POST 2015 DEVELOPMENT AGENDA IN THE NIGER DELTA: THE FIRST MILLENNIUM DEVELOPMENT GOAL (MDG 1) AND ADAPTATION TO CLIMATE CHANGE

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Abstract
This paper drew attention to the need for the integration of climate change issues in poverty reduction strategy in Nigeria. It focused on the Niger Delta for two reasons. First is the fact that the region occupies more than half of Nigeria's coastline. The second point is that about 70 percent of the population whose occupations depend directly on the weather live along the coastline. Designed as a desk study, the paper reviewed and analyzed climate change effects in the Niger Delta and noted the negative impacts on farming and fishing, the major occupations in rural Niger Delta. The point was made that in order to checkmate the rising incidence of poverty, poverty reduction policy should address climate related threats to farming and fishing by making adaptation to climate change a fundamental policy.

Introduction

The Nigerian government has for the past years tried to achieve MDG 1 with a combination of policies such as the midwives service scheme; federal teachers scheme; conditional grants scheme; micro-credit scheme; small and medium enterprises development; vocational training scheme; universal basic education fund scheme; HIV and AIDs scheme; community health insurance scheme; roll back malaria partnership; and national gender data bank (NMDG, 2010). Together, these policies were intended to improve maternal health and quality of teaching/education; ensure availability of social amenities and services such as clean water; provide vocational skills acquisition and entrepreneurship training and access to capital; and dealing with the concerns of malaria, HIV/AIDs and access to Medicare.

However, the increasing poverty rate despite these policy interventions by the Nigerian government indicate that the policies have failed to achieve set objectives; and this failure has been linked to corruption, inadequate funding, faults in implementation strategy and the neglect of pro-poor concerns in public expenditure (Okoroafor & Anuforo, 2012; Lawal & Obasaju, 2012; Odior, 2014). Significantly, climate change effects have been overlooked in the analysis of the factors that constrained the actualization of the MDGs, including goal 1. The Nigeria MDG office and the National Planning Commission, in their strategy document for achieving the MDGs identified the challenges to the achievement of MDG 1 to include:

> The lack of management capacity and access to affordable funds among small business entrepreneurs; The low level of agricultural

> mechanisation; The predominance of older people unfamiliar with modern technologies in agricultural production; Poor industrial processing and storage technology, resulting in high post-harvest losses and weak links with markets; Poor rural infrastructure, spurring migration and leading to high unemployment in urban areas; Huge under-investment in poverty alleviation projects, infrastructure and agricultural production in rural areas; and Poor water, sanitation and hygiene, leading to recurring diarrhoea and nematode infections, child malnutrition, low productivity and low incomes. (NMDG, 2010, P.23)

But the 2012 floods which ravaged the country brought into focus the impacts of climate change effects on the goals of MDG 1. The floods which were characterized by high tidal flow and an average height of 2.4 meters submerged communities, displaced persons and destroyed public infrastructure and utilities (Mmom & Aifesehi, 2013:218). About 7.1 million Nigerians were affected, resulting in 363 human deaths and the displacement of 2.1 million persons (Allen & Dube, 2012:119). The flood resulted in the destruction of farmlands/farms and other means of livelihoods such as fish farms/ponds, poultries, etc. thus destroying economic growth, particularly rural economies that were directly impacted. Scholars, researchers and practitioners have recognized climate change effects on the Niger Delta and the need for the adoption of adaptive strategies; however, emphasis is placed on farmers awareness of climate change and implications for the MDGs, determination of indigenous adaptive measures adopted by farmers and constraints to climate change adaptation (Uyigue & Agho, 2007; Ajayi, 2014; Akinro, Opeyemi, & Ologunagba, 2008; Nzeadibe, Chukwuone, Egbule, & Agu, 2011), but the need for the integration of adaptive strategies into poverty reduction policy or the definition of an adaptation to climate change framework for poverty reduction or achieving MDG 1 has been under indicated in the analysis. This paper attempts to address this.

The paper has two objectives: (1) To reflect on the actual and potential impact of climate change on the Niger Delta environment, means of livelihood, poverty, and the threat this posed to MDG 1; (2) To explore the integration of adaptation to climate change measures in poverty reduction policy in post MDG development agenda. The focus on the Niger Delta is informed by a number of reasons. Firstly, the Niger Delta accounts for about 450km of Nigeria's 853 km long coastline, where rising sea levels induced by climate change exacerbate coastal erosion and flooding. Secondly, 70 percent of the Niger Delta population lives in the coastal areas (Onuoha & Ezirim, 2010, p.8). Thirdly, fishing and farming, the dominant occupations of the people are easily impacted on by climatic changes as they depend directly on environmental resources. Fourthly, the region is just two metres above sea level (Singh, Moffat & Linden, 1995, p.8) and is characterised by high rainfall and seasonal flooding.

The paper is divided into five sections, including the introduction. The section which follows the introduction, ''Climate Change and the Risks to MDG 1 reflects on the climate change MDG 1 nexus. The third, "Adaptation to Climate

Change" makes a theoretical discourse on adaptation to climate change, while the fourth, ''the Niger Delta and Climate Change'' examines the challenges climate change pose to the Niger Delta environment and the economy. The fifth section, ''Niger Delta Beyond 2015; Bringing Adaptation into Poverty Reduction Policy'', attempts to define an adaptation to climate change framework for poverty reduction in the region. The last section, ''Challenges and the Way Forward: Concluding Remarks'' concludes the study by highlighting challenges to adaptation and suggestions on how they can be dealt with.

Climate Change and the Risks to MDG 1

This section explains the nature and causes of climate change and makes a theoretical analysis of its impact on the environment and economy. It further interrogates the issue of adaptation to climate change to provide the context of analysis for the study.

(a) Climate Change

Climate change is the variation in the Earth's global or regional climate overtime (Etuonovbe, 2008, p.4) as a result of natural variability or anthropogenic factors caused by increasing concentrations of greenhouse gases (GHGs). The production and consumption patterns of different regions and countries have resulted in the" emission of high volumes of gaseous materials such as carbon dioxide (CO2), methane (CH4) and Chlorofluorocarbons (CFC) into the atmosphere, leading to the absorption of the earth's radiation, warming of the earth's surface , and altering of the world's climate" (Efe, 2011, p.43). "The burning of fossil fuels (oils, natural gas and coal); burning of wood, wood products, and solid wastes; raising of livestock and the decomposition of organic wastes ion solid wastes landfills; combustion of solid wastes and fossil fuels in industrial and agricultural activities; bush burning; and deforestation" (Idowu, Ayoola, Opele, & Ikenweiwe, 2011:147) are the primary sources of GHGs that have resulted in global warming.

All countries of the world, both developed and developing contribute to climate change. For example, Russia, Nigeria, Iran, Iraq, Algeria, Angola, United States, Kazakhstan, Libya, and Saudi Arabia contribute to climate change through gas flaring. Data indicate that in 2010, these ten countries flared a total of 3,364 billion cubic feet of gas (ERA, 2007, P.7). Nigeria is a major culprit of gas flaring in the world. In 1970 for example, it flared 91.04 percent of the 8.04 trillion cubic feet of gas it produced (Adeyemo, 2008:64). Available information indicates that as at 1993, Nigeria flared gas more than any other country in the world and contributed significant release of CO_2 into the atmosphere estimated at 30 million tons in 1989 and 35 million tons in 1994 (Singh, Moffat & Linden, 1995, p. 50). Akinro, Opeyemi, & Ologunagba, (2008) have also noted that Nigeria is ''the highest emitter of greenhouses in Africa''. The country is reported to have 123 flare sites and some 45.8 billion kilowatts of heat are discharged into the atmosphere…. from flaring 1.8 billion cubic feet of gas every day'' (2008, p. 170).

Essentially, climate change manifests as ‘‘increases in global temperatures (or global warming); changes in cloud cover and precipitation particularly over lane; melting of ice crops and glaciers; and reduced snow cover and increases in ocean temperatures and ocean acidity’’ (Akinro, Opeyemi, & Ologunagba, 2008, p. 167). Global warming is expected to make the climate warmer, wetter, and wilder’ (Berghot & Lujala, 2012, p.147). On account of climate change, the earth’s temperature is estimated to increase by 0.3^0-1.1^0 since 1990, an increase that is expected to result in increase precipitation in about 2-3 percent for each degree of global warming and sea level rise by 50cm (Efe, 2011, p. 54). The Intergovernmental Panel on Climate Change (IPCC) has made some forecast on climate change impact on different regions of the world that raises serious concerns for development and human existence.

Table 1: Forecast on Climate Change Effects on different Regions of the World

Region	**Forecast**
North America	Decreasing snowpack in the western mountains; 5-20 percent increase in yields of rain-fed agriculture in some regions; increased frequency, intensity and duration of heat waves in cities that currently experience them
Latin America	Gradual replacement of tropical forest by savannah in eastern Amazonia; risk of significant biodiversity loss through species extinction in many tropical areas; significant changes in water availability for human consumption, agriculture and energy generation
Europe	Increased risk of inland flash floods; more frequent coastal flooding and increased erosion from storms and sea level rise; glacial retreat in mountainous areas; reduced snow cover and winter tourism; extensive species losses; reductions of crop productivity in southern Europe
Africa	By 2020, between 75 and 250 million people are projected to be exposed to increased water stress; yields from rain-fed agriculture could be reduced by up to 50 percent in some regions by 2020; agricultural production, including access to food may be severely compromised
Asia	Freshwater availability projected to decrease in Central, South, East and Southeast Asia by the 2050s; coastal areas will be at risk due to increased flooding; death rate from disease associated with floods and droughts expected to rise in some regions.

Source: Adapted from National Aeronautics and Space Administration (nd), Vital Signs of the Planet: Global Climate Change, www.nasa.gov

The above indicates the impacts of Climate change and the huge disaster that awaits the world if it remains unchecked. The impacts which are multidimensional are discussed in the next section

(b) The Effects of Climate Change

The literature has noted that climate change effects are environmental, social, economic and political. Although the discussion of the impacts was initially based on projections and potentialities, empirical literature has emerged to document actual impacts of climate change in some regions and countries. Droughts, floods, and typhoons have become typical environmental effects of climate change globally. However, because of the link between the environment, development and the social well-being of man, climate change has triggered socio-economic and political problems. An exciting debate has emerged on the linkages between climate change, economic growth, conflict, and political stability. One of such literatures made this point that:

> An evolving consensus that the earth is becoming warmer has led to increased interest in the social consequences of climate change. Along with rising sea levels, varying patterns of precipitation, vegetation, and possible resource scarcity, perhaps the most incendiary claims have to do with conflict and political violence. A second consensus has begun to emerge among policymakers and opinion leaders that global warming may well result in increased civil and even interstate warfare, as groups and nations compete for water, soil, or oil.... climate change will give rise to an increase in heated confrontations as communities compete in a warmer world (Gartzke, 2012, p. 177).

The point here links climate change to future resource scarcity and conflicts in countries, a debate that is hinged on the resource scarcity-violence nexus. Resource scarcity is linked to frustrations, discontent and grievances that create conditions for conflict (Evans, 2010; FT, 2010). Given that the environmental effects of climate change tend towards resource scarcity, the concern is that climate change effects can either trigger or aggravate conflict. However, the literature does not suggest a cause and effect relationship between climate change and conflict; neither does it argue that climate change can stand alone as a causal factor of conflict. Rather, it posits that climate induced resource scarcity makes society prone to violence in combination with other factors. While some look at this from the point of inter-state violence, others consider intra/inter ethnic or communal violence (Slettebak, 2012; Gartzke, 2012; Hendrix & Salehyan, 2012; Bergholt & Lujala, 2012).

The other point is that climate change impacts negatively on economic growth and by extension poverty reduction. Although there are no quantitative data to illustrate this point, empirical studies have provided a strong indication that climate change effects undermine economic growth. For example, Koubi, Bernauer, Kalbhenu, & Spilker (2012) noted in a study on "Climate Variability, Economic Growth, and Civil Conflict", that "rainfall growth increases economic growth in

Africa, just as higher temperatures have negative effects on economic growth in poor countries" (p. 117). Agreeing with this, Devitt & Tol (2012) notes that climate change slows growth and traps some countries in poverty, while Bergholt & Lujala (2012) insists that climate-related natural disasters impacts negatively on growth and highlighted the impacts of climate related disasters on economic activity to include- "income changes, demand and supply shocks, shifting terms of trade, and increased inflation (p. 148). In a study entitled, "A Review of Linkages between Climate Change, Agricultural Sustainability and Poverty in Malaysia", Siwar, Alam, Murad, & Al-Amin (2009) concluded that:

> The development rates of agriculture crop... accelerate in response to an increase in CO2 concentration from 160 ppm (parts per million) to 900 ppm with standard temperature (<35oC). But the increasing temperature above the tolerance limit (>26oC) and CO2 variation reduces the photosynthesis, increase the respiration and shorten the vegetation and grain-filling periods and ultimately decreases the overall Malaysian agriculture yields (p.315)

The issues raised above points to the negative impacts of climate change on economic growth. Climate change is seen as "one of the most serious environmental and human threats undermining the achievement of the MDGs" (Ajayi, 2014, p.4). The Global Leadership for Climate Action (GLCA) also makes a categorical point that climate change 'frustrates poverty alleviation programmes' (2009, p.10). Table 2 below provides some details on the nature and possible effects of climate change on the MDGs.

Table 2: The Implications of Climate Change for the MDGs

MDGs	**Effect of Climate Change**
Eradicate extreme poverty and hunger	Food security jeopardized; more intense disasters threaten livelihoods.
Achieve universal primary education	More vulnerable livelihoods mean more children engaged in employment; infrastructure damage from disasters.
Promote gender equality and empower women	Women make up two-thirds of world's poor and are more adversely impacted by disasters.
Reduce child mortality	Children more vulnerable to malaria and other diseases which are spread more widely by climate change.
Improve maternal health	Pregnant women are particularly more susceptible to malaria.
Combat HIV/AIDS, malaria and other diseases	Increased prevalence of mosquito-borne diseases.
Ensure environmental	Climate change indication of unsustainable practices.

sustainability	Move towards more energy-efficient models of consumption
Promote global partnerships for development	Wider forums must acknowledge the role of climate change in impacting MDGs.

Source: Adapted from Mitchell & Tanner, 2006, p.8; UNDP, 2006, pp. 43-44

In most cases, the poor depend on economic activities such as agriculture and forestry that are sensitive to climate; for this reason, adverse changes in climate conditions can undermine productivity and diminish livelihoods (USAID, 2007). According to the UNDP (2010):

> For 75% of the world's poor who live in rural areas and largely depend on natural resources such as forests, fisheries, water and marginal lands for their livelihoods and income, climate change is expected to accentuate poverty and hunger. Vulnerability is intensified by the limited number of adaptation strategies and coping mechanisms available to the poor owing to limited or lack of access to natural, physical, financial, human, and social capital. Development goals for poverty reduction and growth are, therefore, inextricably linked to climate change (p.2).

In Nigeria, aquaculture (fish farming) which is a major economic activity of the poor is vulnerable to flooding. Thus, sea level rise caused by climate change is a threat to livelihoods. Idowu, Ayoola, Opele & Ikenweiwe (2011) have noted that inadequate rainfall and extremely high temperatures which result in drought and loss of grazing land puts livestock production at risks and reduces the production of meat and milk, just as ''uncertainties and variations in the pattern of rainfall, and flooding devastate farmlands and instigate the migration of pests and diseases, noting further while high temperature smoother crops''…., drought and flooding reduces arable land ''noting that this results in crop decline'' (p.146-147). Although other studies have pointed to the fact the impact of climate change on agriculture could be negative or positive, depending on the climate scenario, "climate change adaptations have significant impact on farm productivity" (Apata, nd, pp. 31& 45). The interest of this study lies with adaptation given that despite mitigation measures, some "degree of climate change is unavoidable" (GCLA, 2009, p.10).

Adaptation to Climate Change

Although climate change presents risks which have negative implications for environmental and human security, it also comes with opportunities. Thus, understanding and planning for adaptation enables individuals and societies to exploit the opportunities, and at the same time reduce the risks (USAID, 2007). Adaptation refers to ''actions taken to help communities and ecosystems moderate, cope with or take advantage of actual or expected changes in climate conditions'' (USAID, 2007,

p.2). Essentially, the goal of Adaptation is to build resilience and reduce vulnerability, and can be anticipatory or reactive[1]. One way to achieve Adaptation is to ensure the development of adaptive capacity, the ability or potential of a system to respond to climate change by local communities. Adaptive capacity is ensured by factors that include political and economic processes; access to decision making and resources; social structures, relationships and gender. A proper mix of these factors results in high adaptive capacity which ensures quick response to climate change. Improving access to resources, education and information, infrastructure, institutional capacity and efficiency, reducing poverty, lowering inequities of resources and wealth among groups are issues that ensures the development of adaptive capacity (Mitchell & Tanner, 2006; USAID, 2007; Bizikova, Neal & Burton, 2008; GLCA, 2009; GTZ, nd).

Table 3: Adaptation to Climate Change Strategies

Strategy	**Objective/Description**
Prevention Loss	This seeks to reduce the susceptibility of exposure units (resources, group, and region) to climate change effects.
Tolerating Loss	This method tolerates short term effects of climate change on exposure units which can absorb the effects without long term damage or destruction.
Spreading or Sharing Loss	This approach distributes losses related to climate change effects to a larger region that is not directly affected. For example, is support to victims of climate related natural disasters by governments of other nations and non-governmental organizations
Changing Use or Activity	This strategy seeks to adjust resource use to adverse climate change effect. For example, "switching from the cultivation of water demanding crops to crops that are less water demanding''; or substituting high yielding/quick maturing crops for traditional crops that require longer time for maturity or changing occupation, for example, from crop-farming to fish farming, artisanal fishing to fish farming, or agriculture to poultry farming.
Changing Location	Relocation of people, production plants, etc to a more suitable location to avoid flooding, for example.
Restoration	This deals with restoring exposure units to their original state. For example, reclaiming erosion impacted land that is vulnerable to flooding or "restore a building that is prone to flood damage".

Source: Adapted from Efe, 2011, p.57

[1] Anticipatory adaptation is proactive, and it prepares to deal with expected environmental changes related to climate change, while Reactive adaptation responds to climate change related environmental problems.

Adaptation responds to the effects of climate change in a manner that prevents individuals and societies from loosing livelihood, infrastructure (roads for example) and basic social needs such as clean water and housing. It also harnesses opportunities of climate change such as increase in fish catch which comes with flooding in some environments. Table 4 below provides some illustrations.

Table 4: Illustrative Adaptations to Climate Change

Climate Issues	**Illustrative Adaptations**
Flooding, storm surges and sea level rise (coastal erosion)	Urban drainage system, higher levees, watershed restoration, lining the river bed and building channels through the city to divert flood waters, construction of groins, construction of breakwaters offshore
Water supply reduction	Construction of water dams, water conservation and demand management recycling of water
Rise in temperatures and increase in variability of precipitation	Construction of a water gate for flood irrigation, increase crop diversification, use of improved soil management practices, access to agriculture equipment and fertilizer
Flooding, longer wet season	Shift to flood tolerant crops, agro forestry, and aquaculture, construction of weirs, provision of upland grazing areas, new market development, reformed compensation programs for flood loss

Source: USAID, 2007, P. 3

Significantly, effective response to climate change adaptation requires that ‘‘national policy should be anchored in a country’s framework for economic growth and sustainable development, and integrated with its poverty reduction strategies’’ (GLCA, 2009, P.6). However, this is not the case in Nigeria at the moment and this is the concern of this paper as it relates to the Niger Delta

The Niger Delta and Climate Change

This section locates the setting of the study by discussing the geographic, environmental and socio-economic features of the Niger Delta and the nature of climate change impacts

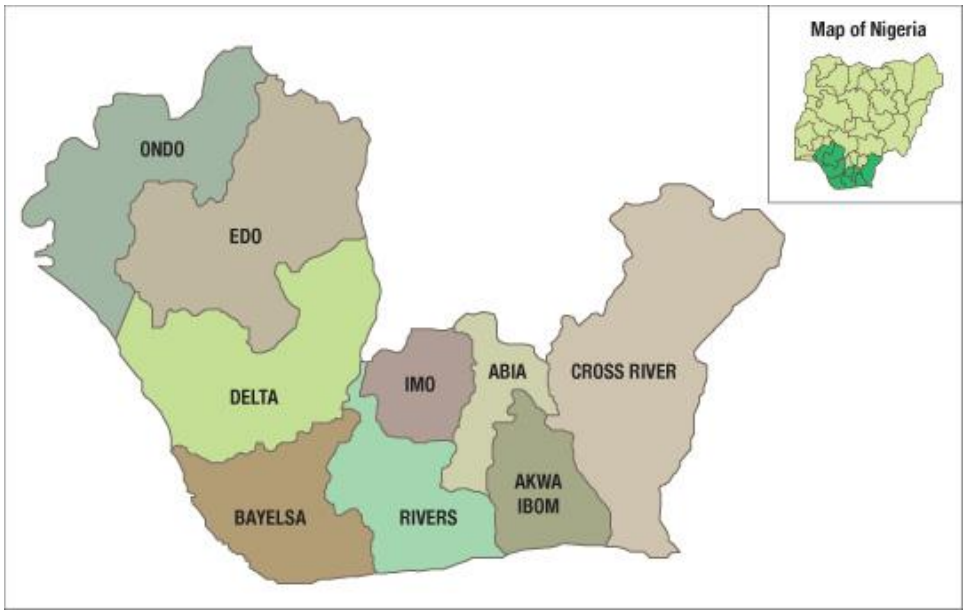
(a) The Niger Delta

The description of the Niger Delta has elicited two broad view points, one that describes it as a geographic entity and the other which sees it as an oil producing region. Whereas the geographic definition lists 6 states (Akwa-Ibom, Bayelsa, Cross River, Delta, Edo and Rivers) as the component states of the region, Abia, Imo and Ondo states are included in the conception of the Niger Delta as oil producing region. However, this later view widely described as the political definition of the Niger Delta is the accepted definition in policy circles (Etekpe, 2007; Tamuno, 2008; Omotola, 2010).

The Niger Delta is located in the southern part of Nigeria and has a landmass of about 112,110 kilometers, covering 9 states of the 36 states in Nigeria - Abia (4,877km^2), Akwa-Ibom (6,806km^2), Bayelsa (11,007km^2), Cross River (21,930km^2), Delta (17,163km^2), Edo (19,698km^2), Imo (5,165km^2) Ondo (15,086km^2), and Rivers (10,378km^2). The vast land mass of the region is spread across five ecological zones (low land rain forest zone, the montane zone, derived savannah zone, fresh water swamp zone and mangrove forest/vegetation zone) (NDDC, 2006)).

The topography of the Niger Delta is just two metres above sea level (Singh, Moffat & Linden, 1995, p.8). It is flat rain fall is high and it is made up of creeks, rivers and estuaries that take about 2,370 square kilometres of its land mass (Unique & Taylor, 2007, p.3) estimated at 20,000 square kilometres (Singh, Moffat & Linden, 1995, p.1).

Figure 1: Map of the Niger Delta Showing the Component States



Source: www.images.search.yahoo.com

A significant portion of the land area is made of rivers, creeks and swamps. This added to its coastal location makes it vulnerable to flooding. The Niger Delta, the cradle and centre of Nigeria's oil and gas industry has about 12,277 settlements and using the 20,000 population criteria for determining urban communities, about 99 percent of these are rural communities (UNDP, 2006, pp. 22-23). The distribution of settlements in the region show that 6,634 settlements are inhabited by a population of less than 1,000, while 4,781 settlements are inhabited by 1,000-5,000 persons. The settlements inhabited by 5,000-20,000 persons are 764 in number while those

inhabited by 20,000 persons and above are 98 (UNDP, 2006,P.23).

The poverty rate in the region was 15.3 percent in 1980, 43.8 percent in 1985, 43.9 percent in 1992, 59.0 percent in 1996, and 32.6 percent in 2004 (UNDP, 2006, P.35). Based on these figures, the population living in poverty rose from 13,847,220 in 1996 to 15,362,512 in 2010. These figures are not only worrisome but are indications that the Niger Delta did not catching up with the goals of MDG 1. Although this suggestion is based on the 2010 poverty profile, the conclusion is proper, given the socio-economic reality which suggests that poverty is getting worse in the region. Taking interest in climate change is thus significant for poverty reduction policy.

(b) Climate Change Effects in the Niger Delta

Climate change effects have impacted on the Niger Delta in different ways. Available data on the socio-economic impacts of climate change on the region indicates a threat to livelihoods and the exacerbation of poverty. Efe (2010, p.11) has noted that on account of climate change, the Niger Delta is 3^0 Centigrade warmer over 102 years' period (1907-2009). Between 1907 and 1941, the mean annual temperature was 30.4 Centigrade but this rose to 32.3 Centigrade between 1942 and 1976 and later 33.4 Centigrade between 1977 and 2009. Efe further noted that from 1956-2009, the mean temperature increased by 0.9^0 Centigrade (p.12), a situation blamed on oil production and gas flaring (Efe & Ndakara, 2010). The increase in temperature is linked to global warming which has contributed to sea level rise and increased rainfall. Scholars have amassed empirical evidence to demonstrate the increasing rainfall and its implications on the environment. For example, Efe (2010) has noted that:

> Rainfall distribution over the past one hundred and two years revealed that the Niger Delta region experienced 2901mm annual rainfall. This varies from 1984.2mm in 1907 to 3855.8 mm in 2001.The region in recent times (1977-2009) has experienced an increase of over 406mm rainfall than in the previous years (1907-1941). In fact, there was an increase in rainfall of over 153mm in 1942-1976 and 254mm in 1977-2009. Port Harcourt had the highest mean annual rainfall (2956.2 mm) and the lowest rainfall (2848.9mm) was experienced in Ondo. The rainfall experienced in the region comes in torrential down pour with high level of intensity which results into flooding (p. 15).

The increasing rainfall has made flooding worse destroying properties and creating socio-economic difficulties for inhabitants of the region. flaring (Efe & Ndakara, 2010). The increase in temperature is linked to global warming which has Mmom & Aifesehi, 2013, Ojeh & Ugboma (2012) and Efe (2010) noted flood effects in the Niger Delta to include: Socio-economic dislocations; destruction of farm lands, crops, and disruption of agricultural activities; physical damage to properties and

social infrastructure; loss of income and services; clean-up costs; pollution of water and ‘‘reduction or alteration of water quality’’; exposure of persons to water-borne diseases, and loss of human lives. Efe (2010) has amassed evidence to show the socio-economic impact of flooding in the region. Using the effect of a single rainfall event in 2010, the data show how inhabitants of nine cities in the region lost millions of Nigerian Naira (NGN) on account of damages to properties caused by flood resulting from persistent rainfall (see Table 6 below). Ojeh & Ugboma also noted the findings of a 2012 study on flood effects which indicated that NGN 3.9 billion (USD 23.9 million) was lost to flood and flooding induced erosion in Benin, the capital city of Edo State (p.24).

Table 6: Effects of Rainfall on Inhabitants of the Niger Delta

Affected Towns	**Properties Affected**	**Estimated Cost (NGN)**
Warri	Over 197 houses, 28 commercial shops, 67 workshops, 5 schools and several farmlands/fish ponds.	1,825,962
Forcados	Several houses and commercial shops, workshops and several farmlands/fish ponds.	1,678,234
Benin City	Over 192 houses, 118 commercial shops, 124 workshops, 11 schools and farm lands.	2,002,376
Yenagoa	186 houses, 27 stores, 34 workshops, 12 schools and several fish ponds.	2,015,309
Port Harcourt	Over 201 houses, 16 commercial shops, 89 workshops, 12 schools and several farm lands/ fish ponds.	2,023,543
Uyo	Over 93 houses, 18 commercial shops, 7 workshops, 3 schools and several farm lands.	1,345,789
Ikot Ekpene	Over 76 houses, 26 commercial shops, 10 workshops, 2 schools and several farm lands.	1,674,980
Calabar	Over 14 houses, 8 commercial shops, 5 workshops and several farm lands.	1,000,123
Ondo	Over 56 houses, 14 commercial shops, 8 workshops, 2 schools and farm lands.	1,543,863
Total		15,110,179

Source: Adapted from Efe, 2010, p.56

Related to rainfall and flooding are the implications of sea level rise on land resources in the region. It is noted for instance that a 0.2 meter rise in sea level would lead to displacement of about 200 villages in the Niger Delta region, while a projected sea level rise of more than 1 meter could flood much of the Niger Delta and force up to 80 per cent of the Delta’s population to higher ground (Onuoha & Ezirim, 2010, p.8-9). Other data indicate that at one metre sea level rise, the region will lose about 15000 square kilometers of land by the year 2100 (Uyigue & Ogbeibu, nd, p.4). Onuoha (2008) has provide information to support the threat of sea level rise to land

resource in the Niger Delta, by noting that although scientists dispute the possible 2.0 metre sea level rise by 2100, evidence on subsidence level in the region suggest that it may in fact be exceeded. Onuoha further noted that the measurement of a tank farm site showed a subsidence rate of 2.5 metres/year (p.1036). Table 7 below provides estimates of land loss to coastal erosion and expected number of displaced persons.

Table 7: Potential Land Loss to Coastal Erosion and Estimated Number of Persons that could be displaced

Estimated Land Loss to Coastal Erosion (km^2		Estimated Number of Persons Likely to be Displaced (millions)	
Low Estimates			
Sea level rise (metre)	Land Loss	Sea level rise	Number of displaced persons
0.2	2,846	0.2	0.10
0.5	7,453	0.5	o.25
1.0	15,125	1.0	0.47
2.0	18,398	2.0	0.21
High Estimates			
0.2	2,865		
0.5	7,500		
1.0	15,332		
2.0	18,803		

Source: Adapted from Awosika, *etal,* cited in Uyigue & Agho, 2007, p.9

Similar information on the menace of erosion in the Niger Delta indicates the socio-economic dangers it poses to the people. Information provided by Mitchell and Tanner (2006, p.33) suggests a high rate of erosion. The data for six erosion prone areas in the region indicates annual erosion rates of 18-24 metres (Ugborodo/Escravos), 20-22 metres (Forcados), 16-19 meters (Brass), 15-20metres (Karamo), 20-24 metres (Bonny) and 10-14 metre (Opobo). Although these studies did not mention the causes of this huge volume of erosion, Singh, Moffat and Linden (1995) have blamed the loss of sediment input to the Delta for the high rate of erosion. However, they noted the vulnerability of the region to climate change induced sea level rise and the associated consequences due to the widespread erosion and flooding that is natural to the region (pp.9 & 10). The UNDP (2006) also emphasized the interface by noting that floods on the region are exacerbated by rising sea levels, coastal erosion, and land subsidence (p. 74). Similarly, the Intergovernmental Panel on Climate Change (IPCC) has noted the vulnerability of the location of the Niger Delta to environmental problems induced by climate change, in particular, the effects of sea level rise such as flooding and coastal erosion, and the negative impacts on agriculture, fisheries, and infrastructure, including oil infrastructure (Singh, Moffat & Linden, 1995; Onuoha, 2008).

The environmental impact of climate change constrains three goals of

sustainable development (SD) – environmental protection (pollution control/sustainable exploitation of resources), wealth creation, and poverty reduction, making it a fundamental challenge to poverty reduction. The impact of climate change on livelihood and poverty is not difficult to appreciate when located in the context of the local economies of the Niger Delta. The Niger Delta Environmental Survey (NDES, 2004, p. 60) reported that 32.5 percent and 23.5 percent of the population engage in farming and fishing respectively. Other studies indicate that 37 percent engage in fishing, while 34 percent live on farming (Emuedo, 2011, p.126). The NDDC (2006, p.68) has also noted that 44. 2percent of the population engage in farming, fishing and forestry. Crop farming and fishing activities account for about 90% of all forms of economic activities in the rural areas and it is estimated that about 50%-68% of the active labour force engage in fishing and farming and other agriculture related activities (Celestine, 2003, p.2.33). Significantly, climate change has affected agriculture in the region due the high dependence of farmers on rain and changes in rainfall pattern. The change in rainfall pattern makes farmers to run into huge losses as delayed rainfall negatively affects crop yield (Uyigue & Agho, 2007). Furthermore, flood arising from high rainfall and sea-level rise destroys crops and farmlands, resulting in income lose, as shown in Table 8 below.

Table 8: Damage to Agricultural Crops in Niger Delta (Orashi Province) linked to Climate Change Effects

Agro Crops	Area Damaged (000ha)	Yield Loss (tons/ha)	Projected Production Loss (hundred tons)	Projected Loss in Monetary Terms (USD)
Cassava	3.7	25.1	4.1	105,000.00
Yam	2.0	12.4	2.5	74,217.00
Plantain	1.5	19.1	3.7	102,000.00
Banana	1.1	14.9	1.4	53,000.00
Cocoyam	0.5	X	0.7	5,000.00
Potatoes	1.5	5.7	0.9	7,000.00

Source: Adapted from Mmom & Aifesehi, 2013, p. 223

Reduction in crop yield and farm income contributes to reduction in the quality of food intake, purchasing power, life expectancy, access to basic social amenities such as health services and clean/safe water.

Climate change effects on fishing are both negative and positive. High rainfall and sea-level rise which results in flooding increases fish catch but it has also shown "negative signs to aquaculture production in ponds system" (Aphunu & Nwabeze, 2012, p.2). The effects of climate induced high temperatures are also noted to hinder fisheries production just as flooding of ponds reduces harvest for those engaged in aquaculture (Idowu, Ayoola, Opele, & Ikenweiwe, 2011). This is critical to poverty reduction in the Niger Delta for two reasons. Firstly, the decline in fish catch would mean declining income for fishermen/women. Significantly, the decline is huge as indicated by the Nigeria wide data. For example, Idowu, Ayoola, Opele, &

Ikenweiwe, (2011) reported ‘‘a decline in catch per unit effort (CPUE) of 0.85-0.45 metric tons/fisher/year from 2004-2008’’ (p.147). The second important point is that due to the effects of oil production, mainly oil spills, several fishermen/women have been forced to shift from artisanal fishing (particularly inland) to fish farming (aquaculture) involving the use of ponds. The negative effect of climate change on the pond system is thus a threat to means of livelihoods in the region.

Conclusion

Current poverty reduction policies in Nigeria and the Niger Delta focus on training and acquisition of vocational and entrepreneurship skills, access to credit, provision and access to basic social amenities/infrastructure, improvement in quality of education, access to education, support to farmers in areas such as fertilizer and improved seedlings, development of aquaculture, and improvement/development of the value chain of agricultural and aquaculture products. Thus far, there is no linkage between poverty reduction policy and climate change. Looking beyond 2015, it will be significant to bring adaptation to climate change into poverty reduction policy.

The focus on adaptation is informed by the fact that global warming would still occur, even in the face of mitigation measures. The analysis clearly indicates that climate change effects of high temperatures, sea-level rise, high rainfall and changing weather patterns impacts negatively on agriculture and fisheries (artisanal/fish farming). Given that farming and fishing are the major occupations of the people, particularly the rural dwellers who constitute the majority of the Niger Delta population, this need to be addressed if the population living in poverty has to reduce.

The study identified adaptive measures that have been adopted by farmers and fishermen and noted that the Nigerian government has not supported these measures. Furthermore, challenges to adaptation were noted and the study made the point that the government would need to address these challenges and also support the farmers and fishermen to strengthen the adaptive measures that have been adopted by the farmers and fishermen. The point was made that poverty reduction policy should address the climate related threats to farming and fishing by supporting adaptation strategies. The paper suggested that relevant Ministries, Departments and Agencies (MDAs) such as Agriculture, Environment, and Information should anchor the policy through prohibitive practices, education/enlightenment and funding. Among others, the paper suggested adaptation measures such as the introduction of quick and high yielding crop and fish species to enable farmers and fishermen cope with climate change effects.

The paper noted, however, that the success of adaptation policy in the region will depend on adequate knowledge of climate change, its effects and risks and the provision of advice and information to farmers and fish farmers by agricultural extension officers. In this regard, climate change education is imperative and the use of the mass media, farmers and fish farmers’ associations, community based associations, and community leadership structures appear to be the most effective mediums that can be utilized. On funding, current efforts to provide capital through micro-credit schemes and the Nigerian Agricultural and Cooperative Bank should

clearly target the funding of adaptation strategies, including making funds available to farmers and fishermen to replace equipment/implements or seedlings damaged by climate change effects, or the rehabilitation of farmlands or fishponds destroyed or rendered useless by climate related natural disasters.

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