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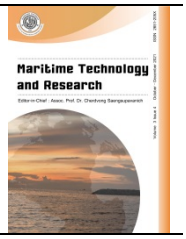

Research Article

Developing marine and coastal resources in Nigeria: Prospects and challenges

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Abstract

Nigeria, with a coastline of about 853 km bordering the Atlantic Ocean in the area of the Gulf of Guinea, has a maritime area of about 46,000 km^2, with significant and diverse natural marine resources. The country has numerous economic activities, in which the highest percentage depends on or is derived from the ocean resources, but it is explicitly clear that her blue economy potentials are far from being fully harnessed. The Nigerian maritime domain is rich with a variety of resources that support livelihoods and economic development. These include established activities like fisheries, shipping, offshore oil and gas, maritime and coastal tourism, marine manufacturing and construction, dredging, etc., and emerging activities such as marine aquaculture, deep and ultra-deepwater oil and gas, offshore wind energy, ocean renewable energy, marine and seabed mining, etc. The main purpose of this paper was to qualitatively investigate the prospects and challenges in developing marine resources in Nigeria and to suggest necessary recommendations. Existing literatures and documents from secondary sources were reviewed. The paper revealed that the challenges in harnessing marine resources in Nigeria are an inadequate scientific data bank, inconsistent government policy, climate change, and inadequate manpower. This paper recommends that the government need to enhance targeted capacity building, particularly at the policy, institutional, legal, and technical levels, for developing coastal states. This may result in effective exploration and mining, which may lead to sustainable marine resources.

1. Introduction

The ocean is one of Earth's most valuable natural resources. It provides food in the form of fish and shellfish, with about 200 billion pounds caught each year (Akpabio & Ekanem, 2008). It is used for the transportation of both passengers and luggage shipping. Also, the ocean provides a treasured source of recreation for humans. Minerals (salt, sand, and gravel, and some manganese, copper, nickel, iron, and cobalt found in the deep sea) and crude oil are mined from ocean.

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The ocean plays a critical role in removing carbon from the atmosphere and in providing oxygen (Folami, 2017). It regulates Earth's climate. In recent years, the ocean has become an increasingly important source of biomedical organisms, with enormous potential for fighting diseases (Etim, 2010). The ocean is critical to life on earth. Therefore, there is a need to understand proper management and conservation measures of the ocean for a healthy future generation (Flora, 2007).

The Nigerian coastline is about 900 km in length, with a total shelf area of about 42,000 km^2 (UNEP, 2014). However, Nigeria's maritime space could be broadly classified into territorial sea and the Exclusive Economic Zone (EEZ). The territorial sea extends from the coastline to a breadth of 12 nautical miles, in which sovereignty covers the air space as well as its underlying seabed and subsoil. The map below shows the territorial sea and the EEZ of Nigeria.

The EEZ is the zone beyond and adjacent to the territorial sea, extending to 200 nautical miles. A coastal state has sovereign rights to explore and exploit, conserve and manage the natural resources of the waters superjacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone (Abubakar, 2019).

The marine environment is an integral part of the natural and cultural heritage of the world, with its vital diversity of marine and estuarine animals, plants, and communities, which are critical components of self-sustaining systems of local, national, regional, and international significance (Folami, 2017). The marine environment comprises of many activities, which are largely grouped into environment, development, security, and transportation, as shown in **Figure 1** below.

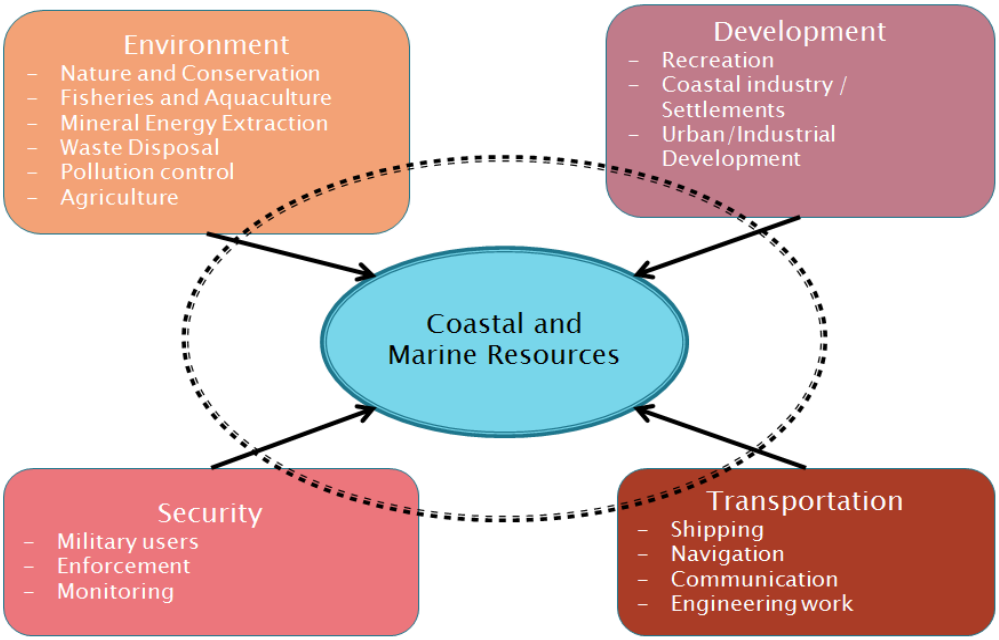

Figure 1 Various activities in marine environment (adapted from Boateng, 2006).

1.1 Objectives of the study

The general objective of this paper was to discuss qualitatively the prospects and challenges of developing marine resources in Nigeria, looking at all of the integrated factors. However, the specific objectives include, among others, to:

1) Identify the different marine and coastal resources in Nigeria;
2) Review the challenges facing the development of marine and coastal resources in Nigeria;

3) To proffer solutions to challenges facing the development of marine and coastal resources in Nigeria;

4) To make necessary recommendations for the development of marine and coastal resources in Nigeria.

1.2 Literature review

All countries have a 12-mile "territorial sea" around their coast, in which their own laws apply, and a 200-nautrical-mile "Exclusive Economic Zone" (EEZ), in which the nation owns all the economically valuable resources (e.g., fish, oil), and can enforce pollution laws, but otherwise have no special rights. As noted by Folami (2017) and Ayoade (2002), the extant national laws of Nigeria reflect the Geneva Convention on the Law of the Sea (1958) through 3 major enabling statutes: the Petroleum Act, defining the Continental Shelf, the Territorial Water Act, and the EEZ Act.

Abubakar (2019) noted that the hallmarks of blue economy would not only establish pathways for the diversification of the Nigerian economy, as widely anticipated, but could, as well, help in addressing many socio-economic challenges in the country. He stated that achieving these, however, is contingent upon the establishment of and a commitment to a comprehensive legal and institutional framework, as well as the use of important enablers for sustainability like ecosystem-based management, Marine Spatial Planning, and innovative financing mechanisms.

Folami (2017) ascertained the inadequacy of the international conventions to give clear directives on maritime institutional frameworks. Also, the lack of cohesive and well-coordinated Integrated Ocean Governance policies threatens the sustainability of the Marine Ecosystem and Environment. Hence, it is therefore imperative to devise coherent and coordinated Integrated Ocean Governance policies that would be robust and practicable in order to harness the potentials of the industry to optimum capacity.

Oladele et al. (2018), in their paper titled "Potentials of Coastal and Marine Tourism in Nigeria", found that the identification of aquatic resources in Nigeria and their sustainable utilization for tourism will offer the country several benefits of diversified economy capable of withstanding the instability of an oil-based monoeconomy. They concluded that some of the prospects of coastal and marine tourism that Nigeria can tap include revenue generation, job creation, and resource conservation, among others.

2. Materials and methods

Nigeria, located on latitude 9.0820° N and longitude 8.6753° E, is a country in West Africa along the Atlantic Ocean's Gulf of Guinea. Located at the extreme inner corner of the Gulf of Guinea on the west coast of Africa, Nigeria occupies an area of 923,768 sq. km (356,669 sq mi), extending 1,127 km (700 mi) E-W and 1,046 km (650 mi) N-S (Folami, 2017). Its land borders are with Benin to the west, Cameroon and Chad to the east, and Niger to the north. With a population of about 203,452,505 people, Nigeria is the most populous country in Africa, and the 7th in the world. It has a maritime area of 46,500 km^2 and an exclusive economic zone of 210,900 km^2 (Folami, 2017). **Figure 2** is the map of Nigeria showing her maritime space.

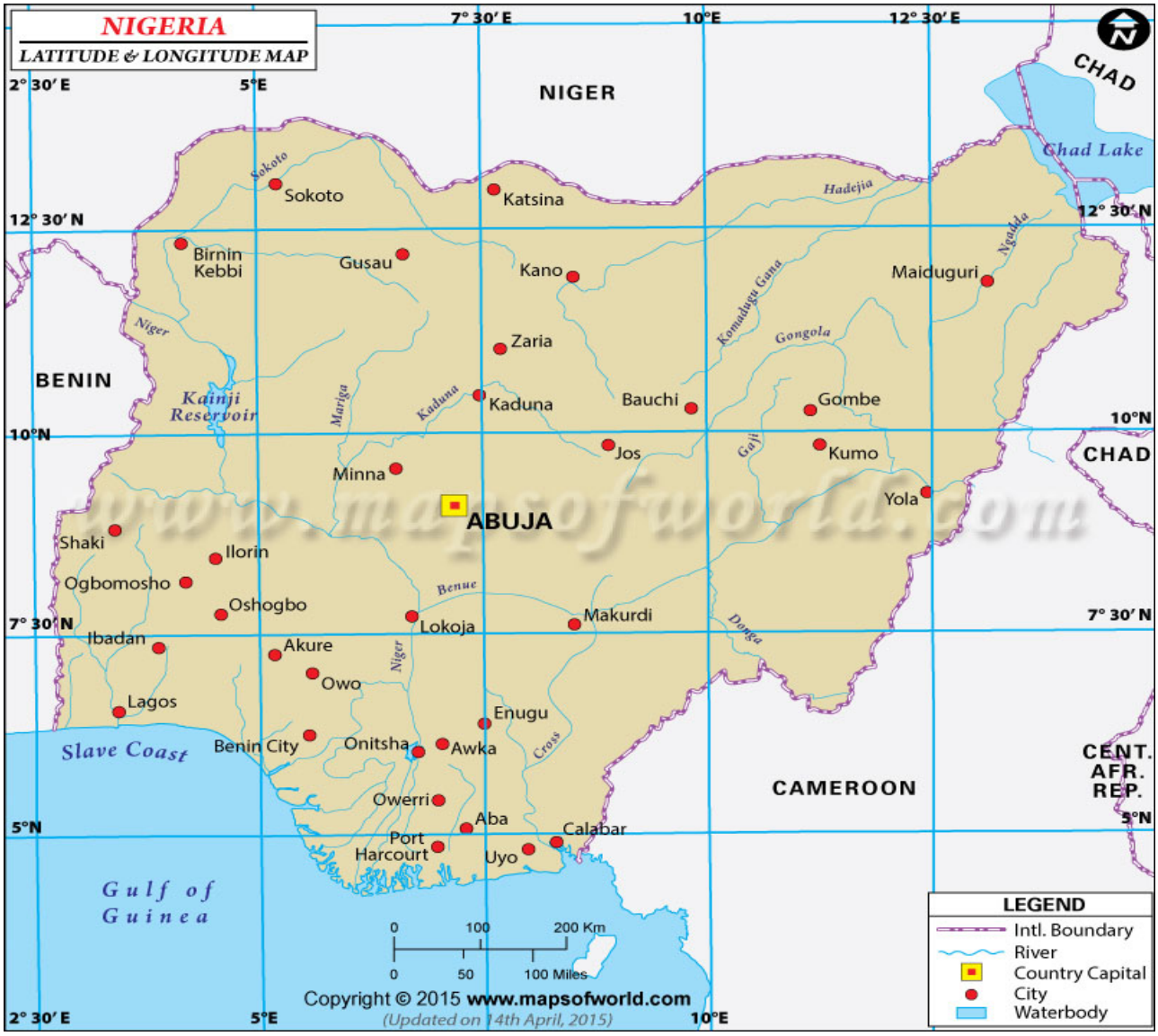

Figure 2 Map of Nigeria showing the coastal area. Source: Etim (2010).

The method used in this study is a qualitative one, specifically, the documentary method. In documentary studies, therefore, information is gathered in the form of words, pictures, descriptions, narratives, and numerals from secondary sources such as documentary studies of official documents, library materials, the internet (websites), etc. In other words, the documentary method is a secondary source of data, or an indirect method of collecting data. These sources include existing literatures and various publications of the Nigerian Maritime Administration and Safety Agency (NIMASA), Nigerian Port Authority (NPA) publications, particularly NPA annual reports and handbooks, and the Nigeria Bureau of Statistics (NBS). The internet review involved a thorough desktop search using the Google Scholar search engine, using the key searching phrases ocean resources, description of Nigerian maritime domain, and challenges facing marine resources in Nigeria. The search began with a global perspective regarding ocean resources, then focused on coastal and marine resources publications. In all, 40 literature sources were reviewed for this study, out of which 12 had a global perspective, while 18 were appropriate for the situation in Nigeria. All literature sources referred to were acknowledged and appropriately cited.

3. Results and discussion

In order to objectively evaluate, appraise, and discuss the development of marine resources in Nigeria, I divide this section into 3 parts. In part one, I discuss the abundance of the various marine and coastal resources available in Nigeria. In part 2, I evaluate or appraise the challenges facing the development of marine resources in Nigeria. In part 3, I examine and proffer solutions to challenges facing the development of marine resources in Nigeria.

3.1 Marine and coastal resources in Nigeria

The marine and coastal resources available in the Nigerian territorial sea and EEZ are summarized in **Figure 1**, above. The 7 types of coastal and marine resources below are the most common resources in Nigeria because they are the most important and will generate more revenue for the Nigerian government.

3.1.1 Fisheries

Fisheries production, especially marine, is important for the socio-economic development of Nigerians and for its contribution to the nation's economic growth through the Gross Domestic Product (GDP) (Etim, 2010). Nigeria is enriched with marine fisheries resources that could enhance its production. However, fish supply from domestic production is far below the fish demand of her citizens (Etim, 2010). It is noted that fishery is an important economic sector in terms of employment, food security, enterprise development, and foreign exchange earnings, and is also important in terms of the livelihoods of many rural people and nutrition (Etim, 2010). Within the EEZ, Nigeria has exclusive rights to the exploration and exploitation of fishes and other natural resources. According to Etim (2010), 9 of the 36 federal states in Nigeria have a coastline with the Atlantic Ocean.

Artisanal fishing is supported in the brackish and coastal waters of Nigeria. Industrial fishing can only be operated outside the 5 nautical miles restriction of the 1992 Sea Fisheries Act (Folami, 2017). At the marine artisanal level, fisheries resources include fish belonging to the Sciaenid community, including croakers and bonga, shad, catfish, sardines, soles, shiny-nose, and Polydactylus spp. (polynemidae), as well as members of the Sphyraenidae, Lutjanidae, Elopidae, Serranidae, and Carangidae families. Sharks, sail/saw fishes, penaeids, palaemonids, and carid shrimps are also caught by small-scale fishermen. Nigerian industrial coastal fishing activities consist of trawling for demersal finfish, shell fish, and penaeid shrimps. There are about 104 marine fish species, belonging to 50 families, in Nigeria (Essien-Ibok and Umoh 2013). According to Essien-Ibok and Umoh (2013), the species composition is dominated by croakers (Pseudotolithus spp.), grunts (Brachydeuterus spp.), various soles, catfish (Arius spp.), and shrimps (Penaeus spp.)

Ekpo (2012b) ascertained that fish supply to meet increasing fish demand by Nigerians is from 2 major groups, which are the domestic production of fish and the importation of fish. Importation has served as a major supply of fish in Nigeria, providing more than half (56.0 %) of the fish supply in 2010 (Ekpo, 2012b). Fish importation refers to the supply of fish to Nigeria from foreign countries in order to augment the locally produced fish in the country. According to Olalekan and Wahab (2018), Nigeria spent over ₦125 billion per annum on the importation of 1.90 million metric ton of fish in 2015. According to Ekpo (2012b), Nigerian fish importation increases every year, in spite of all the endowed marine resources, rivers, lakes, and creeks of the nation. Based on the study of Ipinmoroti (2012) on the analysis of major food imports obtained from the National Bureau of Statistics, fish as a major food commodity had the highest import bills in the period 2006 - 2010, with an annual average of ₦113.63 billion. The relevant figures indicated that the value of fish imports has been increasing, and this could be attributed to the growth rate of the Nigerian population, while domestic fish production is decreasing. According to the 2018 Food and Agriculture Organization (FOA) report, annual fish demand is estimated at 3.32 million metric

tonnes- an unsurprisingly high number considering Nigeria's teeming population of about 186 million people- but domestic production produces only about 1.12 million metric tonnes. This leaves a deficit of 2.2 million metric tonnes, which is largely supplied through fish importation, costing about 700 million USD annually. This makes Nigeria the fourth largest importer of fish in the world, following China, Japan, and the United States. **Figure 3** shows the demand gap for fish in Nigeria.

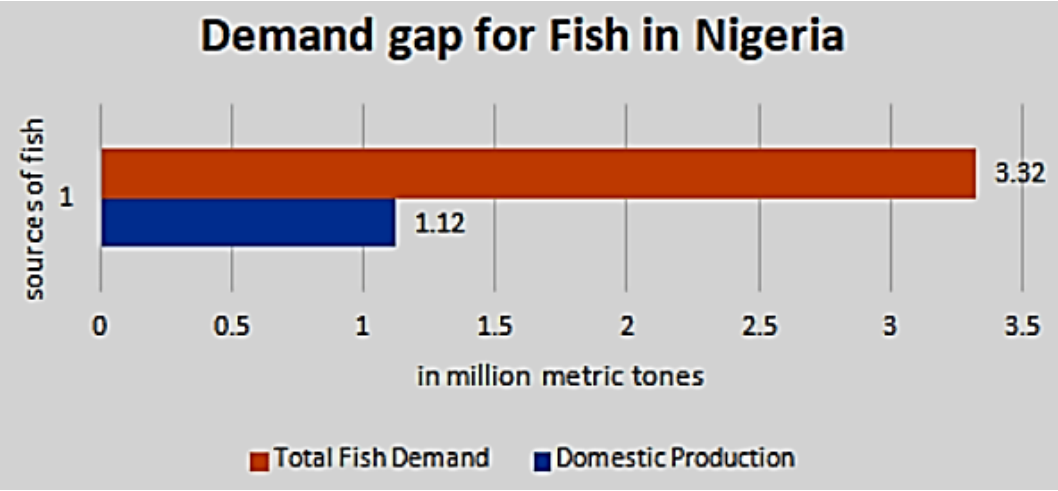

Figure 3 Demand gap for fish in Nigeria. Source: Food and Agriculture Organization (FOA), 2018

3.1.2 Oceanic energy

Like hydroelectric and geothermal power, the ocean is a potential source of renewable electric energy. The ocean's energy may be harnessed from tides, winds, waves, or even the temperature difference between the mixed layer and the deep ocean (Meiner, 2011).

In some places in the world, for example, Barrage de la Rance, France, tides are already being used to generate electrical power (Meiner, 2011). In some places (such as Denmark), offshore "wind farms" are already generating power (Meiner, 2011). There are great possibilities for the development and existence of offshore wind farms and wave power and Ocean Thermal Energy Conversion (OTEC) in Nigeria within the near future. Nigeria, with a population of over 180 million people, generates less than 6,000 megawatts of electricity, mostly from gas turbines. With a large maritime domain, Nigeria can generate many more megawatts of electricity from tides, winds, and waves from the ocean.

3.1.3 Shipping

In the Nigerian maritime sector, shipping is an indispensable component of the important drivers of the economy (Usoro, 2008). The Nigerian economy is import-oriented but is also the biggest oil exporter in Africa. A high percentage of Nigeria's international cargo trade is facilitated by sea carriage. Nigeria trades about 180 million tons of sea borne cargo per annum. Annual freight paid is about $6.8 billion (#1,088bn). More than 80 % of this is earned by foreign firms (Usoro, 2008). There is a big opportunity for Nigerians to own vessels.

Oil remains the mainstay of the Nigerian economy, contributing about 55 % to the GDP, 95 % of export earnings, and about 70 % of governmental revenue (Ekpo, 2012a). Since a preponderant proportion of Nigeria's oil is produced in shallow or deep waters, accessing and maintaining a presence in these areas is facilitated by marine craft, such as supply boats, tug boats, and barges. These craft are leased on a continuous basis to the oil and gas industry. The total value

of freight paid on oil exports amounts to more than $84 million annually, none of which comes to Nigeria, as Nigerians do not own any Very Large Crude Carriers (VLCCs) carrying Nigerian crude oil (Ekpo, 2012). The only legitimate claims of Nigerians are as commission agents.

Nigeria, being a major oil and gas producing and trading nation, can assure investors in the tanker trade of the full employment of their vessel on a sustainable basis, especially for the affreightment of national cargos. These investments will create robust trade for gas carrier operators. Also, industrial chemicals constitute a major import component of Nigeria's freight trade. Generally, investment in VLCCs, largest ship to transit Suez canal (SUEZMAX), liquefied natural gas/liquefied petroleum gas LNG/LPG, ultra large crude carriers (ULCC), etc., tankers remains commercially viable for Nigerian crude trade (Usoro, 2008).

3.1.4 Tourism

Tourism is the fastest growing division of the world economy and is responsible for more than 200 million jobs all over the world (Ekpo, 2012a). In the US alone, tourism has resulted in an economic gain of 478 billion dollars (Ekpo, 2012a). With 700 million people traveling to another country in the year 2000, tourism is in the top 5 economic contributors to 83 % of all countries and the most important economy for 38 % of countries (Ekpo, 2012a).

The ocean provides tourism in Nigeria in the sense that tourists are able to cruise by boat and coastal vessels to the Atlantic Ocean and natural beaches on the Nigeria coastlines for the purpose of sightseeing and relaxation. Through this avenue, the state and the federal government realize revenue which is channeled to developmental projects. For example, the Lagos state government gains substantial revenue from users of such beaches like Eleko, Lekki, and others (Oladele et al., 2018). The hospitality business has made it possible for guest houses, hotels, and resort centre to be built in this area, which in turn provide revenue and employment for people (Oladele & Digun-Aweto, 2017).

3.1.5 Mining

Humans began to mine the ocean floor for diamonds, gold, silver, metal ores like manganese nodules, and gravel in the prehistoric age (Cristelle & Suva, 2010). Diamonds are found in greater numbers and quality in the ocean than on land but are much harder to mine. When diamonds are mined, the ocean floor is dredged to bring it up to boat and to sift through the sediment for valuable gems. The process is difficult, as sediment is not easy to bring up to the surface but will probably become a huge industry once technology evolves to solve the logistical problem.

The mainly marine mineral resource activities which contribute tremendously to the Nigerian blue economy are offshore oil deposits. Nigeria is endowed with vast natural gas and crude oil reserves. Her natural gas reserves are put at more than 166 TSCF (Trillion Standard Cubic Feet) and the recoverable crude oil reserves are estimated at 28.5 billion barrels, of which a large percentage is offshore (Etim, 2010).

Interesting reports abound on the significant increase and potentials of offshore oil and gas exploration in the last 30 years. From about 20 percent of energy needs through oil extraction being met from offshore sources in 1980, this has increased to 30 percent by 2014 amid new discoveries being made offshore (OECD, 2016). Likewise, potentials of gas extraction from both deep and shallow waters is projected to rise from 17 million barrels per day in 2014 to about 27 million barrels per day by 2040 (OECD, 2016). The oil and gas industry, generally, is projected to grow with hydrocarbon from offshore sources, contributing about 3.5 percent annually by 2030 (IEA, 2014).

Apart from petroleum, sand is one of the most important resources in the Nigerian coastal zone. Sand is mined along major estuaries, lagoons, near shore, and along the beach. Much of the sand mined from lagoons and near shore areas is used for the nourishment of eroding beaches, like the Bar beach in Lagos, for sand filling swamps for development, like in the Lekki area of Lagos,

and for the construction of buildings and roads (Abubakar, 2019). Local people usually mine beach sand for construction. Such activities are very prevalent among the rural dwellers in the Niger delta. Other non-renewable resources include heavy minerals, salt, gravel, and clay.

At the moment, Nigeria has not applied the concept of Maritime Spatial Planning (MSP) for the sustainable use of her ocean in order to improve the potentialities of harnessing its ocean resources for future use (Etim, 2010). MSP is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that have been specified through a political process.

3.1.6 Marine aquaculture

Nigeria is still lagging behind in aquaculture production. She has not been able to meet domestic production demand for the populace, despite its history dating back about 50 years ago. In marine-water aquaculture, the water chemistry requirement for salinity based on dissolved salts is 0.30 - 50.00 ppt (Akinsorotan, 2019). Fish farming in this zone will have some major constraints because of the choppy conditions and heavy rainfall which occur in the coastal belt (Akinsorotan, 2019). The teeming population of engineers of various disciplines, fisheries researchers (biologists and ecologists), seasoned aquaculturists, technologists, and technicians, and the thousands of kilometers of low lying coastline containing billion cubic meters of marine water, are great offshore aquaculture potentials (Akinsorotan, 2019). The continental shelf is narrow, extending for only about 15 km in the western area, and ranges from 60 to 80 km in the eastern province. The culturing of marine fish species can be a possibility in Nigeria if all the available potentials can be harnessed.

Nigeria is a good site for fish offshore aquaculture. It is a coastal state surrounded in the South by the Atlantic Ocean. First, potential Nigerian offshore aquaculture is very diverse. Nigeria has a very large exclusive economic zone, with a good portion of the Atlantic Ocean. There are many different species which could be farmed in the Nigerian EEZ, using many different types of technologies, which in the long run would bridge the gap in the shortfall being experienced in fish production from aquaculture (Akinsorotan, 2019). For effective offshore aquaculture practices, suitable areas for offshore aquaculture need to be identified and properly mapped out. This should be the exclusive duty of the Federal Department of Fisheries (FDF). Proper policies to provide an overall plan for the development, management, and conservation of the Nigeria Exclusive Economic Zone need to be developed. Finally, proper monitoring should be ensured in order to keep the environment and the people safe.

3.1.7 Marine biotechnology

Marine biotechnology can be broadly defined as technology that uses living marine organisms, or their parts, to make or modify products (Helen, 2017). Marine biotechnology is defined as the application of scientific and engineering principles to the processing of materials by marine biological agents to provide goods and services (Helen, 2017).

Marine biotechnology explores the oceans to develop novel pharmaceutical drugs, chemical products, enzymes, and other industrial products and processes. It also plays a vital role in the advancement of biomaterials, health care diagnostics, aquaculture and seafood safety, bioremediation, and biofouling. The population and human needs continue to increase and, obviously, the pressure on natural resources will also continue to grow. To meet these growing needs, we can turn towards the marine environment, which occupies one-third of our planet.

Bioprospecting is not just a search for medical drugs, though. For example, recently, a scientist studying dead bacteria in seafloor mud used his research to develop a way to catch athletes who cheat by taking synthetic/artificial testosterone, a popular (and banned) anabolic steroid. Another team of scientists studied how an ocean worm makes a strong glue that can harden underwater and learned how to make it themselves. Many scientists hope to find chemicals that will

help them create "biofuels," fuels derived from the remains of plants or algae. An example of a biofuel that you may have heard about is ethanol (Helen, 2017).

Exploring potentials of marine biotechnology in developing countries could help solve problems of food shortage, poverty, and unemployment, and disease outbreak by discovering novel bioactive compounds needed to combat resistant pathogens (Helen, 2017). Underdeveloped countries like Nigeria can also move ahead and meet up with global challenges. Marine sponge (Halichondria okadai) and fungi, which are used to produce Eribulin mesylate and Cephalosporin, respectively, are found in the Nigerian marine environment (Helen, 2017). Eribulin mesylate is used as an anticancer agent, while Cephalosporin is used as an antibiotic.

3.2 Challenges facing the development of marine resources in Nigeria

3.2.1 Inconsistent government policy

Unlike other areas, government policies toward the development of marine recourses in Nigeria have been very poor. There are no viable government polices to help harness marine resources in Nigeria, and the little that have been formulated have been erratic. This has hindered the development of marine resources greatly. The repeated changes in government policies in Nigeria have posed a number of threats to the country's development economically and socio politically. One policy that has perhaps suffered quite a number of twists over the years is that of developing marine resources in Nigeria. The policy of previous administrations, to establish an export processing zone (EPZ) to help develop marine resources, was made dormant by this present administration. Lack of government policies have helped foreigners to fish in our waters, depleting fish stock and making our local fishermen be at their mercy (Folami, 2017).

3.2.2 Inadequate scientific data bank for marine resources

Enyenihi (2007) identified a lack of basic research on the biology and population dynamics of exploitable aquatic fauna, and hence unscientific exploitation of marine resources, as a source of destabilization of the environment. Moses (2002) observed that a lack of sufficient biological, geological, statistical, etc., data makes it necessary to shy away from drawing a definite conclusion as to whether the various resources that constitute ocean resources are fully utilized. The author also noted that the fisheries are unmanaged, probably because of insufficient and unreliable biological and statistical data on the stocks on which they are based. There is an urgent need to develop state, regional and national data banks of species of fish and of other marine resources, which should be easily accessible to anyone who desires them.

3.2.3 Open access nature of marine resources

The concept of open access property, in which there is no restriction on entry into property, because there are no property rights, is not fully implemented, and is the main problem of developing ocean resources in Nigeria.

According to Etim (2010), open access is a situation in which there is no restriction of entry into a common property, irrespective of whether the property is owned by an individual, community, or state. Marine fisheries, for example, are open access properties. Unrestricted entry into these fisheries has resulted in heavy fishing pressure on stocks. Lack of enforcement of extant regulations is a common problem in developing countries, due mainly to lack of manpower or equipment, and political factors, like the case study in Ibeno (Ifunanya, 2010). Sand is illegally mined in some coastal communities, leading to coastal erosion.

3.2.4 Climate change

Marine resources, like other productions, are influenced by climatic factors (Ipinmoroti, 2012). Ekpo and Nzegblue (2012) reported that such changes are the key water variables (temperature, salinity, wind speed direction, ocean currents, and strength of upwelling) affecting the

abundance and distribution of fish populations and fisheries activities. Sea level rise causes beaches and other resort centered along the coast to be washed away. The impact of climate change on aquatic ecosystems includes increase in mean annual temperature, latitudinal and depth shift in range, lower dissolved oxygen concentration, coral bleaching, threat to mangrove swamps, threat to the phenology of marine organisms, and ocean acidification (Etim, 2010; Ipinmoroti, 2012).

3.2.5 Over exploitation/pollution

Nigeria does not observe the allowable catch policy in fishing in coastal waters. This has led to over exploitation (Etim, 2010). Although some marine resources are renewable, and fishes are renewable resources, their stocks are not unlimited. They are affected by overexploitation. In the past, people have erroneously thought that fisheries resources are inexhaustible. Etim (2010) attributed over exploitation to the invention and increased sophistication of fishing gear and craft such as steam trawlers and factory trawlers, and technical developments such as the invention of hydraulic winches, inboard refrigeration, and acoustic fish finders, which came with the reality of man's ability to over exploit and deplete water resources. Pollution is also a major treat to the sustainability of marine resources.

3.3 Solution to the challenges facing development of marine resources in Nigeria

The conservation and management of marine resources in our aquatic ocean need a sound knowledge of the resources itself, methods of exploiting them at maximum sustainable levels, current scientific data on such resources (Essien-Ibok & Umoh, 2013), and the ecosystems and possible hazards of negative practices. Etim (2010) noted that scientific research must take the lead in developing marine resources. Kenya has adopted some of these measures in successfully managing her marine and coastal fisheries (Mangi et al., 2007, as cited in Dzoga et al., 2020). Therefore, the ways forward are:

3.3.1 Integration and coordination of ocean activities

Integration is the most important factor in the moving forward of the maritime economic agenda of Nigeria. According to Etim (2010), integration and coordination are critical to attain sustainable development amid competing uses of the ocean, to conserve the ecological integrity, life-supporting functions, and biodiversity of the ecosystem. Beyond this, integration is relevant for achieving a better balance of the 3 core pillars of Sustainable Development Goals- social, economic, and environmental- and for facilitating cooperation across different agencies, departments, and levels of government (Folami, 2017).

3.3.2 Comprehensive policy framework

Closely linked to integration is the development of a comprehensive policy framework for coordinating various activities in the management of natural capital and the regulation of those activities, whereby the ocean is recognized as an important space for opportunity and development (Ehler & Douvere, 2007). Such policies also consider the ecosystem integrity and adhere to sustainable blue economy principles, which are to realize the ecological, economic, and social objectives (Patil et al., 2017).

3.3.3 Data management and capacity development

According to the OECD (2016), data is essential for policy-makers and researchers alike for measuring indicators, assessing performance, and developing policies relevant to the management of ocean resources. Data management is important for providing critical information in many ocean and marine sectors, especially for Marine Spatial Planning and fisheries stock assessment data. Management of data is important to better understand ecosystem goods and services, thereby

contributing to solving major problems like poverty, food security, and capacity development, among others.

3.3.4 Financing the maritime economy

Blue economy, as a new realm of development, even in advanced countries, requires a lot of resources, capital, and commitment. This, naturally, presents a challenge for developing countries, like Nigeria, even though it is, arguably, a democratic and thriving developing country.

Etim (2010) summarizes the solutions to the challenges in developing ocean resources in Nigeria as follows:

1) Clarification of the roles and responsibilities for improved ocean governance and policy coordination and facilitation of implementation (cooperation and collaboration).

2) Diversification of livelihood strategies among sea going fishermen by encouraging engagement in alternative occupations, such as aquaculture or farming.

3) Development of a transparent legal, regulatory, and fiscal framework to control/regulate and adjust revenue streams.

4) Adoption of regional approaches where relevant to achieve economies of scale, for example, development of "model" agreements for adaptation at the national level; the design and development of regional and national databases.

5) Development of environmental policies, regulations, and guidelines to control/regulate exploration and mining.

6) The urging of international organizations (such as the International Maritime Organization, IMO) to take an active role in supporting Nigerian ocean resource development.

Conclusions

The study examined the importance of ocean resources to the Nigeria economy and the problems facing the development of ocean resources in Nigeria and provided solutions to such problems. The coastal area in Nigeria comprises Lagos and the economically important Niger Delta region, and these are classified into 2 geographical zones, the western coast (the Lagos region) and the eastern coast (the Niger Delta region). The maritime space of Nigeria could be broadly classified into territorial sea and the Exclusive Economic Zone (EEZ). Ocean activities comprise all economic activities with direct reliance on ocean natural resources. These economic activities can be classified into ocean-based activities, which are those activities that are undertaken in the ocean, such as fisheries and aquaculture, offshore oil and gas, seabed mining, offshore energy wind farms, shipping and marine transportation, marine tourism, and marine construction; and ocean-related activities which are those activities which use the products from, e.g., seafood processing, marine biotechnology, and chemicals, to mention but a few, and produce products and services for ocean and ocean-based activities such as shipbuilding and repair, port construction, communication, maritime law and insurance, etc. The study found out that some of the challenges facing the harnessing of ocean resources in Nigeria are poor or inconsistent government policies, inadequate marine data banks, exploitation, etc.

The contributions of marine resources to the national domestic product is quite substantial, to the tune of 70 %: offshore oil drilling accounts for almost 60 % of Nigeria oil exports, and fishery caters for the economic and health needs of about 170 million people in Nigeria. Therefore, the need to protect the resources and the marine environment should be vigorously pursued and implemented.

Recommendations

1) Government should ensure targeted capacity building at policy, institutional, legal, and technical levels of developing coastal states that results in effective exploration and mining, leading to the sustainable management of marine resources.

2) International and regional organizations are strongly urged to support developing costal states to coordinate the development and implementation of appropriate and effective legal and technical policy and regulatory frameworks.

3) The academic community should carry out more research on the ocean resources of Nigeria so as to develop scientific data for the Nigeria maritime domain.

4) Coastal communities and oil industries should avoid pollution of the marine environment.

5) Government should make funds available for the development of ocean resources in Nigeria.

References

Abubakar, H. H. (2019). *A study of Nigeria's blue economy potential with particular reference to the oil and gas sector* (Master thesis). World Maritime University, Sweden.

Akinsorotan, A. M, Akinsorotan, O. A, Jimoh, J. O, Adene, I. C., & Akiwowo, U. A. (2019). Offshore aquaculture practice: A potential for meeting Nigeria fish demand: A review. *Journal of Physics: Conference Series, 1299*, 012111. doi:10.1088/1742-6596/1299/1/012111

Akpabio, I. A., & Ekanem, J. T. (2008). Extension needs of fish marketers in Akwa Ibom State, Nigeria. *Journal of Agriculture & Social Sciences, 4*(1), 1-5.

Akpan, A. W. (2007). *Total hydrocarbon, polycyclicaromatic hydrocarbon and other organic pollutants in the coastal soil, sediments and water in Qua Iboe River estuary*. In Proceedings of the 21st Annual Conference of Soil Science Society of Nigeria, University of Uyo, Uyo, Nigeria.

Amnesty International. (2009). *Nigeria: Petroleum, pollution and poverty in the Niger Delta*. Amnesty International Publications, USA.

Boateng, I. (2006). *Institutional framework in the administration of coastal and marine space in Africa*. International Issues, Munich, Germany: Administering Marine Spaces, International Federation of Surveyors.

Cristelle, P., & Suva, F. (2010). Non-living resources capacity building: Challenges and opportunities. In Proceedings of the UNICPOLOS XI. New York.

Dzoga, M., Mulala, D. S., & Cosmas, M. (2020). Application of the DPSIR framework to coastal and marine fisheries management in Kenya. *Ocean Science Journal, 55*(2), 193-201. doi:10.1007/s12601-020-0013-y

Ehler, C., & Douvere, F. (2007). *Visions for a sea change: Report of the first international workshop on marine spatial planning*. Intergovernmental Oceanographic Commission and Man and the Biosphere Program, Paris: United Nations Educational, Scientific, and Cultural Organization (UNESCO).

Ekpo, E. I. (2012a). Impact of shipping on Nigerian economy: Implications for sustainable development. Journal of Educational and Social Research, 2(7), 107-117. doi:10.5901/jesr.2012.v3n7p107

Ekpo, I. E. (2012b). Diversity and condition factor of fish species of Ikpa River at Nwaniba in Niger Delta, Nigeria. *FUTA Journal of Research in Sciences, 8*(2), 36-47.

Ekpo, F. E., & Nzegblue, E. C. (2012). Climate change impact and adaptation opportunities on agricultural production in communities around Itu bridge-head in Itu LGA, Akwa Ibom State, Nigeria. *International Journal of Environmental Sciences, 2*(4), 2191-2202. doi:10.6088/ijes.002020300107

Essien-Ibok, M. A., & Umoh, I. A. (2013). Seasonal association of physico-chemical parameters and phytoplankton density in Mbo River, Akwa Ibom State, Nigeria. *IACSIT International Journal of Engineering and Technology, 5*(1), 146-148. doi:10.7763/IJET.2013.V5.529

Etim, L. (2010). *The tragedy of the commons: Alleviating the tragedy by managing the commons in Nigerian waters*. In Proceedings of the 27th Inaugural Lecture of the University of Uyo. University of Uyo, Nigeria.

Flora, A. (2007). *A comparative study on marine protected areas between Australia and Tanzania*. United Nations: The Nippon Foundation Fellow.

Folami, O. (2017). *Towards an integrated ocean governance regime and implementation of the Sustainable Development Goal 14 in Nigeria* (Master thesis). World Maritime University, Sweden.

Food and Agriculture Organization. (2018). *FAO Country Programming Framework (CPF) Federal Republic of Nigeria* (pp. 1-41). Federal Republic of Nigeria: Fiat Panis.

GOK/MEMR. (2010). *Integrated coastal zone management policy (Draft)* (p. 40). Ministry for Environment and Mineral Resources, Government of Kenya.

Helen, N. E. (2017). Exploring the potentials of marine biotechnology for poverty eradication and national development. *Knowledge Review, 36*(1), 1-6.

Igberi, C. O., & Ogunniyi, M. B. (2013). Has maritime transport sector impacted on the growth of Nigeria's economy? *Journal of Business and Economics, 4*(8), 722-736.

Imaobong, E. E., & Mandu, A. E. (2013). Development, prospects and challenges of artisanal fisheries in Akwa Ibom State, Nigeria. *International Journal of Environmental Science, Management and Engineering Research, 2*(3), 69-86. doi:10.5281/zenodo.1602095

Ipinmoroti, O. (2012). *Salvaging fisheries systems in the face of climate change* (pp. 167-175). In Etim, L., & Oribhabor, B. (Eds). Current issues in sustainable tropical agriculture. Faculty of Agriculture, University of Uyo, Uyo.

Meiner, A. (2013). Spatial data management priorities for assessment of Europe's coasts and seas. *Journal of Coastal Conservation, 17*, 271-277. doi:10.1007/s11852-011-0173-0

Moses, B. S. (2002). *Tropical fisheries* (p. 150). Abeam Publishing, Nigeria.

Oladele, A. H., Digun-Aweto, O., & Merwe, P. V. D. (2018). Potentials of coastal and marine tourism in Nigeria. *Tourism in Marine Environments, 13*(2-3), 165-173. doi:10.3727/154427318X15276699095952

Oladele, A. H., & Digun-Aweto, O. (2017). Strengths weakness opportunities and threats analysis of aquatic tourism in Nigeria. *Journal of Environmental Management & Tourism, 8*(6), 1259-1267. doi:10.14505/jemt.v8.6(22).13

Olalekan, J. O., & Wahab, G. O. (2018). Marine fisheries in Nigeria: A review. Intechopen Publication. doi:10.5772/intechopen.75032

Patil, P. G., Virdin, J., Diez, S. M., Roberts, J., & Singh, A. (2016). *Toward a blue economy: A promise for sustainable growth in the Caribbean: An overview*. The World Bank, Washington DC, USA.

Tabor, I. G. (2000). *A decade (1998-1999) of fisheries Research Activities at the Nigeria Institute for Oceanography and Marine Research: Hope for self-sufficiency in fish production in Nigeria* (pp. 28-29.). In Proceedings of the 18th Annual Conference of the Committee of Directors Research Institutes, NIDMR, Nigeria.

United Nations Environmental Programme (UNEP). (2014). *The status of the Nigerian Coastal Zones*. Retrieved from https://www.unep.org/abdjanconvention/docs

Usoro, M. (2008). *Optimal utilization of Maritime manpower: The role of policy makers and stake holders.* Maritime Quarterly, Lagos, Maritime Publication.