International Journal of Environment and Pollution Research
Vol.7, No.1, pp.1-20, January 2019
Published by European Centre for Research Training and Development UK (www.eajournals.org)

OIL SPILL INCIDENTS AND WETLANDS LOSS IN NIGER DELTA: IMPLICATION FOR SUSTAINABLE DEVELOPMENT GOALS

Wali Elekwachi, Nwankwoala Hycienth O., Ocheje Johnmark F. and Chinedu J. Onyishi

[1]Department of Geography, University of Nigeria, Nsukka
[2]Department of Geology, University of Port Harcourt, Nigeria

ABSTRACT: *The implementation of a comprehensive founded sustainable development strategy, strengthened by careful management of oil and gas wealth, combined with an continuing exemplary for preservation of the natural environment, is an vital for the Niger Delta region. Oil spills have occurred over the year in the Niger Delta and wetland ecosystems has been degraded by the impact of the spills. Nigeria is showcasing an average of 11 Ramsar-listed coastal and freshwater wetlands, which together cover, 1 076 730 ha. Of these 11 sites, two are located in the Niger Delta region. The Niger delta Region of Nigeria is a wetland of its own covering about 76,000sq km and has the biggest mangrove forest wetlands ecosystem in Africa (11,134 sq km) and the third biggest in the world with its exceptional huge floodplain area in south-south geopolitical zone of Nigeria. National Oil Spill, Detection and Response Agency (NOSDRA) alerted with a recent aid through data acquisition in monitoring of oil spill from January 2013 to September 2014 reveals that there were 1,930 oil spill incidents in the core Niger Delta are primarily offshore incidence in wetlands ecosystem. Therefore oil spills occurred as a result of inadequate servicing and maintenance of the oil and gas facilities such as preventer blowout, wellhead, flow lines or pipelines, sabotage, accidental and equipment failures by the oil companies. The implementation of wise use concept of wetlands ecosystem as an approach, within the context of sustainable development goals as a centerpiece of modern efforts to manage wetlands will help the policy makers to integrate wetlands ecosystem to environmental planning to ensure availability and sustainable management of water and sanitation for all.*

KEYWORDS: Oil Spillage, Wetlands, Ecosystem, SDGs, Niger Delta.

INTRODUCTION/BACKGROUND

Oil spills have happened continually for decades in the Niger Delta and large parts of the land and wetlands are chronically affected by oil spills. Due to the influence of the tides and at periods, floods in connection with rains, spilt oil is rapidly distributed over large areas and remobilized with rising tides. The oil originates from leaking pipelines, wellheads, and flow stations; from spills in connection with transport of mostly stolen oil; from illegal tapping of the wells; and from artisanal refining under very primitive conditions (Linden *et al*., 2013). As a result of the contamination of oil in mangroves and wetlands as well as on land, oil has penetrated into soils down to several meters and has contaminated ground waters over large areas (Plate.1). This has resulted in the contamination of water wells as a particularly serious concern from a human health perspective (Moffat and Linden 1995; Ana et al.2009; Mmom and Arokoyu 2010; UNEP 2011; Linden *et al*., 2013). Yet, in several places, the forests have

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

been widely logged and agriculture has encroached into the wetland (Moffat and Linden, 1995 Mmom and Arokoyu, 2010). Most of the lowland rainforests that used to characterize the areas landward from the swamp forests are now derived savannah or agricultural land with only small areas of more or less degraded coastal rainforest left. The high rainfall and river discharge during the rainy season combined with the low, flat terrain, and poorly drained soils cause frequent and widespread flooding and erosion. Often over 80 % of the delta is affected by seasonal floods stretching from the Benin River in the west to Bonny River in the east (Moffat and Linden, 1995). The tidal range at Port Harcourt metropolis is on average 1.8 m (Linden *et al.*, 2013).

Plate 1. Oil Spill Contaminated Site (UNEP PHOTO, 2011)

From the framework adopted by Ramsar, Convention (Article 1.1), defined "wetlands 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 meters". Hence, as defined by the Convention, wetlands include a wide variety of inland habitats such as marshes, peat lands, floodplains, rivers and lakes, and coastal area such as saltmarshes, mangroves, intertidal mudflats and sea grass beds, and also coral reefs and other marine areas no deeper than six meters at low tide, as well as human made wetlands such as dams, reservoirs, rice paddies and wastewater treatment ponds and lagoons (Ramsar, Iran ,1971; RCS,2007; RCS, 2016 , Wali *et al.*, 2018a).In addition, Ramsar convention on wetlands (Article 2.1) also provide that they may integrate riparian and coastal zones nearby to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetland (Ramsar Iran,1971; RCS, 2007, RCS,2016).

Wetland therefore is "an ecosystem that arises when accumulated by water produces soils dominated by anaerobic processes, which in turn, forces the biota, particularly rooted plants, to adapt to flooding" (Keddy, 2010). Wetland ecosystems are among the most important in the world, providing a diverse range of ecosystem services vital to human well-being (Barbier *et al.*, 1997; RCS, 2007). They gave rise to the first modern global nature- conservation convention (Matthews, 1993) and remain the only single group of ecosystems with their own

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

International Convention (Turner *et al.*, 2000; Ramsar, 2010). It has prominent significance not only in maintaining the regional and global ecological balances, but also providing a living environment for wild animals and plants (Yin *et al,* 1988; Laga , *et al.*,2014). On a global scale, wetlands are estimated to cover 5–10% of the earth's terrestrial surface (Mitsch and Gosselink, 2007; RCS, 2007), some 1,280 million hectares, although, it is believed that this is an underestimate (MEA 2005).

Wetland ecosystems are among the most important in the world, providing a diverse range of ecosystem services vital to human well-being (Barbier *et al.,* 1997; RCS, 2007). They gave rise to the first modern global nature- conservation convention (Matthews, 1993) and remain the only single group of ecosystems with their own International Convention (Turner *et al.,* 2000; Ramsar, 2010). It has prominent significance not only in maintaining the regional and global ecological balances, but also providing a living environment for wild animals and plants (Yin et al, 1988; Laga, *et al.*,2014). On a global scale, wetlands are estimated to cover 5–10% of the earth's terrestrial surface (Mitsch and Gosselink, 2007; RCS, 2007), some 1,280 million hectares, although, it is believed that this is an underestimate (MEA 2005).

Wetland ecosystems are part of our natural wealth. At a world wide scale, they provide us with services worth trillions of US dollars every year-entirely free of charge-making a vital contribution to human health and well-being. With the global population set to increase to nine billion by 2050, increasing pressure on water resources and the threats posed by climate change, the need to maximize these benefits has never been greater or more urgent (Ramsar, 2011). Numerous factors contributed to the degradation of natural wetlands in Nigeria especially in the Niger Delta region. The most important among them were land demand by a large population oil explorations and exploitation, a lack of understanding of wetland values, a misguided policy, a lack of environmental laws and regulations, and water diversion needed because of rapid economic growth (Ohimain *et al.*, 2002; Wali *et al.*, 2018a). Scientists and environmentalists have discussed ecosystem services for decades; these services were popularized and their definitions formalized by the *UNITED NATION 2005 MILLENNIUM ECOSYSTEM ASSESSMENT (M.A.),* a four-year intensive study involving more than 1,300 Scientists World- Wide (M.A., 2005). They group ecosystem services into four broad categories. The Millennium Ecosystem Assessment (MA) report (2005), define ecosystem services as benefit people obtain from the ecosystem service and distinguishes four categories of the ecosystem services: they are provisioning service, such as the production of food and water; "product obtained from ecosystem" are sea food and game, crops, wild food and spices, minerals and diatomite, pharmaceuticals, bio-chemicals and industrial products, energy, hydropower, biomass fuels. Regulating service include the control of climate and disease, "benefits obtained from the regulation of ecosystem processes such as carbon sequestration and climate regulation, waste decomposition and detoxification, purification of water and air, crop pollination, pest and disease control; supporting as in nutrient cycles and seed dispersal that are necessary for the production of all other ecosystem services", such as nutrient dispersal and cycling, seed dispersal. Non-material benefits people obtain from ecosystem services are spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences, such as cultural, intellectual and spiritual experiences, including ecotourism and scientific discovery (M.A., 2005).

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

THE STUDY AREA

Nigeria has a littoral line of about 85km towards the Atlantic Ocean lying amid latitude 4°15' to 4°50' and longitude 5°25' to 7°37' with a land mass of about 28000sq/km area within the coastal region. The surface area of the continental shelf is 46300sq/km. The coastal areas consist of freshwater swamp, mangrove swamp, beach ridges, sand bars, lagoons marshes and tidal channels. Nigeria has a total land mass of 923,768sq/km; 918,768sq/km being terrestrial land and 13000 sq/km being aquatic (CIA World Fact Book, Adati, 2012). The coastal area is humid with a mean average temperature of 24-32°C and coastal area has an average annual rainfall ranging between 1,500-4,000m (Kuruk, 2004). Nigeria has two large rivers; the Niger-Benue and the Chad River. There are several rivers that channel into the Atlantic Ocean directly, all other flowing waters flow into the Chad basin or into the lower Niger to the sea eventually (Kuruk, 2004).The Niger Delta is located in the Atlantic coast of Southern Nigeria and is the world's second largest delta with a coastline of about 450km which ends at Imo river entrance (Awosika, 1995). The region is about 20,000sq/km as it is the largest wetland in Africa and among the third largest in the world (Powell, *et al*., 1985; CLO, 2002; Anifowose, 2008; Chinweze and Abiola-Oloke, 2009). 2,370sq/km of the Niger Delta area consists of rivers, creeks, estuaries and stagnant swamps cover approximately 8600sq/km, the Delta mangrove swamp spans about 1900sq/km as the largest mangrove swamp in Africa (Awosika, 1995). The Niger Delta is classified as a tropical rainforest with ecosystems comprising of diverse species of flora and fauna both aquatic and terrestrial species. The region can be classified into four ecological zones; coastal inland zone, freshwater zone, lowland rainforest zone, mangrove swamp zone and this region is considered one of the ten most important wetlands and marine ecosystems in the world (FME, *et al.*, 2006; ANEEJ, 2004). The Niger Delta consist of the following states Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Ondo, Imo and Rivers respectively (Fig.1,2, 3,). As of 1991 from the National Census estimated about 25% of the entire Nigerian population lives within the Niger Delta region (Twumasi and Merem, 2006; Uyigue and Agho, 2007). The Niger Delta region has a steady growing population of approximately 30 million people as of 2005, accounting for more than 23% of Nigeria's total population (Twumasi and Merem, 2006; Uyigue and Agho 2007).

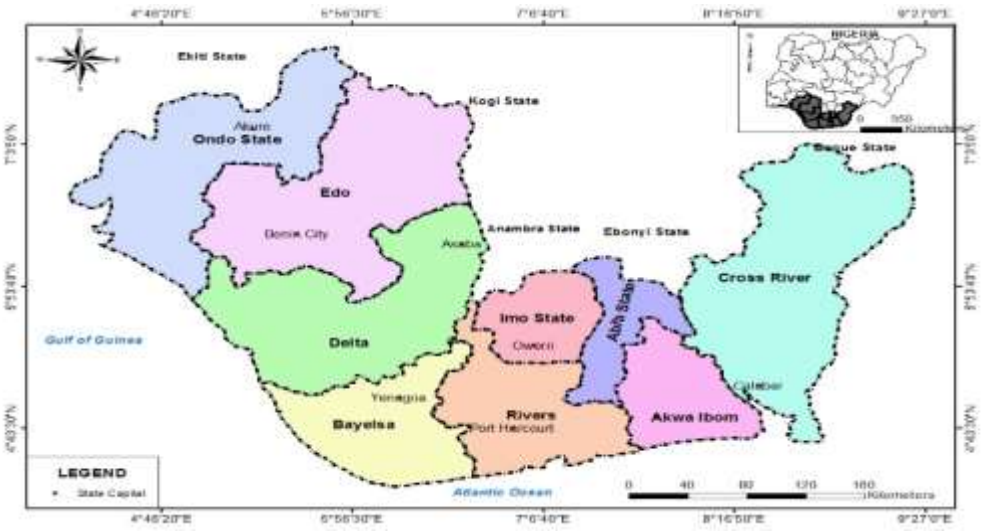

Figure 1: Niger Delta Region Showing Nine State.

***(Source:** Cartography and GIS, Dept. of Geography and Env. Mgt. UNIPORT, 2018).*

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

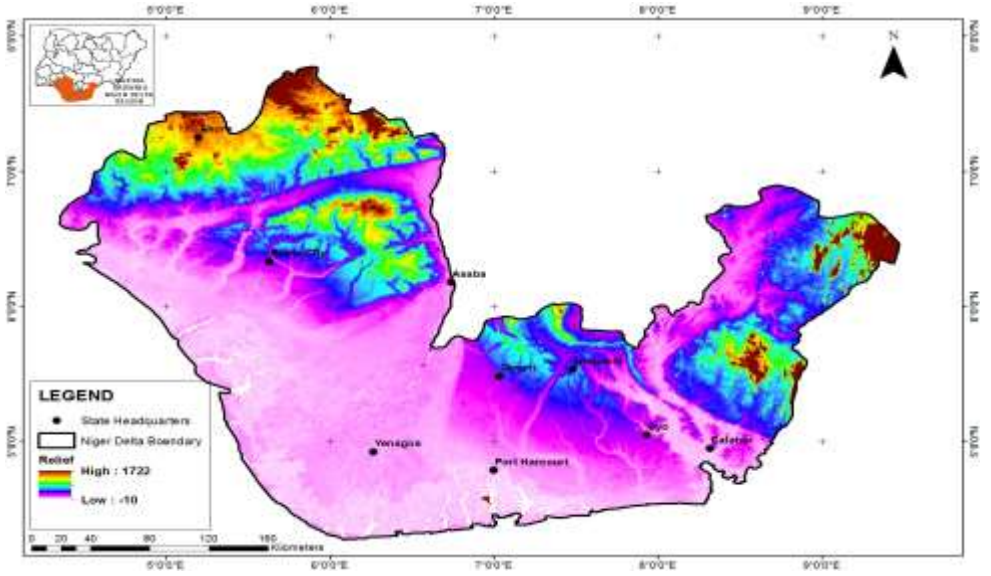

Figure 2: Relief of Niger Delta Region

(***Source:*** *Cartography and GIS, Dept. of Geography and Env. Mgt., UNIPORT, 2018).*

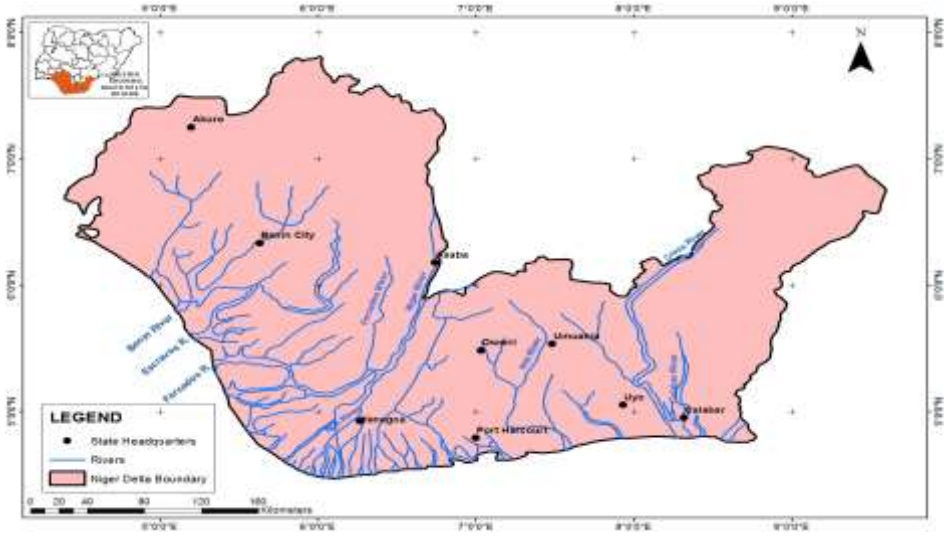

Figure 3: Drainage of Niger Delta Region

(***Source:*** *Cartography and GIS, Dept. of Geography and Env. Mgt., UNIPORT, 2018).*

Nigeria is showcasing an average of 11 Ramsar-listed coastal and freshwater wetlands, which together cover, 1 076 730 ha (Table 1). Of these 11 sites, two are located in the Niger Delta region (Fig.4). The Niger delta Region of Nigeria is a wetland of its own covering about 76,000sq km and has the largest mangrove forest ecosystem in Africa (11,134 sq km) and the third largest in the world (Spalding *et al.*, 1997) with its unique vast floodplain area in southern

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

Nigeria (Ebeku, 2004). It has been noted as one of Africa's most valuable biodiversity hotspots, it provides a living ground for numerous endemic species e.g the Niger Delta red colobus monkey and Slater's guenon (Ebeku 2004; Phil-Eze and Okoro 2009). Within the delta, two regions are Ramsar-listed: Apoi Creek Forests (Bayelsa) and Upper Orashi Forest (Rivers State). The former, which is one of the selected study areas, is 29 213 ha and contains mainly mangrove forests, marshes and freshwater swamps (Ramsar Convention Secretariat 2007; Ayansina , *et al.*, 2015). Given its ecologically valuable flora and fauna, such as the aforementioned Niger Delta red colobus monkey and the vulnerable African dwarf crocodile, and its provision of important breeding and nursery grounds for fish, Upper Orashi Forest Reserved and Apoi Creek Forest fulfils Ramsar Listing Criteria Nos 1, 2 and 7: it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region. It supports vulnerable, endangered, or critically endangered species or threatened ecological communities. It supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity' (Ramsar Convention Secretariat 2007, 2010*a*). ACF contains ecosystems that are common in the Niger Delta, such as marshes, mangroves and freshwater swamps, and thus represents an important reference site for the region. The Delta state own, Olague Forest Reserves (OFR), is to date not Ramsar-listed and very little information is accessible. It encompasses, 32 970 ha, primarily consists of mangroves and was established for a sustainable use of the forest (FAO 1999; IUCN and UNEP-WCMC 2014; Ayansina *et al.*, 2015).

Table 1. Nigeria's 11 Ramsar Site (1,076,728 Hectares)

S/N	Site	Date of Designation	State (s)	Area (ha)	Coordinates
1	Nguru lake (and Marma Channel) complex	02/10/2000	Jigawa & Yobe	58, 100	10^0 22′ N 012^0 46′ E
2	Apoi Creek Forests	30/04/2008	Bayelsa	29, 213	05^0 47′ N 004^0 42′ E
3	Baturiya Wetlands	30/04/2008	Kano	101, 095	12^0 31′ N 010^0 29′ E
4	Dangona Sanctuary Lake	30/04/2008	Yobe	344	12^0 48′ N 010^0 44′ E
5	Foge Islands	30/04/2008	Kebbi & Niger	4, 229	10^0 30′ N 004^0 33′ E
6	Lake Chad Wetland	30/04/2008	Borno	607, 354	13^0 04′ N 013^0 48′ E
7	Lower Kaduna-Middle Niger Floodplain	30/04/2008	Kwara & Niger	229, 054	08^0 51′ N 005^0 45′ E
8	Maladumba Lake	30/04/2008	Bauchi	1, 860	$10^0$24′ N 009^0 51′ E
9	Oguta Lake	30/04/2008	Imo	572	$05^0$42′ N 006^0 47′ E
10	Pandam & Wase Lake	30/04/2008	Nasarawa	19, 742	08^0 42′ N 008^0 58′ E
11	Upper Orashi Forests	30/04/2008	Rivers	25, 165	04^0 53′ N 006^0 30′ E

(Source: Asibor, 2009)

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

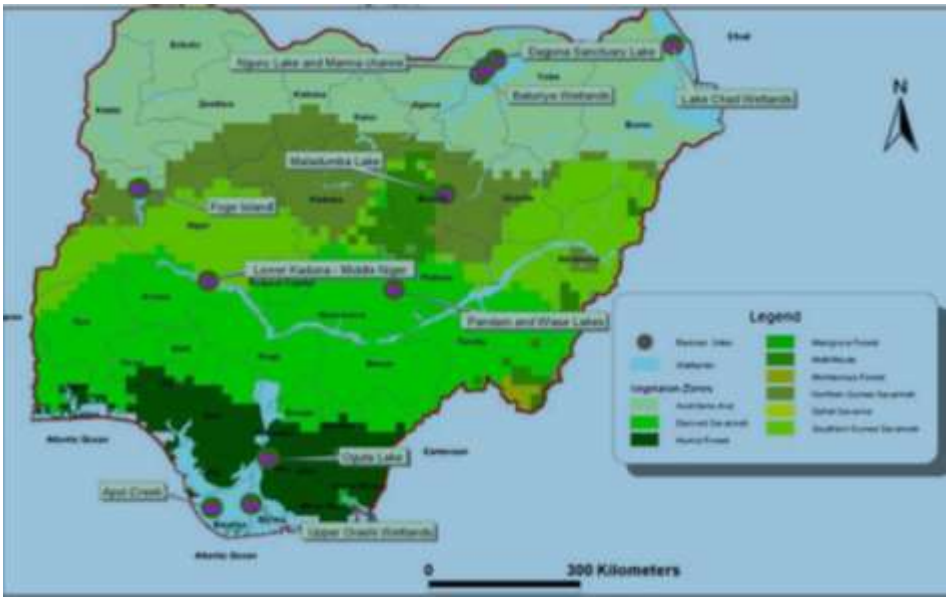

Figure 4: Map of Nigeria showing the 11 Ramsar sites.

(Source: Adekola et al., 2012).

SUSTAINABLE DEVELOPMENT GOALS (SDGs)

In September 2015 the world's governments signed an historic agreement to eradicate poverty, improve the living standards and well-being of all people, promote peace and more inclusive societies and reverse the trend of environmental degradation. The 2030 Agenda for Sustainable Development commits to promoting development in a balanced way economically, socially and environmentally in all countries of the world, leaving no one behind and paying special attention to those people who are poorest or most excluded. It contains 17 Sustainable Development Goals (SDGs) with associated targets to assess progress (UN, 2015d; ILO, 2016b; World Bank group, 2016; UNDP, 2016f).

The 2030 Agenda builds on earlier commitments, more recently the aspirations set out in the Millennium Development Goals (MDGs) and Millennium Declaration. In much of the period leading up to and through the MDGs' target date, and in many parts of the world, progress in several areas that are also reflected in the SDGs has been strong. This is especially the case for income poverty, access to education and health services, and improved sources of clean water. In other areas progress has been steady but less marked, including on gender equality, nutrition and access to sanitation facilities (UNDP, 2016f).

The SDGs are, however, universal, more ambitious and comprehensive. For example, the 2030 Agenda affirms explicitly with a dedicated goal that sustainable development requires building peaceful, just and inclusive societies. The SDGs aim at completing the unfinished business of the MDGs and also include targets on areas that have deteriorated or become more challenging since the turn of the century, including growing income disparities within countries, insecure and low-paid employment, climate change and environmental degradation (UN, 2015d ,ILO, 2016b). While the future is impossible to predict, as the global economic and financial crisis

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

and many disasters in the MDG era acutely illustrate, this report assesses recent trends in six critical areas that are either reflected directly in the SDGs or are so important that they are likely to condition the prospects for achieving all of the goals. These six "mega-trends" relate to poverty and inequalities, demography, environmental degradation and climate change, shocks and crises, development cooperation and financing for development, and technological innovation (World Bank Group, 2016). Positive developments in these areas will radically enhance the prospects for achievements of the entire Agenda. These will be more likely with collaboration and cooperation between countries, in addition to natural competition and innovation in the private sector. Yet it is also possible that negative developments in some (or all) have the potential to derail the SDGs. Because we have no precise knowledge about what may happen, this points to the need for a sophisticated policy response of preparedness, investment and cooperation (UNDP, 2016f).

Of these, the Sustainable Development Goals (SDGs) specifically mention wetlands in relation to six of the goals and climate change in the other goal and its targets , then hence provide a policy context for the implementation of the Ramsar Convention and its new Strategic Plan, through to 2030 (Ramsar handbook, 2016) .

The sustainable use of water and wetlands, by protecting the services they provide, is critical to enable society to achieve sustainable social and economic development, adapt to climate change and improve social cohesion and economic stability. The proposed United Nations Sustainable Development Goals (SDGs) offer a universal agenda that, for the first time, recognizes the need for restoration and management of water-related ecosystems, including wetlands, as a basis for addressing water scarcity and water risks. Wetlands are a solution for several key challenges around the world related to water, food and climate, and key to meeting the SDGs. Most of the proposed SDGs are relevant in some way or another to wetlands, but the following are of particular importance (World wetlands day, 2015; RCS, 2016)

Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Rice grown in wetland paddies is the staple diet of nearly three billion people. The average human consumes 19 kg of fish each year. Most commercial fish breed and raise their young in coastal marshes and estuaries. 70 % of all fresh water extracted globally is used for crop irrigation.

Goal 6: Ensure availability and sustainable management of water and sanitation for all

Wetlands ensure fresh water, help replenish ground aquifers, and purify and filter harmful waste from water – such as fertilizers and pesticides, as well heavy metals and toxins from industry.

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Wetlands act as natural sponges absorbing rainfall, providing protection against coastal and river flooding to (partially) offset the need for man-made infrastructure. They also help reduce drought, protect coastal areas for fisheries nurseries and regulate sediment transport thereby contributing to land formation and coastal zone stability.

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

Goal 13: Take urgent action to combat climate change and its impacts

Wetlands act as carbon sinks. Peatlands alone store more than twice as much as all the world's forests. Coastal wetlands reduce the impact of rising sea levels, acting as storm surge buffers and providing erosion control.

Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Without wetlands, the water cycle, carbon cycle and nutrient cycles would be significantly altered. Water cycles, essentially the continuous movement of water on, above and below the surface of the Earth, are of critical importance to biodiversity and to the functioning of virtually all terrestrial and coastal ecosystems. Coastal wetlands are important for sustaining seas and marine resources, for example as nursery grounds for many marine fisheries.

Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

The values of benefits provided by wetlands, per unit area, have been consistently shown to be orders of magnitude higher than for other ecosystems with the major benefit delivered through improving water security (World wetlands day, 2015; RCS, 2016)

The overarching characteristics of the SDGs are their universality, the desire to include everyone in all countries in building a better life ("no one left behind"), and their focus on linking sustainability with economic growth and development in each of the goals. Building on experiences with the Millennium Development Goals (MDGs), which focused on developing countries, with environmental sustainability as just one of eight goals, the seventeen SDGs are more holistic, ambitious and visionary. The Ramsar Convention on Wetlands is uniquely equipped to respond to the challenge of the SDGs, because from its inception in 1971 it has worked on the conservation and the wise use of wetlands, with the third policy pillar of international cooperation (RCS, 2016). The concepts of conservation on one hand, and wise use on the other, address sustainability as well as the economic growth and development aspects of the SDGs (Ramsar handbook, 2016).

In the 4th Ramsar Strategic Plan 2016-2024, the aim is to be congruent both with the SDGs and with the Aichi Biodiversity Targets (many of which have in turn been incorporated into the SDGs). Unusually for the Ramsar Convention, this Strategic Plan therefore covers 9 years (3 triennia) rather than 6 years (2 triennia), enabling its timing to harmonize with both the SDGs and the Aichi Biodiversity Targets. The 5th Ramsar Strategic Plan will once again be a 6 year plan, covering the years 2025 to 2030, which is the final target date for the SDGs. Also important to note regarding timing, the midpoint review of this new 4th Strategic Plan will fall in 2020, when the Aichi Biodiversity Targets will be revised, to enable a realignment at that point towards the new biodiversity targets which will emerge to 2030(Ramsar handbook, 2016).

The Ramsar Convention on Wetlands will work directly in support of the achievement of all the SDGs, since wetlands contribute towards a very broad range of the aspirations set out in the SDGs. Specifically, the Strategic Plan notes the reference to water and wetlands in the proposals for the Sustainable Development Goals, and also recalls (Resolution XII.2, paragraph 4) the Rio+20 outcome, that water is at the core of sustainable development. This is a key point

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

to note. In SDG 6 which focuses on water and sanitation, for the first time in history the world has a coherent policy framework for water issues, ranging from drinking water supply and sanitation, to integrated water resources management, and the importance of water-related ecosystems. Wetlands are specifically mentioned under target 6.6, and the structure of the goal links wetlands directly with the increasingly urgent questions of water allocation, water risks and water scarcity, while opening the door to the other 16 SDGs (RCS, 2016).

Biodiversity issues arise within Goal 14 on oceans, seas and marine resources, and in Goal 15 on terrestrial ecosystems. Target 14.2 calls for the management and protection of coastal and marine ecosystems, while wetlands are once again specifically mentioned within target 15.1. Thus wetlands have a direct relevance to three of the SDGs, and indirect links to many more. The 4th Ramsar Strategic Plan was finalized just before the SDGs themselves were agreed; however, the broad shape of the SDGs was already visible. Hence the Ramsar Strategic Plan states in paragraph 15: "...all wetlands and the Ramsar Sites network will have a direct relevance for any Sustainable Development Goals which are related to water quality and supply, food and water security, adaptation to climate change, energy supply, healthy living, biodiversity and sustainable use of ecosystems, sustainable human settlements, poverty eradication, innovation and the development of appropriate infrastructure "(Ramsar handbook, 2016).

The implementation of the 4th Ramsar Strategic Plan will therefore support the achievement of many of the Sustainable Development Goals. It will guide the actions and decisions of the Contracting Parties through until 2024, as well as reaching out to all stakeholders involved with wetland conservation and management, including the many new and concerned stakeholders in other sectors. The specific linkage of wetlands with the SDGs raises the profile of the Convention as never before, and will help to develop broad new coalitions of support for wetlands and sustainable development (Ramsar handbook, 2016).

CONCEPT OF WISE USE IN WETLANDS ECOSYSTEMS

Among the many far-sighted concepts contained in the 12 Articles of the Convention was Article 3.1 that required Contracting Parties to 'formulate and implement their planning so as to promote . . . the wise use of wetlands in their territory.' Wise use of wetlands is now defined as the 'maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development' and is the centerpiece of modern efforts to manage wetlands (Finlayson *et al.*, 2011; Gardner and Davidson, 2011; Finlayson, 2012).

The Conceptual Framework developed by the Millennium Ecosystem Assessment (MA) for the maintenance of ecosystem services for human well-being and poverty reduction provides a multi-scalar approach which indicates how and where policy and management interventions and decision-making can be made. Under the MA framework, "wise use" equates to the maintenance of ecosystem benefits/services to ensure long term maintenance of biodiversity as well as human well-being and poverty alleviation.

Following the Conference of the Contracting Parties (COP 9) in 2005, under article 3.1 on the convention, members agree to „formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

in their territory". In much broader perspective, the Ramsar „wise use" concept applies to all wetlands and water resources in a Contracting Party's territory, not only to those sites designated as Wetlands of International Importance. Based on the above, the COP"s recognized the need for greater precision and adopted revised definition of wise use of wetland at the 3rd meeting in Regina, Canada, in 1987. This definition was revised in Resolution IX.1 Annex A (2005) as follows: "Wise use of wetlands is the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development." In this context, sustainable development could be explained as human use of a wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. Essentially, the wise use concept means that the natural productivity and biodiversity at a site can be utilized as long as the basic ecological functioning of the wetland is not disturbed (Hails, 1996). There also exist the „Wise Use Guidelines" emphasizing the importance for Contracting Parties to:

1. Adopt national wetland policies that involves a review of the existing legislation and institutional arrangements to deal with wetland matters either as separate policy instruments or as part of national environmental action plans, national biodiversity strategies, or other national strategic planning;

2. Develop programmes of wetland inventory, monitoring, research, training, education and public awareness; and

3. Take action at wetland sites which involves the development of integrated management plans covering every aspect of the wetlands and their relationships with their catchments.

The Ramsar Convention believes that the Wise Use Guidelines would ultimately emphasize the benefits and values of wetlands in today's environmentally compromised world.

OIL SPILL INCIDENTS A THREAT TO WETLANDS ECOSYSTEM IN THE DELTA REGION

The U.S. Department of Energy estimates that over 4,000 oil spills discharging more than two million barrels of crude have occurred in the Niger Delta environment since 1960. Oil spill cover the region. Blow-outs and leaks affect creeks, streams, ponds, rivers, seas and related traditional sources of livelihood, poisoning the water supply, destroying mangrove forests, eroding soil plots and killing aquatic life. Hundreds of well –sites have flares, which come from burning of associated gas. The flares heat up everything nearby and turn day to night, releasing 25 million tons of Co_2 and 12 million tons of methane yearly. Producing sulphuric acids mists damages wetlands plants, shrubs and forest ecosystem. Flares pollute rain water, because acid rain, that contribute to regional climate change (Tamuno, 2011).

Nigeria has documented oil spill occurrences at different periods along its shoreline. Existing works discloses that oil spillage habitually occurs in the Niger Delta region, despite its flimsy ecosystem and biodiversity. According to Dublin -Green et al., (1998) about 5,334 reported cases of crude oil spillage occurred between 1976 and 1997, with an estimated 2.8 million barrels of oil released into estuaries, inland and coastal waters, land and swamps of Nigeria.

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

The associated impacts of oil spills in mangrove vegetation and coastal waters cannot be overemphasized. Generally, oil spills in Nigeria are not reported, as they are considered "minor" spills. Major spills recorded in the coastal zone are the Texaco Funiwa-5 blowout in 1980 of about 400,000 barrels, GOCON's Escravos spill in 1978 of about 300,000 barrels and SPDC's Forcados Terminal tank failure in 1978 of about 580,000 barrels. Others are those of the Jesse Fire Incident with a loss of about 1,000 people and the Idoho Oil Spill in January 1998, of about 40,000 barrels and the Abudu pipe line in 1982 of about 18,818 barrels. Nigeria's largest spill was an offshore well-blow out in January 1980 when an estimated 200,000 barrels of oil (8.4million US gallons) spilled into the Atlantic Ocean from an oil industry facility, damaging 340 ha of mangrove (Nwilo and Badejo, 2005). Annon (2006) described Nigeria's Niger Delta as one of the world's most severely impacted ecosystem by petroleum, with an estimate of 9 to 13 million barrels of oil spilled in the Niger Delta ecosystem in the past 53 years, 50 times the volume spilled in the Exxon Valdez Oil Spill in Alaska in 1989 (Leschine *et al.,* 1993; Weiner *et al.,* 1997). Others include the Okoma pipeline spillage in 1985, the Bomu 11 blowout in 1970, the Oyakana pipeline spillage of 1980 and the Oshaka pipeline of 1993 Goi Trans Niger pipeline oil spill, 2004, the recent Deep water Horizon oil spill, also referred to as the BP (British Petroleum) oil spill, occurred on April 20, 2010 and is considered the largest marine oil spill in the history of the petroleum industry (Campbell , *et al,* 2010).The enormous spill put the Gulf of Mexico's ecosystem in crisis, releasing an estimated 4.9 million barrels of oil into the Gulf of Mexico, causing a decline in seafood catches, as well as deformities and lesions found in fish (Stuart , 2014).

Between 1976 and 1996 a total of 4,647 incidents resulted in the spill of approximately 2,369,470 barrels of oil into the environment. An estimated 1,820,410.5 barrels (77%) of this quantity was lost to the environment. About 549,060 barrels of oil, representing 23.17% of the total oil spilt into the environment, was recovered. The heaviest recorded spill so far occurred in 1979, 1980 and 2010 with a net volume of 694,117 barrels, 600,511 barrels and 4.9 billion barrels respectively (Department of Petroleum Resources (DPR 1991; Campbell, *et al.,* 2010; Staurt, 2014).

Furthering from our oil spill incident records of oil spill occurrences in Nigeria's upstream petroleum sector, of the two multi-national company Exxon Mobil and Chevron Limited.

Mobil Producing Nigeria Limited was penalized ten million naira by National Oil Spill, Detection and Response Agency for infringement of the provisions of Oil Spill Recovery, Clean Up, Remediation and Damage Assessment Regulations 2011 and for failure to clean up the oil spill incidence that occurred at Qua Iboe Terminal in 2015. In the Bonga oil field coast of the Niger Delta, about 40,000 barrels leaked along the coast of the Niger delta. Shell claims that the escape stopped and eviscerated before getting to the shore. However, National Oil Spill, Detection and Response Agency (NOSDRA) confirmed that the spillage affected the offshore ecosystem. The penalty awarded to Shell was not adequate considering the adverse effects of the spillage on the environment. One would have expected application of stiffer penalties on Shell to serve as a firm deterrence to future infractions (Olujobi *et al.,* 2018).

At the Chevron North Apoi Gas Rig in Southern Ijaw in Bayelsa state; a blowout took place on January 16, 2012. It caused severe gas fire and accidental spillage which continued for over 46 days, causing critical damage to the wetlands ecosystem. The oil spills that have occurred from upstream petroleum operations have remained largely un-remedied due to weak enforcement of environmental laws and regulations (Olujobi, 2017). Evidently, there are recurring questions about the fulfilment of contractual obligations on the issue of effective

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

cleaning up of oil spillages and the restoration of affected localities back to conducive states. Owing to the poor slide record credited to Nigeria's upstream sector, other incidents will perhaps come to the bright and will add to give confidence to the scale and scope of this environmental risk (Olujobi *et al.,* 2018). The Apoi creek is one of the Ramsar site in the Niger Delta region reached with diversity of plant and animal species selected as Ramsar site of international importance that has been designated since 2008 with 29,213 areas of land in hectares has degraded as a result of blowout from Chevron oil spill and gas flare that damage the form of plant and animal species.

Oyegun (2012b;2018) stated in literature between 2006-2012 that oil spill incident in volume associated with five multi-national companies in the region , that combined oil spill amounted to 178,677.592bbls in 5,475events (Table.2)

Table 2. Oil Spill Incidents and Volume (2006-2012).

Company	Number of Spills	Percentage of Occurrences	Volume	Percentage by Volume
SPDC	**2,191**	**40%**	**44,945.25**	**25.1%**
NAOC	**1833**	**33.5%**	**76,902.03**	**43%**
Exxon Mobil	**973**	**17.7%**	**6,889.098**	**3.9%**
Chevron	**442**	**8.1%**	**6,195.49**	**3.5%**
SNEPCO	**3**	**0.1%**	**40,050.144**	**22.4%**
	5,475	**100**	**178,677.592**	**100**

Source: Oyegun (2012b, 2018).

From the incidents table above, Shell Petroleum Development Company (SPDC) ranked the highest incidents of oil spill with 2,191 incidents. This interpreted to 40% of the events but 25.1% by volume to place second after Nigeria Agip Oil Company Limited (NOAC) with 33.5% of the oil spill events but 43% of the total volume of oil spilled .Exxon Mobil hit the incident table with 17.7% of the events and 3.9% of the total volume. Chevron has 8.1% of the occurrences with 3.5% of the volume. Shell Nigeria Exploration and Production Company (SNEPCO), documented only 0.1% of the oil spill events with only 3 number of occurrences but record 22% of the volume of oil spilled to place fifth (Oyegun, 2012b; Oyegun , 2018).

NOSDRA (2013) notified with a recent aid through data acquisition in monitoring of oil spill from January 2013 to September 2014 reveals that there were 1,930 oil spill incidents in the core Niger Delta with a predominantly offshore incidence in wetlands ecosystem of Akwa Ibom State. Oil spills pose one of the greatest environmental challenges globally, constituting harmful effects on both human health and aquatic organisms (Plate.2). Fishing resources can be damaged through physical contamination, bio-accumulation, and damaging of spawning grounds, as well as habitat destruction, depending on the circumstances of the spill and time of response. Many coastal communities are affected (Okonkwo *et al.,* 2015).

Ukoli, (2005) highlighted some major pollutants released from oil industries into the environment as tracks:

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

- Pollutants from petroleum refining activities which includes: Phenol, suspended solids, oil and grease, hydro-carbons and total suspended solids, cyanide and sulphide

- Oil exploration and oil production activities causing changes to the physical and chemical properties of the wetlands such as changes in temperature, turbidity, drilling muds, biological oxygen demand, heavy metals, salinity and pH.

Plate 2. An Aerial View of Oil Spill Environment in the Niger Delta (UNEP PHOTO, 2011).

IMPACT OF OIL SPILL ON WETLAND ECOSYSTEM.

Oil spills mainly impact vegetation and wildlife, such as seabirds. Most of the impacts are due to the physical characteristics of the oil. The adhesive properties lead to reduced mobility and dissolution of natural fats and waxes on body surfaces, feathers etc. (NRC2003; ITOPF ,2011a). Certain aromatic petroleum hydrocarbons may also cause direct toxic impacts due to ingestion or penetration through body surfaces such as gills (Middleditch1984; Jenssen 1996; Heubeck *et al.,* 2003). Many of the toxic as well as non-toxic hydrocarbons evaporate and are degraded by microorganisms quite rapidly (NRC, 2003; ITOPF, 2011b)

However, there may be adverse long-term effects under a particular conditions (Peterson *et al., 2003*). An estimated 2 million tons of oil is released into the environment annually from human and natural processes (NRC, 2003). About half of this comes from natural seepage of oil into the sea and coastal environments from oil deposits on the continental shelf (NRC, 2003).

Once oil has contaminated wetlands such as marshes and mangroves, it is often very difficult to remove without causing further damage to these environments (NOAA 1994, 2002; NRC, 2003; Chan and Baba, 2009). Oil slicks may enter such areas during high tide and as the tide recedes, oil is deposited on the vegetation causing asphyxiation of the plants (Plate. 3). Toxic effects may also occur if the oil is fresh and contain a high amount of light aromatic hydrocarbons. Obviously, if the mangrove vegetation dies, many plants and animals associated with this ecosystem will also suffer due to the keystone character of the mangrove vegetation (Linden, 2013).

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

Plate 3. Crude Oil Spill Deposit on Plant Species. (Ajakaiye, 2008).

During 2009–2011, at the request of the Federal Government of Nigeria, the United Nations Environment Programme (UNEP) carried out a survey on the nature and extent of oil pollution in Ogoni land. The assessment covered contaminated land, ground and surface water, sediments, vegetation, air pollution, public health, industry practices, and institutional issues. The UNEP report has identified over 300 potentially contaminated sites from information provided by NOSDRA, SPDC and satellite imagery. The findings of the assessment will be used for remediation to aid the rehabilitation of Ogoni land to meet international standards. The assessments were made in collaboration with a number of partners in the region including experts from Rivers State University of Science and Technology, Nigerian Government, agencies at national, state, and local government levels, traditional rulers, and various community groups. An additional objective was to determine appropriate remediation measures to rehabilitate contaminated sites to the level of international standards. The full report including the results from all the assessments and the recommendations regarding rehabilitation and remediation was published in 2011 (UNEP, 2011; Adati, 2012). The results presented in this paper were collected as a part of the UNEP assessment and focus on the petroleum hydrocarbon contamination of surface waters, drinking water from wells, sediment, and biota (Linden, 2013).

As part of UNEP's reports and recommendation that the wetlands around Ogoni land are highly degraded and facing disintegration. However, it is still technically feasible to restore effective ecosystem functioning, although this will only be possible if a series of technical and political initiatives are undertaken. In order to demonstrate the Federal Government's resolve for effective action and its sustained interest in this issue, it may be appropriate to declare the intent to designate the wetlands around Ogoni land as a Ramsar site in due course. This would provide the Government with a roadmap for restoration and sustainable management of the wetland. This would also bring the site onto the international spotlight, which will act as a peer pressure to make the agencies focus on the task (UNEP, 2011).

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

CONCLUSSION

This study assesses the ecological condition of human exploration and exploitation on wetlands ecosystem through the induced hydrocarbon constituents on terrestrial and marine environment in the core Niger Delta State. Addressed mostly on scientific reports in this paper, it is unblemished that oil spill incidents has triggered myriad environmental damage and health risks both flora and fauna , as an outcome of the emission of certain gases such as sulphur oxides, nitrogen and carbon-monoxide, with an impact on wetlands vegetation, water, land and weather system. The study has discussed the complexities of spills from oil. It is a well-known fact that oil spills occurred as a result of inadequate servicing and maintenance of the oil and gas facilities, preventer blowout, wellhead, flow lines or pipelines, sabotage, accidental and equipment failures by the oil companies.

The implementation of wise use concept of wetlands ecosystem as an approach, within the context of sustainable development goals as a centerpiece of modern efforts to manage wetlands should be given consideration to all the Conference of the Contracting Parties as stipulated in article 3.1 of COP .9 applies to all wetlands and water resources in all territory of Contracting Party's.

REFERENCES

ADATI .A. K. (2012): Oil Exploration and Spillage in the Niger Delta of Nigeria. Civil and Environmental Research www.iiste.org ISSN 2222-1719 (Paper) ISSN 2222-2863 (Online), 2 (3): 23 - 29

ADEKOLA O, WHANDA S, and OGWU F. (2012).Assessment of Policies and Legislation that affect management of wetlands in Nigeria. Wetlands 32: 665–677.

AJAKAIYE, B.A. (2008):"Combating Oil Spill in Nigeria: Primary role and responsibility of the National Oil Spill Detection and Response Agency (NOSDRA)" Stakeholders' Consultative Workshop. August 4 – 6, 2008, Calabar, Nigeria.

ANA, G.R., M.K.C. SRIDHAR, AND E.A. BAMGBOYE. (2009): Environmental risk factors and health outcomes in selected communities of the Niger delta area, Nigeria. Perspectives in Public Health 129: 183–191.

AND D.B. IRONS. (2003): Long-term ecosystem response to the Exxon Valdez oil spill. Science 302: 2082–2086.

ANEEJ (2004): Oil of Poverty in the Niger Delta. A publication of the African Network for Environment and Economic Justice.

ANIFOWOSE, B (2008): Assessing the Impact of Oil & Gas Transport on Nigeria's Environment. U21 Postgraduate Research Conference Proceedings 1, University of Birmingham UK.

ANNON (2006): Niger Delta *Natural Resource Damage Assessment and Restoration* Project. Phase 1– Scoping Report. Federal Ministry of Environment, Abuja Nigeria Conservation Foundation, Lagos.

AWOSIKA, L. F. (1995): "The West African Coastal Zones: a regional approach to the process of integrated coastal zone management". In Beukenkamp, P. et al. (eds) "*World coast conference proceedings". Coastal zone management center, The Hague, vol. 2, 697-704.*

AYANSINA AYANLADE and ULRIKE PROSKE (2015): Assessing Wetland degradation and loss of ecosystem services in the Niger Delta, Nigeria. CSIRO publishing, marine & fresh water resources http://dx.doi.ogr/10.1071/MF15066.

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

BARBIER, E. B. Acreman, M. and Knowler. D. (1997): *Economic Valuation of Wetlands: a guide for policy makers and Planners.* Gland (Switzerlands): Ramsar Convention Bureau.

CAMPBELL R. & CLIFFORD K. (2010): Gulf Spill is the Largest of its kind, Scientists Say, N.Y.Times. Aug. 2, 2010, at http://www.nytimes.com/2010/08/03/us/03spill.html?_r=0 Nat'l Comm'n Report, supra note 3, at vii, 56, 62, 67-68, 132-39.

CHAN, H.T., AND S. BABA. (2009): Manual on guidelines for rehabilitation of coastal forests damaged by natural hazards in the Asia-Pacific region. ISME & ITTO

CHINWEZE, C. AND ABIOL-OLOKE, G (2009): Women Issues, Poverty and Social Challenges of Climate Changes in the Nigerian Niger Delta Context. 7th International Conference on the Human Dimension of Global Environmental Changes, UN Campus, Bonne, Germany.

CIA, CENTRAL INTELLIGENCE AGENCY (2005): Accessed August 10 2010 the World Fact Book-Nigeria.htm

CLO, CIVIL LIBERTIES ORGANIZATION (2002): Blood Trail: Repression and Resistance in the Niger Delta, Ikeja. Country Analysis Brief http:/www.eia.doe.gov/cab/index.html.pds

DUBLIN-GREEN, CO, NWANKWO, JN, IRECHUKWU, D.O (1998): Effective regulation and Management of the issues in the petroleum industry in Nigeria. Paper presented at: SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production; 1998 Jun 7–10; Caracas, Venezuela.

EBEKU, K. S. A. (2004): Biodiversity conservation in Nigeria: an appraisal of the legal regime in relation to the Niger Delta area of the country. *Journal of Environmental Law* **16**, 361–375.

FAO (1999): Forest Resource Situation Assessment of Nigeria. Available at: www.fao.org/3/a-ab578e.pdf [accessed March 2010].

FINLAYSON C.M (2012): Forty years of wetland conservation and wise use. AquatConserv Mar FreshwatEcosyst. 2012; 22:139–43.

FINLAYSON CM, DAVIDSON N, PRITCHARD D, MILTON GR, MACKAY H. (2011): The Ramsar Convention and ecosystem-based approaches to the wise use and sustainable development of wetlands. Journal of International Wildlife Law and Policy 14: 176–198.

FME (2006): FEDERAL MINISTRY OF ENVIRONMENT Abuja, Nigerian Conservation

Foundation Lagos, WWF UK and CEESP-IUCN Commission on Environmental, Economic, and Social Policy, May 31, (2006). Niger Delta Resource Damage Assessment and Restoration Project.

GARDNER RC, DAVIDSON NC. (2011): The Ramsar Convention. In Wetlands: Integrating Multidisciplinary Concepts, Le Page BA (ed). Springer: Dordrecht; 189–203.

HAILS, A.J. (1996): *Wetlands, Biodiversity, and the Ramsar Convention*; Ramsar Convention Bureau: Gland, Switzerland, 1996.

HEUBECK, M., K.C.J. CAMPHUYSEN, R. BAO, D. HUMPLE, A. SANDOVAL REY, B. CADIOU, AND S. BRA¨GER.(2003) : Assessing the impact of major oil spills on seabird populations. Marine Pollution Bulletin 46: 900–902.

INTERNATIONAL LABOUR OFFICE, ILO (2016b): *World Employment Social Outlook: Trends 2016*. Geneva.

ITOPF. (2011a): Effects of oil pollution on the marine environment. International Tankers Owners Pollution Federation (ITOPF).

IUCN AND UNEP-WCMC (2014): The World Database on Protected Areas (WDPA). Cambridge, UK. Available at: www.protectedplanet.net [accessed August 2017].

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

JENSSEN, B.M. (1996): An overview of exposure to, and effects of, petroleum oil and organochlorine pollution in grey seals (Halichoerus grypus). Science of the Total Environment 186: 109–118.

KEDDY, PAUL A. (2010): *Wetland Ecosystem: principles and conservation (2nd ed.).* New York: Cambridge University Press. P.497

KURUK, P (2004): Customary Water Laws and Practices: Nigeria. http:/www.fao.org/legal/advserv/FOA/UCNCS.Nigeria.pdf

LAGA TONG, XIN LIANG XU, YING FU and SHUANG LI (2014): Wetland Changes and Their Responses to Climate in "Three –River Headwaters Region of China Since the 1990's. Energies 2014, 7, 2515-2534; doi: 10.3390/en7042515.www.mdpi.com/journal/energies

LESCHINE TM, MCGEE J, GAUNT R (1993): Federal on-scene Coordinator's report T/V Exxon Valdez Oil Spill, vol. I. Department of Transportation, Springfield, Virginia.

LINDEN .O; JONAS. P. (2013): Oil Contamination in Ogoniland, Niger Delta. Royal Swedish Academy of Sciences 2013 www.kva.se/en AMBIO 2013, 42:685–701 Springer

MIDDLEDITCH, B.S. (1984): Ecological effects of produced water effluents from offshore oil and gas production platforms. Ocean management 9: 191–316.

MILLENNIUM ECOSYSTEM ASSESSMENT (M.E.A) (2005): Ecosystem and human well-being: Synthesis. Washington (DC): Island Press.

MITSCH, W. J. and GOSSELINK, J. G. (2007): Wetlands. 4th ed. Hand book (N.J): Wiley

MOFFAT, D., AND LINDEN, O. (1995): Perception and reality: assessing priority for sustainable development in the Niger Delta. *Ambio* 24, 537–538.

MMOM, P.C., AND S.B. AROKOYU. (2010): Mangrove forest depletion, biodiversity loss and Traditional resources management practices in the Niger Delta, Nigeria. Research Journal of Applied Sciences, Engineering and Technology 2: 28–34.

NOAA. (1994): Recovery of mangrove habitats at the Vesta Bella spill site. Hazmat Report, 1–37. National Oceanic and Atmospheric Administration (NOAA).

NOAA. (2002): Oil spills in mangroves: Planning and response considerations. Report, 1–72. National Oceanic and Atmospheric Administration (NOAA). http://archive.orr.noaa.gov/ book_shelf/34_mangrove_complete.pdf.

NOSDRA: National Oil Spill Detection and Response Agency (2013)

NRC. (2003): Oil in the sea III: Inputs, fates, and effects. Washington, DC: National Academy Press.

NWILO, C.P. AND BADEJO, T.O (2005): Oil Spill Problems and Management in the Niger Delta. International Oil Spill Conference, Miami, Florida, USA.

OHIMAIN, E.L., IMOOBE, T.O.T AND BENKA-COKER (2002): Impact of dredging on zooplankton communities of Warri Rivers, Niger –Delta. African Journal of Environmental Pollution and Health. 1:37-45.

OKONKWO C.N.P, KUMAR.L, TYLOR S. (2015): The Niger Delta Wetlands Ecosystems: What threatens it and why should we protect it. African Journal of environmental Science and Technology .Vol.9 (5) pp 451-463, may, 2015.Doi .10.5897/AJEST,2014:1841.

OLUJOBI, J.O, OYEWUNMI, O.A, OYEWUNMI, A.E. (2018): Oil Spillage in Nigeria's Upstream Petroleum Sector: Beyond the Legal Frameworks. International Journal of Energy Economics and Policy, 2018, 8 (1), 220-226 IJEEP. http: www.ecojournals.com

OLUJOBI, O.J. (2017): Legal framework for combating corruption in Nigeria: The upstream petroleum sector in perspective. Journal of Advanced Research in Law and Economics, 8(23), 59-68.

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

OYEGUN, C.U. (2012b): Petroleum Development and the Niger Delta Environment .Paper Presented at the University of Port Harcourt Book and Research Fair. April 2012.

OYEGUN, C.U. (2018): Hydrocarbon Pollution and Oil Spill Contingency Management in the Niger Delta in Elenwo E.I. and Ogeche F.U (ed), Environment, Resources and Sustainability in the Niger Delta Region, Nigeria.

PETERSON, C.H., S.D. RICE, J.W. SHORT, D. ESLER, J.L. BODKIN, B.E. BALLACHEY,

PHIL-EZE, P. O., and OKORO, I. C. (2009): Sustainable biodiversity conservation in the Niger Delta: a practical approach to conservation site selection. *Biodiversity and Conservation* 18, 1247–1257. Doi: 10.1007/ S10531-008-9451-Z

POWELL, C.B., WHITE, S.A., IBIEBELE, D.O., BARA, M., DUT KWICZ, B., ISOUN, M. AND OTEOGBU, F.U. OSHIKA (1995): Oil Spill Environmental Impact; effect on Aquatic biology. Paper presented at NNPC/FMHE International Seminar on petroleum industry and the Nigerian Environment 11 – 13 Nov. 1985, Kaduna, Nigeria, 1985:168 – 178.

RAMSAR CONVENTION (2010): Accessible at http://www.ransar.org/cda/ransar/20/04/2011.

RAMSAR CONVENTION SECRETARIAT (2007): *Wise use of Wetlands: A conceptual framework for the Wise use of wetlands.* Ramsar handbooks for the wise use of wetlands. 3rd ed. Gland (Switzerland): RCS.

RAMSAR CONVENTION SECRETARIAT RCS (2016): An introduction to the convention on wetlands, RCS, Gland, Switzerland.

RAMSAR HANDBOOKS (2016): The fourth Ramsar strategic plan 2016-2024. 5th Edition. SER/IUCN (2006): Ecological restoration – A means of conserving Biodiversity and sustaining.

RAMSAR IRAN (1971): The Ramsar Convention Manual: a guide to the Convention on Wetlands (Ramsar, Iran, 1971), 6th edn. Ramsar Convention Secretariat, Gland, p 112.

SPALDING, M., BLASCO, F. and FIELD, C. (1997): *World Mangrove Ecosystem Atlas.* The International Society for Mangrove Ecosystem (ISME). Japan.

TAMUNO, T.N. (2011): Oil Wars in the Niger Delta 1849-2009. Stirling –Horden Publishers Ltd.

TUNNER, R. K., VAN DEN BERGH, J. C. J. M., SODERZVIST, T., BARENDREGT A., VAN DER STAATEN J., MALTBY, E., VAN LER LAND, E. C. (2000): "Ecological – Economic analysis of Wetlands: Scientific integration for Management and Policy". *Ecol Econ. 35:7-23.*

TWUMASI, Y. AND MEREM. E. (2006): GIS and Remote Sensing Applications in the Assessment of Change within a Coastal Environment in the Niger Delta Region of Nigeria. International Journal of Environmental Research & Public Health, 3:1, 98-106. www.ijerph.org

UKOLI, M.K. (2005): Environmental Factors in the Management of the Oil and Gas Industry in Nigeria. www.cenbank.org

UNEP. (2011): Environmental assessment of Ogoni land, 1–262. United National Environmental Programme (UNEP): Nairobi.

UNITED NATION DEVELOPMENT PROGRAMME (2016f): *UNDP Support to the Implementation of Sustainable Development Goal 15: Protect, Restore and Promote Sustainable Use of Terrestrial Ecosystems* .Available on www.undp.org/content/dam/undp/library/Sustainable%20Development/15_Terrestrial%20_Jan15_digital.pdf. Accessed 1 February 2017.

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)

UNITED NATION, UN (2015d): Transforming Our World: The 2030 Agenda for Sustainable Development (A/RES/70/1). New York.

UYIGUE, E. AND AGHO, M. (2007): Coping with Climate Change and Environmental Degradation in the Niger Delta of Southern Nigeria, Community Research and Development Centre (CREDC) Nigeria.

WALI E., PHIL-EZE P.O, and NWANKWOALA H.O (2018a): Saltwater- Freshwater wetland ecosystem and urban land use change in Port Harcourt metropolis, Nigeria. Earth Sciences Malaysia, 2 (1) 01-07, DOI: http://doi.org/10.26480/esmy/.01.2018.01.07

WEINER A., BERG C., GERLACH T., GRUNBLATT .J. HOLBROOCK K, and KUWANDA .M, (1997): "The Exxon Valdez Oil Spill Vol.1. Department of Transportation, Springfield, Virginia Valdez Oil Spill: Habitat protection as a restoration Strategy. Rest Ecol 5 (1): 44-55.

WORLD BANK GROUP (2016): *Global Monitoring Report 2015/2016: Development Goals in an Era of Demographic Change*. Washington, DC: World Bank Group and International Monetary Fund.

WORLD WETLANDS DAY (2015): Wetlands and Sustainable Development. Wetlands for Our Future: 2015, Time for Global Action for People and Planet.

YIN, K.Q.; NI, J.R. (1998) Review of wetland studies. *Acta Ecol. Sin.* 1998, *18*, 539–546.

Print ISSN: 2056-7537(print), Online ISSN: 2056-7545(online)