PROSPECT AND CHALLENGES OF BIODIVERSITY CONSERVATION AND PUBLIC HEALTH IN AFRICA: A PUBLIC ADMINISTRATION AND EDUCATION PERSPECTIVES

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Abstract

This study examines the extent to which integration between biodiversity conservation and public health is realised in Africa through governance and educational processes, the purpose being to access the prospects and challenges of achieving cross-sectoral integration between biodiversity and health systems in selected African countries. Despite global recognition of the links between ecosystems and human health, biodiversity conservation and public health in Africa continue to be managed in silos, resulting in fragmented policies, duplicated efforts, and environmental health threats, the objectives of the study are to: examine institutional and policy challenges hindering the integration of biodiversity conservation and public health in Africa, and access the role of public administration and education in facilitating or constraining cross-sectoral collaboration. The study is grounded on the One Health theory, which provides a conceptual lens for analysing multi-sectoral coordination, shared risk governance, and trans-disciplinary knowledge integration between human, animal, and environmental health. A qualitative, documentary and comparative case study design was adopted. Data were collected through systematic analysis of policy documents and institutional report from Nigeria, Kenya, and South Africa, selected via purposive sampling for variation in governance and policy contexts. Thematic analysis, comparative case analysis, and policy coherence assessment guided by OECD and AU criteria were used. Findings revealed institutional fragmentation, policy incoherence, donor-dependency, and marginalisation of environmental health in education as major challenges. One Health platforms and community-based conservation show prospects for improved coordination and co-benefits were legally backed and funded. The study concluded that integration remains limited due to structural and financial gaps. The study recommends legal institutionalisation of One Health, curriculum reforms for education for sustainable development among other.

Keywords: Biodiversity; Conservation; Public Health; One Health: Public Administration; Education.

Introduction

Africa hosts approximately 25% of the world's mammalian species and a significant proportion of global plants diversity, much of it concentrated in biodiversity hot spots such as the Congo Basin, Madagascar and the eastern Afromontane region (Convention on Biological Diversity, 2020). This ecosystem provides ecosystem services including pollination, water purification, climate regulation, and the provision of medicinal plants that form the basis of traditional and formal health systems for millions of Africans. At the same time, biodiversity loss is accelerating due to deforestation, agricultural expansion, poaching, and urbanisation. The Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019) reported that Africa has experienced the fastest rate of land degradation globally, with direct consequences for food security and disease dynamics. The link between biodiversity and public health is evident in the emergence and spread of zoonotic diseases. Over 60% of known infectious diseases and 75% of emerging infectious diseases in humans are zoonotic, mainly originating from wildlife habitats disrupted by human activity (Jones, *et al*, 2008). The Ebola outbreaks in West and Central Africa, and more recently, COVID-19, have underscored how environmental degradation and wild life human interactions can precipitate public health crisis. Conversely, well managed ecosystems can act as buffers against disease transmission and support nutrition and mental health through access to green spaces and natural resources.

From a Public Administration perspective, managing this nexus requires coherent policy coordination across Ministries of Environment, Health, Agriculture and Education. However, institutional fragmentation, limited funding, and weak enforcement mechanisms often undermine implementation. Education also plays a pivotal role, as public understanding and attitudes towards conservation and health behaviours are shaped by formal schooling, community outreach, and media engagement. Without deliberate integration of conservation and health education into curricular and public campaigns, policy interventions risk limited uptake and sustainability.

Purpose and Statement of Problem the Study

The purpose of this study is to analyse the prospects and challenges of linking biodiversity conservation with public health in Africa, adopting a Public Administration and Education perspectives. It seeks to understand how governance structures, policy frameworks, and educational interventions can be aligned to promote both ecological integrity and population health. By focusing on institutional practices, policy coherence, and educational approaches, the study aims to generate recommendations that enhance cross-sectoral collaboration and community participation in sustainable health and conservation outcomes. Despite growing recognition of the One Health

approach, Africa continues to face fragmented governance and weak implementation of policies that link biodiversity conservation with public health. Ministries, departments and agencies (MDAs) often operate in silos, with limited data sharing, joint planning, or resource pooling. This fragmentation is compounded by low public awareness and limited integration of environmental health topics in school curricular and teacher training programmes. As a result, conservation efforts may neglect public health implications, while public health interventions may overlook environmental determinants of disease. The problem is further exacerbated by inadequate funding, corruption, and competing development priorities that marginalise both biodiversity and health sectors. Without addressing these governance and educational gaps, Africa risks continued biodiversity loss, increased zoonotic disease risk, and undermine progress towards Sustainable Development Goals (SDGs) 4, 13, and 15.

Objectives of the Study

a. examine the institutional and policy challenges that hinder integrated governance of biodiversity conservation and public health in selected African countries,
b. assess the role of Public Administration and Education systems in promoting awareness, behavioral change, and community participation in conservation and health initiatives, and
c. identify prospects and best practices for enhancing cross-sectoral collaboration and policy coherence between environmental and health sectors in Africa.

Scope and Significance of the Study

The study is delimited to sub-Saharan Africa (SSA), with particular reference to Nigeria, Kenya, and South Africa as case examples due to their varying governance structures, biodiversity profiles, and public health challenges. It focuses on national and sub-regional public administration institutions responsible for environment, health, and education, as well as formal and non-formal education programmes that address conservation and health topics. The study period covers policy development and programmes implemented between 2015 and 2025, aligning with the sustainable development goals framework. It excludes private sector wildlife enterprises and clinical medical interventions, concentrating instead on governance, education, and community level interactions.

This study is significant for academic and policy audiences. Academically, it contributes to the growing literature on One Health and environmental governance in Africa by providing an integrated analysis that bridges public administration and education studies. While much existing research examines biodiversity or public health in isolation, this study highlights their interdependence and the institutional mechanisms required to manage them jointly. It also adds to understanding of how education systems can function as vehicles for behavioral change and policy uptake in environmental health context.

Literature Review

Overview of Related Literature

IPBES (2019)'s "Global Assessment Reports on Biodiversity and Ecosystem Services" documents the rapid decline of biodiversity in Africa and links ecosystem degradation to increased risk of zoonotic diseases, food insecurity, and reduced resilience to climate change. Jones *et al* (2008) in their work, "Global Trends in Emerging Infectious Diseases", establishes that 75% of emerging infectious diseases are zoonotic and often linked to habit disruption and wildlife trade. WHO and CBD (2015) "Connecting Global Priorities: Biodiversity and Human Health" provides a policy framework for integrating biodiversity and health agendas under the One Health approach.

Allen *et al* (2017), "Biodiversity and the Prevention of Zoonotic Diseases" – analyses evidence that intact ecosystems reduce pathogen's spill over and argues for cross-sectoral governance. Ostrom, (1990) in his work, "Governing the Commons" lays the theoretical groundwork for polycentric governance and institutional design in managing shared natural resources. Krasny and Tidball (2012) in their work, "Civic Ecology: Adaptation and Transformation through Environmental Stewardship" explores how community-based education and stewardship enhances conservation and public health outcomes. African Union (2020) in its "African One Health Policy Framework" outlines continental commitment to integrate human, animal and environmental health governance. Finally, UNESCO (2017) in "Education for Sustainable Development Goals: Learning Objectives" provides guidance on embedding biodiversity and health literacy into education systems.

Conceptual Review

The conceptual review situates the study within interdisciplinary scholarship that connects environmental governance, public administration, and education. It draws on theories of institutional design, social-ecological systems, and transformative learning to explain how policies and educational practices shapes behaviours and outcomes at the biodiversity health interface. The key concepts below provide the analytical lens for examining prospects and challenges in the African context.

Biodiversity

Biodiversity, short form of biological diversity, refers to the variety of life at all levels of biological organisation, from genes to ecosystems (Wilson, 1988; Gaston & Spicer, 2004). It is commonly structured into three hierarchical components: Genetic, Species, and Ecosystem diversities respectively. Genetic diversity denotes the variation in genetic information within and among populations of a single species (Frankham, *et al*, 2010). Genetic diversity underpins a species' capacity to adapt to environmental change and resist disease, as seen in the variation among dog breeds such as chihuahuas, huskies, and labradors (Allendorf, *et al*, 2013).

Species diversity comprises species richness, the number of species in a community, and species evenness, the relative abundance of those species (Magurran, 2004). For example, a tropical coral reef supporting hundreds of fish, coral, and invertebrate species exhibits higher species diversity than a monocultural wheat field (Hooper *et al*, 2005). Ecosystem diversity refers to the variety of habitats, communities, and ecological processes within a region, including forests, wetlands, deserts, and oceans (Noss, 1990). Each ecosystem supports distinct biotic and abiotic interactions that sustain ecological functions. The significance of biodiversity cannot be overemphasised as higher biodiversity enhances ecosystem stability, resilience, and the provision of ecosystem services such as pollination, nutrient cycling, water purification, and food production (Cardinale *et al*, 2012; Diaz *et al*, 2019). Loss of species and genetic variation reduces the capacity of ecosystems to buffer disturbances, increasing vulnerability to collapse (Tilman *et al* 2014). Biodiversity is typically quantified using metrics of species richness and evenness (Magurran, 2004).

Biodiversity Conservation

Biodiversity conservation refers to the protection, management, and restoration of ecosystems, species and -genetic diversity to maintain ecological integrity and ecosystem services. In Africa, conservation efforts have historically focused on protected areas, wildlife management, and anti-poaching initiatives. However, IPBES (2019) highlights that protected areas alone are insufficient without addressing drivers of loss outside their boundaries, such as agricultural expansion and unsustainable resource use. From a public administration perspective, conservation requires coherent policy design, inter agency co-ordination, and effective enforcement mechanisms. Ostrom (1990) work on common-pool resources shows that decentralised, community-involved governance often yields better outcomes than centralised resources for livelihoods. Challenges in Africa include underfunded conservation into broader land-use planning and leveraging payments for ecosystem services to create economic incentives for local communities. Education plays a role by building environmental literacy and fostering stewardship values among youth and community leaders.

Public Health

Public health in this context concerns the prevention and control of diseases that arise from interaction between humans, animals and the environment. Biodiversity underpins the ecological systems that sustains human health by regulating disease, supporting nutrition, and providing medicinal resources. Ecosystems with high species and genetic diversity regulate climate, water quality, and air quality, reducing exposure to heat stress, waterborne pathogens, and respiratory irritants (WHO & CCD, 2015). Pollination by diverse insect communities supports 75% of global crops, directly influencing dietary diversity and micronutrient intake (IPBES, 2019). Genetic diversity within crop and livestock species provides resilience against pests and disease, decreasing reliance on chemical inputs that can harm human health (FAO, 2010). Intact ecosystems also regulate infectious disease dynamics. The “dilution effect” describes

how high biodiversity reduces the abundance of competent disease reservoirs and vectors, lowering transmission risk for pathogens such as Lyme disease and hantavirus (Keesing *et al*, 2006). Loss of habitat and species simplification disrupts these checks, increasing human-wildlife contact and spillover risk. Biodiversity further contributes to mental and physical health through access to green space. Exposure to biodiverse natural environments is associated with reduced stress, improved mood, and increased physical activity, which lower the burden of non-communicable diseases (Sandifer *et al*, 2015). Urban planning that preserves green infrastructure functions as preventive public health intervention.

Policy frameworks increasingly recognise these linkages. The Convention on Biological Diversity and World Health Organisation frame biodiversity conservation as essential for achieving SDGs 3 on health and well-being (WHO & CBD, 2015). Integrating biodiversity indicators into health surveillance improves early warning for environmental health risks. Challenges include underfunding of environmental health programmes and fragmentation between health and environment ministries. Addressing these requires cross-sectoral data sharing, workforce training in eco-health, and valuation of ecosystem services in health economic analyses.

Theoretical Framework

This study adopts One Health Theory as its theoretical framework. One Health theory was propounded from conceptual roots in Rudolf Virchow's 19th-century "zoonosis" and Calvin Schwabe's 1964 veterinary medicine, but formalised as "One Medicine–One Health" by William Karesh and the Wildlife Conservation Society in 2004, New York, USA, during the Manhattan Principles. The One Health approach recognises the interdependence of human, animal, and environmental health and promotes integrated, cross-sectoral action to address complex health challenges (WHO, 2017). It emerged from the recognition that 60% of known infectious diseases and 75% of emerging infectious diseases are zoonotic, requiring collaboration between public health, veterinary, and environmental sectors (Jones *et al*, 2008). The theory was propounded to address the 60% of infectious diseases and 75% of emerging pathogens that originate in animals. Veterinary and human medicine operated in silos, missing early signals from wildlife. The 2003 SARS and H5N1 crises exposed institutional fragmentation. The core tenets at that human, animal, and environmental health are interdependent. Solutions require integrated surveillance, joint risk assessment, and shared governance among public health, veterinary, and ecological sectors. The 2019 Quadripartite Alliance FAO, UNEP, WHO, WOAH operationalised it. The theory directly frames the present study as it explains why ministries of health must co-manage forests with environment ministries, and why education for sustainable development must train transdisciplinary professionals. It provides the normative basis for institutionalising One Health units in public administration.

This theory was adopted as appropriate and the framework for the study because it

uniquely integrates the ecological mechanisms identified in the Dilution Effect, the institutional design insights of Social-Ecological Systems, and the normative public management logic of Public Value Theory into a single operational paradigm for public administration. While Dilution Effect explains 'why' biodiversity loss increases disease, and SES explains 'how' to govern commons, One Health explains 'who' must act together and 'through' what institutional processes to prevent health crises at their ecological source. Public Value Theory then explains 'why' governments should invest in such integration. Thus, One Health sits at the intersection of cause, governance, and justification, making it the most comprehensive framework for analysing public health as it relates to biodiversity.

Gap or Controversies in the Literature

Despite expanding scholarship linking biodiversity to public health, zoonotic disease, and governance, critical gaps and unreserved debates persist that limit policy uptake and operational effectiveness. Empirical findings remain fragmented across disciplines, with contradictions regarding casual mechanisms, scale effects, and institutional arrangements. Measurement inconsistencies, geographical biases, and siloed methodologies have produced controversies about whether biodiversity consistently protects health, which governance models are effective, and how public administration should integrate ecological variables The present study is positioned to address these deficits by integrating multi-sectoral data, testing contested mechanisms in a development country context, and evaluating institutional frameworks that connect ecological integrity to health outcomes within public administration practice.

Keesing *et al* (2006) and Ostfeld & Keesing (2012) report dilution effects where high hosts diversity reduces pathogen transmission. Conversely, Randolph & Dobson (2012) argue that diversity can amplify disease if additional species are competent reservoirs, citing west Nile virus in North America. Wood *et al* (2014) found no consistent effect across 45 host-pathogen systems. The controversy leaves public administrators without clear guidance on whether conserving biodiversity reduces or increases risk. The gap is that few studies test dilution across tropical, multi-pathogen contexts with human incidence data. This study fills the gap by analysing community-level biodiversity, land-use, and clinical zoonotic data in Nigeria to determine net effects and threshold conditions.

Methodology

This study adopts a qualitative, documentary, and comparative case study design grounded in an explanatory paradigm. The design is descriptive-explanatory and non-experimental. It is suited to examine institutional processes, policy interactions, and educational practices within complex socio-ecological systems in Africa. The approach enables in-depth interpretation of how public administration and education systems address the integration of biodiversity conservation and public health.

Document Selection Criteria

Documentary analysis is the primary data collection method. To ensure transparency and replicability, documents were selected using the following criteria:

1. **Time Frame:** 2015 to 2025. This aligns with the SDGs period and captures recent policy developments on biodiversity, health and education in Africa.
2. **Geographic Scope:** Sub-Saharan Africa only
3. **Content Requirement:** Documents must address at least two of the following themes: biodiversity management, public health, zoonotic disease, environmental education, or cross-sectoral governance.
4. **Source Type:** Included sources are national policy documents, legislation, national biodiversity strategies and action plans, national health policies, One Health implementation reports, education sector plans, programme evaluations, and reports from AU, ECOWAS, WHO, CBD, IPBES, FAO, and UNESCO. Peer-reviewed journal articles are used to triangulate findings.
5. **Exclusion Criteria:** Document excluded are those dealing exclusively with clinical medicine, private sector wildlife enterprises, or contexts outside sub-Saharan Africa. Internal memos and non-public documents were also excluded due to access constraints.

All documents were sourced from official government portals, organisational repositories, and academic data bases. A total document log was maintained to ensure traceability.

Case Selection Justification

The study employs purposive sampling and uses three country cases for comparative analysis, namely: Nigeria, Kenya, and South Africa. The cases were selected based on maximum variation sampling to allow analytical generalisation across different institutional context: Nigeria selected as a federal system with significant institutional fragmentation and weak inter-ministerial coordination, it represents governance challenges common in large, multiethnic states. Kenya, selected for its established One Health coordination unit and community-based conservation models, it represents a case of structured cross-sectoral collaboration. Finally, South Africa, selected for its advanced policy and legislative frameworks for both biodiversity and health, it is along-side persistent implementation and co-ordination challenges at sub-national levels. Together, the three cases provide variation in governance structure, biodiversity profile, public health burden, and policy maturity, allowing for comparison of prospects and challenges of integration.

Data Analysis

Data analysis followed three integrated procedures, namely: Thematic Analysis: Data were analysed using Braun & Clarkes Six Phase thematic approach. The process is familiarisation > Open Coding > Axial Coding >Theme Development > Review > Reporting. A coding framework derived from the conceptual review focused on:

institutional mandate, coordination structures, funding flows, stakeholder participation, curriculum content, and reported outcomes. Analytical memos were kept to document coding decisions. Second, Comparative Case Analysis: Findings from Nigeria, Kenya and South Africa were compared across the three themes: institutional challenges, role of public administration and education, and prospects for collaboration. This identifies patterns, divergencies, and context-specific factors, and finally, Policy Coherence Analysis: Using OECD and AU criteria, policies across biodiversity, health and education sectors were mapped and assessed for consistency, complementarity, and coordination. This identified overlaps, gaps and contradictions in objectives, instruments and responsibilities.

Conclusion

The study found that institutional fragmentation, policy incoherence, donor dependency, and fragmented data systems are the primary barriers to integrating biodiversity conservation and public health in Nigeria, Kenya, and South Africa. Ministries operate in silos with limited coordination, and where One Health platforms exist, they remain under-resourced and lack legal mandates. Community-based conservation produces positive ecological and health co-benefits when local tenure and participation are secured, but such models are limited in scope. Environmental health and biodiversity topics are marginal in formal education systems, reducing public literacy and cross-sectoral capacity. Policy coherence is weak between biodiversity, health, and education sectors, and heavy reliance on donor funding undermines the sustainability of integrated programmes. Integrated data systems are underdeveloped, constraining evidence-based decision-making.

Recommendations for Future Research

1. Future research should assess the legal and fiscal mechanisms required to embed One Health units within national governance structures and evaluate their impact on co-ordination and outbreak response over time.
2. Studies should examine how secure community land rights and benefit-sharing arrangements influence both biodiversity recovery and zoonotic disease risk, using mixed-methods designs across multiple African contexts.
3. Research is needed on the effectiveness of interdisciplinary curricula and experiential learning in building systems thinking and cross-sectoral competencies among students and public sector professionals.

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