Meteorology, Climate Change and the Nigerian Economy

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being 2013 Induction Lecture of the Nigerian Academy of Science (NAS)

Part One: Introduction

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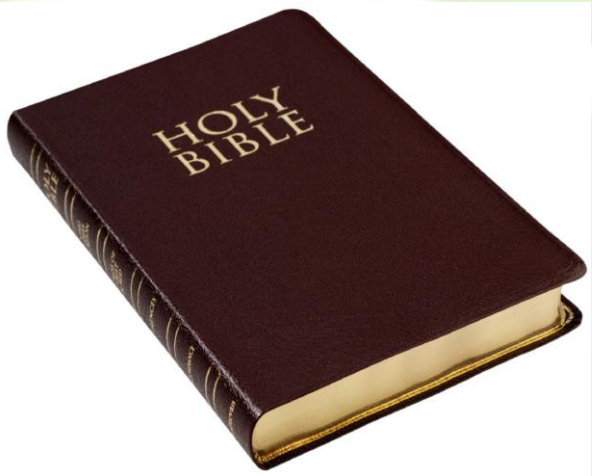
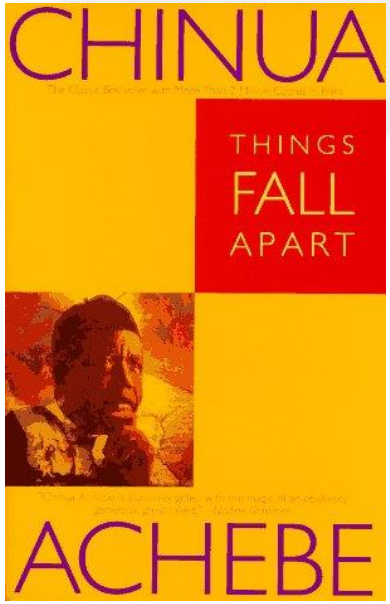
Part Three: Conclusion

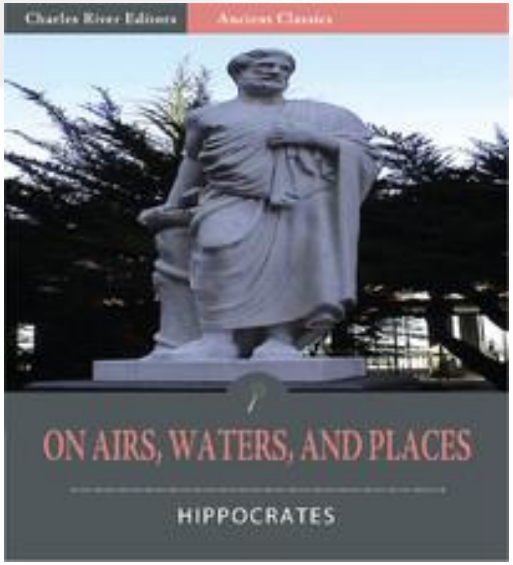
3.0 Conclusion
4.0 Recommendations

In the Beginning …..

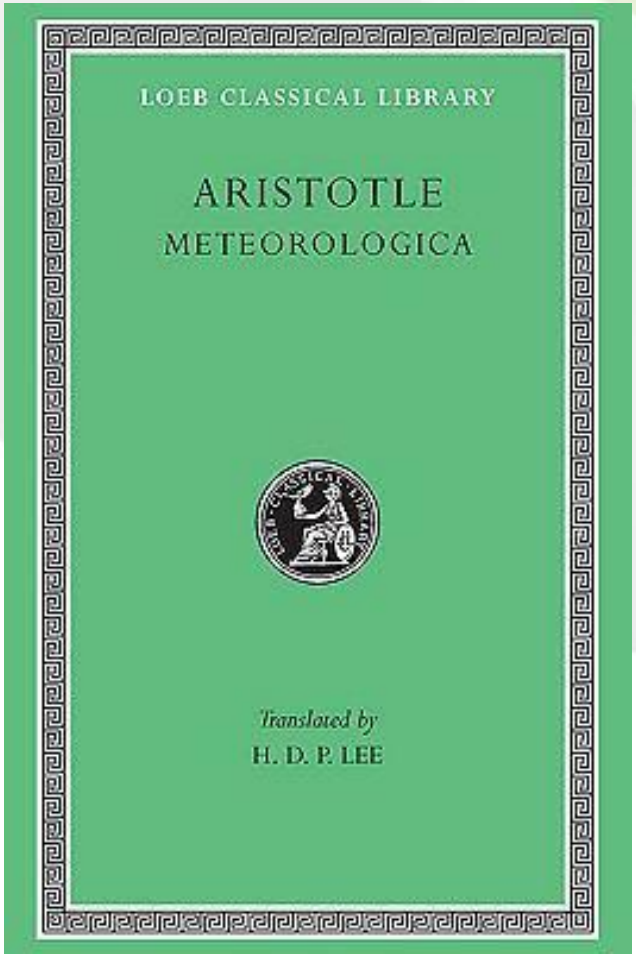


Weather and climate have always been part of the physical environment in which the human society thrives. The Bible, The Quran, Hippocrates and even the novel Things Fall Apart allude to this fact.



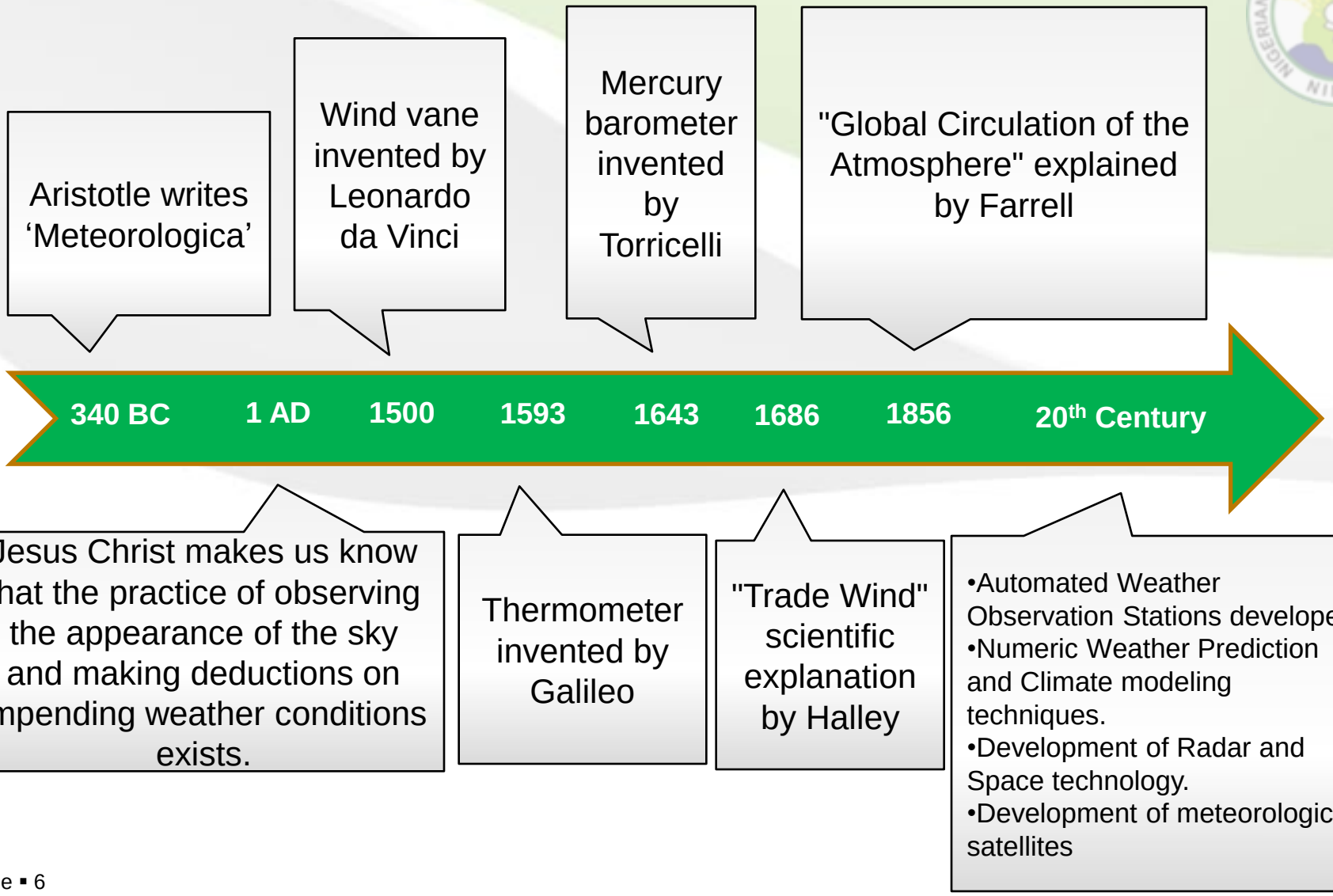


What is Meteorology?

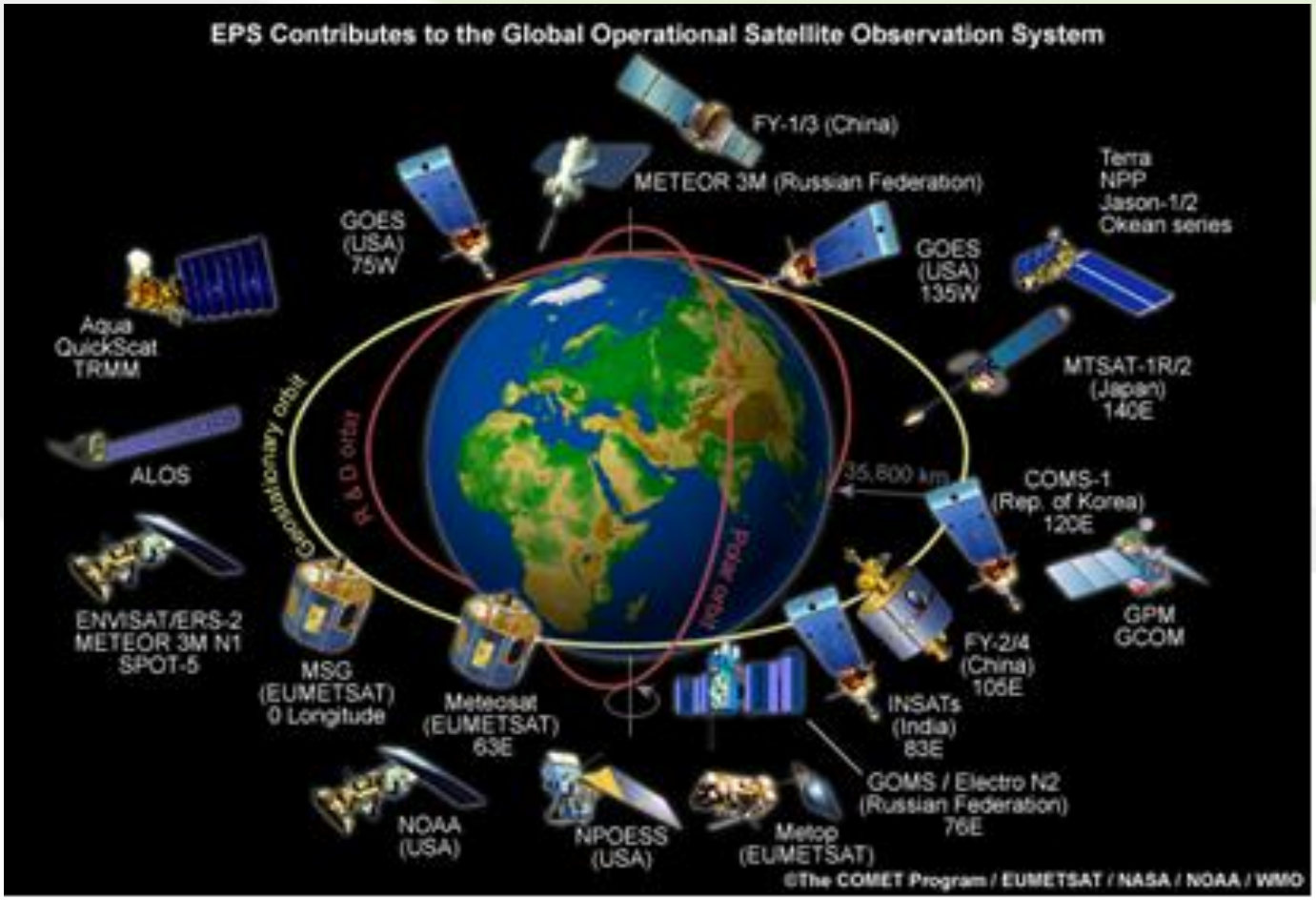


- Meteorology is the scientific study of atmospheric phenomena as related to weather.
- The word 'meteorology' was coined from a book, 'Meteorologica' which was written by Aristotle, the Greek scientist and philosopher around 340 BC.

Evolution of Meteorology

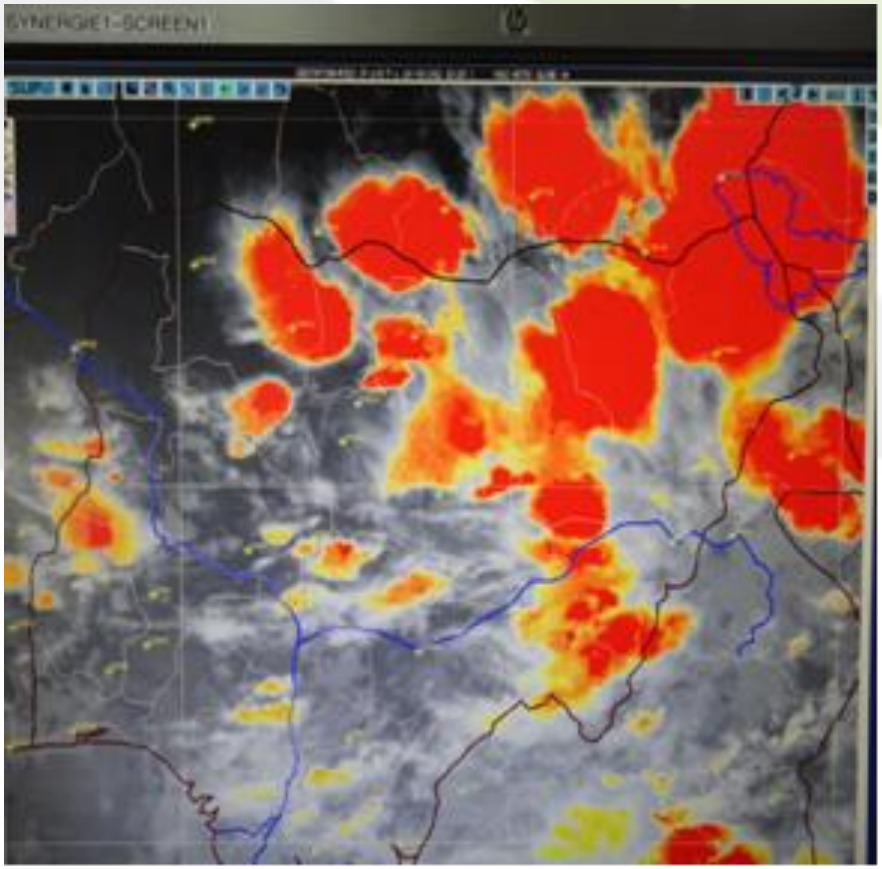


Constellation of Meteorological Satellites



TIROS-1 (Television Infrared Observational Satellite

Satellite Image over Nigeria showing areas of Active Weather



Evolution of Meteorology in Nigeria

In Nigeria meteorological services started in 1892 when the first weather observatory was established by the British colonial government at the then Race Course, Lagos. Thereafter the Meteorological Department operated under various ministries at different times until June 2003 when the Nigerian Meteorological Agency bill was passed and signed into law thereby creating NIMET as a parastatal under the Federal Ministry of Aviation.

The Nigerian Meteorological Agency is charged with the responsibility of providing the weather and climate information requirements of all sectors of the Nigerian economy, and also fulfilling the obligations to the international community through the World Meteorological Organization (WMO).

Some Specific Functions & Responsibilities of NIMET

1. **Advise the Federal Government on all aspects of Meteorology.**
2. Project, prepare and interpret Government policy in the field of Meteorology.
3. **Issue weather forecasts for the safe operation of aircraft, ocean-going vessels, land transportation, and oil rigs.**
4. Promote the services of meteorological agency in agricultural, drought and desertification activities.
5. **Provide meteorological services in operational hydrology and water resources activities.**

Present Operational Capacity of NIMET

- Corporate headquarters in Abuja located at the National Weather Forecasting & Climate Research Centre Abuja
- National Weather Forecasting & Climate Research Centre
- State of the art instrument calibration laboratory (the first of its standard in sub-Saharan Africa)
- 6 Zonal offices (Enugu, Ibadan, Kaduna, Kano, Maiduguri and Port Harcourt).
- 54 Synoptic Stations spread all over Nigeria.
- Marine weather stations at Calabar, Eket, Victoria Island, Lagos.
- 1 Central Forecast Office Abuja
- 4 Independent Forecast Offices (Abuja, Ikeja, Kano and Port Harcourt).
- 8 Upper Air Stations (Abuja, Calabar, Enugu, Jos, Kano, Lagos, Maiduguri and Yola).
- 30 Automatic Weather Stations
- WMO Regional Training Centre, Oshodi Lagos
- 500 Rainfall Stations (most of these are now being resuscitated recalibrated).
- Operational Base in Oshodi, Lagos.
- Network of Agro-meteorological and climate monitoring stations (now being resuscitations)

Weather Equipment Acquired and Installed by NIMET

Doppler Weather Radar Stations installed **Abuja and Port Harcourt and** another four at various stages of completion at **Maiduguri, Yola, Kano and Lagos .**

Low Level Wind Shear Alert System (LLWAS) in Abuja, Lagos, Port Harcourt, Kano, Yola, Owerri, Maiduguri, Benin, Enugu airports.

Integrated Aviation Weather Observing and Display System (AWODS)

Air Quality and Ozone Monitoring Station in Abuja and Lagos.

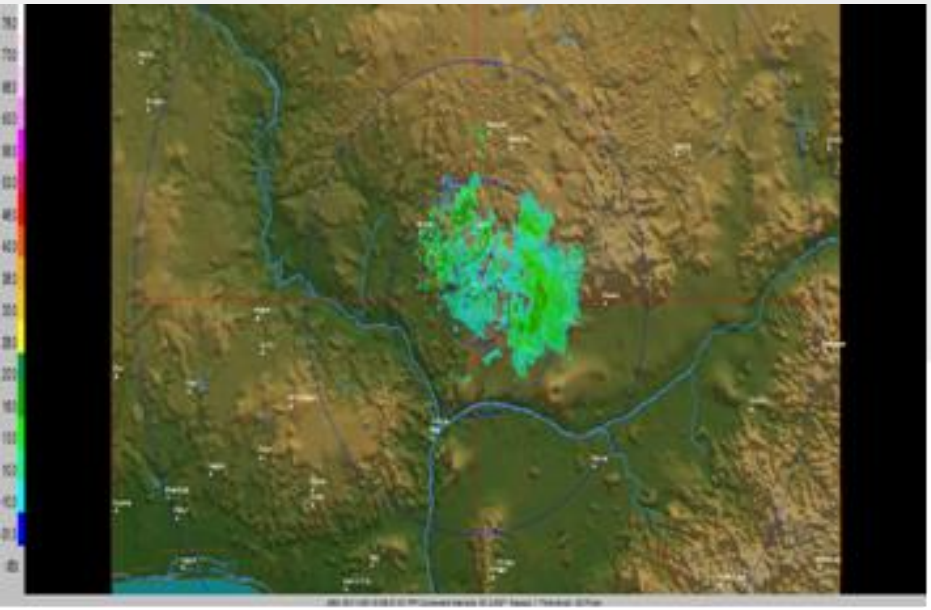
Marine Weather Buoy (soon to be installed in Apapa, Lagos)

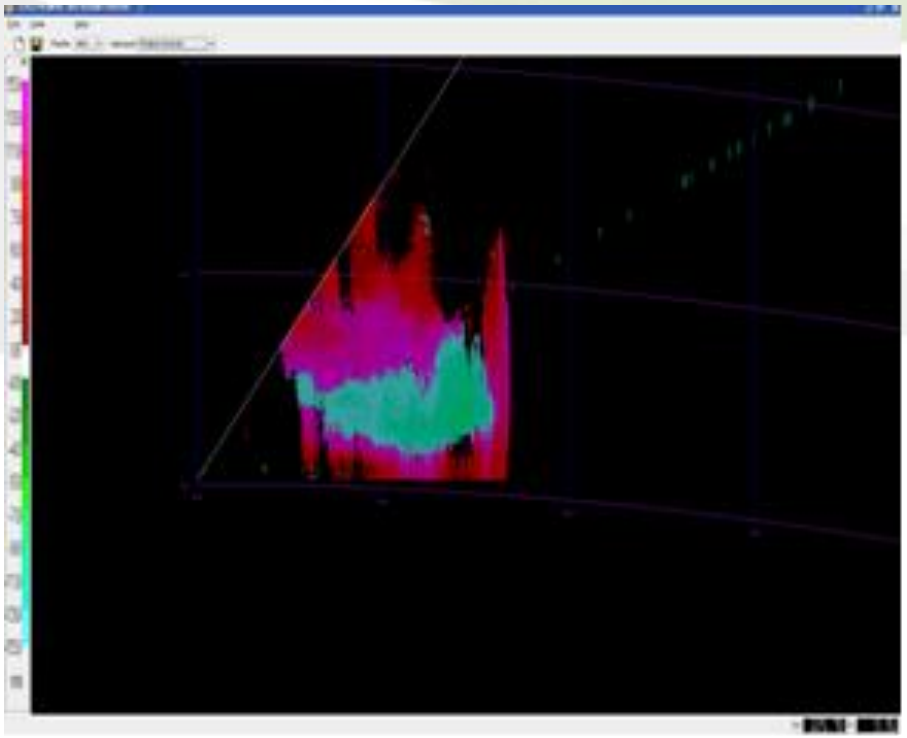
Weather Equipment: Doppler Weather Radar

Doppler Weather Radar in Abuja

Weather Equipment: Doppler Weather Radar

Doppler Weather Radar Image Over Abuja showing areas of active weather was captured on the 28th September 2011 at 3:05pm





Definitions and Basic Concepts

Climate is the average condition of weather in a place. It is expressed as the mean state described by temperature, wind, rainfall, sunshine etc. By the standard stipulated by WMO, the condition should be averaged over at least a 30-year period

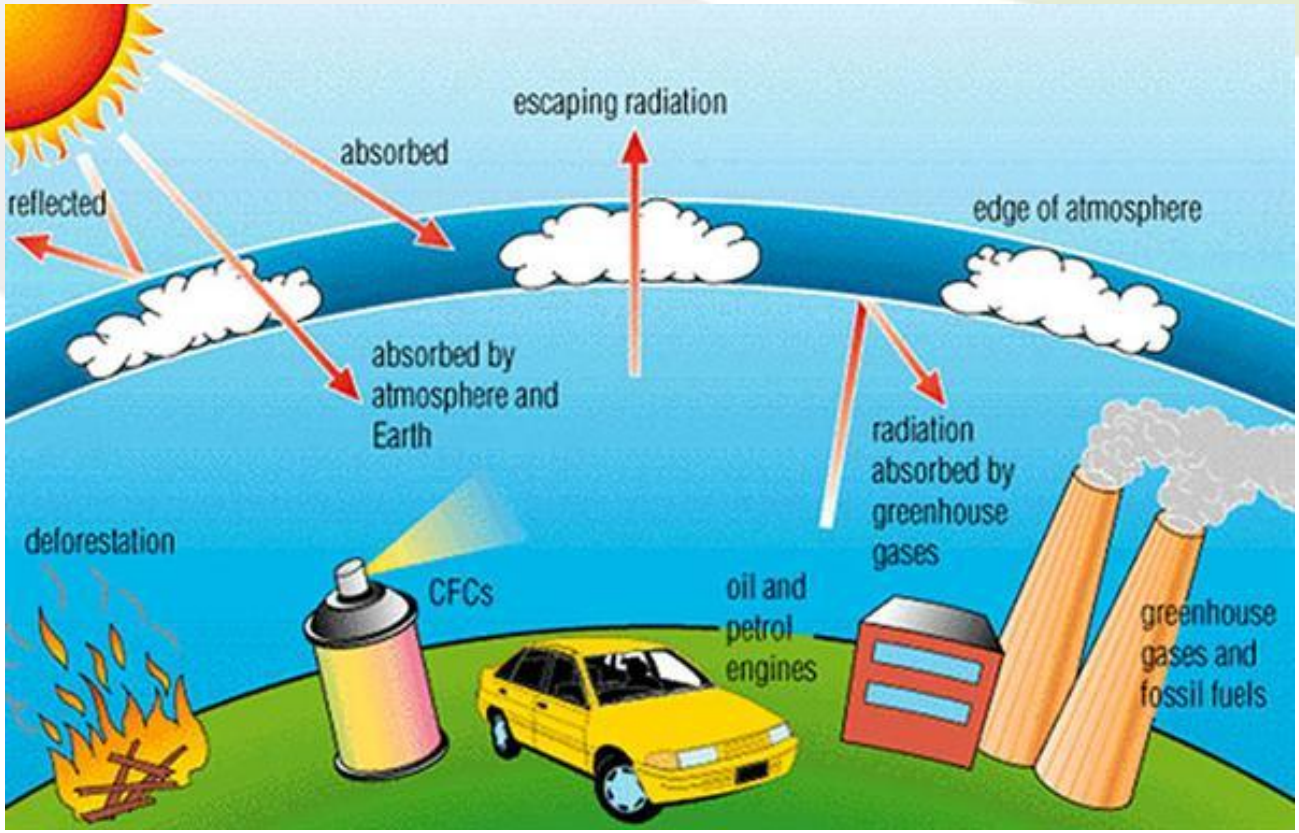
Climate Change as defined by the Inter-governmental Panel on Climate Change (IPCC) is "***a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer)"***

Climate Change as defined by United Nations Framework Convention on Climate Change (UNFCCC), is: ***"attributed directly or indirectly to human activity that alters the composition of global atmosphere and, which is, in addition to natural climate variability observed over comparable periods"***. IPCC defines

Climate Variability as the "***variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events"***.

Global Warming

Definition: This term is often used in describing changes in the behavior of the Climate System as a result of observed long term increase in air temperature of the Earth, due to increasing concerntrations of GHGs.



Global Warming … How it all Started

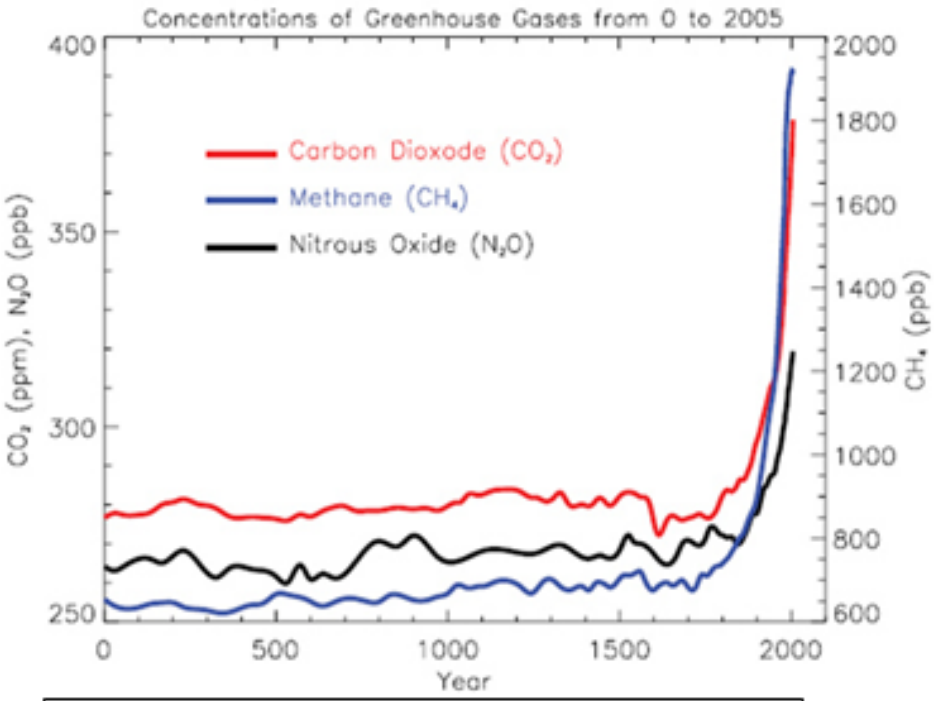


Figure 5: Atmospheric concentrations of major GHGs over the past 2000 years.
(*Source*: IPCC Fourth Assessment Report, (2007)).

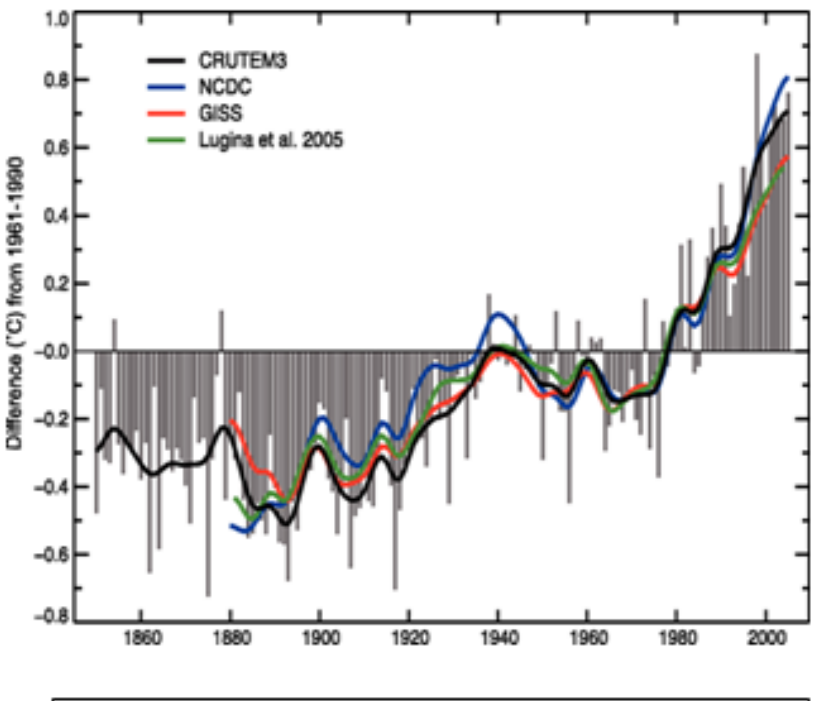


Figure 6: Trend in global air temperature anomalies from 1850 to 2005
(*Source*: IPCC Fourth Assessment Report (2007))

VULNERABILITY, MITIGATION AND ADAPTATION

VULNERABILITY

Is defined as the combined measure of threats to a particular system. It is the degree to which a system or community is susceptible to, or unable to cope with, the adverse effects of extreme weather phenomena, including climate variability

MITIGATION

Is any strategy or action taken to remove the GHGs released into the atmosphere, or to reduce their amount .

ADAPTATION

This can be understood as a continuous process addressing several factors and environmental stresses, rather than just climate change in particular.

EWS and Disaster Risk Reduction

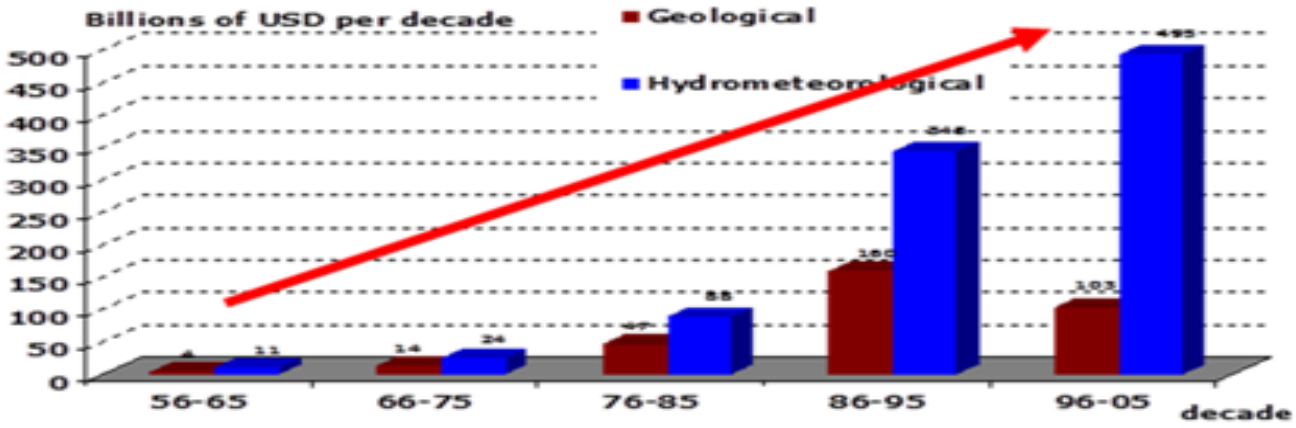


Figure 7(a): Increasing economic losses due to extreme weather

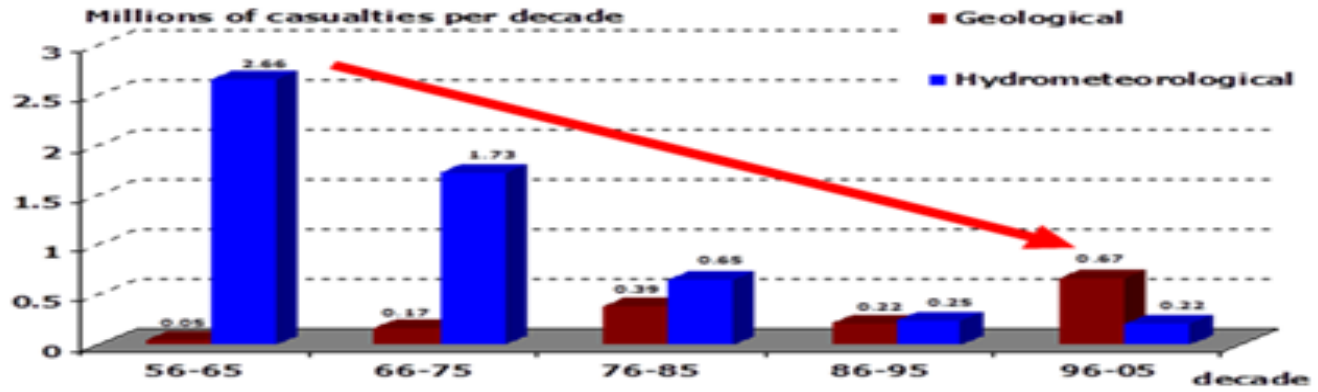
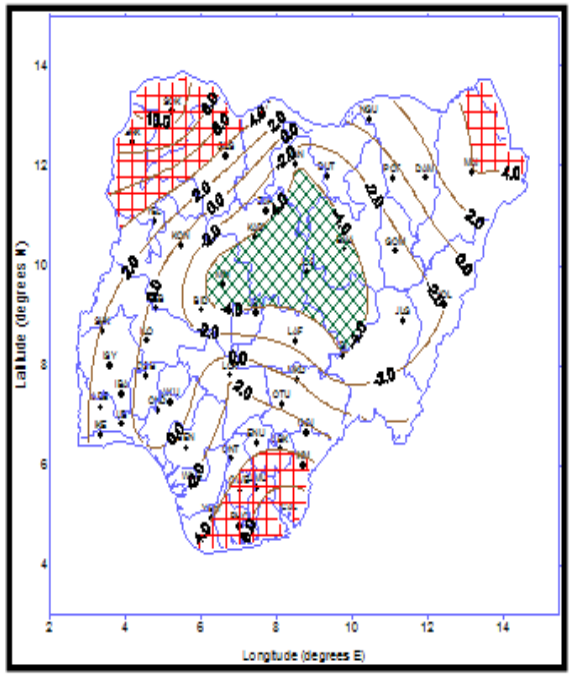


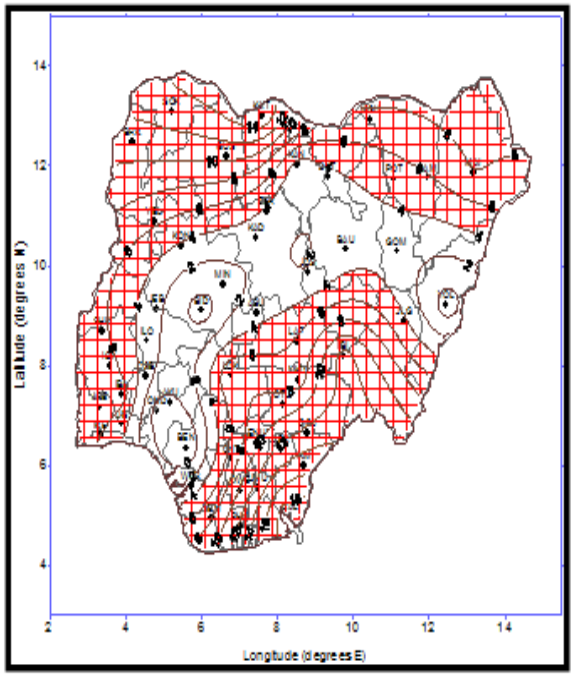
Figure 7(b): Decreasing loss of life over the same period

*(**Source**: EM-DAT: The OFDA/CRED International Disaster Database)*

Illustration showing Normal Cessation of Rainy Season

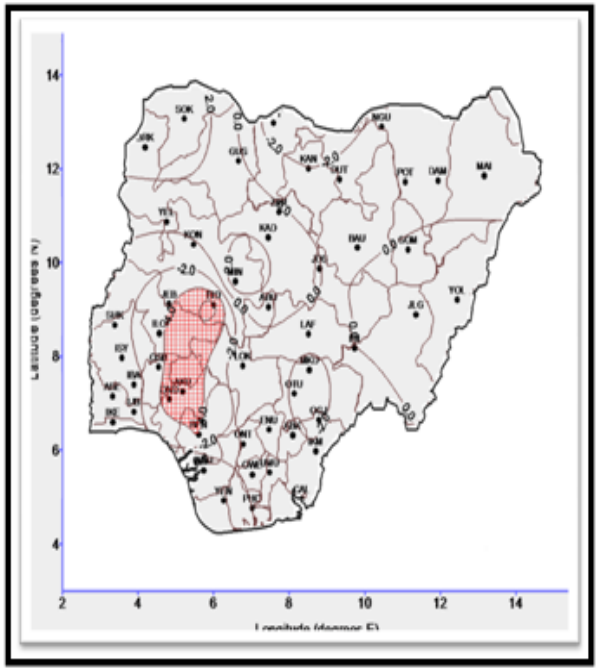


(a) Deviation of 1941 – 1970 mean onset date of rainy season from the 1911 – 1940 onset dates. (Note the relatively small area of the country (shown in red) experienced late onset).

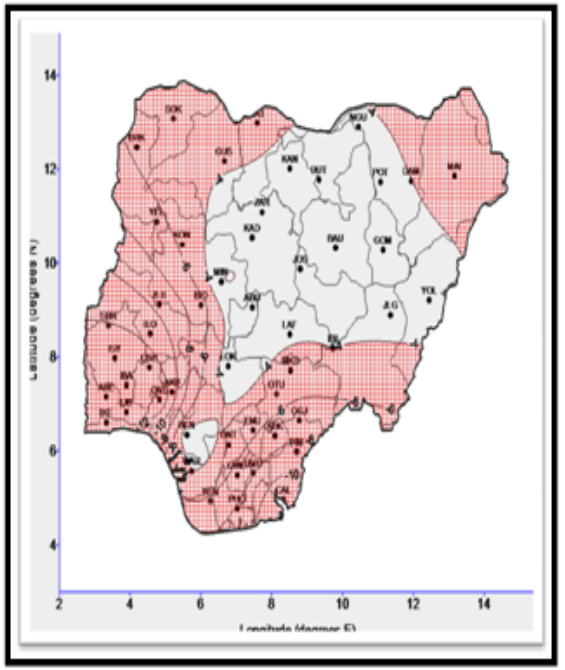


(b) Deviation of 1971 – 2000 mean onset date of rainy season from the 1911 – 1940 onset dates. Note that late onset had spread to a much larger area (shown in red) by 1971 – 2000.

Changes in Cessation Dates of Rainy Season between 1911 and 2000



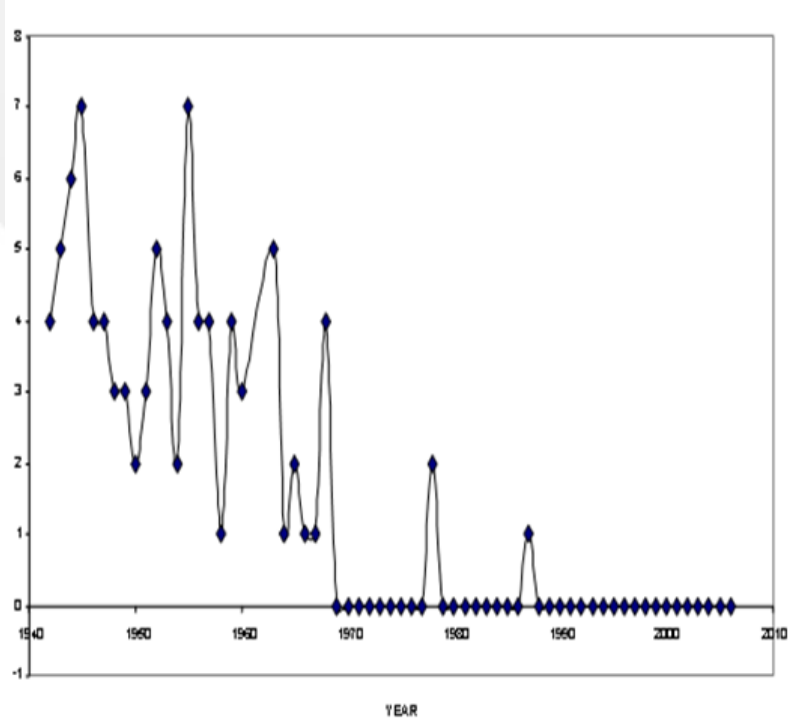
(a) Deviation of 1941-1970 mean cessation date of rainy season from the 1911-1940 cessation dates. (Note the relatively small area of the country (shown in red) experienced early cessation of rainfall.

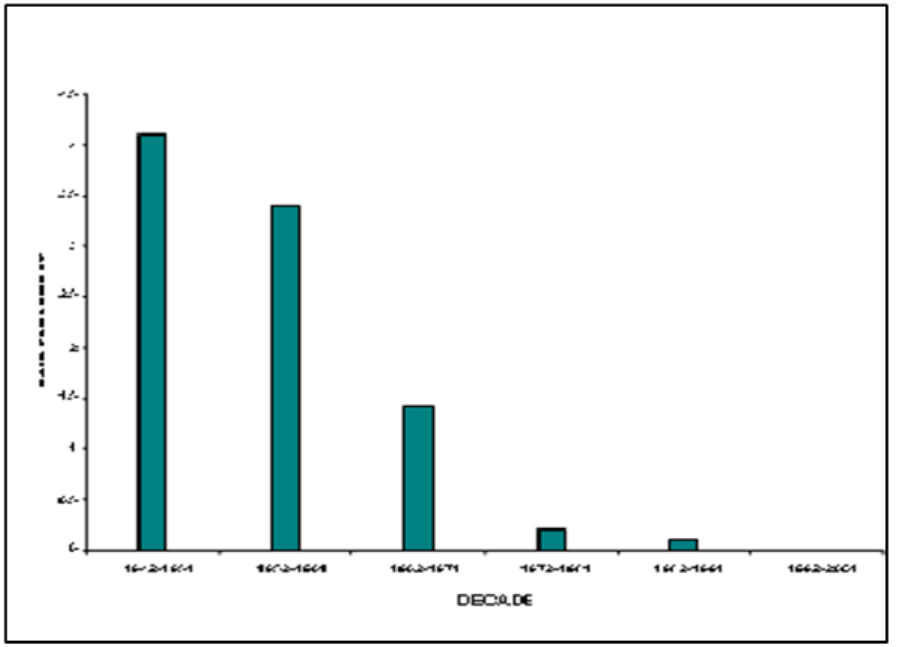


(b) Deviation of 1971-2000 mean cessation date of rainy season from the 1911-1940 cessation dates. Note that early cessation had spread to a much larger area (shown in red) by 1971 – 2000.

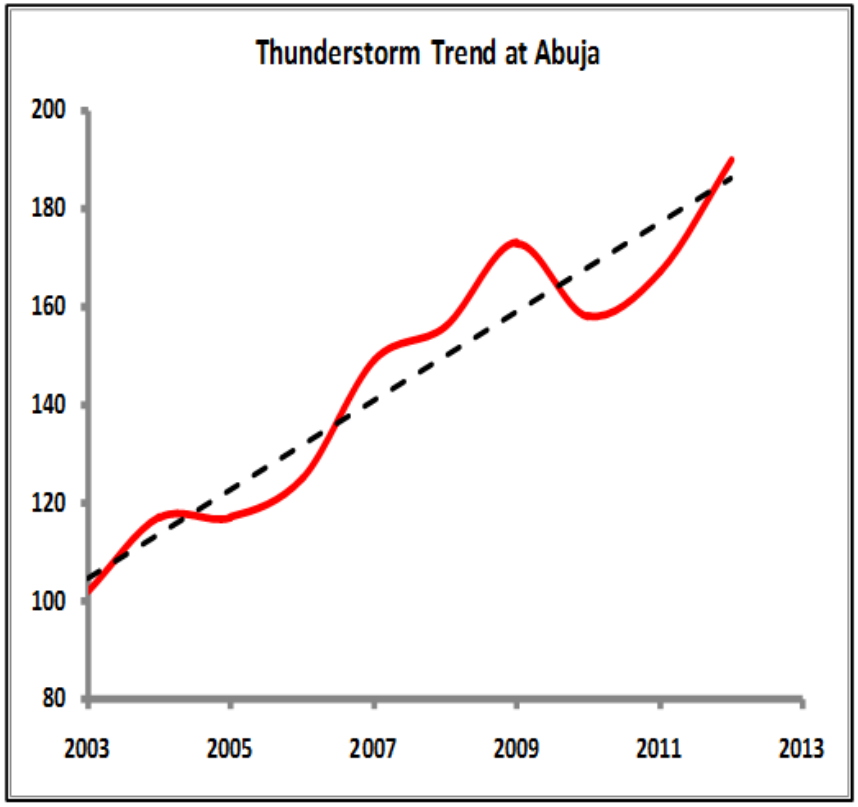
Climate Change and Variability in Nigeria

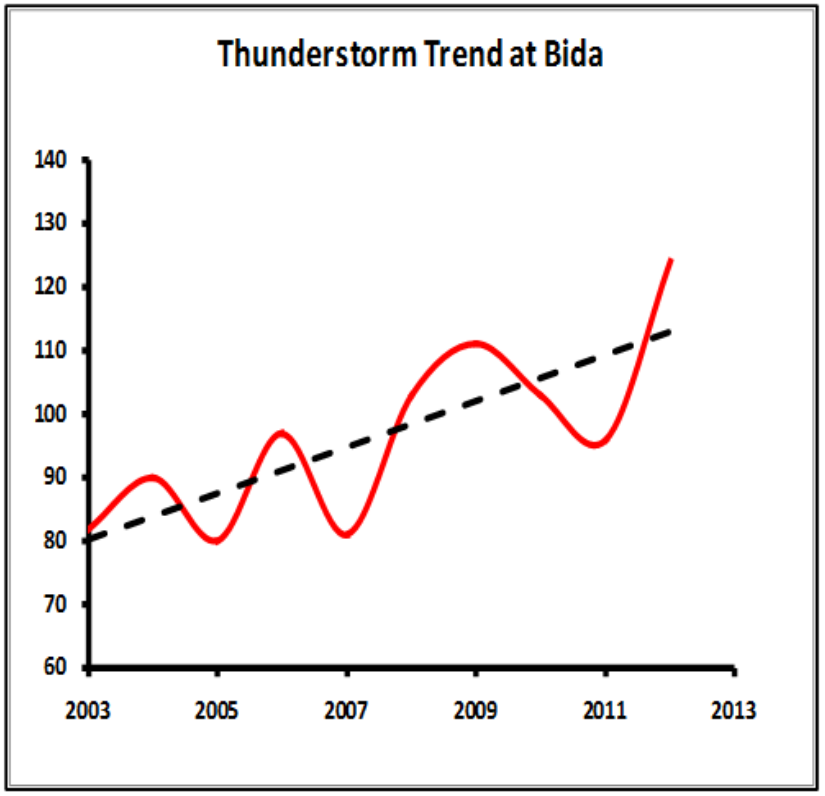
Time Series Indicating Hail Occurrence





Rising incidence of thunderstorms in selected cities in the North (Abuja and Bida)





Temperature showing Warmer Conditions in the Last 2 Decades

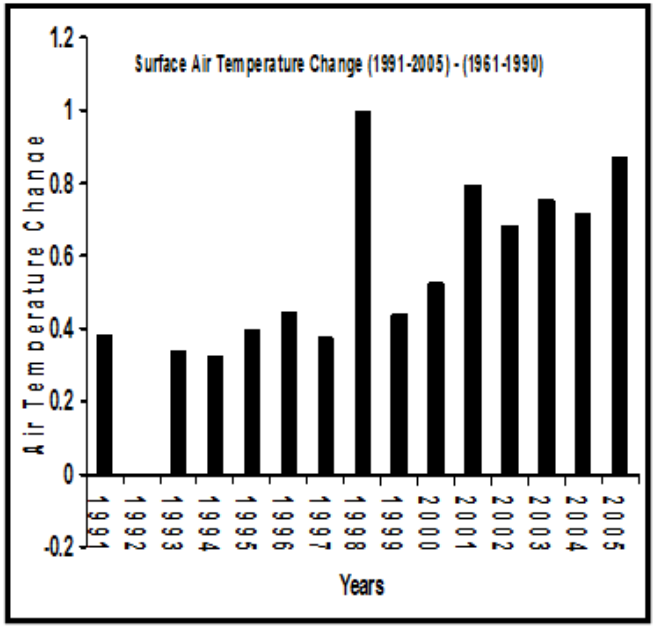


Figure 12: Temperature anomaly (1991-2005) compared to (1961-1990)

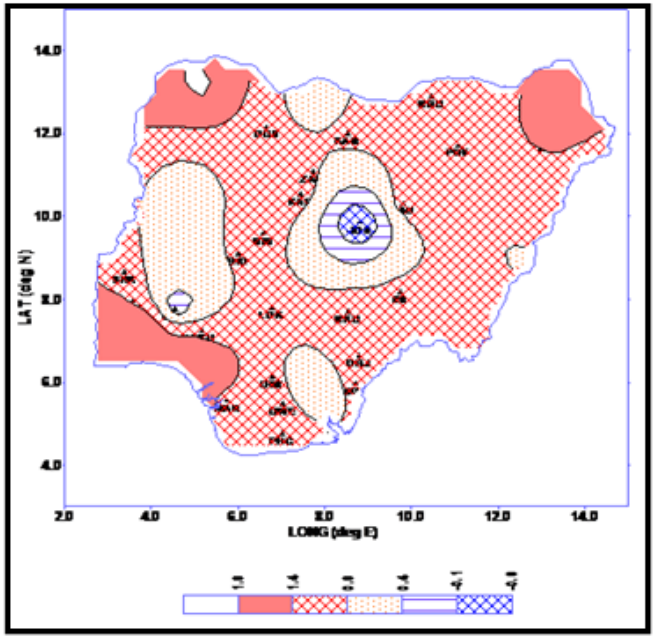
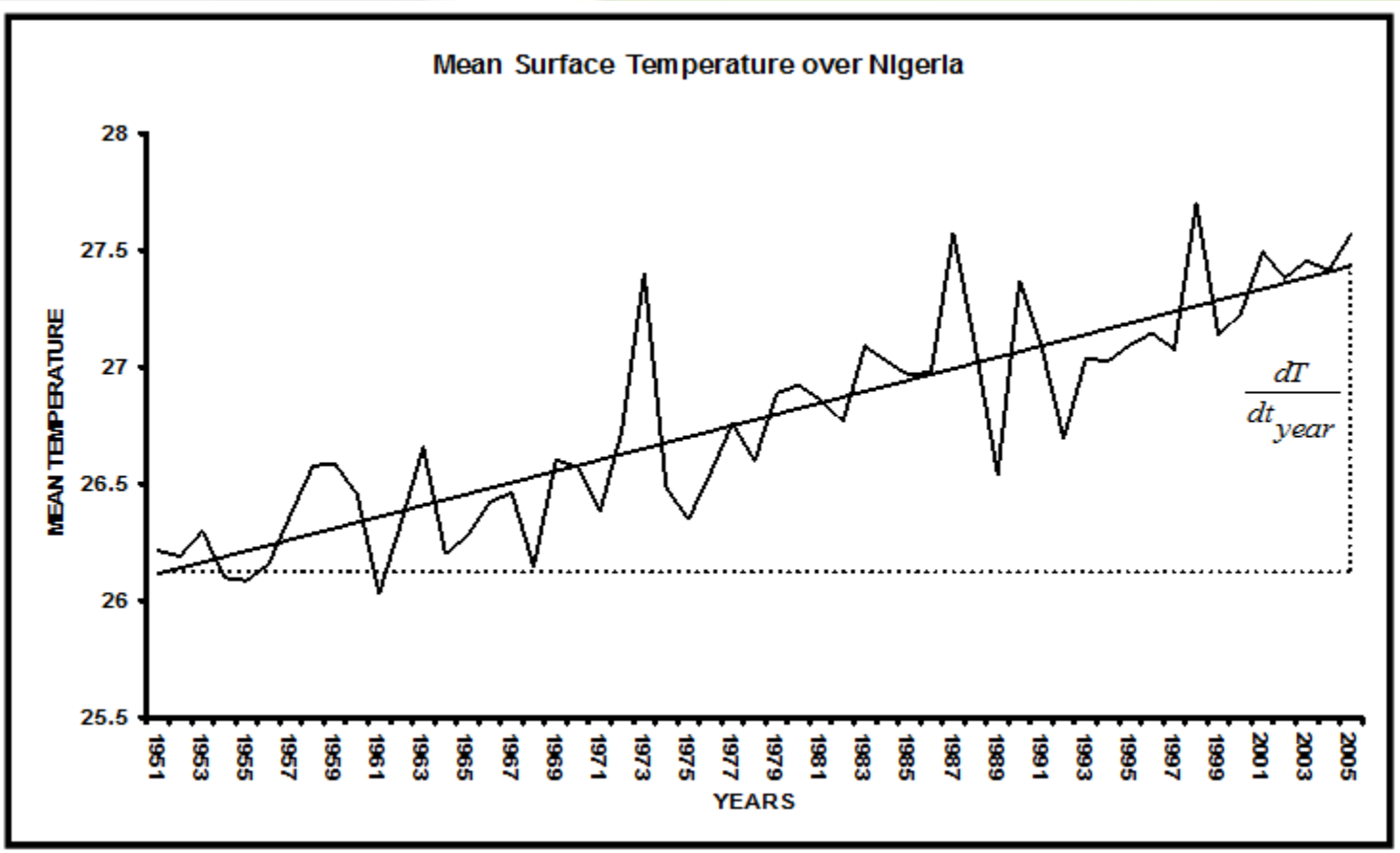
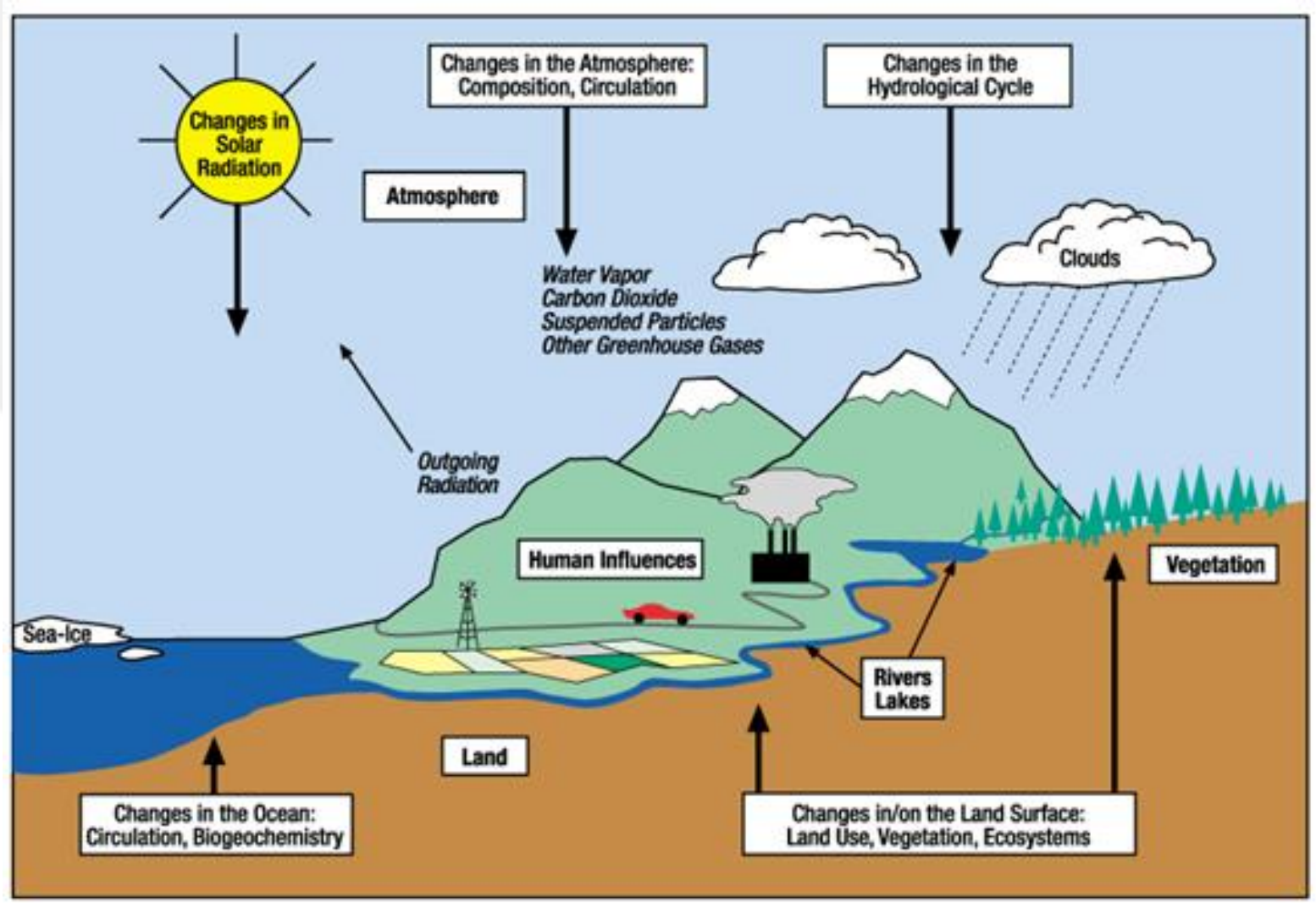


Figure13: Spatial distribution of 1991 - 2005 temperature anomaly over Nigeria

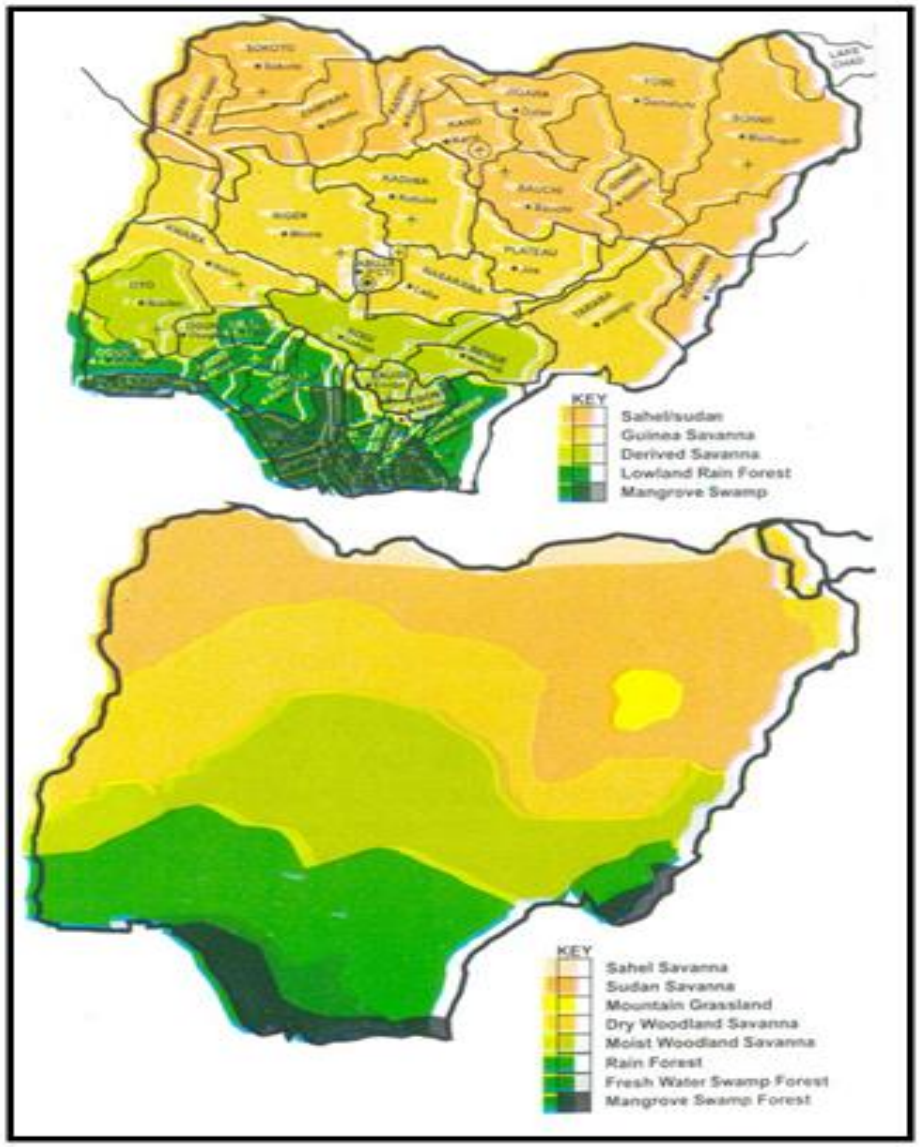
Temperature trend over Nigeria



Interaction of Climate & Environment

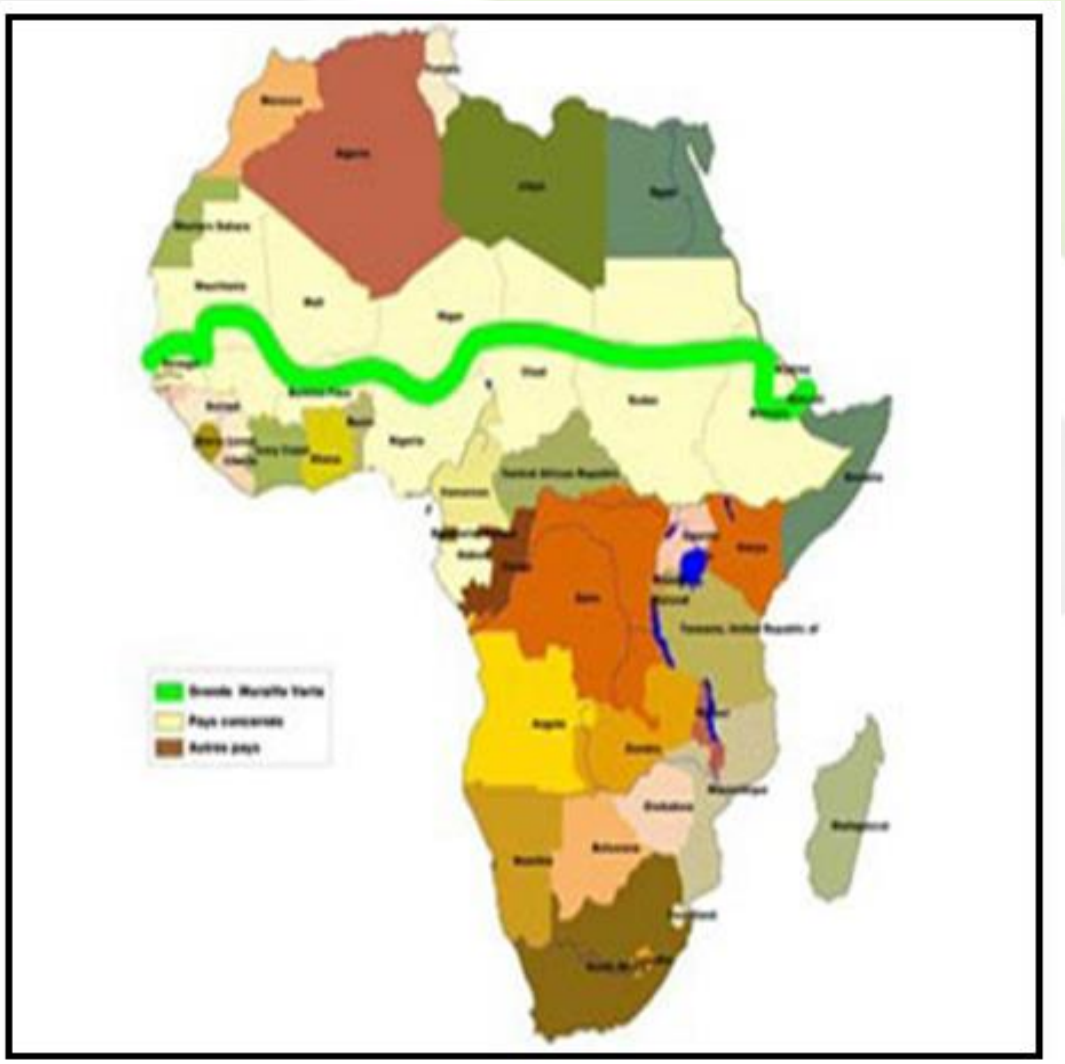


Climate Change, Environment and the Economy >> Ecosystems



In Nigeria we have witnessed the disappearance of some agro-ecological zones. As a result of this the number of the zones has reduced from eight to five presently.

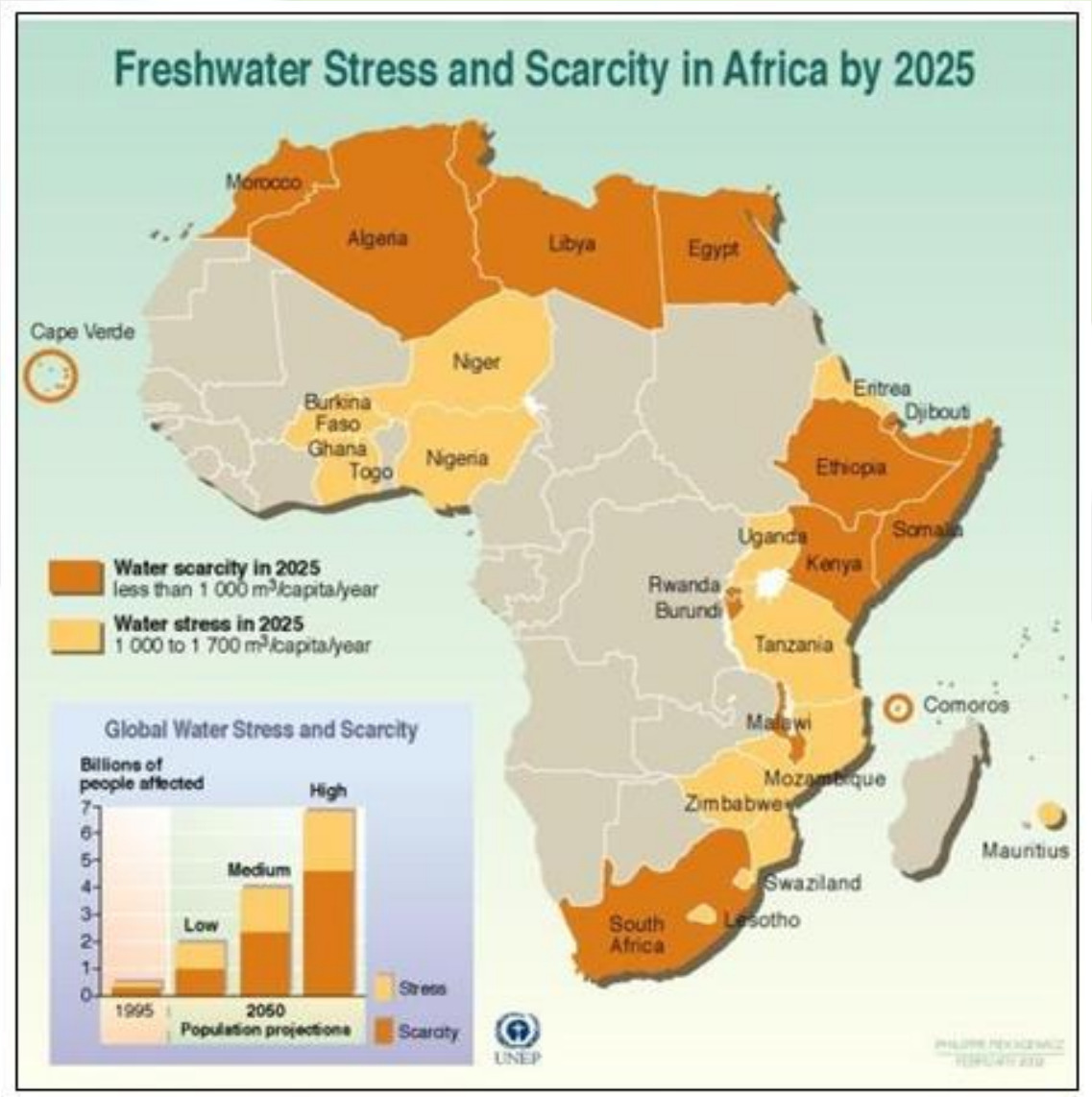
Climate Change, Environment and the Economy >> Drought



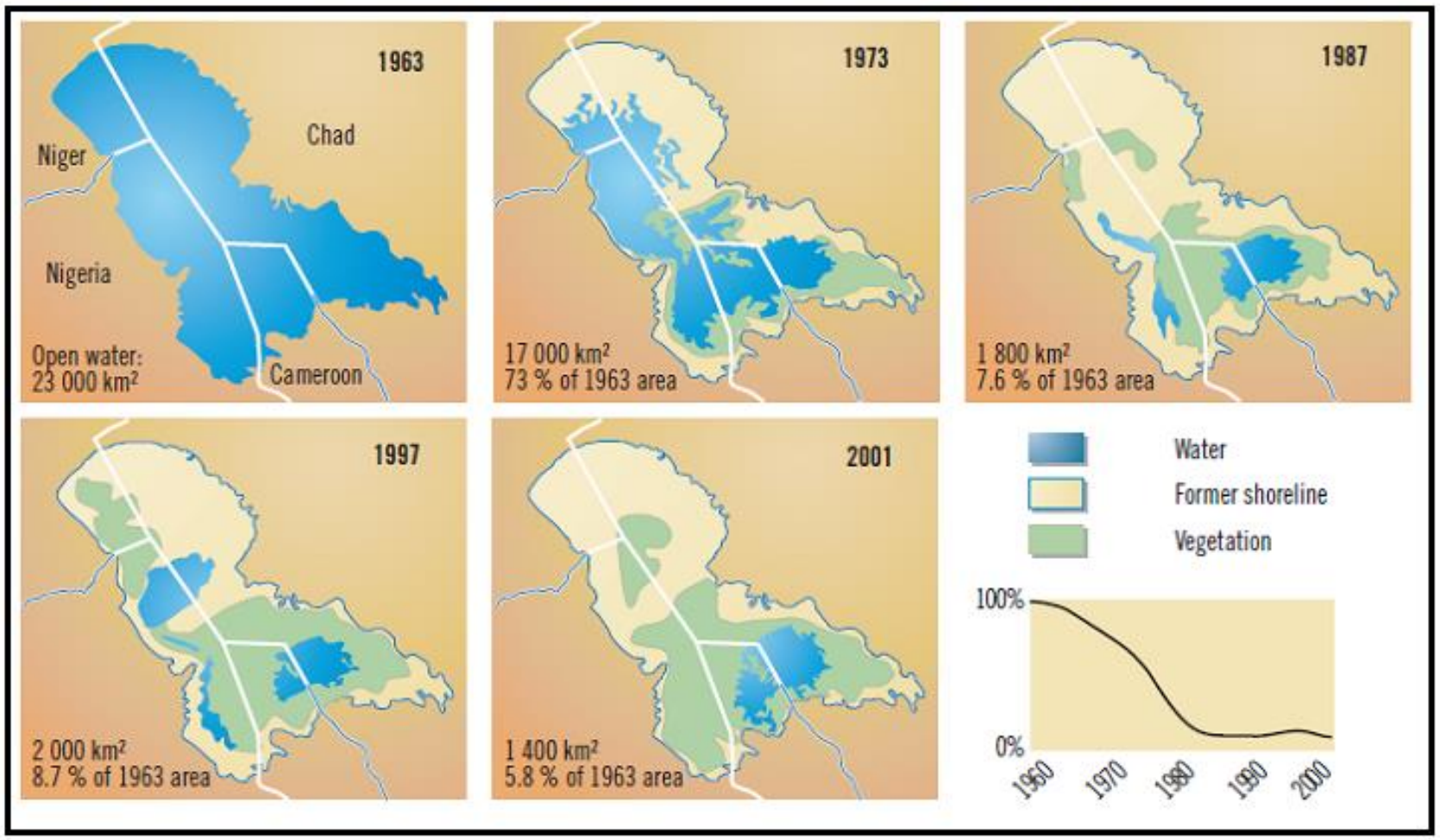
As part of the mitigation measures against southward advancement of the Sahara desert the African Union initiated the Great Green Wall Sahara initiative. The Green Wall is essentially a 15km wide tree plantation stretching a distance of 7,775 km from Senegal to Djibouti.

Low-lying highly developed Coastal City vulnerable to Sea Level rise.

Climate Change, Environment and the Economy >> Water Resources

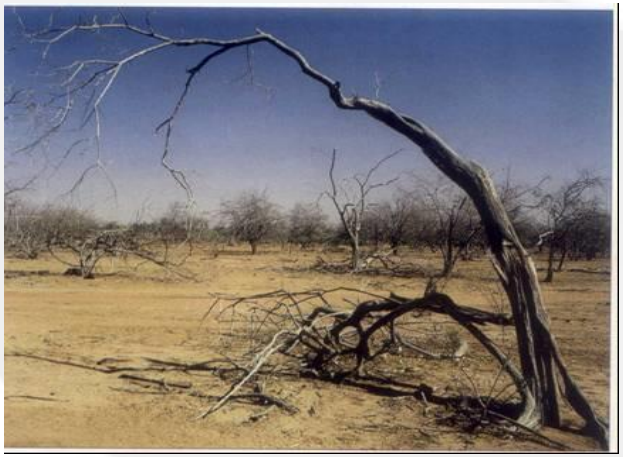


Lake Chad (*Source*: UNEP GRID Arendal, 2003)



Climate Change, Environment and the Economy >> Agriculture

Agriculture suffers from severe water stress ..



Agriculture is one of the economic sectors that are most vulnerable to Climate Change. Africa is highly vulnerable to the impacts of Climate Change, and therefore food security in the continent may be increasingly threatened by extreme weather resulting from Climate Change, if adequate adaptation strategies are not put in place.

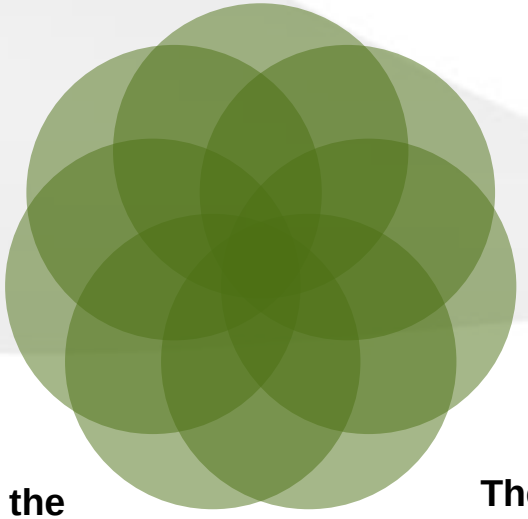
.. and from too much rainfall like what happened last year.

Some Statistics on the Nigerian Economy

Nigeria has a population of about 167 million people.

Agriculture accounts for nearly 40% of the nation's GDP and employs about 70% of the labour force.

Nigeria has a land area of 923,768 KM sq



In 2011, the oil and gas sector accounted for 79% of revenue of the Federal Government.

Nigeria is the largest economy in West Africa and the second largest in Sub-Saharan Africa.

In the 1960s the contribution of agriculture to the GDP was about 55%.

The Nigerian economy is predominantly primary product oriented (agriculture and crude-oil production).

More Statistics on the Nigerian Economy

It is ranked 30th in the World in terms of Purchasing Power Parity-measured GDP.

It is ranked 25th worldwide and 1st in Africa in farm output; and 63rd worldwide and 5th in Africa in service output.

Nigeria has about 34 different minerals across Nigeria including gold, iron ore, coal, and limestone;

Nigeria has 37.2 billion barrels of proven oil reserves and 187 trillion cubic feet of proven natural gas.

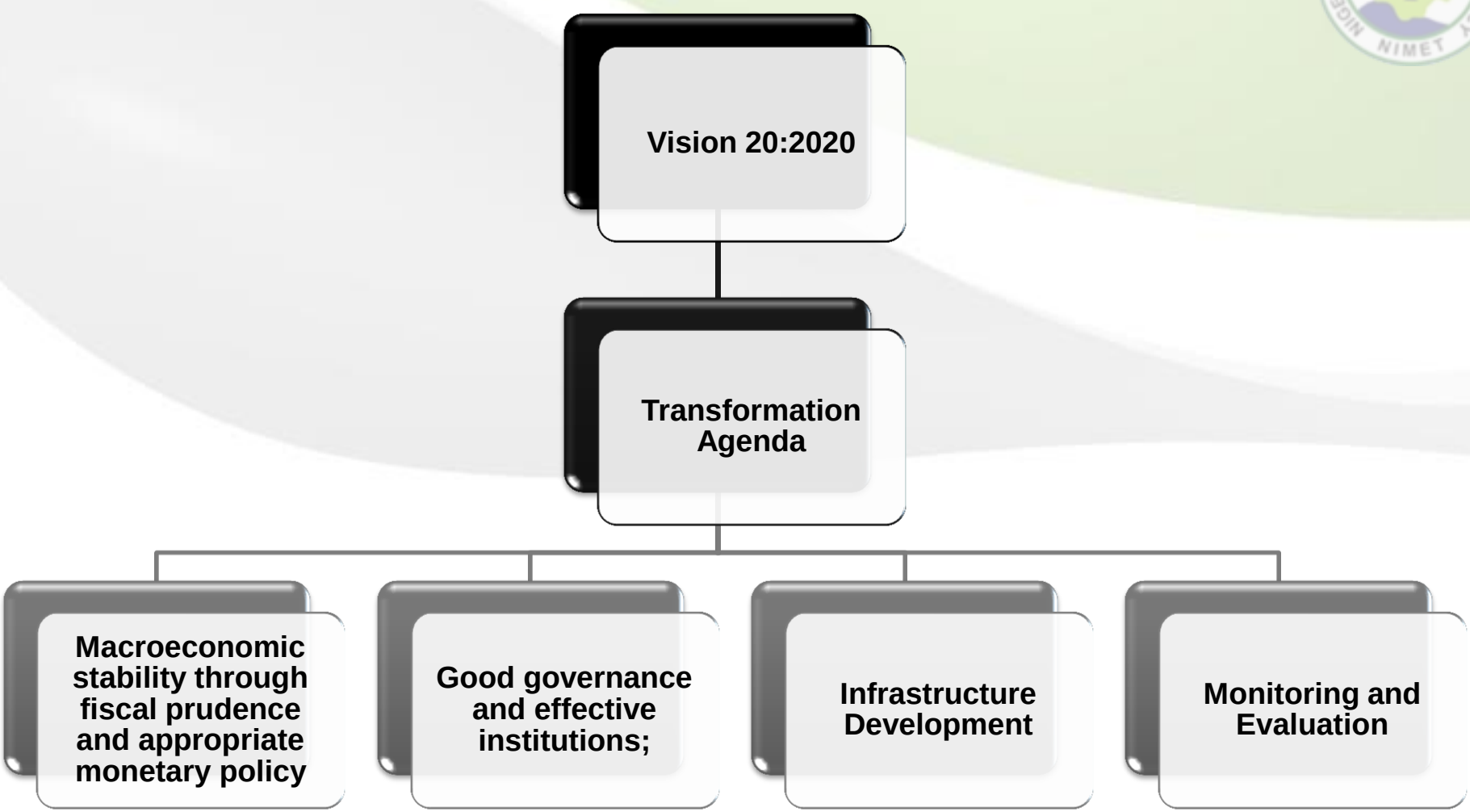
Total Foreign Direct investment (FDI) increased from $5.7 billion in 2009 to $8.9 billion in 2011, representing 20% of the total FDI to Africa in 2011 mostly in the oil sector.

Contribution of Various Sectors to the GDP of Nigeria

	SECTOR	*PERCENTAGE CONTRIBUTION TO GDP*		*SECTOR*	*PERCENTAGE CONTRIBUTION TO GDP*
1	Agriculture	39.24	7	Finance and Insurance	3.45
2	Crude Petroleum and Natural Gas	14.71	8	Real Estate	1.75
3	Building and Construction	2.09	9	Posts and Telecommunications	5.71
4	Wholesale and Retail	20.66	10	Solid Mineral	0.36
5	Hotel and Restaurant	0.47	11	Business and other Services	0.92
6	Manufacturing	4.16	12	Others	6.68

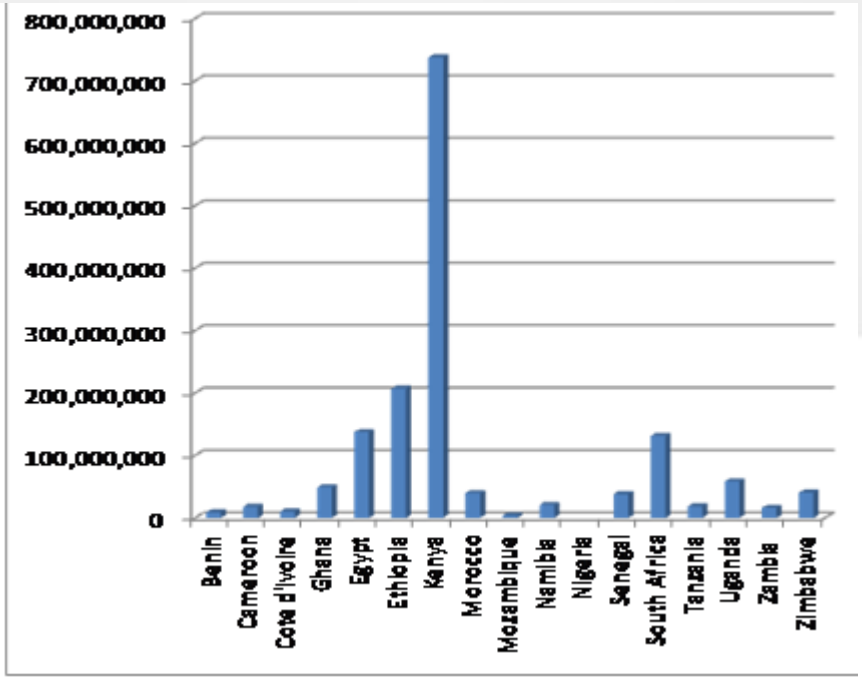
Source: National Bureau of Statistics (2012) & African Development Bank (2012)

***Core Elements of Nigeria's Vision 2020 Economic Transformation Blueprint*.**

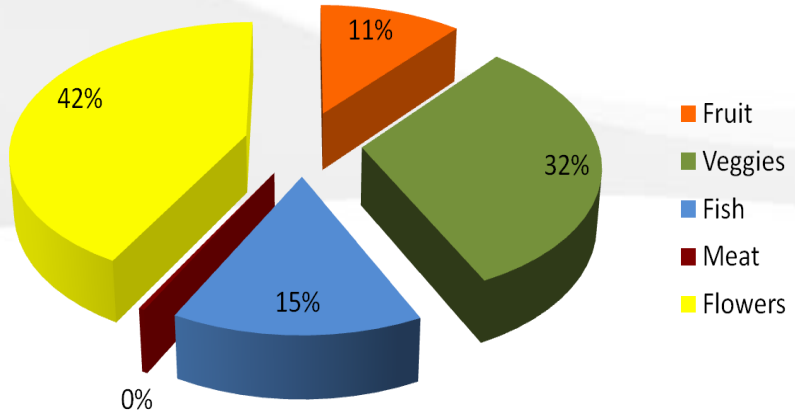


The Perishable Cargo terminal initiated by the Honourable Minister of Aviation, Princess Stella Oduah is a totally new concept in Nigeria. It is noteworthy that Agro-Perishable Cargo is a multi-million dollar business which a good number of African countries are benefitting from

Accumulated Earning from Perishable Cargo Export in $



The Perishable Cargo Market by Commodities



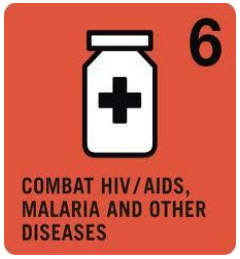
(*Source*: DHL Cargo)

Increase in Crop Yield using Rainfall Information by rural farmers in Mali

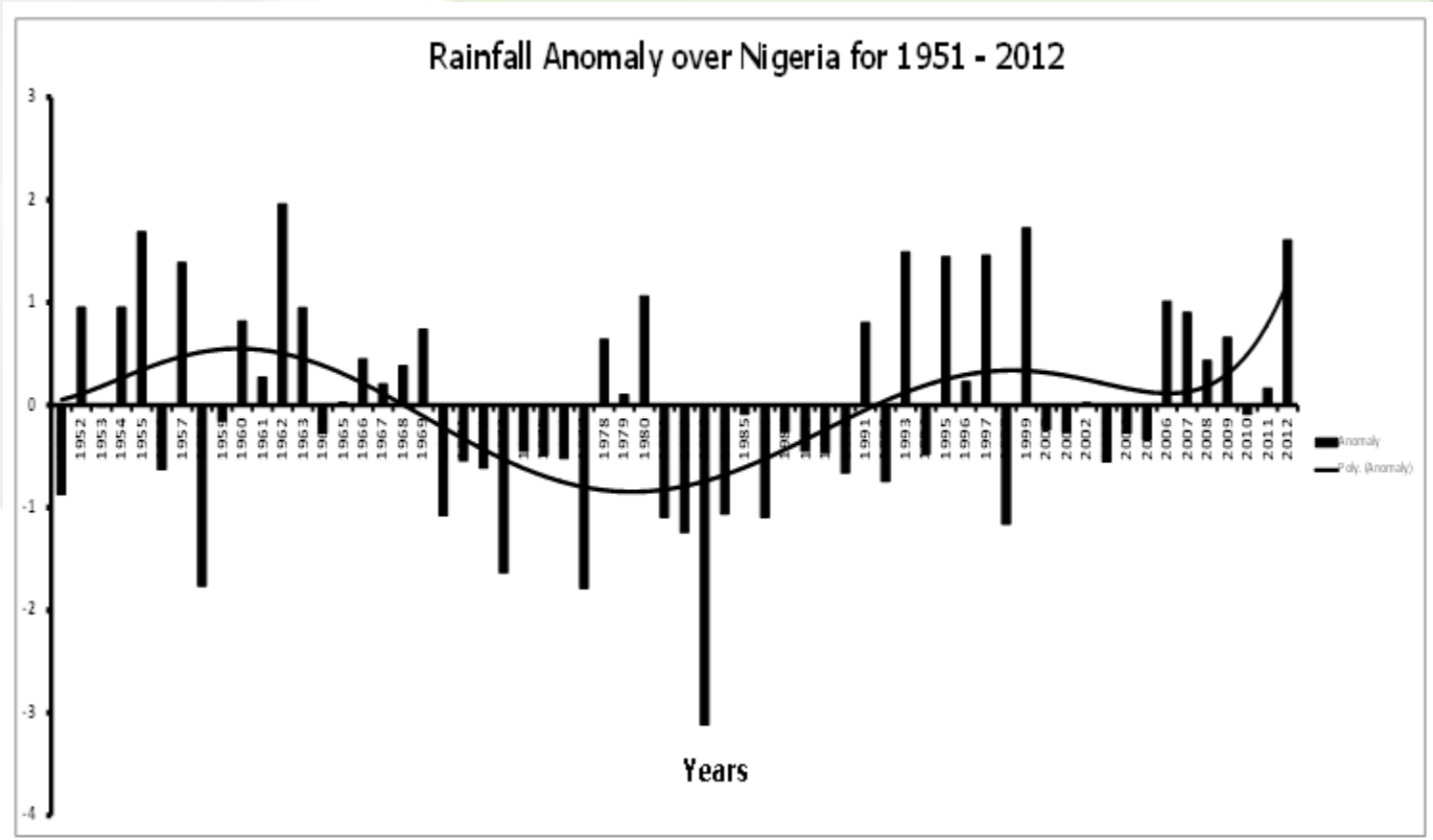
Crop	Development Zone	Field Type	Area (ha)	Average Yield/ha	Gross Income ($/ha)	Income gain in Agromet Field (%)
Pearl millet	OHVN	Agromet	2,600	1,204	175	26
		Non-agromet	67,168	957	139	
	DRAMR	Agromet	750	757	110	10
		Non-agromet	45,790	690	100	
	ORS	Agromet	10,400	1,247	181	48
		Non-agromet	461,915	840	122	
Sorghum	OHVN	Agromet	5,375	1,427	193	42
		Non-agromet	470,996	1,005	136	
	DRAMR	Agromet	28,275	955	129	10
		Non-agromet	222,662	871	118	
	ORS	Agromet	2,850	1,562	212	56
		Non-agromet	179,853	1,002	136	
Maize	OHVN	Agromet	6,075	1,984	249	80
		Non-agromet	27,079	1,105	139	
Groundnut	DRAMR	Agromet	6,060	874	237	25
		Non-agromet	102,113	702	190	

Source: WMO Climate Information for Food Security

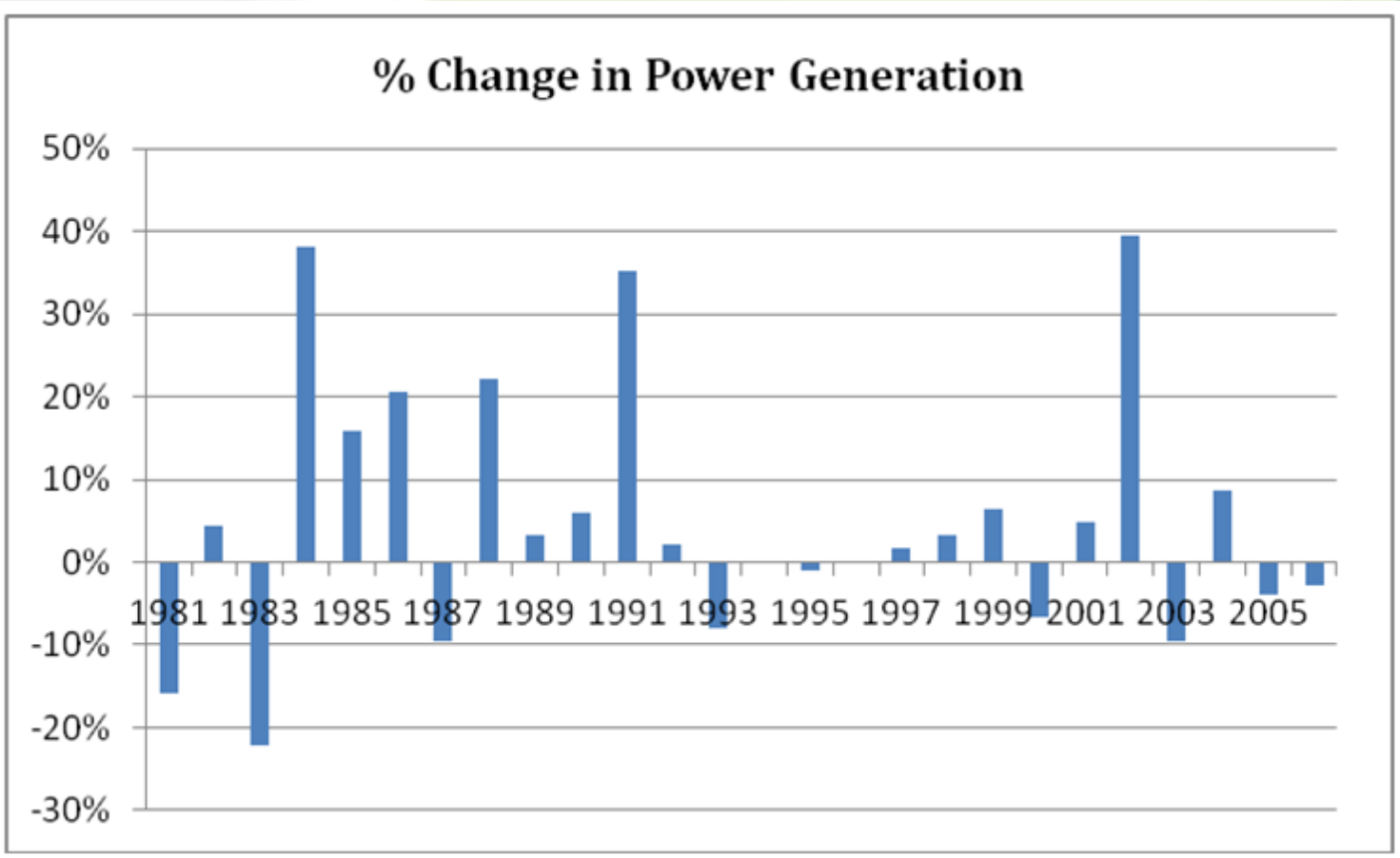
GOALS	Example of Climate Change Linkages
	Climate change is projected to reduce the value of the assets and degrade the livelihoods of many poor people, e.g. in terms of health, access to water, homes and infrastructure. Climate change is expected to alter the path and rate of economic growth due to changes in natural systems and resources, infrastructure and labour productivity. A reduction in economic growth affects poverty through, e.g. reduced income opportunities. Climate change is projected to alter regional food security. Particularly in Africa, food security is expected to worsen. Adverse impacts on food security could be seen in Latin America as well as in South and Southeast Asia.
	In the developing world in particular, women are disproportionately involved in natural resource–dependent activities, such as agriculture, which are particularly vulnerable to climate change. Women's traditional roles as primary users and managers of natural resources, primary caregivers and labourers engaged in unpaid labour (i.e., subsistence farming) mean they are involved in and dependent on livelihoods and resources that are put most at risk by climate change.

GOALS	Example of Climate Change Linkages
  	Direct effects of climate change include increases in heat-related mortality and illness associated with heat waves (although fewer winter cold–related deaths may happen in some regions). Climate change may increase the prevalence of some vector-borne diseases (e.g. malaria and dengue fever), and vulnerability to water-borne, food-borne or infectious diseases (e.g. cholera and dysentery). Children and pregnant women are particularly susceptible to vector- and water-borne diseases. Anaemia, which results from malaria, is responsible for a quarter of maternal mortality. Climate change will likely result in declining quantity and quality of drinking water in many locations. It will also exacerbate malnutrition—an important source of ill health among children—by reducing natural resource productivity and threatening food security, particularly in Sub-Saharan Africa, but also in many other low-latitude areas.

GOALS	Example of Climate Change Linkages
	Climate change is likely to alter the quality and productivity of natural resources and ecosystems, some of which may be irreversibly damaged. These changes may also decrease biological diversity and compound existing environmental degradation.
	Climate change is a global issue and response to it requires global cooperation, especially in helping developing countries adapt to its adverse impacts.



Alternating Periods of Above Normal & Below Normal Rainfall (Based on NIMET Historic Rainfall Data)



Percentage Change in Hydroelectric Power Output in Nigeria from 1980 to 2006. (*Adopted from United States Energy Information Administration*)

Summary of damage and losses caused by the 2012 Nigeria Floods

Sector	*Subsector*	*Disaster Effects, Damage*	*Million Naira Losses*	*Total*
Social		**1,256,299.3**	**73,557.9**	**1,329,857.2**
	Education	82,134.6	15,211.2	97,345.8
	Health	18,204.8	9,476.8	7,681.7
	Housing	1,155,959.9	48,869.9	204,829.7
Productive		**147,996.5**	**1,037,070**	**1,185,066.5**
	Agriculture	101,008.2	380,520.8	481,528.9
	Manufacture	21,008.2	74,425.0	96,220.2
	Commerce	18,693.1	357,124.2	375,817.3
	Oil Industry	6,500.0	225,000.0	231,500.0
Infrastructure		**54,019.6**	**8,013.6**	**62,033.2**
	Water and Sanitation	12,902.2	---	12,902.2
	Electricity	329.0	8,013.6	8,342.6
	Transport	40,788.4	---	40,788.4
Cross-Sectoral		**23,804.2**	**17,167.0**	**41,007.2**
	Environment	23,804.2	17,167.0	41,007.2
Total		**1,482,155.6**	**1,135,808.5**	**2,617,964.0**

***Source**: Estimation by PDNA Assessment Team on the basis of official information*

Impact of the Flood Disaster on Growth

Item	2012
2011 GDP in current basic prices (Million Naira)	37,409,861
2012 GDP in current basic prices (Million Naira)	40,541,633
Share of total production loss in GDP (%)	1.4
2011 GDP in 1990 prices (Million Naira)	834,001
2012 GDP in 1990 prices (Million Naira)	889,143
Real GDP Growth 2012 (%)	6.61

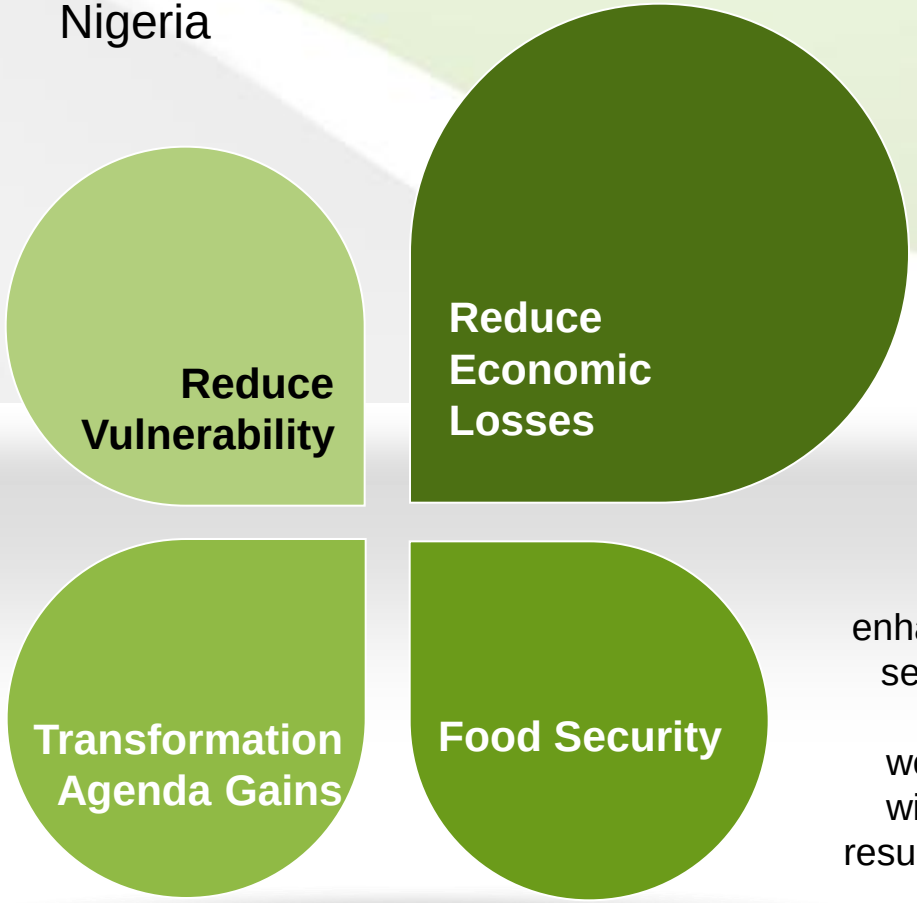
The Report went further to estimate that N884 billion (US$5.5 billion) are required to finance disaster-resilient reconstruction of assets that were destroyed in the affected areas. Apart from the damage to infrastructure weather-induced disasters also result in loss of GDP and further losses in terms of cost of reconstruction and recovery.

***Source**: National Bureau of Statistics & PDNA Sectoral Reports*

THE NIGERIAN ECONOMY, CLIMATE CHANGE AND METEOROLOGY

Reduce the vulnerability of millions of Nigerians to disaster risks associated with extreme weather phenomena such as floods, drought and desertification. As in most other developing countries, more than 70% of natural disasters in Nigeria are due to extreme weather phenomena.

NFACS is built upon GFCS to provide a holistic platform and framework for the application of Climate Services in Nigeria



Significant reduction in economic losses resulting from destruction of roads, buildings and other infrastructure by severe weather events.

Ensure the gains of the Transformation Agenda in infrastructural development are not eroded by severe weather events: particularly in the areas of agriculture, food security and infrastructure.

Improved crop yield and enhancement of national food security. (It is estimated that proper application of weather/climate information with necessary inputs could result in up to 30% increase in agricultural yield).

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NIMET's Product in Support of Climate Change Adaptation

- Seasonal Rainfall Prediction (SRP)
- Drought & Flood Monitor Bulletin (DFMB)
- Agrometeorological Bulletin (AMB)
- Annual Climate Review Bulletin (AWRB)
- Quarterly Weather Review Bulletin (QWRB)
- Marine Met Quarterly Bulletin (MQB)

RECOMMENDATIONS

- Sustain the continuous strengthening of institutional capacities and infrastructures to observe weather and provide accurate weather and climate information that are tailored to meet the specific needs of key economic sectors.
- Sustain and deepen the on-going effort to develop a National Framework for Application of Climate Services in Nigeria.
- Review the engineering standards for designing and building our infrastructure taking into account the expected hotter weather, more violent winds, uncertainty in rainfall patterns and other weather and climate parameters.
- Support scientific research in meteorology and the earth sciences.
- Encourage awareness campaigns and programs on the role and value of meteorological information and promote climate literacy.
- Mainstream weather and climate information into formulation of policy, planning and execution of projects and programs at all levels.
- Institutionalize the integration of meteorological information into the activities of weather and climate dependent sectors to enhance performance.
- Encourage climate sensitive sectors of the economy to develop appropriate adaptation and mitigation strategies to reduce their vulnerability to climate change impacts.
- Develop tools for improving the interpretation and application of meteorological information.
- Facilitate the dissemination of early warning meteorological information for disaster risk reduction.
- Empower vulnerable communities through awareness campaign programs

CONCLUSION

The Federal Government of Nigeria recognizes that Climate Change is ***"a critical challenge that must be responded to by any economy seeking sustainable growth in the years leading up to 2020."***

In addressing this challenge it has taken a number of measures:-

- Development of the National Action Plan and Adaptation Policy on Climate Change.
- Strengthening the operational capacity of NIMET through the provision of modern infrastructure and facilities for weather observation and forecasting.
- Strengthening the capacity of NEMA to respond to weather-induced disasters
- Setting in motion the process of developing a ***National Framework for Application of Climate Services (NFACS)*** by inaugurating a high-powered Inter-Ministerial Committee to develop the Framework; among others.