

Coastal Settlement and Climate Changes – The Effects of Climatic Change / Sea Level Rise on the People of Awoye in Ondo State Nigeria.

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Key Words: Access to land, Coastal Zone Management, Informal Settlements, Land Management, Coastal Erosion, Canalization, Mangrove Swamp, Sea Level rise.

SUMMARY

The coastal zone, with their vast resources of food, energy, and minerals, not only are composed of various fragile ecosystems, but are scenes of a variety of often conflicting uses. At present, the uncontrolled development of the coastal zone and the almost haphazard exploitation of their natural resources threaten to turn the promise of economic prosperity into an environmental nightmare that portends great dangers for present and future generations (Ibe A.C. 1987).

The Niger Delta environment as a result of several decades of oil production, and industrial and infrastructural developments had witnessed tremendous environmental degradation. Profound changes have often had adverse effects on local livelihoods and social well-being. For years, local people hoped for protection that never came from successive Federal and State Governments. Attempts to fight back have at times compounded their environmental challenges—the sabotage of oil pipelines, for example, has only exacerbated oil pollution.

The level of infrastructure and industrial development demanded can hardly be sustained by the fragile ecosystems in the core Niger Delta, particularly in the unique mangrove swamp zone

THE PEOPLE OF AWOYE

The Ilajes are the predominant group in Awoye. They occupy largely three local government areas in Ondo State: Ilaje local government area, Ilaje west local government area and Okitipupa local government area. The major occupation of the Ilaje people is fishing. This is why they settle in riverine areas. Their original houses were wooden-built and suspended on water just like the Ijaw people. They are also found in most places in Nigeria and some neighbouring countries, especially, where there is much water, lagoon or creek. For instance, in Lagos State, they are found in areas like Bariga, Ikorodu, Ojo, Olodi Apapa and Ijora among others. They are also seen among Ijaw, Ikale, Oron in Akwa Ibom, Cameroun, Gabon and Equatorial Guinea, all in large groups.



Figure 1: Niger Delta Map

A delicate balance exists between the human population in the Niger Delta and its fragile ecosystem. There is a strong feeling in the region that the rate of environmental degradation is pushing the delta towards ecological disaster. The lack of land makes settlement difficult and costly, forcing some communities to engage in uncontrolled land reclamation.

In the mangrove areas, floods continually modify river courses, rendering the rivers useless as modes of transportation. This has serious impacts on human life and economic activities.

The natural terrain and hydrology of the Niger Delta have always caused certain environmental problems, especially flooding, siltation, occlusion, erosion and the shortage of land for development. The local people have lived with these problems for many years.

Communities, roads and farmlands are partially or totally submerged from channels or by water flowing over the levees. In the mangrove swamp forest areas, diurnal tidal movements result in floods exacerbated by rising sea levels, coastal erosion and land subsidence. The floods also cause continual modification of river courses in the area, rendering the rivers useless as modes of transportation. This also has significant impacts on the pattern of human life and economic (Ibe A.C., 1988b)

Erosion of river bank and coastal, is prevalent due to natural and human causes. Communities have been displaced and forced to relocate as a result of it. Public facilities, houses and other economic assets have been lost.

A shortage of land for development stems from the scarcity of dry and relatively well-drained land, especially in the barrier island forest, mangrove and freshwater swamp forest zones. This has made housing and settlement development very difficult and costly, and to some extent accounts for neglect of the region by successive governments. The dynamics of flood and tidal movement further reduce available land space, forcing many communities to engage in uncontrolled land reclamation with negative environmental impacts.

CLIMATIC CHANGE, WHAT IS IT?

Climate change refers to the variation in the Earth's global climate or in regional climates over time. It describes changes in the variability or average state of the atmosphere over time scales ranging from decades to millions of years. These changes can be caused by processes internal to the Earth, external forces (e.g. variations in sunlight intensity) or, more recently, human activities (Wikipedia, the free encyclopedia)

Global climate change is caused by the accumulation of greenhouse gases in the lower atmosphere. The global concentration of these gases is increasing, mainly due to human activities, such as the combustion of fossil fuels (which release carbon dioxide) and deforestation (because forests remove carbon from the atmosphere). The atmospheric concentration of carbon dioxide, the main greenhouse gas, has increased by 30 percent since pre-industrial times.

WHAT IS SEA LEVEL RISE

Sea level rise is an increase in sea level. Multiple complex factors may influence such changes. It can be a product of global warming through two main processes: expansion of sea water as the oceans warm, and melting of ice over land. Global warming is predicted to cause significant rises in sea level over the course of the twenty-first century.

EFFECTS OF SEA LEVEL RISE

The Intergovernmental Panel on Climate Change Third Assessment Report (IPCC TAR) WG II report notes that the current and future climate change would be expected to have a number of impacts, particularly on coastal system. Such impacts may include increased coastal erosion, higher storm-surge flooding, inhibition of primary production processes, more extensive coastal inundation, changes in surface water quality and groundwater characteristics, increased loss of property and coastal habitats, increased flood risk and potential loss of life, loss of nonmonetary cultural resources and values, impacts on agriculture and aquaculture through decline in soil and water quality, and loss of tourism, recreation, and transportation functions.

There is an implication that many of these impacts will be detrimental. The report does, however, note that owing to the great diversity of coastal environments; regional and local differences in projected relative sea level and climate changes; and differences in the resilience and adaptive

TS 8F – Economic Benefits of Hydrography

3/14

Angela Etuonovbe

Coastal Settlements and Climate Change: The Effect of Climate Change / Sea Level Rise on the People of Awoye

Strategic Integration of Surveying Services

FIG Working Week 2007

Hong Kong SAR, China, 13-17 May 2007

capacity of ecosystems, sectors, and countries, the impacts will be highly variable in time and space and will not necessarily be negative in all situations.

EVIDENCE OF CLIMATIC CHANGE

Evidence for climatic change is taken from a variety of sources that can be used to reconstruct past climates. Most of the evidence is indirect—climatic changes are inferred from changes in indicators that reflect climate, such as vegetation, sea level rise and glacial retreat.

HUMAN INFLUENCE ON CLIMATE – A GLOBAL OVERVIEW

Anthropogenic factors are acts by humans that change the environment and influence climate. The biggest factor of present concern is the increase in carbon dioxide (CO₂) levels due to emissions from fossil fuel combustion, followed by aerosols (particulate matter in the atmosphere) which exerts a cooling effect. Other factors, including land use, ozone depletion, animal agriculture and deforestation also impact climate.

- Land Use

Prior to widespread fossil fuel use, humanity's largest impact on local climate is likely to have resulted from land use. Irrigation, deforestation, and agriculture fundamentally change the environment. For example, they change the amount of water going into and out of a given locale. They also may change the local albedo by influencing the ground cover and altering the amount of sunlight that is absorbed. For example, there is evidence to suggest that the climate of Greece and other Mediterranean countries was permanently changed by widespread deforestation between 700 BC and 0 BC (the wood being used for ship-building, construction and fuel), with the result that the modern climate in the region is significantly hotter and drier, and the species of trees that were used for ship building in the ancient world can no longer be found in the area. [William F. Ruddiman (2005)],

The above could be likened to the Awoye terrain where the canoe and boat industry once thrived.

CLIMATE CHANGE AND HUMAN HEALTH

Human societies over the ages have depleted natural resources and degraded their local environments. Populations have also modified their local climates by cutting down trees or building cities. It is now apparent that human activities are perturbing the climate system at the global scale. Climate change is likely to have wide-ranging and potentially serious health consequences. Some health impacts will result from direct-acting effects (e.g., heat wave-related deaths, weather disasters); others will result from disturbances to complex ecological processes (e.g., changes in patterns of infectious disease, in freshwater supplies, and in food production).

IMPACTS ON HEALTH

To assess the potential impacts of climate change on health, it is necessary to consider both the sensitivity and vulnerability of populations for specific health outcomes to changes in temperature, rainfall, humidity, storminess, and so on. Vulnerability is a function both of the changes to exposure in climate and of the ability to adapt to that exposure.

It is important to distinguish between "climate and health" relationships and "weather and health" relationships. Climate variability occurs on many time scales. Weather events occur at daily time scale and are associated with many health impacts (e.g., heatwaves and floods). Climate variability at other time scales also affects health. In particular, the El Niño Southern Oscillation has been shown to influence interannual variability in malaria, dengue, and other mosquito-borne diseases. These are constant features in Awoye. Climate change is the long-term change in the average weather conditions for a particular location. Climate change will become apparent as a change in annual, seasonal, or monthly means. Thus, incremental climate change will be superimposed upon the natural variability of climate in time and space.

- Natural Disasters.

Climate change will increase the risk of both floods and droughts. Ninety percent of disaster victims worldwide live in developing countries, where poverty and population pressures force growing numbers of people to live in harm's way—on flood plains and on unstable hillsides. Unsafe buildings compound the risks. The vulnerability of those living in risk-prone areas is perhaps the single most important cause of disaster casualties and damage.

- Water Quality and Quantity.

Human health depends on an adequate supply of potable water. By reducing fresh water supplies, climate change may affect sanitation and lower the efficiency of local sewer systems, leading to increased concentrations of pathogens in raw water supplies. Climate change may also reduce the water available for drinking and washing. In developed countries, the anticipated increase in extreme rainfall events, which may be associated with the outbreaks of diarrhea diseases, may overwhelm the public water supply system. Flooding is likely to become more frequent with climate change and can affect health through the spread of disease. In vulnerable regions, the concentration of risks with both food and water insecurity can make the impact of even minor weather extremes (floods, droughts) severe for the households affected. The only way to reduce vulnerability is to build the infrastructure to remove solid waste and wastewater and supply potable water. No sanitation technology is "safe" when covered by floodwaters, as fecal matter mixes with floodwaters and is spread wherever the floodwaters go.

- **Food Security.**

Current assessments of the impact of climate change indicate that some regions are likely to benefit from increased agricultural productivity while others may suffer reductions, according to their location and dependence on the agricultural sector. The IPCC has reviewed the results of many modeling experiments that project future changes in crop yields under climate change. Climate change may increase yields of cereal grains at high and midlatitudes but may decrease yields at lower latitudes. The world's food system may be able to accommodate such regional variations at the global level, with production levels, prices, and the risk of hunger being relatively unaffected by the additional stress of climate change. However, populations in isolated areas with poor access to markets may still be vulnerable to locally important decreases or disruptions in food supply.

- **Heat Waves**

Heat stress is a direct result of exposure to high temperatures. Stressful hot weather episodes (heat waves) cause deaths in the elderly, as well as heat related illnesses such as heat stroke and heat exhaustion. A change in world climate, including an increase in the frequency and severity of heat waves, would affect the quality of life in many urban centers. Heat waves are responsible for a significant proportion of disease-related mortality in developed countries such as the United States and Australia, where the impact of weather disasters has been significantly reduced. And of course in the developing world you will expect that little or no technological respite to such heat waves, the effect in Awoye will be overwhelming as the day is usually very hot and the night almost the same as the surrounding waters emits the absorbed heat during the day at night.

However, on the other hand, milder winters under climate change would reduce the excess morbidity and mortality, such as the United Kingdom, the beneficial impact may outweigh the detrimental.

- **Air Pollution.**

The air is full of particles and gases that may affect human health, such as pollen, fungal spores, and pollutants from fossil fuel emissions and vagaries of crude oil activities. Weather conditions influence air pollution via pollutant (or pollutant precursor) transport and/or formation. Exposures to air pollutants have serious public health consequences. Climate change, by changing pollen production, may affect timing and duration of seasonal allergies.

- **Social Dislocation.**

The growth in the number of refugees and displaced persons has increased markedly. Refugees represent a very vulnerable population with significant health problems. Large-scale migration is likely in response to flooding, drought, and other natural disasters. Both the local ecological

disturbance caused by the extreme event and the circumstances of population displacement and resettlement that is predominant in the area in quo due to the continuous activities of oil companies essentially the activity of canalization; would affect the risk of infectious disease outbreaks. Even displacement due to long-term cumulative environmental deterioration, including sea level rise, is associated with such health impacts.

- **Infectious Diseases.**

Climate change may alter the distribution of important vector species, and this may increase the risk of introducing disease into new areas. Vector-borne diseases are transmitted by insects (e.g., mosquitoes), and ticks that are sensitive to temperature, humidity, and rainfall. Temperature can also influence the reproduction and survival of the infective agent within the vector, thereby further influencing disease transmission in areas where the vector is already present. However, the ecology and transmission dynamics of vector-borne diseases are complex. The climate factors that could critically influence transmission need to be identified before the potential impact of a changing climate can be assessed.

Malaria is on the increase in the world at large, but particularly in Africa by inclusion Nigeria, and Awoye to be specific. In several locations around the world, malaria is reported in the twenty-first century at higher altitudes than in preceding decades, such as on the mountain plateaus in Kenya. The reason for such increases has not yet been confirmed but includes population movement and the breakdown in control measures. Climate change may contribute to the spread of these major diseases in the future in highlands and other vulnerable areas. Climate change impact models suggest that the largest changes in the potential for disease transmission will occur at the fringes—in terms of both latitude and altitude—of the potential malaria risk areas. The season transmission and distribution of many diseases that are transmitted by mosquitoes (dengue, yellow fever), sand flies (leishmaniasis), and ticks (Lyme disease, tick-borne encephalitis) may also be increased or decreased by climate change.

Erosion:

Deforestation, canalization and land subsidence have worsened erosion. Apart from the riverbank erosion mentioned earlier, coastal erosion is on the increase. This is partly the result of rising sea levels and strong tidal wave currents. But oil and gas activities have also contributed to the increasing menace of erosion through the construction of canals, shore-crossing pipelines, jetties and moles. In Ondo State, for instance, one oil operator constructed a canal in the Awoye area to improve its activities, but because of this disturbance and the ensuing saltwater intrusion, more than 20 hectares of land have been lost.

CONSEQUENCES OF CLIMATIC CHANGE IN AWOYE- A LITERATURE REVIEW

In Awoye, environmental degradation included the loss of fresh water sources while the company opened up numerous channels from the sea towards the coast to install their equipment. According to Bola Oyibo, leader of a group of one hundred and twenty-one young people from 42 communities advancing on the Chevron Parabe platform to protest against the continuous destruction of their environment “For years Chevron has systematically undertaken a war against our lands, forests and waters. Come to the Awoye Community and see for yourselves what they have done. All is dead, mangroves, tropical forests, fish, fresh water, wildlife. All has been killed by Chevron...” (See WRM bulletin No. 92).

“...The application of new technologies in this century has increased man’s influence to such an extent as to imperil the healthy functioning of coastal waters in ecological and social terms by disrupting them in a variety of ways. Nowadays, however, it is also possible to direct ecological development of entire basins as a matter of ‘planned ecology’ analogous to ‘planned economy’. Unfortunately, technological ability and primary economical and social requirements, such as safety, have too often led to short sighted choices which in turn caused increasing stresses on, in this case coastal ecosystems. Many projects take a long time for preparation, execution and follow-up. The time of 20-40 years appears to be normal for coastal engineering projects like the Delta Project

“...Thus we have seen that under natural conditions a river seeks to establish a morphology which is adjusted to its hydrology and hydraulics, i.e. a morphology which will allow it to carry its discharge and load with least effort and maximum efficiency. However, man can easily upset the natural equilibrium of a river by altering either the catchments surface or the river channel itself. By changing the surface of the watershed man may affect the hydrological cycle and thus sediment yield and river morphology. He may also directly change hydrologic and morphologic characteristics of a river by channelling, dredging, or damming it. He must understand the results of any such tampering, and work in collaboration with ecological principles governing fluvial action...Let’s make certain that the result will be harmonious with the natural system

“.... For River reaches where sinuosity is very high; a period of instability and meander cut-off can be expected. If these reaches are identified, selective cut-offs may partly reduce the impact of the inevitable river patterns change or avulsion. This is in no way a recommendation for canalization. The brutal forcing of a channel into an unnatural straight alignment almost always produces serious consequences. Unless the new course is cut in resistant materials the channel will attempt to resume its meandering course. In addition, the greatly increased gradient of the straightened channel will normally cause incision and rejuvenation upstream, thereby producing a high sediment load that will probably enlarge and aggrades the aligned channel and cause flood-plain destruction

According to the Niger Delta Environmental Survey report; “Historically, for much of the Delta, the rate of [coastal] erosion has been balanced by sediment transport from the hinterland and by longshore drift. However, a number of factors, including natural delta subsidence and rising sea level, canalization, coastal structures, large boat traffic, and decreased sediment input have promoted erosion at various locations along the delta and its major rivers, particularly at:

. Escravos: caused by the construction of two moles trapping the NNW movement of the longshore drift and resulting in shoreline retreat at a rate of between 18 and 24 m/y (Ibe, 1988);

. Forcados South Point: more than 400 m of coastal land has been eroded within the last 20 years, credited to long-term and, recently, heavy maritime traffic in the area (Ibe, 1988)

. Brass: the zone of erosion covers the Brass River to St Nicholas River barrier island and is estimated at 16-19 m/y (Oyegun 1990); Molume mud beach area: just west of the Benin River, showing some of the highest natural erosion rates in the world due primarily to natural causes, but augmented by canal development (Gundlach et al., 1985)

Coastal erosion is caused mainly by the reduced flow of the river during the dry season because of the extensive damming upstream. Other contributing factors are the canalization of estuaries and the use of large ocean going vessels near the port complexes.

According to Geomatics Nigeria Ltd, an environmental consultancy organization that does extensive work for the government;

“...A remote sensing and GIS [Geographical Information System] analysis study was conducted along the coast of Nigeria near Awoye in the Niger Delta oil production area. It was shown that the coast had receded approximately 1.5 km between 1971 and 1991. It was established that the reason was likely either canal construction/maintenance or petroleum exploration activities in the very sensitive Niger Delta alluvial deposits

With regards to riverbank erosion, this has been a natural phenomenon since the delta came into being. It becomes a problem when towns and villages situated near the banks, are subjected to massive erosional forces caused by man tampering with the river and estuary environment. In this case prevention measures must take into account the natural flow of the river.

ENVIRONMENTAL CONSEQUENCES OF RIVER / COASTAL DREDGING

However, a general summary of the effects of man’s activity in the area in discuss can be attempted. There is no gainsaying the fact, that canalization and dredging forms the hallmark of man’s pursuit in this locality. Below are some of the highlights of environmental consequences of River / Coastal dredging.

- a. Accelerated riverbank erosion and bank failure, towns and villages along the route will disappear.
- b. Accelerated coastal erosion and bank failure.
- d. Accelerated pollution of the waterways due to the huge increase in river traffic.
- e. Loss of fishing livelihood due to the heavy pollution from ships and barges.

- f. Loss of farming livelihood, due to canalization and commandeering of farm lands to dump the dredged up material along the banks, which consists of high silicate material detrimental to farming most food crops.
- g. Destabilization of the waterways as the river seeks to cope with the overload and re-establish meanders along the altered courses.
- h. Migration of the salt-water marine environment into the freshwater marine environment with the resultant destruction of freshwater ecosystems. This is due to the canalization process.
- i. Increased risk of severe flooding due to the increased carrying capacity of the river that is transmitted downstream.
- j. Loss of use of fresh water for drinking purposes due to pollution by heavy-duty ship oils.

These concerns raised above are not invented; they are borne out through the study of the effects of man altering the marine environment in other countries;

ADAPTATION AND MITIGATION

There are two responses to global climate change:

- **Mitigation.**

Intervention or policies to reduce the emissions or enhance the sinks of greenhouse gases. The current international legal mechanism for countries to reduce their emissions is the United Nations Framework Convention on Climate Change (UNFCCC).

- **Adaptation.**

Responses to the changing climate (e.g., acclimatization in humans) and policies to minimize the predicted impacts of climate change (e.g., building better coastal defenses).

The key determinants of health—as well as the solutions—lie primarily outside the direct control of the health sector. They are rooted in areas such as sanitation and water supply, education, agriculture, trade, transport, development and housing. Unless these issues are addressed, it can be difficult to make improvements in population health and reduce vulnerability to the health impacts of climate change.

CONCLUSION

The Ilaje people of Awoye are the direct and indirect victim of oil action. They lived on the coastland and along the River bank, using its waters to bathe, eat and drink. However the waters are polluted and they continue to use them, as they have no other option.

To the genocide of entire peoples are added isolated, concealed deaths caused by oil accidents and by the terrible contamination they generate.

The contact of pollution with the organism comes by way of personal hygiene, consumption and breathing, thus generating skin diseases, diseases of the respiratory system, the digestive apparatus, eyes, nose and throat and gynaecological troubles. However, it also contributes to increase malnutrition, anaemia, tuberculosis and miscarriages. The cancer prevalence rate has increased enormously in the peoples close to the sources of contamination, and most affects children under 14 years of age

The wells close to the crude oil ponds are polluted by the chemical products that infiltrate them, also killing domestic animals which for many members of the communities, fulfill the functions of consumption, trade and economic reserves in times of emergency. For these families, their disappearance leaves them in poverty and deprives them of their food sovereignty.

It is perhaps ironic that the problems of the coastal zone derive from their usefulness and in particular from the settlement of humans on or near the coast.

In oil-producing coastal states, a network of canals for hydrocarbon exploitation and transportation, on or near the coast, constitutes a visible structural modification of the coastal zone that has adverse effects on coastline migration.

In the coastal zone of Awoye, in response to increasing demands for fish and fish products, trawling now prevails in areas formerly dominated by traditional fishermen. However, these operations are largely unregulated (or do not conform to regulations where they exist), with incorrect mesh sizes resulting in destructive fishing, including the catching of undersized fish (Ajayi, personal communication).

Mining of sand (siliceous and calcareous), gravel, and other construction materials (e.g. limestone) from estuaries, beaches, or the nearshore continental shelf is common (Ibe 1982, 1987a,b; Ibe and Queleennec 1989) in the coastal states. The mining of sand and gravel from coastal rivers and particularly from estuaries tends to diminish the amount of fluvial sediment input to the coastline, thereby accelerating shoreline retreat. Sand extraction directly from beaches seriously depletes the sediment pool available, and beach retreat is either induced or accelerated. Dredging of sand from the inner continental shelf is an obvious cause of beach erosion in Awoye. Therefore, dredging of sand/gravel for replenishment, land reclamation, or other civil engineering construction from the shore area or, for that matter, anywhere else within the dynamic system inevitably disrupts this equilibrium and enhances shoreline retreat. Besides the increased threat of erosion, the mining of construction materials from the coastal zone has a tendency to disrupt fragile ecosystems such as coral reefs and mangroves and affect their productivity (Ibe 1982; Ibe et al. 1985).

The exploration, exploitation, refining, and transportation of oil and gas in Awoye, although contributing to economic development, bring worrying problems because these activities routinely contribute a variety of pollutants to the coastal zone and oceans. These include hydrocarbons from occasional spills but perhaps more importantly, from chronic low-level

releases associated with leaking valves, corroded pipelines, ballast water discharges, and production water effluents. Drilling fluids contain diesel and some toxic chemicals that cause pollution. Heavy metals, particularly vanadium and nickel, are introduced through oil-field operations and are known to affect life forms (Ibe 1989; Ibe and Ojo 1993; Ojo 1992; Tobor and Ibe 1992).

The foregoing are in addition to the general possible problems in coastal areas which had as been highlighted previously in this study, relates to the expected effects of global warming on Shallow Ocean and coastal zones, in particular the impact of the associated rise in sea level. The negative implications of all these for sure are overbearing on the ecosystem and of course the people.

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12/14

Angela Etuonovbe

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BIOGRAPHICAL NOTES

Mrs. Angela Kesiena Etuonovbe has a B.Sc.(Hons) degree in Surveying, Geodesy & Photogrammetry from the University of Nigeria, Enugu Campus. She is a Registered Surveyor and the first female Surveyor in Private Practice in Delta State. With over fourteen years of experience in the practice of Surveying, Engineering and Mapping. She also has a Master in Business Administration (MBA).

She is a Federal surveyor, a consultant of no mean repute, a prolific writer, a Lady of the Knights of Saint Mulumba Nigeria, Member of the Nigerian Institution of Surveyors, the indefatigable Public Relations Officer of the Nigerian Institution of Surveyors - Delta State Branch, and the Coordinator, Women – In - Surveying for Edo and Delta States.

Over the period, she had successfully executed a research work on “**ROAD CONSTRUCTION IN NIGERIA – DEFECTS AND SOLUTIONS.**” And she is currently on a research on lasting “**SOLUTIONS TO EROSION PROBLEMS IN DELTA STATE NIGERIA.**”

From her school days, she has always been an icon to female Surveying Students and has been championing the course of Gender inequality in the Survey Profession in Nigeria.

She presented two papers “Under Represented Group – Projecting the Image of the Nigeria Female Surveyor” and “Administering Marine Spaces: The Problem of Coastal Erosion In Nigeria – A case study of Forcados South Point, Delta State” at the XXIII International FIG Congress at Holiday Inn, Munich, Germany.

She had authored eight informative, educative exciting and highly spiritual books currently on the Bookshelves. Over 5000 copies of **God the Father Loves You Personally** have been printed in the past two years and distributed freely to prisons, hospitals, communities, youths, schools and the needy.

She is excited at challenges the Survey challenges not an exception.

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