental concerns.

Environmental literature critiques postcolonial narratives and reconstitutes an understanding of relationships and responsibilities from an environmental perspective. The purpose of this literature is to highlight the importance of local environmental knowledge and local ecologies, while not undermining the actual science. Environmental decisions are placed in context when they are grounded in local and placed based ecologies.

Conclusion

African environmental storytelling shows ecological crises as having material, historical, cultural, and ethical dimensions. African ecocriticism has advanced when it has critiqued outsider theories of 'nature' and showed the various histories through which landscapes become places of livelihood, memory, extraction, and struggle. African environmental storytelling embraces oral and written forms, as well as visual and performing arts. This storytelling shapes the audiences' ability to envision the past and articulate their opposition.

The Niger Delta is an especially good case for this example. The novel Oil on Water portrays the extraction of oil and its many associated consequences. It does not provide a direct description of environmental destruction. Oil on Water uses fragmented journeys, unreliable testimony, and the wreckage of the landscape to express the violence of extraction. This method of storytelling lacks many of the functions of scientific storytelling. It cannot describe the ways in which the world has been altered due to extraction and destruction. By enhancing our perception of the environment, and framing this within the context of injustice, the art and literature of Africa can help envision the future.

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THE GARDEN OF EDEN WITH THE NEW JERUSALEM AS MODEL FOR BIODIVERSITY CONSERVATION: IMPLICATIONS FOR PUBLIC HEALTH IN AFRICA

Mark Omorovie Ikeke, PhD
Foundation for Indigenous
& Intercultural Relations,
Ovwor, Delta State, Nigeria
Omorovie77@gmail.com

Abstract

Biodiversity, which refers to the variety and multiplicity of life forms in the universe, is often endangered by human industrial activities. The growth in human population, the advancement of scientific technology and industrial activities, unplanned urbanisation, resource wars, poverty, human migration, environmental refugeeism, deforestation, desertification, climate change, global warming, etc all bring about destruction of plants, animals, organisms and other life forms as they happen. Take, for instance, the issue of a warming climate. As the climate warms, some organisms cannot cope with the heat, and so they die out. The creation of more human habitation and industries means more natural places have to be cleared, and in the process, animals and birds have their habitation destroyed. This paper argues that the divine creator, by creating the Garden of Eden and even when Eden was lost, promising a new heaven and a new Jerusalem, has provided a model for all life that he created on earth should be conserved and managed. The paper also shows the implications of environmental conservation for public health and the entire biotic well-being. The paper uses critical biblical hermeneutics and analysis to examine the issues above. The paper discovers that biodiversity is facing destruction and extinction. The paper concludes that the conservation of biodiversity can help to promote

public health and biotic well-being on earth.
Keywords: Africa, Biodiversity, Biotic, Conservation, Eden, Environment, Garden, Jerusalem, Health, Public, Well-being.

Introduction

The world religions have played a role and can continue to play a role in mitigating the environmental crisis, fostering good public health, and promoting biotic flourishing. Many authors (Gottlieb, 2006; Berry, 2009; Berry, 1988; Ruether, 2005; Smith, 1997; Borde, Ormsby, Awoyemi & Gosler, 2023) have stated that religion can play a role in environmental conservation and, by implication, promote public health and biotic wellbeing. It is true that at times, some persons may have abused and used religion to degrade the environment. But that does not erase the core teachings of the religions, which see God as the creator of planet Earth and all life on the Earth. The Christian religion in particular, of which the paper is concerned, promotes stewardship and conservation of environmental resources, as Hart (2004), Anah (2019), Menamparampil (2012), and Francis (2015) enunciate. All through the biblical records, there are stories, images, models, and examples that inspire environmental conservation of human and non-human lives.

God creates a diversity of plants, vegetative and tree life. Biodiversity is God's desire and its conservation is God's concern. In addition to plants, trees, and vegetation, God further commands: the waters to teem with living creatures, birds to fill the air, and beasts to fill the earth; and they are all commanded to flourish (Genesis 1:21-25). This paper uses critical hermeneutics and evaluative methods to argue that the resources of the Christian religion, such as the images/stories of the Garden of Eden and New Jerusalem, can be used to motivate people to conserve nature and all life on earth. In carrying out the purpose of this paper, a conceptual clarification is made, followed by an examination of the state of biodiversity conservation in Africa. The implication of this

for public health is then presented. How the images of the Garden of Eden and New Jerusalem can help to inspire biodiversity conservation is then deciphered. When this has been done, the paper is brought to a conclusion.

Conceptual Clarifications and Analyses

The basic concepts that require clarification in this paper are Garden of Eden, New Jerusalem, Model, Biodiversity Conservation, and Public Health. The Britannica Editors (2026) write that the Garden of Eden in Genesis from the Hebrew Bible is the biblical earthly paradise in which Adam and Eve, the woman and man created first, lived, before they were driven out for their disobedience of God's command. The Britannica Editors (2026) state further that the word Eden probably comes from *edinu*, an Akkadian word borrowed from the Sumerian word *eden* (plain). EBSCO (2020) states that the Garden of Eden speaks of innocence and also the consequences of human action, as Adam and Eve are expelled from the garden for their disobedience.

It is stated in the Encyclopedia of Environment and Society (2007) that: "The Garden of Eden appears in the writings of the Abrahamic religions, Judaism, Christianity, and Islam. In the biblical creation story of Genesis, it is a beautiful garden of trees planted by God in the land of Eden and watered by a river. God intends that the first man and woman, Adam and Eve, live there in contentment and innocence" (para. 1). The Garden of Eden represents and stands for a place of peace, tranquillity, beauty, serenity, goodness, harmony and ecological flourishing. Adam and Eve are entrusted with the garden to keep and conserve while they are sustained by the resources of the garden. But they are not to deplete the garden as they are commanded to cultivate it, till it, and enhance the flourishing of all life in the garden.

The next term that requires clarification is "New Jerusalem." Hahn (2009) states that in the Old Testament, the prophetic vision of a

glorified city, the New Jerusalem, exceeded the restored city of Jerusalem after the exile, and so there is a greater reality of a city more noble than the old one; this new Jerusalem is celestial and heavenly, and is the spiritual capital of God's creation. The New Jerusalem is like Eden restored, as the beautiful scenic view and landscape in Eden are replicated in the New Jerusalem.

Collins (2005) states that: "A model of an object is a physical representation that shows what it looks like or how it works. The model is often smaller than the object it represents" (para. 1). A model is what represents something else. It points to something else. To say that the Garden of Eden is a model for biodiversity conservation is to say that just as Adam and Eve took care of the Garden and protected it from harm, so also humans are to work to conserve Eden, which represents the larger earth. Marais (2012) states that: "The New Jerusalem is the finality of God's reign and rule with His people, forever."(para. 1). The New Jerusalem is mentioned only in the book of Revelation and is seen as a culmination of God's salvific work and redemption. In the New Jerusalem, Eden is restored, and a life of eternal bliss, happiness and harmony among all creation is restored.

The African Development Bank Group (n.d) states that biodiversity conservation refers to protection from loss, safeguarding, management, and restoration of species and their natural habitats to foster biodiversity. Biodiversity is the short way of writing biological diversity. There are millions of species of different forms of life on Earth, and these include animals, plants, microorganisms, ecosystems, both seen and invisible forms of life and diverse entities on planet Earth. Sponsel (2008) writes that biodiversity is "the variety, variability, and processes of life at all levels from the genetic to the biosphere. However, usually the focus is on the number of species in an area or biome. (Biome refers to similar types of ecosystems, such as tropical rainforest)" (P. 179).

The CDC Foundation (n.d) writes that public health concerns protecting the health of whole populations such as a neighbourhood, a region, or even an entire country. Cleveland Clinic (2024) states that: "Public health is a field that's dedicated to improving our health and well-being. Public health experts assess the needs of particular groups, or populations, rather than the needs of any one person. This makes public health different from healthcare, which involves diagnosing and treating individuals. Such a big-picture approach allows public health efforts to benefit lots of people at once — including you and those you love" (para. 1). Public health has to do with groups of people and communities or the entire population. As presented in this paper, public health is impacted by the state of health of biodiversity.

What then is biodiversity and biodiversity conservation? Greenpeace Middle East and North Africa (2024) states that biodiversity is also called biological diversity and refers to the variety of all life on Earth, such as living things (bacteria, fungi, plants, animals, insects, etc). Flint (1991, as cited in Phil-Eze, 2007) says that biodiversity is variability and variety of all animals, plants and microorganisms on Earth. Ikeke (2020) writes that all life on Earth in its different species and varieties is what biodiversity is all about. Table Debates (2025) states that: "Biodiversity conservation refers to all human activity aimed at the preservation of both the variety and variability of living organisms in a particular area of concern, or on earth in general" (para. 1). It is all anthropogenic efforts and actions to protect the varieties of different life forms on Earth. Humans will use some biodiversity in sustaining themselves, but it should be done sustainably.

Biodiversity Conservation and Public Health in Africa

It is imperative in this section to first state the situation of biodiversity conservation in Africa. World Health Organisation Regional Office for Africa (2023) rightly states that: biodiverse

systems and well-functioning ecosystems foster healthy communities; and this healthy system provide varied ecosystemic services such as fresh water, food, medicine, clean air, nutrition security, diseases regulation, climate regulation, pollination, mitigating extreme events, forest services (natural watershed warden, regulation of quality and quantity of river water, and sustenance of life). According to the African Development Bank Group (n.d) Africa is rich with biodiversity, with diverse ecosystems and their species such as lions, elephants, giraffes, plant species, tropical rainforest, savannah, coral reefs, etc. The African Centre for Strategic Studies (2022) states that: "The African continent (20 per cent of the planet's land) is home to one-quarter of the world's mammal species and one-fifth of the world's bird species. At least one-sixth of the world's plant species are endemic to Africa. The continent also boasts 369 wetlands of international importance" (para. 1).

The African Centre for Strategic Studies (2022) states that it is estimated that 20% of the land surface in Africa will be degraded by pollution, soil erosion, salinisation and loss of soil fertility or vegetation; the Congo Basin is depleted of 500,000 to 1.2m hectares annually. Writing about the Central African Forests, De Bruin (2015) writes that: "The constant rise in logging concessions, many of which are illegal, the voluminous bush meat trade, and poaching are putting the animals of the forest in huge jeopardy. As with so much of Africa's wildlife, the ivory of forest elephants is becoming a valuable commodity, and poaching is reducing their numbers rapidly" (para. 2). Greenpeace Middle East and North Africa (2024) states that biodiversity loss results from human activities and climate change.

Much of the destruction of biodiversity or their endangerment comes from anthropogenic activities. The African Centre for Strategic Studies (2022) states that the drivers of biodiversity destruction in Africa include mining, destructive farming,

dangerous fishing practices, and logging. Much of Africa, as in the Niger Delta, Ikeke (2020) writes, suffers from biodiversity destruction caused by the exploration and exploitation activities of oil companies. In a place like the Niger Delta, oil companies care very little about the environment and biodiversity. They slowly attend to oil spillage. They fell trees to give room to pipelines and their equipment. They flare gas day in and day out. Sponsel (2008) writes that causes of biodiversity loss include: European colonialism, industrialisation, globalisation, economic development, coercive and rampant missionisation from Christian and Islamic groups. Wherever there are mining activities or extractive industries, as you find in much of Africa in the Democratic Republic of Congo, Nigeria, Liberia, Namibia, Equatorial Guinea, etc there is bound to be destruction of biodiversity, as the extractive industries often care little or nothing for biodiversity. All that matters to them is the profit that they are going to make.

Diverse solutions have been proposed for biodiversity conservation in Africa. The WHO Regional Office for Africa (2023) states that there should be enhanced surveillance, stringent monitoring and regulation of trade in wildlife, treatment of zoonotic diseases and public education that empowers individuals to make the right decisions. For the African Development World Bank Group (n.d), through technical assistance, knowledge generation, capacity building, policy advisory, finance, wildlife conservation, and natural capital cultivation, biodiversity can be conserved. Similar suggestions are given by the following authors Bezeng et al. (2025) " (i) accelerate data collection, data sharing and analytics for informed policy and decision-making; (ii) innovate education and capacity building for future generations; (iii) enhance and expand protected areas, ecological networks and foundational legal frameworks; (iv) unlock creative funding channels for cutting-edge conservation initiatives; and (v) integrate indigenous and local knowledge into forward-thinking

conservation strategies"(para. 1).

It should be clear from the above that biodiversity and healthy biodiversity, for that matter, play a great role in good public health and biotic wellbeing. When biodiversity is destroyed and endangered, the multitude of services that come from healthy ecosystems and their diversities of life are also endangered or vitiated. The implications for public health come in various ways. Take, for instance, as the African Centre for Strategic Studies (2022) states, much of the rural population in Africa depends on natural ecosystems for water, food, and energy to secure their livelihood and health. You can imagine that as the natural ecosystems are degraded from the various factors listed above and others, their state of health is endangered and public health facilities come under stress. The African Centre for Strategic Studies (2022) states further that the Congo Basin, which is called the second lung of the world, absorbs up to four (4) per cent of global emissions of carbon, and this offsets more than the continent's yearly emissions. You can see the implications of this. Human beings need to breathe in oxygen to survive and also emit carbon dioxide. Destruction of forests affects human health; the more trees are destroyed, the more physical entities that provide oxygen for humans are reduced. Biodiversity is important for human health and wellbeing. Greenpeace Middle East and North Africa (2024) writes that: "Biodiversity is the life-support system of our planet. We rely on it for food, energy, medicine, fresh water and soil purification, pest control, breaking down waste and many, many more. Without it, the environment couldn't provide us with the things we need to survive" (Sec. 3).

Some of the implications of biodiversity loss to Africa are well stated by the African Centre for Strategic Studies (2022) as follows: human intrusion into forest places can create viruses, etc. When biodiversity is affected, it affects the health and life of people. The more people get sick as a result of the degradation of biodiversity,

the more it puts public health facilities under strain. The state of biodiversity then affects public health. Rim-Rukeh (2009) opines that the importance of biodiversity includes water resource protection, soil formation and protection, nutrient storage and cycling, water disposal, climate regulation, maintenance of ecosystems, pollination of flowers, food source, medical resources, wood products, ornamental plants, eco-tourism, cultural values, research and education. The fact is that all the ecosystemic services that biodiversity provides for humans are crucial for protecting the population of people. When ecosystems are diseased or degraded, they affect the health of humans and, by implication, the state of public health.

Osunderu (2022) has shown from cases in Ogun and Lagos States of Nigeria that the forest resources that traditional medical practitioners depend upon are being affected by climate change, and as the trees and plants they depend on are destroyed, human wellbeing and security are affected, and this impacts public health. This can lead to public health emergencies; the more people are sick they more they put strain on public health facilities. Oyekunle (2024) notes that biodiversity is undervalued and its implications for public health are less known, as it is continuously degraded by overexploitation, pollution, extraction, population growth, poverty, etc. In a work that connects environmental degradation to public health concerns, Adeosun et al. (2024) indicate that climate change in Nigeria leads directly to heat-related diseases, death, mental health problems, injury, and phenomena like flooding, food insecurity, and displacement that affect the lives of people. What happens to the environment and, by extension, the biodiversity in it affects the health of people and public health concerns.

The Garden of Eden with the New Jerusalem as Model for Biodiversity Conservation

Rivers and streams flowed in the Garden of Eden. Adam was given the assignment to name the animals. Adam and Eve were to eat

from the trees in the Garden. There are also rivers and streams in the New Jerusalem. There was the presence of the tree of life in Eden, and in the New Jerusalem there will be a tree of life. The presence of God is manifest in the Garden of Eden, and his presence will fill the New Jerusalem, which will unite with the new heaven and the new earth (Revelation 21). There are precious stones in the Garden of Eden and in the New Jerusalem. The images in both the Garden of Eden and the New Jerusalem as depicted in vision are strikingly similar. Both are the abode of the divinity, the supreme being, God. Both are places of bliss, harmony, peace, and all diversities of life; humans, plants, animals, birds, flowers, etc live in co-existence and harmony. The New Jerusalem is generally seen as Eden restored, or paradise regained.

The mandate given to human beings (Adam and Eve) and by extension all their descendants has not ceased. Christians generally see the whole earth as God's garden. Metaphorically, the Garden of Eden is not limited to that particular spot in which Adam and Eve lived their lives. The story of the Garden of Eden should not be separated from the first account of creation in Genesis 1, in which man and woman are tasked with having dominion over the earth. The Encyclopedia of Environment and Society (2007) states that the Garden of Eden, which is also called the garden of God, points to contentment for humans and renewal for God's people after the Babylonian captivity. In the Encyclopedia of Environment and Society (2007) just mentioned, it is related that the location of the garden is hypothetical, and is a symbol of harmony between humans and God, between humans and nature and a model for botanical gardens, and all these should drive species conservation. Magezi (2021) notes that: that Eden is a call to Christian stewardship, as humans are created and called by God in Genesis 1:28 and 2:15 to take care of the earth, the entire environment with all living and non-living creatures. Human beings are called to ecosystem management and to allow the earth to flourish. The responsibility of taking care of all life on Earth in its diversity

remains, and humans are to be inspired by the image of the Garden of Eden to work for biological conservation. They should also be inspired by the New Jerusalem, which speaks of the supernatural restoration that is coming in the future. But humans have the duty now, not waiting for that future alone. They are the instruments that God will use to restore the Earth from a degraded state. Ndoga (2022) writes that Genesis 2:15 provides an ecological mandate and strategy for humans to take care of the earth. The Garden of Eden and the New Jerusalem should be an inspiration to make cities and urban locations places of beauty, serenity and harmony. There ought to be more green spaces in cities and towns than just populating everywhere with buildings, industries, and factories. There should be the creation of more serene environments with water springs, fountains, trees, plants, etc where people can sit and reflect. Eden and the New Jerusalem should be an inspiration to engage in a green revolution that makes human habitation more peaceful and serene. Tonstad ( ) says that both Genesis and Revelation are books that have ecotheological motives, as the God who created in Genesis and blessed creation is also the same God who heals a broken earth in Revelation and restores access to the tree of life. Both creation in Eden and the New Jerusalem, which is the earth restored, should impel humans to be environmental conscience and conserve the diversity of life on earth, not simply for human selfish interest but for the entire cosmic good.

It is imperative to remark here that the mandate to have dominion over creation and creatures, which provides the basis also for stewardship, should not be misconstrued as domination or exploitation. Much of the Christian tradition, such as the World Council of Churches, the Vatican, and the Ecumenical Patriarch of Constantinople, have all condemned exploitative abuse of nature. Paul (1971) in *Octogesima Adveniens* writes that: "By an ill-considered exploitation of nature, he [humanity] risks destroying it and becoming in his turn the victim of this degradation ... flight from the land, industrial growth, continual demographic expansion

and the attraction of urban centres bring about concentrations of population difficult to imagine." (no. 21). In a similar vein, Francis (2015) condemned a throw-away culture that has filled the earth with garbage. While noting that to have dominion does not amount to exploitation. They ought to do this knowing that as they do this, they also contribute to improving both human and public health in Africa.

From the above, it is imperative to state how the Garden of Eden and the New Jerusalem serve as a model for biodiversity conservation. When you look at the Garden of Eden in pictorial and scenic form, you find streams and rivers, trees and plants and vegetation, plants and animals, birds living in peace and serenity. There is no violence in the Garden. It is the same imagery that you find in the New Jerusalem, Eden restored. Humans should take the scenes and landscape of the above and replicate them on earth. Earthly cities should not just be filled with buildings; there should be a real transition to a green economy and deliberate efforts to green the cities. Streams and rivers should be allowed to flourish. Natural waterways should be allowed to flourish. There should be deliberate attempts to plant more gardens, plants and vegetation in empty spaces. Just as there is deliberate effort to plant trees to slow down desertification, so also there should be more planting of trees as in Eden, to beautify the towns and cities. As Adam and Eve acted as stewards in the Garden, so human beings are to act as stewards in taking care of forests, trees, streams, rivers, animals, birds, etc. Both Eve and the New Jerusalem should inspire humans to be protectors of green spaces and the protection of the diversity of life on earth. A model serves as an example. Eden and the New Jerusalem show human beings what they should strive for on earth. Eden and the New Jerusalem cannot be replicated exactly as they are presented in the biblical text, but human beings can be inspired to work to create an environment in which peace flourishes among human beings and the diversities or plants and animals on earth. Humans should create bird and animal sanctuaries and have

restricted areas where humans don't encroach for agriculture or industries.

The image of Eden and the New Jerusalem should inspire re-afforestation programmes in Nigeria and beyond. Government in Nigeria and in other African countries should create environmental parks and a serene environment where people can find time to rest to reduce stress. Eden and the New Jerusalem are clean and peaceful places. There must be environmental laws and regulations that promote a clean environment and facilitate access to clean water as in Eden. Environmental laws should be enforced to protect from air pollution. It is painful to note that in a country like Nigeria, the air, especially in the Niger Delta, is polluted with gas flaring and other oil extractive activities. All these impede public health and the safety of people. The image of Eden and the New Jerusalem should drive the desire to protect public health facilities and the people from all forms of environmental pollution. The health of Adam and Eve in the Garden depended on the health of the garden and the environment in the garden.

Conclusion

The paper examined the state of biodiversity in Africa. It was shown that biodiversity is facing serious threats and much biodiversity has also been destroyed. It was shown that biodiversity is often endangered or degraded by human factors such as industrial growth, agricultural activities, urbanisation, deforestation, violence and war, etc. It was also revealed that healthy biodiversity contributes to a healthy society and people. When biodiversity is poisoned, degraded and endangered, it affects people's health as humans depend on services rendered by biodiversity for their health and survival. When human health is affected negatively, it invariably affects the state of public health facilities, as people depend on public health facilities for health and well-being. The paper argued for the need for the conservation of biodiversity for the numerous functions it performs for humans and

the entire ecosystemic good. The image of the Garden of Eden with the New Jerusalem in the bible that stands for eco-peace, harmony, serenity, and beauty was proposed in the paper as motivation for biodiversity conservation. Both the Garden of Eden and the New Jerusalem are places of diversity of life, and God has mandated humans to cultivate the garden, a task which is equally reflected in the New Jerusalem, Eden restored. The attitude of humans should not be to wait for the New Jerusalem to come only, but they should join God in creating that New Jerusalem as they work for ecological restoration of the Earth through engaging in a green revolution.

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THE ROLE OF OKUGBEAKPEJE AND IGWEBUIKE PHILOSOPHIES IN BIODIVERSITY CONSERVATION FOR ECO-WELLNESS IN AFRICA

Mark Omorovie Ikeke, PhD
Foundation for Promotion of Indigenous & Intercultural Relations, Ovwor, Nigeria

Toma Brume,
Michael and Cecilia Ibru University, Agbarha-Otor

Abstract

The question of environmental wellbeing has become increasingly urgent in contemporary Africa, where the degradation of ecosystems continues to threaten both human health and the wider biotic community. The erosion of biodiversity not only undermines ecological balance but also compromises public health, given humanity's dependence on nature for food, medicine, and overall wellbeing. This situation calls for a rethinking of the ethical and philosophical foundations of human interaction with the natural environment. This paper argues that African indigenous philosophical resources provide critical insights for addressing the challenges of biodiversity loss and its implications for eco-wellness. It engages the Urhobo concept of Okugbeakpeje, which affirms the unity, solidarity, and interrelatedness of all forms of life, alongside the Igbo philosophy of Igwebuike, which emphasises strength in communal interdependence. These philosophies articulate a worldview in which existence is fundamentally relational, thereby offering a moral basis for ecological responsibility. Employing cultural hermeneutics and critical analysis, the paper examines how these concepts can be re-

appropriated within contemporary environmental discourse to foster collective commitment to biodiversity conservation. It contends that the current ecological crisis reflects, in part, a breakdown of relational consciousness embedded in indigenous thought. The paper concludes that a recovery and constructive appropriation of Okugbeakpeje and Igwebuike can contribute significantly to biodiversity conservation and the promotion of eco-wellness, thereby advancing a more holistic understanding of public health in Africa.

Keywords: Biodiversity, Eco-wellness, Public Health, Africa, *Okugbeakpeje*, I*gwebuike*, Indigenous Philosophy.

Introduction

The state of biodiversity in Africa and other parts of the world is dire. A diverse number of species such as monkeys, elephants, squirrels, fish, etc are threatened, and some have been lost as a result of illegal wildlife poaching and trade, illegal logging, mining, rapid urbanisation, deforestation, etc. Africa is a land that is rich with enormous biodiversity. Isa (2024) writes that the rich biodiversity of Africa includes wide varieties of living organisms, genetic differences and ecosystems such as rainforest, savannah and over 50,000 species of animals and plants. All life on Earth depends on the rich resources that come from biodiversity. When biodiversity is depleted or brought into extinction, human life and the life of other entities in the ecosystem are also endangered. Delio, Warner & Wood (2008) write that:

> Life is amazing. All life is entirely dependent upon our planet for everything it needs …. Water falls from the sky and runs through creeks and rivers. Plants and animals grow and are all part of the circle of life. Air circulates around the globe, refreshing and renewing all life's creatures. The sun, trees, plants, oil, coal and gas provide energy. The beauty of

> creation grabs our attention, inspiring us and providing for our needs (p. 21).

This is the variety of life. This is biodiversity. Life is beautiful. But life is also being endangered by human activities. There is a need for concerted efforts to mitigate the harm that humans are doing to the health and well-being of humans and the entire Earth. This is the concern of this paper. The paper argues that it is not just individual efforts that are required to mitigate biodiversity loss and other environmental problems. Rather, humans should band together and come together to confront the problem. The paper uses the lens of the indigenous philosophies of *Okugbeakpeje* from the Urhobo people of the Western Niger Delta of Nigeria and *Igwebuike* from the Igbo people of the Eastern Niger Delta to argue for human solidarity, joint efforts, collective actions and galvanising the strength of the community or group to facilitate biodiversity conservation.

Consequent on the above, the paper shall, through a critical analytic and hermeneutic method, present conceptual clarifications, look at the state of biodiversity loss in Africa and its implications for eco-wellness, and discuss the role of the indigenous philosophies of *Okugbeakpeje* and *Igwebuike* for biodiversity conservation. When that has been done, the paper will be brought to a conclusion. It should be noted that not every solution to biodiversity loss can be examined in a paper like this; the focus shall be on the two indigenous philosophies mentioned above and how they can help in mobilising for action for conservation of biodiversity.

Conceptual Clarifications

Concepts that pervade this paper that require explication for the better understanding of this research are: *Okugbeakpeje*, *Igwebuike*, biodiversity conservation and eco-wellness. Ikeke (2025) writes that among the Urhobo people, from whom the word

Okugbe comes, *Okugbe* means the collective, together, and gathering; and it also stands for unity, collective care, solidarity, and common concern. *Okugb*e is comparable and akin to African concepts like Ujamaa, Ubuntu, and Igwebuike. The term *Okugbeakpeje* can be broken into three words: *Okugbe* (togetherness or togetherness), *akpo* (life or world) and *eje* (all). *Okugbeakpeje* means the togetherness of all life. It means all life in relationship to one another. It is solidarity and complementarity of all life. All things are radically interconnected. *Okugbeakpeje* denotes ecological solidarity, and from an African vantage point, Afroecosolidarity; these are concepts that Ikeke (2022) has extensively discussed in other papers. Ikeke writes that: "Ecosolidarity is solidarity with and for the earth. It is both an attitude and action paradigm. Afroecosolidarity or its like terms-Afroecosolidarity or Afroecosolidarity, or African ecological solidarity stands for the reality that ecosolidarity is an African value and indigenous way of life. Standing in solidarity with the earth is not foreign to Africa" (p. 323).

The other word that requires definition is *Igwebuike*. Kanu (2015) writes that the term Igwebuike literally means there is strength or might in number, and from that literal meaning comes the notion that when human beings stay together, are in solidarity or live complementarily, they are unconquerable. Human beings are created for shared existence. Wisdom Library (2025) states that:

> Igwebuike is a name of Igbo origin, a prominent ethnic group in southeastern Nigeria. The name translates to 'unity is strength' or 'community is power.' 'Igwe' means community, people, or multitude, while 'bu ike' means 'is strength' or 'is power.' The name reflects the Igbo emphasis on communalism, cooperation, and the belief that collective effort leads to success and resilience. This name is often

given as a testament to the importance of togetherness and mutual support within the family and community.

Another cardinal concept in this paper is biodiversity conservation. Sponsel (2005) writes that: "The scientific concept of biodiversity has revolutionized biology, conservation, and related arenas in Western society since the 1980s. Biodiversity refers to the variety, variability, and the processes of life at all levels from the genetic to the biosphere" (p. 179). Biodiversity is the different kinds of life on Earth, including the class they belong to and all the ecosystemic processes of life in which they inhabit and interact. You cannot speak of biodiversity without thinking of ecology, the interaction of all life forms in their environments. Biodiversity is protecting these species of plants, birds, animals, flowers, microorganisms, etc from harm and extinction. Humans will make use of environmental resources, but it should be done sustainably. Wilson (1992, as cited in Phil-Eze, 2009) states that biodiversity refers to the "variety of living organisms at all levels-from genetic variants belonging to the same species, through arrays of species, families and genera, and through population, community, habitat and even ecosystems levels" (pp. 33-34).

In this research, the term eco-wellness or ecowellness or EcoWellness shall be used interchangeably. Reese (2015) states that: "EcoWellness is a sense of appreciation, respect for, and awe of nature, resulting in feelings of connectedness with the natural environment and holistic wellness. …Nature is conceptualized in Eco-Wellness as a positive, direct or indirect, and purposeful engagement with a nonhuman entity. Such definitions might include positive interactions with a domesticated animal, watching a sunset on a beach, and indirectly experiencing nature via a mindfulness meditation where the participant visualizes his or her favourite natural landscape" (p. 317). Ecological well-being is a generic term that is used in several disciplines, such as ecology,

sociology, politics, psychology, and economics, to describe the wellness of the ecological system and more generally the planet Earth. Because an ecological system includes its inhabitants, human quality of life is directly tied to the health of the environment and vice versa. Therefore, ecological well-being does not only refer to the well-being of the natural environment or the planet but encompasses the relationship between humans and the environment. The actions of humans (individuals or societies) on their natural environment may impact the well-being of ecological systems, which in turn impact the.

Biodiversity Loss and Implications for Eco-wellness

Isa (2024) writes that over 4m hectares have been decimated by deforestation, logging and infrastructure development; the destruction of forests has led to countless extinctions of species; illegal wildlife trade threatens rhinos, pangolins and elephants, and there is massive destruction of fauna and flora on the African continent. Clements et al. (2025), in their study, indicate that almost a quarter of the biodiversity of Sub-Saharan Africa from pre-industrial times has been lost, more than 75% of the population of mammals has decreased, and 80% of the wildlife of animals and plants left are outside protected areas, subjecting them to endangerment. One human activity that has a great impact on biodiversity is agriculture. Clements et al. (2025) state that: "Intensive, high-yield agriculture reduces habitat diversity and increases chemical inputs, with significant impacts on a wide range of species. In contrast, traditional smallholder systems tend to maintain more ecological complexity and support higher levels of biodiversity." This highlights the importance of transforming modern agriculture to be more earth-friendly and protective of biodiversity. Isa (2024) states that the following solutions can help in mitigating biodiversity loss: government creation of nature reserves and national parks, massive financial support by international organisations to help Africa, reducing cultural reliance on endangered species, etc.

One of the fundamental reasons for biodiversity conservation is to promote eco-wellness. Biodiversity loss leads to many negative impacts on the African continent. Njoku (2025) writes that: "According to the International Union for the Conservation of Nature (IUCN), over 6,400 animals and 3,100 plants in Africa are at risk of extinction. The decline of Africa's abundant ecological biodiversity poses a significant threat to millions of livelihoods. It exacerbates food insecurity and conflicts over land, leading to volatile agropastoral and geopolitical contentions over grazing land." (p.2). The question of healthy biodiversity cannot be separated from your health, both personal and that of public health. HOG (2025) states that there is interconnections between environmental sustainability and personal health, for if the planet is not healthy, your health is impacted. It is important to create a healthy planet and protect the planet's biodiversity, which fosters healthy ecosystems, if human beings are to live healthy lives. The definition of ecowellness certainly implies that beautiful and serene nature which is made up of various diversities of life forms, enhances human health. When biodiversity is destroyed, which leads to a lot of health problems for humans and a reduction of ecosystemic services, human health is impacted. Polluted environments, environments filled with garbage and refuse, degraded landscapes, and polluted atmospheres all make life uncomfortable for humans and also lead to the death of organisms. Blankespoor, Dasgupta & Wheeler (2025) argue that: "Biodiversity is essential for ecological stability, human well-being, and economic progress, providing critical ecosystem services such as clean water, food, and climate regulation. However, it faces unprecedented threats, with extinction rates accelerating to 1,000 times the natural baseline due to habitat destruction, overexploitation, pollution, invasive species, illegal trade, and climate change" (p. 2).

It is important here to state and relate the negative impact of

biodiversity loss to eco-wellness. Biodiversity should be conserved for it provides places and landscapes that humans can visit for ecotourism and enhance their mental health and satisfaction. When biodiversity is lost, it has serious consequences for humans. Phil-Eze (2009) shows that there are environmental consequences such as coastal erosion, soil erosion, desertification, loss of soil fertility, hydrological upset, disease outbreak, change in climate, and even environmental refugeeism. Biodiversity provides a lot of services for the environment and humans. When there is deforestation and trees are felled, it exposes the soil to erosion, microorganisms are destroyed, pharmaceutical resources are lost, and the climatic conditions are also affected. When nature is rich with biodiversity, with forest cover, a beautiful scenic landscape, there are places that people can go for eco-tourism for retreats and reflection. It is important to pay attention to biodiversity loss.

Role of *Okugbeakpeje* and *Igwebuike* Philosophies in Biodiversity Conservation

Many solutions have been proposed for biodiversity conservation and curbing biodiversity loss. These solutions are good, but they are not enough. All hands must be on deck to solve the problem. This paper proposes that humans should stand in solidarity and in a common united front to solve the problem. The problem of biodiversity loss and other environmental problems cannot be solved by individuals alone; there is a need for people in every society to come together, work together, synergise, and collaborate to confront these problems. There should be a dialogue among people from all backgrounds to harmonise ideologies and philosophies from various cultural traditions to combat the problem. Kanu (2019) states that:

> This understanding, in terms of complementarity, provides an ontological horizon that presents being as that which possesses a relational character of mutual

> relations. As an ideology, Igwebuike holds that 'to be' is to live in solidarity and complementarity, and to live outside the parameters of solidarity and complementarity is to suffer alienation. 'To be' is 'to be with the other', in a community of beings (p. 97).

Human beings are to live in complementarity and search for solutions together. None should see environmental problems as the concern of others alone or become disinterested. There should be no place for rugged individualism or selfishness in environmental management. This is precisely what the two philosophies of *Okugbeakpeje* and *Igwebuike* imply and call for. A popular saying states, "United we stand, divided we fall." Human beings need to hold a sense of common purpose. The problem of biodiversity loss is a common challenge for all humanity. No human being should exempt himself/herself from the problem. Every biodiversity loss affects all humanity. Think, for instance, that a problem of biodiversity loss in a village that leads to environmental refugeeism can make people move from their environment, putting pressure on other locations. Almost all environmental problems are transboundary environmental problems. As this paper is being written, there is news on Smith (2026) that wildfire smoke is entering the United States from Canada. Not only is this wildfire destroying biodiversity in Canada and affecting human lives, but it is also affecting biodiversity and human lives in the United States. Thus, environmental problems in one country can affect another.

The indigenous Igbo philosophy of *Igwebuike* rightly asserts that there is strength in numbers. The Urhobo people say, "only one finger cannot remove a lice from the head." There is tremendous strength when people band together. You see the strength of common purpose even in the Judeo-Christian tradition. In the book of Nehemiah, even though the people of Israel faced opposition,

with the leadership of Nehemiah and the people joining together with him, they were able to build the wall. Look at many of the former colonised nations; they united to fight for their independence, and with common effort they were able to gain independence. Nkama, Okoro & Egbule (2022) write that:

> Grassroot mobilization by traditional rulers as custodians of culture scored 91.6 percent, probably because the respondents believe so much in the capacity of these leaders to command the respect and loyalty of their subjects, which is natural in the Igbo setting. However, this has to be properly channeled, especially as it concerns the subject of our discussion, to the effect that they mobilize their subjects to directly harness and repackage some of their cultural practices in a manner that it is relevant to the common man (sec. 5.2).

Both *Okugbeakpeje* and *Igwebuike* call for collective mobilisation of people. They are indigenous philosophies that promote the common good. Traditional African communities are grounded in the philosophy of seeing and living life together. Community labour and work were emphasised in rural places, and this is still prevalent in some places. That spirit of coming and working together to tackle common problems is what this paper is calling for. Environmental problems like biodiversity loss should not be confronted anyhow or following individual idiosyncrasies. At the grassroots level, where there is much biodiversity in villages and rural places, there is a need for traditional authorities supported by government efforts through public policies and financial support to galvanise traditional authorities to bring people together to enlighten them about the value of biodiversity. There is a need to guide and educate against bush burning, felling of trees, careless throwing of waste, wanton destruction of birds and animals, and

many other things that cause biodiversity loss. There is strength when the community comes together rather than individuals working on their own. There is a vital need for collaborative efforts at all levels. This is what *Okugbeakpeje* and *Igwebuike*'*s* philosophies are calling for. There is a vital need for synergy and for efforts to be harnessed, instead of individuals just working alone. Blankespoor, B., Dasgupta, S., & Wheeler, D. (2025) argue that: "Effective conservation requires urgent, coordinated global action, as ecosystems and species habitats often transcend national borders. Collaboration among governments, industries, and communities is essential to restore habitats, protect endangered species, strengthen policies, and enforce conservation measures" (p. 2). Biodiversity conservation efforts will achieve less if people work at cross-purposes. There is also the need for sharing of local knowledge among communities. A popular proverb says: "Two heads are better than one." In the Biblical parlance, "Iron sharpens iron." In a world that has become globalised and affected by cultural diffusion, there is a need to share knowledge across borders and boundaries. That is the spirit of *Okugbeakpej*e and *Igwebuike*.

Community, communalism, and coming together are powerful forces in the African universe. They should not be neglected. The African philosophy of Ubuntu says, "I am because we are." And so there is a need for the individual not to isolate himself/herself from others, but to collaborate and share in solidarity with them. This is *Okugbeakpeje.* It is living and working together to solve common problems. There is strength when people come together to discuss, dialogue, converse, think, and see how to solve common environmental problems like that of biodiversity loss. This should never be discounted. The United Nations (1992) in articles 7, 9, and 10 propounds that solving environmental problems requires the cooperation of States and that environmental problems are better handled through the participation and efforts of all citizens. *Okugbeakpej*e and *Igwebuike* are indigenous African philosophies

that emphasise cooperative existence and living, harmonious efforts to solve human problems.

Conclusion

The paper has examined the role that the two African indigenous philosophies of *Okugbeakpeje* and *Igwebuike* can play in mobilising for biodiversity conservation. The paper showed that indeed there is biodiversity loss in Africa and in the world. The paper showed that the *Okugbeakpeje* (togetherness of all life, unity, or solidarity) together with *Igwebuike* (strength in number or unity) can help in galvanising collective efforts to combat environmental problems. Environmental problems cannot be resolved by individuals on their own, there is need for coming together, dialogue, conversation and synergy among humans to tackle the crisis. Biodiversity loss often occur on large scale and some can have cross-border effects. It is important that the entire community or group is mobilised to find a solution and promote conservation efforts. The benefits of biodiversity especially the ecosystem services that come from them were highlighted in the paper. Healthy biodiversity is necessary for human life and wellbeing, and ecowellness. When biodiversity is poisoned or damaged it affects the state of the health of people. It was shown in the paper that if communal efforts were taken they will help to promote an Africa that is experiencing ecowellness and secured. Let the two indigenous philosophies then be an inspiration to harness the strength of the community or the entire people for the wellbeing of the health and people.

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AN AFRICAN DIASPORA INTERPRETATION OF EZEKIEL 47 AND PUBLIC HEALTH ECOLOGY IN CONTEMPORARY AFRICA

Bazza. Mike Boni PhD
Department of History and International Relations,
Veritas University, Abuja
danbazza68@gmail.com

Kanu, Anthony Ikechukwu, PhD
Department of Philosophy, Veritas University, Abuja
ikee_mario@yahoo.com

Pilani, Michael Paul, PhD
Department of Theology, Veritas University, Abuja
pilanim@veritas.edu.ng

Michael Sunday Sasa, PhD
Department of Philosophy, Veritas University, Abuja
dvc@veritas.edu.ng

Abstract

Environmental degradation and public health crises increasingly converge across contemporary Africa. Water pollution, biodiversity loss, climate change, and poor sanitation reveal the interdependence of ecological wellbeing and human health. This article offers an African diaspora interpretation of Ezekiel 47:1–12 as a biblical-theological framework for addressing these challenges. The study employs a qualitative interdisciplinary design combining biblical exegesis, documentary research, and African diaspora theological interpretation, with ecological hermeneutics as the principal interpretive lens. The exegetical analysis examines Ezekiel 47:1–12 within its historical, literary, and canonical contexts, while documentary analysis engages scholarship in Old Testament studies, African biblical

hermeneutics, environmental theology, and public health, alongside reports on water security and biodiversity. The study argues that, although the river flowing from the restored temple has traditionally symbolised Israel's restoration after the Babylonian exile, the passage carries profound ecological and public health significance when read through African diaspora hermeneutics. The analysis shows how biblical faith, cultural memory, and indigenous ecological knowledge illuminate the healing waters as symbols of environmental renewal and communal wellbeing. It further places Ezekiel's vision in dialogue with public health ecology, demonstrating that environmental restoration contributes to disease prevention, food security, biodiversity conservation, and communal resilience. The article argues that churches can advance ecological restoration through environmental education, water conservation, sanitation initiatives, and public advocacy. Ezekiel's vision thus provides a theological paradigm for integrating environmental ethics and public health policy in Africa.

Keywords: African diaspora hermeneutics; public health ecology; environmental theology; water justice; biodiversity; Ezekiel 47

Introduction

The twenty-first century has witnessed extraordinary advances in science, medicine, and technology, yet humanity faces an equally unprecedented ecological crisis that threatens global public health (Kanu, 2017). Climate change, biodiversity loss, environmental pollution, freshwater scarcity, and emerging infectious diseases together demonstrate that human wellbeing cannot be separated from the health of the natural environment (Kanu, 2022). These challenges are particularly acute across Africa, where inadequate sanitation, polluted rivers, deforestation, and climate variability continue to undermine both ecological sustainability and public health. The World Health Organization consistently identifies unsafe drinking water and inadequate sanitation among the leading causes of preventable disease in developing countries (World

Health Organization [WHO], 2024). Cholera, typhoid fever, diarrheal diseases, malaria, and schistosomiasis remain closely associated with degraded ecosystems and poor environmental management. Climate change has further intensified droughts, flooding, food insecurity, and the emergence of zoonotic diseases (Intergovernmental Panel on Climate Change [IPCC], 2023). These realities expose the artificial separation that has often existed between environmental conservation and healthcare policy.

Scholars from environmental science, public health, theology, and ethics increasingly argue that ecological restoration is not merely an environmental concern but a public health imperative. This interdisciplinary perspective, often described as public health ecology, recognises the reciprocal relationship between ecological integrity and human flourishing. Healthy forests protect watersheds, healthy rivers provide safe drinking water, and biodiversity contributes to food security and disease regulation (Kanu, 2023). Conversely, ecological degradation produces profound health consequences that disproportionately affect vulnerable populations. Biblical theology offers important resources for understanding this relationship. Contrary to earlier assumptions that biblical religion focuses exclusively on human salvation, recent scholarship demonstrates that Scripture consistently portrays creation as participating in God's redemptive purposes (Horrell, 2022). Among the most striking examples of this ecological vision is Ezekiel 47:1 to 12, where the prophet describes a miraculous river flowing from the restored temple, transforming barren landscapes into fertile ecosystems characterised by abundant life, thriving fisheries, and healing for the nations.

For centuries, interpreters have understood Ezekiel's vision primarily within the framework of Israel's national restoration following the Babylonian exile. The river symbolises divine presence, covenant renewal, and eschatological hope. While these

interpretations remain indispensable, they need not exhaust the passage's theological significance. Contemporary ecological hermeneutics has increasingly recognised that water, vegetation, biodiversity, and agricultural abundance are not incidental literary features but essential elements of the prophet's vision of holistic restoration (Kim, 2021). This article argues that Ezekiel 47 acquires even greater interpretive richness when read through African diaspora hermeneutics. African diaspora communities occupy a distinctive interpretive location shaped by biblical faith, African cultural memory, colonial histories, migration, and contemporary struggles for environmental justice. Many African worldviews understand environmental health and human health as mutually constitutive dimensions of communal life rather than separate concerns (Nabofa, 2022; Kanu, 2024).

The objective of this article is fourfold. First, it undertakes an exegetical study of Ezekiel 47:1 to 12 within its historical and literary context. Second, it explores the distinctive contributions of African diaspora hermeneutics for interpreting the ecological dimensions of the passage. Third, it places Ezekiel's vision in dialogue with public health ecology. Finally, it proposes practical theological implications for churches, policymakers, and environmental practitioners seeking holistic approaches to ecological and public health challenges across Africa. Across the continent, millions of people depend directly on rivers, wetlands, forests, and agricultural ecosystems for survival, yet these natural resources face unprecedented pressure from industrial pollution, urbanisation, extractive industries, and unsustainable land use. The consequences are not merely environmental but medical, social, and economic (Pilani, 2024). Water pollution increases disease burdens, ecosystem collapse threatens food security, biodiversity loss undermines traditional medicine, and environmental degradation disproportionately harms the poorest communities. Far from representing an ancient religious metaphor detached from present concerns, the river flowing from the temple offers a

theological imagination for contemporary ecological renewal, one whose waters symbolise the inseparable relationship between healthy ecosystems and the abundant life God intends for all creation.

The article is structured into eight sections. Section 2 reviews literature on Ezekiel 47, African diaspora hermeneutics, public health ecology, and environmental theology, highlighting a scholarly gap. Section 3 explains the interdisciplinary methodology used. Section 4 establishes the historical and literary context of Ezekiel 47. Section 5 offers a detailed exegesis of Ezekiel 47:1–12, emphasizing the river from the Temple and its transformative effects. Section 6 interprets this passage from an African diaspora perspective, focusing on cultural memory and community wellbeing. Section 7 connects Ezekiel 47 to public health ecology, discussing clean water and environmental restoration. Finally, Section 8 summarizes the theological and policy implications for various stakeholders, concluding that Ezekiel 47 presents a vision where ecological renewal and human flourishing are interconnected.

Literature Review

Ezekiel 47 in Biblical Scholarship

Ezekiel 47 has long occupied a central place in biblical studies because of its vivid imagery of life-giving waters flowing from the restored temple. Classical interpretations emphasised the chapter's eschatological significance, viewing the river as a symbol of Israel's restoration, covenant renewal, and the re-establishment of Jerusalem as the centre of divine presence (Block, 1998; Allen, 1994). Classical commentators have generally understood the progressive deepening of the river as signifying the ever-expanding blessings of God that extend from the sanctuary to the entire world, a reading that remains theologically indispensable even as newer approaches broaden its scope. Recent scholarship, however, has increasingly recognised that Ezekiel's imagery

extends beyond spiritual symbolism. Ecological hermeneutics draws attention to the remarkably detailed environmental descriptions within the passage, where saline waters become fresh, deserts become fertile, and fish populations multiply (Lyons, 2021; Van Vliet, 2024). This reflects a broader movement within Old Testament scholarship to recover Scripture's ecological dimensions, in which Ezekiel 47 functions as one of the Bible's clearest portrayals of ecological flourishing.

This development reflects a broader movement within Old Testament scholarship that seeks to recover Scripture's ecological dimensions. Rather than treating creation merely as the backdrop for human salvation, scholars increasingly argue that biblical theology presents humanity as an integral component of God's wider concern for the whole earth. Much of this literature nonetheless remains rooted in Western interpretive traditions. Although ecological readings have expanded significantly over the last two decades, comparatively little attention has been devoted to African diaspora interpretations that connect the prophetic vision with African environmental and public health realities, a gap this article seeks to address.

African Diaspora Hermeneutics

African biblical hermeneutics emerged partly as a response to interpretive traditions that overlooked African cultural experiences and indigenous knowledge systems (Adamo, 2019). African diaspora hermeneutics extends this conversation by incorporating experiences of migration, displacement, and cultural memory. A distinguishing feature of this approach is its holistic worldview. Unlike many Western approaches that sharply distinguish the spiritual from the material, African cosmologies generally understand human beings, nature, ancestors, and the divine as existing within an interconnected relational network (Kanu, 2024). Health therefore cannot be reduced to biological wellbeing alone but encompasses harmonious relationships between people, creation, and God, a perspective that resonates strongly with

Ezekiel's integrated vision of restoration, in which sacred space, water, vegetation, animals, and human communities all experience healing together. African diaspora theology also frequently emphasises memory as a source of resistance and renewal. Communities that remember ancestral relationships with rivers, forests, and communal land management may discover within Ezekiel's vision theological resources for confronting contemporary ecological degradation, resources that a purely historical or Western reading of the passage would be unlikely to surface.

Public Health Ecology

Public health ecology is an increasingly influential interdisciplinary field examining the reciprocal relationship between environmental systems and human health. It challenges earlier biomedical models that concentrated on disease treatment while neglecting environmental determinants of health. Safe drinking water reduces infectious diseases, healthy forests regulate climate and water cycles, and biodiversity contributes to pharmaceutical discovery and ecosystem resilience (UNEP, 2021). The concept aligns closely with the One Health approach, which recognises that human, animal, and environmental health are inseparable, an insight illustrated by emerging zoonotic diseases such as Ebola and COVID-19 (WHO, 2025). Africa presents numerous examples of this ecological-health relationship. Rapid urbanisation often overwhelms sanitation infrastructure, industrial pollution contaminates rivers that remain primary sources of domestic water, climate variability contributes to malnutrition and vector-borne diseases, and deforestation increases human contact with wildlife reservoirs of infection. Despite these realities, public health discussions frequently underutilise religious institutions as partners in ecological restoration, even though churches remain among Africa's most influential and trusted social institutions, possessing extensive educational networks and moral authority capable of mobilising communities around environmental

stewardship (Kanu et al, 2025).

Environmental Theology and Water Ethics

Water occupies a central position throughout biblical theology, from the waters of creation in Genesis to the river of life in Revelation. Scripture consistently portrays water as a divine gift associated with life, cleansing, and renewal (Faramelli, 2021). Ezekiel 47 contributes uniquely to this discussion because the river originates not from human engineering but from God's dwelling place, implying that environmental restoration begins with recognition of divine sovereignty over creation. African theology similarly recognises water as possessing profound spiritual and communal significance, in that rivers frequently function not only as physical resources but also as symbols of communal identity, fertility, continuity, and divine blessing, so that water pollution constitutes both an ecological and a spiritual crisis rather than a merely technical failure of infrastructure.

Research Gap

Although substantial scholarship exists independently on Ezekiel 47, African biblical hermeneutics, and public health ecology, few studies integrate these fields into a coherent interdisciplinary framework. Most exegetical studies remain historically oriented without engaging present ecological realities, public health research often neglects theological resources capable of mobilising community participation, and diaspora hermeneutics has largely concentrated on identity, migration, and liberation rather than ecological wellbeing. This article contributes to that gap by arguing that Ezekiel 47 presents ecological restoration and public health as inseparable dimensions of God's redemptive purposes, and that African diaspora hermeneutics offers a fruitful framework for recovering this holistic vision.

Methodology

This study adopts a qualitative interdisciplinary design combining biblical exegesis, documentary research, and African diaspora

theological interpretation. The exegetical component examines Ezekiel 47:1 to 12 within its historical, literary, and canonical contexts, attending to Hebrew vocabulary and the relationship between Ezekiel's temple vision and broader Old Testament traditions concerning creation and water. The documentary component draws on secondary scholarship in Old Testament studies, African biblical hermeneutics, environmental theology, and public health, alongside reports from international bodies on water security and biodiversity. Ecological hermeneutics serves as the principal interpretive lens, recovering ecological dimensions already embedded in Scripture's theological imagination rather than imposing contemporary concerns upon the text. African diaspora hermeneutics then provides the contextual lens through which the study interprets Ezekiel's vision, recognising the interpretive significance of African cultural memory, migration experience, and indigenous ecological knowledge.

Historical and Literary Context of Ezekiel 47

Ezekiel ministered during one of the darkest periods in Israel's history. Following the Babylonian invasions of Judah in 597 and 586 BCE, Jerusalem was destroyed and Solomon's Temple reduced to ruins. The destruction of the Temple produced not merely a political catastrophe but a theological crisis, since the Temple symbolised God's dwelling among the people. Ezekiel interpreted this tragedy as the consequence of covenant unfaithfulness, yet judgment never becomes his final word. Beginning especially in chapters 33 to 48, the prophet announces a reversal in which God promises to gather the scattered people, renew their hearts, and restore the land. Ezekiel 47 forms the ecological climax of this larger restoration narrative. The restoration Ezekiel envisions extends far beyond rebuilding physical structures. It encompasses the renewal of covenant relationships, political stability, social justice, agricultural productivity, ecological abundance, and divine presence, so that the prophet presents restoration as holistic rather than merely religious in character.

Ezekiel 47 occurs within the prophet's elaborate vision of the new Temple, chapters 40 to 48, which describe a measured sanctuary, renewed worship, and finally the life-giving river emerging from beneath the Temple. The sequence is significant. The Temple is described first because God's presence constitutes the source of all subsequent renewal; only after divine presence is re-established does the river begin to flow. The water first appears as a small trickle beneath the Temple threshold (47:1 to 2), then gradually increases through four successive measurements (47:3 to 5) until it becomes an immense river impossible to cross. The prophet then observes the transformation the river produces (47:6 to 12), as barren land becomes fertile, the Dead Sea comes alive with fish, and medicinal leaves provide healing. The literary movement deliberately emphasises expansion, since divine blessing never remains confined to sacred space but moves outward until the entire environment participates in God's life-giving purposes.

The river's point of origin also carries theological weight. Unlike ordinary rivers arising from mountains or rainfall, this river flows directly from beneath the Temple, communicating that genuine life originates from God's presence rather than from political reform or technological innovation alone. The river flows eastward toward the Arabah and eventually into the Dead Sea, a direction that recalls humanity's exile from Eden even as it shows God's restorative presence pursuing creation into its most devastated condition.

Exegesis of Ezekiel 47:1 to 12

The River Emerging from the Temple (47:1 to 2)

The vision begins with the prophet brought back to the Temple entrance, where water issues from below the threshold toward the east. The Hebrew noun *mayim*, water, appears repeatedly throughout the chapter, emphasising water as the dominant theological symbol. In the Hebrew Scriptures, water consistently signifies life, blessing, and new creation, while its absence signifies

curse and death. Initially the water is only a trickle, a detail of real importance. God's transformative work frequently begins in ways that appear small before producing comprehensive transformation. For African contexts, this symbolism carries practical significance, since environmental restoration frequently begins with modest initiatives such as community tree planting, local sanitation campaigns, or protection of springs, interventions that often generate increasingly extensive ecological benefits.

The river's point of origin also carries an ethical message. Unlike ordinary rivers arising from mountains, springs, or rainfall, this river flows directly from beneath the sanctuary. Ancient readers would immediately recognise the symbolism, since throughout the Ancient Near East temples frequently represented cosmic centres where heaven and earth met. Creation flourishes when humanity recognises divine ownership of the earth rather than assuming autonomous control over it, and environmental exploitation often reflects precisely this illusion of ownership rather than a posture of responsible stewardship.

The Increasing Depth of the River (47:3 to 5)

One of the chapter's most memorable features is the progressive measurement of the river. A heavenly guide measures one thousand cubits four times, and at each stage the river deepens, from ankle-deep to knee-deep to waist-deep, until it becomes an uncrossable river. Many commentators observe that these measurements carry symbolic rather than engineering significance (Allen, 1994). The river grows without receiving tributaries, so its increasing volume cannot be explained by natural processes; its source remains entirely divine. Ecologically, the imagery also reflects how healthy ecosystems generate cumulative benefits, as restored watersheds improve soil fertility, vegetation stabilises climate, and biodiversity strengthens resilience. The prophet eventually reaches a point where the river becomes impossible to cross, an image that challenges modern tendencies toward purely technocratic

domination of nature and instead invites humanity to participate humbly within God's ecological order. Theologically, this progression illustrates that God's restorative activity continually exceeds human expectations, and human beings can no longer master or control the river but must submit themselves to its life-giving power.

Healing the Dead Sea (47:8 to 10)

Perhaps the most dramatic transformation occurs when the river enters the Dead Sea, one of the harshest environments known in the ancient world, whose extreme salinity prevented ordinary aquatic life from surviving and made it a powerful symbol of sterility and death. Ezekiel proclaims an astonishing reversal in which the waters become fresh, fish multiply abundantly, and fishermen spread their nets along the shoreline. This imagery resonates strikingly with contemporary African ecological crises, where rivers contaminated by industrial waste, mining, and untreated sewage often resemble Ezekiel's Dead Sea, with wetlands disappearing, fisheries declining, and communities experiencing rising disease burdens. The prophet's vision challenges contemporary readers not to accept environmental degradation as irreversible; faith nurtures ecological hope, and hope inspires restorative action.

Trees for Food and Healing (47:12)

The chapter concludes with one of Scripture's most comprehensive pictures of ecological abundance, in which the fruit of the trees provides food and the leaves provide healing. Several themes converge here. The trees bear fruit continuously, symbolising sustainable provision rather than seasonal scarcity. The river also sustains diverse vegetation, illustrating the ecological richness accompanying healthy freshwater systems. Finally, the healing leaves point to biodiversity as a source of medicine, an insight that modern pharmacology continues to confirm, since countless contemporary medicines originate from plants whose preservation

depends on healthy ecosystems (Zalanga, 2023). For African societies, where traditional medicinal knowledge remains deeply connected with indigenous biodiversity, this insight carries particular relevance, since forest destruction threatens not only wildlife but centuries of accumulated medical knowledge. The vision ultimately points toward what may be called ecological shalom, the harmonious flourishing of God, humanity, and the entire created order.

An African Diaspora Interpretation of Ezekiel 47

Biblical interpretation is never undertaken in a cultural vacuum. African diaspora hermeneutics begins from the recognition that the lived experiences of Africans and peoples of African descent constitute legitimate contexts for biblical interpretation, shaped by histories of slavery, colonialism, migration, and persistent struggles for environmental justice (Masenya, 2022). Within this framework, Ezekiel 47 becomes far more than an ancient description of Israel's restoration. It becomes a living theological narrative that speaks to communities seeking healing after centuries of displacement and environmental injustice. Just as Israel experienced exile from its land, many African peoples have experienced different forms of exile through forced migration, colonial dispossession, and environmental degradation, so that the prophet's vision of restoration resonates deeply with African diaspora experience.

Throughout African societies, water carries significance beyond biological necessity, functioning as a source of communal identity, livelihood, and religious symbolism (Kanu et al., 2026). Rivers historically sustained agriculture, fishing, and communal ritual life, and diaspora communities continue to carry these memories across continents even when physically separated from ancestral landscapes. Reading Ezekiel 47 through this cultural memory reveals the temple river not merely as a miraculous phenomenon but as God's restoration of the conditions necessary for communal

flourishing, and it speaks directly to African communities whose rivers have been polluted through mining, oil exploration, and rapid urbanisation. The healing waters become symbols of ecological justice, calling faith communities to participate actively in restoring degraded ecosystems rather than accepting environmental destruction as inevitable.

A second contribution of African diaspora hermeneutics is its communal orientation. Many African theological traditions understand salvation as encompassing the wellbeing of the entire community rather than the individual believer alone, so that health, prosperity, and suffering are understood communally (Kanu, 2024). This corresponds closely with Ezekiel's vision, in which the river blesses the entire ecosystem rather than selected individuals, as the land becomes fertile, the sea becomes healthy, and communities thrive together. Such comprehensive restoration reflects what many African philosophers describe as relational existence, in which human beings flourish only when their relationships with God, one another, and creation remain healthy, so that environmental degradation represents not merely an ecological failure but also a disruption of communal life.

African diaspora interpretation also encourages dialogue between biblical theology and indigenous ecological knowledge. Long before contemporary environmental science emphasised biodiversity conservation, many African communities practised sustainable land management through sacred forests, seasonal farming systems, and customary protection of rivers and wildlife, traditions that share common principles of respect for nature, communal responsibility, and intergenerational stewardship (Zalanga, 2023). These values resonate strongly with Ezekiel's vision, in which creation is never portrayed as an unlimited resource for human consumption but as God's gift whose flourishing sustains human life. African diaspora hermeneutics accordingly encourages constructive dialogue between biblical

revelation and indigenous ecological ethics, a dialogue that neither romanticises traditional cultures nor dismisses modern scientific knowledge but seeks complementary wisdom capable of addressing contemporary ecological crises.

Finally, African diaspora churches increasingly occupy influential positions within global society, operating schools, hospitals, and development initiatives alongside worship. Ezekiel's temple river offers a powerful metaphor for this vocation, since just as life flows outward from God's sanctuary, churches are called to become centres from which ecological healing radiates into society, making environmental stewardship an essential dimension of Christian discipleship rather than an optional social concern.

Ezekiel 47 and Public Health Ecology in Contemporary Africa

One of Ezekiel 47's most significant contributions to contemporary theological ethics lies in its holistic understanding of health. Modern healthcare has often concentrated primarily on diagnosis and treatment of disease, sometimes overlooking the broader ecological conditions that sustain or undermine wellbeing. Ezekiel presents a different vision in which health begins with healthy creation, corresponding closely with contemporary ecological public health, which recognises that environmental conditions shape patterns of disease, nutrition, and life expectancy. Safe water remains one of the most important determinants of public health. Across many African countries, contaminated water contributes to cholera, typhoid fever, diarrhoeal diseases, and numerous parasitic infections, while poor sanitation allows pathogens to circulate within vulnerable communities (WHO, 2024). In Ezekiel's vision, healing begins when polluted waters become fresh, anticipating the public health principle that clean water saves lives. Faith communities therefore possess theological grounds for supporting watershed protection, improved sanitation, community boreholes, rainwater harvesting, river conservation, and hygiene education,

activities that should be viewed not merely as humanitarian projects but as participation in God's continuing work of healing creation.

The abundant fish and fruit trees of Ezekiel's vision also illustrate that biodiversity contributes directly to human wellbeing. Healthy ecosystems provide food, medicine, climate regulation, and clean water, while biodiversity loss increases food insecurity and heightens vulnerability to environmental disasters. Africa contains some of the world's richest biodiversity, yet deforestation, illegal mining, desertification, and overfishing continue to threaten these resources, so protecting biodiversity becomes an act of theological obedience as well as ecological responsibility. The prophet's vision reminds readers that flourishing ecosystems are themselves manifestations of divine blessing, and that their loss diminishes not only ecological resilience but also the material and spiritual resources on which human communities depend. Climate change has intensified droughts, flooding, and forced migration throughout many African regions, producing malnutrition, infectious disease outbreaks, and psychological trauma (IPCC, 2023). Although Ezekiel did not address climate change in its modern scientific sense, his vision nevertheless offers a theology of ecological restoration that remains profoundly relevant, since God's intention is environmental renewal rather than destruction. Communities of faith therefore have moral responsibilities to support climate adaptation, sustainable agriculture, and reforestation. Finally, an emerging field within public health recognises that healthy natural environments contribute significantly to psychological wellbeing, since exposure to green spaces reduces stress and anxiety while strengthening social cohesion. Ezekiel's vision depicts not merely physical survival but abundant flourishing, in which the restored landscape becomes a place of beauty, productivity, security, and hope, reminding contemporary readers that ecological restoration also nurtures emotional, spiritual, and communal resilience alongside physical

health.

Theological and Policy Implications

The interpretation advanced in this study carries several practical implications.

First, biblical theology should recover a holistic doctrine of salvation that includes the renewal of creation alongside the redemption of humanity, since Ezekiel 47 demonstrates that ecological restoration belongs intrinsically to the biblical vision of salvation. Second, churches should integrate environmental stewardship into pastoral ministry and Christian formation, emphasising humanity's responsibility as caretakers of God's creation through preaching, catechesis, and youth programmes. Third, theological institutions across Africa should strengthen interdisciplinary engagement between biblical studies, environmental science, and public health, so that future church leaders are prepared to address ecological crises alongside traditional pastoral concerns. Fourth, governments and policymakers should recognise faith communities as strategic partners in achieving environmental sustainability and public health goals, given their extensive grassroots networks for sanitation campaigns and environmental education (Kanu & Pilani, 2024). Fifth, African diaspora organisations should serve as bridges connecting global environmental advocacy with local African ecological initiatives, using their transnational networks for research collaboration and resource mobilisation. Sixth, church-based water and sanitation programmes should be prioritised as concrete, replicable models of ecological shalom, since they translate theological conviction directly into measurable public health outcomes.

Taken together, these implications suggest that ecological restoration and public health advocacy are not peripheral to Christian mission in Africa but central to it. A church that proclaims healing for the soul while remaining silent about polluted rivers and

vanishing forests offers an incomplete gospel. Ezekiel's vision instead calls the church toward a fuller witness in which spiritual renewal and ecological renewal advance together.

Conclusion

Ezekiel's vision of the river flowing from the restored temple remains one of Scripture's most profound portrayals of holistic renewal. Although originally addressed to an exilic community longing for restoration, its theological significance extends far beyond its immediate historical context, presenting a vision in which God's presence transforms not only human hearts but rivers, landscapes, and ecosystems. This study has argued that an African diaspora interpretation reveals fresh dimensions of this prophetic vision by bringing the biblical text into dialogue with African ecological realities, indigenous environmental knowledge, and contemporary public health challenges (Anthony and Michael, 2026).

Ezekiel 47 anticipates many concerns now emphasised within ecological public health. The healing river symbolises environmental restoration that prevents disease, secures food systems, preserves biodiversity, and strengthens communal resilience, offering not merely a religious metaphor but a theological imagination capable of informing contemporary environmental ethics and public health policy. For African churches and diaspora communities, the passage issues both a promise and a vocation, the promise that God remains committed to the renewal of creation despite its present degradation, and the vocation that communities of faith are called to participate actively in that divine work through environmental stewardship and public health advocacy.

Ultimately, the temple river points toward a vision of ecological shalom in which humanity lives in reconciled relationship with God, neighbour, and the whole created order, a vision urgently

needed as Africa confronts the intertwined challenges of climate change, biodiversity loss, and water insecurity. By recovering Ezekiel's holistic theology of healing, the church may become, like the river itself, a source of life flowing into a thirsty world. Such a recovery demands neither a retreat into abstract spirituality nor an uncritical embrace of secular environmentalism, but a genuinely theological environmentalism, rooted in Scripture, informed by African ecological memory, and answerable to the public health needs of the communities it serves.

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PROPHETIC IMAGINATION AND THE THEOLOGICAL ENGAGEMENT OF PUBLIC HEALTH ADVOCACY AMONG AFRICAN DIASPORA COMMUNITIES

Pilani, Michael Paul, PhD
Department of Theology,
Veritas University, Abuja
pilanim@veritas.edu.ng

Kanu, Anthony Ikechukwu, PhD
Department of Philosophy,
Veritas University, Abuja
ikee_mario@yahoo.com

Bazza. Mike Boni PhD
Department of History and International Relations,
Veritas University, Abuja
danbazza68@gmail.com

Michael Sunday Sasa, PhD
Department of Philosophy,
Veritas University, Abuja
dvc@veritas.edu.ng

Abstract

The contemporary world faces interconnected public health challenges marked by emerging infectious diseases, food insecurity, ecological degradation, and widening health inequalities. These crises are particularly acute across many African societies and among African diaspora communities whose experiences of migration, socioeconomic vulnerability, and historical marginalisation shape their access to healthcare and environmental resources. This article examines how African diaspora faith communities employ biblical imagination, particularly the covenantal vision of 2 Chronicles 7:14, as a

theological resource for public health advocacy and community transformation. Through biblical exegesis, theological analysis, and documentary research, the study explores how the Chronicler's vision of humility, repentance, prayer, and divine healing of the land can be interpreted within contemporary public health contexts. Drawing on Walter Brueggemann's concept of prophetic imagination, African public theology, and liberation theology, the article argues that 2 Chronicles 7:14 should be read not merely as a promise of supernatural intervention but as a summons toward ethical responsibility, social repair, and ecological stewardship. The study demonstrates that African diaspora churches frequently function as important sites of health communication, community mobilisation, and advocacy. The article concludes that stronger partnerships between religious communities, healthcare professionals, and policymakers are necessary for addressing the complex health challenges confronting African populations and their global diaspora networks.

Keywords: 2 Chronicles 7:14; prophetic imagination; public health theology; African diaspora; zoonotic diseases; ecological theology

Introduction

The twenty-first century has witnessed an unprecedented convergence of public health crises that challenge traditional approaches to disease prevention and social wellbeing. Emerging infectious diseases, climate-related health threats, environmental degradation, and widening inequalities have revealed that health cannot be understood merely as a biomedical concern but is deeply connected to social structures, ecological systems, and spiritual worldviews (Kanu, 2022). The COVID-19 pandemic demonstrated the interconnected vulnerability of human communities and exposed longstanding inequalities in access to healthcare, information, and vaccines (World Health Organization [WHO], 2022). For many African communities and African diaspora populations, these challenges intersect with historical

experiences of colonialism, economic marginalisation, and migration pressure (Kanu, 2023).

Africa continues to experience significant public health burdens associated with infectious diseases, food insecurity, and environmental vulnerability (Pilani, 2024). Although considerable progress has been made in disease control, many communities remain exposed to recurring outbreaks of cholera, malaria, mpox, and other emerging zoonotic infections (Africa Centres for Disease Control and Prevention [Africa CDC], 2023; Kanu, 2017). These challenges are intensified by climate change, which affects disease transmission, agricultural productivity, and human displacement (Intergovernmental Panel on Climate Change [IPCC], 2023; Kanu et al., 2026). Contemporary public health therefore requires approaches that address not only medical intervention but also ethical responsibility and community participation.

Within this context, religious communities have increasingly become significant actors in public health engagement. Faith communities often possess extensive social networks, moral authority, and grassroots structures capable of reaching populations that formal institutions struggle to access. During the COVID-19 pandemic, religious leaders played important roles in disseminating health information, combating misinformation, and encouraging preventive behaviour (Osei-Tutu et al., 2021; Kanu 2024). Among African diaspora communities, churches frequently serve as social and cultural centres where questions of identity, wellbeing, and collective responsibility are negotiated.

This raises an important question. How can biblical traditions contribute to contemporary responses to health crises without reducing complex social realities to purely spiritual explanations? This question is particularly significant in relation to 2 Chronicles 7:14, in which God promises that if the people humble themselves, pray, seek God's face, and turn from their wicked ways, then God

will hear from heaven, forgive their sin, and heal their land. Historically this verse has often been interpreted within contexts of national repentance and divine restoration. Its theological significance nonetheless extends beyond individual spirituality, presenting a vision of covenant responsibility in which human behaviour, communal ethics, and the wellbeing of the land are interconnected.

This article argues that 2 Chronicles 7:14 provides a valuable theological framework for understanding public health advocacy among African diaspora communities. Read through the lens of prophetic imagination, the text challenges communities to envision alternative realities characterised by healing, justice, and collective wellbeing. Walter Brueggemann's concept of prophetic imagination is particularly useful because it emphasises the role of prophetic communities in resisting destructive social patterns and nurturing alternative visions of human flourishing (Brueggemann, 2001). The study therefore examines how African diaspora faith communities interpret biblical traditions as resources for health advocacy, focusing on how healing, covenant, and communal responsibility contribute to responses to infectious disease, food insecurity, and environmental challenges. It does not suggest that religious belief replaces scientific public health approaches, but proposes that theological traditions can complement public health strategies by providing moral motivation and ethical frameworks.

The objectives of this study are threefold. First, it examines the theological meaning of 2 Chronicles 7:14 through exegetical analysis. Second, it explores how prophetic imagination provides a framework for interpreting contemporary public health challenges. Third, it analyses the role of African diaspora churches in health advocacy and community resilience.

Literature Review

Prophetic Imagination

Walter Brueggemann's concept of prophetic imagination provides a foundational theoretical framework for this study. Brueggemann argues that the task of prophetic ministry involves nurturing consciousness and perception alternative to the dominant culture, which normalises oppression, consumerism, fear, and the concentration of power (Brueggemann, 2001). Against such realities, prophetic communities cultivate a different consciousness rooted in covenant, compassion, and hope. Prophecy therefore involves more than predicting future events, it is the task of helping communities perceive reality differently and act toward transformation.

This framework is particularly relevant for public health theology because many contemporary health crises are not simply biological events but manifestations of social, economic, and ecological disorders. A prophetic theological response asks not only how disease can be treated, but what social conditions produce vulnerability and what moral transformations are necessary for healing. Brueggemann's later work on land theology strengthens this approach, arguing that biblical understandings of land are inseparable from justice, covenant responsibility, and communal wellbeing (Brueggemann, 2002). The land is not merely a possession but a gift requiring responsible stewardship, providing an important theological bridge between biblical interpretation and contemporary ecological health concerns.

African Public Theology and Communal Health

African theological traditions have historically emphasised relationality, community, and the interconnectedness of human existence. African theologians such as Mbiti and Magesa have demonstrated that African worldviews frequently understand humanity within networks of relationships involving God, ancestors, community, and the natural environment (Mbiti, 1990;

Magesa, 1997). The individual is not isolated but exists within a communal framework where personal wellbeing is connected to collective flourishing, a perspective that resonates with contemporary public health approaches emphasising community participation and social determinants of health. African public theology extends theological reflection beyond ecclesial boundaries into social concerns such as poverty, injustice, and governance (Pobee, 1992; Orobator, 2008; Kanu & Pilani, 2024). Within diaspora contexts, this orientation becomes especially significant, as migrant churches function not only as places of worship but as centres of social support, cultural preservation, and community organisation, providing assistance related to employment, education, and healthcare navigation (Hanciles, 2021).

Liberation Theology and Health Advocacy

The connection between theology and social transformation has also been developed within liberation theology. Gutiérrez's foundational work argues that Christian faith requires commitment to liberation from structures that produce suffering and injustice (Gutiérrez, 1988), rejecting approaches that separate spiritual salvation from social realities. This perspective has influenced theological approaches to health advocacy, particularly among communities experiencing poverty and exclusion, since health inequalities are often connected to broader systems of economic injustice and racial discrimination. Cone's work on racial injustice further contributes to this discussion by demonstrating how Christian theology must confront systems that dehumanise vulnerable communities (Cone, 2011). For African diaspora communities shaped by histories of colonialism and racial inequality, health advocacy becomes a dimension of the struggle for dignity and justice.

Faith-Based Organisations and Public Health Engagement

Recent scholarship on religion and health demonstrates that faith-

based organisations are important partners in global health initiatives, possessing trusted leadership structures and culturally relevant communication systems. During the Ebola crisis in West Africa and the COVID-19 pandemic, religious leaders played significant roles in promoting health education and encouraging protective behaviours (Marshall & Taylor, 2020; WHO, 2021), their effectiveness often depending on their ability to translate scientific information into culturally meaningful narratives. Scholars nonetheless caution that faith-based engagement must operate in constructive partnership with scientific institutions, since religious interpretations attributing disease exclusively to spiritual failure may contribute to stigma and undermine public health responses.

Diaspora Theology and Transnational Responsibility

African diaspora communities occupy unique positions within global health networks, their experiences connecting African societies with countries across Europe, North America, and beyond through financial support, knowledge exchange, and advocacy. Diaspora churches frequently serve as bridges between different healthcare systems and cultural contexts. According to Hanciles (2021; kanu et al., 2025), African migration has produced new forms of global Christianity characterised by transnational networks and social engagement, suggesting that African diaspora churches can contribute significantly to public health advocacy by mobilising resources across geographical boundaries.

Methodology

This study employs a qualitative theological research design integrating biblical exegesis, theological analysis, and documentary research. Rather than treating Scripture as an isolated religious text, the study examines how biblical interpretation functions within communities of faith as a resource for ethical reflection and public engagement. The primary text examined is 2 Chronicles 7:14, selected for its themes of covenant responsibility,

repentance, prayer, divine forgiveness, and healing of the land. The exegetical approach considers the literary, historical, and theological dimensions of the passage, attending to the Hebrew terminology underlying key concepts such as humbling oneself, seeking God's face, turning from wicked ways, and healing the land.

The study further employs documentary analysis of contemporary discussions on public health, faith-based organisations, and African health challenges, drawing on sources from the World Health Organization, Africa CDC, and the Intergovernmental Panel on Climate Change, interpreted alongside theological literature on prophetic imagination, liberation theology, and African public theology. The study also adopts an African hermeneutical approach, recognising that biblical interpretation is a communal process in which Scripture engages concrete experiences of suffering, hope, and transformation (Ukpong, 2006; West, 2016). The central assumption guiding the research is that health crises are simultaneously biological, social, ecological, and moral realities requiring integrated responses, rather than a claim that religious faith alone resolves public health problems.

Historical and Theological Context of 2 Chronicles 7:14

The books of Chronicles represent a distinctive theological interpretation of Israel's history, traditionally attributed to the Chronicler and emerging within the post-exilic period, likely the fifth to third centuries BCE. The community addressed by Chronicles lived after the destruction of Jerusalem and the Babylonian exile, and questions of identity, worship, land, and covenant faithfulness were central concerns (Japhet, 1993; Williamson, 1982). Unlike the Deuteronomistic history in Joshua through Kings, Chronicles retells Israel's story with particular emphasis on the temple, priesthood, and the relationship between obedience and blessing. A major theme is the conviction that God remains faithful despite Israel's failures, exile being interpreted not

simply as political catastrophe but as the consequence of covenant unfaithfulness, while restoration remains possible because divine mercy exceeds human failure.

Second Chronicles 7:14 appears within the narrative of Solomon's temple dedication (2 Chronicles 5 to 7). The temple represents more than a religious building, functioning as the symbolic centre of Israel's covenant relationship with God, and its dedication marks a moment of divine-human encounter in which worship, obedience, and communal wellbeing are interconnected. The Chronicler does not present the temple as a magical institution guaranteeing automatic protection. Divine presence remains connected to covenant faithfulness, and when injustice and social corruption dominate, the presence of the temple alone cannot secure communal wellbeing, a perspective important for contemporary reflection since religious institutions cannot assume that spiritual identity automatically produces social transformation.

The phrase “heal their land” reflects the biblical connection between covenant faithfulness and the wellbeing of creation. In biblical theology, land is not merely geographical territory but a theological gift entrusted to human beings, one that responds to human actions, as injustice and disobedience produce disorder while righteousness contributes to communal flourishing (Deuteronomy 28; Leviticus 25). This does not imply a simplistic formula in which every natural disaster or illness is interpreted as direct punishment for sin, but expresses the broader biblical conviction that human moral behaviour affects social and ecological realities, an insight contemporary ecological theology has developed by emphasising that environmental destruction often results from patterns of exploitation and disregard for the interconnectedness of creation (Pope Francis, 2015).

Exegesis of 2 Chronicles 7:14

Second Chronicles 7:14 forms part of God's response to Solomon's prayer after the temple dedication. Solomon's prayer in chapter 6 acknowledges that Israel will experience moments of failure, including drought, famine, military defeat, and disease, and Solomon petitions God to hear the prayers of the people when they turn toward the temple in repentance. God's response directly addresses these concerns, promising that if the people humble themselves, pray, seek God's face, and turn from their wicked ways, then God will hear from heaven, forgive their sin, and heal their land. The verse contains a conditional structure in which human actions are connected to divine response, four human movements being identified, humility, prayer, seeking God, and turning away from destructive ways, followed by three divine actions, hearing, forgiving, and healing. The phrase "my people who are called by my name" establishes covenant identity. The people belong to God, and this relationship carries ethical obligations, since divine belonging is not merely a privilege but a responsibility. In biblical thought a name represents character, authority, and relationship, so those who bear God's name are expected to reflect God's purposes. Applied to faith communities today, this suggests that religious identity must be expressed through practices that promote life, justice, and wellbeing.

The first required response is humility, which biblically involves recognising human dependence rather than self-sufficiency. Seeking God's face is likewise inseparable from seeking justice, since the prophets repeatedly reject worship disconnected from ethical action (Isaiah 1:11 to 17; Amos 5:21 to 24). Prayer cannot therefore become an escape from social responsibility, and for public health theology this means that prayer should inspire practical action. The final human requirement is repentance, turning from wicked ways. The Hebrew verb shuv means to return or restore, and repentance in biblical theology involves transformation of direction rather than mere emotional regret. In

contemporary society, wicked ways may include structures and behaviours that contribute to health injustice, such as environmental exploitation, misinformation, and neglect of vulnerable populations, so repentance has social as well as personal dimensions.

The climax of the verse is God's promise to heal the land. The Hebrew verb rapha means to heal, restore, or make whole, and while often used for physical healing, it carries broader meanings of restoration and renewal. The land includes not only territory but the social and ecological environment in which human life unfolds, so healing involves restoration of relationships between God, people, and creation. This theological vision resonates strongly with contemporary public health approaches that understand health holistically, corresponding with the WHO's definition of health as complete physical, mental, and social wellbeing (WHO, 2022).

Prophetic Imagination and Public Health Theology

Brueggemann's framework suggests that prophetic ministry involves two complementary tasks, the critique of destructive realities and the articulation of alternative visions of human flourishing (Brueggemann, 2001). The prophet does not merely announce divine judgment but exposes realities that diminish life and awakens communities to possibilities shaped by justice and hope. Applied to public health, prophetic imagination challenges communities to move beyond reactive responses to disease outbreaks and examine the deeper social, economic, and ecological conditions that produce vulnerability, asking why certain populations experience disproportionate exposure to illness and why environmental degradation continues despite its consequences for human wellbeing. This aligns with the social determinants of health framework, which emphasises that health outcomes are strongly influenced by income, education, housing, and environmental quality (WHO, 2022).

The first dimension of prophetic imagination is criticism. Prophetic communities resist social systems that create suffering while presenting themselves as inevitable, examining structures such as unequal access to healthcare, poverty-driven exposure to preventable disease, environmental pollution, and misinformation that undermines public health interventions. For African communities and African diaspora populations, these issues are often connected to historical and contemporary patterns of inequality shaped by colonial legacies and global disparities (Adebisi et al., 2021). A prophetic reading of 2 Chronicles 7:14 therefore requires communities to ask not only whether individuals need repentance, but whether societies must also repent from collective patterns that undermine human dignity.

Prophetic imagination is not limited to criticism, however. Brueggemann emphasises that prophets also cultivate hope by creating alternative visions of reality, imagining communities where healthcare is accessible, vulnerable populations are protected, environmental resources are preserved, and scientific knowledge and cultural wisdom cooperate. This vision corresponds with the biblical idea of healing the land. Divine healing in 2 Chronicles 7:14 does not imply passive waiting for supernatural intervention but creates a moral imagination in which communities participate in restoration. African theological traditions provide important resources for this vision through the philosophy of Ubuntu, which emphasises that human wellbeing is relational, encapsulated in the phrase “I am because we are” (Gyekye, 1997; Ramose, 1999). This principle challenges individualistic understandings of health and highlights collective responsibility, connecting spiritual transformation with social reconstruction and calling theological engagement with public health to move beyond prayer as a private practice toward active participation in healing processes.

African Public Health Challenges and the Need for Theological Engagement

One of the most significant public health challenges facing Africa and the global community is the increasing emergence of infectious diseases. The relationship between human health, animal health, and ecological systems has become increasingly important due to the rise of zoonotic diseases, illnesses transmitted between animals and humans. The COVID-19 pandemic demonstrated the global consequences of infectious disease emergence, exposing weaknesses related to healthcare infrastructure, vaccine access, and misinformation (WHO, 2022). Beyond COVID-19, outbreaks of mpox, Ebola, and viral haemorrhagic fevers continue to demonstrate the importance of integrated approaches recognising the connection between human behaviour, animal ecosystems, and environmental conditions, an emphasis captured in the One Health framework promoted by the WHO, FAO, and other international bodies (WHO et al., 2022). From a theological perspective, this interconnectedness resonates with biblical understandings of creation, which presents humanity as embedded within the wider community of creation.

The COVID-19 pandemic created significant opportunities and challenges for religious communities, which became important spaces for health communication while also facing challenges related to misinformation and tensions between religious gatherings and public health restrictions. Faith leaders possess significant influence within communities and can effectively support public health interventions when they collaborate with scientific institutions (Osei-Tutu et al., 2021). In many African diaspora communities, churches served as trusted institutions where migrants received information and material support during periods of uncertainty. A prophetic theological approach interprets such actions as expressions of covenant responsibility, in which caring for the sick and promoting truthful information become practical expressions of seeking God's healing.

Cholera remains a significant challenge in several African countries, particularly where communities experience inadequate access to clean water and sanitation, with recent outbreaks linked to climate-related factors, displacement, and conflict (WHO, 2023). The biblical emphasis on healing the land provides an important framework for understanding these challenges, since water is repeatedly presented in Scripture as a symbol of life and divine provision, while biblical theology also assumes human responsibility in protecting life-giving resources. Food insecurity, driven by conflict, climate change, and disrupted agricultural systems, remains one of the most pressing challenges affecting African populations (Food and Agriculture Organisation [FAO], 2023). Biblical traditions consistently connect faithfulness to God with concern for food justice, through the Sabbath and Jubilee traditions, prophetic critiques of exploitation, and Jesus' concern for feeding the hungry, demonstrating that access to basic necessities is a theological concern.

Climate change represents one of the greatest long-term threats to global health, as rising temperatures, extreme weather events, and biodiversity loss increasingly affect disease patterns, food production, and human wellbeing (IPCC, 2023). African communities are particularly vulnerable despite contributing relatively little to global greenhouse gas emissions, raising theological questions about responsibility and solidarity in the face of climate injustice.

African Diaspora Churches as Sites of Public Health Advocacy

African diaspora churches occupy a distinctive position within global health networks, frequently functioning as informal social welfare systems, particularly important where migrant populations experience barriers to healthcare through language differences and distrust of public institutions (Ager & Ager, 2011). From the

perspective of prophetic imagination, these churches represent communities capable of imagining and embodying alternative models of care, their theological convictions providing moral motivation for protecting life and pursuing communal wellbeing. During epidemics, faith leaders often serve as mediators between scientific information and community practice, and during the Ebola outbreaks in West Africa religious leaders contributed to public health interventions by promoting safe burial practices and encouraging cooperation with healthcare workers (Marshall & Taylor, 2020). Similarly, during COVID-19, faith-based organisations worldwide contributed through health education, food distribution, and advocacy for responsible public behaviour, activities the WHO recognised as important given religious leaders' influence and capacity to reach populations beyond formal healthcare structures (WHO, 2021). African diaspora churches participated through health information dissemination via sermons and community meetings, material assistance including food distribution and financial support, emotional and spiritual support during periods of social disruption, and community advocacy for equitable healthcare access.

Vaccination remains one of the most important tools in preventing infectious disease, yet vaccine acceptance is influenced not only by scientific knowledge but by cultural belief, political trust, and religious interpretation. Research demonstrates that trust is a central factor in public health decision-making, with communities more likely to accept health interventions when they perceive institutions as respectful and transparent (Larson et al., 2022). African diaspora churches can contribute positively by functioning as spaces of trusted communication, translating medical information into culturally meaningful messages and demonstrating that science and faith need not be presented as competing authorities. A prophetic interpretation of health advocacy understands vaccination campaigns not merely as

technical programmes but as expressions of solidarity, reflecting the biblical command to love one's neighbour.

Food insecurity represents another area of significant contribution, as many diaspora congregations operate food assistance programmes and community kitchens reflecting longstanding Christian traditions of hospitality and care for those experiencing deprivation. Biblically, food is consistently associated with justice and covenant responsibility, the prophets condemning societies where wealth existed alongside hunger and exploitation (Isaiah 58:6 to 7; Amos 5:11 to 15). The growing recognition of the relationship between environmental conditions and human health has further expanded the role of faith communities in ecological advocacy, often rooted in biblical teachings concerning creation care, since Genesis presents humanity as entrusted with responsibility for the earth (Genesis 2:15) and Psalm 24:1 declares that the earth belongs to God. The ecological theology of Pope Francis's Laudato Si' has further encouraged Christian communities to understand environmental responsibility as an expression of faith, arguing that ecological crises cannot be separated from social injustice because environmental harm disproportionately affects vulnerable populations (Pope Francis, 2015). African immigrant churches in Europe and North America became important support structures during the COVID-19 pandemic, functioning as social infrastructures where migrants develop networks of mutual support and resilience (Hanciles, 2021), a role the HIV and AIDS epidemic illustrates as well, since faith-based organisations became important actors in prevention, care, and advocacy after initial responses that sometimes contributed to stigma (Blevins, 2018).

Toward Integrated Healing

A significant challenge for faith-based health engagement is moving beyond temporary charity toward addressing structural causes of illness. While food distribution and emergency assistance

are essential, prophetic theology calls communities to examine why suffering exists, engaging questions of justice, governance, and environmental responsibility, since health crises often emerge from conditions created by human decisions. For African diaspora communities, this may involve advocacy for equitable healthcare access, immigrant health rights, environmental justice, and global vaccine equity.

Effective public health responses require cooperation among governments, healthcare professionals, and religious communities. Faith communities possess social trust and grassroots access, while public health institutions provide scientific expertise and technical capacity, and rather than competing authorities the two can function as complementary partners, with the One Health framework offering a particularly important model of cross-disciplinary cooperation (WHO et al., 2022). Ultimately, the theological significance of 2 Chronicles 7:14 lies in its vision of restoration, in which healing is not limited to individual recovery from illness but involves renewal of relationships, communities, and environments. African diaspora churches contribute to such healing by cultivating resilience through worship, social networks, education, and humanitarian action, creating spaces where communities can respond creatively to crises and transform despair into collective hope.

Conclusion

The contemporary world stands at a critical moment in which public health challenges increasingly reveal the interconnectedness of human societies, ecological systems, and moral responsibilities. This study has examined 2 Chronicles 7:14 as a theological resource for understanding public health advocacy through the framework of prophetic imagination. The passage presents a dynamic relationship between human responsibility and divine restoration, in which God's promise to heal the land is not

merely a statement about supernatural intervention but an invitation toward communal transformation.

A theological reading of this passage within contemporary public health contexts reveals several significant insights. The biblical concept of healing extends beyond individual physical recovery to encompass social restoration and ecological renewal, so that healing the land involves addressing conditions that diminish human flourishing, including poverty, environmental destruction, and exclusion. Prophetic imagination provides a valuable framework for connecting biblical theology with public health engagement by exposing social realities that contradict God's vision while creating imaginative possibilities for alternative futures. African theological perspectives further enrich this discussion by emphasising relationality and shared responsibility, offering an important corrective to individualistic approaches to health that resonates with contemporary public health approaches emphasising social determinants and community participation.

The future of public health advocacy requires stronger partnerships between religious communities, healthcare institutions, governments, and development organisations. Faith communities provide moral credibility, cultural knowledge, and grassroots networks, while public health institutions provide scientific expertise and evidence-based interventions, and together these resources can contribute to more effective and culturally responsive health strategies. The theological vision of healing the land also requires renewed attention to ecological responsibility, since climate change and environmental degradation demonstrate that human health is inseparable from the health of creation. For African diaspora communities, this ecological dimension is particularly significant because many maintain strong connections with African societies affected by environmental vulnerability, and their transnational networks create opportunities for knowledge exchange and collaborative response to global health challenges.

Ultimately, 2 Chronicles 7:14 invites communities of faith to imagine healing not as passive expectation but as active participation in God's restorative purposes. Prophetic imagination transforms communities from observers of suffering into participants in healing, calling churches to become spaces where prayer leads to action, worship leads to justice, and faith leads to responsible engagement with the world. In an age of unprecedented health and ecological challenges, African diaspora churches and faith communities can contribute significantly to building communities of resilience, justice, and hope.

Recommendations

Based on the theological and public health analysis developed in this study, the following recommendations are proposed. First, governments and healthcare institutions should develop intentional partnerships with religious communities, recognising their influence and capacity for community engagement, including training programmes that equip religious leaders with accurate health information while respecting theological and cultural perspectives. Second, theological institutions, seminaries, and churches should incorporate public health theology into ministerial formation, so that future religious leaders possess the resources needed to address infectious disease, mental health, environmental responsibility, and health inequality. Third, faith communities should integrate ecological stewardship into preaching, teaching, and community action, understanding environmental protection not merely as a political issue but as a theological responsibility rooted in the biblical vocation of caring for creation.

Fourth, religious leaders should participate in health communication initiatives by promoting accurate information, reducing stigma, and encouraging responsible health decisions, engagement grounded in dialogue between scientific evidence and theological reflection.

Fifth, African diaspora communities should be encouraged to use their transnational networks to support healthcare development, research collaboration, and advocacy addressing health challenges across Africa. Sixth, public health agencies should establish formal monitoring and evaluation mechanisms for faith-health partnerships, ensuring that collaboration between religious institutions and scientific bodies produces measurable improvements in community health outcomes rather than remaining symbolic.

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THE CHURCH OF NIGERIA ANGLICAN COMMUNION AND THE FUTURE OF ENVIRONMENTAL ETHICS, JUSTICE AND HUMAN SURVIVAL

Eberechukwu Blessing Amaka Aniagboso. PhD
Department of Religious and Cultural Studies,
Ignatius Ajuru University of Education,
Rumuolumeni, Port Harcourt, Nigeria.
eberechukwu.aniagboso@iaue.edu.ng

Metong E. Amakiri, PhD
Department of Religious and Cultural Studies,
Ignatius Ajuru University of Education,
Rumuolumeni, Port Harcourt, Nigeria.
metong.amakiri@iaue.edu.ng

Abstract

Nigeria's escalating ecological crisis, evident in pollution, flooding, deforestation, land degradation, biodiversity loss, and climate-related vulnerability, posed significant threats to human flourishing and raised pressing theological and ethical questions for the Church. Although the Anglican tradition recognized creation care as integral to Christian mission, a gap persisted between theological affirmation and its translation into sustained ecclesial teaching, institutional practice, and public engagement in Nigeria. This article examined the theological, ecological, ecclesiological, and missiological resources available to the Church of Nigeria Anglican Communion for responding to environmental degradation, environmental injustice, and threats to human survival. Historical Institutionalism provided the theoretical framework, while a qualitative historical-theological methodology was employed to analyze Anglican documents, historical materials, theological scholarship, and literature on African Christianity, environmental ethics, and missiology. The

findings indicated that the Church's historical structures, theological traditions, and patterns of social engagement provided substantial resources for ecological action, but these resources had not been sufficiently integrated into a coherent environmental ethic and institutional strategy. The study argued that environmental responsibility should be understood as an integral dimension of Anglican mission rather than a peripheral social concern. The study recommended strengthened ecological theological education, environmental discipleship, prophetic advocacy, responsible institutional practices, and collaboration with affected communities and relevant organizations.

Keywords: Church of Nigeria Anglican Communion, environmental ethics, ecological theology, creation care, human survival.

Introduction

The ecological crisis has become a defining challenge of the twenty-first century, with consequences that extend well beyond environmental degradation. Climate change, flooding, pollution, deforestation, biodiversity loss, land degradation, and climate-related displacement increasingly affect livelihoods, public health, food and water security, economic stability, and the conditions necessary for human flourishing. In Nigeria, climate-related risks are already closely connected to development outcomes, including agricultural productivity, infrastructure, poverty, disaster vulnerability, and livelihood security (World Bank, 2026). The ecological crisis is therefore not exclusively a scientific, economic, or governmental problem. It also raises fundamental theological and ethical questions concerning the relationship between human beings, God, and the created order. Christian Scripture presents creation as belonging to God and locates human beings within, rather than outside, the created order (Gen. 1:26–28; 2:15; Ps. 24:1). Anglican Christianity in Nigeria emerged through the missionary work of the Church Missionary Society, with the establishment of the Christian mission in the nineteenth century,

and subsequently developed into an indigenous ecclesial institution with its own Episcopal leadership, diocesan structures, theological institutions, educational networks, and forms of social engagement. Its historical development illustrates the broader process through which Christianity in Africa moved from missionary establishment toward indigenous leadership and contextual ecclesial identity. Anglican engagement in Nigerian society has historically included education, healthcare, social welfare, moral formation, community development, and other forms of public ministry. These activities demonstrate that the Church has not operated solely as a worshipping institution but has repeatedly negotiated the relationship between Christian faith and the social conditions within which Nigerian communities live. The problem, therefore, is not simply whether the Church acknowledges environmental concerns. It is whether its inherited theological traditions, institutional structures, and established patterns of social engagement can be intentionally adapted to address an ecological crisis whose consequences increasingly affect livelihoods, health, social stability, and human survival.

Conceptual clarification

This study is grounded in an interdisciplinary framework that brings environmental ethics, ecological theology, human survival, ecological sustainability, and historical inquiry into conversation. Environmental ethics concerns the moral relationship between human beings and the natural world. It asks what obligations humans have toward the created order and whether non-human life, ecosystems, and the natural environment possess value beyond their usefulness to human beings. (Manyonganise & Matutu, 2024). Human survival extends beyond physical existence to include access to adequate food and clean water, healthcare, sustainable livelihoods, secure and habitable communities, human dignity, peace, and social wellbeing. In its 2018 Standing Committee communiqué, the Church of Nigeria expressed concern about communities affected by flooding, including deaths,

displacement and loss of property (ACEN 2019). Rather than treating flooding simply as an unfortunate natural event, the Church called for greater attention to climate change, public enlightenment and avoidance of building along waterways. Ecological theology refers to theological reflection on the relationships among God, humanity, and the created order. It examines how Christian doctrines of creation, salvation, stewardship, sin, redemption, and human responsibility shape attitudes toward the environment. African ecological theology has challenged forms of Christianity that have prioritized an otherworldly understanding of salvation while neglecting the material and ecological conditions of human existence (Golo 2013) The Anglican Communion's environmental programme explicitly connects creation care with Christian discipleship and responds to the interconnected challenges of climate change, biodiversity loss, and pollution.

Ecological sustainability refers to the capacity of human communities to meet present needs without undermining the ecological systems and resources required by future generations. It therefore involves responsible resource use, ecosystem protection, climate resilience, sustainable livelihoods, and intergenerational justice. Creation care provides the practical expression of these theological and ethical commitments. It encompasses the protection of ecosystems, conservation of natural resources, reduction of environmental harm, sustainable patterns of consumption and production, ecological education, and advocacy for environmental justice. The study employs a historical-theological methodology, supported by documentary and contextual analysis. The central analytical premise is that environmental responsibility cannot be separated from Christian mission when ecological degradation directly threatens human wellbeing and community survival.

Historical Institutionalism theory

Historical Institutionalism provides a framework for examining how the Church of Nigeria has inherited, maintained, and potentially transformed institutional responses to social and environmental challenges. The study used Historical Institutionalism to trace how the Church of Nigeria's historical formation has shaped its institutional capacity to respond to ecological challenges (Mahoney, 2000). It examines continuity, path dependence, critical junctures, and institutional adaptation to determine whether contemporary environmental pressures are reinforcing established ecclesial patterns or generating new directions in Anglican theology and mission. The Church of Nigeria did not emerge in an institutional or theological vacuum. Its contemporary identity has been shaped by successive historical layers, including missionary Anglicanism, colonial structures, indigenous Christian leadership, theological education, Nigerian nationalism, ecclesial independence, and postcolonial transformation (Sanneh, 2008).

Development of Anglican Church in Nigeria

The history of Anglican Church in Nigeria provides an essential foundation for understanding the institutional and ecclesial character of the contemporary Church of Nigeria. Anglicanism emerged through the interaction of missionary Christianity with indigenous societies, colonial structures, education, and the gradual development of African ecclesial leadership. Its history was therefore not simply a process of religious conversion; it was also a process of institutional formation, cultural negotiation, leadership development, and social transformation (Sundkler & Steed, 2000). From a Historical Institutionalist perspective, this development is significant because institutions are shaped by accumulated historical experiences. Structures established during the missionary period were subsequently reconfigured through African leadership, ecclesial autonomy, and changing Nigerian social conditions. The contemporary Church of Nigeria is thus the

product of both institutional continuity and historical adaptation. Anglican Christianity became established in the territories that later constituted Nigeria during the nineteenth century, particularly through the activities of the Church Missionary Society (CMS). Its expansion occurred within the wider context of British imperial expansion, the suppression of the transatlantic slave trade, commercial interests, and increasing encounters between European missionaries and African societies. Missionary activity consequently unfolded within both religious and colonial contexts (Babalola, 1976).

Contributions of the Anglican Church in Nigerian

The Niger and Niger Delta regions became important centres of Anglican missionary activity. Churches, schools, mission stations, and translation initiatives provided the institutional foundations for the formation of Anglican communities. Missionaries also developed relationships with local rulers, communities, and emerging African Christian leaders, producing a complex process of religious and cultural interaction. Education was one of the principal instruments of Anglican mission in Nigeria. Mission schools provided literacy, Christian instruction, and formal education, while the translation of biblical and liturgical materials into African languages facilitated the communication and localisation of Christian teaching (Babalola, 1976). Education therefore became an important channel through which African Christian leadership developed. Anglican mission also became involved in healthcare, social welfare, and community development. These activities extended the Church's institutional presence beyond worship and evangelism and established a pattern of engagement with the social conditions of local communities. A concrete institutional example is Iyi Enu Mission Hospital in the Diocese on the Niger. The Church reports that the hospital has been transformed into a modern medical facility. The Diocese has also supported scholarship programmes and other social development initiatives. There is also empirical evidence of Anglican

participation in preventive healthcare. A study conducted among Anglican churches in Lagos examined physical activity and healthy eating interventions in the Diocese of Lagos Mainland. The research involved church based medical committees and tested health promotion interventions within Anglican congregations. Another example provides an important bridge between healthcare and environmental ethics. Research on Anglican welfare programmes in 30 churches in Osun State between 1991 and 2012 found four major categories of intervention: healthcare delivery, vocational rehabilitation, micro-credit and women's empowerment. The programmes also included free health campaigns, widow-support workshops, and sensitization, counseling and social advocacy. These developments created institutional pathways that continue to influence ecclesial structures, leadership patterns, theological priorities, and approaches to mission. The Church's public engagement also expanded during the postcolonial period. Anglican institutions continued to participate in education, social welfare, community development, peace building, and wider national discourse. An interesting example comes from the Anglican International Academy in Abuja. In reporting the development of the school, the Church of Nigeria specifically mentioned not only classrooms, hostels, boreholes and roads but also flower and tree planting as part of the development of the school environment. Although tree planting around a school should not be exaggerated into a comprehensive environmental programme, it illustrates an important point: Anglican educational spaces can become practical sites for teaching students that the physical environment is part of communal responsibility (CON 2025).

Environmental Ethics, Justice And Human Survival

Current researches continue to document the extent and persistence of petroleum contamination in the region (Ewim et al., 2023). A recent scoping review further identifies links among oil exploitation, environmental degradation, food insecurity,

economic disruption, and human health in the Niger Delta (Ewim et al., 2025). Flooding increasingly affects both urban and rural communities, damaging homes, infrastructure, agricultural land, and sources of livelihood. Deforestation and land degradation weaken ecosystem functions and agricultural resilience, while desertification remains a significant concern in northern Nigeria. Along the coast, erosion, changing sea conditions, and wetland degradation threaten settlements and livelihood systems. Inadequate waste collection, disposal, and wastewater management further contribute to environmental pollution and public-health risks. These pressures are compounded by climate variability and the limited adaptive capacity of economically vulnerable communities. The Anglican Communion's environmental programme explicitly connects creation care with Christian discipleship and responds to the interconnected challenges of climate change, biodiversity loss, and pollution. Nigeria's environmental crisis is increasingly intertwined with questions of human wellbeing, livelihood security, and social justice. The country faces multiple and overlapping environmental pressures, including oil pollution, flooding, deforestation, desertification, coastal erosion, inadequate waste management, and growing climate vulnerability. A research on Ogoniland, for instance, places environmental degradation within an explicit environmental-justice framework and highlights its unequal consequences for affected communities (Olunusi & Adeboye, 2025). Communities whose livelihoods depend directly on land, forests, rivers, wetlands, and coastal ecosystems are often the most exposed and least equipped to absorb environmental losses. Environmental degradation must therefore be examined not only as an ecological problem but also in terms of distribution, vulnerability, participation, and justice: who bears environmental costs, who benefits from natural resources, and whose interests are represented in decisions concerning environmental governance (Kalu, 2008). The Church of Nigeria's 2025 Abuja Synod expressed concern about deforestation, oil spills, plastic pollution

and illegal mining and called for reforestation and land rehabilitation. In Anambra state Anglican Dioceses provided relief materials, opened church facilities to displaced persons, offered medical and psychological support, and advocated for government responses during recurrent flooding (Afunugo 2024). During the 2018 floods, the Diocese of Mbamili reported that 45 of its churches were affected, showing that Anglican churches were themselves vulnerable to environmental disaster (Ujumadu & Nwaiwu, 2018). Diocese of Ogbaru made facilities available as temporary shelters for displaced persons, while the Church of Nigeria set up a relief committee to respond to members affected by natural disaster. The Diocese of Nnewi through the mothers' Union visited people affected by flooding in Anambra state and provided foodstuffs and clothing. Research involving church leaders across Anglican, Catholic, and Pentecostal traditions found considerable awareness of climate change, although perceptions of its causes and the churches' responsibilities varied across traditions (Nche, 2020). Anglican resolutions and initiatives have encouraged churches to strengthen climate advocacy, disaster preparedness, resilience, and support for communities vulnerable to environmental change (Anglican Alliance, 2024).

Findings

The findings suggest that the ecological challenge confronting the Church of Nigeria should not be understood simply as a new area of ecclesial responsibility. Rather, it represents a test of the Church's capacity to adapt historically established institutions and practices to changing social and environmental conditions. Historical Institutionalism provides an appropriate analytical lens because it explains institutional development through the interaction of continuity, path dependence, critical junctures, and institutional change. From this perspective, the ecological crisis raises not only the question of how the Church should respond, but also how it's historical inheritance shapes the possibilities and limits of that response. Important foundations for ecological responsibility can

already be identified within the Anglican tradition. The Church's longstanding involvement in education, social welfare, community development, public engagement, and human wellbeing demonstrates that Anglican mission has grown beyond worship and pastoral administration. This tradition of social engagement provides an institutional and theological basis for responding to contemporary environmental challenges. The Anglican Communion's Fifth Mark of Mission gives this historical orientation a more explicit ecological expression by calling the Church to safeguard the integrity of creation and sustain and renew the life of the earth (Anglican Communion, 2024). Ecological responsibility can therefore be interpreted not as a departure from Anglican identity but as an extension of established commitments to stewardship, justice, service, and the common good. Although elements of ecological responsibility can be located within the wider Anglican tradition, Nigeria's contemporary environmental conditions present challenges that have not previously occupied the same position within the Church's institutional agenda. Oil pollution in the Niger Delta, recurrent flooding, deforestation, desertification, coastal erosion, inadequate waste management, and increasing climate vulnerability have altered the material and social conditions within which Nigerian communities live. Churches need to interpret these problems as matters relevant to Christian mission, public responsibility, human wellbeing, and social justice. Climate related disasters, environmental pollution, livelihood insecurity, and ecological health risks may compel the Church to reassess established priorities and modes of ministry. The central issue, therefore, is whether Nigeria's ecological crisis will generate a durable reorientation of Anglican institutional practice or remain a peripheral concern within existing patterns of ministry. The Church of Nigeria already possesses organizational structures through which ecological concerns can be incorporated. Theological institutions can strengthen environmental education; parishes can integrate ecological concerns into discipleship and community engagement; schools can promote environmental

awareness; women's and youth ministries can support community mobilization; and diocesan structures can coordinate environmental advocacy and locally relevant initiatives. This approach preserves institutional continuity while allowing the Church to respond meaningfully to emerging environmental realities. The broader contribution of this study is therefore to locate ecological responsibility within the historical development of Nigerian Christianity rather than treating it as an external addition to Christian mission. Contemporary environmental challenges both operate through existing institutional pathways and place pressure upon those pathways to change. Historical Institutionalism makes it possible to analyze this interaction between inheritance and transformation, demonstrating how ecclesial institutions can preserve historical identity while adapting to new social and ecological realities.

Conclusion

This article has argued that Nigeria's ecological crisis presents the Church of Nigeria (Anglican Communion) with both a theological challenge and a significant historical opportunity. Environmental degradation, climate vulnerability, oil pollution, flooding, declining livelihoods, and environmental inequality increasingly shape the social conditions within which the Church exercises its ministry. These developments require renewed consideration of how the Church's inherited theological commitments and institutional structures can respond to changing ecological realities. The analysis demonstrates that the Church of Nigeria does not encounter this challenge without substantial historical resources. Its development through missionary Christianity, education, social ministry, indigenous leadership, ecclesial autonomy, and public engagement has produced an extensive institutional infrastructure capable of accommodating emerging areas of responsibility. The Anglican Communion's Fifth Mark of Mission also provides an established theological basis for safeguarding the integrity of creation and sustaining the life of the

earth. Historical Institutionalism provides a useful framework for understanding the relationship between this institutional inheritance and contemporary change. The Church's historical development has generated patterns of continuity and path dependence, but these do not necessarily prevent institutional adaptation. Rather, inherited structures can provide the organizational resources through which new priorities are interpreted and incorporated. The contemporary ecological crisis may therefore constitute a critical juncture in the historical development of the Church of Nigeria. Whether it produces substantive institutional change will depend on the capacity of ecclesial actors to recognize emerging environmental realities, reinterpret inherited commitments, and modify established practices. In conclusion Nigeria's environmental crisis constitutes a critical juncture in the historical development of the Church of Nigeria (Anglican Communion). Responding to this crisis does not require the abandonment of inherited Anglican traditions; instead, it calls for their creative adaptation to the ecological realities of contemporary Nigeria. Such adaptation would enable the Church to connect its longstanding commitments to education, social responsibility, public engagement, human dignity, and Christian mission with the environmental conditions that increasingly shape human survival and community wellbeing.

Recommendations

In light of the findings, the study proposes the following institutional directions: Seminaries and theological institutions should incorporate environmental theology, environmental ethics, climate justice, and creation care into ministerial formation and continuing theological education. Ecological responsibility should become part of Christian formation through programmes that connect Christian faith with responsible environmental practices and community engagement. Clergy and lay leaders should engage biblical themes of creation, stewardship, justice, neighbor-love, and human responsibility within preaching, Bible study, and

Christian education. Dioceses should consider establishing appropriate structures to coordinate environmental education, research, advocacy, community engagement, and practical initiatives. Environmental responsibility should be incorporated into relevant diocesan and institutional policies addressing waste management, water use, energy consumption, land management, and sustainable development. The Church should use its public and prophetic voice to promote environmental justice, institutional accountability, effective remediation, community participation, and protection of vulnerable populations. Given the region's history of petroleum-related environmental degradation, Anglican institutions should strengthen community engagement around environmental health, livelihoods, justice, remediation, and sustainable development. Churches, schools, seminaries, offices, and other Anglican institutions should model responsible environmental practices through effective waste management, conservation, efficient resource use, and sustainable facility management. Partnerships with universities, research institutes, civil-society organizations, and relevant environmental agencies should be encouraged to strengthen access to scientific evidence, environmental data, technical expertise, and interdisciplinary research. Further research should investigate the historical relationships among Christian missions, land use, natural resources, environmental change, public health, community development, and ecological crises. Such scholarship would contribute to the development of environmental history as an emerging field within Nigerian Church History. These recommendations do not propose an entirely new institutional agenda for the Church. Rather, they seek to extend and adapt existing Anglican institutions and traditions to contemporary ecological realities.

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ANTHROPOGENIC ACTIVITIES AND RISING TEMPERATURE REGIMES OF UYO METROPOLIS IN AKWA IBOM STATE

Moses Idongesit Peters
Department of Sociology and Anthropology
Akwa Ibom State University, Obio Akpa Campus
mosesidongesit@aksu.edu.ng

Abstract

Uyo, serving as the capital municipality of Akwa Ibom State and an expanding metropolitan area, is experiencing heightened human-induced activities, encompassing a proliferation of structures, transportation infrastructure, paved surfaces, pedestrian pathways, vehicular parking facilities, residential and commercial roofing, motor vehicle circulation, electrical supply problems, and elevated atmospheric carbon emissions originating from automobiles and power generation equipment. This research presents qualitative data on the anthropogenic activities that have shaped temperature regimes in the Uyo metropolis in Akwa Ibom State. This exploratory research was conducted in Uyo Metropolis, the Akwa Ibom State capital city. The Human Forcing Besides Greenhouse Gases Theory (HFBGG) was used as a theoretical framework for the study. The Human Forcing Besides Greenhouse Gases Theory (HFBGG) is one of the seven theories of climate change edited by Joseph Bast of Heartland Institute, USA. The researcher used a combination of stratified and simple random sampling techniques to select respondents. In the metropolis, streets and roads demarcate each group of houses and delineate the dividing streets and roads. Thus, each set of houses demarcated by a street and/or road was considered a stratum. This occurred repeatedly within Oron Road, Barracks Road, Ikpa Road, Itu Road, Udi Street, and Ibiam Street. The researcher also used simple random sampling to select households from every stratum and to select participants from every household. Selection was carefully

made such that men and women were selected at random without duplication. The findings of the study show that increases in the use of automobiles within the metropolis, failures in electricity provision, which lead to increased use of generators, and expanding deforestation due to urbanisation, contribute to the rising temperature regime in Uyo metropolis, with people not knowing that they are responsible for the changes in the metropolis's temperature. It was recommended that, among others, the government should make good use of the Ministry of Environment for education and the checking of indiscriminate anthropogenic activities across the metropolis.

Keywords: Anthropogenic, Temperature regimes, Environment, Climate change and Uyo

Introduction

Temperature regimes describe the changes in temperature data across air, soil, and water. According to Meastas *et al.,* (2023), temperature regimes are defined by specific mean soil temperatures, and seasonal fluctuations from the mean, within the main root zone. Moisture regimes refer to the duration of time when plant-available moisture is present during the growing season. Soil temperature regulates the biogeochemistry of terrestrial environment, especially those occurring below ground (Seyfried *et al.,* 2001; Qi and Song, 2003). Changes in soil temperature may alter the distribution, physiology, and growth of plant species, the decomposition of soil organic carbon, and the CO2. Most climate records and climate change scenarios projected by the general circulation models are for atmospheric conditions. Soil temperature data, especially areal-wide long-term data, are seldom recorded. Soil temperature is governed by the heat transfer process between the atmosphere and the soil surface and is expected to respond to emissions from the soil to the atmosphere (Brooks *et al.,* 2004; Schimel *et al.,* 2004).

Tropical climate zones are located between 23.5N and 23.5S latitudes and include many rapidly developing countries like Nigeria in Africa (Marcotullio *et al.*, 2021). There are at least 106 countries with tropical zones within their borders, and the total populations of the countries with more than 15% of their land area classified as tropical accounted for approximately 48% (3.5 billion) of the total world population in 2015 (UN, 2017). The United Nations (UN) projected that by 2050, this population will increase to 54% (5.3 billion) of the world population and by 2100, the population in these countries are projected to account for over 59% of the world population, which will be at 6.6 billion (UN, 2017).

Within the urban centres, heat island has given rise to different forms of temperature regimes like the soil temperature regimes and air temperature regimes, due to the rising temperature across the urban areas as a result of anthropogenic activities. Temperature regimes are defined by specific mean soil temperatures, and seasonal fluctuations from the mean, within the main root zone (Maestas, *et al.*, 2016). The degrees of heat or thermal pressure experienced in the urban areas are directly proportional to the state of the soil and air temperature regimes. According to Maestas *et al.* (2016), as urban centres experienced increase in temperature, the soil temperature regime is at a descending order whereby the top surface is hotter and decreases down the earth from hyperthermic, thermic, mesic, frigid, cryic, to pergilic. This state of the soil temperature regimes correlates with the state of the air temperature regimes. The air temperature regime is set to convey the solar energy emission from the solar source (Sun) and other heat emitting structures within the urban areas.

As the cities in the developing nations like in Sub-Saharan Africa are experiencing increase in human density and city expansion, there is increase in anthropogenic activities within the city areas as adaption processes. Kundu (2007) explained that United Nations

has warned that rapid urbanisation and migration would lead to tripling of slum population by 2050. As humans migrate to these cities from rural areas, survival and adaptation become the major issue. The quest for survival and adaptation has led to many anthropogenic effects on the urban city environment. Urbanisation and human activity within an urban system produce many destructive and irreversible effects on natural environments such as climate change, air pollution, sediment and soil erosion, increased flooding magnitude, and loss of habitat (Kundu, 2016). Cities in an urban environment change the local climate dramatically, with a rise in temperature in both the air and in the soil.

In Nigeria, many state capitals are known to be the major cities within each state of the federation. These cities have witnessed mass movement of people from other parts of such states and the neighbouring states to the capital cities. The increase in human density has led to an increase in anthropogenic effects on the city environment. These effects have generated the rising temperature regimes and climate change experienced among the urban cities of Nigeria. The anthropogenic nature of activities found in the urban centres has contributed to climate change in the tropics. Coolgeography.co.uk reports that due to human activities, the temperature in an urban microclimate is higher than that of the surrounding areas. Urban areas are said to be urban heat islands (UHI) as under calm conditions, temperatures are highest in the built-up city centre and decrease towards the suburbs and countryside (Coolgeography.co.uk, 2025). Marcotullio, et al., (2021) maintained that the rising temperatures and heat waves in the cities are exacerbated by the higher temperatures in the core urban areas as compared to surrounding areas, and this is referred to as the urban heat island UHI effect, which provides a clear example of anthropogenic impacts on climate. Urban heat islands have been known for centuries and have subsequently been identified in cities around the world (Dawson and Spannagle, 2008).

Uyo, being one of the urban cities in the tropical region of Nigeria, has experienced mass movement of people from other parts of the state and other parts of Nigeria into the city on a daily basis. This migration has led to overpopulation of the main Uyo metropolis with eco-effects on the expansion of the suburban areas of Uyo, which make Uyo metropolis to include Itu, Uruan, Ibesikpo-Asutan, Nsit Ibom, Abak, and Etinan Local Government Area (aksg.gov.ng). Uyo, as the capital city of Akwa Ibom State and a growing urban centre, is witnessing increasing anthropogenic activities, including an increase in the number of buildings, roads, pavements, walkways, car parking lots, roofs, vehicles, traffic, electricity supply, and carbon gas emissions from cars and generators. The city is also experiencing a reduction in green land space, the number of trees, and other natural landmarks. These anthropogenic effects have led to the rising temperature regimes experienced within Uyo as an urban centre, and there is a rising concern about climate change around Uyo due to the rising temperature regimes in the urban area as a result of the increase in human density. Studies on other urban cities of the nation, Nigeria (Harrington *et al.*, 2016), have shown that urbanization contributes to the rising temperature regimes along the tropics. The rise of urban cities like Uyo in Nigeria within the tropical region and the increase in the temperature regimes due to the influence of anthropogenic activities in the urban cities is the gap which this research work seeks to fill. Against this backdrop, this research seeks to examine the roles of the anthropogenic activities which characterize the urban nature of Uyo on the rising temperature regimes within the urban metropolis in Akwa Ibom State.

Theoretical Framework

The Human Forcing Beside Greenhouse Gases Theory (HFBGG)

The researcher adopted one of the Seven Theories of Climate Change for theoretical explanation of the study. This theory is the

Human Forcing Besides Greenhouse Gases Theory HFBGG. The Human Forcing Besides Greenhouse Gases Theory HFBGG being one of the seven theories of climate change edited by Joseph Bast (2010) of Heartland University USA as proposed by Roger Pielke, Sr. states that although the natural causes of climate variations and changes are undoubtedly important, the human influences are significant and involve a diverse range of first-order climate forcing, including, but not limited to, the human input of carbon dioxide (CO2).

The theory of climate change holds that mankind's greatest influence on climate is not its greenhouse gas emissions, but its transformation of Earth's surface by clearing forests, irrigating deserts, and building cities. Roger Pielke, Sr., a climatologist at the University of Colorado – Boulder, phrases the theory as follows: "although the natural causes of climate variations and changes are undoubtedly important, the human influences are significant and involve a diverse range of first-order climate forcing, including, but not limited to, the human input of carbon dioxide (CO2)."

Short descriptions of some of these "human forcing" other than greenhouse gases (not all of them reported by Pielke) are as follow;

Urban Heat Islands

Cities tend to be warmer than suburbs, and suburbs warmer than rural areas, because they have greater concentrations of energy-producing machines and vehicles and large amounts of concrete, asphalt, and other building and road materials that absorb solar energy and then re-emit thermal energy. These "urban heat island" effects have been documented by many authors. De Laat *et al.,* in a 2004 study published in Geophysical Research Letters, concluded that "the 'real' global mean surface temperature trend is very likely to be considerably smaller than the temperature trend in the CRU [Hadley Center/Climatic Research Unit] data." Advocates of the anthropogenic (man-made) global warming AGW theory falsely

attribute higher temperatures caused by urban heat islands to rising atmospheric CO2 levels.

Aerosols and ozone

Anthropogenic aerosols and ozone have shorter lifetimes than greenhouse gases, and therefore their concentrations are higher in source regions and downwind. Pielke and colleagues estimate the effect of human aerosols on the gradient of radiative heating on regional scales "is on the order of 60 times that of the well-mixed greenhouse gases." With many surface-based temperature stations located in urban or near-urban areas, it is likely they are registering the warming effects of these aerosols and ozone, not CO2.

Deforestation

Removing trees by burning, a common practice in developing countries releases CO2 into the atmosphere and prevents forests from sequestering carbon in the future. The pasture or crop land that replaces the forest lacks the shade created by a forest canopy and tends to be warmer. The IPCC has estimated that between one-quarter and one-third of anthropogenic CO2 emissions are due to deforestation, not the burning of fossil fuels, though this estimate has been challenged as being too high.

Coastal development

Anthropogenic activities in coastal areas such as logging, agriculture, construction, mining, drilling, dredging, and tourism all can increase or (more rarely) decrease surface temperatures of nearby bodies of water. For example, storm runoff from city streets following heavy rains can result in seawater dilution and temperature increases. Development can produce sediment that reduces stream flow and damages coral reefs by reducing the penetration of sunlight or by direct deposit on the coral, causing damage mistakenly attributed to global warming.

Jet contrails

Anyone living in or near a large city knows that jets often leave trails behind them, called contrails (short for "condensation trails"). Composed of water vapor, they precipitate the creation of low clouds that have a net warming effect. According to a 2006 study published in the International Journal of Climatology, contrails in the U.S. "may cause a net warming of the surface rivaling that of greenhouse gases" and "in certain regions, contrails already may contribute as much as the present anthropogenic CO2 forcing on climate.

Several of these "human forcing" have local and regional effects on climate equal to or even exceeding that of anthropogenic greenhouse gas emissions. This leaves little or no warming left to be explained by the theory. Unfortunately, as Roger Pielke concludes, the IPCC in 2007 "did not sufficiently acknowledge the importance of these other human climate forcing in altering regional and global climate and their effects on predictability at the regional scale. It also placed too much emphasis on average global forcing from a limited set of human climate forcing."

Key Elements of the theory (The Human Forcing Beside Greenhouse Gases Theory HFBGG)

The following points generalise the key positions of the Human Forcing Beside Greenhouse Gases Theory (HFBGG)**;**

i. Human activities within the urban centres generate or create a cloud of heat over the urban cities known as the Urban Heat Island (UHI), which contributes to the urban areas' higher temperature than the sub-urban or rural areas.
ii. Human activities in creating hard concrete surface which become surface-based temperature stations located in urban areas, and cause more urban rising temperature refer to as anthropogenic aerosols and ozone.
iii. Human in their quest to urbanize the city take to deforestation by cutting down the canopy trees thereby exposing the urban area to direct sunlight and emission of

CO_2 which contribute to the rising temperature of the urban areas especially as the human expand their urban areas.

iv. Human activities at the coastal city areas like logging, agriculture, construction, mining, drilling, dredging, and tourism, contribute to the rising temperature of the urban areas.

v. Human activities in the urban areas with the use of jets always bring upon the urban area the jets trails which present anthropogenic CO2 forcing on climate within the urban areas and contribute to the rising temperature of the urban areas.

The synthesis of the factors of the Human Forcing Beside Greenhouse Gases Theory (HFBGG) explains that humans in their acts of urbanization have created the various factors which have make the urban areas hotter than the rural areas, and have contributed to the rising challenge of future climate change callings.

Methodology

This exploratory research was conducted in Uyo Metropolis which

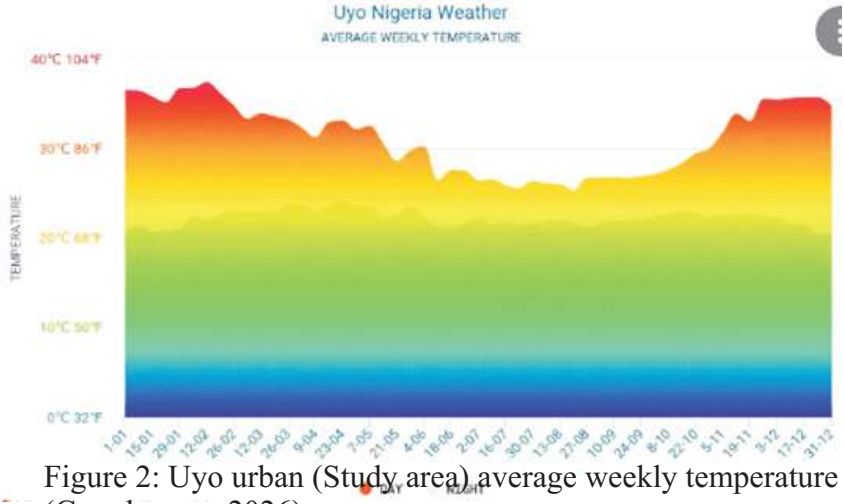


Figure 2: Uyo urban (Study area) average weekly temperature (Google.com, 2026)

A qualitative research method was adopted for the study. Uyo is the capital of Akwa Ibom state and one of the most popular cities in the South-South of Nigeria. Uyo became the capital of Akwa Ibom on September 23 1987, after its creation from Cross River State. Uyo is situated between latitude 5° 01' North of the Equator and longitude 7° 56' East of the Meridian. It is bounded in the west by Abak, east by Uruan, north by Ikono, Ibiono Ibom and Itu and in the south by Etinan, Ibesikpo/Asutan and Nsit Ibom Local Government Areas. Uyo urban centre has undergone many evolutionary processes of political, administrative, spatial, demographic and economic changes.

Fetterman's (2010) big-net approach was used to get the sample for the study out of the Uyo metropolis residents. This gave way for qualitative research data collection (Peters, 2019). The main study participants were adults between the ages of 18 years and above, found along selected segments of the Uyo metropolis. The researcher made use of a combination of stratified and simple random sampling techniques to select the study participants. In the metropolis, streets and roads demarcate each group of houses and delineate the dividing streets and roads. Thus, each set of houses and shops demarcated by a street and/or road were considered a stratum. This occurred severally within Oron Road, Barracks Road, Ikpa Road, Itu Road, Udi Street, and Ibiam Street. The researcher also used simple random sampling to select households that form the stratum from every strata and as well as select participants from every household. The selection was carefully made such that men and women were selected at random without duplication.

Results

Emission of CO_2 and Temperature Regime in Uyo Metropolis

Gathered data by the researcher through narratives of the study participants during interviews revealed increase in the use of generators within Uyo metropolis due to poor supply of electric

energy by the electric power supply company. Being an urban centre with continuous influx of people from within and outside Akwa Ibom State, and coupled with the poor general electric energy supply, the use of generators is becoming increasingly visible in Uyo metropolis with increase in the demand for personal electric energy supply to meet up the electric energy needs for businesses and household use. According to gathered data, the dangerous part of the use of generators by the residents of Uyo metropolis is the emission of Carbon dioxide into the atmospheric pressure at a state of ignorance of the consequences of the effects on the temperature of Uyo metropolis. During interviews one of the study participants in his narratives reported that;

We are enjoying a bit cool of weather because of the rainy season, but when it is dry season, my brother you know that you is becoming hotter from the day through the night. So, we need electric power to power on our fans and air conditioning to be able to cope with the hot weather of the hot season. And you know that during this season NEPA (electric energy supply) used to be funny and will not be giving light. Even now, when rain is not falling, the temperature here is high and when there is no NEPA (electric energy supply) light we will have to use generators and you can imagine how many generators will be put on by almost every house (male, trader, 40 years, interviewed on 27th August 2024 at Oku Udi street, Uyo)

Another study participant reported that;

We use generators because we cannot depend on NEPA and we don't know what you mean by the emission of CO2 by generators and how it affects temperature. The only thing I know

> is that the temperature here is becoming hotter by the day especially when rain is not falling and I don't know if that has anything to do with the use generator. Moreover, we are using the generator because we have to generate our electric power to do our business here (Male, printer, 46 years, interviewed on 27th August 2024 Ibiam Street)

The researcher found the emission of Carbon dioxide to the atmospheric pressure by humans to be not limited to the use of generators. The urbanization of the Uyo metropolis has witnessed an increase in human density which has directly brought about the increase in the use of motor vehicles within the metropolis. The increase in the use of cars, trucks, tricycles, and motorcycles in the suburbs contributes to the generation of emission of Carbon dioxide (CO2) into the atmosphere. This emission is brought about by a population with a mix of educated people who have ideas of the contribution of the CO2 to the climate and Ozone layer and of those who are ignorant of the contributions of the CO2 to the atmosphere. According to study participant, the populace believe they are not guilty of the problem, and they have to develop coping mechanism to the problem if it cannot be solve. In her words, a participant also reported that;

> We know that carbon is not that good for the atmosphere but we cannot be held responsible for that because we have to drive to work and we have to use public transport when we cannot drive as it is now due to high fuel pump price. So, you can see that the situation is such a serious one because we cannot help ourselves with this unless there is effort on the path of the government to see how this can be solved. The bad part of it is that the

> fuel we use is bad with much carbon (female, Civil Servant, 50 years, interviewed on 28th August 2024 at Oron road).

The use of generators and motor vehicles are great means of emission of Carbon dioxide gases to the atmosphere in Uyo metropolis. The facts of this findings are that; the use of generators and motor vehicles are necessitated by provision of alternative means of electric energy to substitute for poor general supply of electric energy and the use of motor vehicles that use petrol as fuel for transportation in Uyo metropolis. These have contributed to the rise in the temperature of the metropolis.

Expanding Deforestation and Temperature Regime

Urbanization is effected by massive movement of people to settle at a given place. The Uyo metropolis is a growing city in the South-South geopolitical zone of Nigeria with daily movement of the people from other parts of the state, other parts of the nation to the city. Gathered data have shown that due to the movement of people into Uyo, the urban centre has witnessed expanding communities and business areas through the killing of the natural green areas of Uyo. Uyo is continually witnessing increase in building structures across the metropolis and fast disappearance of natural soil which ought to provide moisture for cooling processes of the atmospheric environment of the metropolis. Buildings by individuals, organizations, institutions and government are fast taking over the green and natural areas of the Uyo metropolis and these are contributing to the rising temperature of the metropolis due to the reduction in size of the natural lands for the production of counter moisture for heat radiation from the sun. One of the study participants said that;

> There is no how you cannot say that Uyo is becoming hotter by the day and the fact that not everybody knows that the increase in population is becoming a serious problem to

> us who moved into the city. Yes, life is in the city and we move into the city from our villages, but we have refused to notice that we came into Uyo and we need places to live and places to do our businesses. So, we build houses and we build offices, and we build shops, and I can tell you we build indiscriminately without the city plan. The problem a lot of us not know is that the more we build the more we kill the natural bush with green trees and vegetation that suppose to give us moisture for a cooling environment. So, we kill the natural lands and build our artificial floor and houses with black zincs that attract more heat from the sun and the place is becoming hotter everyday and the villages we left remain cool (Male, public servant, 52 years, interviewed on 28th August 2024 at Ikpa road)

Another study participant in her words reported that;

> The heat in Uyo that Uyo are talking about is becoming a serious issue that many people are complaining but nobody is asking questions. You will see that we are building new houses and shops everyday with pavements and german floor across many compounds. These acts automatically take away the natural areas that supposed to help in absorbing heat and generating moisture in the morning for a cool day as we used to see in our villages. But, what we have now are cemented areas that absorb heat and retransfer the heat back through the day thereby forming a cycle of heat from

> morning through the night to the next day (female, public servant, 54 years, interviewed on the 27th August 2024 at Oku Street).

Gathered data have shown that anthropogenic activities like building of houses, shops, offices and expansion of the cemented areas through building of cemented floors and walk ways have contributed to rising temperature of Uyo metropolis due to the fact that the cemented areas will absorb heat during the day and recycle it through the night and the next day. Data revealed the rising temperature of Uyo based on the day to day movement of the people into the city and the consequent increase in buildings within the metropolis.

Discussion of Findings

Emergence from analysis of qualitative data gathered through interviews shown that anthropogenic activities like the use of generators which bring about emission of Carbon dioxide (CO2) and the use of motor vehicles have contributed to the rising temperature in Uyo metropolis. Findings shown that increase in the use of generators within Uyo metropolis is due to poor supply of electric energy by the electric power supply company. The continuous influx of people from within and outside Akwa Ibom State, and the poor general electric energy supply, make the use of generators increasing visible in Uyo metropolis with increase in the demand for personal electric energy supply to meet up the electric energy needs for businesses and household use. Findings revealed that the dangerous part of the use of generators by the residents of Uyo metropolis is the emission of Carbon dioxide into the atmospheric pressure at a state of ignorance of the consequences of the effects on the temperature of Uyo metropolis. These findings agreed with Einstein and Kogan (2016), who postulated that urban environments produce air pollution that harm the natural environment due to human activities. Much of air pollution is

concentrated in and around urban areas, where automobiles and industry emit mass amounts of waste into the environment by humans' activities.

Urbanization of Uyo metropolis is the movement of people into Uyo. Analyses of findings show that the urban centre has witnessed expanding communities and business areas through the killing of the natural green areas of Uyo. Findings also show that Uyo is continually witnessing increase in building structures across the metropolis and fast disappearance of natural soil which ought to provide moisture for cooling processes of the atmospheric environment of the metropolis. Analysis show that buildings by individuals, organizations, institutions and government are fast taking over the green and natural areas of the Uyo metropolis and these are contributing to the rising temperature of the metropolis due to the reduction in size of the natural lands for the production of counter moisture for heat radiation from the sun. Findings shown that anthropogenic activities like building of houses, shops, offices and expansion of the cemented areas through building of cemented floors and walk ways have contributed to rising temperature of Uyo metropolis due to the fact that the cemented areas will absorb heat during the day and recycle it through the night and the next day. These findings give credence to Qiao *et al.,* (2020) who posit that human-oriented urbanization and related land-use change processes significantly affect the thermal environment of cities and their surrounding areas by transforming the natural landscape into an impervious surface.

Conclusion

Anthropogenic activities refer to the human works carried out in natural areas of land due to urbanisation through the movement of people to settlement areas. Uyo metropolis is experiencing urbanisation and expanding urbanization through the development of the suburbs by anthropogenic activities. This study examined these anthropogenic activities that have affected rise in the

temperature regimes of the Uyo Metropolis. The increase in population and failure in the supply of electric energy has led to the increase in the use of generators which emit carbon dioxide (CO2) to the atmosphere and the use of motor vehicles also contribute to the emission of CO2 which contribute to the rising temperature of Uyo metropolis. The focal point is that the majority of those who use these gas-emitting engines do not know that they are responsible for the rising temperature of Uyo metropolis. Same is found among the populace who build and construct cemented pavements and floors outside their houses which bring about the fast disappearance of natural soil for the production of moisture for absorption of heat from the sun, but provide the metropolis with floors that absorb heat and recycle of heat within the metropolis.

Recommendations

Based on the findings of the study, the researcher makes the following recommendations;

1. The government should make good use of the Ministry of Environment for education and check of indiscriminate anthropogenic activities across the metropolis.
2. The state government should see to the constant provision of electric energy to reduce generator use among the populace.
3. The government should make good use of the Ministry of Environment for the education of the populace on the need for green vegetation and natural soils for moisture generation.

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CLIMATE CHANGE, ENVIRONMENTAL SUSTAINABILITY AND BIODIVERSITY: CHALLENGES AND WAY FORWARD FOR AFRICA

Clement Chimezie Igbokwe, PhD
Department of History and International Relations
Abia State University, Uturu
igbokwe.clement@abiastateuniversity.edu.ng

Mbakwe Chisom Sunday
Department of History and International Relations
Abia State University, Uturu
sunday.mbakwe@abiastateuniversity.edu.ng

Abstract

Climate change remains one of the fundamental global challenges of the 21st century with far-reaching implications for environmental sustainability and biodiversity. Although the African continent contributes relatively little to global greenhouse gas emissions, it faces severe consequences, including rising temperatures, unpredictable rainfall, desertification, flooding, etc. These changes in climatic conditions disrupt ecosystems, accelerate biodiversity loss, and threaten the livelihoods of communities that depend on natural resources for survival. This paper examines the relationship between climate change, environmental sustainability, and biodiversity in Africa, emphasizing how ecological systems are increasingly strained by both climatic pressures resulting from human activities such as deforestation, gas flaring, oil spillage, and unsustainable land use. It highlights the vulnerability of Africa's diverse ecosystems and the urgent need for adaptive and sustainable responses. Using a qualitative approach, the study draws on existing literature and policy frameworks to assess current efforts aimed at addressing

environmental challenges across the continent. It argues that sustainable environmental management in Africa requires stronger governance, community-based strategies, and enhanced regional and international cooperation. The paper concludes that safeguarding Africa's biodiversity and ensuring environmental sustainability demands immediate and coordinated action. By integrating climate adaptation measures such as ecosystem-based adaptation and coastal protection with conservation efforts, African countries can build resilience and promote a more sustainable future.

Keywords: Climate change, environment, sustainability, biodiversity, climate adaptation.

Introduction

Climate change has emerged as one of the most significant global challenges of the twenty-first century. Across the world, environmental systems are increasingly experiencing disruptions caused by rising temperatures, changing rainfall patterns, floods, droughts, desertification, sea-level rise, and other extreme weather events. These climatic changes threaten ecological systems, economic development, and human survival. Although climate change is a global issue, its impacts are not evenly distributed. Developing regions, particularly Africa, remain among the most vulnerable despite contributing minimally to global greenhouse gas emissions. Africa contributes less than four percent of global carbon emissions, yet the continent suffers disproportionately from the consequences of climate change (Intergovernmental Panel on Climate Change (IPCC), 2023). This vulnerability is associated with widespread poverty, weak infrastructure, dependence on climate-sensitive sectors, and inadequate technological and financial resources. Agriculture, which serves as the main source of livelihood for millions of Africans, is highly dependent on rainfall and stable weather conditions. As climate variability increases, agricultural productivity continues to decline, threatening food security and economic stability.

The effects of climate change in Africa are already visible in many regions. Countries in the Sahel and the Horn of Africa frequently experience prolonged droughts and desertification, while several coastal regions face severe flooding and erosion. Rising temperatures have also contributed to water scarcity, declining crop yields, increased disease outbreaks, and loss of biodiversity. Environmental degradation caused by human activities such as deforestation, mining, overgrazing, and urbanization further intensifies these climate-related challenges. Environmental sustainability has therefore become a critical concern for African governments, policymakers, and international organizations. Environmental sustainability refers to the responsible management and utilization of natural resources in ways that ensure ecological balance and preserve environmental quality for future generations. Sustainable environmental practices seek to protect ecosystems while supporting economic and social development. Closely linked to environmental sustainability is biodiversity, which refers to the variety of living organisms within ecosystems. Biodiversity includes plants, animals, microorganisms, and genetic diversity. Africa possesses rich biodiversity resources and unique ecosystems such as tropical rainforests, wetlands, savannahs, deserts, and marine environments. These ecosystems provide essential services including climate regulation, food production, medicine, tourism, and water purification.

However, biodiversity in Africa is increasingly threatened by climate change and unsustainable human activities. Rising temperatures, habitat destruction, pollution, and changing weather patterns continue to disrupt ecosystems and endanger wildlife species. Biodiversity loss weakens ecosystem resilience and reduces the capacity of communities to adapt to environmental stress. The interaction between climate change, environmental sustainability, and biodiversity is therefore complex and interconnected. Climate change accelerates biodiversity loss,

while environmental degradation reduces ecosystem resilience and increases vulnerability to climate shocks. These challenges also contribute to poverty, migration, food insecurity, and conflicts over natural resources. Recognizing these threats, African governments and international institutions have introduced several environmental policies and adaptation initiatives aimed at promoting climate resilience and biodiversity conservation. Programs such as the Paris Agreement, the Sustainable Development Goals (SDGs), and the African Union Agenda 2063 emphasize environmental sustainability and climate adaptation. Nevertheless, implementation challenges such as weak governance, corruption, inadequate funding, and political instability continue to hinder progress.

This paper examines the relationship between climate change, environmental sustainability, and biodiversity in Africa. It explores major environmental challenges facing the continent, analyzes the impacts of climate change on biodiversity and livelihoods, discusses adaptation strategies and policy responses, and highlights the challenges affecting sustainability efforts in Africa.

Literature Review

Climate change and environmental sustainability have become major areas of scholarly debate in recent years because of increasing global concern about ecological degradation and sustainable development. Several studies have examined the impacts of climate change on African ecosystems, biodiversity, agriculture, and socio-economic development. According to the IPCC (2023), Africa is one of the regions that is most vulnerable to climate change because of its dependence on climate-sensitive sectors such as agriculture, forestry, fisheries, and tourism. Rising temperatures, changing rainfall patterns, and increasing climate variability have intensified droughts, floods, and food insecurity across the continent. The report further notes that climate change is likely to worsen poverty and inequality in Africa if effective

adaptation measures are not implemented. Research conducted by the United Nations Environment Programme (UNEP, 2022) shows that environmental degradation in Africa is driven by both climatic and human factors. Climate change, deforestation, pollution, mining, urbanization, and unsustainable agricultural practices have significantly degraded ecosystems and endangered wildlife species. UNEP emphasizes that environmental sustainability is essential for poverty reduction, economic growth, and long-term development.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2022) highlights the role of biodiversity in maintaining ecological stability and resilience. Biodiversity enables ecosystems to adapt to climate stress and environmental disturbances. However, increasing habitat destruction, overexploitation of resources, and species extinction continue to threaten biodiversity across Africa. Scholars have also examined the role of governance and institutions in addressing environmental challenges. Adebayo (2021) argues that weak environmental institutions, corruption, and poor policy implementation remain major obstacles to climate adaptation and sustainability efforts in Africa. Environmental laws often exist but are poorly enforced due to inadequate political will and limited institutional capacity. Several studies have focused on sustainable agriculture and renewable energy as strategies for addressing climate change in Africa. The Food and Agriculture Organization (FAO, 2021) emphasizes that climate-smart agricultural practices such as agroforestry, irrigation, conservation farming, and crop diversification can improve food security while protecting ecosystems. Similarly, renewable energy development has been identified as an important strategy for reducing greenhouse gas emissions and promoting sustainable development.

Despite increasing research on climate change and biodiversity conservation in Africa, there remains a need for integrated studies

that examine the relationship between climate change, environmental sustainability, and biodiversity within a comprehensive framework. This paper contributes to existing literature by analyzing these interconnected issues and emphasizing the importance of coordinated environmental management strategies.

Methodology

This study adopts a qualitative research approach based on secondary data. Information used in the study was obtained from academic journals, books, conference papers, institutional reports, policy documents, and publications from organizations such as the IPCC, UNEP, FAO, UNDP, and the African Union. The qualitative approach was selected because it allows for detailed analysis and interpretation of environmental issues across different African contexts. Secondary sources were reviewed to identify major themes related to climate change, biodiversity loss, environmental degradation, sustainability challenges, and adaptation strategies.

Thematic analysis was used to organize and interpret the data collected. Themes identified include climate-induced environmental changes, biodiversity threats, environmental governance, adaptation strategies, and policy responses. Case studies from different regions of Africa were also used to illustrate the impacts of climate change and sustainability efforts across the continent.

Conceptual Clarifications

Climate Change

Climate change refers to long-term changes in temperature, rainfall, and weather patterns caused mainly by increased greenhouse gas emissions from human activities such as fossil fuel combustion, industrialization, and deforestation. Climate change manifests through rising temperatures, changing rainfall patterns, floods, droughts, heatwaves, and sea-level rise.

Environmental Sustainability
Environmental sustainability refers to the responsible management and conservation of natural resources in ways that protect ecosystems and ensure long-term environmental balance. Sustainable practices seek to meet present needs without compromising the ability of future generations to meet their own needs.

Biodiversity
Biodiversity refers to the variety of living organisms within ecosystems, including plants, animals, microorganisms, and genetic diversity. Biodiversity supports ecological balance, food production, medicine, tourism, and climate regulation.

Climate Adaptation
Climate Adaptation means adjusting to actual or expected climate change and its effect with the aim of reducing vulnerability and building resilience targeted at ensuring that communities, countries and peoples can live with climate change realities.

Climate Change And Environmental Challenges In Africa
Africa faces several environmental challenges associated with climate change. Rising temperatures, droughts, flooding, desertification, deforestation, and pollution continue to affect ecosystems and livelihoods across the continent. For example, in the Nigeria's Niger delta, flooding displaces communities in Bayelsa and Delta state with severe consequences on their sources of livelihood. It is rather unfortunate that government seem to be docile in following up with recommended climate adaptation measures. Key areas where Africa must pay attention to are:

1. Rising Temperatures and Heatwaves: Africa has experienced increasing temperatures over recent decades. According to the IPCC (2023), some African regions are warming faster than the

global average. Rising temperatures contribute to heatwaves, increased evaporation, and declining water availability. Globally, the world especially Europe since this year (2026) is grappling with serious heeatwave like never has been witnessed in human history resulting from climate change leading to wild fire incidences ravaging not just the ecosystem but human existence. Africa must learn from these experiences to be able to adapt with the realities of climate change.

Heatwaves negatively affect agriculture, livestock production, and human health. Farmers increasingly struggle with declining crop yields due to heat stress and reduced rainfall. High temperatures also contribute to the spread of diseases such as malaria and cholera.

2. Drought and Water Scarcity: There is no doubt that water availability and quality have been adversely affected as a result of climate change. To collaborate this argument, Rankoana, Agnes (2020) posits in her article titled "Climate change impacts on water resources in a rural community in Limpopo province, South Africa: a community-based adaptation to water insecurity" that water quality and availability have deteriorated in most areas of Africa, particularly due to climate change. Furthermore, the paper argues that water resources are vulnerable and have the possibility of being strappingly impacted by climate change with vast ramifications on human societies (*Rankoana, 2020).* Drought remains one of the most severe environmental challenges confronting Africa. Countries in the Sahel, East Africa, and Southern Africa frequently experience prolonged droughts that threaten food security and livelihoods.

Reduced rainfall affects crop production, livestock farming, and access to clean water. Millions of people face hunger and displacement because of recurring drought conditions. Communities that depend on rain-fed agriculture are particularly

vulnerable to climate variability. Water scarcity has also intensified competition over natural resources. Conflicts between farmers and pastoralists have increased in several African countries because of shrinking water and grazing resources.

3. Desertification and Land Degradation: Desertification refers to the degradation of fertile land into desert-like conditions. Climate change, deforestation, overgrazing, and unsustainable agricultural practices contribute significantly to desertification in Africa. The Sahel region has experienced severe desert expansion and declining soil fertility. Land degradation reduces agricultural productivity and contributes to poverty, migration, and food insecurity. The African Union introduced the Great Green Wall initiative to combat desertification through reforestation and sustainable land management. Although the initiative has recorded some progress, implementation challenges continue to affect its effectiveness.

4. Flooding and Coastal Erosion: Flooding has become increasingly common in several African countries due to heavy rainfall and inadequate drainage systems. Countries such as Nigeria, Mozambique, Kenya, and Sudan frequently experience devastating floods. Flood disasters destroy homes, roads, farmlands, schools, and public infrastructure. Flooding also contributes to disease outbreaks and displacement of vulnerable populations. Coastal erosion threatens major African cities such as Lagos, Alexandria, and Dakar. Rising sea levels damage coastal ecosystems and increase saltwater intrusion into freshwater systems.

5. Deforestation and Environmental Pollution: Deforestation remains one of the leading causes of environmental degradation in Africa. Forests are cleared for agriculture, fuelwood, urbanization, and mining activities. The destruction of forests contributes to biodiversity loss and greenhouse gas emissions. Environmental

pollution from industrial waste, oil spills, and poor waste management also threatens ecosystems and public health. In the Niger Delta region of Nigeria, oil exploration has caused severe environmental damage and destruction of aquatic ecosystems.

Impacts Of Climate Change On Biodiversity And Environmental Sustainability

Africa is a continent with a remarkable biodiversity, including the many endemic and endangered mammals and plants. However, the reality of these species abundance and diversity is seriously threatened and declining as a result of increasing. Climate change. The United Nations Framework Convention on Climate Change is of the view that climate change is one of the greatest threats to biodiversity. Recent studies have also corroborated the view that climate change impacts significantly on biodiversity in Africa. For instance, the studies attribute the loss of biodiversity, fragmented ecosystem and extinction of millions terrestrial species to climate change. Another important corridor by which climate change affects African biodiversity is through the reduction of the amount and availability of suitable habitats and through eliminating vital species necessary for the survival of other species (Dawson et al. 2011). A loss of species from an ecosystem not only affects the species that is lost but also the interactions with other species as well as the general ecological functions, which are expected from these interactions. Despite growing awareness that biodiversity is one of the most vulnerable to climate change, Africa is one of the least studied region in terms of biodiversity dynamics and climate variability (Getahun and Shefine 2015). Nye et al. (2010) opines that the impact of climate change on biodiversity, has orchestrated the migration of Africa's many species geographically in response to rapid changes in temperature and precipitation regime towards higher elevations.

Climate change has serious implications for biodiversity in Africa. Rising temperatures and changing rainfall patterns disrupt

ecosystems and threaten wildlife populations. Many species struggle to adapt to changing environmental conditions, increasing the risk of extinction. Wildlife species such as elephants, rhinos, gorillas, lions, and cheetahs face growing threats from habitat destruction and climate stress. Wildlife migration routes are increasingly disrupted by environmental degradation and human settlements. Forest ecosystems are particularly vulnerable to climate change and human exploitation. Tropical forests such as the Congo Basin play important roles in carbon storage, climate regulation, and water conservation. However, logging, mining, and agricultural expansion continue to destroy forest habitats and threaten biodiversity. Marine ecosystems are also affected by climate change. Rising ocean temperatures and pollution threaten fisheries and coral reefs along African coastlines. Coastal communities that depend on fishing experience declining incomes and food insecurity because of reduced fish populations.

Climate change further threatens agricultural biodiversity by reducing crop diversity and affecting traditional farming systems. Indigenous crops and livestock species may disappear if environmental conditions continue to worsen. Loss of agricultural biodiversity weakens food security and increases vulnerability to future climate shocks. Environmental degradation also contributes to socio-economic challenges. Reduced agricultural productivity increases poverty and unemployment, especially among rural populations. Competition over scarce resources such as water and fertile land may intensify communal conflicts and migration. The shrinking of Lake Chad illustrates the relationship between climate change, environmental degradation, and human insecurity. Millions of people in Nigeria, Niger, Chad, and Cameroon depend on the lake for agriculture, fishing, and domestic water use. However, climate variability and unsustainable water use have significantly reduced the size of the lake, contributing to poverty, displacement, and insecurity in the region.

Policy Responses and Adaptation Strategies

African governments and international organizations have introduced several policies and initiatives aimed at addressing climate change and promoting environmental sustainability. The Paris Agreement encourages countries to reduce greenhouse gas emissions and strengthen climate adaptation efforts. African countries have developed Nationally Determined Contributions (NDCs) outlining their climate commitments and adaptation strategies. The African Union Agenda 2063 and the Sustainable Development Goals emphasize environmental sustainability, biodiversity conservation, and climate resilience. Regional organizations such as ECOWAS and SADC also support environmental cooperation among African states. Climate-smart agriculture has become an important adaptation strategy in Africa. Practices such as agroforestry, irrigation, crop rotation, and conservation farming improve agricultural productivity while protecting ecosystems.

Renewable energy development is also expanding across Africa. Countries such as Kenya, Morocco, Ethiopia, and South Africa have invested in solar, wind, geothermal, and hydroelectric energy projects. Renewable energy reduces dependence on fossil fuels and promotes sustainable development. Reforestation and afforestation programs are important for restoring degraded ecosystems and combating desertification. Tree planting initiatives improve soil fertility, reduce erosion, and increase carbon sequestration. Community-based conservation programs have also contributed to biodiversity protection in several African countries. Local communities participate in wildlife conservation and environmental management through ecotourism and sustainable resource use programs.

Challenges to Sustainability Efforts in Africa

Despite growing awareness of climate change and environmental

sustainability, Africa continues to face several challenges in implementing effective environmental policies. Poverty remains one of the greatest obstacles to sustainability because many communities depend directly on forests, wildlife, and natural resources for survival. Economic hardship often encourages environmentally harmful practices such as illegal logging and overexploitation of resources. Weak governance and corruption undermine environmental protection efforts in many African countries. Environmental laws are often poorly enforced, allowing illegal mining, wildlife trafficking, and deforestation to continue. Rapid population growth and urbanization place additional pressure on land, forests, water resources, and energy supply. Expanding urban areas contribute to pollution, waste management problems, and habitat destruction. Another major challenge is inadequate climate financing. Many African countries lack sufficient financial and technological resources needed for climate adaptation and biodiversity conservation projects. Political instability and armed conflicts also contribute to environmental degradation by weakening environmental institutions and disrupting conservation programs.

Recommendations

African governments should strengthen environmental governance by enforcing environmental laws and promoting transparency in natural resource management. Anti-corruption measures are necessary for improving policy implementation and environmental protection. Investment in renewable energy and climate-smart agriculture should be expanded to reduce greenhouse gas emissions and improve food security. Governments should provide financial support and training for farmers adopting sustainable agricultural practices.

Regional cooperation among African countries should be strengthened to address transboundary environmental challenges such as desertification, water scarcity, and wildlife conservation.

Community participation should be encouraged in biodiversity conservation and environmental management because local populations possess valuable indigenous knowledge about natural resource conservation. International organizations and developed countries should increase climate financing and technological support for African sustainability and adaptation projects. Environmental education and public awareness campaigns should also be promoted to encourage sustainable environmental practices among citizens.

Conclusion

Climate change remains one of the greatest threats to environmental sustainability and biodiversity in Africa. Rising temperatures, droughts, flooding, desertification, deforestation, and environmental pollution continue to affect ecosystems, livelihoods, and economic development across the continent. The relationship between climate change, biodiversity loss, and environmental degradation is deeply interconnected. Climate change accelerates biodiversity loss, while environmental degradation weakens ecosystem resilience and increases vulnerability to climate shocks. Addressing these environmental challenges requires coordinated efforts from governments, regional organizations, international institutions, and local communities. Sustainable agriculture, renewable energy development, reforestation, biodiversity conservation, and effective environmental governance are essential for improving climate resilience and promoting sustainable development. Ultimately, protecting Africa's biodiversity and ensuring environmental sustainability depend on integrating climate adaptation measures with conservation and responsible resource management. Through stronger cooperation, improved governance, and long-term commitment, African countries can build resilient ecosystems and achieve a more sustainable future.

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URBAN WASTE MANAGEMENT AND ITS IMPACT IN PORT HARCOURT METROPOLITAN CITY: A CRITICAL EVALUATION

Chinnah Promise Chinwe, PhD
Department of Public Administration and Governance,
World Innovators University, USA
promise.chinnah@wiuglobal.com

Chinnah Charity, PhD
Department of Fine and Applied Arts,
Ignatius Ajuru University of Education
charity.chinnah@iaue.edu.ng

Atanya Bernard Owedano
Department of Political Science,
Yakubu Gowon University.
owedsben@gmail.com

Abstract

Rapid urbanization, industrialization, commercialization, and population growth have significantly increased municipal solid waste generation in Port Harcourt Metropolitan City, Nigeria. Despite the establishment of the Rivers State Waste Management Agency (RIWAMA) in 2015 and the adoption of Public–Private Partnership (PPP) arrangements, waste management challenges remain pervasive due to inadequate infrastructure, weak institutional coordination, insufficient funding, ineffective enforcement of environmental regulations, and limited public environmental awareness. This study critically evaluates urban waste management in Port Harcourt using a qualitative policy review design based on secondary data. A systematic documentary review was conducted of peer-reviewed journal articles, government publications, RIWAMA reports, NESREA policy

documents, World Bank reports, UNEP reports, WHO publications, and other credible institutional sources published between 2015 and 2025. Data were analyzed using thematic content analysis to identify major patterns relating to waste generation, institutional capacity, environmental impacts, and policy effectiveness. Findings indicate that Port Harcourt generates approximately 2,000–3,000 tonnes of municipal solid waste daily [Rivers State Waste Management Agency, 2023; exceeding the capacity of existing waste management infrastructure. Major constraints include inadequate funding, poor institutional coordination, weak enforcement of sanitation laws, inadequate waste collection infrastructure, and limited recycling capacity. These challenges have contributed to flooding, environmental pollution, public health risks, ecosystem degradation, and declining urban aesthetics. The study concludes that achieving sustainable waste management in Port Harcourt requires integrated institutional reforms, increased investment in waste infrastructure, adoption of modern waste-processing technologies, strengthened public-private partnerships, improved environmental education, and effective enforcement of environmental regulations.

Keywords: Urban waste, waste management, RIWAMA, environmental pollution, Port Harcourt, sustainability.

Introduction

Urban waste management has become one of the most pressing environmental governance challenges confronting rapidly urbanizing cities in developing countries. Accelerated population growth, industrialization, commercial expansion, and changing consumption patterns have substantially increased the volume and complexity of municipal solid waste, often exceeding the capacity of municipal authorities to provide efficient collection, transportation, treatment, recycling, and recovery services [UNEP, 2023; World Bank, 2019]. Port Harcourt, the capital of Rivers State, is one of Nigeria's foremost industrial and commercial

centers. The city hosts numerous oil and gas industries, manufacturing firms, commercial establishments, educational institutions, and residential settlements that collectively generate substantial quantities of municipal solid waste daily. Once celebrated as the "Garden City" because of its environmental beauty and greenery, Port Harcourt has experienced progressive environmental deterioration due to rapid urbanization, inadequate urban planning, poor waste management practices, and weak enforcement of environmental regulations [Stanley & Owhor, 2018]. Current estimates indicate that the metropolis generates between 2,000 and 3,000 tonnes of municipal solid waste daily [Rivers State Waste Management Agency, 2023], considerably exceeding the operational capacity of existing waste management systems. Consequently, indiscriminate disposal of refuse along roadsides, drainage channels, markets, and open spaces has become widespread, contributing to flooding, environmental pollution, public health challenges, and declining urban aesthetics [Ogene & Elechi, 2021].

In response, the Rivers State Government established RIWAMA in 2015 through the RIWAMA Law to coordinate waste collection, transportation, disposal, environmental sanitation enforcement, and public awareness campaigns [Rivers State Government, 2016]. The agency also collaborates with licensed private waste operators through PPP arrangements to improve service delivery. Nevertheless, persistent operational challenges continue to undermine effectiveness [RIWAMA].[2023]. While existing studies have examined technical disposal or pollution in Nigerian cities [Ayomoh, 2018; Ogbonna et al., 2017; Omokaro et al., 2025], fewer have integrated institutional capacity, governance performance, environmental sustainability, and public health outcomes within the post-2015 RIWAMA policy context. Comparative studies of Lagos [Omole & Alakinde, 2022] and Abuja focus on technical operations rather than governance outcomes. This study addresses that gap by providing a critical,

governance-focused evaluation of urban waste management in Port Harcourt between 2015 and 2025, situated within Environmental Health

Theory and the SDG framework.

Research Objectives

The study seeks to:

1. Assess existing waste management practices in Port Harcourt Metropolitan City.
2. Examine institutional and operational challenges affecting RIWAMA.
3. Evaluate the environmental and public health implications of poor waste management.
4. Recommend sustainable policy strategies for improving urban waste management in Port Harcourt.

Significance of the Study

This study contributes to literature by integrating environmental governance, institutional performance, and public health perspectives into the analysis of urban waste management in a post-reform context. It provides evidence-based recommendations useful to policymakers, environmental regulators, urban planners, development practitioners, and researchers on sustainable urban development. The comparative and conceptual dimensions also make it relevant to other Gulf of Guinea cities facing similar governance deficits.

Methodology

This study adopted a qualitative policy review design based exclusively on secondary data. A systematic documentary review was employed to synthesize evidence on urban waste management in Port Harcourt Metropolitan City between 2015 and 2025.

Data Sources and Search Strategy: Materials were identified from Scopus, Web of Science, Google Scholar, government

portals, and institutional repositories using Boolean search terms: "Port Harcourt AND waste management", "RIWAMA AND governance", "municipal solid waste Nigeria", "PPP AND waste Africa", and "urban environmental health". Included sources comprised peer-reviewed journal articles, books, RIWAMA annual reports, NESREA policy documents, World Bank publications, UNEP reports, WHO reports, and other credible institutional documents. Excluded sources were non-peer-reviewed blogs, undated reports, and materials outside the 2015–2025 period.

Analytical Approach: The collected data were analyzed using thematic content analysis [Braun & Clarke, 2006]. Initial codes were developed around four a priori themes: waste generation trends, institutional/operational capacity, environmental and health impacts, and policy effectiveness. Themes were refined through iterative review to ensure internal coherence. Credibility was enhanced by triangulating estimates and claims across at least two independent institutional sources. To reduce bias, coding was cross-checked by both authors.

Limitations of Design: The reliance on secondary data limits direct validation through field observation or stakeholder perspectives. This is acknowledged in Section 8.0. However, for a post-policy evaluation, documentary analysis provides a valid basis for assessing institutional performance and policy gaps.

Conceptualization and Literature Review

Concept of Urban Waste

Urban waste refers to unwanted materials generated from human activities within urban environments, including household, commercial, institutional, industrial, and construction sources [Ezeudu & Ezeudu, 2022]. In Port Harcourt, the waste stream is heterogeneous due to industrial activity, market trade, and household consumption patterns.

Concept of Waste Management: Waste management refers to the systematic process of preventing, collecting, transporting, sorting, treating, recycling, recovering, and safely disposing of waste in ways that protect public health and the environment [NESREA]. Modern waste management follows the waste hierarchy: Prevention → Reduction → Reuse → Recycling → Recovery → Disposal [UNEP]. The hierarchy prioritizes upstream interventions over end-of-pipe disposal. [2023]

Global Public-Private Partnership Models in Urban Waste Management.

Public-Private Partnerships have become a dominant institutional response to municipal waste crises in rapidly urbanizing economies. The underlying logic is risk-sharing: government retains regulatory and planning authority while private actors provide capital, technology, and operational efficiency [World Bank, 2022]. In Brazil, São Paulo's "Clean City" program demonstrates a concession model where private firms are paid per tons collected and penalized for missed routes. This increased collection efficiency from 78% in 2010 to 92% in 2020, but required strong municipal monitoring units [World Bank, 2022]. Performance-based contracts were central. India's Swachh Bharat Mission 2.0 emphasizes PPPs for waste-to-energy and composting plants in cities like Pune and Indore. Indore's achievement of "zero waste to landfill" status in 2021 is attributed to decentralized segregation at source, strict enforcement, and community-based micro-enterprises contracted through PPPs [Ezeudu et al., 2024; Kaza et al., 2018]. Community participation and behavioral change were institutionalized.

In Sub-Saharan Africa, South Africa's eThekwini Municipality uses long-term PPP contracts for landfill management and recycling. A key success factor has been ring-fenced budgets and independent regulatory oversight. Ghana's Accra Metropolitan Assembly has piloted PPPs for transfer stations, but faces

challenges of contract enforcement and informal sector integration [Oteng-Ababio, 2018].[Ogwueleka][2022] For Port Harcourt, the lesson is clear: PPPs alone do not resolve capacity gaps. Effectiveness depends on 1) transparent contracting, 2) performance-based payment, 3) independent monitoring, and 4) citizen participation. RIWAMA's model aligns with the concession approach, but lacks the monitoring and community segregation components observed in Indore and eThekwini. This comparative gap justifies the current study's focus on institutional and behavioral dimensions beyond technical collection.

Waste Governance in Other Nigerian Metropolitan Cities.
Within Nigeria, Lagos and Abuja provide important comparators. The Lagos State Waste Management Authority (LAWMA) was restructured in 2017 to introduce private sector operators under franchise agreements. Studies show improved road clearance but persistent challenges in low-income areas where collection fees are unaffordable [Omole & Alakinde, 2022; Popoola et al., 2020]. Abuja's Environmental Protection Board has attempted integrated solid waste management, but faces inter-agency duplication with the Federal Capital Development Authority. Kano faces similar issues of funding, enforcement, and informal dumping [Omokaro et al., 2025].[Agunwamba][2017] Port Harcourt differs in two ways. First, RIWAMA was created after the 2015 flood events, giving it a specific disaster-risk mandate [Rivers State Government, 2016]. Second, the city's oil and gas industrial base creates hazardous and commercial waste streams not dominant in Kano. However, like Lagos and Abuja, PHC exhibits weak data harmonization, limited recycling infrastructure, and low public compliance.

Existing literature on Lagos [Omole & Alakinde, 2022] and Kano [Omokaro et al., 2025] emphasizes technical or economic factors. Few studies integrate RIWAMA's post-2015 governance reforms with public health and SDG outcomes. This study fills that gap by

evaluating PHC as a governance case, not only a technical one.

Conceptual Framework: Linking Governance, Environment, and Health

To guide analysis, this study develops an integrated framework [Figure 1]. Environmental Health Theory provides the foundation: environmental degradation creates pathways for disease, flooding, and ecosystem loss [WHO]. Institutional capacity mediates this relationship.[2023]

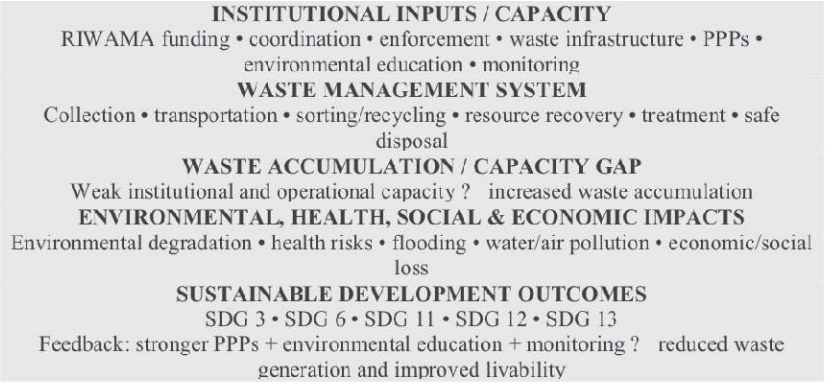


Figure 1. Integrated Waste Governance Framework for Port Harcourt

Note. The framework shows how institutional inputs produce environmental and health outcomes aligned to SDGs. Source: Authors' conceptualization, 2025.

The framework posits that when RIWAMA's funding, coordination, enforcement, and infrastructure are weak, waste accumulation increases. This leads to the five impact domains identified in Section 6.0: environmental degradation, health risks, flooding, water/air pollution, and economic/social loss. These outcomes directly undermine SDG 3, 6, 11, 12, and 13.

Conversely, strengthening PPPs, environmental education, and

monitoring creates feedback loops that reduce waste generation and improve livability. This model situates PHC within global SDG discourse while keeping RIWAMA at the center of analysis.

Waste Management In Port Harcourt Metropolitan City

4.1 Waste Generation Trends and Capacity Gap, 2015–2025

Table 1 synthesizes estimates from RIWAMA, World Bank, and peer-reviewed studies.

Table 1. Selected secondary – sources of estimates Municipal Solid Waste Generation vs Collection Capacity, Port Harcourt, 2015-2025*

Year	Est. Generation [tonnes/day	Estimated Collection [tonnes/day]	Capacity Gap [%]	Source
2015	1,800	1,200	33.3	Rivers State Government, 2016
2018	2,100	1,350	35.7	Stanley & Owhor, 2018
2021	2,500	1,500	40.0	Ogene & Elechi, 2021
2023	2,800	1,650	41.1	RIWAMA, 2023
2025	3,000	1,700	43.3	World Bank, 2022

The available secondary evidence is consistent with World Banks observations that waste generation in rapid urbanizing cities can outpace infrastructure investment, World Bank, 2019, 2022.

The estimates presented in table 1 indicates a great increase in waste generation pressure alongside a continuous lacuna between estimated waste generation and stated collection capacity. This analysis is based entirely on secondary sources. Therefore, the figures in Table 1 reflect estimates reported elsewhere, not primary data gathered by the researchers. The estimates span different sources, reporting years, and approaches, which means they are not fully comparable over time. The table is included to demonstrate the broad trend of rising waste-generation pressure and the reported gap in collection capacity, rather than to assert exact annual measurements. In cases of conflicting data, priority is given

to RIWAMA and other recognized institutional or peer-reviewed sources, with an acknowledgment of possible methodological variation. For PHC the direct implication is that without capital investment in trucks, transfer stations, recycling facilities and other waste management facilities the existing capacity gap may continue to be on the increase.

Data for the study were gathered through secondary sources, the figures presented in table 1 should be interpreted as reported estimates rather than direct measurement by researchers. Besides these estimations are gotten from different sources, reporting periods, and with different methodological approaches. The data on the table are not longitudinal dataset. The table is used to show the astronomical increase of waste generation pressure and collection capacity.

Institutional Mapping of RIWAMA and PPP Actors

RIWAMA's mandate includes collection, transportation, disposal, enforcement, and public education [Rivers State Government, 2016]. Operationally, it contracts licensed private waste operators under PPPs. However, institutional challenges persist: budget allocations have not matched waste growth, inter-agency coordination with the Ministry of Environment is weak, and monitoring of contractor performance is limited [RIWAMA].[2023]. Funding flows are often ad hoc, with limited ring-fencing for capital expenditure. This contrasts with eThekwini's model of dedicated waste levies. Furthermore, the informal waste sector, which handles significant recycling in other cities, is not formally integrated into RIWAMA's structure [Oteng-Ababio, 2018]. Strengthening these institutional linkages is critical for sustainability .[Ogwueleka][2022]

The Informal Waste Sector and Resource Recovery

The informal waste sector and resource recovery is a very essential sector in waste management in urban cities because of their role in

management of waste. The informal sector refers to person, group of persons or network of people that are significantly important in the waste management sector although not officially authorized or fully integrated by government as part of the waste management team. There functions and roles cannot be overemphasized in Port Harcourt city when it comes to management of waste. They are people or small businesses that sorts, collect, buy, sale and recycle waste aside the official recognized certified bodies by the government. Waste pickers, scrab dealers and other scavengers for waste materials. They are also involved in recycling of waste. Resource Recovery. This simply means extracting useful materials, energy, nutrients or produce from waste instead of sending everything to the landfill or open dumping. Under this process so many waste are converted useful things such as plastics, condemn iron, papers or energy are recovered from waste disposed items or things. It's is imperative for the informal sector to be integrated, registered, guided and given operational guidance and monitored by government for effective waste management.

Existing Policy Measures

Policy responses include the RIWAMA Law 2015, NESREA's National Environmental (Sanitation and Wastes Control) Regulations 2009 as revised, and public awareness campaigns [NESREA]. Enforcement remains weak due to limited personnel and logistical constraints. Recycling is minimal, with most waste disposed at open dumpsites rather than engineered landfills.[2023]

Theoretical Framework

The study is anchored on Environmental Health Theory, which explains the relationship between environmental quality and human health [WHO]. It posits that poor environmental management contributes directly to disease transmission, pollution, flooding, and environmental degradation. [2023]. The Environmental Health Theory is used as an instrument for evaluating how poor urban waste management affect the

environmental and human health condition and its sustainability. The theory regulates the analysis in establishing connection between poor waste management and other adverse affect to the environment and humanity in general. The theory goes further to highlight the relationship between institutional / operational weakness in management of waste. It provides a sound logical ground for interpreting how waste management practices creates environmental conditions and health challenges. The theory helps us to explain and understand why improvement in waste management, environmental education, recycling, enforcement and institutional capacity are essential for curbing health challenges.
The framework aligns with:

SDG 3: Good Health and Well-being; SDG 6: Clean Water and Sanitation; SDG 11: Sustainable Cities and Communities; SDG 12: Responsible Consumption and Production; SDG 13: Climate Action. This alignment allows the study to assess waste management not only as an environmental issue but as a development issue.

Impacts of Poor Waste Management in Port Harcourt Metropolitan City

Poor waste management in Port Harcourt has profound environmental, public health, economic, and social consequences. These impacts are interrelated and demonstrate the need for an integrated approach to urban environmental governance.

Environmental Degradation

Indiscriminate dumping has degraded the physical environment. Refuse accumulation on roadsides, markets, waterways, and open spaces has diminished environmental quality and undermined the city's historical reputation as Nigeria's "Garden City." Uncontrolled disposal also contributes to soil contamination, loss of biodiversity, and deterioration of urban landscapes. [Ayomoh]

[2018]

Public Health Implications
Improper disposal creates breeding grounds for mosquitoes, flies, rodents, and other disease vectors. Communities become more vulnerable to communicable diseases such as cholera, typhoid fever, diarrhoea, and malaria. Open burning of refuse releases particulate matter and toxic gases, increasing respiratory illnesses, particularly among children and older adults [WHO, 2022; WHO, 2023].

Flooding and Drainage Obstruction
Disposal of waste into drainage channels obstructs water flow during heavy rainfall. This contributes to recurrent flooding across Port Harcourt, resulting in infrastructure damage, displacement, disruption of economic activities, and financial losses [Ogene & Elechi, 2021]. Flooding has become an annual occurrence in several wards.

Water Pollution
Leachate from unmanaged dumps contaminates surface water and groundwater. This threatens drinking water quality and increases waterborne disease risk. Pollution of rivers, streams, and wetlands also affects aquatic ecosystems and local livelihoods dependent on fishing. [Ayomoh] [2018]

Air Pollution and Climate Change
Open burning emits methane, carbon monoxide, sulphur compounds, and fine particulate matter, contributing to air pollution and climate change [UNEP]. These emissions worsen existing air quality challenges associated with industrial activity in Port Harcourt [WHO].[2023][2022]

Economic Consequences
Poor waste management discourages investment, reduces tourism

potential, lowers property values, and increases public expenditure on sanitation and healthcare. Resources that could support development are often redirected to emergency waste management and flood response [World Bank, 2022].

Social and Psychological Effects

Living in polluted environments reduces residents' quality of life, weakens community pride, and affects mental well-being [Popoola et al., 2020]. Persistent environmental neglect may also normalize indiscriminate disposal, making behavioral change more difficult.

Discussion of Findings: A Comparative and Policy Lens

The study demonstrates that municipal solid waste generation in Port Harcourt has exceeded the operational capacity of existing systems. This aligns with World Bank and UNEP observations that rapid urbanization has overwhelmed waste management in many developing countries [World Bank, 2022; UNEP, 2023]. Institutional weaknesses—including inadequate funding, insufficient infrastructure, weak regulatory enforcement, and poor inter-agency coordination—remain major barriers. Although RIWAMA has introduced PPP initiatives, impact has been constrained by implementation gaps and resource limitations [RIWAMA]. This mirrors findings from Lagos, where franchise models improved main roads but not peripheral settlements [Omole & Alakinde, 2022].[2023]

Comparatively, Indore's success shows the importance of segregation at source and micro-enterprise integration [Ezeudu et al., 2024]. Accra's experience highlights the need to formalize informal recyclers [Oteng-Ababio, 2018]. Port Harcourt lacks both components. The absence of a circular economy approach means recyclable materials continue to enter landfills, increasing environmental load.

The findings reinforce Environmental Health Theory by showing a direct relationship between environmental quality and public health outcomes. Poor waste management contributes to flooding, water pollution, disease outbreaks, and declining urban livability, underscoring the importance of preventive environmental management [WHO].[2023]. From an SDG perspective, PHC's current trajectory undermines progress on SDG 11.6 “reduce the adverse per capita environmental impact of cities” and SDG 12.5 “substantially reduce waste generation through prevention, reduction, recycling and reuse”. Without reform, SDG targets for 2030 are unlikely to be met. Overall, evidence suggests that improvement requires more than increased collection. It demands integrated reforms involving institutional strengthening, investment in modern technologies, behavioral change through environmental education, and stronger collaboration among government agencies, private operators, informal actors, and communities.

Limitations of The Study

This study relied exclusively on secondary sources. It did not include primary data from interviews, surveys, or field observations. Variations in reporting methods among institutions may also account for differences in waste generation estimates. Despite these limitations, the study synthesized recent, credible literature from 2015–2025 to provide a comprehensive, policy-relevant assessment. Future studies should adopt mixed-methods approaches, combining documentary analysis with household surveys, interviews with RIWAMA officials and contractors, and field observations to generate richer empirical evidence. Geospatial analysis of dumpsites would also strengthen the evidence base.

Conclusion

This study critically evaluated urban waste management and its impacts in Port Harcourt Metropolitan City. Rapid urbanization,

population growth, and industrial expansion have increased municipal solid waste generation beyond the capacity of existing infrastructure. Although RIWAMA and PPP arrangements have improved coordination, persistent challenges including inadequate funding, weak infrastructure, ineffective enforcement, low public environmental awareness, and limited recycling capacity, continue to undermine sustainability. The consequences are evident in environmental degradation, recurrent flooding, water and air pollution, increased public health risks, and declining urban livability. Comparative analysis shows that cities that have improved outcomes combined PPPs with monitoring, community participation, and circular economy practices. Addressing these challenges requires coordinated policy reforms, sustained investment, stronger institutions, technological innovation, and active public participation. The Integrated Waste Governance Framework proposed here provides a basis for such reforms.

Recommendations

The study recommends that:

1. Government should substantially increase and ring-fence funding for RIWAMA to improve operational capacity and infrastructure.
2. Modern waste management technologies, including recycling facilities, composting plants, and waste-to-energy systems, should be developed.
3. PPPs should be strengthened through transparent, performance-based contractual arrangements and effective independent monitoring.
4. Environmental education and public awareness campaigns should be intensified to encourage segregation at source and responsible disposal.
5. Environmental sanitation laws should be strictly enforced, with appropriate sanctions for offenders.
6. Recycling and resource recovery programmes should be expanded to promote a circular economy and reduce dependence

on landfills.
7. Urban planning authorities should integrate waste management infrastructure into future city expansion plans.
8. Government should establish continuous monitoring and evaluation systems to assess RIWAMA's operational performance and policy outcomes.
9. Community-based organizations, civil society groups, traditional institutions, and informal waste actors should be actively involved in promoting environmental sanitation.
10 informal waste collectors and recyclers should be integrated and monitored by government for effective waste management.

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URBANISATION, WASTE MANAGEMENT AND ENVIRONMENTAL POLLUTION IN NIGERIA: TOWARDS AN ECO-PHILOSOPHICAL FRAMEWORK FOR SUSTAINABLE CITIES

Vincent Gerald Onwudinjo
Department of Philosophy and Religious Studies,
Tansian University, Umunya
vincentgerald58@gmail.com

Charity Ifunanya Ogbodo
Department of Philosophy,
Nnamdi Azikiwe University, Awka,
c.ogbodo@unizik.edu.ng

Bernadette Chidiebere Uzozie
Department of Philosophy and Religious Studies,
Tansian University, Umunya,
uzoziechidiebere@gmail.com

Abstract

The current research focuses on the interaction between urbanization, waste management, and environmental pollution in Nigeria through an application of eco-philosophy in order to develop a philosophical perspective on a sustainable environment for the Nigerian city. Urbanisation in Nigeria has been proceeding at a faster rate than ethical planning, social responsibility, and awareness of ecological issues, leading to the occurrence of environmental problems including waste dumping, choked drainages, air and water pollution, and a decline in the quality of urban life. This research recognizes the root cause of the problem as a philosophical problem in the relation between man and nature as well as society and the environment rather than just a failure of practicality. In terms of methodology, the philosophical methodologies of analysis and hermeneutics have been used for the

purpose of this study. Analysis has been applied to unravel the concept of the interrelation between urbanisation, waste, pollution, responsibility, and sustainability, while hermeneutics has been used for interpreting the meaning behind the attitude towards the environment as found in Nigerian culture. From the findings, it can be concluded that the issue of environmental pollution in urban areas within Nigeria is due to the lack of ethics, lack of good civic culture, disorganised government, and development process that is characterised by the pursuit of growth rather than environmental equilibrium. The results indicate that what is needed for sustainable cities in Nigeria is not only structural reform but also the adoption of an eco-philosophical approach based on responsibility and humanity's connection with nature.

Keywords: Urbanisation, Waste Management, Environmental Pollution, Eco-Philosophy, Nigeria.

Introduction

Urbanisation is now a defining feature of Nigeria's social and economic transformation, creating opportunities for employment, commerce and development while placing intense pressure on infrastructure and the environment.[1] Since independence, cities such as Lagos, Abuja, Kano, Port Harcourt, Onitsha, Ibadan and Benin City have expanded rapidly through population growth, migration and commercial activity.[2] Yet, urban expansion has frequently moved faster than the provision of housing, drainage, sanitation, waste collection and other essential environmental services. The consequences are visible in overflowing refuse points, blocked drains, plastic-filled waterways, open burning, polluted air and recurrent flooding across many Nigerian communities. The problem is therefore not simply the quantity of waste produced, but the failure to organise urban growth in ways that protect both human well-being and ecological systems.

At a deeper level, this crisis raises a philosophical question about

how Nigerians understand their relationship with nature and the moral responsibilities that accompany development. The anthropocentric tendency to regard nature primarily as a resource for human use encourages patterns of production and consumption that can undermine ecological integrity.[3] Consequently, waste management and pollution should be understood not only as technical problems but also as questions of environmental ethics, civic responsibility and justice. An eco-philosophical approach is therefore necessary for examining whether sustainable Nigerian cities require not merely better systems, but also a transformation in environmental consciousness.

Nigeria has established institutions and regulations to confront these problems, including FEPA, NESREA and various state environmental agencies, yet persistent illegal dumping, open burning and inadequate waste collection show the limits of policy without effective implementation.[4] Weak enforcement, inadequate funding, poor planning, fragmented responsibilities and limited public participation continue to separate environmental laws from everyday realities in Nigerian cities.

Philosophers such as Arne Næss, Aldo Leopold and Holmes Rolston III challenge the purely instrumental treatment of nature by emphasising ecological interconnectedness, moral responsibility and the intrinsic value of the natural world.[5] Their insights provide a useful basis for questioning whether environmental sustainability can be achieved by only regulation and technology.

This study therefore examines the relationship between urbanisation, waste management and environmental pollution in Nigeria from an eco-philosophical perspective. It investigates the historical development of environmental challenges and policies, the conditions of selected Nigerian cities,

and relevant international approaches to sustainable urban environmental governance. Through conceptual analysis and hermeneutics, the study interprets the ethical assumptions underlying environmental practices and explores their implications for Nigerian urban life. It argues that sustainable cities require the integration of effective institutions and infrastructure with ecological consciousness, civic responsibility and respect for the intrinsic value of nature. The study consequently seeks to develop an eco-philosophical framework capable of complementing conventional policy responses and promoting environmentally sustainable Nigerian cities.

Urbanisation, Waste and Pollution: A Conceptual Analysis

Urbanisation refers to the increasing concentration of population in towns and cities through natural growth, industrialisation and rural–urban migration.[6] It is therefore not merely the physical expansion of cities but a transformation of production, consumption, governance and social relations. When properly planned, urbanisation can support employment, innovation, infrastructure and improved living conditions through sustainable urban governance.[7] However, where population growth exceeds the capacity of public institutions, overcrowding, poor sanitation, flooding and pollution become persistent features of urban life. Nigeria illustrates this tension as cities such as Lagos, Port Harcourt, Onitsha, Kano and Abuja expand faster than environmental infrastructure and waste services. Waste, as a result, becomes more than discarded material; it reflects patterns of consumption, resource use and society's conception of what is valuable or useless.[8] The conceptual relationship between urbanisation and waste therefore exposes both an infrastructural problem and a deeper question of social and environmental responsibility.

The Basel Convention defines waste as substances or objects disposed of, intended for disposal, or required to be disposed of under national law.[9] In practice, effective waste management requires segregation, collection, transportation, treatment, recycling, recovery and environmentally safe disposal.[10] The waste hierarchy consequently places prevention and reduction before reuse, recycling, recovery and final disposal, shifting attention from disposal to resource efficiency. Yet many Nigerian cities still experience indiscriminate dumping along roads, markets, drainage channels and waterways, with open burning adding further environmental and health risks. This governance deficit is evident in cities where population growth has outpaced collection infrastructure and where weak institutional coordination limits effective waste services.[11] Environmental pollution consequently emerges through contaminated land and water, polluted air, blocked drainage and the accumulation of plastics and other hazardous materials.[12] Thus, urban waste is not an isolated municipal problem but a major pathway through which unsustainable urban development becomes ecological degradation.

From an eco-philosophical standpoint, pollution also reveals an ethical problem in humanity's relationship with nature. An anthropocentric outlook that values forests, rivers, land and other ecosystems mainly for their usefulness encourages patterns of production and consumption that disregard ecological limits.[13] Arne Næss challenges this orientation by affirming the intrinsic value of living beings, while Aldo Leopold extends moral concern to the wider ecological community. Their perspectives shift environmental responsibility from controlling nature for human purposes towards recognising human beings as participants within an interconnected ecological order. This is particularly relevant to Nigeria, where technological solutions and environmental regulations have not always

prevented recurring dumping, burning, flooding and pollution. Sustainable urban development therefore requires not only stronger institutions and infrastructure but also changes in environmental values, civic conduct and patterns of consumption. An eco-philosophical analysis consequently links urbanisation, waste and pollution through a common question: how can human development proceed without undermining the ecological conditions that sustain life?

Theoretical Framework

The study adopts an integrated eco-philosophical framework combining Deep Ecology, Leopold's Land Ethic, Sustainable Development Theory and African eco-communitarian thought.[14] Næss challenges anthropocentrism by affirming the intrinsic value of living beings and calling for a fundamental transformation in humanity's relationship with nature.[15] He further argues that ecological crises arise from distorted assumptions about humanity's place within the natural world, requiring changes in values and patterns of living.[16] Leopold complements this position by extending ethical consideration to soils, waters, plants and animals, making ecological integrity a moral responsibility.[17]

Leopold's Land Ethic therefore provides a basis for interpreting pollution, indiscriminate dumping and ecological destruction as failures of environmental responsibility.[18] Sustainable Development Theory complements these perspectives by defining development in terms of meeting present needs without compromising those of future generations.[19] Its emphasis on balancing economic, social and environmental concerns is reinforced by the United Nations Sustainable Development Goals, particularly Goal 11 on sustainable cities.[20] Accordingly, this framework provides a normative basis for examining Nigerian urbanisation and proposing development grounded in ecological

ethics, effective governance and intergenerational responsibility.[21]

African Eco-Communitarianism

African eco-communitarianism provides an important indigenous dimension to the philosophy of urbanisation and environmental responsibility in Nigeria.[22] Godfrey Tangwa describes the traditional African outlook as eco-bio-communitarian, stressing the interdependence and peaceful coexistence of humans, animals, plants and the earth.[23] This perspective challenges an understanding of nature as merely an object for human exploitation and instead places human life within a wider network of relationships.[24] Kanu's Igwebuike philosophy similarly presents life as a shared reality founded on complementarity, solidarity, relationality and communality.[25] The moral implication is that environmental harm cannot be treated simply as damage to an external object, because the community itself depends upon the health of its ecological surroundings.[26] African eco-communitarianism therefore connects individual conduct with communal wellbeing and gives environmental responsibility a distinctly social character.[27]

Waste disposal, pollution and destruction of natural resources consequently become matters of collective ethical responsibility rather than private behaviour alone. This makes the approach particularly relevant to Nigerian cities where environmental conditions are shaped by the actions of households, businesses, communities and public institutions. The strength of this perspective lies in its capacity to bring ecological responsibility into the everyday moral life of the community.

Frans Kruger, Adré le Roux and Kevin Teise argue for an African eco-communitarianism that extends the idea of community beyond humans to the more-than-human world.[28] Similarly, M. F. Murove relates African environmental ethics to ukama and ubuntu,

emphasising relatedness and the moral significance of communal existence.[29] Such thinking does not require the rejection of modern environmental science or public regulation; rather, it supplies an ethical foundation upon which these instruments can operate. For Nigeria, the approach can encourage communities to regard clean streets, protected waterways, forests and responsible waste practices as expressions of shared civic obligation. It also shifts environmental education from merely instructing people about rules to cultivating habits of care, restraint and responsibility. Eco-communitarianism thus complements deep ecology and the land ethic while grounding environmental responsibility in African relational thought.[30] Its relevance to urbanisation lies in reconnecting development with the common good, ecological interdependence and the long-term conditions necessary for communal flourishing.

Nigeria's Environmental Challenges

Nigeria's environmental crisis is expressed through interconnected problems of waste accumulation, pollution, flooding, ecosystem degradation and weak environmental management.[31] The National Policy on Environment acknowledges that the volume of solid waste has placed considerable pressure on urban authorities and that indiscriminate disposal remains a serious problem.[32] Ezeah and Roberts further identify weaknesses in waste governance, including inefficient institutional arrangements and difficulties in coordinating sustainable waste management in Nigerian cities.[33] The problem extends beyond visible refuse, since poorly managed waste can block drains, contaminate land and water, encourage open burning and increase environmental health risks.[34] Air pollution presents another serious challenge, with the World Health Organisation recording substantial exposure to fine particulate matter in Nigeria.[35] Oil pollution adds a distinct dimension, particularly in the Niger Delta, where UNEP documented extensive contamination of land, groundwater, surface water and

vegetation in Ogoniland.[36]

Urban flooding further demonstrates the connection between environmental neglect and urban infrastructure, as waste obstructs drainage systems and reduces the capacity of cities to manage heavy rainfall. These conditions show that Nigeria's environmental challenges are not isolated problems but interconnected failures of planning, consumption, infrastructure, regulation and collective responsibility. The philosophical significance of these challenges lies in the relationship between human choices and the ecological consequences that follow from them. The problem is therefore not simply that Nigerian cities produce waste, but that waste is frequently generated, consumed, discarded and governed without sufficient regard for its wider consequences. Recent World Bank analysis identifies low collection rates, inadequate waste systems, open dumping, limited recycling and uncontrolled burning among the problems affecting several Nigerian cities.[37]

Plastic waste has intensified the difficulty because its persistence allows everyday consumption to become a long-term environmental burden.[38] The regulatory framework has developed considerably, including NESREA regulations covering sanitation, waste control, air quality, water quality, plastics and other environmental concerns.[39] Yet the existence of regulations does not by itself guarantee responsible environmental conduct; implementation requires institutional capacity, public participation, monitoring and consistent enforcement.[40] The challenge is consequently both practical and philosophical, requiring a transformation of how development, consumption, public space and responsibility are understood. Nigeria needs an environmental philosophy that can connect ecological knowledge with moral discipline, communal participation and effective governance

Towards an Eco-Friendly Philosophy of Urbanisation/Waste Management in Nigeria

An eco-friendly philosophy of urbanisation must begin by recognising the city as an ecological community rather than merely a space for economic activity. Urban development should therefore integrate human needs with the carrying capacity of land, water, air and other ecological systems.[41] This requires moving beyond the linear pattern of production, consumption and disposal towards prevention, reuse, recycling and responsible recovery of materials.[42] Waste management should consequently be treated as part of urban planning from the point of production and consumption rather than as a problem to be addressed only after waste has been discarded. Nigeria's existing environmental policy already calls for sustainable and environmentally friendly practices and the integration of environmental concerns into economic decision-making.[43]

NESREA's regulatory framework similarly provides institutional mechanisms for sanitation, waste control, pollution prevention and environmental protection.[44] The philosophical task is to give these policies an ethical foundation by cultivating restraint, responsibility, ecological awareness and concern for future generations. Urbanisation then becomes not a process of conquering nature, but an attempt to organise human settlement within the limits and possibilities of the natural world. Such a philosophy must also recognise that effective waste management depends upon cooperation between government, communities, households, businesses and informal waste workers. Ezeah and Roberts show that waste governance in Nigerian cities is closely connected with institutional arrangements and the participation of different actors.[45] The practical response should therefore combine reliable collection systems, source separation, recycling, recovery facilities, sanitary disposal and public environmental education.

The World Bank's recent assessment of Nigerian cities similarly points to inadequate collection, limited recycling and open dumping as important weaknesses requiring systemic improvement.[46] An eco-friendly urban philosophy should also support circular approaches in which materials are retained in productive use for as long as possible rather than continually transferred from consumption to disposal. This approach connects ecological ethics with social responsibility because cleaner cities depend not only on government enforcement but also on everyday habits and community cooperation.

The overall objective is a form of Nigerian urbanisation in which development, public health, environmental protection and communal wellbeing reinforce one another.[47] Such an approach brings African eco-communitarianism into practical dialogue with sustainable development, making environmental responsibility both a philosophical principle and a concrete practice of urban governance.[48]

Evaluation, Conclusion and Recommendations

Nigeria's urban environmental crisis is not merely a consequence of rapid urbanisation and inadequate infrastructure but also reflects a deeper ethical disconnect between humanity and nature. Despite environmental laws, regulatory agencies and sanitation initiatives, pollution remains widespread because institutional reforms have not been matched by environmental consciousness and civic responsibility. Poor planning, indiscriminate waste disposal, plastic pollution, inadequate drainage and weak enforcement continue to undermine urban sustainability. Experiences from Lagos, Cross River and Akwa Ibom show that effective governance, political commitment and public participation can improve environmental conditions. International examples from

Sweden, Germany, Singapore, Japan and Rwanda further demonstrate that legislation, institutional continuity, technology and active citizenship must work together. Eco-philosophy provides a framework that promotes stewardship, ecological justice and interdependence rather than treating nature merely as an object of economic exploitation. This approach also reflects indigenous African values of communal responsibility and respect for nature, making moral transformation essential to sustainable Nigerian cities.

The study therefore recommends stronger environmental education, enforcement of existing laws and adequately funded regulatory institutions free from political interference. Government should invest in recycling, waste-to-energy technologies and circular-economy initiatives, while urban planning should protect green spaces, improve drainage and prevent developments that obstruct natural waterways. Environmental sustainability must become a shared responsibility involving government, traditional and religious institutions, businesses, civil society and local communities. Sustainable cities cannot be achieved through legislation and technology alone but require ethical values, responsible governance and environmentally conscious citizens. Nigeria possesses the human resources and policy foundations necessary for sustainable urban development, but political will and collective moral commitment remain indispensable. Environmental protection should consequently be regarded as a common obligation owed to present and future generations, rather than solely a governmental responsibility. Through an eco-philosophical approach integrating ethical responsibility with practical governance, Nigerian cities can become cleaner, healthier and more sustainable while promoting human wellbeing and ecological balance.

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The Book

It is with profound delight and a deep sense of scholarly responsibility that I present this second volume of the proceedings of the 10th International Conference of the Association for the Promotion of African Studies (APAS), titled Biodiversity, Climate Change and Environmental Sustainability in Africa: Challenges, Consequences and Ecological Responses. The volume emanates from the international conference of APAS held at Veritas University, Abuja, from Tuesday, 26 May to Friday, 29 May 2026, on the theme, "Biodiversity, Conservation and Public Health in Africa: Challenges and Prospects." This volume, together with the other two volumes arising from the conference, represents an important intellectual contribution to the continuing conversation on Africa's environmental condition and the continent's search for sustainable pathways to human and ecological flourishing … The essays contained herein do not claim to exhaust the complex questions surrounding biodiversity, climate change and environmental sustainability in Africa. Rather, they provide multiple points of entry into a conversation that must continue among scholars, policy-makers, educators, religious communities, environmental practitioners, indigenous knowledge holders, civil society organisations and local communities … May the scholarship gathered here stimulate further research, encourage responsible environmental action, strengthen ecological consciousness and inspire renewed commitment to the protection of Africa's rich natural heritage … Therefore, I commend this volume to scholars, researchers, students, policy-makers, environmental practitioners, religious leaders and all persons committed to the pursuit of a sustainable and flourishing Africa.

Professor Ejikemeuwa J. O. NDUBISI, PhD
President, Association for the Promotion of African Studies (APAS)

APAS
13245 Trebleclef Lane Silver Spring
20904 Maryland,
United States of America

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