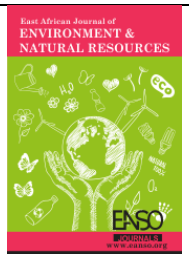

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Original Article

Balancing between Conservation and Livelihoods in African Inland Wetlands: Synthesis of Published Information, Reflection of Reality on the Ground, and Review of Possibilities for Sustainable Use

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ABSTRACT

Wetlands are among the most threatened global ecosystems. African wetlands have unique vulnerability concerning sustainability and wise use. Apart from many threats, including reclamation, pollution, and climate change, these wetlands have unique challenges associated with livelihoods and demand pressures. The current trends in wetland utilisation for livelihoods in most African countries are unsustainable. African scenarios are characterised by unique circumstances about how people interact with natural ecosystems, and this determines the success or failure of any conservation efforts put forward by local, national, and international institutions. To unravel the complex issues surrounding human-wetland interaction, there is a need to not only unpack the science behind the global concepts, such as the Ramsar wise use. There is a need to understand the entire social, economic, and ecological nexus in which African wetlands exist. In a region where economic and livelihood dependency is high throughout the seasons and coupled with limitations of qualitative and quantitative data on wetlands, it is difficult to quantitatively conceive the magnitude of human impacts on wetlands. To promote sustainable use, new innovative approaches are required to create a trade-off between the competing interests of conservation and utilisation for livelihoods. The maintenance of ecological character is paramount and requires that the ecosystem properties are not compromised by the pursuit of provisioning, regulating, cultural, and supporting ecosystem services, particularly concerning utilisation for human well-being. The situation for African wetland ecosystems is currently complicated by the demographic trends around these ecosystems and the attendant livelihood demands, but also by uncertain climate change. There is not only a need to understand the social, economic, and ecological nexus within which African wetlands exist, but also to identify gaps in knowledge. This paper reviews published information on African inland wetlands and explores the possibilities of sustainable use to support human wellbeing while maintaining their ecological functions.

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INTRODUCTION

Globally, there is a need for every effort to sustain wetlands by virtue of their benefits to humanity (Smardon, 2009; Russi *et al*., 2013; Davidson *et al.*, 2019). Global wetland loss estimates of 55-57 % (Davidson, 2014) and up to 64% (Ramsar, 2019) are something that should concern every wetland scientist and policymaker. Junk *et al*. (2013) indicate that destruction or modification of wetlands is variable across regions but could be as high as 30-90%. These figures paint a gloomy picture about sustainability, bearing in mind the cost of ecosystem restoration.

African wetlands are diverse, occurring both inland and coastal, and range from freshwater, brackish to saline systems. Most extensive freshwater wetland systems include those associated with major lakes such as Victoria, Chad, Tana, lakes of the African Rift valley and the major rivers such as the Nile, Niger, Komadougou-Yobe, Senegal, Zaire, Kafue, Zambezi among others. Other significant wetland systems occur in the dry areas of the Northern and Southwestern parts of the continent. Owing to the continental variability in the environmental conditions, the African wetlands support a plethora of plant and animal diversity. Their productivity provides the natural resources essential to the well-being of a considerable proportion of the rural population. Many of these wetlands, therefore, form a major resource base for livelihood through diverse products such as mats and baskets, construction material, medicine, as well as subsistence food, particularly seasonal crops (Akwetaireho & Getzner, 2010; Rebelo *et al.*, 2010; van Dam & Kipkemboi, 2016). In some areas, extensive floodplains are not only associated with subsistence activities but also extrinsic values such as commercial farming, tourism, and mining, among other enterprises.

Over the years, human interaction with wetlands has led to the continued loss of these valuable ecosystems. Information on the magnitude of wetland loss in Africa is scant. Some site-specific studies have revealed a loss of 34-50% (Owino & Ryan 2007), but this could be higher in some areas due to a lack of good databases. Dugan (1993) cites the inner Niger floodplain wetlands as some of the wetlands threatened with livelihood based short-term gains. Often, many reports on wetland loss focus on the decline in area with little or no consideration of biodiversity. Owethu Pantshwa & Buscheke (2019) opine that there is a need to look at ecosystem services vis-à-vis the biodiversity hotspots. Whilst there is a need to take stock of the loss of wetlands, the sustainability of the remaining wetlands is inevitable. This paper reviews the importance of wetlands for livelihoods in Africa, the drivers of change (population growth, climate change, agricultural development, and the trade-off between sustainable livelihoods and threats and explores possibilities for sustainable uses.

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MATERIAL AND METHODS

Over time, there has been a progressive increase in published information on African wetlands emanating from diverse sources, ranging from large research projects, postgraduate research, to individual research among others. In order to appreciate the existing information and to reflect on how this translates into sustainable use, this study uses secondary data through an extensive literature review of the literature on these ecosystems. The secondary source was obtained using search tips provided by Google Scholar and library information accessible to the author. Published literature information were categorised based on the major wetland systems and further into areas of focus. The data were populated in Excel for the purpose of summarising and synthesising existing information based on publication focus, major wetland systems and cumulative information from 1900 to date. The data is presented inform of pie charts and bar graphs. The synthesis of the existing information explores the trade-off between wetland conservation and livelihoods by reflecting on the dynamics of change and possibilities for sustainable use.

UN-PACKING FOR THE NEXUS BETWEEN LIVELIHOODS AND SUSTAINABLE USE OF AFRICAN WETLANDS

Human Interactions with Wetlands and Socioeconomic Values

African wetlands provide diverse ecosystem services that contribute to the well-being of the human communities living around them (Wood *et al.*, 2013). Wetland provisioning, regulating, and cultural services form an integral part of what constitutes good life, health, and social relations for the riparian communities in Africa. Through these, wetlands play a significant role in the livelihoods of most of the rural populations living around these ecosystems (Kipkemboi *et al.*, 2007; Rebelo *et al.*, 2010; van Dam *et al.*, 2011; Wood *et al.*, 2013; Grünberger, 2013). Ecosystem services related to food production, freshwater availability, and sources of fibre form the cornerstone of livelihoods for many communities living at the edge of wetlands in sub-Saharan Africa. Many wetlands, particularly those adjacent to lacustrine and large riverine systems, form the cradle of artisanal fishery. Schuyt (2005) highlights the importance of wetlands to the households living around them and the economic implications of the degradation of these ecosystems. The recent economic value of African wetlands is limited, but various earlier sources indicate valuation of hundreds to billions of dollars per year (Schuyt, 2005; Ikiara *et al.*, 2010; Kakuru *et al.*, 2013). Chaikumbung *et al.* (2016) acknowledge that managing environmental resources such as wetlands is a major challenge for developing countries, and valuation is a factor of multiple factors, including size, whose data is scant. Some wetlands may be small in size to feature in national wetland inventories but constitute the lifeline of communities living around them (Blackwell & Pilgrim, 2011). There is no doubt that economic valuation forms the basis of decision making and striking a balance between ecosystem services and livelihoods (Jogo, W. & Hassan, R., 2010). Hence, viewing human interaction with wetlands through the lens of economic valuation is inevitable.

Drivers of Change in African Wetlands

In the recent decades, the average population density in Sub-Saharan Africa has been estimated to grow at a rate of over 2.5% implying that at this rate it is likely to double in about 30 years (World Bank, 2019). The increasing demand for products and services to support livelihoods by the rural poor population and the impact of urbanisation on the adjacent wetlands cannot guarantee the maintenance of ecosystem properties. With almost 60% of the population depending on agriculture for food and income, and the uncertainty in terrestrial food production, many wetlands will continue to be threatened by over-exploitation. Climate change and the associated effects on rainfall patterns, hydrological extremes may aggravate the situation in wetlands, adding to their plight (Mitchell, 2013; Moomaw *et al.*, 2018). Land use changes in the landscape and

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excessive exploitation and abstraction of water during the dry season predispose wetlands to even more threats to their ecological integrity.

Wetland hydrology is not only an antecedent feature that influences other ecosystem properties and by extension functions, but also a gateway determinant of human interaction with these ecosystems. The variability in hydroperiod pattern in most wetlands creates a highly dynamic pattern that influences their ecological and socioeconomic function and, by extension, human access and use (Adams, 1993; Giordano, 2006). This variability, characterised by inundation in the wet season causing extensive flooding and drainage in the dry season, largely influences the exploitation of these ecosystems. Masih *et al.* (2014) analysed drought occurrence in Africa during 1900–2013 and concluded that drought incidence has intensified in terms of their frequency, severity, and geospatial coverage over the last few decades. There are many towns that are dependent on water supplies from the wetlands. The volume of water available to wetlands depends on landscape characteristics and the capacity for recharge of aquifers (Dallas Rivers-Moore, 2013; Elias *et al*., 2019). Due to the increasing degradation of most landscapes, there has been increased runoff and decreased recharge. The net yield of water available to wetlands therefore declines on a minor trigger of negative water balance, creating ease for hydrological modification. The advent of technological advancements such as drainage mechanisation used to reclaim wetlands for agriculture contributes threats at a larger scale. The paradox is that whereas the conversion of wetland to crop production may provide quick economic benefits, it only provides a short-term solution to food security.

One major threat to most African wetlands is perhaps those related to human activities, particularly conversion to agriculture (IWMI, 2014). Dugan (1991) identified anthropogenic activities such as intensive agriculture, policies on the use of wetlands for self-sufficiency in rice and other staple foods, among other development projects, as some of the major contributors to the loss of wetlands and their resources. The long-term effect of these activities is a compromise on the livelihood of those who depend on wetlands. The role of wetland in water supply in rural areas where many communities rely on shallow wells for their daily water supplies and from streams that flow through riverine marshes is often taken for granted. Poorly managed non-point source pollution associated with land use changes in most landscapes is gradually compromising this service. The net effects are the quality of life and health-related problems. The major culprit of these unprecedented effects is the dependent human population and the endemic wetland biota, particularly obligate species.

Trade-off between Ecosystem Services and Utilisation of Wetlands

Benefits associated with biodiversity are the basis for some of the most important but minimally exploited economic values through eco-tourism. It also has a high intrinsic/cultural value in Africa. Understanding the weakest link in the quest for sustainable use of African wetlands rests on the delicate balance between economic exploitation, sustainable livelihoods, and impending threats. The threats can be unpacked into both anthropogenically and naturally induced changes that affect the ecosystem properties (Beuel *et al*., 2016). Human hydrological interventions in the landscape have profound impacts on wetlands (Zwarts *et al.*, 2006). The situation may be worsened by climate change and subsequent decline in rainfed terrestrial production, compounded by the growing population (Rebello & McCartney, 2010; Adeleke, 2017). Figure 1 shows the link between the drivers of change and the consequences of human activities on wetlands with specific reference to African wetlands. The emphasis is on the need to understand the utilisation of wetlands for livelihood demands in the context of changing pressures on wetland ecosystems. The consequence of unregulated exploitation is a gradual loss and which often irreversible and expensive.

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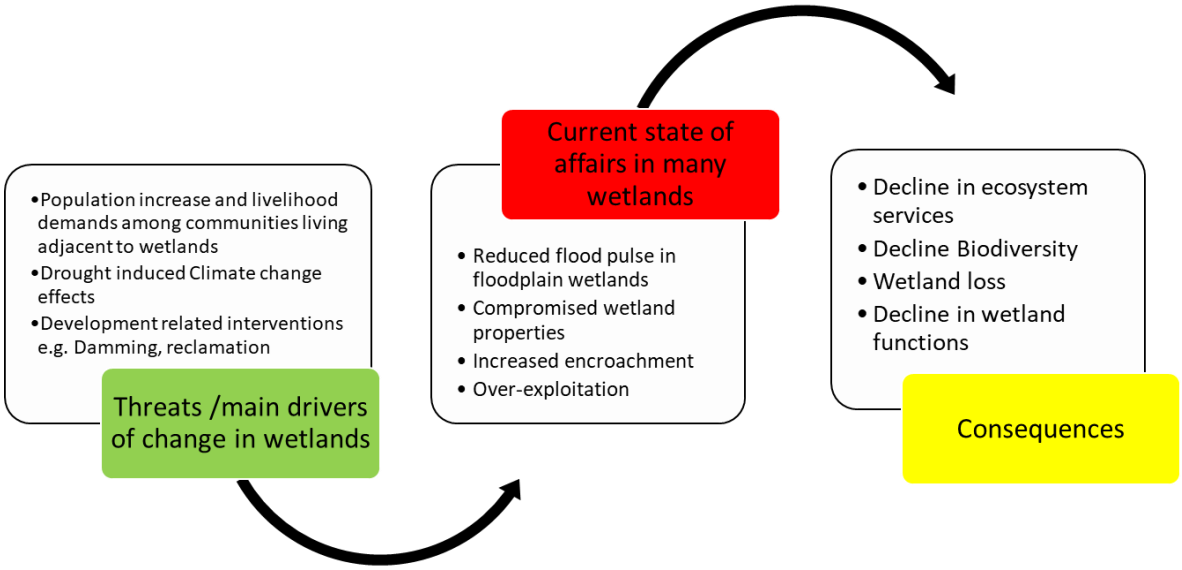
Figure 1: Conceptualising the State of Affairs in Many African Wetlands



OVERVIEW OF THE STATE OF KNOWLEDGE IN AFRICAN WETLANDS

Knowledge Review and Status

Knowledge on African wetlands can be viewed in the form of often un-discontented indigenous information and published literature. This article focuses on the latter. Most of the published information about African wetlands focuses on the key aspects ranging from hydrology, biotic and physico-chemical characteristics, ecosystem functions and applications, valuation, livelihoods and ecosystem services, management, policy and governance issues, and general information such as spatial occurrence and extent, among others. Figure 2 (a) shows the proportional distribution of accessible literature concerning the different domains of knowledge as perceived to contribute to sustainable wetland management. Most research and publications have concentrated on the large wetland systems such as the Lake Victoria/Kyoga system, The Okavango delta, The Lake Naivasha, The Sudd, Kafue system, Inner Niger Delta and the Lake Tana system (Fig. 2b). There is also appreciable information on relatively smaller systems such as the Hadejia-Nguru in Nigeria, the Chad ecosystem, the Rift valley lakes, large rivers like the Nile, Senegal and Tana among others. Significant publications have been produced in the last two decades (Fig. 2 b). There is, however, still scant information about the Zaire and the South Sudan wetlands. Documented indigenous knowledge is also limited for many wetlands.

In the development of this article, a literature review was conducted based on published secondary data sources. Google Scholar was used to search for published articles on African wetlands. For this article, the scope was limited to inland wetlands. The search was based on keywords "wetland properties, namely: hydrology, biota, and the physico-chemical characteristics and their interaction as identified by functions, values and ecosystem services" in combination with "Africa". Over 700 published articles on African wetlands were reviewed and form the basis for discussion. This search was limited to publications in English. The articles were populated and organised into aspects addressing the ecology and management of wetlands. The resulting information and in addition to the author's expert knowledge, was synthesised into information that could contribute to the understanding of sustainable management of African wetlands. Over the past two decades, a number of young and middle-aged professionals on wetlands in Africa have grown through training by IHE Delft, the Netherlands, BOKU, Austria, among other international and African institutions of higher learning. This is expected to not only improve the expertise pool and

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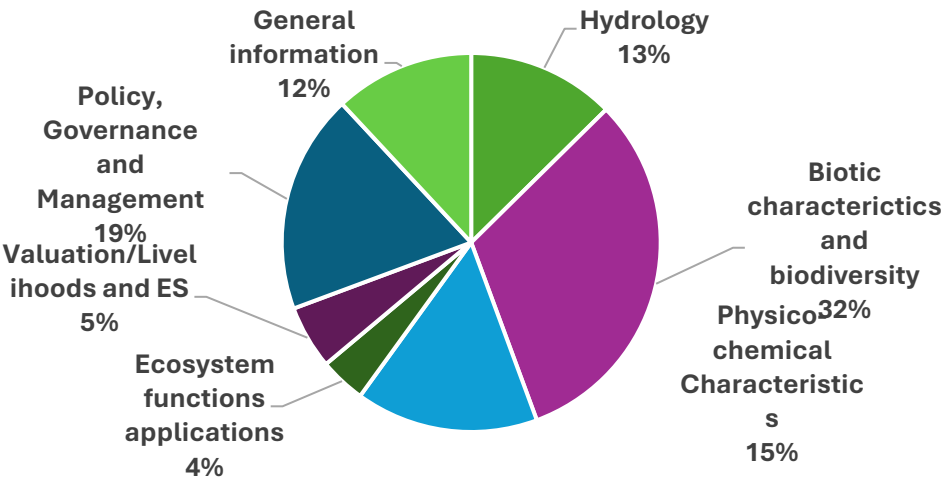
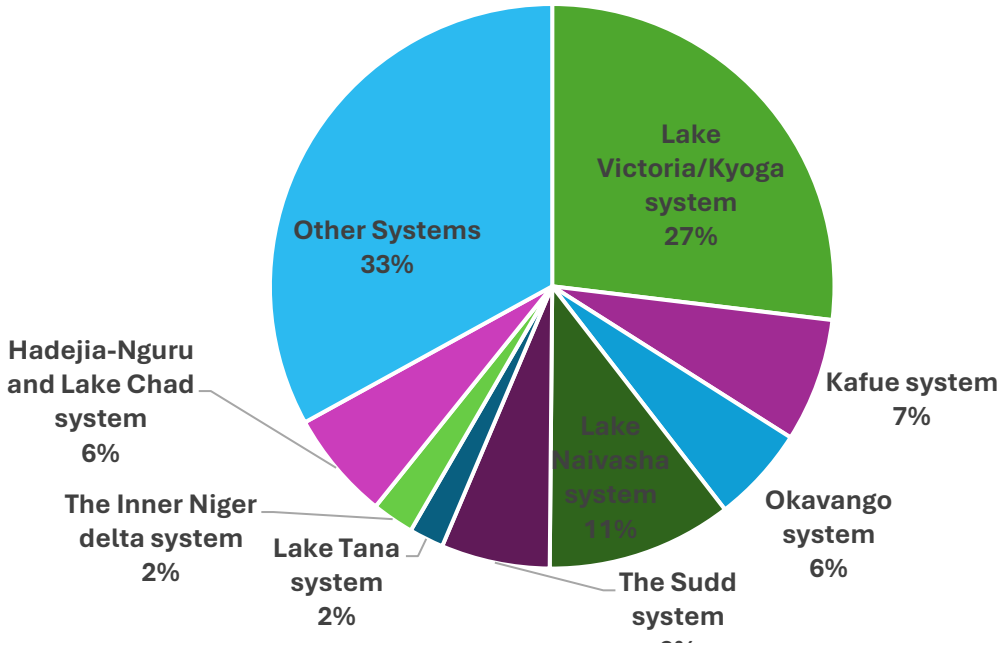
knowledge base but also stimulate decision making with respect to the conservation and sustainable management of aquatic ecosystems and aquatic resources.

Figure 2: Overview of Accessible Literature on African Wetlands Based on (a) Domain, (b) System, (c) Time Scale (Valid at the Date of Preparation of this Article)

(a) Domain



(b) System



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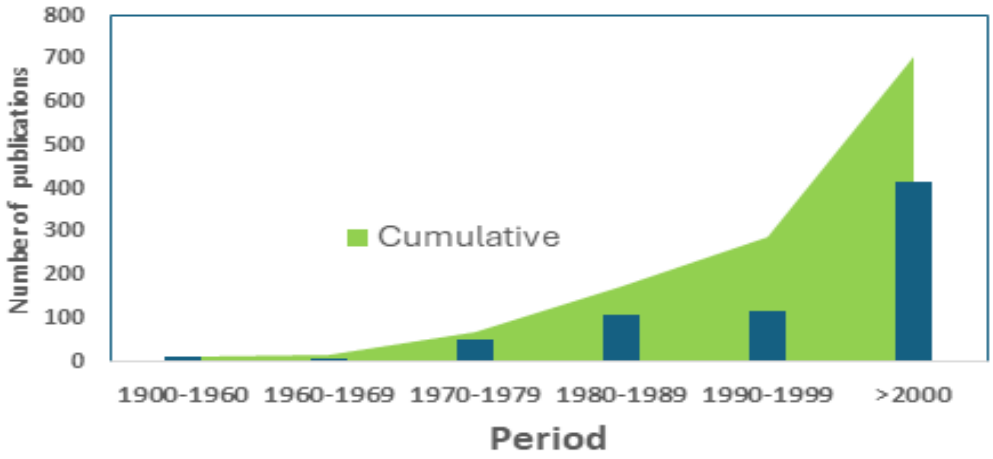
(c) Time Scale



Knowledge to Policy

Knowledge about wetland ecosystems forms the cornerstone of sustainable use of these ecosystems through not only shaping how stakeholders appreciate the ecosystem benefits but also understanding the relationships between humans and the ecological systems. Knowledge is a critical ingredient in policy formulation. Although there has been a steady increase in the number of refereed publications on various knowledge domains on African wetlands, some of the publications are not readily accessible. The Ramsar Convention handbook on National Wetland Policies emphasises innovative scientific, socio-economic, and technological research and the link between science and wetland management (Ramsar, 2010).

Some countries in Africa, such as Uganda, Zimbabwe, Kenya, Senegal, Namibia, among others, have either stand-alone polices on wetlands or are at various stages of development, while others have integrated policy strategies into other environmental-related policies. Even with existing policies or strategic documents, there is still a challenge in realising sustainable use of wetlands (Peimer *et al*., 2017).

Denny (2001) identified two areas of knowledge gaps that are required for the sustainable management of wetlands. One of the priority areas identified was the establishment of the extent and status of wetlands through inventories, assessment, and monitoring of wetlands. The other area of focus is primary and secondary research into the processes, structure, and functioning of wetland ecosystems. To date, there are still gaps in knowledge in these areas. Information on the actual extent of wetlands is still inadequate (Davidson *et al.*, 2018). The state of wetlands and particularly activities that lead to loss and degradation require deliberate effort to strengthen wetland assessment, monitoring, and restoration (Gardner *et al.*, 2015). Reflecting on the concept of wetland wise use that emphasises the maintenance of the ecological character within the context of sustainable development, there is therefore still many concerns about the sustainability of many wetlands in Africa.

The ecological character of every wetland is intricately related to its inherent properties, namely hydrology, biota, and the physicochemical environment. It is therefore valuable to review knowledge availability and gaps from the perspective of these properties in addition to the societal benefits. Decomposing biota into plants and animals, and plants further into smaller units, one would be able to see areas of gaps in knowledge. Research on wetland microphytes, bacteria, Archaea, and Eucarya has not received much attention. For animals, most studies have focused on fish, birds, and mammals, with limited studies on amphibians and reptiles.

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For most wetlands, there is appreciable information on physico-chemical characteristics and hydrology; however, this is often based on large wetland systems, and hence, there is still a need for continued research on small-scale wetlands. Where wetlands receive pollutants associated with human activities, either as non-point sources from converted landscapes or point sources when used as receptacles of wastewater from urban centres, there is still limited knowledge about their capacity.

Over the past three decades, there has been a significant increase in donor-driven research focused on applied research, especially on livelihoods and ecosystem services, and less focus on basic sciences around the fundamental ecological and social understanding. There is a dearth of inventories on small wetlands (permanent and seasonal wetlands less than 8 hectares), both in public and private lands, in many countries. Thus, since there is limited or a lack of baseline information, the rate of loss of such small wetlands in the landscape may not be known soon. The land tenure systems vary from country to country, but generally, the ownership and responsibility for maintaining of ecological character of most wetlands is unclear in many instances. How wetlands are affected by climate change also remains a continuous assignment for wetland scientists (Mitchell, 2013).

The use of earth observation techniques for inventory and mapping, assessment and monitoring, as well as specific applications that support conservation and management, presents good opportunities for dealing with some of the aforementioned challenges. Initiatives such as GlobWetland Africa, which utilise satellite observations for the conservation, wise-use, and effective management of wetlands, will go a long way, particularly if they are complemented by mobile applications and associated digital technologies to ease the collection of data.

Reflecting on the Sustainable Use of Wetlands in the African Context

Wetland-based Livelihoods and Pillars of Sustainable Development

The relationship between humans and wetland ecosystems needs to be viewed holistically. The economic valuation of wetlands is largely because of their benefits to humanity; however, some of the beneficial activities have negative implications. In many instances, some of the major threats to most African wetlands can be linked to livelihood activities, particularly encroachment for agriculture and subsequent over-exploitation (Wood & Dixon, 2007; Adekola & Mitchell, 2011; Wood *et al.*, 2013). The quest for sustainable management will not, therefore, be feasible unless key issues directly related to these threats are addressed. Turner (1991) demonstrates the link between wetland economics and management. For Africa, where the household economy is often largely dependent on ecosystem services, it is challenging to realise sustainable utilisation unless there is a balanced approach to the ecology, social, and economic nexus within the local context. Increasing populations and per capita demand on wetland products and services may outweigh the ecosystem threshold, and hence negative implication on ecosystem benefits. Even with efforts for sustainable management of wetlands, there is a need for a parallel enhancement of the economic status and resilience of the communities living around wetlands through ensuring that the productivity of terrestrial ecosystems is optimal. The connectivity between properties (hydrology, biota, and physico-chemical condition), land use, and human socioeconomic activities becomes paramount in the prescription of policy interventions (Thompson & Polet, 2000).

Re-thinking the Wise Use Concept in the Context of the Sustainable Use of African Wetlands

The wetlands wise use concept adopted by the Ramsar Contracting Parties during the 3rd meeting in Regina, Canada, in 1987, is yet to be realised in many African countries. The nobility of ideas on policy legislation, ensuring that resources allocated, strategies are developed, objectives are set with best practice, and intersectoral coordination among institutions remains a mirage. Finlayson *et al*. (2018)

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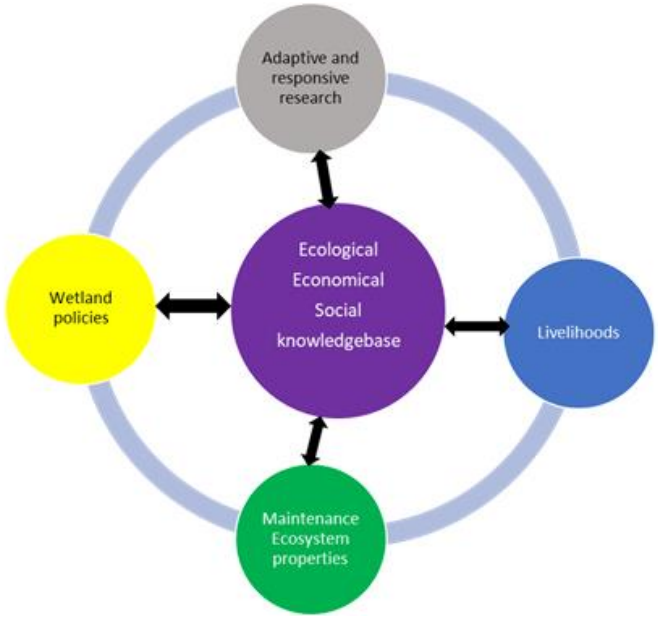
recommend a proactive and coordinated policy response to reduce further loss of these valuable ecosystems.

The role of governance processes, including but not limited to the development and implementation of wetland policies, is a major step towards the wise use recognition of the value of these ecosystems (Ramsar, 2010; Gardner *et al.*, 2023). Wetland policies not only continued the generation of knowledge on wetlands but also the education of the stakeholders, particularly the communities living around these ecosystems. Several countries in Africa have made significant steps in developing wetland policies to guide on sustainable use of wetland resources. Different countries have, however, different approaches. For instance, Uganda, Kenya, and Zambia have an inclination to standalone policies, while Rwanda, South Africa and Tanzania, and many other African countries integrate wetland-related issues in related environmental policies (Dini & Everard, 2016; NBI, 2017). These policies have noble objectives and intentions, but resources allocated to the lead agencies to realise the stated objectives remain wanting in many cases. Additionally, these policies need to be viewed in terms of holistic context in which wetlands exist particularly considering the drivers of change which include but not limited to demographics and livelihood dependency and emerging issues such as climate change (Fig. 3). The challenge that constraint policy implementation lies in balancing between policy implementation and livelihoods requirement requires (Langensiepen *et al.*, 2023).

Figure 3: Holistic Approach in Promoting Sustainable Use of Wetlands



The already high and increasing dependence of communities in Africa on wetlands for livelihoods poses a sustainability challenge. Without exaggerating, the current trends of wetland exploitation in Africa are not sustainable in the long term. The increasing inequalities in wealth distribution in Africa are also an issue of concern, where the majority of the rural populace are socio-economically deprived, hence largely dependent on the natural ecosystems for day-to-day livelihood requirements. The situation may be complicated by the ever-changing demographic trends, coupled with growing unemployment and poverty aggravated by global climate change. Economically empowered riparian communities will create an enabling environment for policy implementation by reducing the pressure on wetlands' ecosystem services, particularly provisioning, and hence immensely contribute to the sustainable exploitation of these resources. Capital development projects such as multi-purpose dams and agriculture should not outweigh the cost of ecosystem services and complement

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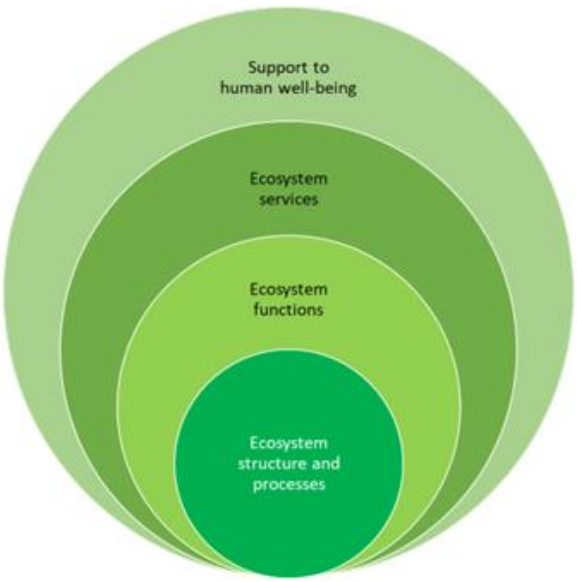
existing uses, where wetlands are utilised for livelihoods.

How can we optimise benefits from wetland ecosystems? There is also a need for adaptive and responsive research on innovative and appropriate technologies, as well as best management practices on the utilisation of wetland resources. Well-structured research outcomes with shared benefits arising from biotechnological and ecological engineering will raise the portfolio of wetlands. Wetland-based food production technologies that require less hydrological modifications, such as integrated small-scale fish production, such as the Fingerponds systems (Kaggwa *et al*., 2005; Kipkemboi, 2006; Denny *et al*, 2006; van Dam *et al.*, 2006), and other climate-smart wetland productivity and utilisation can be employed to overcome overfishing is a common phenomenon in many African wetlands.

The benefits of wetlands can be enhanced by product value addition and marketing. If well-planned economic activities, such as ecotourism, can support livelihoods without necessarily compromising the ecological integrity of natural wetlands. Understanding the wetland products value chain will, in the long term, enhance their value and contribution to sustainable livelihoods. Lack of or ineffective implementation of wetland management plans, weak documentation and sharing of best management practices for the majority of African wetlands is perhaps the weak link between theoretical intention of wetland policies, where they exist and the actual practice Whereas policies and the associated management plans present opportunities for sustainable use of wetlands, but these can only succeed if there is commitment in bridging the gap between policy and practice. Until such time that this is put in place so that proposals such as zoning of human activities in wetlands can be realised, it will be difficult to realise sustainable use with the growing competing interests. Linking ecosystem services to human well-being in the long term should be at the core of every initiative for sustainable wetland use (Fig.4). Where zoning proposal is considered in the context of land use management plans, a trade-off between conservation and use for livelihoods should indicate where natural conditions should be maintained and areas where limited modification of wetland properties can be tolerated. Livelihood activities that do not compromise wetland hydrology, such as regulated harvesting of biomass, need to be promoted, particularly for small wetlands, which are increasingly threatened.

Figure 4: Linking Ecosystems Features to Human Benefits



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Pollution is another major threat to many African wetlands that requires attention. Whereas the impacts may not be obvious, the ecological integrity of these ecosystems is highly compromised by both point and non-point pollution. Where wastewater is generated, appropriate technologies such as constructed wetlands for wastewater treatment can be used to mitigate the effects of pollutant influx on natural ecosystem properties. In many areas of Sub-Saharan Africa, most small towns that do not have comprehensive wastewater treatment systems use natural wetlands and or nearby lotic and lentic aquatic ecosystems as receptacles of partially treated wastewater to natural wetlands. As populations increase and subsequent sewerage connectivity, more inadequately treated or untreated wastewater will end up in wetlands. Coupled with poor maintenance and operations of the existing treatment plants, there is likely to be not only increased negative implications on the ecological integrity of these wetlands but also a compromise of the provisioning services, particularly those related to human food production.

CONCLUSIONS

The future of African wetlands rests on translating research output into benefits through validating sustainable livelihood practices, technologies, and innovations. This requires a holistic approach to the best approach to maintain the ecosystem properties while ensuring continued benefits from ecosystem services to human well-being, particularly food and biomass production. In many instances, their rural communities may not conceptualise that the ecosystem properties that support wetland processes and function must be maintained in order to realise sustained benefits from ecosystem services. Deliberate efforts are therefore required to ensure that a holistic approach is understood and embraced by all stakeholders. Whether the provision of essential ecosystem services to communities living around them promotes the need to protect these ecosystems to guarantee continued provision of services or contributes to the demise through "tragedy of the commons" is an issue that requires deep understanding. The vital role of wetlands in the continued support for livelihood activities can only be sustained if there is maintenance of essential ecological processes and life support systems.

There is a need to understand and tackle the root cause of the major challenges affecting sustainable use. Of great importance are drivers leading to over-exploitation of wetland resources and degradation from a landscape perspective, and factors that limit the implementation of policies, and exploring wise use practices that integrate indigenous knowledge. Secondly, there is a need for a governance framework that can contribute to balancing human needs, economic development, and conservation alongside strengthening institutions and leveraging International Cooperation. Thirdly, any initiative should factor in climate change impacts and mitigation/adaptation while leveraging technology to support management and conservation. Last but not least is the need to empower local communities to sustainably utilise natural resources while promoting eco-friendly technologies and production systems.

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