

## SUB-THEME 4



Management of Fisheries, Wildlife and Recreational  
Resources of the Mangroves and Wetlands



# **MANAGEMENT OF FISHERIES, WILDLIFE AND RECREATIONAL RESOURCES OF THE NIGERIAN MANGROVES AND WETLANDS**

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## **LEAD PAPER: SUB-THEME 4**

### **Abstracts**

Nigeria is a country richly blessed with both coastal and inland wetlands, which altogether cover about 3% of the country's land surface. Nigeria wetlands and mangrove biodiversity and conservation has received significant importance in the recent past as research has increased the understanding of values, functions and attributes of these ecosystems and the role they play in providing important ecological services and livelihoods for the associated communities. The sustainability of these ecosystem services is being threatened by a wide range of social, cultural, economics and natural issues which if not properly addressed may lead to complete destruction of these natural systems which may affect negatively the social and economics fabrics of Nigeria. Various Action plans needed to address these challenges were discussed in this presentation.

### **Introduction**

Wetlands are one of the world's most important environmental assets, containing disproportionately high number of plants and animal species compared to other areas of the world. Several definitions of wetlands have been proposed and opposed for a variety of reasons (Olalekan *et al.*, 2014; Uluocha and Okeke, 2004). Generally, the basic deductions from these various definitions are: wetlands are vital link between land and water; they are land area saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. Ramsar Convention on Wetlands (1971) defined wetland as "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". The primary factor that distinguishes wetlands from other land forms or water bodies is the characteristics vegetation of aquatic plants, adapted to the unique hydric soil.

The greatness of a nation and its economic progress could be judged by the way its natural resources is cherished and managed. The integration of biodiversity conservation into a national policy can reasonably reduce poverty; facilitate growth; ensure ecological sustainability and social equity. In recent years, growing scientific evidence sentience on wetlands and mangroves of the world has challenged all stakeholders and sectors.

Extraction of resources, industrial production, consumption of goods and services, mobility and leisure by man has resulted in massive destruction of wetlands and mangroves. Various form of threats to wetlands and mangroves have been extensively discussed (Olalekan *et al.*, 2014; Nwankwoala, 2012; MEA, 2005), but establishing sustainable management measure and implementation using relevant operational policy remains a major challenge. This presentation on management of fisheries, wildlife and recreational resources of the Nigerian mangroves and wetlands will provide an understanding on the functions and uses of wetlands, as well as the issues affecting wetland, which is necessary in order to ensure sustainable use of these resources.

### **Distribution of Wetlands**

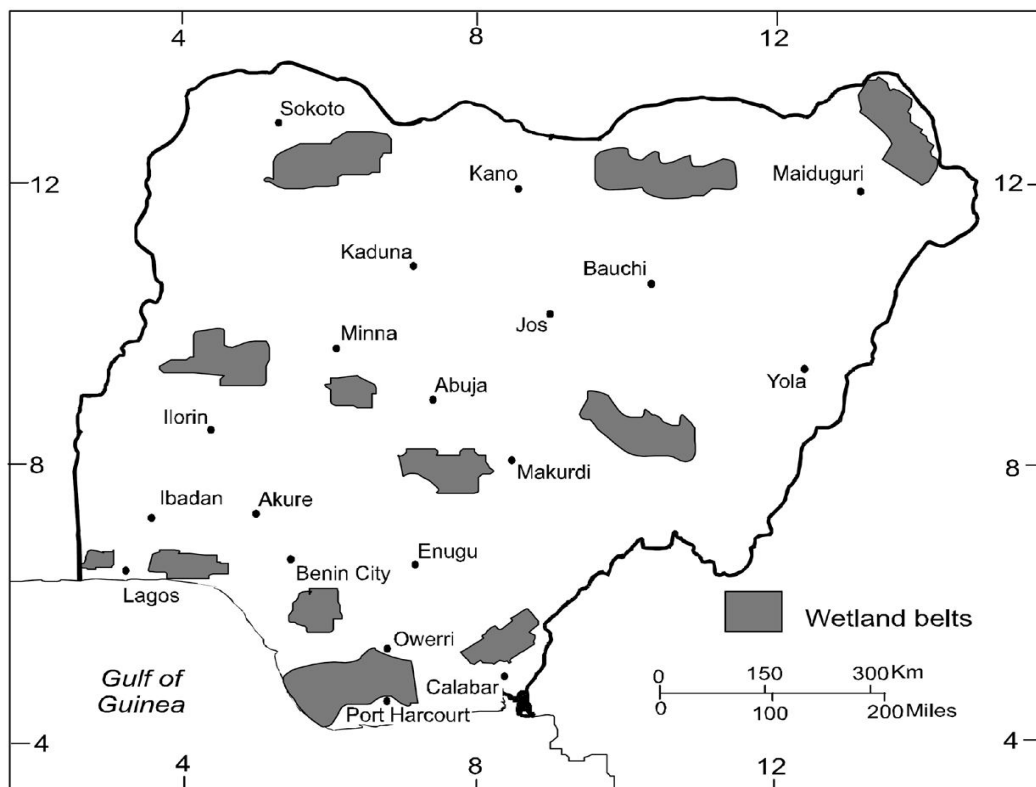
Wetlands ecosystems are estimated to cover more than 1,280 million hectares of the entire world's surface, an area 33 per cent larger than United States and 50 per cent larger than Brazil. According to Kar (2013), an estimated 6 per cent of the land surface of the world is wetland, though about 134,216,253 ha of the total world wetlands are internationally recognized as wetland and this excludes marine and coastal wetlands. They are distributed in all climatic zones of the earth except Antarctica, the largest including the Amazon River basin, the West Siberian Plain, and the Pantanal in South America. Africa is endowed with abundant wetland resources.

Africa has 131 million hectares of wetlands, varying in type from saline coastal lagoons in West Africa to fresh and brackish water lakes in East Africa. Wetlands are found in most African countries with a wide range of ecosystem services. The greatest concentration of wetlands occurs roughly between 15°N and 20°S. It includes some rather spectacular areas of the four major riverine systems (Nile, Niger, Zaire and Zambezi), Lake Chad, and wetlands of the inner Niger Delta in Mali, the Rift valley lakes (notably Victoria, Tangayika, Nigasa, Turkana, Mweru and Albert), the Sudd in Southern Sudan and Ethiopia, and Okavango Delta in Botswana, all of which display a richness and uniqueness in biodiversity.

In Africa, Nigeria is a country richly blessed with both coastal and inland wetlands, which altogether cover about 3% of the country's land surface. With a land area of about 923,769 km<sup>2</sup> a north-south length of about 1,450 km and a west-east breadth of about 800 km, total land boundary of 4,047 km coastline is 853 km, Niger Delta, remain the most important wetlands in Nigeria and the third largest in the world (Ajani and Nwanna, 2009). It encompasses four main flourish and rich ecological zones: Coastal barrier Islands, Mangroves, Freshwater swamp forest and Lowland rainforests. Internationally, 11 wetlands are recognized in Nigeria as important sites for biodiversity (Figure 1). These include Apoi Creek forest reserve in Bayelsa, Upper Urasi forest in Rivers, Pandam/Wase in Nasarawa and Baturiya Games reserve in Kano. Others are Dogona Sanctuary Lake in Yobe, Foge Island in Niger State, Lake Chad wetland in Borno, Lower

Kaduna-Middle Niger flood plain in Niger, Maladumba Lake in Bauchi, Nguru Lake in Yobe and Oguta Lake in Imo.

Nigeria, a resourceful, diverse and bio complexity country discovered more of her wetlands sites in a recent inventory of wetlands in Nigeria conducted by Oyebande (2013). Fourteen major wetlands belts were identified which the country is asking the United Nation's Convention on Wetlands to accord international recognition as Ramsar sites in addition to the existing ones. These comprises of the wetlands of Sokoto-Rima, Komadugu Yobe, Lake Chad and Komadugu Yobe Basins the Upper Niger and Kainji Lake, the Middle Niger-Lokoja-Jebba-Lower Kaduna, the Lower Benue-Markurdi, the Cross River, the Lower Niger, the Niger Delta, Benin-Owena and Okomu, Lagos Lagoon and Lekki Peninsula, the Lower Ogun River, the Ologe Lagoon, Badagry and Yewa Creeks, and the trans-boundary wetlands of the Upper Benue.



**Figure 1. Map of Nigeria Showing Wetland Belts (Uluocha and Okeke, 2004)**

### **The Mangroves Ecosystem**

Mangrove forests occupy about 15.2 million hectares of tropical coast worldwide (Spalding *et al.*, 2010). Africa represents about 19% of this mangrove cover, totalling some 3.2 million hectares. The African country with the largest mangrove area is Nigeria with 1 million hectares (Table 1). Mangrove forests in Nigeria range along 708 km of coastline and extend from 16 to 90 km inland, encompassing 5,591 km<sup>2</sup> of land (Isebor and Awosika, 1993). By far the largest proportions of mangrove occur in Asia and Americas. Countries with the largest area of mangrove are Indonesia (4.25 x 10<sup>4</sup> km<sup>2</sup>; Spalding *et al.*, 1997), followed by Brazil (1.3 x 10<sup>4</sup> km<sup>2</sup>; Spalding *et al.*, 1997), Nigeria (1.05 x 10<sup>4</sup> km<sup>2</sup>; Saengar and Bellan, 1995), and Australia (1.0 x 10<sup>4</sup> km<sup>2</sup>; Robertson and Duke, 1990). Mangrove biodiversity and conservation has received significant importance in the recent past as research has increased the understanding of values, functions and attributes of mangrove ecosystems and the role they play in providing important ecological services and livelihoods for the mangrove associated communities.

**Table 1: Estimates of Total Mangrove areas in ten countries of the world (Ajani and Nwanna, 2009).**

Countries	Estimated Mangrove areas (ha)
Indonesia	3,493,110
Brazil	1,012,376
Nigeria	997,700
Australia	995,277
Bangladesh	622,482
Malaysia	587,269
Cuba	529,700
India	487,100
Papua New Guinea	464,000
Mynanmar	452,492

Mangroves are trees, shrubs, palms or ferns found above mean sea level in the intertidal zone of coastal and estuarine environments (Duke, 2006). Most are associated with soft muddy sediments occurring along the sheltered inter-tidal coastlines, mudflats, river banks in association with the brackish water margin between land and sea in tropical and subtropical areas. They are among the most productive and complex ecosystems on the planet, thriving in salty and brackish conditions that would just kill ordinary plants very quickly. They are home to many uniquely adapted biodiversity. Worldwide, mangrove ecosystems support at least 50 species of mammals, over 600 species of birds, and close to 2,000 species of fish and shellfish, which include shrimps, crabs and oysters. Mangroves are also important for migratory birds and endangered species. Nigerian mangroves are dominated by red mangroves (Rhizophoraceae) and also include white mangroves (Avicennia) and a few other mangrove species.

**Wildlife in Wetlands**

Animals tend to congregate around wetlands. There are some species which are always found near water, such as hippopotamus, waterbuck, warthog, elephant, crocodile, sitatunga, and water birds such as flamingos and ducks. These animals are part of a complex food chain which is reflected in the high diversity of biota in wetlands. Unique primate species like the Cross River gorilla (*Gorilla gorilladiehli*), the drill (*Mandrillus leucophaeus*), and a number of smaller guenons are found only in Nigeria and adjacent forest areas. An extraordinary diversity of butterflies, amphibians, and other species has been tallied in Nigerian wetland and mangrove habitats. African Water bird census counts were 259,769 in 1995; 201,133 in 1996 and 324,510 in 1997 (Bibby *et al.*, 2000). Wetlands are known for their abundance of birds. Lameed (2011) noted that the use of wetlands and their resources is widespread among many diverse bird taxa of the world.

Mangrove ecosystems are important habitat for at least 1,300 species of animals including 628 species of mammals, birds, reptiles, fish, and amphibians (Ajani and Nwanna 2009). They provide areas for breeding, nesting, foraging, and shelter. The mangrove forest provides a multitude of habitats for resident, seasonal, and transient organisms from adjacent terrestrial and marine habitats. Many of the larger motile species are not restricted to mangroves, but are seasonal or opportunistic visitors. However, most invertebrate and some resident vertebrate species are totally dependent upon mangroves to survive and complete important life cycle functions. Fish and invertebrates from the marine environment are frequent visitors to mangrove communities, as are birds and mammals from nearby terrestrial systems. Other vertebrate species visit the mangrove habitat during the period that best suits their life cycle. The most seaward habitat is the mangrove fringe area containing red and/or black mangroves. The littoral and benthic components of this micro habitat contribute to the structure and resources available to organisms. Transient species are not dependent upon prop roots, but use them intermittently for shelter, feeding, and/or breeding. The prop root system also provides an important nursery for organisms that develop here and spend their adult lives elsewhere. Many of the birds associated with mangroves are neo-tropical migratory birds that utilize the habitat in their migration. The high productivity of mangrove ecosystems provides an energy source important for migrating bird species travelling on long distance routes.

**Fish Species Diversity in Wetlands and Mangroves**

African wetlands and mangroves are home to over 2000 known species of indigenous freshwater fish. Aquatic mammals such as dolphins and manatees, as well as terrestrial mammals such as monkeys were found here. Berra (2007) reported that Zaire River Basin has over 700 identifies fish species of which 560 are endemic to the basin.

Ajani and Nwanna (2009) reported that over 70% of coastal fish catches in Nigeria are directly or indirectly dependant on the mangroves. Furthermore, Nigerian wetlands has a

wide variety of shellfish resources ranging from the molluscs such as ark clams (*Senila senilis*), cockles (*Cardium costatum*), periwinkle (*Tympanotonus fuscatus*) to the crustaceans which includes the penaeidae (shrimps), palaemonidae (prawns), portunidae (swimming crabs) and palinuridae (lobsters) (Table 2). Nigeria generated about US \$54million in 2005 from export of shrimps and prawns alone. This figure decreased to about US \$38million in 2007 due to overexploitation thus decreasing production from 13,767mt in 2006 to an alarming 5,995mt in 2007 (Jimoh and Lemomu, 2009). Mangrove forests create a wide diversity of niches, which serve as suitable habitats for feeding, breeding, spawning and hatching of sedentary and migratory species. In particular, they are an important nursery habitat, for fish and crustaceans of commercial value.

**Table 2: Fishes caught in commercial quantities within the Nigeria's mangrove area**

Common name	Scientific name	Family
Bonga	<i>Ethmalosa fimbriata</i>	Clupeidae
	<i>Mugilcephalus</i>	Mugilidae
Atlantic bumper	<i>Chlorocombrus chrysurus</i>	Carangidae
Crevalle jack	<i>Hippo caranx</i>	Carangidae
Mudskipper	<i>Petropthalmus barbatum</i>	Gobiidae
Red snapper	<i>Lutjanus goreensis</i>	Lutjanidae
Tilapia	<i>Oreochromis niloticus</i>	Cichlidae
Silver catfish	<i>Chrysichthys nigrodigitatus</i>	Bagridae
Mango tilapia	<i>Sarotherodon melanocheilus</i>	Cichlidae
Jewel fish	<i>Hemichromis fasciatus</i>	Cichlidae
Croaker	<i>Pseudolithus elongatus</i>	Sciaenidae
Sole	<i>Cynoglossus</i> spp	Cynoglossidae
Ray	<i>Dasyatis margarita</i>	Dasyatidae
Grunter	<i>Pomadasys</i> spp	Haemilidae
Hammer head shark	<i>Sphymacouardi</i>	Sphyrnidae

Source: Adapted from Okpiliya *et. al.*, 2014

### **Importance of Wetlands and Mangroves Biodiversity**

The importance of wetlands and mangroves to life are enormous. They provide fundamental life support in the form of consumptive and public-good services. Wetlands are ecosystems that provide a range of functions to human, fish and wildlife. They are the corridors through which life evolved, prospered, came ashore and conquered the terrestrial areas. They are the kidneys of the biosphere as they moderate the flow of nutrient and silt from land to water by trapping them. They are the perpetuators of the global hydrological cycle and harbours a significant portion of earth's biodiversity. Wetlands commonly called morass are among the most biologically productive ecosystems that provide habitat for a diversity of natural resources and afford various



ecosystem services. According to Costanza *et al.* (1997), wetlands provide ecosystem services estimated to be worth at least \$14 785 ha/yr, a substantially higher value than any other ecosystem (Table 3).

**Table 3: The economic value of global ecosystem services**

Ecosystem	Area Million ha	Value US\$/ha/yr	Global Value US\$trillions/yr
Open ocean	33,200	252	8.4
Coastal	3102	4052	12.6
Tropical forest	1900	2007	3.8
Other forests	2955	302	0.9
Grasslands	3898	232	0.9
Wetlands	330	14,785	4.9
Lakes and rivers	200	8498	1.7
Cropland	1400	92	0.1
Total annual worth of the services provided by the Biosphere			33.3

Mangroves also have important ecological and socioeconomic functions, particularly in relation to seafood production, as a source of wood products, as nutrient sinks, and for shoreline protection (Rönnbäck, 1999). Moreover, wetlands and mangroves across the world play a critical role in food security, recreation and tourism; water shed management, habitat for fish and wildlife, climate and flood regulation (IWRB 1992; Dugan 1990).

### **Food Security**

World's food supply shortages are met basically through wetland production. The mangroves supply forestry products (firewood, charcoal, timber, honey etc.) and fishery products (fish, prawn, crabs, mollusk etc.). Hence, wetlands provide life support and livelihood to millions of poor people. The vast majority of our nation's fishing and shell fishing industries harvest wetland-dependent species. In United States, this catch is valued at \$15 billion a year. In Nigeria, wetland contributes about 56 per cent of the country's food supply, while upland and other domestic production contribute 33.4 and 10.3 per cent respectively (Oyebande *et al.*, 2003). According to the United Nations Food and Agriculture Organization, the total fish catch from inland waters (rivers and wetlands) was 8.7 million metric tonnes in 2002 (Ajani and Nwanna 2009). A review of mangrove fisheries suggests approximate ranges in production and value (on a per hectare per year basis) respectively, of 13 kg-756 kg and US\$91-5 292 for penaeid shrimp, 13kg-64 kg and \$39-\$352 for mudcrab, 257 kg-900 kg and \$475-\$713 for fish, and 500 kg-979 kg and \$140-\$274 for mollusks (Rönnback, 1999).

**Habitat for Fish and Wildlife**

Wetlands contribute to diversity by providing food and habitat that supports a wide variety of plants and animals. Detritus i.e. enriched organic material formed by the decay of plant and animal material in water is food for insects, shellfish and forage fish. In turn, fish (such as striped bass and bluefish), mammals, reptiles and amphibians feed on the insects and forage fish. The growth of wetland plants and algae is also nourished by nutrients they provided in the detritus. Wetland plants provide food and shelter for fish and animals. Approximately 40 % of the world's species depend on wetlands and three-quarters of the breeding bird species in North America use wetlands at some point during their life cycle. Economic important fish species of wetlands include *Lutjanus spp.*, *Clarias spp.*, *Lates spp.*, *malapterurus spp.*, *Bonga spp.*, *Sciaenops spp.* etc. Also, Wetland-dependent mammals include: muskrat, beaver, moose, raccoon, bobcat, swamp rabbit, and white-tailed deer. Bald eagles, ospreys, hawks, egrets, herons and kingfishers are just a few of the birds that thrive in wetlands. Fish, amphibians and reptiles also use wetlands for breeding, egg deposition, and nurseries.

**Recreation and Tourism**

The human love for watery places has sustained tourism and recreation in wetlands around the world for countless decades. This unique natural scenery is one of tourism's greatest assets and a fundamental cornerstone that provides opportunities for bird watching, wildlife photography, sailing, painters, hikers and opportunity for simply relaxing while appreciating the wonders of nature. In Africa, the heavy dependence of large mammals on wetlands is of immense economic value to African countries since they are the mainstay of the tourist industry. These animals include elephant, buffaloes, antelopes, crocodiles, hippos and zebras and the major predators, lion, wild dogs and hyena. The lives of Africa's large mammals are often inextricably linked to wetlands.

**Water Shed Management**

Wetlands perform a multitude of ecological functions such as water regime management, groundwater recharge, nutrient recycling and waste water treatment (RCS, 2007). They are a key link in watershed management. The role that they play in our watersheds is critical to protecting water quality and moderating water quantity. They reduce severity of floods downstream by retaining water and releasing it during drier periods. Wetlands also protect stream banks and shorelines from erosion.

**Climate and Flood Regulation**

Another valuable role of wetland to humans lies in their influence on the flow and quality of water. Wetlands often act like giant sponges, soaking up water that runs off the land. This feature can help slow floodwaters, lower flood heights and reduce shoreline and stream bank erosion. Similarly, mangroves capacity to protect against storms and even

sea level rise make them indispensable for coastal communities in their fight against climate change.

### Challenges Facing Wetlands and Mangroves

Between 1993 and 2007, the global acreage of wetlands decreased by 6 per cent (Pringent *et al.*, 2012). Verones (2013) however, stated that about 50 per cent of the world wetlands are presently lost due to drainage and water diversions. According to Morse *et al.* (1996), Pacific Coast estuarine wetland in Canada has been reduced by 80 per cent, New Zealand wetland area by 90 per cent and Canea river system in Colombia by 75 per cent. Similarly, Thailand has lost 84 percent of its mangroves, the highest rate of mangrove loss of any nation, while the Ivory Coast, Guinea-Bissau, Tanzania, Mexico, Panama, Malaysia, Myanmar, Pakistan, and the Philippines have each lost more than 60 percent of their mangrove forests. This reduction in wetland has drastically diminished the population of many wetland-dependent taxa (Gray *et al.*, 2013). For example, freshwater turtles and amphibians are the most imperiled vertebrate taxa in the world (Stuart *et al.*, 2004). Table 4 present the summary of main threats to wetland by regions of the world.

**Table 4: Summary of the Main Threats to Wetland/Mangrove by Region**

Threats	South and Southeast Asia	Africa	Central and South America
Natural disasters	Low-High	Medium	Low
	Increasing	Increasing	Increasing
Population pressure	High	High	Low – Medium
	Increasing	Increasing	
Over-exploitation by traditional users	High	High	Low
	Increasing	Increasing	Stable – Decreasing
Forestry	High	Medium	Low
	Stable	Increasing	Stable
Agriculture	High	High	Low
	Decreasing	Increasing	Stable – Decreasing
Aquaculture	High	High	Low
	Decreasing	Increasing	Stable – Decreasing
Salt production	High	Low	Medium – High
	Decreasing	Increasing	Increasing
Mining	Low – Medium	Medium	Low
	Decreasing	Increasing	Decreasing
Urban and industrial development	High	Medium	Low – Medium
	Increasing	Increasing	Increasing
Tourism	Low – Medium	Low	Low – Medium

Hydrological diversions e.g. dams	Increasing Medium – High	Increasing Medium – High	Increasing Low– High
Coastal pollution	Increasing Medium – High	Increasing Medium – High	Increasing Medium – High
Management shortcomings	Increasing Medium – High Decreasing	Increasing High Stable	Increasing Low – High Stable

Source: World Bank, 2003.

Some of the key threats to sustenance of ecological benefits of Nigerian wetlands and Mangroves are as discussed below:

**Degradation of the fisheries and wildlife resources:** The important fisheries wildlife sectors are constrained by various factors, including:

- (i) poor management and degradation of the resource (a.o. due to over-fishing, use of inappropriate vessels, pollution, spread of water hyacinth which modifies water quality and thus fish diversity, misalignment of legal and regulatory management framework, inadequate numbers of qualified personnel, and lack of up to date information);
- (ii) inadequate infrastructure;
- (iii) limited opportunities for alternative sources of income;
- (iv) low levels of education and literacy among fisher folk communities, which hinders their capacity to understand issues relating to fisheries management, environment management, fish quality and fish business management;
- (v) difficulties in marketing due to remoteness of principal fishing areas, and vi) post-harvest losses. In the last decennia, there has been a steady decline in the Catch per Unit of Effort indicator, suggesting that the stocks of different fish species are probably over-exploited.

This threat (resources degradation) is the most widespread problem although varied in intensity (particularly intense in Latin America, Africa and Asia). It includes timber and non-timber forest products extraction, fisheries and wildlife utilisation (Ajani and Nwanna, 2009). Human population pressure and eagerness for development are the major driver. The most drastic human effect is the degradation of the ecosystem and the change of mangrove forest and their environmental conditions to the extent that subsequent natural re-establishment is prevented or becomes very difficult and costly.

Over exploitation of wetland resources due to increasing human population and change from subsistence to commercial exploitation of wetlands resources continue to exert pressure on limited wetland resources resulting into its decline. Unsustainable

exploitation practices such as over fishing, bark (tannin) extraction, charcoal and fuel wood production and exploitation of timber and other products is now on the increase thereby damaging the system. The wetland and mangrove trees provide firewood, charcoal, timber and raw materials for paper and chipboard. The forest also provides other socially and economically important materials such as fodder for livestock, medicines, and dyes. In addition, wood extraction, mainly for firewood, is causing the mangroves population to decline.

Locals prefer using this wood because it last longer and is cheap. However, wetland and mangroves have a slow regeneration rate, usually taking about 30 to 40 years to grow back. Currently, there is no land set aside for conservation measures. In order for the mangrove population to increase and stay healthy, there needs to be a balance between the land's needs and the peoples' needs. Getting to that point will, however, not be an easy feat. Efforts should be made at conservation of the mangroves against use for firewood. However we can begin by partnering up with already established groups. Educating the locals about how important their resources are will also help reduce the loss of mangroves. If they understand how exploiting their resources are actually affecting them, they may be more willing to practice more conservation methods.

***Environmental problems as impediments to development:*** The major environmental challenges faced by the wetland and mangroves are related to indiscriminate pollution of the water and the degradation of the natural forest in the catchment area utilised for various domestic activities. A degraded watershed (incl. forests) causes reduced agricultural productivity, greater erosion and subsequently higher levels of poverty, which in turn results in more pressure on the natural resources of the watersheds as well as the wildlife and fisheries resources in the mangrove and wetlands, thereby resulting in conflicts on the use of natural resources.

Poverty, weak technical supervision and means, and unsustainable practices of exploitation and management of natural resources are still perpetuating, including: poor agricultural practices, overgrazing, bush fires, clearing for firewood or construction, misuse of pesticides, etc. These practices are the main cause of land, water and ecosystem degradation. Wetlands landscape in Nigeria is characterized by: (i) high population growth leading to increased need for food production and social services such as schools, potable water and sanitation, and health facilities; and (ii) high levels of poverty which has led to hunger being a cause of mortality in some parts of the wetlands. Also environmental degradation, poor rural infrastructure and low capacity of local government and civil society in areas of planning and implementation of programs hamper development efforts in the wetlands.

The Nigerian wetland and mangrove has been under threat for many decades from unsustainable natural resource exploitation practices with alarming consequences. The situation is complicated by the region's vulnerability to climate variability, which has exacerbated these degradation phenomena due to a decrease in rainfall. Thus, halting and reversing land degradation is a critical step towards improving the livelihoods of the population in these ecosystems. With exception of some localized efforts in watershed management and initiatives against encroachment of wetlands and deforestation, there is little evidence of sustainable integrated catchment management practices. Implementation of a livelihood-based watershed management approach is thus a major priority in order to address environmental degradation and poverty.

In addition, these wetlands and mangroves are threatened by clearing for agriculture, urban, tourism, and industrial development, and particularly to make aquaculture ponds. Agricultural activities are big threats to wetland since farmers drain and farm in wetland due to its fertility and availability of water. Hundreds of thousands of hectares of wetlands have been drained for agriculture. Similarly, many tourist activities taking place in wetlands have led to draining of these wetlands so as to establish tourist facilities like hotels or camping sites. Conversions of wetlands and mangroves to alternative uses have decreased the habitat quality for species living there. Changes in hydrology due to stream diversions for irrigation and dam construction are causing nutrient deprivation and hyper-salinization in wetland system. Worldwide, there are now over 40,000 dams which alter the natural flow of water and impact on existing ecosystem (Chipeta, 2012). River regulation and water diversion affect many aspects of wetlands, including their plants and animals, hydrology, water quality and geomorphology (their physical shape in the landscape). As a result, 'alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands' has been identified as a key threatening process in wetland system. Insufficient flows to inland wetlands can result in the loss of aquatic and semi-aquatic plant communities and the death of animals that rely on natural water flows, and also reduce opportunities for water birds to breed.

***Lack of integrated resource management:*** Numerous factors constrain progress, including centralized water resources management (WRM) systems and a multiplicity of actors, inadequate numbers of qualified personnel; outdated environmental legislation, policy and regulatory frameworks; unavailability of basic environmental management information; low public awareness on environmental issues; and limited consultation with local communities, civil society organizations, private sector and the public. Given the nature of these environments with cross-cutting interests and impacts, there is a critical need to ensure availability of adequate water in terms of quantity and quality for all the proposed interventions to be achieved. These call for an Integrated Water Resources Management approach in the basin to ensure that water and other resources are equally shared and wisely used for the well-being of all peoples.

***Volatile security situation:*** The presence of armed groups and political instability in wetlands region especially Niger Delta region and Chad basin areas in Nigeria during the last 15 to 25 years has made management and regulation of fisheries and related water resources difficult. The latest cycle of conflict has led to the displacement of millions of people from their homes in areas of ongoing conflict. Additionally, the conflict has disrupted agricultural production and trade and in the process increased the vulnerability of the population to hunger, malnutrition and poverty. Issues related to the status and return of refugees in particular remain a source of tension within the region, while displacement overall continues to negatively affect the stability and prospects for economic development, which calls for addressing the regional dimensions of poverty and forced displacement. The underlying factors are multi-dimensional and are determined by a complex combination of political, security, social, economic and environmental factors.

***Oil and mineral extraction:*** Huge oil deposits have been discovered in the wetlands and mangrove areas in Nigeria especially the Niger delta. Oil is not only one of Nigeria's most valued resource, but it also one of the main source of revenue. All the nation's oil fields are located in the Niger Delta region. 45% of the fields are located within the mangrove ecosystems range. This is bad for two reasons. The first reason is that the formation of the fields removes parts of the ecosystem in order to allow them to dig. This and the pipelines they build to transport the oil degrades the land. The second reason why this is not beneficial is because of oil spills. Oil spills can be caused by broken pipes, blow ups, or groups sabotaging the fields. These spills then enter into the mangrove ecosystem and kill off aquatic species. It also kills mangroves because the oil attaches onto the mangroves' roots, blocking their breathing pathways. Oil fields are also implicated in gas flaring, which is the process of burning unwanted fuel during oil productions.

Development of oil reserves with accompanying infrastructural and environmental pollution problems have led to alter waterways and drainage patterns, leading to flooding during the rainy seasons, pollution of water sources through waste run-off (including oil leaks and spills) and the spread of diseases which have destroyed the agrarian and fishing livelihoods and infringe the right to adequate living conditions. Extraction of oil and other industrial activities have been the growing concern in wetland areas, affecting drinking water sources and biological diversity. Drainage and run off from fertilized crops and pesticides used in agriculture introduce nitrogen and phosphorous nutrients and other toxins like mercury to water sources. These chemicals can affect the health and reproduction of species posing a serious threat to biological diversity. Sources of pollution also include dumping of industrial and sewage effluents and chronic or

catastrophic oil spills. The Niger delta region of Nigeria suffers the serious from effect of oil spill as a result oil exploration in the area.

The United Nation Millenium Ecosystem Assessment (2005) reported that environmental degradation is more prominent within wetland systems than any other ecosystem on earth. The primary indirect drivers of degradation and loss of inland and coastal wetlands have been population growth and increasing economic development. The primary direct drivers include infrastructure development, land conversion, water withdrawal, eutrophication and pollution, overharvesting and overexploitation, and the introduction of invasive alien species (MEA, 2005).

**Limited knowledge:** Water resources of wetland basins in Nigeria are generally insufficiently known and increasingly threatened by rising demand for water, adverse effects of hydrological variability/climate change and degradation of water quality due to pollution from various sources. The lack of reliable information on past and present hydro-meteorological conditions and future climate changes makes it very difficult for governments and water managers to assess suitable adaptation options and to develop guidelines and standards for planning and water management purposes.

**Low Institutional capacity:** There are many legal instruments for water and environment management, but these are still poorly enforced at national level. Moreover, the institutional framework is facing serious problems of limited technical capacity, lacking essential tools for ecological and socio-economic monitoring, to support decision making in basin management. Finally, civil society remains weakly involved in the management of the basin and community initiatives.

**Climate change impacts:** Recent assessments by climate impact in Nigeria indicate that Climate Change will increase the vulnerability of Nigeria wetlands and mangrove, due to temperature increases, changes in precipitation patterns, frequent severe weather events, and prolonged droughts. These factors, in turn, will further diminish the ability of natural systems to filter water and create buffers to flooding. Higher water temperatures and changes in extremes, including floods and droughts are projected to affect water quality and exacerbate water pollution – from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt as well as thermal pollution. Increase in extreme precipitation and flooding will increase erosion rates and wash soil based pollutants into the waterways more so from the oil exploration. Increase in water temperatures will lead to more algal and bacterial blooms that contaminate water supplies, thus contributing to environmental health risks and impact on wetlands productivity and distribution of fish. Changes in water quality will contribute to changes in ecosystem composition, function and services.



Coastal wetlands, especially estuarine and marine wetlands, are naturally altered by high energy events such as erosion and inundation from sea level rise and storms. The impacts of these processes may be magnified by climate change and shoreline armoring. Estuarine wetlands typically protect the coastline from erosion and flooding, but if sea level increases and development prevents inland migration of wetlands, more wetlands will be converted to open water.

### **Managing Recreational Activities in the Wetland and Mangrove: The Management Strategies**

In last ten years, the management idea has found its way into ecology (GNF, 2004). According to Gray *et al.* (2013), wetland management is the manipulation of ecosystem processes using prescribed techniques to create high quality habitat. Wetland is by nature very complex and will inevitably involve many different sectors (fishermen, NGO's, politicians, and government) in identifying key problems and possible solution. The most common method of conserving mangrove ecosystems is by the creation of protected areas in undisturbed sites such as National parks and game reserves with community-based participation.

Tourism is spreading along mangrove-fringed coasts. In cases where it is improperly done, mangrove has been destroyed to build coastline communities. However, when sustainably done, ecotourism has become a new tool to promote environmentally and culturally friendly tourism. The potential of ecotourism for assisting in resource conservation and community development has drawn considerable attention. Ecotourism has unique characteristics that need special management regimes in order for tourists to enjoy their stay, while at the same time maintaining the natural environment. In mangrove communities there could be establishment of golf courses, cruise ship ports and pleasure craft marinas, hotels, condos, and restaurants.

### **Significance of Wetland and Mangrove Ecotourism**

#### **Nature-based setting**

Ecotourism permits tourists to appreciate the surrounding nature while at the same time learning about a unique culture. Since ecotourism is based on natural biophysical attributes, conservation of natural resources is fundamental. Ecotourism sites should be rich in natural attractions; have diverse flora and fauna; be conducive to adventure and travel; have unique features and some historical and cultural values, which may be interesting and educational; not be frequented by mass tourists and not threatened by destructive activities; have untouched native or tribal tradition; and be suitable for rehabilitation and conservation by tourism activity. The area should be ideal for walking, hiking, bird watching, swimming and similar activities. All these excellent conditions can be provided by mangrove. Ecotourism involves travelling to relatively undisturbed natural areas to study/appreciate and enjoy the scenery and its flora and fauna. It is an environmentally sound tourism activity in a given ecosystem that yields socioeconomic

benefits and enhances natural/cultural conservation. It is a means to generate income and employment for the local population, to help develop rural infrastructure, to raise funds and to build political support for nature conservation. However, ecotourism may alter norms, beliefs and the lifestyle of the host community.

### **Educational Value**

Ecotourists normally seek educational experiences to learn more about the environment. Through interpretative programmes such as high-quality guided tours, ecotourism can also promote environmental awareness and cultural understanding. This will also form practical bases for postgraduate research.

### **Local Participation and Benefits**

The underlying concept is the reduction of local dependence on consumptive use of natural resources through benefits from tourism. By participating in ecotourism activities (such as guiding, providing camel rides and food services), local people can earn supplementary income while at the same time ensuring the conservation of biodiversity. Sustainable resources are essential for sustainable ecotourism. To achieve both resource conservation and sustainable economic use, ecotourism must have a wide variety of groups who directly or indirectly determine the use of an ecotourism area, a strong local and hotel and resort operators' cooperation and support, some mechanisms for the involvement of different groups in the planning and management process and education of various groups.

### **Encouraging Conservation Awareness**

Ecotourists are normally willing to volunteer or contribute to conservation or development projects within the area. This can include identifying birds and wildlife, participating in ecosystem restoration projects and assisting in trash collection. In return, tourists receive a sense of satisfaction for conserving nature or assisting in the development of an area or community. Providing awards or certificates showing that they have contributed to the protection of the environment or assisting in community development can enhance these initiatives.

### **Low impacts and sensitivity to the environment**

The tourism industry is the principal force in the development of ecotourism. There are, however, environmental costs and benefits and to ensure that the benefits exceed the costs, management structures should be in place. Care should also be taken to ensure that it is sustainably done.

### **Strategies for sustainable mangrove tourism development will entail the following**

1. Identifying appropriate locations for ecotourism development;

2. Identifying proper ecotourism activities that do not harm the environment;
3. Managing visitors;
4. Controlling the number of visitors per trip;
5. Controlling impacts by taking in all necessities needed as well as bringing out all trash to remote areas; and
6. Designing the facilities, which emphasize blending with the natural surroundings.

**Ecological Sustainability**

- Maintaining the genetic diversity of the area involved;
- Maintenance of the resilience of the ecological systems affected; and
- Maintaining the biological productivity of the area.

**Economic Sustainability**

- Satisfy basic needs of resident population and reduce poverty;
- Enhance equity through ownership, management responsibility and participation in decision making; and
- Increase the useful goods and services used in the area or region.

**Sustainability of the Social System**

- Maintenance of cultural diversity of the region;
- Sustaining local and national institutions and traditions.

**Strategic Actions for Sustainable Management of Mangrove, Wetlands and its Resources**

To attain a balance between sustainable use and conservation, the following guidelines are suggested:

**Reassess the Value of wetland ecosystems:** Comprehensive studies are needed to properly evaluate wetland and mangrove ecosystems *in situ* and *ex situ*. Improved quantification of ecological services rendered by wetland and mangrove ecosystems is also needed to be obtained while systematic investigations for new wetland and mangrove products and services as well as for value-addition can further increase their assessable value. The wetland and mangrove ecosystem therefore yields goods and services of high economic value and earns tremendous foreign exchange for the producing country without compromising its ecological and environmental integrity when properly managed. The complex, multi-faceted and often long-term nature of these benefits means that they have sometimes been overlooked in simple economic models. A proper assessment however, will promote research and surveys with scientists and organisations for the conservation, rational management, and sustainable utilisation of mangrove and their ecosystems. It will also serve to provide data-bank on wetland and mangrove ecosystems; while also enhancing public awareness on the importance of wetland and mangrove ecosystems

**Encourage Community Regulation:** Remove open access to wetland and mangrove ecosystems by encouraging community regulation and management. All coastal areas and resources need to be streamlined in a pattern of community usage and acceptance, and development policies must be based on such an approach. Such policies must include community participation at all stages of development of any management policy. Community ownership of natural resources leads to self-policing and regulation. This will encourage the planning and use of localised management plans and subsequent community stewardship. In some countries, there is strong evidence that traditional resource stewardship has led to considerable levels of protection. Such a form of traditional stewardship may greatly help toward protection of wetland and mangrove ecosystems

**Zone Wetland and Mangrove Ecosystems:** wetland and mangroves can be zoned for the ease of management. Suggested zonation could be into conservation reserves, mangrove forest reserves, mangrove fisheries reserves and alienable mangrove land. In many countries the opportunities to protect pristine wetland and mangrove areas are rapidly diminishing. Although the setting aside of reserves is important for genetic diversity, it is important to realise that a diversity of structure is also crucial. Any reserve should be sufficiently large to accommodate representative systems of the wetland and mangroves. The simple setting aside of wetland and mangrove ecosystems as reserves without a more comprehensive framework, does not necessarily offer a permanent solution.

**Develop Wetland Management Plans:** Wetland development plans should be done with references to ecological, economic and social needs. However, recognition of the variable dynamics of each of the ecosystems is crucial. It may not yield desirable result to apply a single management option to all mangrove regions. Broad supplementary objectives may be initially set and these may subsequently be refined to meet the peculiarities of specific locations. For such each management plan, sustainability must be the underlying approach. This practice, resulting in a continuous supply of a variety of products, cost little more than the non-sustainable extraction of products in the long-term.

**Improve Community Information:** For informed community involvement in regulation of mangrove ecosystems, better public education and information networks need to be established. This process can be enhanced through hands-on type experiences via wetland/mangrove boardwalks and ecotourism initiatives. In most countries there is considerable scope to improve public understanding and appreciation of the value of mangrove resources and of the benefits to be obtained from their sustainable management. The explanation of sustainable management systems needs to be undertaken within the formal educational systems, but must also be offered to the general public and to particular sectors within the population such as decision makers and local

people. There is a need to improve the communication and flow of knowledge between scientists, managers, holders of traditional knowledge and the wider public

**Rehabilitation of Degraded Wetland Systems:** In many areas, degraded wetland and mangrove ecosystems can be easily restored to provide the whole spectrum of ecological functions. Rehabilitation is technically feasible but involves costs and human resources. In addition, newer techniques such as air-layering and tissue culture need to be established and evaluated in terms of the silvicultural improvement that may be attainable for improved mangrove growth.

**Control of over use:** To overcome the overexploitation of the wetland and mangrove ecosystem, there is the need to encourage, where appropriate, development schemes that support replacement of wetland and mangrove fuel wood with alternate fuel sources. Enforce the principle of “no-use without replacement,” to have the situation where every time a tree is harvested other are planted. Encourage monitoring, on a regular basis, of the state and health of mangrove ecosystems. Encourage laws or policies that prevent the total clearance of new areas of mangroves and match local socio economic requirements with environmental realities of the local mangroves. Licensing should also be done to overcome overfishing and indiscriminate hunting.

**Aquaculture:** The conversion of former mangrove areas to aquaculture is a widespread activity, particularly in Southeast Asia, East Africa and Latin America. Mangrove soils are not suitable for most types of aquaculture. When sited on mangrove soils, most aquaculture ponds tend to become uneconomic and are abandoned within a few years because the soil becomes logged with acid sulphates. The application of inappropriate technologies exacerbates these environmental problems and contributes to pollution, eutrophication and sedimentation. Quite apart from these problems, of being unsustainable, there are much wider effects on the local communities. Such developments often displace local communities or disrupt patterns of local usage of mangrove resources. There are well known and quantified examples of extensive mangrove conversion to aquaculture ponds, which have led to drastic reductions of adjacent fisheries yields. To battle these and particularly stop the spread to other countries, there is the need to encourage the promulgation and enforcement of laws or policies that prohibit the clearance of new mangroves areas for aquaculture ponds, support adherence to EIA (Environmental Impact Assessment) policy, restoration of abandoned ponds, and making this a legal requirement in all new or ongoing developments and establishing a financial framework to ensure compliance.

**Pollution/sedimentation (including oil/gas):** Substances including solid waste, toxic chemicals, hydrocarbons, persistent organic pollutants, nutrients, particulate matter affect mangrove communities. They may be derived from single or multiple sources including

industry, sewage, dredging, pond effluent, agricultural and urban runoff. Their effects range from complete destruction to disruption of ecosystem functioning leading to chronic poisoning of mangroves and associated fauna and to the loss of biodiversity and productivity. In some cases, tidal flushing and biological processes of mangrove components may have the capability to assimilate and to transform pollutants (wastes treatment), providing a natural biological filter. However, there are clear limits beyond which levels of pollution rapidly become harmful. Similarly, mangroves are highly adapted to survive in areas of relatively high levels of sedimentation. When levels of sedimentation impede drainage, the newly created anaerobic conditions in the soil lead to the death of mature trees. There should be deliberate attempts to support programmes that reduce waste and runoff, promote the creation of artificial wetlands for the treatment of wastes containing nutrients and other organic wastes, support programmes that reduce waste and runoff, encourage the enforcement of existing legislation and apply recognised methods for ensuring purification and heavy sanctions for erring companies.

**Regulations and enforcement:** Most governments have not developed any legislation for mangrove sustainable utilisation or conservation, it is particularly vulnerable to trans-national pressures and the allocation of the resources is not in the interest of local communities. This is particularly well illustrated in the case of oil extraction and industrial shrimp pond construction in mangroves. For many countries there are few or no legislation or policies related to mangrove management. Where they exist, they are widely dispersed between institutions (such as those dealing with fisheries, forestry, planning, agriculture and environment). There is also little or no coordination between countries in respect of mangrove management approaches. In addition, existing legislation is either rarely enforced or often inappropriate, with little or no consideration for social and economic needs of the population. There is urgent need to support the integration and co-ordination of legal and managerial regimes between institutions and agencies, raise awareness on the existing and desirable legal systems, particularly of success stories and encourage exchange of experience. There should also be appropriate mechanisms to strengthen enforcement.

With the growing global extinction crisis of wetland and mangroves resources, instrument of sustainable management become crucial. Meanwhile, formulation of wetlands management plans should be based on the principle of integrated wetland assessment (i.e. private management, fishermen cooperative management, Community-based fisheries management and open access) that enabled combined biodiversity, economic and livelihood analysis across different disciplines and sectors. The conservation of wetlands and mangroves can only be achieved by the combined effort of individuals, communities and government. Some of the important steps that can be adopted for integrated wetland management include:

- Identification and collaboration with interest groups (e.g. fishermen, hunters etc.) which have direct dependency on wetlands for primary source of their income and food security.
- Empowerment of interest groups which can be an efficient move for promoting partnership between these stakeholders and political decision makers.
- Identifying and implementing pertinent options, which combine food security and biodiversity conservation.
- Recognizing the rights of local communities over the biodiversity that exists on wetlands they manage and use, and the rights over their traditional knowledge and practices.
- Promotion of sustainable use value among local people through an appropriate combination of the best traditional knowledge/practices and the latest technical and scientific understanding.

Nevertheless, government must play a leading role in the proper management of these areas.

### **Conclusion**

Effective management wetlands and mangroves biodiversity around globe faces many challenges as the threats to ecosystem integrity are strong and growing stronger in the face of population growth and unsustainable practices. Human wealth is based on the use and consumption of natural resources, including materials, energy and land. Continued increase in resource use and related environmental impacts can lead to ecological challenges, food security and threaten livelihood. The sustainable use and management of wetlands and mangroves resources have therefore become crucial. Over the past 50 years, man have changed wetland and mangrove ecosystems more rapidly and extensively than in any comparable period in human history, largely due to pressing need to meet rapidly growing demands for food, fresh water, timber, fiber and fuel at a cost of wetland and mangrove ecosystem degradation.

According to Wetland International (2015), the pressure on wetlands is likely to intensify in the coming decades due to increased global demand for land and water, as well as climate change. Hence, the need for inclusive economic policies and management plans to safeguard aquatic biodiversity, wildlife and rights of local communities. The future of wetlands and mangroves lies in a stronger political will to protect them, based on sound wetland policies and encouragement of community participation in their management.

### **Recommendation**

With wetlands and mangroves biodiversity suffering decline around the globe, and integrated management approach in mind, following recommendations become imperative.

- The goal for protected wetlands and mangroves should continue to be conservation of endangered and fragile sites.
- Greater efforts should be focused on wetlands and mangroves outside protected areas.
- Industries including agriculture should improve their best management practices to reduce the effects of non-point source pollution on wetlands and surrounding environments.
- Reduce fishing pressure in lagoons and estuaries by introducing alternative livelihood activities or adoption of sustainable management approach.
- There is need to formulate new management strategies that incorporates the stakeholders and sectors.
- Integrated wetland management through partnership between various interest groups for better understanding of the major issues surrounding wetlands and to prevent conflicts.

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