FEDERAL MINISTRY OF ENVIRONMENT
ABUJA, NIGERIA
(SPECIAL CLIMATE CHANGE UNIT)

NATIONAL ENVIRONMENTAL, ECONOMIC AND DEVELOPMENT STUDY (NEEDS) FOR CLIMATE CHANGE IN NIGERIA

(Final Draft)

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EXECUTIVE SUMMARY

The weight of scientific evidence indicates that human-induced global climate change is occurring and is having biophysical, social and economic impacts at local, national, regional and global scales. It is likely to become more severe over the coming decades. Like many developing countries, climate change has become a major threat to the attainment of sustainable human development in Nigeria.

Responding to climate change from both mitigation and adaptation angles require strategic approaches from policy, regulatory and institutional frameworks and capacities. In general, the effectiveness of environmental and other policies in Nigeria, as well as their potentials to support adaptation and mitigation measures is yet to be fully realized. Most of the policies remain very broad and are not in position to provide the country the required focused response to climate change concerns of the country. While climate change is mentioned in some key government policies, there is yet to be specific policies or strategies for climate change adaptation and mitigation sector activities. The policy framework for aligning human development and climate change management remains largely undeveloped in the country. Nevertheless, Government has recognized the need to adapt exiting national policies, strategies and plans to address climate change response. Thus, it is ensuring that climate change adaptation and mitigation concerns are properly integrated into its current national development plan, known as Vision 20:2020.

Nigeria contributes minimally to greenhouse gas (GHG) emissions. The total GHG emissions (in CO_2 equivalent) for the three main greenhouse gases (CO_2, CH_4 and N_2O) and from the five main sectors (energy, industry, agriculture, land use change and forestry - LUCF – and waste) was about 330,946 Gg CO_2e in 2000. The GHG emissions were distributed unevenly between the three main gases, i.e. net CO_2 was 214,523 Gg, representing 65% of the National GHG emissions, methane (CH_4) was 109,319 Gg CO_2e or 33%; and nitrous oxide (N2O) totalled 7,104 Gg (CO_2e) or 2%.

Energy: Total CO_2 emissions in the energy sector amounted to about 108,000 Gg CO_2 in 1995, and this is expected to rise to 186,000 Gg CO_2 in 2020, 232,000 Gg CO_2 by year 2030 in the baseline scenario and 359,000 Gg CO_2 in 2050, at an average annual growth rate of 2.2%. Cumulative reduction from baseline till 2030 is 887,000 Gg CO_2.

The most promising mitigation options in the Nigeria's energy system are:

(i) introduction of compact fluorescent light (CFL) bulbs at a negative incremental cost of \$58/ton CO_2, with 5.155m ton CO_2 reduction capacity;
(ii) introduction of improved kerosene stoves in households, at a cost of \$21/ton of CO_2 reduced (6.122 m ton CO_2 reduction capacity) ;
(iii) fuel-oil to natural gas fuel substitution in the cement industry at \$18/ton (7.49m ton CO_2 reduction capacity);
(iv) improved electrical appliances (\$16/ton) and wood-stoves (\$3/ton) in the residential sector (9.566m ton CO_2 reduction capacity); and
(v) introduction of efficient motors in industry at \$15/ton (10.738m ton CO_2 reduction capacity).

Taking all the abatement options studied in the country's energy sector into consideration, the country's First Communication indicated that Nigeria's energy sector requires about US$874 million in 2020 and US$1.41 billion in 2050 as additional investments per year for the reduction of emissions to meet the non-binding emission reduction target of 25%. This translates to about US$174.8 million in 2020 and US$280 million in 2050 per year to reduce emissions by 5% in the energy sector.

Land use and forestry: By the year 2030 the total carbon that can be sequestered in the planted forest of about 7.5 million ha would be 638 MtC at an annual incremental rate of 16.0 MtC. The volume of carbon expected to be sequestered using the afforestation is well in excess of the estimated net emissions of 427.4 and 580.5 MtC at 1.3% and 2.6% deforestation rates respectively. The average initial cost of establishment is $500/ha or an average unit cost of $13.4/tC. This implies a capital need of $3.8 billion over a period of 40 years (about $94 million/yr). This scenario implies that for Nigeria to be able to sequester 578 MtC in 2020 and 958 MtC in 2050, it will require total or cumulative investments over the years of US$2.9 billion and US$4.8 billion in 2020 and 2050 respectively in the afforestation sector.

With regard to agroforestry as a mitigation option, a total of 311 MtC is projected to be sequestered by the year 2030 at an annual incremental rate of 7.77 MtC. The average initial cost of establishment is $320, while the unit cost of carbon is $17.17. Thus the total capital requirement for the 40-year period is $2.4 billion, or $60.1 million/year. The estimated volume of carbon expected to be stored over the period is less than that which will be released by 2030. This implies that this option alone is incapable of absorbing the released carbon and meeting the wood needs of the country. In terms of cost, above scenario implies that Nigeria should be able to sequester 233 MtC in 2020 and 466 MtC in 2050, requiring total or cumulative investments over the years of US$1.78 billion and US$2.98 billion in 2020 and 2050 respectively in agroforestry for climate change mitigation.

It is estimated that the initial cost of establishing protected forest units is about $79/ha, or at a unit cost of $0.73/tC. Thus, the capital requirement for the 40-year period is $758.4 million or $18.96 million/year. By the year 2030, a total of about 1036 MtC will be stored in the protected forests at annual incremental rate of 25.9MtC/year. This is almost two times the amount that needs to be sequestered in absorbing the atmospheric carbon in the country. In terms of cost, this scenario implies that Nigeria should be able to sequester 777 MtC in 2020 and 1554 MtC in 2050 through forest protection, requiring total or cumulative investments over the years of US$444 million and US$889 million in 2020 and 2050 respectively.

In terms of the country's climate change spatial vulnerability there is increasing evidence that a few areas of Nigeria are receiving higher amount of rainfall while others are receiving far less than normal, while temperatures are also generally higher than long-term mean conditions. In general, the nature of the changes in climate is not uniform across the country. In particular, the southwest is relatively less vulnerable than most other parts of the country. On the other hand, the northeast is most vulnerable. Understanding these spatial vulnerabilities is crucial to analyzing climate change impact and putting in place adaptation actions imperative to shaping climate-resilient development in Nigeria, as well as determining the cost implication of tackling the crisis.

Although Nigeria is yet to fully undertake detailed assessment of cost estimates for national adaptation actions and programmes, available information from various sources in the country indicate that it will be very costly for Nigeria to adapt well to anticipatory climate changes.

Using information from the recent national sectoral plans, estimates for adaptation were obtained for the priority sectors of agriculture and water resources, health and transport. The incremental cost in the agriculture and water resources is estimated at US$3.06 billion per year by 2020 and about US$5.50 billion in 2050. The health sector will require about US$3.06 billion in 2020. This is expected to increase to US$5.50 billion by the year 2050. Because of the poor transport conditions, the incremental cost for its adaptation will be high. The transport sector will require about US$5.33 billion and US$9.69 billion per year by 2020 and 2050 respectively.

The government of Nigeria has recognized the need to have a critical mass of financial resources to tackle climate change. To this end, the government is in the process of putting in place a *Nationally Strategic Climate Change Trust Fund* (NSCCTF) as a response to the need to broaden the scope of national interventions for impact at all levels of governance.

Some key lessons from this NEEDS study are as follows:

i. Responding adequately to climate change in Nigeria will, in general, be costly. It is, however, important for the country to undertake detailed assessment of mitigation and adaptation costs on sectoral basis in order to plan effectively for its response.
ii. Detailed vulnerability assessment and analysis of the key sectors of the economy is needed for a roper understanding of the impacts of climate change on the socio-economic development of the country. It is yet to be fully done.
iii. Nigeria is not performing as well as expected in envisioning the country's climate future and building dynamic response strategies, including adequate research and infrastructure development. A lot needs to be done in the area of climate change scenario analysis for both mitigation and adaptation response measures and their cost implications on aggregate basis. This should enable the country to plan very for its response to changes in its climatic conditions.
iv. Up-to-date data that is critical for climate change analysis and information dissemination, as well as improve our understanding of the climate problem in the context of sustainable national development, is not readily available in Nigeria in a coherent and accessible manner. The country will need to reinforce its efforts at putting in place a comprehensive climate change information management system that is updated periodically and readily accessible.
v. A proactive response, rather than a reactive response to climate change issues, will best serve the development needs of Nigeria in the context of sustainable development in general and the attainment of the objectives of its Vision 2020, in particular.
vi. Integrated and sustainable approach is grounded in the fact that mitigation is essential to avoid the unmanageable, while adaptation is no less essential to

manage the unavoidable. This should constitute the basis for the country's efforts at mainstreaming climate change into national sustainable development.

vii. Effective resource mobilization strategy, based on private-public-partnership (PPP) principle is critical to enhancing national capacity to capitalize on a number of existing and potential financial inflows into climate change at national, regional and international levels.

This NEEDS study points to the fact that Nigeria needs to adopt a more comprehensive and coordinated approach to the issues of climate change within its national development context than what currently obtains. Significant national efforts are needed to ensure that climate change concerns are properly integrated into the country's Vision 20:2020, which currently constitutes the country's blueprint for sustainable rapid socio-economic development. In the immediate, the country may focus on:

i. Finalizing a National Climate Change Policy and Response Strategy for the country;
ii. Finalizing and launching the *Nationally Strategic Climate Change Trust Fund;*
iii. Commissioning an extensive study for an up-to-date GHHG emission profile, projection and mitigation strategies;
iv. Commissioning an extensive study on the socio-economic impacts of climatic change;
v. Undertaking detailed costing of adaptation initiatives for planning purposes;
vi. Developing and implementing a well-formulated action plan and process for the mainstreaming of climate change into national development plans, particularly Vision 20:2020; and
vii. Strengthening national capacity at the Federal, State and Local Government levels to plan and respond effectively to climate change impacts, using evidence-based and well-researched scientific information.

1. OVERVIEW

1.1 Introduction:

Climate change is now a serious and long-term threat that has the potential to affect every part of the globe. The impacts of climate change are already being felt in many sectors, and significant harm from it is already occurring. Recent evidence indicates that the world has already warmed by 0.8^{o}C since the pre-industrial era. Under a business as usual scenario, global mean temperature could reach around 2^{o}C by 2060 (PACJA, 2009).

Climate models suggest that Africa's climate will generally become more variable, with high levels of uncertainty regarding climate projections in the Africa Sahel zone. Temperatures in West Africa, and particularly the Sahel, have increased more sharply than the global trend, and the average predicted rise in temperature between 1980/99 and 2080/99 is between 3°C and 4°C, which is more than 1.5 times the average global trend.

For Nigeria, a recent study by DFID (2009) predicts a possible sea level rise from 1990 levels to 0.3 m by 2020 and 1m by 2050, and rise in temperature of up to 3.2°C by 2050 under a high climate change scenario. This is based on IPCC climate change assumptions, latest research findings and results of a consultation exercise in Nigeria. The low estimate predictions are for sea level rise of 0.1 m and 0.2 m by 2020 and 2050 respectively, and a temperature increase of 0.4 to 1°C over the same time periods. Sea level rise of 1m could result in loss of 75% of the Niger Delta.

Accelerated climatic changes are expected to lead to potentially large impacts across Africa, including Nigeria, in the future. The scale of climate change will increase with high anthropogenic emissions, greenhouse gas (GHG) concentration, and average global temperature. PACJA's 2009 study predicts that the economic cost of a mean average global temperature of 1.5^{o}C by just after 2040 will result in mean economic cost equivalent to 1.7 per cent of Africa's GDP. As the mean temperature rises to 2.2^{o}C by 2060, economic cost increase to the equivalent of 3.4 per cent of Africa's GDP. By 2100, with a mean temperature rise of 4.1^{o}C, the economic costs are equivalent to about 10 per cent of the continent's GDP.

With specific reference to Nigeria, DFID's (2009) study[1] predicts that climate change could result in a loss in GDP of between 6% and 30% by 2050, worth an estimated US$ 100 to 460 billion dollars. By 2020, if no adaptation is implemented, between 2-11% of Nigeria's GDP could potentially be lost.

Because of the resultant disruption of economic activities, climate change is no longer just an environmental issues but a development issue. It has become a major threat to the sustainable development of Nigeria, like many other developing countries. The challenge now is to keep climate change from reversing all the development gains accumulated in the last few decades.

[1] The study is based on IPCC climate change assumptions and it used an Integrated Assessment Model.

Responding to climate change from both mitigation and adaptation angles require strategic approaches from policy, regulatory and institutional frameworks and capacities. While all sectors of the economy should be effectively addressed because of the multi-faceted nature of the expected impacts of climate change, the required financial resources and technological capabilities are severely limiting. Thus, mitigation and adaptation measures and financing needs be properly identified. In this regard, the United Nations Framework Convention on Climate Change (UNFCCC) is supporting Nigeria, as well as other 10 developing countries, under the National Economic and Development Study (NEEDS) initiative to facilitate the identification of priority mitigation and adaptation measures and how these measures can be effectively supported financially by various sources (global and national) of funding or investment.

This report presents the findings of a rapid assessment study on Nigeria's required sectoral mitigation and adaptation measures and financial needs within the context of advancing national sustainable development, while promptly addressing the development and environmental challenges of climate change in the country.

.1.2 National Climate Policy Development Framework - Climate-relevant Policies, Strategies and Plans in Nigeria

Climate-relevant policies are part of the political framework conditions and an important outcome of the political process of a country. This is because they limit and reflect the uses made of climate capacities of that country. A country with a focused climate change policy and mitigation and adaptation strategies should be in a better stage of preparedness to respond to climate change impacts than a country that has none. Sustainable policies are prerequisites for a strong national adaptive capacity.

Nigeria's response to climate change threats in the context of policy development framework remains a major challenge. Despite its high dependence on fossil fuel and high vulnerability to climate change, Nigeria is just in the process of putting in place a climate change policy or a response strategy that could address the issues of mitigation and adaptation measures and financial requirements and mobilization. There are ongoing frantic efforts to put then in place before the end of the year. However, there are a number of existing policies that could be adapted and implemented in anticipation of climate change to reduce its potential adverse effects.

National Environment Policy: Towards meeting the challenges of addressing the key environmental problems and challenges of land degradation (deforestation, desertification and coastal and marine environment erosion), and air and water pollution, urban decay and municipal waste, as well as hazards of drought, coastal surges, floods and erosion, the Nigerian government elaborated a *National Environmental Policy* in 1989. The policy was revised 1999 to accommodate new and emerging environmental concerns. The goal of the revised the policy is to achieve sustainable development in Nigeria and, in particular to (i) secure a quality of environment adequate for good health and well being; (ii) promote the sustainable use of natural resources; (iii) restore and maintain the ecosystem and ecological processes and preserve biodiversity; (iv) raise public awareness and promote understanding of linkages between environment and development; and (v) cooperate with government bodies and other countries and international organizations on environmental matters.

Nigeria has also enacted a number of specific policies and action plans for the implementation of the National Environment Policy. These policies that could be adapted to support national climate change mitigation and adaptation response efforts include (i) National Policy on Drought and Desertification; (ii) Drought Preparedness Plan; (iii) National Policy on Erosion, Flood Control and Coastal Zone Management; (iv) National Forest Policy; and (v) National Biodiversity Strategy and Action Plan. In addition, Nigeria has many laws and regulatory measures to promote sustainable environmental management in many sectors of the economy. Some of the critical laws that may have influence on climate change response, particularly as they relate to ecosystem adaptation, include (a) *National Park Service Act* – retained as Cap N65 LFN 2004 (for conservation and protection of natural resources (wildlife and plants) in national parks; (b) *Endangered Species (Control of International Trade and Traffic) Act*- retained as Cap E9 LFN 2004 (conservation of wild life and protection of threatened and endangered species).

The **National Policy on Drought and Desertification**, in particular, recognizes that climate change could intensify drought and desertification in the part of the country that are very prone to these environmental problems. Thus the policy emphasized the need to equip relevant agencies, institutions and citizens adequately to collect, analyze and use climate data effectively to ameliorate and combat drought and desertification. Specific implementation strategies for the policy include: (i) strengthening of agencies, institutions and facilities for the collection and analyses of meteorological and hydrological as well as for dissemination of information; (ii) upgrading the existing national early warning facilities for more efficient service delivery; (iii) developing appropriate awareness programmes for formal and informal education to enhance knowledge on climate and environment issues; and (iv) encouraging appropriate land use that enhances carbon dioxide sequestration, such as afforestation, reforestation and agro-forestry. This also reduces soil erosion and increase crop productivity for economic development

The **National Forest Policy** is geared towards ensuring sustainable forest management, promoting participatory process of development, facilitating private sector – forestry development and adopting an integrated approach to forestry development. Government is currently embarking on a number of afforestation programmes. Under the guidance of the African Union Commission, Nigeria is keying into the project on the "Green Wall Initiative" in which a "green wall" of trees (40 million trees annually in the next 10 years) will be planted across the dry-land area of Nigeria to not only push back deforestation and secure agriculture and livelihoods across the Sudano-Sahelian zone of the country, but also enhance the carbon sequestration of biological diversity resources in the region for climate change mitigation.

The goal of the **National Biodiversity Strategy and Action Plan** is to develop appropriate framework and programme instruments for the conservation of Nigeria's biological diversity and enhance its sustainable use by integrating biodiversity considerations into national planning, policy and decision-making processes. It provides frameworks for addressing (i) biodiversity conservation, (ii) sustainable use of biological resources, (iii) equitable sharing of benefits, (iv) conservation of agro-biodiversity, (v) biosafety, and (vi) biodiversity-industry interface, all of which should

improve the quality of the country's biological ecosystems to play the essential role of moderating the global carbon cycle and, therefore, climate.

The goal of the **National Erosion and Flood Control Policy** is to ensure coordinated and systematic measures in the management and control of the climate-related hazards and risks of erosion and floods to reduce their impacts on the people and the environment. Key strategies for the implementation of the policy are to: (i) evolve a mechanism for forecasting, monitoring and control of erosion and floods; (ii) review the land use laws and regulations; (iii) promote and strengthen training at all levels in erosion and flood prevention, management and control; (iv) creating public awareness to encourage participation; (iv) protection of the marginal lands by limiting utilization to their carrying capacity; (v) subjecting resources users and developers to guidelines in order to reduce the vulnerability of the environment to flood and erosion-related disasters; and (vi) providing early warning systems to avert the escalation of flood and erosion hazards. All these would have significant implications for climate change adaptation measures that would need to be adopted to increase people resilience.

***Agricultural Policy*:** The main objectives of the 2001 Nigerian Agricultural Policy include: (i) the achievement of self-sufficiency in basic food supply and the attainment of food security; (ii) increased production of agricultural raw materials for industries; (iii) increased production and processing of export crops, using improved production and processing technologies; (iv) generating gainful employment; (v) rational utilization of agricultural resources, improved protection of agricultural land resources from drought, desert encroachment, soil erosion and flood, and the general preservation of the environment for the sustainability of agricultural production; (vi) promotion of the increased application of modern technology to agricultural production; and, (vii) improvement in the quality of life of rural dwellers.

A key feature of the policy is to reduce risks and uncertainties in agriculture by reducing the natural hazard factor (*which may include climate change*) militating against agricultural production and security of investment. The policy framework covers many issues that may be impacted by climate change. They include (i) crops, livestock, fisheries and agro-forestry production, (ii) pest control, and (iii) water resources and irrigation.

***Water Policy*:** The National Water Policy seeks to improve on the nation's water resources management including the management of hydrological risks and vulnerabilities. Emphasis is for the assessment of water resources is to improve real time forecasting of hydrological phenomena, a major adaptation measure required to reduce societal vulnerability to the impacts

Coastal Resources: Nigeria has no clear policy directed at coastal zone management, and there has been persistent call for the country to have in place an integrated approach to coastal zone management. However, Nigeria is participating in the implementation of the UNDP/UNE/UNIDO/GEF project on *Combating coastal area degradation and living resources depletion in the Guinea Current Large Marine Ecosystem (GCLME) through regional actions. A major output of this project implementation is the development of Strategic Action Programme to address sustainable* management of the environment of the sub-region. Some of the remedial actions to address priority transboundary problems in the project portend good

opportunity for anticipatory adaptation response to climate-induced changes to the coastal environment in Nigeria.

Energy: Nigeria envisions a peaceful and prosperous nation driven increasingly by renewable energy. By the middle of the century, sustainable and affordable renewable energy will provide half of the country's total energy demand, thereby contributing to the country's efforts to keep GHG at barest minimum. It has the specific objectives:

- Expanding access to energy services and reducing poverty, especially in the rural areas;
- Stimulating economic growth, employment and empowerment;
- Increasing the scope and quality of rural services, including, schools, health services, water supply, information, entertainment and stemming the migration to urban areas;
- Reducing environmental degradation and health risks, particularly to vulnerable groups such as women and children;
- Improving learning, capacity-building, research and development on various renewable energy technologies in the country; and
- Providing a road map for achieving a substantial share of the national energy supply mix through renewable energy, thereby facilitating the achievement of an optimal energy mix.

Summary

An analysis of the above-mentioned environment-related and other sectoral policies as well as strategies and action plans that have been reviewed in this section indicates that Nigeria has many ongoing policy and strategy initiatives which activities, if properly implemented, can serve as adaptive climate change measures. For example, many of the initiatives in the National Action to Combat Desertification and in the implementation of the National Policy on Drought and Desertification (e.g. rehabilitation of oases) can be taken as anticipatory adaptation measures, even though they are not clearly spelt out. This is because they are capable of cushioning the effects of climate change on drought and desertification. Similarly, the Greenwall Initiative and Presidential Initiative on Afforestation, that are being implemented in the context of the Forest Policy initiative, will serve as anticipatory measures to combat desertification, land degradation and address climate change effects.

Similar inferences to the above can be made in the agriculture, water and even in the ongoing LME initiative for the coastal and marine environment. Thus we summarize that Nigeria has a number of policies, strategies and plans with potential of fine-tuning them into policy options for climate change adaptation in many vulnerable sectors of the country. These policies are capable of addressing desertification control, forests and ecosystem adaptation, and policy options for water resources, agriculture and even the coastal and marine environment that is vulnerable to sea level rise.

A major constraint is that government has not been able to put in place a comprehensive implementation strategy that will enable these policies to translate into meaningful inter-sectoral activities for sustainable environmental management, which could easily make these policies to become anticipatory adaptation options for

Nigeria's response to climate change. This is despite the fact that the issue of climate change has become of global prominence since the 1990s.

Despite the fact that Nigeria is a signatory to UNFCCC under the Non-Annex I parties, for which it is expected to meet some obligations (e.g. produce four key National Communications; produce National Adaptation Programmme of Action, undertake vulnerability and adaptation assessment, produce four in-depth review summaries; etc) the country has no *National Climate Change Policy and Strategy* that should have presented Nigeria's current and future efforts to address climate change vulnerability and adaptation. The First National Communication was produced November, 2003, while the process for the production of the Second National Communication should be completed sometime later in 2010.

The closest Nigeria is to having an acceptable adaptation response framework is a working document on *Adaptation Strategies of Action* prepared by HBS for the Special Climate Change Unit (SCCU) of the Federal Ministry of Environment, the Nationally Designated Authority for climate change in Nigeria. But there is no clear indication that the document has been adapted as a national plan of action. The SCCU is currently working in partnership with Heinrich Boell Foundation (HBF), Nigerian Environmental Study Action Team (NEST), Nigeria Climate Action Network (NigeriaCAN) and the UNDP to develop a National Adaptation Strategy and Plan of Action (NASPA) that will identify priority activities to enable Nigeria to respond to the critical needs of adapting to climate change. In addition, government is embarking on the process of putting in place a climate change policy.

In general, the effectiveness of environmental and other policies in Nigeria, as well as their potentials to support adaptation and mitigation measures is yet to be fully realized. The policies are very broad and are not in position to provide the country the required focused response to adaptation concerns of the country. While climate change is mentioned in some key government policies, an indication of Nigeria's little or no preparedness for climate change adaptation and mitigation is lack of any specific policies or strategies for climate change sector activities. The policy framework for aligning human development and climate change management efforts is largely undeveloped in the country. Government recognizes the need to adapt exiting national policies, strategies and plans to address climate change response. Thus, it is ensuring that climate change adaptation and mitigation concerns are properly integrated into its current national development plan, known as Vision 20:2020.

1.3 Current National Development Plan - Vision 20:2020

Government is in the process of finalizing a ten-year plan for stimulating Nigeria's economic growth and launching the country onto a path of sustained and rapid socio-economic development. The blueprint, known as Vision 20:2020, articulates Nigeria's economic growth and development strategies for the ten-year period between 2010 and 2020, and will be implemented using a series of medium term development plans. The goal of Nigeria's Vision 20:2020 is to position the country to become one of the top 20 economies in the world by 2020. A major objective of the vision is to stimulate economic growth and launch the country onto a path of sustained and rapid socio-economic development. It aims, among others, to reduce the impact of climate change

on socio-economic development processes in the overall context of preserving the environment for socio-economic development. In that regard, it would:

(i) strengthen environmental governance;
(ii) promote environmental education; and
(iii) optimize economic benefits from sustainable environmental management.

The Vision 2020 policy document is still at its infancy and needs to be fully legislated before the potential of mainstreaming climate change concerns into it can be realized. Government is, nevertheless, determined to accelerate the process of policy initiation and the implementation of the Vision.

1.4 GHG status, Projection and Mitigation Scenarios

1.4.1 Current status of GHG emissions

The Vision 20:2020 envisages a rapidly growing economy that will make Nigeria to significantly increase its energy production. As Nigeria's economy improves, its per capita greenhouse gas emissions may tend towards those of the developed nations of the world today, especially if it pursues an energy intensive development approach. This combined with continued gas flaring and a large population will further worsen Nigeria's standing as a key emitter of greenhouse gases globally.

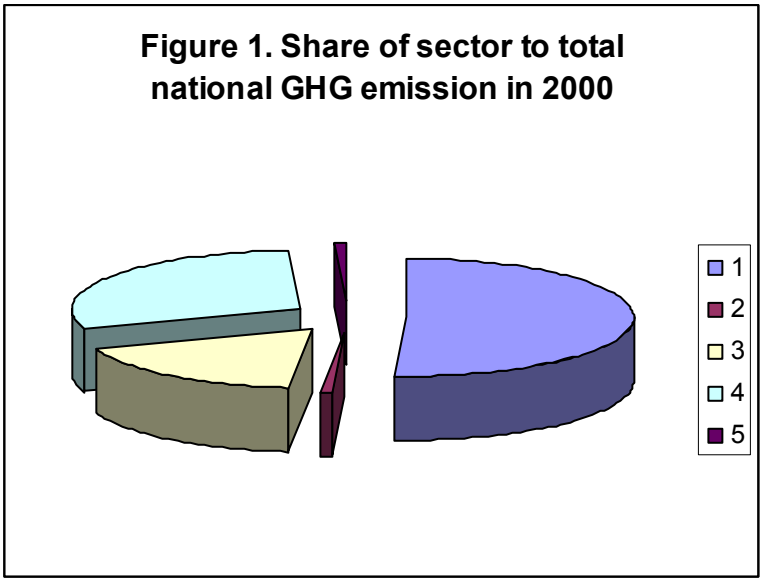
Since the submission of its First National Communication in 2003, Nigeria is yet to complete a comprehensive assessment of its greenhouse gases emissions. However, there is an ongoing assessment that should be completed and made available before the end of 2010. In view of the absence of very current information, we base the following analysis on the working papers and summary of findings used for the First Communication with projections to 2030. A major modification introduced was to use the GHG emission estimates for 2000 obtained by Obioh (2003) as the baseline. These estimates were made using the 1996 IPCC Reporting guidelines.

The total GHG emissions (in CO_2 equivalent) for the three main greenhouse gases (CO_2, CH_4 and N_2O) and from the five main sectors (energy, industry, agriculture, land use change and forestry - LUCF – and waste) was about 330,946 Gg CO_2e in 2000 (Table 1). The GHG emissions were distributed unevenly between the three main gases, i.e. net CO_2 was 214,523 Gg, representing 65% of the National GHG emissions, methane (CH_4) was 109,319 Gg CO_2e or 33%; and nitrous oxide (N2O) totalled 7,104 Gg (CO_2e) or 2% (Figure 1).

Table 1. Summary of 2000 GHG emission (in Gg)

	CO_2 emission	**CH_4**	**N_2O**	**CO_2e**
Energy	115,038	50,508	2,960	168,506
Industry	2,101			2,101
Agriculture		57,730	2,664	60,394
LUCF	97,384	184		97,568
Waste		897	1,480	2,377
TOTAL	214,523	109,319	7,104	330,946

Source: Obioh (2003)



1 = Energy; 2 =Industry; 3 = Agriculture; 4 = LUCF; 5 = Waste (from Figure 1)

1.4.2 GHG emissions projections to 2030 horizon under the business as usual

Energy: Using the IPCC Reference Approach to account for GHG emissions and accounting for only the carbon in fuels supplied to the economy, irrespective of the technologies consuming the fuels or whatever transformations they went through before, Adegbulugbe (2003) projected GHG emissions from 1995 to 2030. Emphasis was on the energy sector. In addition the IPCC default CO2 emission factors were adopted. Figure 2 shows the CO_2 emission trends for the energy sector in Nigeria (1995 – 2030). Both the baseline and GHG abatement scenarios were used in the analysis

Total CO_2 emissions in the energy sector amounted to about 108,000 Gg CO_2 in 1995, and this is expected to rise to 232,000 Gg CO2 by year 2030 in the baseline scenario, at an average annual growth rate of 2.2%. Also shown in Figure 2 is the CO_2 situation under an abatement scenario. Cumulative reduction from baseline is 887,000 Gg CO_2, of which the *no-regrets* (0US$/t$CO_2$ eq.) abatement options[2] contribute only 76,000 Gg CO_2 or 8% of total reduction; gas-flare reduction in the oil industry is responsible for the rest. Under these circumstances, the projected natural gas requirement of the economy for the two scenarios is shown in Figure 3[3].

[2] "No Regrets" abatement options are usually defined as those for which the cost of abatement is negative. This implies that implementation of such abatement options actually leads to cost savings for the entity implementing the abatement. Typical example is the retrofit of lighting systems from incandescent to compact fluorescent bulbs, which apart from reducing energy consumption per unit time, is also attained at a much lower cost, than the use of incandescent lighting system.

[3] The discussion in this section is from Adegbulugbe (2003) as described in the First National Communication

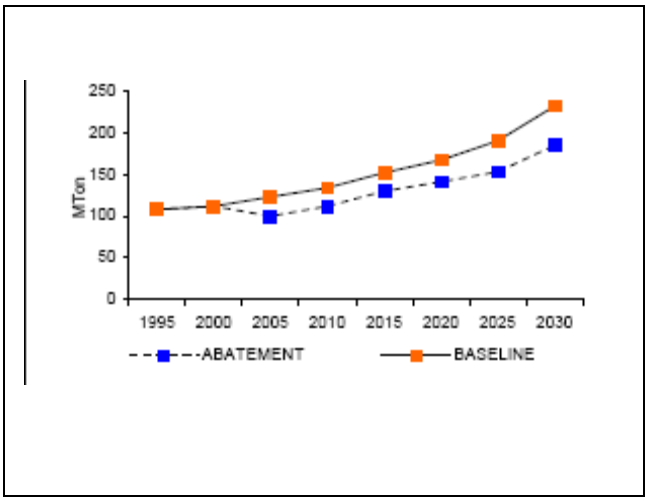


Figure 2. CO_2 emission projection for the energy sector in Nigeria to 2030 (Adebulugbe, 2003)

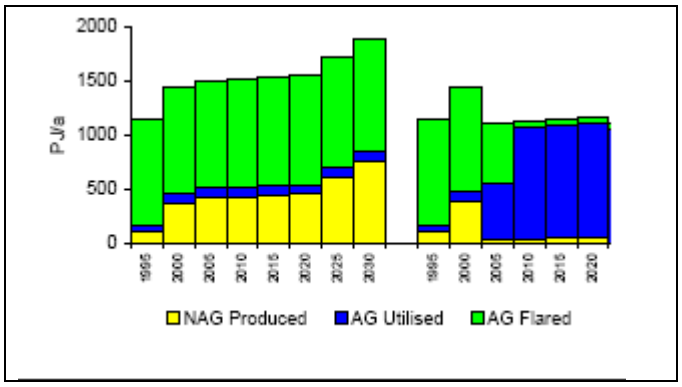


Figure 3.Natural Gas Production

In terms of energy supply, total primary energy consumption of Nigeria was 1270 PJ in 1995, projected to 1360PJ in year 2000, 1718 PJ in 2010, 2800PJ in 2020, and 3140PJ in 2030 in the baseline scenario. The analysis by Adegbulugbe (2003) indicated that of the total energy requirements in Nigeria in 1995, oil accounted for 47%, natural gas 14%, solid fuels 32%, while hydropower accounted for only 7%. By year 2030 however, the energy-mix would is expected to change to 52% oil, 25% natural gas, 16% solid fuels, while the contribution of hydropower remains at 7% hydro. Although the percentage contribution of hydro remains the same at about 7%, its absolute contribution to the energy supply is expected to increase considerably (Figure 4).

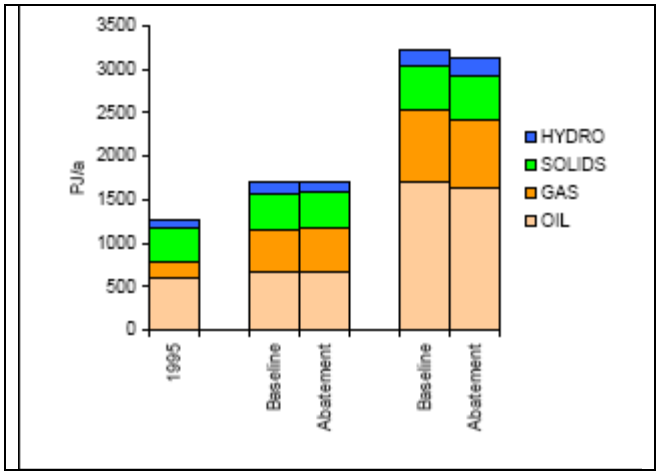


Figure 4. Primary energy consumption in Nigeria

Figure 5 shows the primary energy intensity in terms of the amount of primary energy consumed per GDP as indicative of the energy required to sustain the projected economic and structural developments for the period 1995-2030. It shows that primary energy intensity decreases with time over the period under investigation, an indication that the GDP is growing faster than primary energy consumption

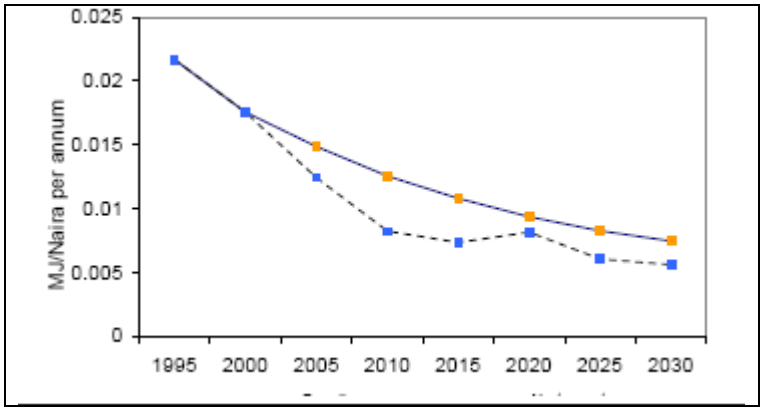


Figure 5 Primary energy intensity

Land use change and forestry: As expected, agriculture is the highest contributor to emission and uptake of carbon in the land use and forestry sector, being responsible for 63% and 70% respectively.

1.4.3 Abatement scenario(s) at 2030 time horizon.

Energy: Using the baseline total electricity production of 61 PJ in 1995, Nigeria has been projected to produce about 136 PJ in 2030. A reduction of about 20% from the projected 2030 production estimates are observed under the abatement scenario. Hydroelectricity has a lot of potentials in Nigeria's energy mix. For instance, in the abatement case, the share of the projected hydroelectric generation rises from 44% in 1995 to 64% in 2030 (Adegbulugbe, 2003).

In the residential and commercial subsector, out of the total of 494 PJ of energy requirements in 1995, fuelwood consumption accounted for about 78%. Total energy demand is projected to increase to 660 PJ in 2010 and 1030 PJ in 2030 at an average

rate of 2% per annum. Demand for electricity (29 PJ in 1995) is expected to drop from the baseline projection of 96PJ in 2030 to about 75 PJ in the abatement scenario, principally with the penetration of compact fluorescent bulbs into the Nigerian market.

Energy demand in the industrial sector is broken down to electricity, oil products (principally diesel and fuel oil), solid fuel consisting of coal, coke and charcoal, and gas. The fuel contributions in 1995 in the baseline scenario are oil products (37%), natural gas (49%) and electricity (11%). The remaining share of 3% is taken up by coal, coke and charcoal.

Land use change and forestry: The baseline scenario shows that at the current deforestation rate of 1.3%, emissions are expected to increase from 9.5 MtC/year in 1990 to about 15.5 MtC/year in 2030. At a deforestation rate of 2.6%, emission is expected to increase to about 26.5 Mt/C-year 2030. There would be an increasing demand for wood products corresponding to population growth rate. With the exception of pulpwood supply, it is expected that there would be a shortfall in the supply of other wood products. For instance, the annual demand for fuelwood is expected to rise from 1990 level of 73.9 million m^3 to 99.0 million m^3 in 2030, while supply to 63.0 million m^3 in 2030. About 4.5 million hectares of fuelwood plantation would have to be established in order to meet the shortfall in fuelwood supply. It is estimated that the land requirement, will be about 1.7 million ha in 2010, and 7.5 million ha in 2030.

1.4.4 Mitigation options

Energy: From the various analysis of Adegbulugbe (2003), the most promising mitigation options in the Nigerian energy system are the introduction of compact fluorescent light (CFL) bulbs at a negative incremental cost of \$58/Ton CO_2, followed by the introduction of improved kerosene stoves in households, at a cost of \$21/Ton of CO_2 reduced. Other viable options include fuel-oil to natural gas fuel substitution in the cement industry (\$18/Ton), introduction of efficient motors in the industry (\$15/Ton), and improved electrical appliances (\$16/Ton) and wood-stoves (\$3/Ton) in the residential sector.

Land use change and forestry: Analysis reported in the First National Communication has shown that afforestation could be the most effective mitigation measure for Nigeria in the land use change and forestry. The results of the analysis show that by the year 2030 the total carbon sequestered in the planted forest of about 7.5 million ha would be 638 MtC at an annual incremental rate of 16.0 MtC. The volume of carbon expected to be sequestered using the afforestation is well in excess of the estimated net emissions of 427.4 and 580.5 MtC at 1.3% and 2.6% deforestation rates respectively. The average initial cost of establishment is \$500/ha or an average unit cost of \$13.4/tC. This implies a capital need of \$3.8 billion over a period of 40 years (about \$94 million/yr).

With regard to agroforestry as a mitigation option, a total of 311 MtC is projected to be sequestered by the year 2030 at an annual incremental rate of 7.77 MtC. The average initial cost of establishment is \$320, while the unit cost of carbon is \$17.17. Thus the total capital requirement for the 40-year period is \$2.4 billion, or \$60.1

million/year. The estimated volume of carbon expected to be stored over the period is less than that which will be released by 2030. This implies that this option alone is incapable of absorbing the released carbon and meeting the wood needs of the country.

It is estimated that the initial cost of establishing protected forest units is about $79/ha, or at a unit cost of $0.73/tC. Thus, the capital requirement for the 40-year period is $758.4 million or $18.96 million/year. By the year 2030, a total of about 1036 MtC will be stored in the protected forests at annual incremental rate of 25.9MtC/year. This is almost two times the amount that needs to be sequestered in absorbing the atmospheric carbon in the country.

1.5 Vulnerability and Adaptation Assessments and Scenarios

1.5.1 Vulnerability indices

Nigeria's economy and other sectors of development are very vulnerable to climate change. Figure 6 shows the relative vulnerability of Nigeria among the countries of the world. It demonstrates that Nigeria is one of the most vulnerable countries in the world. The assessment of Nigeria's vulnerability to climate change in various sectors is critical to determining the impacts of as well as planning appropriately costed adaptation strategies to addressing climate change in the country. Figure 6 shows the relative vulnerability of Nigeria among the countries of the world. It demonstrates that Nigeria is one of the most vulnerable countries in the world.

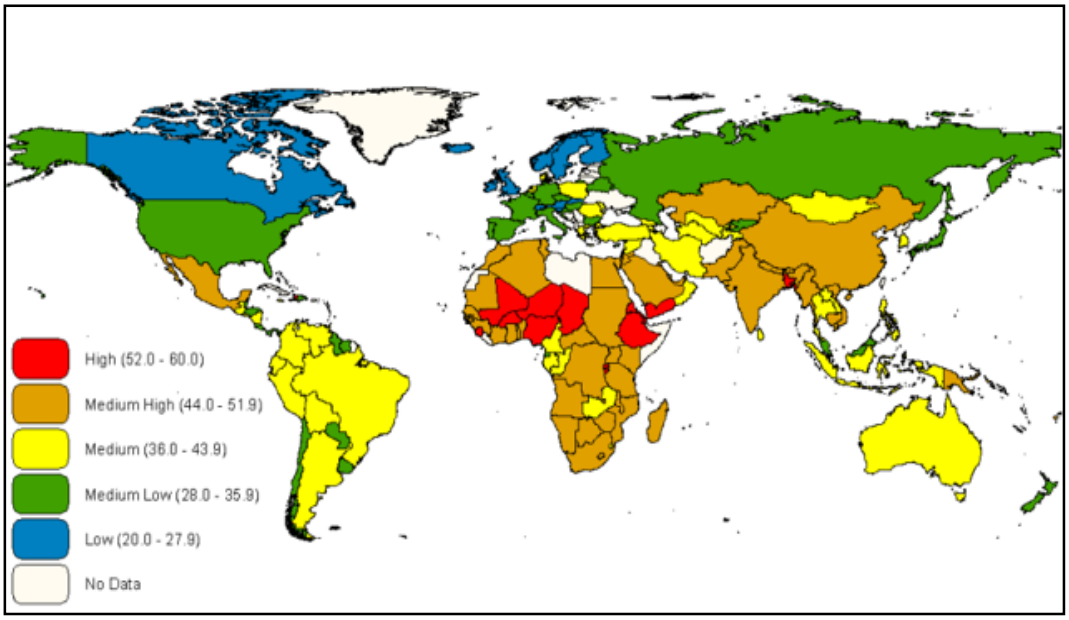


Figure 6: Relative Vulnerability of Nigeria among the Countries of the World

A recently nationally commissioned study used the *Indicator Method*, to determine the spatial changes in the vulnerability of Nigeria on geopolitical basis. The study focussed on three principal determinants of vulnerability – adaptive capacity, sensitivity and exposure. The indicators used in the study were a combinations of many variables ranging from physical (e.g. rainfall, temperature, changes in sea level,

relief, soil conditions etc.) to socio-economic (e.g. education, assets, income, aceess to information, services and technology, poverty, etc.), and they were sufficiently broad in relevance to allow a meaningful assessment of vulnerability of different parts of the country to climate change. Vulnerability was defined as:

:

$$V = f(I - AdC),$$

where V is vulnerability, I potential impact, and AdC is adaptive capacity. Since vulnerability was taken as a function of AdC, sensitivity and exposure, it was thus the addition of exposure and sensitivity. The following are some of the spatial implications of the vulnerability analysis for Nigeria.

Adaptive capacity: Figure 7 depicts the broad variation of adaptive capacities across the country. It shows that the north-eastern zone has the least adaptive capacity, followed by the north-western zone. The south-western sub-region has highest adaptive capacity, followed by the southeast. The pattern is a general reflection of both the geographical extent and level of socio-economic development of the country, and implies that special attention must be given to improving the factors of adaptive capacity in the north-eastern and north-western zones of the country.

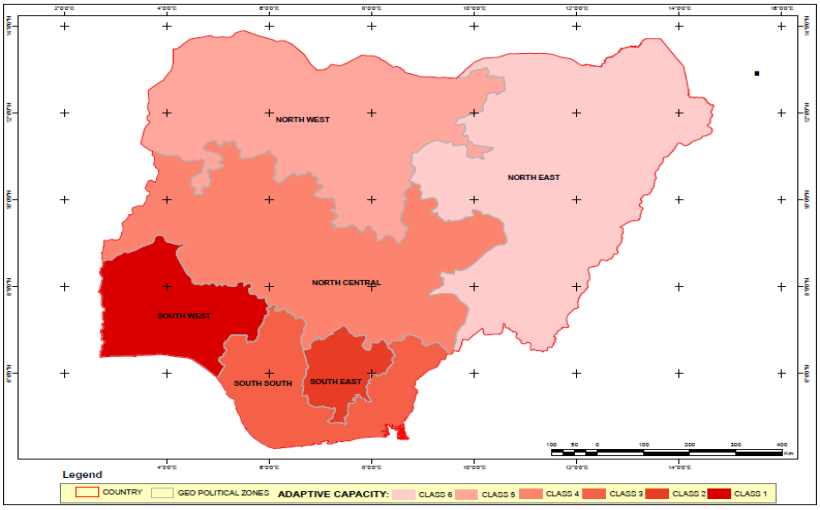


Figure 7: Spatial Variation in relative adaptive capacity for climate change over Nigeria

Sensitivity: The spatial variation of the country's sensitivity to climate change is given in Figure 8. The north central has the lowest sensitivity, while the south-south has the highest. The relatively higher value of sensitivity in the north-western zone compared with the other two zones in the north is associated with presence of large human-made water bodies that are used for irrigation in the zone.

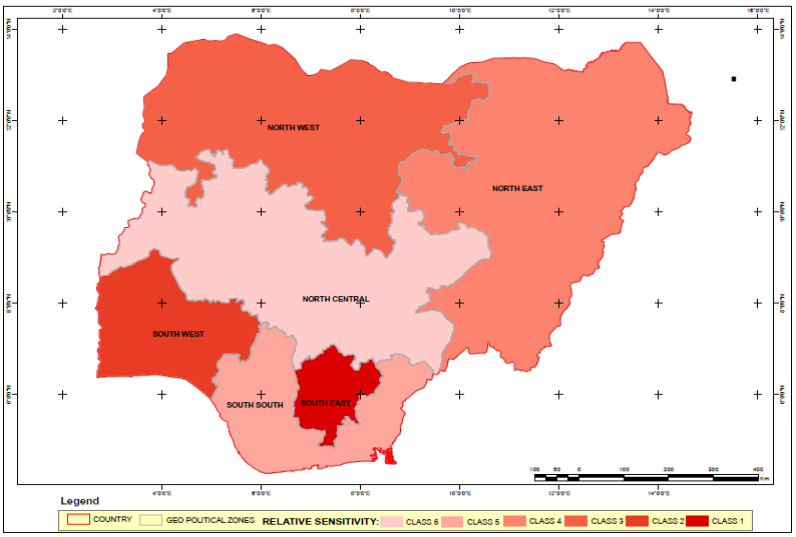


Figure 8: Spatial Variation in relative sensitivity to climate change over Nigeria

Exposure: The relative exposure of the various parts of Nigeria to climate change shows that the southwest is the least exposed while the most exposed are the northeast and southeast zones (Figure 9). Clearly, exposure to the challenges of climate change is not a purely regional phenomenon in terms of north/south divide. Rather, it is a wholly national phenomenon, which implies that exposure factors should be addressed in the various parts of the country. For example, while rainfall decline and, therefore water supply, is an exposure issue in the northern part while land management to prevent water loss through infiltration is crucial in the south east.

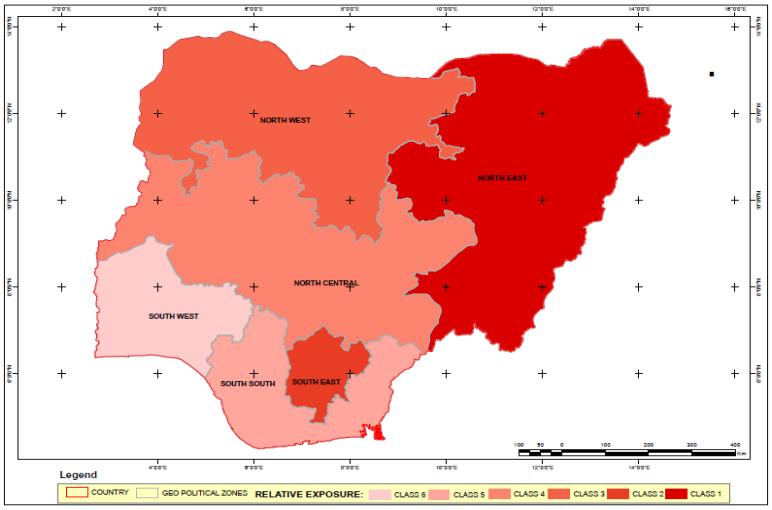


Figure 9: Spatial Variation in relative exposure for climate change over Nigeria

Relative vulnerability: The relative vulnerability of the six geopolitical zones of Nigeria is shown in Figure 10. There is a general south-north divide, but the south west is relatively the least vulnerable of the zones. The three zones in the north show higher vulnerability when compared with those in the south, a reflection of the higher rainfall and certain better socio-economic development in the south. The south-south shows highest relative variability of the three zones in the south, reflecting the

challenges of coastal flooding and erosion as well as petroleum exploration and exploitation in that part of the country.

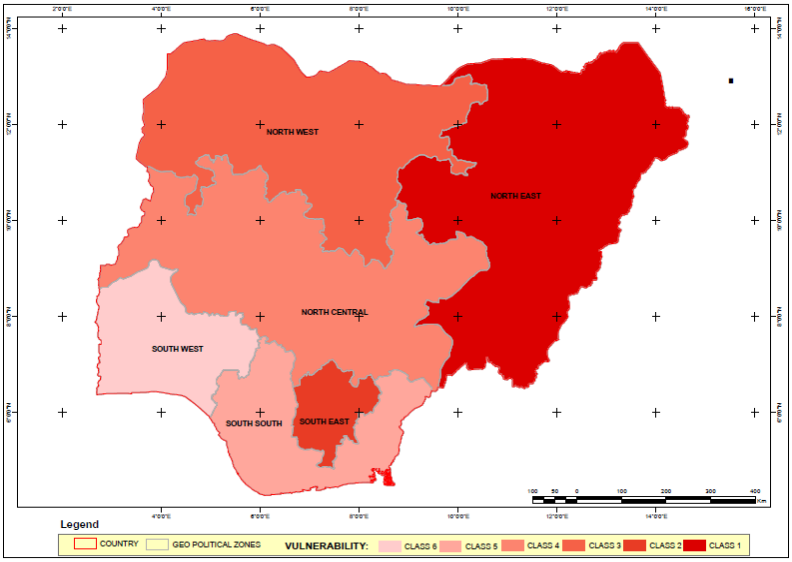


Figure 10: Spatial Variation in relative vulnerability to climate change over Nigeria

Coastal and marine environment: Figure 11 depicts the spatial pattern of vulnerabilities along the Nigerian coast. It shows that the Niger delta region has the largest spread and depth of vulnerability of the country's marine and coastal environment.

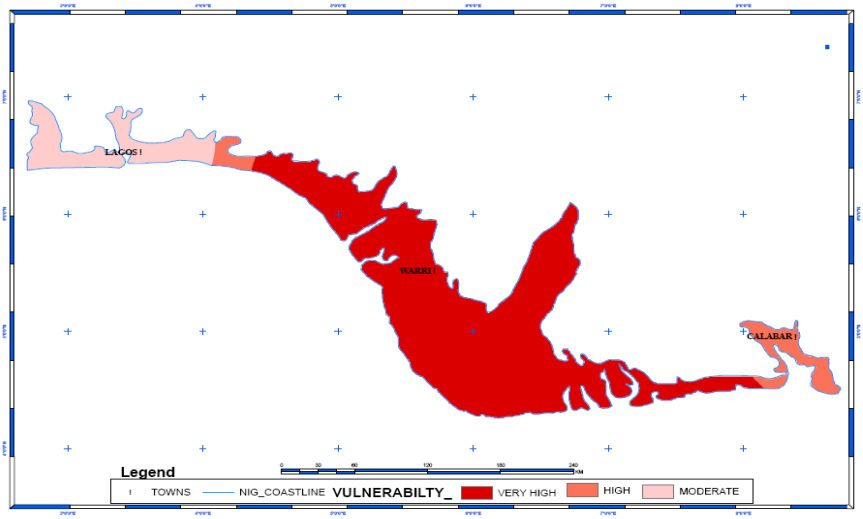


Figure 11: Spatial variation in the relative vulnerabilities along the coast

Summary: Climatic analysis shows that Nigeria has been experiencing climatic changes. Using physical and socio-economic variables to assess the vulnerability of the country to climate change shows that a few areas of Nigeria are receiving higher amount of rainfall while others are receiving far less than normal, while temperatures are also generally higher than long-term mean conditions. In general, the nature of the changes in climate is not uniform across the country. In particular, the southwest is relatively less vulnerable than most other parts of the country. On the other hand, the northeast is most vulnerable. Understanding these spatial vulnerabilities is crucial to analyzing climate change impact and putting in place adaptation actions imperative to

shaping climate-resilient development in Nigeria, as well as determining the cost implication of tackling the crisis.

1.5.2 Sectoral analysis

The vulnerability analysis assessment was also carried out for a number of sectors in which adaptation is critical for Nigeria. They included water resources, agriculture (crop production and livestock), forest and forestry, coastal areas, energy, human health, settlements, tourism, population, industry and transport, in addition to cross-cutting sectoral issues such as gender. The following is based on various sectoral studies (see e.g. Adesina et al, 2010; Federal Government of Nigeria's Working Papers of the Vision 2020 Technical Working Groups; 2009; Oladipo, 2008).

Water: Nigeria has a vast expanse of fresh water surfaces in excess of 20 million hectares that yield more than 214 cubic kilometres of fresh water. About 53 cubic kilometres of fresh water is additionally available from other sources including groundwater and rainfall over the country's geographic space. However, with a population of over 150 million people, the country's water sector remains highly vulnerable to climate change, particularly with respect to fresh water supply,

In addition to climate change, declining trends in the in-flow of water into dams due to decreasing rainy season, poor rural water redistribution infrastructure, persistent pollution of fresh water resources from various sources (e.g. oil spillages, agriculture, industrial and domestic waste, mining etc.) and wetland degradation, through widespread occurrence of floating weeds, affect the vulnerability of the water sector in Nigeria. A considerable proportion of the population is at risk of water stress, with less than 40% with potable water. Also, hydro-electric power generation suffers frequently from low in-flow into the dams, and water transportation along inland channels has also been negatively impacted. The situation is expected to worsen in the very near future and it requires that the country puts in place appropriate preparedness.

***Agriculture*:** Agriculture is the main source of food and the main employer of labour in Nigeria, employing over 70% of the population, and contributing to about 40% of the national economy.Nigeria is exposed to a range of climate conditions and extreme weather events that have significant implication for the country's food security. Changes in the sea surface temperature and the fluctuations in the latitudinal positions of the Inter-tropical Discontinuity (ITD) strongly influence rainfall patterns in the country, bringing periodic drought in the north and rising sea levels in the south. Moreover, storm surges, and extreme rainfall events are common in the coastal areas of the country. Climate change will significantly alter the dynamics of these events, possibly increasing their frequency and intensity in many parts of the country.

Low-lying areas along the coast, including the Niger Delta, will face the highest exposure to rising sea levels, which will increase the risk of floods that might affect millions of people in the region. In the same vein, increased drought frequency in the northern part of the country will have devastating effects on agriculture. Rainfall decline would also affect the productivity of wetlands. Also, land and water degradation— important causes of crop yield decreases—will also make agriculture in many parts of the country more sensitive to a changing climate.

Crop failures and yield losses that are likely to accompany climate change and severe variability would exacerbate the problem and create greater health concerns particularly for the poor in the country. They would also have adverse effects on many important economic activities associated with the processing, distribution and sale of food items and allied products. This is already evident at the household, artisanal and industrial processing levels.

Under a "business as usual scenario", agricultural productivity in general could decline between 10 to 25 per cent by 2080. For some parts of the country, the decline in yield in rainfed agriculture could be as much as 50 percent. Such trends clearly threaten the achievement of the Millennium Development Goals (MDGs). Rural households engaged as subsistence and smallholder farmers are most vulnerable to the impacts of climate change on agriculture. They may be affected in the following ways:

- increased likelihood of crop failure;
- increase in diseases and mortality of livestock, and/or forced sales of livestock at disadvantageous prices;
- increased livelihood insecurity, resulting in assets sale, indebtedness, out-migration and dependency on food aid; and
- downward spiral in human development indicators, such as health and education.

Such impacts will further aggravate the stresses already associated with subsistence production, such as isolated location, small farm size, informal land tenure, low levels of technology and narrow employment options, in addition to unpredictable and uneven exposure to world markets that smallholder farmers particularly risk-prone in the face of climate change.

With nearly 70% of the country's population depending on agriculture for sustainable livelihoods, and agriculture still contributing nearly 40% of the country's GDP, the country is highly vulnerable to climate variability and long-term climate change, which could result in higher food prices, and lower domestic revenues. There would also be indirect effects of climate change on agriculture include the effects on pests and diseases and the impacts of these on agricultural production, the impacts on health, and the impacts on agro-related socio-economic activities. Various pests, including rice stink bug, lima-bean pod borer, rice weevil, and soybean pod borer would probably expand their distribution areas in the event of climate change.

***Coastal Areas*:** The coastline of Nigeria is already undergoing pronounced morphological changes as a result of natural and anthropogenic activities. The natural phenomena include occasional sea surges and tidal waves, while human activities include (i) haphazard construction of ill-designed jetties and groynes, (ii) sand mining, (iii) unplanned and accelerated infrastructural development, (iv) pollution and (v) general land degradation. Accelerated sea level rise (ASLR) of 0.5 - 1m that is anticipated for Nigeria would most likely worsen these problems. Many low lying areas will be affected by ASLR and increased flooding from storm surges due to global warming. Beach erosion could pose more threat as a result of ill-designed jetties/groynes which could cause alterations in current directions with the result that erosion could shift to other places as being witnessed on the Bar Beach on Victoria

Island, Lagos. The filling up of some mangrove wetlands for development is already causing flooding in many areas and could be worsened by climate-change related ASLR. With the "business as usual" scenario, about 75% of the population living within 200 km of the coast that derive livelihoods from coastal & marine ecosystems will be affected.

***Forest and Forestry*:** The total area occupied by reserved forests in Nigeria is less than 10 per cent of the total landmass. The remaining forest area in Nigeria will likely disappear by 2020 if the current rate of forest depletion continues unabated. The value of lost forest cover has been estimated at US$750 million annually at 1989 prices. The trend is being aggravated by growing climatic variabilities. The impacts of the climatic variability include the difficulty of tree replanting, retardation of the regeneration process, death of trees, and loss of habitat as well as depreciation species diversity.

Energy: With a total installed electricity generation capacity of about 6000MW, and actual generation of between 2000MW and 3000MW to serve about 150 million people, the electricity demand in Nigeria far outstrips the supply and the supply is epileptic in nature. The country is currently faced with acute electricity problems, which is hindering its development despite the availability of vast natural resources in the country. As a result of this major shortfall in capacity, most households and businesses have to resort to private fossil fuel generating sets to supplement power supply. These private fossil fuel generating sets (now an essential part of the Nigerian landscape) are major sources of anthropogenic greenhouse gas emissions.

An analysis of the power generation capacity required to support the Vision 2020 economic vision shows that by 2020 Nigeria will need to generate electricity in the range of between 25,000MW to 40,000MW. This is based on the assumption that the country will take a less energy intensive growth path (energy intensity of less than 0.4) with lower electricity consumption, KWh per unit of GDP.

In order to achieve this growth aspiration, it would be necessary that alternative energy resources – hydro, solar, wind, biomass, coal and nuclear- are harnessed to reduce the country's reliance on gas fired power plants and also to contain the negative impacts of fossil-dependent energy sources.

Health: Human health in Nigeria in general is in a poor state. Life expectancy at birth is 43.8 years, infant mortality, 800 per 100,000 live births and maternal mortality, 100 in 100,000. Also, the prevalence of infectious and parasitic diseases like malaria (141 in 100,000), tuberculosis (282 in 100,000), HIV/AIDS (3.9%) and *Schistosomiasis,* among others, remain very high. Furthermore, diseases such as diabetics and cardio-vascular diseases that are often associated with increasing socio-economic wellbeing are becoming significant health problems in the country. Only 48% of the population has "sustainable" access to clean water and just about 44% had good sanitation.

The rather poor human health conditions of many Nigerians make them highly vulnerable to climate change. This could occur in many ways. Some of the direct effects of their vulnerability would include deaths, stroke, illness and injury due to increased exposure to heat waves and effects upon respiratory systems. Indirect effects of climate change and sea level rise would include altered spread and

transmission of vector-borne diseases (including malaria etc.) and altered transmission of contagious diseases (including cholera, influenza etc). Different ecological zones will display different degrees of vulnerability, but details are yet to be fully ascertained.

Urbanization and Physical Infrastructure: Nigeria has one of the highest urbanization rates in the world. A recent estimate by government projected that by 2020, 46% of Nigerians will live in urban areas. Pointing strongly in this direction is the fact that many erstwhile villages are already transiting to urban centres as more population concentrate in them. The rate of urbanization which was 15% in 1950 is projected to about 55.9% by 2015. Poor planning and uncoordinated development of urban settlements are making most of the urban centres and physical infrastructure highly vulnerable to climate change impacts.

Climate change and climate variability would aggravate the subsisting challenges in urban and rural areas of the country. For instance, erratic rainfalls with large gaps between events will impact on access to safe water and good sanitation in settlements and increased temperature will exacerbate heat stress.

Tourism: Tourism, one of Nigeria's fastest growing industries, is based on wildlife, natural reserves, coastal resorts, and an abundant water supply for recreation. Many tourist attractions are located along the coastal zone of the country, thus making them highly vulnerable to sea level rise due to global warming and climate change. These tourist attractions range from modern architectural basis through traditional relics to recreational grounds like beaches. River deltas and maritime wetlands are also potentially endangered, while the existence of coastal settlements, including large cities, is threatened. With the destruction of a lot of these features, most of the socio-cultural features (e.g., the first Christian Church in Badagry, near Lagos) will be threatened. Those tourist-attracting traditional festivals (e.g. Argungu festival on river Argungu in Kebbi State) may decline to the extent that climate change induces shrinkage of such rivers. The anticipated loss of wildlife following the destruction of wildlife sanctuaries and reserves due to reduced vegetation as a result of climate change would discourage tourism.

Transportation: While detailed vulnerability analysis are yet to be undertaken, Nigeria's transport systems will not escape the effects of global warming and climate change. For example, higher sea level rise may require costly changes to other ports and coastal roads and railways as the current means of communications along the coast may be covered by the intruding sea water or washed away by erosion. Changes in lake and river levels would also affect inland navigation, as witnessed by the recent dredging of river Niger at a cost of aboutUS$100 million. More frequent storms would affect shipping and other forms of transport. Also, increased temperatures will exacerbate the problems of road and railways, as for example, the roads will become very hot for vehicle tires. Increased temperatures may also expose these vehicles to increased hazards of road accidents. In addition, increased hot weather could cause increased rail length and consequently potential hazards of rail transportation. Any change in prevailing winds and increased dust haze would affect the safety and efficiency of take-off of flights. Airports near the ocean may also be vulnerable to sea level rise. If sea level should rise, for instance, drainage would be needed at the

international airports of Lagos and Port Harcourt and other coastal airports at rather exorbitant costs.

1.5.3 Scenarios at 2020 and 2050 time horizons for either economy-wide or for identified priority sectors.

Nigeria is yet to finalize a full fledged scenario analysis of the vulnerability of various sectors of the country's economy to climate change over a long-term horizon. However, inferences from just about four sectors (water, coastal areas, forestry and energy) for which some projections are available indicate clearly that the country's vulnerability in the long-term remains rather precarious.

Water: Figure 12 shows that the state of water supply, which is hardly able to meet the demand levels, will remain more precarious by 2020 when the requirement of meeting the demands of about 83% of the ever increasing population would be the target of the country's development vision.

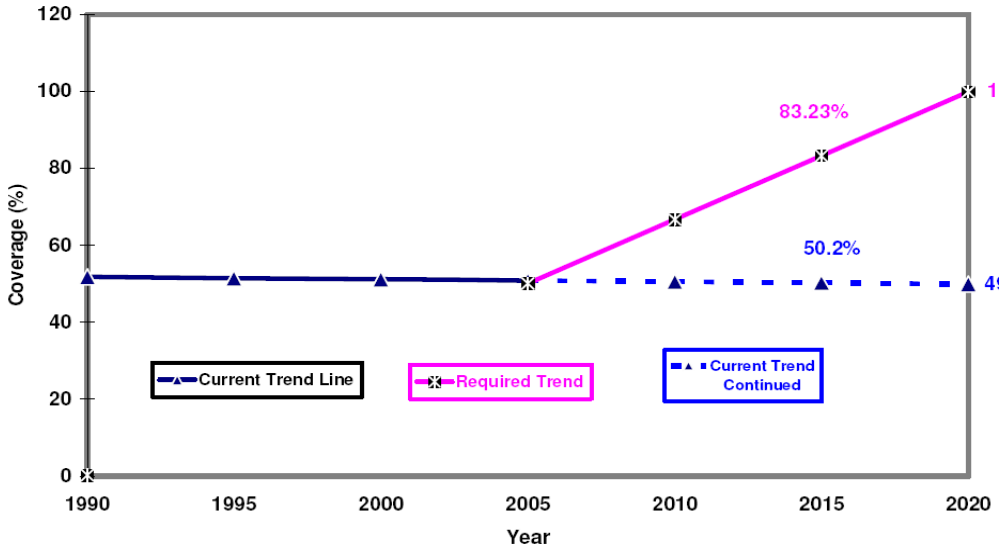


Figure 12: Projected Trend in water supply in the country (Vision20 2020 document)

Coastal Areas: On coastal resources, and with specific reference to the Niger Delta, it is estimated that with an accelerated sea level rise (ASLR) of about 0.5m, about 35% of the delta could be lost under business as usual climate change scenario by 2025. With ASLR of about 1.0 m about 75% of the delta could be lost. The number of people at risk, assuming no measure and development, would be 0.9 million, 2.10 million and 4.50 million with ASLR of about 0.2 m., 0.5 m., and 1.0 m respectively, resulting in massive *environmental refugee.* With the projected climate change and sea level rise the capital values at risk by 2025 would be about $8.05 billion and $17.5 billion respectively with ASLR of 0.2 m and 1.0 m. with no development and no mitigation/adaptation measures.

Forestry: Current estimates indicate that the remaining forest area in Nigeria will likely disappear by 2020 if the current rate of forest depletion continues unabated. But the rate of depletion would be drastically accelerated by increasing changes in

climatic conditions that may increase demand for forest resources. The value of lost forest cover has been estimated at US$750 million annually at 1989 prices.

Energy: Useful energy demand projections have been made for four economic sectors of the energy system – industrial (including agriculture), transportation, residential, and commercial sectors – using a simulation model called MADE-II. In all, the sectors were broken down into 30 demand categories with a total of 102 demand technologies. A summary of useful energy projections is given in Table 2, and shows that Nigeria faces a lot of challenges if it is to meet its energy requirements, judging from the current low level of energy development.

Table 2: Some Energy Projections to 2030

Sector	1995	2010	2030
Residential	**112.58**	**177.02**	**326.06**
• *Cooking*	78.80	119.87	209.76
• *Lighting*	17.27	28.44	55.85
• *Non-substitutable electricity*	16.50	28.72	60.44
Commercial	**6.29**	**13.08**	**34.72**
• *Cooking*	0.47	0.97	2.57
• *Lighting*	4.58	9.51	25.25
• *Non-substitutable electricity*	1.00	2.08	5.52
• *Street Lighting*	0.25	0.52	1.38
Industrial	**81.00**	**114.57**	**134.14**
• *Feed-stock*	14.78	30.38	30.38
• *Process heat*	53.97	70.13	86.88
• *Motive power*	5.61	6.44	7.73
• *Lighting*	1.13	1.30	1.56
• *Non-substitutable electricity*	5.51	6.32	7.59
Transport			
• *Passenger Transport (Billion pass-km/a)*	514.27	1090.73	2960.85
• *Freight Transport ion (Billion-Ton-km/a)*	38.86	80.78	214.34
• *Air Transport*	23.48	48.81	129.51
• *Water Transport*	2.31	4.09	9.76

N.B. Unless otherwise indicated, all units are in petajoules (First National Communication)

2. KEY FINDINGS ON COSTS OF IMPLEMENTING PRIORITY MITIGATION AND ADAPTATION MEASURES

2.1 Cost of implementing priority mitigation measures

2.1.1 Mitigation: Cost estimates for the energy and LUCF for abatement scenarios at 2030 horizon, inter/extrapolated for 2020 and 2050 periods.

The study commissioned for the First National Communication identified and ranked mitigation options for energy, land use change and forestry (LUCF) sectors, using baseline information and scenario projection to 2030. The study also uses incremental costs per ton of carbon removed or sequestrated to show that some of the mitigation options can be implemented at a net negative cost to the total energy system cost. Apart from the obvious case of gas-flare reduction in the oil industry, the study also

shows that significant CO_2 emission reduction could be achieved in the residential, transport and industrial sectors of the energy system.

As at 2000, the most promising mitigation options in the Nigeria's energy system, as demonstrated in Table 3, are:

(i) introduction of compact fluorescent light (CFL) bulbs at a negative incremental cost of \$58/ton CO_2, with 5.155m ton CO_2 reduction capacity;
(ii) introduction of improved kerosene stoves in households, at a cost of \$21/ton of CO_2 reduced (6.122 m ton CO_2 reduction capacity) ;
(iii) fuel-oil to natural gas fuel substitution in the cement industry at \$18/ton (7.49m ton CO_2 reduction capacity);
(iv) improved electrical appliances (\$16/ton) and wood-stoves (\$3/ton) in the residential sector (9.566m ton CO_2 reduction capacity); and
(v) introduction of efficient motors in industry at \$15/ton (10.738m ton CO_2 reduction capacity).

Taking all the abatement options studied in the country's energy sector into consideration, the country's First Communication indicated that Nigeria's energy sector requires about US\$874 million in 2020 and US\$1.41 billion in 2050 as additional investments per year for the reduction of emissions to meet the non-binding emission reduction target of 25%. This translates to about US\$174.8 million in 2020 and US\$280 million in 2050 per year to reduce emissions by 5% in the energy sector.

The available information presented above on the cost estimates for the energy sector portends some difficulty in any attempt to use them to provide good cost estimates for the integration of climate change concern into the country's energy sector in the future or even the current achievable GHG emission reductions. However, the Nigerian Government has recently reckoned that the anticipated growth for the Nigerian energy sector for the attainment of the objectives of Vision 2020 will require a total annual investment in excess of \$18billion in the next 10 years (\$ 12billion for oil & gas and \$6billion for power). Of this, the projected affordable national government allocation will be \$6billion (\$5billion and \$1billion for oil & gas and power respectively). Government expects to finance the \$12billion shortfall will require private funding, including third party and venture capital financing.

Land use and forestry: An analysis of the land use change and forestry sector (Siyanbola et al., 2002) shows that afforestation has the highest potential for carbon sequestration in Nigeria. This is followed by agroforestry and forest protection options respectively. For the afforestation option, the volume of carbon expected to be sequestered is in excess of the estimated net emissions of 427.4 and 580.5 MtC at 1.3% and 2.6% deforestation rates respectively. The analyses showed that the country could significantly reduce net carbon emission while at the same time meet all her essential domestic wood needs, if approximately 7.5×10^6 ha of wasteland could be committed to an afforestation program over the 40 year period of projection (see Siyanbola et al. 2002). The average initial cost of establishment is \$500/ha or an average unit cost of \$13.4/tC. The implication is that Nigeria needs a capital of about \$3.8 billion over a period of 40 years (about \$94 million/yr). Also, the wood product needs of the country would be met over the 40-year period. For the agro-forestry option, the estimated volume of carbon expected to be stored over the period is less

than that which will be released by 2030. In specific terms, and based on the analysis in the First National Communication, the following applies in the afforestation, agroforestry and forest reservation sectors of Nigeria.

Table 3: Ranking of Abatement Options in Nigeria's Energy Sector

Mitigation Option	Incremental Cost, US$m	CO_2 Reduction Capacity, MTon	$/Ton
CFL Lighting	-299	5.155	-58.00
Improved kerosene stove	-131	6.122	-21.40
Displacement of fuel-oil by gas in cement industry	-138	7.49	-18.42
Improved Elec. Appliances in the residential sector	-161	9.566	-16.83
Efficient Motors in Industry	-171	10.738	-15.92
Small-scale Hydro (< 10 MW)	-427	41.313	-10.34
Kainji Hydro Power Plant (Retrofit)	-351	50.01	-7.02
Improved Woodstove in residential sector	-72	18.369	-3.92
Large-scale Hydros	-686	197.353	-3.48
Central Solar	-24	18.735	-1.28
Improved Refrigerators	154	15.793	9.75
Residential Solar PV	74	5.883	12.58
Gas Flare Reduction	45534	919.201	49.54
Efficient Gasoline cars	17478	247.05	70.75
Improved air conditioners	218	1.54	141.56
Efficient Diesel Trucks	9060	60.096	150.76
Improved Electrical Appliances, Industrial and commercial sectors	2485	14.431	172.20

Source: First National Communication

Afforestation: By the year 2030 the total carbon that can be sequestered in the planted forest of about 7.5 million ha would be 638 MtC at an annual incremental rate of 16.0 MtC. The volume of carbon expected to be sequestered using the afforestation is well in excess of the estimated net emissions of 427.4 and 580.5 MtC at 1.3% and 2.6% deforestation rates respectively. The average initial cost of establishment is $500/ha or an average unit cost of $13.4/tC. This implies a capital need of $3.8 billion over a period of 40 years (about $94 million/yr). This scenario implies that for Nigeria to be able to sequester 578 MtC in 2020 and 958 MtC in 2050, it will require total or cumulative investments over the years of US$2.9 billion and US$4.8 billion in 2020 and 2050 respectively in the afforestation sector.

Agroforestry: With regard to agroforestry as a mitigation option, a total of 311 MtC is projected to be sequestered by the year 2030 at an annual incremental rate of 7.77 MtC. The average initial cost of establishment is $320, while the unit cost of carbon is $17.17. Thus the total capital requirement for the 40-year period is $2.4 billion, or $60.1 million/year. The estimated volume of carbon expected to be stored over the period is less than that which will be released by 2030. This implies that this option alone is incapable of absorbing the released carbon and meeting the wood needs of the country. In terms of cost, above scenario implies that Nigeria should be able to sequester 233 MtC in 2020 and 466 MtC in 2050, requiring total or cumulative investments over the years of US$1.78 billion and US$2.98 billion in 2020 and 2050 respectively in agroforestry for climate change mitigation.

Forest reserves; It is estimated that the initial cost of establishing protected forest units is about $79/ha, or at a unit cost of $0.73/tC. Thus, the capital requirement for the 40-year period is $758.4 million or $18.96 million/year. By the year 2030, a total of about 1036 MtC will be stored in the protected forests at annual incremental rate of 25.9MtC/year. This is almost two times the amount that needs to be sequestered in absorbing the atmospheric carbon in the country. In terms of cost, this scenario implies that Nigeria should be able to sequester 777 MtC in 2020 and 1554 MtC in 2050 through forest protection, requiring total or cumulative investments over the years of US$444 million and US$889 million in 2020 and 2050 respectively.

The cost estimates obtained for the land use change and forestry sector are expected to change drastically over time with increasing rate of deforestation in Nigeria. This is due to forest and grassland conversion, the abandonment of managed lands, on-site and off-site burning of forests and the non-sustainable extraction of biomass that are resulting in rapid changes in forest and other woody biomass stocks and also posing serious environmental challenges to the country.

2.1.2 Methodologies used to determine emission projections, abatement scenarios and cost estimates.

2.1.2.1 Energy Sector

The primary modelling tool employed in the study of the future of Nigeria's energy system is the MARKAL model. MARKAL (**MARK***et* **AL***location*) is a large-scale linear optimisation model based on the concept of the reference energy system (RES), and is able to capture the complex interrelationships of an energy system, from primary energy resources to energy service demands. Being a dynamic model, MARKAL can be used to explore mid- to long-term responses to different technological futures, emission constraints and policy scenarios. Given a set of energy demand projections, technologies, emission constraints, MARKAL is able to identify the least-cost path within the RES that best satisfies the overall objectives of the energy-environmental system. In other words then, MARKAL is best suited to answer questions "if □ then □"

Useful energy demand projections have been computed using a simulation model called Model for Analysis of Demand for Energy (MADE-II). MADE employs a

combination of statistical, econometric and engineering process techniques in calculating useful energy demand projections.

Useful energy demand projections are made for four economic sectors of the energy system – industrial (including agriculture), transportation, residential, and commercial sectors. In all, the sectors are broken down into 30 demand categories with a total of 102 demand technologies.

2.1.2.2 Forestry and Land-Use Sector

The analysis of the forest and land-use sector in Nigeria was based on the COPATH and the Comprehensive Mitigation Assessment Process (COMAP) models for integration options. These models have been adequately and respectively described by Makundi et al. (1995) and Makundi and Sathaye (1999) and fully applied to Nigeria by Adesina et. al (1999). In general, while COPATH estimates the amount of carbon stored, released and sequestered in different forest formations in a country, COMAP evaluates the costs and benefits of mitigation options. In order to determine the extent to which mitigation policies could be pursued, the study used the demand, supply and balances for the major wood products in the country to estimate for the base year and projection to year 2030. The end-use based scenario adopted was considered the most appropriate strategy to sustainably implement the mitigation option in Nigeria.

2.2 Cost of implementing priority adaptation measures

2.2.1 Adaptation: Cost estimates for adaptation actions and programmes

In general, costing climate change adaptation actions and programmes faces a number of challenges and marked uncertainties, as they are influenced by a wide range of technical and socio-economic factors, as well as the severity of the anticipated impacts. The situation is compounded for this exercise by the fact that Nigeria is yet to undertake a detailed adaptation cost estimates for its effective response to climate change. Information are widely scattered and they remain largely conjectural. However, in a recent study by Heinrich Boll Stiftung (2009), broad estimates of the cost of climate change were given, taking into consideration what is known about the sectors and the amount of resources that had been committed to the programmes. Table 4 gives a summary of some costs by sector.

Table 4: Cost Adaptation Projects by Sector in Nigeria (HBS, 2009)

S/N	Sector	Option	Cost	Sources	Grand Total
1.	Water Resources	Small dams-about 1000 ha	$50m	Bakalori Dam span 8000 ha costing $400m	Upwards of $1bn
2.	Livestock Production	Enrichment of rangeland	$500 initial cost & $200/yr for 5 years	Estimates by Siyanbola et al., 2002	Upwards of $300m
3.	Crop Production	Breeding of hardier crops	$200,000/trait/ crop	http://www.agra-alliance.org/about/grants/html#fund	$10.5bn
4.	Fish Production	Cropping of hardier breeds	$150,000/trait/ crop	Personal communication(Prof. Omitogun)	Upwards of $10bn
5.	Forest and Forestry	Establishment of plantation	$500/ha (initial cost) & $250/ha for 10 yrs	Estimates by Siyanbola et al., 2002	Minimum of $3.8bn

		Protection of forests	$1000/ha		
6	Coastal areas	Coastline stabilization Settlement Relocation	Between $6bn and $18bn up to year 2030	Sum to about $4.3m apart by Lagos State Government on the cost of stabilizing 1000m	$5bn
7.	Human Health	Primary Health care promotion Immunization Preventive and curative medicine	Between $6bn and $18bn up to year 2030	IRIN 2008 Report (http://www.irinnews.org/report.aspx?Reportid=77651	$6bn
8.	Sensitization	Climate change education			
10.	Energy	Electric power generation[4]	$10bn	Guardian, May 29, 2008	

The estimates provided in the Table need to be used with caution as they are scooped from many sources that do not suggest that any intensive research was conducted to obtain them. Significant efforts are being made by government to enable Nigeria to undertake the sector-specific costs of adaptation in all the regions of the country, especially within the context of the First Implementation Plan of Nigeria's Vision 20:2020 (NPC, 2010). To put Table 4 in a better perspective, we used the cost estimates provided in the national vision document by the National Planning Commission (NPC, 2010) for the agriculture and water resources, health and transport sectors that are very critical to adaptation in Nigeria.

The incremental cost in the agriculture and water resources is estimated at US$3.06 billion per year by 2020 and about US$5.50 billion in 2050. The health sector will require about US$3.06 billion in 2020. This is expected to increase to US$5.50 billion by the year 2050. Because of the poor transport conditions, the incremental cost for its adaptation will be high. The transport sector will require about US$5.33 billion and US$9.69 billion per year by 2020 and 2050 respectively.

2.2.2 Description of methodologies used to determine vulnerability and adaptation assessments scenarios

The approach used for the determination of the vulnerability of the country's various sectors to climate change first built various climate scenarios, upon which a number of physical and socio-economic indices were interpolated. The analyses then progressed with an understanding of vulnerability in both absolute relative terms, using indexing. *Absolute* index describes the state of vulnerability of the country as a whole while *relative* index captures the variability from one part of the country to the other. As indicated in section 1.4 of this report, the study used the *Indicator Method*,

[4] Nigeria's Vision 20:2020 envisages a fivefold increase in the amount of electricity to be generated to drive socio-economic development in the country. This will have implications for energy supplies, including hydro, oil and gas, and thermal power, all of which depend on water at some stage of their production. In addition, the anticipated increase in temperatures will cause an increase in demand for electricity, thereby increasing the vulnerability of energy infrastructure and necessitating putting in place structural and non-structural adaptation measures in the sector.

to determine the spatial changes in the vulnerability of Nigeria. This is based on selecting a number of indicators from a set of potential indicators and then combining them to determine the levels of vulnerability of exposure units. The levels of vulnerability were then analyzed at zonal and national scales using the indicators.

It focussed on three principal determinants of vulnerability – adaptive capacity, sensitivity and exposure. The indicators used in the study were a combinations of many variables ranging from physical (e.g. rainfall, temperature, changes in sea level, relief, soil conditions etc.) to socio-economic (e.g. education, assets, income, access to information and health, services and technology, poverty, etc.), and they were sufficiently broad in relevance to allow a meaningful assessment of vulnerability of different parts of the country to climate change. The selected indicators were properly calibrated and scored. Vulnerability was then defined additively in terms of exposure, sensitivity and adaptive capacity as:

:

$$V = f(I - AdC),$$

where V is vulnerability, I potential impact, and AdC is adaptive capacity. Since vulnerability was taken as a function of AdC, sensitivity and exposure, it was thus the addition of exposure and sensitivity.

As agriculture remains the most important employer of labour and the sustenance for a large majority of Nigerians, the assessment of vulnerability also focused on many critical issues relating to it. Also, Nigeria's agriculture is largely rainfed. An assessment of the agriculture is therefore useful in analyzing the actual and potential challenges of changes in climate particularly with respect to rainfall.

To ensure that all indicators are comparable, their values were standardized to a range of 0 to 100 following UNDP (2002). Also, in order to ensure that high index values suggest high vulnerability in all cases, the index values were reversed where appropriate using '100-index value' for indicators that are expected to decrease with vulnerability.

To ensure that each variable has appropriate value in the analysis, the data were subjected to Principal Component Analysis (PCA) following Cutter et al. (2003) and Thornton et al. (2006). The PCA makes each of the indicators orthogonal and therefore unique in the data sets. Scores of the indicators are then summed together to give the overall assessment of vulnerability to climate change.

For *exposure,* three parameters make up the components of the analysis. These are actual and potential irrigation opportunities, rainfall trend and access to safe water. For rainfall, the study used the beta coefficient of the linear regression of total annual rainfall with time from 1983 to 2008 (25 years). The key input variables for *sensitivity* are quality of building, increasing fertilizer usage, home ownership, crop diversity and population density. A large number of socio-economic and physical features are put in the model for the assessment of the *adaptive capacity.*

Nigeria is yet to undertake a detailed estimation of costs of adaptation to climate change in different sectors of the national socio-economic development. For the purpose of this study, we used the cost estimates provided in the national development

vision document by the National Planning Commission (NPC, 2010) for the agriculture and water resources, health and transport sectors, which are very critical to adaptation in Nigeria. The Sectoral Plans detailed in the NPC report provided good costing of the development needs in the various sectors of the Vision 2020 for the short term plan OF 2010 – 2013. These were extrapolated to 2020 and 2050 using a number of assumptions, including a two-percent change in the growth of each sector. We also took cognizance of the fact that most of the estimates provided in the NPC Implementation Report concerns the Federal interest. In this regard, our approach took into account the possible needs at the state and local levels.

The Government of Nigeria recognizes that the above-mentioned approach used in this study needs remarkable improvement. It intends to use appropriate empirical methodology based on published material and expert opinion on current expenditures at the national level, as well as other methods described in Parry et al., (2009) in future to determine the appropriate cost of adaptation to climate change in different sectors in the country.

3. KEY FINDINGS ON FINANCIAL AND POLICY INSTRUMENTS FOR ADDRESSING CLIMATE CHANGE

3.1 Financial Instruments

3.1.1 Existing financial instruments

Mitigating and adapting to climate change increases the cost of development. The emerging and yet incomplete cost estimates of additional investments needed in Nigeria can be sourced from national, regional and international levels.

National: There is an increasing national awareness about the need to mainstream climate change into national development in Nigeria. Thus, the Federal Government is increasingly devoting a significant proportion of its national budget to climate change or climate change sensitive sectors of the economy. There is an on-going assessment of the national budget in the last five years to determine the quantity of national resources that have been devoted to issues of climate change. At the State level, some States of the Federation have taken keen interest in addressing issues of climate change. Lagos State, for instance, has hosted regional summits on climate change in 2009 and 2010, and is devoting a substantial proportion of its annual budget to study the impacts of sea level rise on its coastal and marine environment. Delta State is also actively involved in the activities of TACC. All these efforts point to the increasing recognition of the imperative to carry the issues of climate change along with national development needs, a fact that should facilitate the mobilization of internal resources for climate change in the country.

Nigeria would also mobilize resources for both climate change mitigation and adaptation through internal reform (e.g., putting resources aside out of core budget or fiscal or pricing reform). In addition, non-concessional financial and investment flows in the public sector and private sector would be encouraged, as well as facilitating philanthropic donations. This will inform the formulation and proper implementation of appropriate macroeconomic policies and programmes targeted for economic growth, along with improved access to social services and infrastructure, are essential

ingredients in any strategy for poverty alleviation in Nigeria. Such macroeconomic policies should involve the deliberate manipulation of policy instruments such as public expenditure to achieve basic macroeconomic objectives.

Regional level: Nigeria is actively involved in the climate change related activities of ECOWAS and AU to source additional and complimentary flow of financial resources to tackle climate change at the regional level.

International level: Possible sources of financial flows for climate change may be categorized as (i) Climate-specific additional resources under the aegis of UNFCCC (GEF, Adaptation Fund, etc. UNFCCC GEF-administered Least Developed Country Fund (LDCF) and Special Climate Change Fund (SCCF), and the Adaptation Fund (AF); (ii) Resources from the carbon market; (iii) Concessional funding (ODA) from the DAC community specifically for mitigation and adaptation (including through MDBs); (iv) Other than climate-specific ODA from the DAC community (including through MDBs); and (v) Non-DAC donor support

Details about these varied sources of finance for climate change are given in World Bank (2009) and in Appendix I.

3.1.2 Potential financial instruments that are under discussion

Nigeria has recognized that its national resources are not enough to respond effectively to the impact of climate change. To this end, the Federal Government is in the process of putting in place a *Nationally Strategic Climate Change Trust Fund* (NSCCTF) as a response to the need to broaden the scope of national interventions for impact at all levels of governance. This is to be done through strategic alliances among development partners and mobilization of additional resources for the sustainability of activities to check the climate chaos. The niche for the proposed Fund will consist of partnership building, fungible programme components, extensive stakeholder participation, cognate technical expertise and broad range of contribution from traditional and non-traditional sources.

The Fund will be designed with a view to tackling climate change impacts to reduce the vulnerability and increase the resilience of the people, as well as improving the overall well-being of people living in the very vulnerable areas of the country. The vulnerable segments of the population in particular will be provided with enhanced opportunities to manage their natural resources for sustainable livelihoods and poverty reduction in the face of climate change consequences. In addition, significant support will be provided for initiatives and activities that will in the long run put Nigeria in the path of low carbon economic development that is becoming the vogue of sustainable development in the world.

The overall objective of the NSCCTF will be to implement short to long-term climate change related actions and activities and measures that will not only increase the resilience of national development sectors to the impacts of climate change, but also enable the country to chart the course of sustainable low carbon economic development. Projects would mostly focus on long-term planned response strategies, policies, and measures, rather than short-term (reactive) activities. The NSCCF would

serve as a catalyst to leverage additional resources from bilateral and other multilateral sources for:

- Implementation of international climate change deals and protocols
- Promoting overall economic development of Nigeria in a sustainable manner that reduces the country's vulnerability and enhances its resilience to climate change

The scope of the NSCCTF will be broad to cover many activities related to climate change and sustainable development in Nigeria. These activities will include, but may not be limited to the following undertakings:

- Projects that will enhance the adaptation capacity of Nigeria to cope effectively with the impacts of climate change
- Schemes designed to strengthen agricultural production systems (crop and livestock) to integrate biodiversity concerns and make them more resistance to climate change-induced weather extremes such as drought.
- Schemes for the promotion of energy efficiency in various sectors such as buildings, transport, etc.
- Initiatives to strengthen national capacity to undertake consistent research, analyse and monitor climate change impacts.
- Projects that will increase the level of awareness of climate change among Nigerians at all levels of governance.
- Other partners' support that will facilitate improved access of technology transfer to support economic diversification and transition from fossil dependent economy to green economy.
- Implementation of global and regional policy initiatives and strategies for a coherent global approach to climate change.

The sources of funding of the NSCCTF, its implementation arrangement and overall structure are under discussion with stakeholders. By the time the process is completed, issues concerning the role of the Fund in harmonizing development resources, resource mobilization for the Fund, its institutional management arrangement, as well as the implementation and execution of projects using the Fund's resources will be properly articulated and launched, possibly before the end of 2010.

3.2 Policy Instruments

3.2.1 Current policy instruments and initiatives

As indicated in Section 1.2 of this report, Nigeria is in the process of finalising a National Climate Change Policy and Response Strategy. Thus it currently relies on environment-related policies and action plans to implement climate change initiatives and activities. Most prominent of these are (i) National Environment Policy; (ii) Drought and Desertification Policy; (iii) Drought Preparedness; (iv) National Action Plan to Combat Desertification, (v) National Biodiversity Strategy and Action Plan; (vi) National Erosion and Flood Control, (vi) Water, (vii) Agriculture, (vii) Forestry; (viii) Energy; (ix) Renewable Energy Master Plan; etc. Most of these policies are good and relevant to climate change, but their implementation and enforcement remain weak. In addition, renewable energy sources remain undeveloped.

3.2.2 Planned policy instruments and initiatives

Nigeria is in the process of finalizing a ten-year plan for stimulating Nigeria's economic growth and launching the country onto a path of sustained and rapid socio-economic development. The blueprint, known as Vision 20: 2020, articulates Nigeria's economic growth and development strategies for the ten-year period between 2010 and 2020, and will be implemented using a series of medium term development plans. The environmental dimension of the vision is encapsulated in a set of national aspirations which commits the country to a level of environmental consciousness that enables and supports sustainable management of the nation's God-given natural endowments to ensure its preservation for the benefit of the present and future generations in the face of increasing climate variability and change.

In recognition of the potential limitation that climate change poses to Nigeria's growth prospects, economic policy for Vision 2020 will need to strategically position Nigeria to avoid the negative consequences of climate change by adopting environmentally friendly practices, while benefiting from opportunities for competitive advantages that could potentially arise as sustainability issues exert greater influence on international trade regulations. Where environmental concerns directly threaten growth initiatives, Nigeria will seek innovative solutions with a view to upholding sustainability as a key principle in her quest for growth.

4. INSTITUTIONAL FRAMEWORK

4.1 Existing and Potential Institutional Arrangements for Climate Change Mainstreaming

4.1.1 Current institutional framework

Nigeria has created a *Special Climate Change Unit* (SCCU) within the Federal Ministry of Environment with the Secretariat in Abuja, Nigeria. The Unit is created to implement the Convention and the protocol activities. The SCC Unit also has responsibility of coordinating the activities of the *Inter-ministerial Committee on Climate Change* with representation from the following ministries; Finance, Agriculture, water Resources, Energy Commission, Nigeria National Petroleum Corporation (NNPC), Foreign Affairs, Nigerian Meteorological Agency (NIMET), industry, NGOs (Nigerian Environmental Study/Action Team), and Academic (Centre for Climate Change and Fresh Water Resources, Federal University of Technology Minna; Centre for Energy , Research and Development, Obafemi Awolowo University Ile-Ife; and Abubakar Tafawa Balewa University, Bauchi. There is also a *Presidential Implementation Committee on the Clean Development Mechanism* (CDM) in the Presidency. Towards improving the national capacity to generate observational climate data and climate monitoring systems, government upgraded the Department of Meteorology in the Ministry of Civil Aviation to a full-fledged Nigerian Meteorological Agency (NIMET) in 2003, which now has a Climate Research Unit for data generation and climatic information dissemination.

Within the democratic political system of the country, the Senate has a standing committee on ecology (Senate Committee on Ecology) while the National House of Assembly has a standing Committee on Climate Change. Members of these Committees have facilitated the passing of a Climate Change Commission (CCC) Bill in both the House and Senate. However, there is still no timeframe as to the time the CCC will take off. In addition to the Committees, there is a National Council on the Environment, made up of representatives of governments at the Federal and State levels. The Council meets at irregular intervals to take stock of the state of the environment in Nigeria.

4.1.2 Opportunities for improving the current framework

In view of the huge challenge that climate change poses to national development, all levels of governance in the country must be actively involved in responding strategically to it. In this regard, it is very imperative that the existing institutional framework at the Federal level should not only be strengthened to coordinate climate change activities in the country, but also be in position to build capacities and facilitate the implementation of activities at State and Local Government levels. This calls for the establishment of functional climate change response institutions in the 36 States and 774 Local Government Areas. In addition, there is a good opportunity to expand the composition of the Inter-Ministerial Committee to include representatives of governance at the State and Local Government levels, even if it is on a geopolitical/zonal basis.

5. LESSONS LEARNED AND THE WAY FORWARD

In responding to climate change, Nigeria faces a number of challenges. Absence of a climate change policy makes it difficult for the development and implementation of pro-active climate change initiatives. The country faces the challenges of:

- Paucity of data and information;
- Limited coordination among responsible institutions;
- Sectoral planning and project implementation;
- Limited commitment of national financial resources to climate change issues;
- Limited private sector participation and, therefore, investment into climate change opportunities.

Responding to climate change is, however, not only about managing risk. It also offers a number of cost-effective opportunities to capitalize mitigation measures into carbon assets and building a resilient society that can rapidly advance national development. Nigeria in the long-term would be pursing a low carbon, high growth, climate resilient, socially equitable, gender sensitive and sustainable development path through ensuring support for the two principle elements of climate change response: mitigation and adaptation.

5.1 Key lessons:

From this study, some of the key lessons are as follows:

i. Responding adequately to climate change in Nigeria will, in general, be costly. It is, however, important for the country to undertake detailed assessment of mitigation and adaptation costs on sectoral basis in order to plan effectively for its response.
ii. Detailed vulnerability assessment and analysis of the key sectors of the economy is needed for a proper understanding of the impacts of climate change on the socio-economic development of the country. It is yet to be fully done.
iii. Nigeria is not performing as well as expected in envisioning the country's climate future and building dynamic response strategies, including adequate research and infrastructure development. A lot needs to be done in the area of climate change scenario analysis for both mitigation and adaptation response measures and their cost implications on aggregate basis. This should enable the country to plan very for its response to changes in its climatic conditions.
iv. Up-to-date data that is critical for climate change analysis and information dissemination, as well as improve our understanding of the climate problem in the context of sustainable national development, is not readily available in Nigeria in a coherent and accessible manner. The country will need to reinforce its efforts at putting in place a comprehensive climate change information management system that is updated periodically and readily accessible.
v. A proactive response, rather than a reactive response to climate change issues, will best serve the development needs of Nigeria in the context of sustainable development in general and the attainment of the objectives of its Vision 2020, in particular.
vi. Integrated and sustainable approach is grounded in the fact that mitigation is essential to avoid the unmanageable, while adaptation is no less essential to manage the unavoidable. This should constitute the basis for the country's efforts at mainstreaming climate change into national sustainable development.
vii. Effective resource mobilization strategy, based on private-public-partnership (PPP) principle is critical to enhancing national capacity to capitalize on a number of existing and potential financial inflows into climate change at national, regional and international levels.

5.2 Possible Next Steps

This NEEDS study points to the fact that Nigeria needs to adopt a more comprehensive and coordinated approach to the issues of climate change within its national development context than what currently obtains. Significant national efforts are needed to ensure that climate change concerns are properly integrated into the country's Vision 20:2020, which currently constitutes the country's blueprint for sustainable rapid socio-economic development. In the immediate, the country may focus on:

i. Finalizing a National Climate Change Policy and Response Strategy for the country;

ii. Finalizing and launching the *Nationally Strategic Climate Change Trust Fund;*
iii. Commissioning an extensive study for an up-to-date GHHG emission profile, projection and mitigation strategies;
iv. Commissioning an extensive study on the socio-economic impacts of climatic change;
v. Undertaking detailed costing of adaptation initiatives for planning purposes;
vi. Developing and implementing a well-formulated action plan and process for the mainstreaming of climate change into national development plans, particularly Vision 20:2020; and
vii. Strengthening national capacity at the Federal, State and Local Government levels to plan and respond effectively to climate change impacts, with evidence-based and well-researched information.

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ANNEX I:

Main Instruments for Financing Climate Change Mitigation (M) and Adaptation (A) – (World Bank, 2009)

Climate-specific additional resources under the aegis of UNFCCC		
Adaptation Fund US$300-600 million by 2012 adaptation-fund.org	**A**	Funding mainly comes from a 2% levy on Certified Emission Reductions (CERs) issuance. Adaptation Fund Board (AFB) as operating entity served by a secretariat (GEF) and a trustee (WB).
Global Environment Facility (GEF) US$1 billion over 2007-10 gefweb.org	**M** **(A)**	Largest source of grant-financed mitigation resources. SPA is a funding allocation within the GEF TF to support pilot and demonstration projects that address local adaptation needs and generate global environmental benefits in all GEF focal areas.
UNFCCC GEF-administered Special Funds US$270 million gefweb.org	**A**	Least Developed Countries Fund (LCDF): helps in the preparation and financing of implementation of national adaptation programs of action (NAPAs) to address the most urgent adaptation needs in the least developed countries Special Climate Change Fund (SCCF): supports adaptation and mitigation projects in all developing countries, with a large emphasis on adaptation.
Resources from the carbon market		
	M	Primary CDM transactions: US$6.5 billion (2008), US$22.9 billion (2002-08) Voluntary market (OTC): US$54 million (2008), US$260 million (2002-08) Size of Carbon funds and facilities: US$16.1billion[25]
Dedicated concessional funding (ODA) from the DAC community		
Climate Investment Funds	**M**	The Clean Technology Fund: to finance scaled-up demonstration, deployment, and transfer of low-carbon technologies.
US$6.3 billion climateinvestmentfunds.org/	**A** **M**	The Strategic Climate Fund: (i) Pilot Program for Climate Resilience (PPCR) to help build climate resilience in core development; (ii) Forest Investment Program; (iii) Program to Scale up Renewable Energy for Low Income Countries.
US$ 10 billion	**M&A**	**Cool Earth Partnership (Japan)**
US$ 1.6 billion	**M&A**	**Environmental Transformation Fund – International Window (UK)**
US$ 180 million p.a.	**M&A**	**International Climate Initiative (Germany)**
US$ 580 million	**M&A**	**Climate and Forest Initiative (Norway)** **International Forest Carbon Initiative (Australia)**
US$ 180 million	**M&A**	**Global Climate Change Alliance (European Commission)**
US$ 160 million	**A**	**International climate Change Adaptation Initiative (Australia)**
US$ 135 million	**M&A**	**UNDP-Spain MDG Achievement Fund**

US$ 100 million US$ 52 million	**M**	**UN Collaborative Program on Reduced Emissions from Deforestation and Forest Degradation**[26]

Examples of non climate-specific support from Donors and MDBs		
Global Facility for Disaster Reduction and Recovery US$15 million for adaptation	**A**	Partnership within the UN International Strategy for Disaster Reduction (ISDR), focusing on building capacities to enhance disaster resilience and adaptive capacities in changing climate. In addition, there are specific instruments for climate risk management
Trust Funds and Partnerships; Guarantees	**M** **A**	Grant financing for knowledge products, capacity building, upstream project work/pilots, such as the MDTF for Strategic Framework for Development and Climate Change (under design); Partial risk guarantees to support development / adoption / application of clean energy technologies, including those not fully commercialized, in client countries.