

Mitigation and Adaptation Strategies to Impact of Climate Change on Nigerian Coastal Zone

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Abstract

Climate change is a global problem of weather variations characterized by extreme conditions measured over several decades. This paper analyses the impact of climate change on the coastal zone of Nigeria with a major focus on the Niger Delta. It is aimed at ascertaining areas which are most vulnerable to the climatic variables and hazards and proffer mitigations and adaptation strategies. Obviously, coastal erosion, heavy rainfall, flooding, shoreline retreat and coastal submergence, degeneration of mangrove vegetation, seawater intrusion into coastal aquifers, change in ocean dynamics, among others are identified as products of climate change in the coastal zone. However, limited mitigation measures by government and private organisations noted include localized embankment of shoreline, beach nourishment, re-forestation, channelization, etc. were more of reactive than proactive which pose serious challenges to management of climate change impact on the coastal zone. Holistic attitudinal change by individuals towards environmental protection, promulgation and implementation of eco-friendly policies by government and private institutions, environmental education as a teaching subject from primary schools, capacity development and poverty eradication, etc., are advanced as adaptation strategies to impact of climate change in Nigerian Coastal Zone.

Keywords: Climate change; Impact; Coastal zone; Mitigation; Adaptation

Introduction

Coastal zone is a region of interactions between marine and terrestrial processes which can be classified according to geology, vegetation and drainage system of the coastline. It can be loosely referred to as a zone of varying breadth including the shore and extending to the landward limit of marine influence and the seaward limit of terrestrial influence [1]. It is an important zone which produces mineral and biological resources that sustains economies of many countries in the world including Nigeria. Eventually, due to its economic and ecological values, human population pressure is on the increase in Nigerian coastal zone on daily basis. In fact, Nigerian coastal zone especially the Niger Delta region is quintessential as it is the richest in petroleum and fishery resources in the Sub-Saharan Africa [2]. However, the integrity and sustainability of coastal zone are threatened by climate change coupled with anthropogenic pressure. A projected possible impact of climate change on the coastal cities of Lagos and Port Harcourt using the Model for the Assessment of Greenhouse Gas Induced Climate Change (MAGICC-SCENGEN) and geographical information system (GIS) interpolation techniques confirms that sea level rise may occur with a consequence of submerging all coastal cities of the Niger Delta area and a larger part of Lagos [3].

Generally, climate change is a global phenomenon of long term effect of extreme weather variations in a decadal scale for which impact is dependent on physiography, vegetation, geospatial features, etc., of a given region. However, adaptation to climate change is also a function and resilience potentials of biodiversity, ecosystem dynamics, socio-cultural and economic system of a particular place. As crude oil remains the major source of revenue to Nigerian economy [4], the sensitivity of Nigerian Coastal Zone and in particular the Niger Delta area, to climate change calls for national attention. The livelihoods of the people of the area in which a greater percentage are vulnerable, women and children, living in abject poverty and deprivation of basic social amenities, cannot be ignored viz -a-vis the revenue generated from this zone to the Federal Government.

It obvious that in the course of upstream and downstream explorations and exploitations of oil and gas in the region over the past decades, in the Niger Delta, the coastal environment has suffered large scale degradation associated with oil spills and industrial pollutions on land and in coastal waters. Destruction of mangrove forest for firewood due to poverty by the coastal dwellers predisposes the coastal area to direct and intense radiation from sunlight which is a threat to biodiversity and health of the ecosystem. Global warming and melting of polar ice related sea level rise combined with change in atmospheric dynamics induce frequent occurrences of storm surges along Nigerian coastline giving rise to coastal erosion and submergence [5]. Also, reports on impacts, vulnerability and adaptations to climate change for Africa, by the United Nations Framework Convention on Climate Change (UNFCCC) estimate that Africa's coastal infrastructure and settlements, particularly in the Gulf of Guinea, where the Niger Delta is located, could be inundated [6].

Moreover, gas flaring from oil production in the Niger Delta exacerbate the impact of climate change through the formation of acid rain which corrodes metal surfaces, reduce productivity of mangrove forest due to increase in soil acidity and alter the physicochemical characteristics of coastal waters with attendant negative impact on biological productivity of the ecosystem. Therefore, this work attempts to assess the impact of climate change in Nigerian Coastal Zone and to recommend sustainable mitigation and adaptation strategies.

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Geologic and Physiographic Setting

Nigerian coastal zone spans a distance of about 800 km bounded by the Republics of Benin in the West and Cameroun in the East respectively. It lies, geographically, between $4^{\circ} 10'$ and $6^{\circ} 20'$ N latitudes and $2^{\circ} 45'$ and $8^{\circ} 35'$ E longitudes adjacent to the Gulf of Guinea (Figure 1). It is underlain by a sedimentary basin comprises of 12 km thick piles of Cretaceous and Tertiary sediment which protrudes into the Gulf of Guinea [7]. The coastal zone is bounded laterally to the north by extensive flood plain which slopes southward from about 20 m above sea level in the Onitsha gap. This narrow zone is mounted on the Benue valley and contains the main channel of the Niger River before and after bifurcation [8]. However, the plain broadens southward with a decrease in slope and subsequent increase in the density of tributaries of the major drainage channel down the coast. To the south, it is bounded by continental shelf characterised by more or uniform gentle slopes truncated at specific points by submarine canyons [9].

However, Nigerian Coastal Zone can be geomorphological classified from the western end into lagoon-barrier coast, transgressive mud coast, the Niger Delta, and the strand coast of Ibeno, Akwa Ibom state in the east (Ibe, 1988). Furthermore, there are 36 estuaries which may be bar-built (e.g. Lagos-Lagoon), drowned river valleys (e.g. Qua Ibo), river deltas (e.g. Niger delta), and mangroves swamps which are essentially estuarine in Nigerian coastal zone [10]. The Niger Delta region, in particular, spans an areal extent of 75000 km². It has been described as the largest wetland in Africa and among the three largest in the world. Moreso, It consists of freshwater swamps, beaches, bars and estuaries and network of tidal creeks, while stagnant swamp covers about 8600 km² [11]. It is the second largest delta in the world with the coastline spanning about 450 km terminating at Imo River entrance [12].

Impact of Climate Change

Increase in temperature

Increase in temperature above normal from approximately 0.2 to 0.3°C has been observed per decades from different ecological zones in Nigeria. These temperature fluctuations became obvious since 1980s with relatively higher figures in 1973, 1987 and 1998 [13]. Despite the small range of increase in temperature, the adverse impact is most significant between June and November each year [14]. This impact is experienced as heat stress in the coastal areas due to direct solar radiation effect in the coastal areas. It is also projected that the global averaged surface temperature will increase by 1.1°C–3.5°C by the year 2100 while a sea level rise will increase from 15 cm to 95 cm [15]. Moreover, according to projections by Ekande et al., as the century progresses, the night will become significantly warmer. However, as the global temperature is expected to rise by between 0.2 to 0.5°C per decade, together with expected thermal expansion of sea and melting of polar ice, these will cause the sea level to rise by about 3 to 10 cm per decade during the next century [16] and will further increase the erosion problem of the coastal area [17]. Also, in Nigeria, according to Huma (2019), a temperature increase of 0.4 to 1°C Over the time period 2020-2050 due to climate change, and an increase of up to 3.2°C by 2050 under a high climate change scenario have been predicted [18].

Heavy rainfall and flooding

Due to increase in water content in the atmosphere as a result of excessive water evaporation consequent upon global warming, excessive rainfalls have been recorded in recent years including but not limited to the year 2012 in Nigeria [19]. This resulted in heavy flooding which drains into coastal zone, by overflows of urban drainage channels, river banks and inundation of flood plains and tidal flats. Flooding has drowned terrestrial fauna, decimated crops in the farmlands, destroyed human lives and property including many houses built at flood plains and tidal flats, etc., and subjected many coastal dwellers into untold

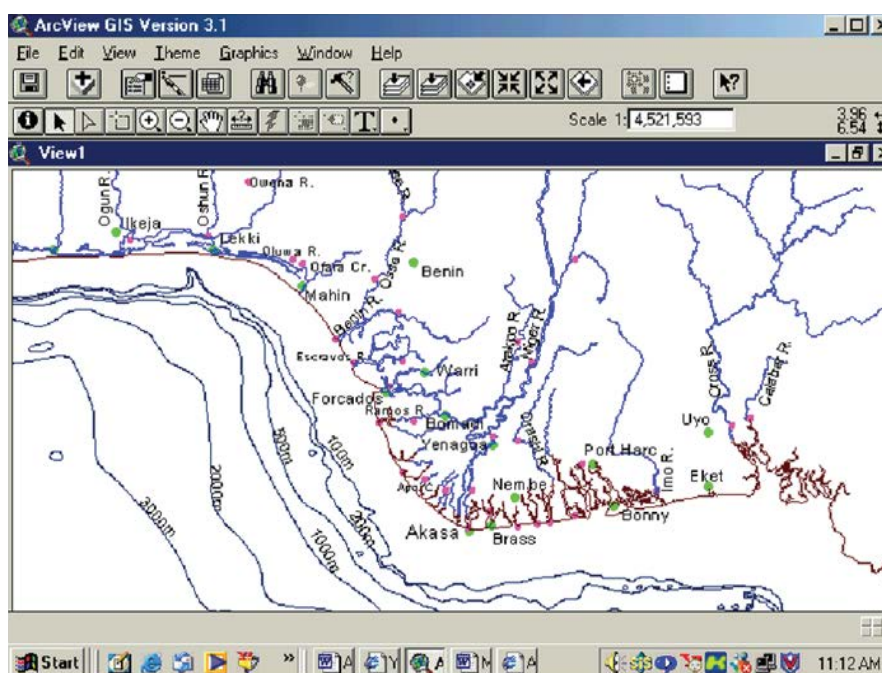


Figure 1: Map of Nigeria Coastal Zone.

hardships and penury. However, the Niger Delta coastal zone with its characteristic network of rivers and drainage system serves as depositional environment of many inland flood incidences in Nigeria which can be attributed to ephemeral shoreline accretion in some areas in the Niger Delta [20]. Moreover, excessive rainfall and wind storms in the coastal zones damage power transmission lines and sub-station equipment [21]. In addition, heavy rainfall, sea level rise, flooding and erosion of farmland also lower agricultural production in the coastal region [22]. Obviously, it is quite instructive that rain fall impact the coastal zone by flood from the land towards the continental shelf while the impact of sea level rise increases from the shoreline towards hinterland.

Sea water intrusion into coastal aquifers

Groundwater resource in Nigerian Coastal Zone is threatened by sea water intrusion into coastal aquifers resulting from marine water incursion into brackish water environment due to sea level rise. However, although sea water intrusion into coastal aquifers could be as a result of over pumping from ground water, crude oil extraction from the coastal area; tidal oscillation is also a driving mechanism of sea water flow into coastal aquifers to compensate for fresh water abstraction from the aquifer. This can be linked to the lifting process of sea water intrusion and landward salt water wedge migration in the coastal aquifer systems in the area [23]. The intrusion of sea water into coastal aquifers however alters the water table and hydro-geochemical characteristics, displaces salt water /fresh water interface and hydraulic gradient landward. This is evident by the presence of high levels of Na⁺ and Cl⁻ ions in groundwater in the coastal zone indicative of the possibility of seawater mixing with the groundwater which reduces the percentage of fresh water in favour of salt water in the aquifer [24]. Cases of sea water intrusion into coastal aquifers are reported in Ibeno, Bonny, Brass Forcados, Escravos, Lagos, etc. thereby making fresh water to be scarce in the coastal environment [25]. Inhabitants of coastal zone who are able depend on sachet water whereas a greater percentage is exposed to poor water quality and unsafe water sources for drinking and other domestic uses.

Coastal erosion and shoreline retreat

The rate of coastal erosion in recent years is on the increase. This is attributed to increase in wind speed and impact of wave energy on the shoreline. Eventually, breaking waves associated with significant waves heights generate high longshore current velocities and cross-shore currents which erode the shoreline rapidly into the sea with a corresponding shoreline retreat. Erosion is noted to be at high rate along the coast of Lagos, Awoye/Molome, Ogberedo, Escravos, Forcados, Brass, Ibeno, etc. [26]. Consequently, shoreline within these areas experienced substantial landward retreat. However, even though there are other coastal environments in Nigeria such as the Niger Delta that have indications of shoreline progression into the Ocean due to sediment influx into coastal zone drained from hinterlands during flood, but such geological process is only transient [27]. Coastal erosion and shoreline retreat as a result of sea level rise, flooding and erosion will drastically reduce the size of the already narrow beaches in the country and compromise value of recreational amenities like hotels and other social facilities that are of importance to tourism could be displaced [28].

Sea-level rise

Sea-level rise is a global phenomenon attributable to global warming and subsequent melting of polar ice. A sea level rise of 15 cm

to 95 cm is projected by the IPCC in 2001 [29]. It can also be induced, regionally, by tectonic uplift in the ocean, changes in atmospheric dynamics that develop hurricanes, typhoons, tsunamis, wind storms, tornadoes, etc., which generate astronomical tides and destructive wave heights and speeds from the ocean that impact the coastline and devastate its area of impact. Moreover, Climate induced sea-level rise in Nigeria is associated with wind storms characterized by frequent storm surges events in Lagos, the strand coast of Ibeno, etc. It has caused intense erosion along the coastline within Nigerian coastal zone [30]. However, Niger Delta region is the most vulnerable to sea level rise due to geologic setting, increased precipitation, coastal erosion and flooding [31]. These coastal processes accounted for coastal submergence which led to loss of coastland and fishing settlements in the coastal areas such as Itak Abasi fishing settlement around Qua Iboe river estuary in Ibeno, Akwa Ibom State for which an estimated land area of 1800 m² submerged into the Atlantic Ocean in 2011 [32]. It is also estimated that with sea level rise, inundation along the Niger Delta coast would extend perhaps 100 km up the Delta, bringing serious consequences to the people and the economy [33].

Decline in Coastal Biodiversity

As 80% of the world biodiversity is concentrated in the coastal areas [34], changes in ocean and atmospheric dynamics are expected to alter the ecology of micro and macro faunal and floral assemblages in the coastal zone in response to fluctuations in thermocline and salinity. Consequently, these changes will affect the migration patterns of fishery resources in search for food and congenial ecosystems both in inland waters and in the ocean. However, coastal fisheries in Nigeria provide the highest total of fish production among inshore/ offshore water with the *Pseudotolithus* spp being the most predominant. Estimated potential yield of the inshore waters is about 16 620 mt for finfish and between 3500-4 020 mt for shellfish resources, while the potential yield of offshore fisheries, within 50-200 m water depth, are estimated at about 9 460 mt, and consist of mostly tuna and tuna-like fishes [35].

As knowledge of climate change is not readily available to local and artisanal fishermen in Nigerian coastal zone, their fishing efforts oftentimes yielded low catch due to their inability to understand new migration routes of fishery resources in the ocean and coastal waters hence a reduction in quantity of their daily catch of fish. Moreover, since 50% of the fish consumed in Nigeria comes from the coastal areas and in particular the Niger Delta, [36], the decline in quantity of daily catch of fish stock due to impact of climatic variations will increase the cost of consumption of aquatic resources in Nigeria. Eventually, many artisanal fishermen could change their occupation for alternative means of sustenance of their livelihoods. These will also lead to a decline in economic activities of the people in the coastal area who trade in fishery resources.

Apart from a decline in fin and shell fishes in fresh, brackish and marine water ecosystems, the lives of mammals, birds, reptiles, etc., such as sea lions, sea turtles, crocodiles, monkeys, manatees, etc., are also threatened through exploitation of mangrove forest and fresh water swamps for timbers by coastal inhabitants as alternative source of livelihood due to low catch of fishery resources experienced by local fishermen. The timbers exploited include, *Rhizophora mangle*, *R. racemosa*, *R. Harrison*, *Athizia zypia*, *Oxystoma manni* which are largely exploited for fuel, building of canoes and houses, wood and charcoal by coastal and urban dwellers accordingly [37]. More so, whales, sea turtles, etc., sometimes, are also found stranded on shore along Nigerian coastline as consequences of sea level rise related changes in ocean waves dynamics.

Ecological succession of mangrove vegetation

According to Sanger and Belland (1995) and based on pollen analysis of sediment from the Niger Delta, offshore cores and peat deposits [38], the extent and floristic composition of the mangrove vegetation of western Africa has altered dramatically in conjunction with changing climatic conditions and palaeo-sea levels over several millions of years. During the Palaeocene (63-55 m.y. BP) there was no mangrove vegetation in the Niger delta but extensive estuarine swamp communities dominated by *Nypa*. This *Nypa* dominated swamp community remained during the Eocene when Sea levels fell and drier conditions prevailed. Two additional genera of palms, *Mauritia* now confined to the Americas and *Kentia*, now only occurring in Australia and New Zealand, were also common members of these estuarine swamps of the Niger delta during this period [39]. Towards the end of the Eocene when seasonally dry conditions were widespread in the region, *Nypa*, *Mauritia* and *Kentia* declined in abundance and finally disappeared in the early Miocene (24 m.y. BP). These disappearances coincided with the sudden and predominating appearance of *Rhizophora* throughout the region - a situation which, with minor fluctuations, remains to the present. However, there was a peak during the Inchrurian transgression (c. 35,000 y. BP) and again during the Nouakchottian transgression around 5,500 y. BP [40].

As the appearances and disappearances of mangrove vegetation in the coastlines of the world including Nigerian coastal zone, in the above geologic history of ecological succession of mangrove vegetation, were not attributed to human but natural climatic factors, this confirms to the fact that climate change is not a new phenomenon in geologic history. However, the degree of climatic variations in the Recent may be alarming due to anthropogenic inducements. Therein, exploitation of mangrove vegetation for the past decades by coastal dwellers and coastal erosion, coastal submergence and shoreline recession gave rise to a replacement of native mangrove vegetation in Nigerian coastal zone with new species as impact of climate change. For example, Mangrove vegetation in the transgressive mud coast which are dominated by mangrove - *Rhizophora racemosa* has been eroded and replaced by hardy grass *Paspalum vaginatum*, *Acrostichum* grasses, *Andropogon* sp. and *Panicum* sp., the shrubs, *Delbergia* and the tree, *Cocorus mucifera*. However, *Nipa fructicans*, *R. harrisonii* and laguncularia vegetations of the strand coast are highly dominated by *Nipa fructicans* [41].

Decline in public health

Public health status is expected to be a reflection of the environment. Already, the forgone analysis of indicators of impact of climatic variations reveals that Nigerian Coastal environment is degraded. This is consequent upon a combination of industrial pollution through oil and gas exploration and production and climate change impact. Sequel to sea water intrusion into coastal aquifer, availability of fresh water supply may be limited to a few coastal dwellers for several reasons including poverty. Thus, a greater percentage will be exposed to unsafe sources of water supplies from their environment which is also characterized by poor waste disposal and management system. Admittedly, many inhabitants of coastal zone in Nigeria are exposed to health challenges such as heat stress/ strokes, heat rashes, sun burns, eyes problems due to increase in atmospheric temperature, ozone layer depletion, greenhouse gases and direct solar radiation, These will also adversely affect plants and animals population distribution in the area. However, various diseases associated with high humidity due to heavy rainfall and flooding, poor water and air qualities such as malaria, typhoid fever, cholera, cardiovascular diseases, etc., are common in the

coastal area. Unfortunately, vulnerability of the coastal dwellers to the above health problems is very high due to poverty [42].

Mitigation and Adaptation Strategies to Impact of Climate Change

Mitigation strategies

Shoreline stabilization: It is therefore recommended that Nigerian government and private sectors operating in the coastal communities should assist in the construction of canals and channels to divert flood waters away from residential areas. Urban drainage system should be maintained by government to avoid abuse by citizens. Government should construct seawalls, embankments, groins to prevent coastal erosion, and dikes to protect houses and farmlands against flooding. Regular beach nourishments should be carried out by appropriate agency like Ministry of Water Resources and or Ministry of Works. Such development can stabilize shoreline retreat and can enable the coastal dwellers, in appreciation, to sustain their livelihoods amidst the challenges and impact of climate change. However, most of the above mitigation and adaption strategies have suffered either poor implementation or total neglect in the past by both the government and the contractors thereby making aims of such projects to be defeated. It is therefore pertinent to consider coastal zone as important area in the award of contracts for construction of shoreline protection and stabilization projects to international construction companies for effective execution and completion [43].

Liquefaction of natural gas: Nigerian Government should enforce zero tolerant to gas flaring and convert the wasted gas into domestic use at affordable cost so as to prevent fishermen and others from cutting down mangrove trees for firewood. Moreover, it will reduce air pollution and ozone layer depletion. On the other hand, welders and electricians should be empowered to construct local ovens powered by electricity or gas, if gas flaring from oil production and flow stations can be harnessed, and installed at strategic locations in the coastal communities for fish drying and preservation instead of smoking with firewood. This can help to reduce the high rate of destruction of mangroves forest and release carbon dioxide and other harmful gases to the atmosphere during smoking of fish using firewood [44].

Remediation of groundwater resources: As rain water is not safe for drinking due to gas flaring and acid rain in the coastal areas, remediation of polluted groundwater resource is an option to be considered by government and private sectors for mitigation of the impact sea water intrusion and other pollutants in the coastal aquifers in Nigeria. The use of sachet water is an alternative, those who cannot afford treated and cleaned fresh water should boil their water at homes and allow it to cool before use.

Aquaculture: The practice of aquaculture should also be encouraged by government and private sectors through empowerment programmes for the poor and less privileges in the coastal zone in Nigeria. This will alleviate the challenges of artisanal fishermen who cannot afford fishing trawlers or boats to embark on commercial and efficient fishing in the continental shelf and perhaps in the deep sea as against scarcity of fish in the nearshore zone.

Clean energy: The use of solar energy to generate electricity as an alternative to fossil fuel is a welcome development but at a very slow rate due to poverty. As many of the inhabitants in the coastal communities use small generators to produce electricity for their domestic needs, there is need for the coastal communities to be empowered by government and private enterprise with solar energy at where there

is no access to hydro-electricity source, this will reduce the risk of their exposure to greenhouse gases emissions from their generators to the atmosphere. Also, implementation of clean energy development policies and legislations in Nigeria should be given a priority. This will boost private sectors to invest in the generation of electricity by the use of abundant natural gas deposits in Nigerian Coastal zone instead of flaring during crude oil production [45].

Afforestation: Establishments of a few mangrove forest reserves and re-planting of mangrove seedlings by government in deforested areas in Nigerian Coastal Zone are commendable such as Apoi Creek Forest Reserve and Stubbs Creek Forest Reserve. Incentives should be given to coastal dwellers to imbibe in the culture of tree planting as replacement to those they had destroyed for logging and firewood.

Health facilities: The provision of primary health facilities in the coastal areas is a welcome mitigation measure. But the health facilities should be spread to the interior locations of the coastal communities because of their peculiar terrain. Provision of medical equipment and quality drugs to the health centres should be given a priority. Moreover, adequate provisions and incentives should be made for medical personnel to reside near the health facilities in the area in case of emergency [46].

Adaptation strategies

Attitudinal change for environmental protection: It is very obvious that we are consciously or unconsciously living amidst the impact of climate change. On the other hand, coastal environment can also be considered as a zone of convergence or interactions of impact of climate change from the land and the ocean. Therefore, a few coastal dwellers are no longer living in thatched houses and shanties but in block houses with floors elevated above the sea level. Due to swampy nature of the terrain, it is not possible for a greater percentage of the fishermen who are living below poverty line to adapt to this development. Therein, it is needful for low housing estate to be constructed and sell at a subsidized rate to inhabitants of the coastal areas by government and private organization operating in Nigerian coastal zone to enable them to embrace modern lifestyles in their area. This gesture will control rural to urban migrations of coastal dwellers. However, it is a good development as a great number of inhabitants in the coastal areas also depend on sachets water for drinking purpose and otherwise. While other sources of water for other domestic uses may be taken perhaps from other nearby water bodies based on their cultural beliefs and customs. So, it is pertinent for government or private sector to provide treated and safe water supply to the coastal communities.

Promulgation and implementation of eco-friendly policies by government and private institutions: There are existing policies and laws formulated and enacted respectively for the protection of environment and the coastal zone in particular, and management of impact of climate change. However, implementations and enforcement of compliance of these policies and laws are weak perhaps due to duplicity and overlap of functions in different ministries and extra-ministerial departments. Establishment of Coastal Zone Management Agency to oversee, coordinate and manage directly the affairs of Nigerian Coastal Zone is imperative [47].

Environmental education as a teaching subject from primary schools: Environmental education as a subject exists in the curricula of a few tertiary institutions in Nigeria. This is because Nigeria is yet to adopt environmental education as effective and mandatory strategy to combat climate change and environmental degradation from

the grassroots. Inclusion of environmental education in the school curricula from the grassroots is essential and awareness for the need to protect our environment should continue to be raised and promoted to the coastal communities. The indigenous knowledge of ocean tidal cycles, breeding cycles of aquatic organisms and atmospheric changes should be considered and synchronized with the satellite-based predicted ocean tide table.

Moreover, the need to protect our environment and to adapt to the impact of climate change is a collective responsibility. This sense of responsibility is viewed to be inculcated into the citizens in the class room under the platform of Environmental Education as mandatory teaching subject from primary school to tertiary institutions. If the above suggestion is given attention, at least, from the primary to secondary level of education, generations of citizens who are aware and conscious of the need to protect the environment and coastal zone in particular and adapt to impact of climate change will be trained into the society [48].

Transformation of exotic species plants to economic use: Nuisance of *Nypa Palm* encroachment predominantly in the eastern axis of the Niger Delta Coastal Zone is converted as temporal barriers against sea level rise and waves impact on the coastline. Moreover, *Nypa palm* are used to design and make useful ornaments and furniture.

Local technology content: Construction of large capacity locally made engine powered boats, in place of commercial fishing trawlers, which flooded Nigerian continental shelf and coastal waters, are designed to overcome, combat, and stabilize the impact of high waves energy as a result of sea level rise. Fishing gears and nets are designed locally in the coastal areas to meet the current changes in ocean dynamics. These innovations by the fishermen guarantee good yields from their fishing occupation hence the need for empowerment and capacity building to promote local content initiatives in marine technological development.

Proper use of health centres: Inhabitants of coastal areas should as a matter of necessity inculcate the culture of visiting medical centres in their communities for their health needs always. Self-medication should be discontinued. Use of safe water sources for domestic purposes and good waste management practice should be encouraged [49].

Conclusion

Climate change is not a new phenomenon in Earth History but the alarming and phenomenal climatic variations in this Era is consequent upon anthropogenic inducements mostly by the developed countries in the world. Even though the contribution of Nigeria to global climate change may be insignificant but the impact of climate change extends beyond, with no regard to, geographical boundaries. Therein, there is need for every country to take responsibility in combating climate change according to the degree of impact or otherwise experienced in the country for the good of her citizens other than shifting the blame to the major polluters who would not compromise the good lifestyles of her citizens for mitigation of climate change impact.

Therefore, it is imperative for the Nigerian government to think globally, plan based on the peculiar situation on ground and act in a bottom-top approach. Given the importance of the Nigerian Coastal Zone in Nigerian economy, adequate attention should be made by implementing sustainable mitigation measures which are location specific and guarantee effective adaptation to climate change in the area.

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