32ND INAUGURAL LECTURE

THE CLIMATIC DILEMMA

DELIVERED BY

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COURTESIES

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Distinguished Members of the University Senate,

Other Invited Guests,

My Beloved Relations, Friends and Schoolmates.

Gentlemen of the Press,

The Entire Populace of Eminent Staff and Students,

Ladies and Gentlemen.

1.0 PRELIMINARY REMARKS

It is with immense gratitude to the Almighty God that I stand before you this afternoon to perform a very important academic tradition which is to deliver an inaugural lecture. An inaugural lecture is essentially an academic tradition which any person appointed/promoted to the position of a professor in a university is normally required to fulfill in the course of his/her career in the University.

As observed by Adalemo (1984), an inaugural address is a quasi-academic exercise whereby each person elevated to the highest academic post in a university is afforded the opportunity to carry out a review of the field of academic pursuit with which he is identified and relate the relevance of his contributions within that field to the needs and aspirations of the society.

Since the establishment of the Lagos State University about 22 years ago, a total of 31 inaugural lectures have been delivered in the University. It is heart-warming to note that 14 of these have been delivered under the current administration. i.e. within the last eighteen months.

Mr. Vice Chancellor Sir, I feel highly honoured to be asked to deliver the 32nd in the series of Lagos State University Inaugural Lectures on behalf of the Faculty of Social Sciences. Today's lecture is the second since the creation of a distinct Faculty of Social Sciences, from the defunct Faculty of Arts and Social Sciences of the University. Unlike the first one which addressed the issue of urbanization within the domain of human geography, today's lecture which examines the challenges of the climate system is the first in the field of physical geography and the specialized field of climatology.

Climatology is the scientific study of climate and is closely related to meteorology which is often generally defined as the science of the atmosphere. As observed by Ayoade (1995), although climatology and meteorology traditionally differ in terms of the focus of their subject matter and methods of analysis, the current trend is to regard them as constituting two sides of the same coin because of the convergence that has taken place in their development in the last few decades.

Although man has for long been interested in his atmospheric environment, the development of the science of the atmosphere did not start until the technological development of the Renaissance period. The development of the first weather measuring instrument which include the first thermometer by Galileo in 1593, the first rain gauge by Castelli in 1643 and the discovery of the principle of mercurial barometer for measuring air pressure by Torricelli marked the beginning of modern meteorology and climatology.

It may be noted that a number of factors further hastened the rapid advancement of meteorology and climatology. Among the factors are the invention of the telegraph which enabled the assemblance of weather data from widely located stations within minutes, the invention of the satellite, and the weather radar. The introduction of these modern weather observing systems resulted in significant improvement in the quality and quantity of weather information and thus led to the emergence of modern climatology. It is also instructive to note that the challenges posed by the needs of modern society contributed significantly in moving climatology from an essentially traditional descriptive approach to a more scientific and problem-solving discipline. As noted by Ayoade (1995) the hallmark of modern meteorology and climatology is the explanation and modelling of atmospheric processes with the aim of gaining full knowledge of the workings of the atmosphere

For the purpose of this lecture, I have chosen the topic "The Climatic Dilemma" for two main reasons. First, climate has remained a topical issue worldwide

because of the climatic extremes being experienced in various parts of the world particularly over the past three to four decades and their attendant challenges. For instance, we are all aware of the havoc wrecked on the United States by hurricane Katrina in July 2005 and the unfortunate tsunami that destroyed majority of the islands off the coast of Indonesia in December 2004. Even in Nigeria, the problems of floods and erosion, drought and desertification, as well as the frequent collapse of buildings are examples of the challenges raised by the climatic dilemma. The second reason is that apart from encapsulating much of the thrust of my research efforts over the last two decades as a climatologist, the topic also deals with aspects of the complex interactions between man and his environment which is the subject matter of the discipline of Geography.

2.0 CLIMATE AND CLIMATIC DILEMMA: CONCEPTS AND DEFINITIONS.

2.1 Climate and Climatic System

Mr. Vice Chancellor Sir, I consider it appropriate at this stage to define the two key concepts in the title of this lecture. These are "Climate" and "Dilemma". It may be noted that several scholars have attempted to define the concept of climate, for example Ojo, (1987) Oguntoyinbo (1992), Ayoade (1995), and Ojo et al (2001). As observed by Ojo (1987), climate is often referred to as an average of weather conditions. He also noted that this widely and wrongly used concept of climate implies that climate can be taken for granted and this has been the case until recent time. Indeed, up to 1950, and particularly between 1900 and 1950, not much was thought of climatic events and their consequences mainly because there were relatively not much adverse consequences of these events on agriculture, particularly on a global scale. At least, the population was well fed and the stomach well catered for. Incidentally, in Europe and America, historical records of climatic data gave scientific support to the concept of constancy in climate (Lamb, 1982). However, recent events all over the world have indicated that climate cannot and should not be regarded as constant and that for all practical purposes, the statistics required to specify climate comprise not only averages but also extremes and frequencies of occurrence of the various characteristics that are of interest to man (Ojo, 1987). It is thus evidently clear that in defining climate, the total experience of weather at any place over some specific period of time must be considered. Thus, it is out of place to continue to have an idea that if a long enough series of observations could be amassed at a location, it would produce a "climatic normal" and an average value of

each climatic element which could be of use for any practical considerations. Ojo (1987).

In essence, far from being average of weather, climate is always changing on a variety of time scales. The underlying mechanisms for the various changes which occur in climate are related to the restless nature of the atmosphere the range of whose activity spans from very local to the very global scales. While the local scales focus upon the short-lived activities near the ground at different places, the global scales include the long-lived general atmospheric circulations. Between these local and global scales lie the meso-scale transitional activities which influence zones and regions at continental or oceanic scale. Indeed, it is the various micro, meso and macro-scale atmospheric processes which produce the various changes and variations in weather and climate.

It is pertinent to note that the global climate system also involves in addition to the atmosphere, the oceans and other surface waters, the world of ice masses, the surface soil and vegetation and geophysical features of the earth. (Fig 1).

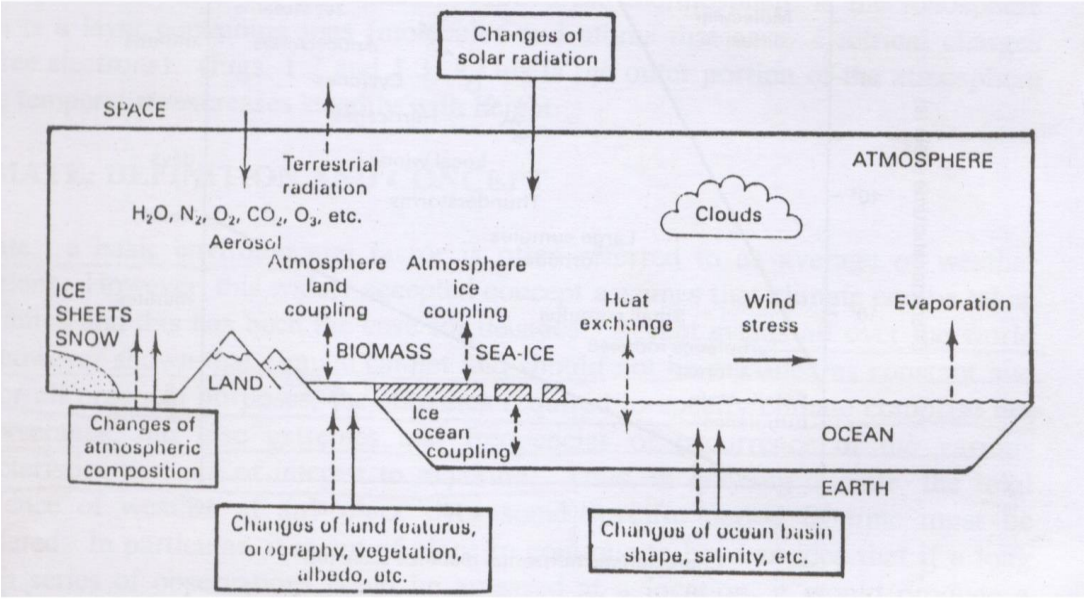

Fig. 1: ***Components of the Climate System. Solid lines are examples of the external processes and dashed arrows are examples of internal processes.***

Another noticeable feature of the climatic system is the temporal dimension of events in the climatic complex which involves climatic revolutions or climatic changes at different time scales. In this respect four categories of scales may be

distinguished. The first refers to climatic revolutions or climatic changes at time scales greater than 1,000 years. The second results in climatic fluctuations at time scales of 10 – 1,000 years, while the third category results in erratic pulsations, usually of less than ten years duration. The fourth and final category results in man-induced climatic fluctuations whose time scales may be ten years or less (Lansberg, 1976). The first two categories are of significance for practical applications of climate to human society.

It must be understood that whatever category or time scale is involved, the climatic system depends mostly on the interactions between the amount of solar energy received and absorbed by the earth-atmosphere system and the infrared radiation lost by this system to space. As observed by (Ojo, 1987, Ojo et al 2001), a fundamental issue in understanding the workings of the global climate system is nature's continuous attempt at balancing the imbalance of the radiation balance of this system (i.e. balancing the difference between the absorbed solar energy and the net infrared radiation or effective outgoing from the earth-atmosphere system). This often results in the various climatic systems and the potentials for climatic variations and climatic changes. In the past, such climatic variations were entirely attributed to natural causes, but recent developments have shown that mankind is capable of influencing the climatic system.

2.2 The Climatic Dilemma:

Now, what is the climatic dilemma, the topic of today's inaugural lecture? As already noted in the introductory remarks, the various characteristics resulting from variations and changes in weather and climate create problems and challenges for mankind and these have resulted in what may be regarded as the "climatic dilemma". Of course, there are various definitions of the word "Dilemma" but the one most relevant to the topic of this inaugural lecture is that given by the Oxford English Dictionary (6th Edition) which describes dilemma as a situation involving challenges in which choices are very difficult to make. No doubt, climate often creates a lot of challenges in which choices must be made no matter how difficult.

Mr Vice Chancellor Sir, permit me to make an allusion to a popular drama text "***The Dilemma of a Ghost***" written by Ama Ata Aidoo. The principal character, Ato, was caught in a situation where he had to choose between the modern American culture as epitomized by his wife, Eulalie and the African Culture through which he was brought up. There was a "Dilemma". His choices were hard, but he had control, when he said "I slapped her" (Act 5). Of course he had

to slap his wife if he was to stay in control. Unfortunately in the climatic dilemma faced by mankind "climate" as a nagging, uncontrollable wife" cannot be slapped. This is because **"slapping"** the climate represents a very formidable challenge, if not an insurmountable task.

In the current discourse, not only are the choices limited and difficult to make, but mankind, unlike the principal actor in the above mentioned drama text does not have control.
In order to drive home the point being made here, Mr. Vice Chancellor Sir, permit me to ask a few rhetorical questions:

i. Should we say because of the fear of urban flooding**,** man should stop building urban centres?
ii. Should we stop the felling of trees because of the adverse consequences of climate?
iii. Should we because of problems related to global warming and ozone layer depletion stop driving our vehicles or stop establishing industries?
iv. Should we stop the clearing of vegetation for farming because of climatic dilemma?
v. Should we stop the construction of dams for the same reason of climatic dilemma?

Mr. Vice Chancellor, Ladies and Gentlemen ***the question therefore is what should man do? This is the crux of the matter.***

Let me emphasize the point, that the issue of the climatic dilemma cannot be totally explained. To do this implies that there is the need to completely appreciate and explain what operates in the earth-atmospheric system and this is what science is all about. No one can do this otherwise there will be no need for further research.

3.0 THE CLIMATIC DILEMMA, AGRICULTURE AND WATER RESOURCES

It is pertinent to note that the various characteristics resulting from variations and changes in weather and climate create a lot of problems and consequently dilemma in many human activities and socio-economic sectors examples of which are agriculture, water resources, health, energy etc. For the purpose of this

lecture, it is necessary to examine aspects of these problems. However because of time constraint, I wish to examine aspects of only two of them which I consider the most important in Nigeria namely: agriculture and water resources. While agriculture is the mainstay of our economy, water is as essential to our existence as the very air we breathe.

3.1 Agriculture

As in many other parts of the world, agriculture in Nigeria not only supplies food, but also provides a lot of opportunities for employment. It is also significant as a source of raw materials for industry and as a major source of income for farmers and others who depend on agricultural products for commercial purposes.

Although crude oil is now by far the most important source of government revenue in Nigeria, about 70% of the labour force is still employed in agriculture. Indeed. , the low per capital income reflects both the continuing reliance of most Nigerians on traditional agriculture. Most Nigerians are still peasant farmers producing their own food crops and deriving income from one or more cash crops as well as from the sale of surplus food crops. Mixed cropping on fields, which rarely exceed 2 ha are characteristics of agriculture in Nigeria. The seasonal nature of much of the farming work shows the significance of the climatic factor with the farmer and his assistant's ability to cope with the busiest agricultural season or otherwise often sets a limit on the area which they can cultivate effectively. In general, the work of the farmer is strongly related to the seasons and productivity reflected by the rains in this regard, the issue of the climatic dilemma comes in to play.

No doubt, weather and climate to a large extent, control agricultural characteristics including plant growth, length of the growing season and the productivity of plants and animals. Thus, the successes of agricultural operations depend very much on man's understanding of weather.

The most critical factor in the trend of agricultural production is rainfall and particularly, the variability and unreliability characteristics. With the Sahelian droughts of the 1970s, for instance food production dropped by over 60% in the northern parts of Nigeria. Similar characteristics were found in other parts of the country, although the growth in total food production has been slightly better than in the northern parts of the country. (Ojo, 1991).

3.2 Water Resources

Another example of the challenges of the climatic dilemma is related to water. No doubt, water is life and Nigeria without water is difficult to imagine. As we all know, water is vital for drinking, sanitation, agriculture, industry, power generation, transportation and countless other purposes. Life on earth began on water and fresh water brings life to mankind including those in the urban centres like Lagos. It provides the habitat for multitude of living things.

There are various sources of water available to man. In Nigeria, as in many other parts of the world, water comes largely from either surface or ground sources. Groundwater sources which include wells and springs are usually safer and more reliable. However, shallow wells and springs, apart from being easily contaminated, may also go dry in the dry season as evidenced by the Lagos condition. Table 1 shows part of the work I did in 1994 and published in 1997. The table shows the depths of the wells as well as the water levels in January (dry season) and June (rainy season) in six locations in Lagos area. It may be noted from the table that seasonal variations in the depths of water levels range from 33% in ijanikin to 60% in Bariga.

Table 1: Seasonal Variations in the Water Levels of Hand-dug wells in the Lagos Area 1993:

Location	Depth (m) of Well	Depth of Waste in January (m)	Depth of Water in June (m)	Seasonal Variations in Water depth (m)	% Seasonal Variation
Ijanikin	**3.2m**	**2.0m**	**3.0m**	**1.0m**	**33%**
Festac Town	**3.0m**	**2.2m**	**3.6m**	**1.4m**	**38%**
Ijeshateddo	**3.2m**	**1.0m**	**2.8m**	**1.0m**	**35%**
Isolo	**20m**	**1.2m**	**2.7m**	**1.5m**	**55%**
Bariga	**18m**	**1.0m**	**2.5m**	**1.5m**	**60%**
Agege	**33m**	**1.8m**	**3.8m**	**2.0m**	**53%**

Source: Ojo (1997): Impact of Rainfall Variations on Ground Water Resources Systems in the Lagos Metropolitan Area, SEDEC.

Surface fresh water includes creeks, rivers, lakes streams and ponds. Major sources of water supply in the country include rivers such as Niger, Benue, Cross River, Osun and Ogun. Indeed, there are three distinct drainage systems in the

country namely:

(i) The Atlantic drainage system comprising the short and fast flowing coastal rivers (Ogun, Osun and Benin rivers West of the Niger valley and the Imo and Cross Rivers to the East)

(ii) The Lake Chad inland drainage system which include Hadejia, Jama'are, Mubi and Yobe rivers and their tributaries and

(iii) The long Niger-Benue drainage system principally the Niger-Benue rivers and their tributaries which together drain about 65% of the country.

All these rivers depend on climate and their levels fluctuate with seasons. In deed, many of them dry up in the dry season and create climatic dilemma.
Nigeria is blessed with abundant water resources estimated at 226 billion cubic meters of surface water and about 40 billion cubic meters of ground water. If properly harnessed, these can meet all human, agricultural and other water supply needs in the country.

Water resources can however mean death/destruction and thus create dilemma as the country as been witnessing. Because the characteristics of water resources are largely dependent on climate, which is the most important factors, there arises problems related to the climatic dilemma.

4.0 CLIMATIC DILEMMA AND ENVIRONMENTAL HAZARDS

Now we come to discussions on the climatic dilemma as related to environmental hazards. Typhoons in the Philippines, droughts in the Sahel, earthquakes in California hurricanes in Indonesia are some of the reports of natural disasters made available almost on a daily or seasonal basis across the globe by the news media. In Nigeria, similar reports are found in our dailies. On Monday 21st August 1995 for example, it was reported that floods sacked 20,000 people and ravaged four villages in Edo State. Similarly a lot of reports are always published in our dallies regarding weather and climate related hazards in many parts of the country.

The question now is what do we do about this dilemma?

Thus the world in general and Nigeria in particular are faced with a lot of climatic hazards and consequently the issue of climatic dilemma. Indeed, weather and climate are responsible for, or strongly influence many natural disasters in the World in general and West Africa and Nigeria in particular. As noted by Smith (1989) for example, ranked by the number of lives lost throughout the world from 1947 to 1980, weather and climate either caused or strongly influenced at least, seven out of ten of the world's major and most devastating types of disasters.

Tropical storms, floods and thunderstorm occur frequently every year over large areas and affect hundreds of millions of people. In addition, to these phenomena, weather and climate contribute significantly to other life – threatening events such as droughts which often cause a lot of havoc in many parts of the world. This is especially true of West Africa in general and Nigeria in particular, where droughts and desertification and many other such disasters have been recurrent phenomena particularly in the Sudano – Sahelian regions of West Africa.

The consequences of the problems arising from the climatic dilemma can perhaps be better appreciated when viewed against the backdrop of the often colossal loss of properties and human lives. For instance, as noted by the **World Meteorological Organization (WMO, 1990**), between 1970 and 1990, more that three million people were killed by natural disasters while a further one billion had their lives adversely affected in one way or another.

It is significant to note that in spite of the vulnerability of mankind to climatic events and their impacts, policy makers do not usually take into account the weather factor. Indeed, recent events have shown more than ever before, the need to evolve effective strategies to address these concerns. This is particularly true of the need for government to recognize the importance of climate in relation to various national and international development programmes.

As a further basis for providing a clear understanding of the problems related to the climatic dilemma, let us now look at some aspects of the dilemma of climate with particular reference to:
Flooding and erosion
Drought and Desertification
Deforestation and
Impact of urbanization

4.1 Flooding And Erosion

In recent times, many parts of Nigeria have been faced with a lot of environmental problems with serious consequences on human welfare and the nation's economic development. This is for example the case with many parts of the country which have often been subjected to flooding and erosion hazards with their adverse effects on the society. For example, from Table 2: it can be noticed that in July 1999 there was widespread flooding in Lagos which resulted in loss of lives and properties worth billions of naira. Also in July 1999 the Ogun River over-flowed its banks in Abeokuta and this resulted in loss of 40 lives. Similarly, in August 1999, about 7,000 people were threatened as a result of Atlantic surge which affected Ogidigben in Delta State). The case of Edo floods which affected 20,000 people and sacked four villages has been referred to as earlier in this lecture

The increasing persistence of such flooding and erosion occurrences with their adverse effects on the society has undoubtedly heightened public awareness about the need to combat this environmental hazard. Experience has shown however that in spite of the increased awareness in combating flood hazards in Nigeria, this menace has persisted. In particular, past flood control strategies have not achieved the desired results. The failure to achieve the desired result is undoubtedly due partly to lack of understanding of the dynamics of the characteristics of the environmental variables particularly weather and climate as they affect the occurrence of these hazards. Yet the need to understand the nature of these environmental variables is of great importance in the formulation of effective flood control policies.

Table 2: FLOODING EPISODES AND THEIR IMPACTS IN NIGERIA (1999)

S/N	DATE	TOWN	OCCURRENCE	REMARKS
1.	**July, 1999**	**Lagos: Lagos State**	**Widespread Flooding**	**One life lost, property damaged worth billion of Naira**
2.	**July, 1999**	**Agiliti (outskirt of Lagos) in Lagos State**	**Ogun River Overflow**	**40 lives claimed.**
3.	**August, 1999**	**Chanchaga, Mariga, Magama, Rijau, Wushishi, Borgu,**	**Many villages flooded, farmlands**	**Thousands of families rendered homeless, damage undetermined.**

		Gbako, Munya, Lapai, bida, Agwora (Nigeria)	**washed away**	**Two lives lost in Minna.**
4.	**August, 1999**	**Bar Beach (Lagos), Lagos State**	**Coastal Erosion**	**Several meters of coastline washed aways. Multi-billion naira properties threatened.**
5.	**August, 1999**	**Goronyo (sokoto) in Sokoto State**	**Flooding of community by River Rima**	**Loss undetermined**
6.	**August, 1999**	**Virtually all 27 LGAs in Imo State**	**Widespread Erosion**	**Many lives, farmlands, homes lost. Thousand rendered homeless.**
7.	**August, 1999**	**Parts of (Jigawa & Yobe States)**	**Floods**	**3,000 farmlands submerged (rice, maize, sorghum destroyed).**
8.	**August, 1999**	**7 LGAs in borno State**	**Floods**	**Hundreds rendered homeless. N25m property destroyed in Railway Corporation Quarters (Maiduguri).**
9.	**August, 1999**	**Ogidigben (Delta State)**	**Atlantic Surge**	**7,000 people threatened.**
10.	**August, 1999**	**Shira (Bauchi State)**	**Floods**	**Seven villages washed away. N20m property lost.**
11.	**August, 1999**	**Bauchi Municipality (Bauchi State)**	**Floods**	**5 dead, 30 injured, 100 houses collapsed.**
12.	**August, 1999**	**Chiyaku & Kwari (Jigawa State)**	**Erosion**	**90 houses destroyed**
13.	**August, 1999**	**Yola (Adamawa)**	**Floods**	**Property worth millions of naira destroyed**
14.	**August, 1999**	**Fufore LGA (Adamawa)**	**Floods**	**13 villages submerged, hundreds of hectares of farmlands washed away.**
15.	**September, 1999**	**Ondo State – Akure North, Owo, Ilaje/Ese Odo LGAs.**	**Atlantic Surge**	**100s of hectares of farmlands washed away, Hundreds of houses destroyed, fishing**

				villages affected.
16.	**September, 1999**	**Ikere, Ado, Aramoko, Efon, Moba, Ileje-Meje and Emure (LGAs) of Ekiti State.**	**Floods Floods/Erosion**	**Farmlands, schools submerged; all intra-LGA roads washed away. Severe gullying in Efon Aramoko – Ido axis.**
17.	**September, 1999**	**Birnin Kudu LGA (Jigawa)**	**Floods (NTA Documentary of 28/9/99)**	**6,000 homeless, millions of naira property lost.**
18.	**September, 1999**	**NIGER (Mokwa, Lavun, Lapai, Agaie LGAs)**	**Floods from Jebba and Shiroro Dams**	**17 dead, farm products household losses. Problems of rural-urban migration.**
19	**September, 1999**	**Hauawal LGA (Borno)**	**Six villages flooded**	**Hundreds rendered homeless. Damage undetermined.**
20	**September, 1999**	**Kwara**	**Nigeria's premier sugar factory BACITA Sugar Cane farms flooded**	**Loss due to flooded farms – N1.417 billion since 1994.**
21	**September, 1999**	**Rivers State – entire low-lying areas.**	**Atlantic surge / flooding**	**Farmlands submerged worth billions of naira, fishing communities sacked.**
22.	**September, 1999**	**Bayelsa (Entire State)**	**Floods**	**Houses destroyed, fishing communities displaced. Losses in billions of naira.**

Source: Climate Change Center, FUT MINNA (1999)

The problems related to ineffective policy formation and implementation can further be illustrated by evidences of inadequate land use planning and non-maintenance of drainage facilities in many developing countries including Nigeria, even in Lagos Metropolis. The lack of effective linkage between policy formulation, implementation and general management lapses which often aggravates flooding and pollution hazards can thus be linked to:

- Failure to adhere to building and health regulations
- Unplanned physical expansion

- Limited access roads inadequate and /or in extreme cases, lack of drainage facilities
- High runoff coefficient
- Conversion of flood plains to building purposes and
- Increased solid waste generation and inadequate management of the water generated which often results in indiscriminate dumping in stream channels

The consequence of this flagrant abuse of land and unhygienic conditions had been catastrophic floods. The case of the Ogunpa, 1980, 1984 and 1997 floods that took considerable toll on lives and property readily comes to mind. The reoccurrence of several destructive floods of high magnitude in Nigeria in general and Lagos Metropolis in particular underscores the fact that channelization and other control measures are yet to be adequately and effectively put in place.

Cases of property development that directly obstructs flow of water because they are in the natural pathway of runoff abound in Lagos State. Areas such as Aguda, Fola-Agoro and Ojuelegba have taken some hard knocks from aggravated flooding. The usual practice of sand-filling wetlands without appropriate hydrological and civil engineering considerations has also taken severe toll on properties in choice ;locations like Lekki, Victoria Island, Ikoyi, Ilaje, Oworonshoki and indeed all the neighbourhood that share common boundaries with the Lagos lagoon, the Badagry-Porto Novo creeks and other major water bodies of the state.

Table 3 shows some examples of the extent and causes of flooding in Lagos Metropolitan area. For instance according to LSMWT (1997), between 1979 and 1997 about 740 ha. of land were flooded in Lagos Metropolitan due to inadequate drainage and the construction of illegal structures along drainage ways. Also, during the same period about 1,220 ha. of land were flooded in Lagos Metropolitan area as a result of construction of the Apapa-Oshodi Expressway. The contents of the table are also largely applicable to many other urban centres in the country and indeed many urban centres in the developing countries.

Now the question is what are we doing about this? In particular, what are our policy makers and the relevant professionals doing about this?

Table 3: Extent and Causes of Flooding in Metropolitan area.

Zone	Flood Type		Causes
	Natural	Man-made	
1	3,400		No natural outlet
2		740	Inadequate drainage plus illegal building in drainage ways
3		1,220	Construction of Apapa-Oworonsoki Expressway,
4		300	Improper street construction near the Lagos University Teaching Hospital, Idi-Araba
5		90	Inadequate drainage, along Agege Motor Road and Nigerian Railway Compound Ebute-Metta.
6	170	140	Natural lowland with inadequate gradient and obstructed channels
7		170	Improper reclamation, subsidence and blocking of existing drains by the Ring Road on Lagos Island
8	310		Natural lowland bordering and subject to tidal variations of Lagos lagoon
		163	Lowland and inadequate outlet of Ebute-Metta Creek
9		154	Lowland behind National Stadium – flooding aggravated by landfill reclamation on Western Avenue

Source: Lagos State Ministry of Works and Transport: Master Plan Project, August, 1979: Updated by Fieldwork (1997) modified by the Author Jan 2007.

In a study of rainfall characteristics in relation to flood hazards in Lagos Metropolitan area, which I carried out (Ojo, 1991) rainfall distribution and its impact on flood occurrences were examined. The index used in the study is the time series of the normalized diurnal rainfall departure.

The study showed that a lot of variations can occur in rainfall between stations that are relatively close to one another. For example, even within Lagos metropolis, the rainfall variability indices for Apapa show a fairly normal condition throughout June during the study period, whereas the value for Victoria Island, vary between approximately +1.5δ and -2.50δ (i.e. very wet

conditions). The study showed that, even on the same day, heavy rainfall may be experienced in one area of Lagos metropolis while no rainfall may be recorded in another area. This no doubt reflects the influence of microclimatic factors on the rainfall patterns in the Lagos metropolitan area. I believe that everybody in this hall is used to this type of localized rainfall events which create a lot of dilemma for the society in general and the scientist in particular and indicate the need for detailed studies and analysis of the characteristics of microclimate in our urban in order to proffer effective solutions to the problems of flooding and erosion

The study also revealed that a lot of variations also occur in the distribution of flood intensities for the Lagos metropolitan area. For example while Apapa showed fairly moderate flood intensities throughout June with generally below +0.5δ, Victoria Island showed relatively higher positive variabilities with values greater than +1.5δ, indicating severe flood intensities. In general, the inland locations showed relatively higher positive variabilities than the coastal locations indicating greater flood intensities in these inland locations.

4.2 Perception of Flood Occurrences

In another study of perception of flood occurrences (Ojo, 1991), newspaper reports of flood occurrences within the Lagos metropolitan area were analyzed in order to have an insight into the perception of flood occurrences by the people. This was also to determine among other things, the extent to which the people's perception agreed with the meteorological concept of floods. Consequently, the climatic index for each of the days on which the reported floods occurred was examined.

For the study, newspaper reports of flood occurrences for the Lagos metropolitan area for two years, 1982 and 1984 were analyzed. The newspapers used for this study include: The Daily Times of Nigeria and the Punch, both of which are based in Lagos. The Nigerian Tribune which is based in Ibadan was also used.

From the analysis, it was observed that in many instances, days on which the reported floods occurred had relatively high climatic indices. For example, the period between 17th to 21st June, 1982 when floods were reported in Ikeja area coincided with a period of relatively high climatic indices in the area.

However, there were some days on which flood occurrences were reported but such days had relatively low climatic indices. Such flood could not have been due to the influence of relatively high rainfall since the rainfall recorded in such areas was low. Rather the floods were probably due to the influence of man who through his activities often cause the blockage of drainage channels in the area

thus aggravating the problems of flooding in the area

In particular, this observation is further supported by the fact that in many parts of the Lagos metropolis where floods usually occur, there are no drainage channels. Furthermore, the flooding problems are often aggravated by human impacts, a classic example of which is the incessant dumping of refuse along the drainage channels. This is, for example, the case in the low income, high density areas such as Mushin, Oshodi, Idi-Oro, Oworonshoki, Badiya and Ajegunle.

Again, what are we doing about this?

5.0. DROUGHTS AND DESERTIFICATION

5.1. Droughts

Droughts have been recurrent phenomena in Nigeria in general and the Sudano-Sahelian regions, in particular which are the areas of West Africa characterized by droughts and desertification. There is no universally accepted definition of drought, although, it is generally agreed that the menace is characterized by moisture deficiency, when the demand for water for particular water use system exceeds the supply available from various sources. As in many other parts of the world, precipitation is the most significant source of water in the supply-demand component of most of the water use systems. Precipitation deficits therefore are closely associated with droughts and with many definitions of droughts.

In general there are three majors' types of droughts, namely, meteorological drought, agricultural drought and hydrological drought. The meteorological drought is generally said to occur when there is a prolonged absence or deficiency or poor distribution of precipitation. It is usually defined as a percentage of the long-term average rainfall in a given region. There are many variations of this definition and thus, a meteorological drought is difficult to identify with any degree of reliability. In contrast to meteorological droughts, agricultural droughts are said to occur when there is not enough moisture available at the right time to meet evaporative demand by crops, vegetation, pastures and other agricultural systems as a result yield and / or absolute production decline (Ojo, 2000). Crops have varying moisture needs through their growth and development cycles, and thus, the timing of rain is crucial in rain fed agricultural regions in determining whether there will be a good harvest or poor one. Hydrological drought it said to occur when the water needs of plants cannot be met by available precipitation.

Some of the characteristics of drought include:

(a) Low rainfall and high rainfall variability.
(b) High evaporation and potential evapotranspiration rates

(c) Generally persistent negative rainfall anomalies
(d) Occasional torrential rains resulting in floods
(e) Rapidly high erosive runoff especially on steep terrains
(f) Sparse vegetation cover
(g) Too little moisture for rain fed cultivation throughout the year

Drought is no doubt an inevitable and often a devastating phenomenon. This is not strange to particular. In general, droughts have occurred throughout the available historical record of climate in West Africa. Severe droughts affected parts of West Africa in the Sahel region in 1445-1452, 1538, 1557-1588, 1681-1687, 1738-1756 and 1828-1839. The droughts of the 1730s to the 1750s were recorded to have killed half of the population of Timbuktu and other parts of the Niger bend and caused famine in the Senegal, Gambia, Mali, Mauritania, Burkina Faso, Benin, Chad and parts of northern Nigeria especially Bornu and Kano regions.
The 1972-73 droughts were also severe, although it was comparatively less than the 1983-84 in scope. In 1984, Food and Agricultural Organization (FAO) reported that some 250 million people in 22 countries in Africa, including northern Nigeria, were affected by food crisis as a result pf persistent droughts of 1972-73 (FAO, 1984)
Thus, droughts have occurred over many parts of West Africa including Northern Nigeria in varying degrees of severity and duration throughout human history, and many regions of the continent have experienced considerable distress arising out of drought occurrences, mass migration, famine and cessation of economic activity in many countries.

5.2 Desertification

Desertification, like drought, is difficult to define, but in general, most available definitions have broadly reflected some degree of land degradation processes. Generally the term desertification, since its adoption by the United Nations Conference on Desertification (UNEP, 1977c) has been swallowing up a number of related terms such as desert encroachment, "the advancing Sahara", desiccation, desertization. The term has also been used to describe the degradation due to burning, clearing and erosion of forest and savanna zones of West Africa.
The United Nations Environment Programme (UNEP, 1977) defined desertification as land degradation in arid, semi-arid and dry humid areas resulting mainly from human activities. This definition was modified by the UN Conference on Environment and Desertification (UNCED), Rio de Janeiro, June 1992, which defines desertification as land degradation in arid, semi-arid and dry

sub-humid areas resulting from various factors including climatic variations and human activities. This definition has been internationally negotiated and approved at the UNCED as the operational standard for Agenda 21. Thus, in general, it is established that desertification may take many forms but it usually refers to widespread land degradation in the dry lands, which is the reduction of biological productivity of dry land ecosystems, including rangeland pastures and rain fed and irrigated croplands, as a results of the acceleration of certain natural physical, chemical and hydrological processes. The processes may include erosion and deposition by wind or water, salt accumulation in soils, groundwater or surface runoff, reduction in the amount or diversity of natural vegetation and a decline in the ability of soils to transmit and store water for plant growth (Williams et, 1994). The degree of desertification in West Africa, however varies significantly from one country to another, and even in the Sudano-Sahelian regions of Nigeria, the degree of desertification varies from one State to another. In general, the degree of desertification is closely linked with climate in addition to population distribution, population density and other socio-economic factors. In general, the main features of desertification include:

a) A reduction in the fraction of the soil covered by the vegetation. In particular, under desertification, the fraction of bare soil increases and vegetation may be reduced to isolated patches.
b) A consequent rise in the reflective capacity (albedo) of the surface for solar radiation, since arid and semiarid soils are lighter-coloured than most plants, even with grey foliage so usual in these climates.
c) A considerable and permanent loss of perennial plants, especially woody shrub and trees
d) Considerable soil erosion and impoverishment, because of removal of fine minerals and organic materials by wind and because of rapid oxidation of the remaining water and soil carbon. Gully and sheet erosion of soils by occasional heavy rainfalls tends to accumulate the eroded materials on valley floors or in basins.
e) Overgrazing and inadequate forage in relation to vegetative resources.

5.3 **Impacts of Droughts and Desertification**

It is virtually impossible to separate the impacts of droughts from that of desertification. As illustrated by Nicholson (1998), the two work together. Consequently, discussions on the two hazards will not be separated in this discussion. The impact of drought-prone and desertification in the drought

and desertified areas of Nigeria are serious on many sectors of the physical and ecological environment, as well as many socio-economic sectors including agriculture and livestock production and management, water resources and water resources management, health, ecosystems, forests and forestry, and other economic activities in the area.

In general, the main socio-economic impacts of drought and desertification include:

a) Unemployment
b) Sharp drop in agricultural activities and production leading to an immediate release of the rural labour force from farming activities.
c) Population dynamics including increased migration from rural areas into the urban centers. There are usually large-scale movements of people from the rural areas to the urban centers. Such movements are characteristic of the Sudano-Sahelian regions, from where migrants even move southwards to urban centers such as Lagos. Such movements can result from the desire of the migrants to better their living conditions. The economic and social consequences of these movements are however substantial.
d) The feedback mechanisms in drought and desertification systems exacerbate its own effects.
e) The effects of drought and desertification do cause political problems (including conflicts and possibly wars) which often lead to a lot of suffering and death.
f) Decline in quality of life, partly because of the decline in the quality of the rural communities; this decline in rural communities is partly caused by lack of water security, lack of sustained availability of fuel and fodder and inadequate income generation.
g) Famine and death

Related to the above listed impacts are physical and ecological impacts of droughts and desertification which include:

- Loss of biodiversity, rapid deterioration of the ecosystems, rapid deterioration in land cover and depletion of water availability through destruction of catchments and aquifers. Others are
- Loss of ecological stability, Soil erosion in loss of soil fertility, Silting of reservoirs and change in hydrological regimes.

One disturbing manifestation of the effect of drought and desertification is the progressive shrinking of Lake Chad, which is one of Nigeria's important landmarks and best- known cultural heritage. The lake which is the remnant of an inland sea was estimated to have covered an area of 400,000km2 about 6000

years ago. (The Punch Newspaper, 30th January, 2006)

Newly released satellite images by the **National Space Research and Development Agency of Nigeria (NASRDA)** shows that Lake Chad has completely withdrawn from Nigeria and is now located in Chad Republic. Furthermore, experts have predicted that the lake may dry up completely by 2010 if the current rate of retreat is maintained. The complete drying up of the lake, no doubt, has a lot of socio- economic, socio- cultural and socio- political implications not only for Nigeria, but also for the other member countries of the Chad Basin Development Commission i.e. Chad, Cameroon and Niger. Of particular concern is the revelation that an estimated 20 million people living in the four countries whose means of livelihood - subsistence agriculture is totally dependent on the lake will be at risk of severe hunger and famine. Studies have also shown that farmers on the Nigerian side of the lake are moving along with the water as it recedes. The implication of this is that we now have some Nigerians living in Chad Republic but still believe that they are within Nigeria and this can generate border dispute and international boundary problems. Mr. Vice Chancellor sir, I hope that we do not have another Bakassi on our hands in the near future because of the problem of the climatic dilemma.

5.4 DEFORESTATION

Deforestation is the removal of forest and other forms of vegetative cover from a site without its replacement. Although this phenomenon has been a recurring feature since the dawn of civilization, reports from various parts of the world indicate that it is now on the increase due to increased socioeconomic activities.

Controversy surrounds the meaning of the word deforestation and this causes problems when it comes to assessing rates of change and causes of the phenomenon (Williams, 1994). It is probably best defined as the temporary or permanent clearance of forest for agriculture or other purposes. (Grainger, 1992). According to this definition, if forest clearance does not take place then deforestation does not occur.

The underlining causes of deforestation can be broadly grouped into five categories. These are demographic factors (human population dynamics, sometimes referred to as population "pressure"), economic factors (commercialization, development, economic growth or change), technological factors (technological change or progress), policy and institutional factors (change or impact of political-economic institutions, institutional change), and a complex of socio-political or cultural factors (values, public attitudes, beliefs and

individual or household behaviour). These broad groups are composed of specific forces or human activities.

In a study conducted by Ayo Omotayo and Kunle Ogundele (2006) on forest resources biodiversity and sustainable human livelihood in Ogun state, it was revealed that forest reserves in the state have been considerably depleted. For example between 1985 and 1995, the Aworo forest reserve decreased by 37.2%. Similarly, the Eggua Forest reserve decreased by 77.7% during the same period. These facts are further illustrated in Tables 4 and 5 and Figures 2 and 3

Fig. 2: Forest Reserves Depletion in Ogun State in 1985

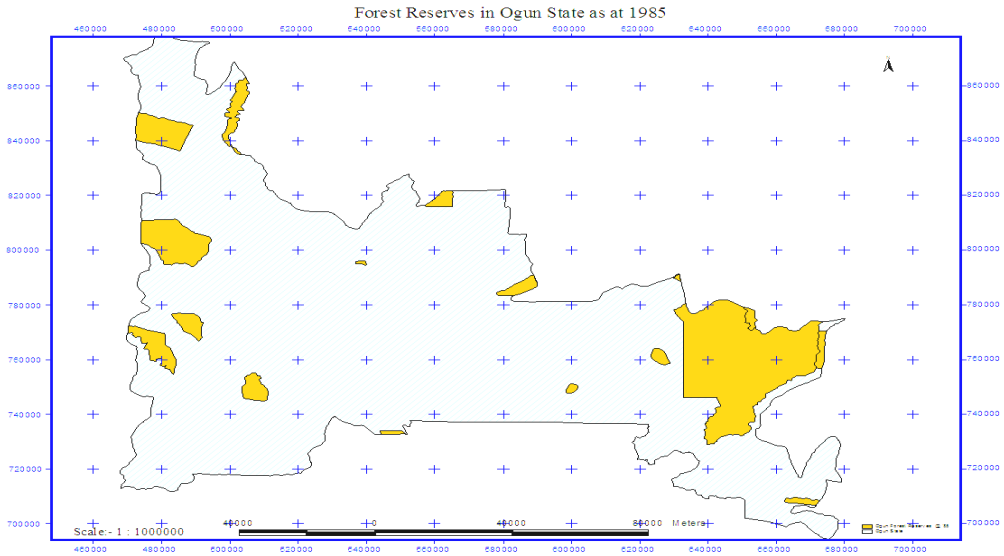

Fig. 3: Forest Reserves Depletion in Ogun State in 1995

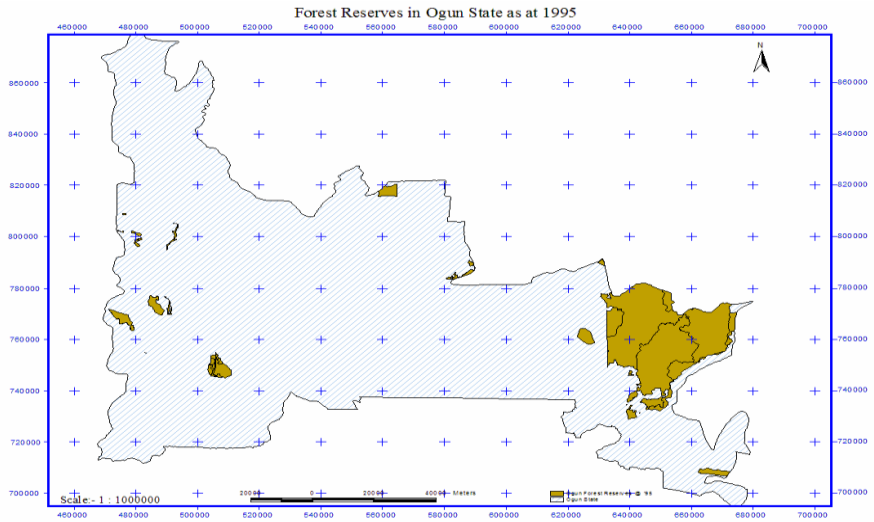

TABLE 4 DEFORESTATION OF FOREST RESERVES IN OGUN STATE 1985 - 1995				
Forest Reserves	Reserve_Area in 1985	Reserve_Area 1995	1985 Reserve as % of 1985	% decrease
Aworo	187455.900	1177.210	0.628	0.372
Eba Island	2364.950	1848.170	0.781	0.219
Eggua	10775.440	2405.490	0.223	0.777
Ilaro	40820.240	4595.340	0.113	0.887
Ohumbe	21517.790	2283.670	0.106	0.894
Olokemeji	5641.300	2249.490	0.398	0.602
Oluwa	85598.690	2118.330	0.247	0.753
Omo	138283.990	1763.620	0.128	0.872
Osun	2253.300	2253.300	0.000	0.000
Total	494711.600	20694.620		

Fig 2 : Showing Forest Reserves in Ogun State as at 1995

Table 5: OGUN FOREST TYPES & SIZES IN HECTARES (ha)		
Forest Type	Area Size @ 1985	Area Size @ 1995
Disturbed Forest	157969	3419
Forest Plantation	400659.63	76365.69
Teak and Gmelina Plantation	73059.98	6920.24
Undisturbed Forest	431442.34	44095.05
Forested Freshwater Swamp	173272.77	4142.6
Riparian Forest	417216.94	5532.58
Total	1653620.66	140475.16

5.6 IMPACTS OF URBANISATION

Cities are increasingly the focus of human habitation. The tendency to agglomerate by large settlements has reached a near-steady state in the developed world. However agglomeration is continuing in the developing

countries including Nigeria driven by rapid population growth, lack of rural opportunities and perceptions of a better life in cities.

In many instances, the pace of urban growth cannot be matched by orderly provision of even the basic necessities of shelter, food, water, sanitation and security. In other cases, some or all of these are provided, but only at the expense of a seriously degraded living environment. The documented effects of urban development on climate are the most clear-cut examples of anthropogenic impacts on climate and climate change. Several of these anthropogenic impacts have significant effects on city-environmental systems for example, as related to health, thermal comfort, security etc. Thus, these impacts significantly affect the city's economies in terms of resource use and degradation of property. Furthermore, cities represent the overwhelming bulk of the sources of pollution including solid, liquid and gaseous emissions. In addition, they underlie many of the real or perceived dilemmas in the urban environment as related to the consequences of urban pollution. It may be noted that such issues at present hold the attention of much of the world community (e.g. depletion of stratospheric ozone, increasing concentration of trace gases, acidification of precipitation and the socio economic and ecological impacts of climate change some of which are discussed in the next section.

In Nigeria, as in many other parts of the world, the creation of urban centers provides the modes of man's greatest impact in destroying the existing microclimates and creating new and usually complex ones, depending on the design of the urban center structures, the density and functions of the buildings and the various activities performed by man in the urban center. Thus, the urban center represents the area, where man has altered the essential resources of the land, air and water and thus, provided the most extreme microclimatic modifications that have ever been created. Indeed, it has been well known for several years that urban center create their own climate

The meteorological and climatological consequences of urbanization have been noted in many parts of the world since the early part of the 19th century (Howard, 1833), although it is only in the last few decades that there have been hundreds of studies in urban and building climatology. (See for example Ojo, 1981 Adebayo 1990, Ojo 1994) Particularly in recent years, scientists have become increasingly aware of the significance of urban and building climates as far as planning of new towns; and re-development of old ones are concerned. There is, also an increasing awareness of the fact that in urban centers, layouts and designs can often turn microclimatic liabilities into assets.

As for many other urban centers, in the tropical areas, Lagos, Nigeria represents a typical urban center whose location, growth and development have been determined by some combination of strategic, social and economic considerations and whose effects have been considerable on the urban and building climates. Specifically, the urban structures of Lagos, the changes in the characteristics of the urban 'active surface' and the various activities in the urban centre all combine to have had considerable impacts on the climates and the characteristics of the climatic components of the metropolis. Thus, the composition of the atmosphere, the energy and water budget components of the urban center and the composition and roughness of the surface have become considerably modified. (Ojo 1981)

I have examined the effect of urbanization on physio-climatic responses to thermal conditions in a study I carried out in Lagos, (Ojo 1994). In the study, two of the empirically developed thermal stress indices – Effective Temperature (ET) and the Relative Strain (RS) were applied to two locations with characteristically different environmental settings and the results were compared with the thermal stress responses of the inhabitants of the two locations.

The two study locations for the case studies namely Oke Afa in Isolo area and Okokomaiko in Ojo area share the common feature of being located along the growing edges of the metropolis and can thus be classified as newly urbanizing areas. However, while the Ojo-Okokomaiko study location represents an emerging relatively unplanned urban area whose core is made up of pre-existing rural settlements, the Isolo Low-Cost Housing Estate Oke-Afa represents a planned newly urbanizing area that was built on a hitherto unoccupied land. The study showed that the dry bulb temperatures for Isolo were higher than those of Okokomaiko for most of the time during the study period thus reflecting the inland location of Isolo.

The measurements which took place simultaneously at the study locations involved the recording of dry and wet bulb temperature readings on an hourly basis for five days – January 15 to 19, 1990 – both days inclusive. The month of January was chosen for the study primarily because, being the peak of the dry season, the direct effect of thermal stress on man would be more readily discernible around this time of the year.
The study shows that in general, the patterns of both indices approximately follow the patterns of temperatures with the lowest ET and RS values occurring during the morning and evening hours and the highest values occurring in the afternoons. At Okokomaiko, values of ET vary between 24.6-25^{o}C during the

morning hours and more than 28°C in the afternoons.
The distribution pattern of RS values exhibited a lot of variations particularly during the night and early morning when RS values of between 0.22 – 0.26 were recorded for Okoko while values for Isolo ranged between 0.35 – 0.53.
Taking the upper limit of thermally comfortable ET conditions of 25.6°C and RS conditions of between 0.2 and 0.3, it can be observed that it was only in the morning hours that thermally comfortable condition of RS=0.2 to 0.3 were recorded. Thus it can be observed that the two locations were thermally comfortable only in the morning hours. While discomfort persisted in the afternoon and evening hours.

In the study, the perception of the people as related to thermal comfort was also examined. The results showed that in spite of the relatively higher ET and RS values recorded in Isolo than those of Okoko, the percentage of the respondents that indicated that they felt slightly warm and hot in Okoko were higher than those of Isolo. The study also showed that about one third of the respondents in each of the two study locations indicated that they were pleasant while two thirds felt either slightly warm or hot during the study period.

5.5 POLLUTION

Air Pollution

One other aspect of the impact of urbanization – related type of climatic dilemma is the creation of air pollution in our cities. In Lagos for instance, two major sources of air pollution are industrialization and transportation. Table 4 shows some examples of the industrial estates in Lagos. Worthy of note particularly are industrial estates in Apapa, Matori, Ikeja, Ilupeju, Oregun, Isolo and Amuwo-Odofin.
Not much has been done to examine the characteristics of pollution in these estates but it is well known that, as in many other cities of the world, the inhabitants of Lagos suffer considerably from the effects of pollution. For example, important physiological functions such as ventilation of the lungs, the transportation of oxygen by hemoglobin and the functions of the nervous system may be impaired through inhaling of air pollution. Discomfort can also be caused by bad odour and impairment of visibility.
In addition, pollution can lead to chronic diseases shortening of life, growth impairment and even death. For example, it has long been observed that increase in lung cancer is more common in urban centres than in the rural areas after other variables have been taken into consideration.

Table 4: Industrial Estates in Lagos State

S/N	Location	Year of Establishment	Size in Hectares
1	Apapa	1957	100
2	Matori	1958	120
3	Matori SME Estate	-	2,079
4	Ikeja	1959	180
5	Ilupeju	1962	110
6	Ijora	1965	160
7	Iganmu	1965	80
8	Oshodi/Isolo	1968	120
9	Isolo/SME Estate	-	6.28
10	Amuwo/Odofin	1969	200
11	Ogba	1969	150
12	Oregun	1981	100
13	Agidingbi	1969	97
14	Gbegada	1958	50
15	Ikorodu	1976	1,582.27
16	Surulere	1981	20
17	Badiya	1958	15
18	Oworonshoki	Proposed	-
19	Oyadiran/Yaba	1970	20
20	Ilasamaja	1971	60
21	Lagos South West	1972	317.40
22	Yaba SME Estate	-	1.112
23	Technology incubator center Agege	-	6
24	Igando SME Estate	-	6
25	Epe SME Estate	-	6
26	Imota SME Estate	-	26
27	Mosafejo/Aradagun (Badagry)	-	214.27
28	Kirikiri	1981	30
29	Abesan/Ikeja	1981	100
30	Akowonjo	1976	50
31	Odosiwole/Odoragunse	Proposed	-
32	Ginti	Proposed	-
33	Agbowa	Proposed	-
34	Oko-Afo/Ilogbo	Proposed	-
35	Ewu-Epe	Proposed	-

Source: Lagos State Investors Guide, 2001. Investment Opportunities in Lagos State, 2001.

6.0 CLIMATE CHANGE.

Mr. Vice Chancellor Sir, I now wish to discuss one of most challenging aspects of the Climatic Dilemma namely climate change. It is now established that humanity is altering the concentration of greenhouse gases and aerosols, both of which influence, and are influenced by climate. Recently, and especially over the past three or four decades, the issue of global climate change due to the greenhouse effects, including global warming (Fig.4) and sea level rise have been a subject of scientific discussions and public debate. Indeed, it is now well recognized that the human factor has become very significant in the balance of forces that determine the earth's climate. In particular, it is generally the consensus of opinion that the atmospheric concentration of a number of gases are known

to be increasing and that some of these gases have important effects in causing the greenhouse warning and keeping the earth warmer that it would otherwise be. (Figs. 4 and 5). Among the greenhouse gases, carbon dioxide has potentially been the most effective in changing the earth's climate, and has been responsible for over 50% of the enhanced greenhouse effect in the past and is likely to remain so in the future. Other greenhouse gases include nitrous oxide (N2O), methane (CH4), chlorofluorocarbons (cfcs), ozone and aerosols. The atmospheric concentration of the greenhouse gases have grown significantly since pre-industrial times (about 1750 A.D): For example CO2 increased from about 280 to almost 360 ppmv3, CH4 from 700 to 1720 ppbv and N2O from about 275 to about 310 ppbv.

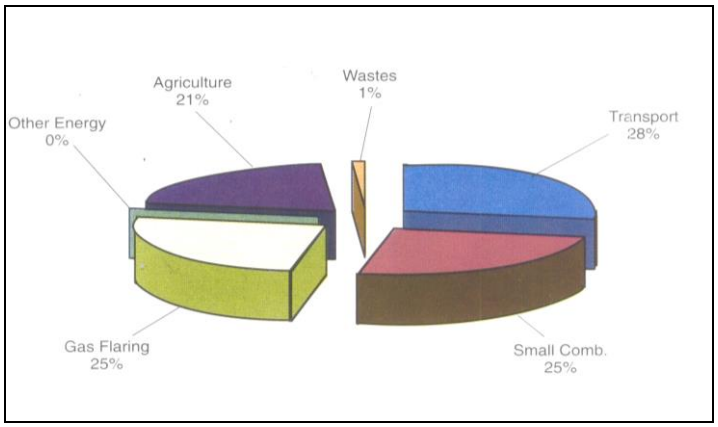

Fig. 4: ***Major Sources of CO Emissions in Nigeria in 1994***
Source: FGN (2003) Nigeria's First National Communication

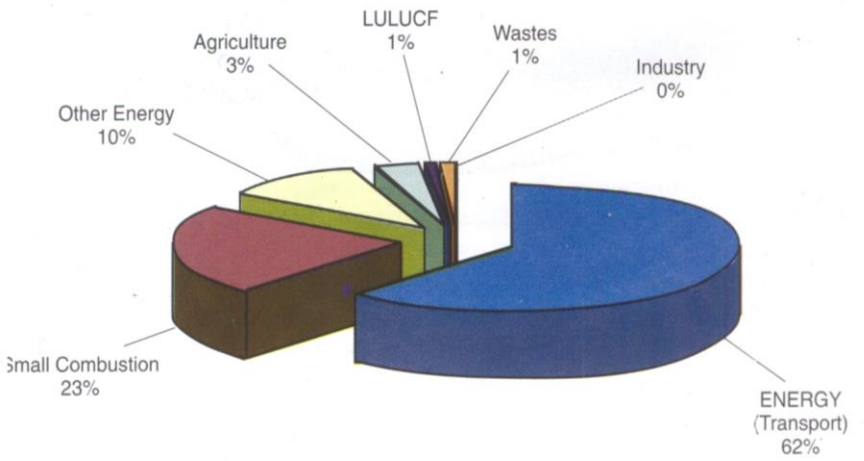

Fig. 5: ***Major Sources of NO_2 Emissions in Nigeria in 1994***
Source: FGN (2003) Nigeria's First National Communication.

Even Nigeria contributes significantly to the greenhouse emissions as can be noted in figures 4 and 5. In figure 5 for example, land use, land use change and forestry (LULUCF) sector generated about 40% of gross national emissions in to the atmosphere. Also significant as sources of CO2 emission are gas flaring and transportation which account for 30% and 20% respectively. These facts are further illustrated in Table 6 and Table 7.

Table 6: Summary of Emissions from the Nigerian Energy Sector 1994
EMISSIONS (Gg).

Sector	Total Energy Consumption (P	CO_2	CH_4	N_2O	CO	NO_x	NMVOC
Public Electricity	100.9	5686.3	0.01	0.20	1.30	5.82	0.00
Auto-generation	9.5	70.67	0.02	0.02	3.34	9.54	0.12
Petroleum Refinery	765.9	60.98.9	0.61	2.91	28.34	4.14	12.10
Industry	18.3	1435.9	0.05	0.12	0.30	3.06	0.04
Transport	545.1	38473.4	12.07	0.86	4728.99	322.47	896.19
Small Combustion	738.5	4700.9	445.21	3.36	4139.25	127.87	4.71
Fugitives	5.2	58080.0	1018.23	0.00	4224.00	28.99	951.10
Total	2183.4	115182.1	1476.21	7.47	13125.53	501.89	1864.26

Table 7: Per Capita Sectoral and Gross Emissions in Nigeria for 1994

	1994 Specific Emissions					
Sector	CO_2 kg C/cap	CH_4 Kg C/cap	N_2O kg C/cap	CO kg C/cap	NO_x kg C/cap	NMVOC (kg NMVOC/cap)
Energy	324.65	11.44	0.05	54.26	1.58	19.27
Industry	4.96	0.00	0.00	0.00	0.00	3.79
Solv. Use	0.00	0.00	0.00	0.00	0.00	0.00
Agric	0.00	18.17	0.03	14.83	0.47	0.00
Luc	212.92	0.14	0.00	0.67	0.01	0.00
Wastes	0.00	16.21	0.00	0.71	0.01	0.00
Total	**542.54**	**45.97**	**0.08**	**70.46**	**2.07**	**23.06**

Source: FGN (2003) Nigeria's First National Communication.

No matter the level of the uncertainties in the knowledge of the characteristics and future trends of climate, climate change and sea level rise will have significant impacts globally, regionally and locally, creating problems for sustainable development and resources management. Indeed climate change and sea level rise would compound the serious problems of sustainability of the environment and management of resources, as well as the currently serious problems in population consumption patterns and characteristics in many parts of Africa. In particular, climate change and sea level rise will threaten the coastal zones and low lying islands, which are already constantly plagued with floods and erosion, while in many cases, the impacts would also be most severely felt in regions such as the Sudan and Sahel areas, which are already under serious water stress. There would no doubt be serious consequences on agriculture and livestock production and management, water resources management, forests and forestry, fisheries and other economic activities.

Perhaps it is important to mention a few things about the Niger Delta area, the main source of petroleum resources on which the economy of the nation substantially depend. As noted by Ojo et al 2001 with sea level rise of one meter, for example, inundation in the Niger Delta alone may render more than 15,000 km^2 of land at risk, while soil erosion may claim more than 300km^2 (Awosika, et al 1994). With sea level rise of 0.3, the land loss due to inundation may exceed 7,000 km^2, while that due to erosion may be up to 120km^2. With ASLR of 1.0m, about 2-3 million people could be displaced in the Niger Delta (Awosika et al, 1994).

It has also been estimated that along the coastline of the Niger Delta alone, about 110 villages with values of 35 million US dollars and about 550 villages with values of 175 million US dollars would be impacted with a sea level rise of about 0.2m and 1.0m respectively. Indeed, the entire municipality of Post Harcourt (about 70 km^2) may be inundated. Other significant localities that may be inundated in the Niger Delta area include Warri, Abua, Okrika, Nichia, Ahoada, Bori, Bonny, Brass, Degema and Yenogoa, all of which are local government headquarters.

In a study carried out by my humble self on Lagos Metropolitan area (Ojo 1998), I emphasized that, the implications of climate change and sea level rise for water resources and water supply-demand management systems in the Lagos Metropolitan area would be significant for a number of reasons. For example, there would be changes in the magnitude and timing of water resources and these would necessitate changes in water management strategies and greater conservation efforts would be required in order to balance water supplies and demands. Also, in the event of a sea level rise of between 0.3m and 1.0m in the Lagos area, most of the water resources in and around the Metropolis would be polluted by the intrusion of salt water and water resources management would place greater emphasis on desalination.

Another likely consequence of the impact of climate change and sea level rise on water resource systems in the Lagos area is the possible alteration of the characteristics of the hydrological systems with serious consequences on the availability of water resources in the area. This is particularly important for water resources planning in the area because already more than half of the population in the metropolis could be subjected to further stress as a result of the likely adverse effects of climate change and salt level rise on ground water resources in the area.

Apart from the direct impacts of climate change and sea level rise on the water supply-demand systems in the Lagos Metropolitan area, there are a lot of implications on socio-economic and socio-cultural sectors which are indirectly linked to water resources. For example, the impacts of climate change and sea level rise would include damages and losses due to flood, erosion, inundations and loss of vegetation and possible displacement of people from flooded area (Awosika at al 1994).

In another study carried out for Lagos State by the Climatological Research

group, Laboratory of Climatology, University of Lagos of which this author is a member. Ojo et al (2000). It was emphasized that Lagos state which consists of large areas of lowlands that are very vulnerable to the impacts of climate change and sea level rise. This is particularly so because the state is generally characterized by low lying areas, most of which are below 5m. The summary of the results of the studies Tables 8 and 9 show that considerable physical, ecological and socio-economic losses would be incurred with the expected rise in sea level of about 05m and 1.0m respectively, if adequate response measures are not taken.

For example, almost all parts of the Eti-Osa Ibeju Lekki, Lagos Island, Ojo Shomolu and Badagry Local Government areas will be inundated resulting in considerable physical ecological and socio-economic consequences. In particular, all the 189km^2 land of the Eti-Osa Local Government Area, about 230km2 of land in Lagos Mainland LGA and about 445km^2 of land in Shomolu LGA will be inundated with and expected SLR of about 1.0m. In the Eti-Osa Local Government areas of the metropolis (this includes the Victoria Island and Ikoyi, which form the most expensive areas in Nigeria), for example, more than 200 industrial establishments worth more than US$45 billion will be lost. Table below shows the capital values at risk in the Eti-Osa Local Government Council Area of Lagos State.

Table 8: Capital values at risk in Lagos State by Local Government Area (LGAs) (in US $ DOLLARS)

Local Government Authority	Value at risk with SLR (0.5m)	Value at Risk With SLR (1.0m)
ETI OSA	16.0	25.0
SOHOMOLU	4.0	6.0
LAGOS MAINLAND	6.0	12.0
LAGOS ISLAND	8.0	14.0
MUSHIN	2.4	4.0
SURULERE	3.1	5.0
OSHODI-ISOLO	2.6	4.0
AGEGE	1.6	3.0
ALIMOSHO	1.1	2.0

IBEJU LEKKI	1.8	3.0
IKEJA	2.8	4.0
OJO	1.8	3.0
BADAGRY	1.4	2.0
IKORODU	0.3	0.5
EPE	0.3	0.5
TOTAL	53.2	88.0

Source : ***Ojo O. et al. 2001 : Fundamentals of Physical and Dynamic Climatology, SEDEC.***

Table 9: Capital Values at Risk in Eti-Osa Local Government Area
(Values in US $ Dollars)

INDUSTRIES	0.2
EMBASSIES	2.4
OIL COMPANIES	1.5
RESIDENTIAL BUILDINGS	12.0
BANKS	0.2
COMMERCIAL ACTIVITIES	0.8
SOCIAL SERVICES	0.8
LAND	6.0
TOTAL	24.7

Source : Ojo O. et al. 2001 : Fundamentals of Physical and Dynamic Climatology, SEDEC.

CONCLUSION: WHICH WAY FORWARD?

In Nigeria the rainy season is supposed to be a blessing and indeed it is. While the rains bring relief from heat and hold out promise for rich and bumper farm harvests, there are other sides that are not so appealing to Nigerians as the rains compound perennial problems related to the climatic dilemma, for example, strong winds, floods and erosion e.t.c. These problems (some of which have been discussed) result in environmental degradation/damage, agricultural losses and many property losses/damage e.t.c. This is particularly true of many of

urban centers where many houses have been damaged and in some cases, such damage has resulted in total collapse of buildings.

Perhaps one can give a detailed illustration of the Lagos roads with many troubles of flooding, erosion and neglect which make commuting difficult. As reported in the Guardian newspaper of Thursday June 22nd 2006, Lagosians would have loved that those whose duty it is, were able to do something about the roads and ease their many pains.
There was a time the Lagos State government had roads on its mind and committed resources towards rehabilitating several of them.

That was when roads such as those on Oregun, Ikotun-Igando, Ikotun-Ijegun and many streets in the Ikoyi, Victoria Island, Ikeja, Surulere and a few others were built to the joy and gratitude of residents of those areas.
The Federal Ministry of Works, on the other hand, does not seem to have put as much premium on roads as so many of the so-called federal roads are in a state of disrepair. Residents, motorists and other road users often spend hours on a journey that otherwise should take a few minutes. Not even the resolution of the dispute between the Federal and Lagos State governments seems to have made the issue any better easier. Yet, as bad as they are, the roads remain the links to other parts of the nation and the gateways to the nation's commercial nerve centre.
I have illustrated the issues related to the problems of arising from the consequences of the climatic dilemma with discussions on the Lagos roads. There are many other problems related to all sectors of the Nigeria economy. In the publication by the Presidency tilted "Nigeria's National Agenda 21", the mission statement was to enable every Nigerian achieve sustainable livelihood through the pursuit of policies and strategies that simultaneously address issues of development, sustainable resources management and poverty alleviation. The objectives include:

i To provide all Nigerians with the opportunity to earn a sustainable livelihood ,

ii To develop strategies and programmes for sound and sustainable management of the environment by the most vulnerable group particularly women and children.

The document discussed specific mission statements, objectives and activities related to the challenges of the various environmental issues such as erosion and

flooding, drought and decertification municipal urban waste and various aspect of pollution, climate change and human health e.t.c. The document also discussed issues related to the integration of environmental management into development planning and decision making. Such other issues as strengthening the legal basis for sustainable development, as well as well as strengthening, improving and coordinating the implementation of environmental management strategies, where discussed in the document. Other issues discussed in this document include (a) State and Local Government responsibilities, (b) creating and improving capacity for sustainable development, (c) implementing global Agenda 21, (d) forging viable partnership among various stakeholders and interest groups at national and international levels, (e) managing environmental Information for sustainable development, funding mechanism; (g) environmental Education, Information and public awareness.

No doubt, it is no longer in dispute that Nigeria is faced with a catalogue of environmental problems created by the climate dilemma the. On the national and the international scene a lot of efforts are being made through legal and institution arrangements as well as policy framework. The global agenda 21 is an initiative that had its roots in the 1992 World Conference on Environment and Development and the subsequent follow-up international meetings particularly the United Nation General Assembly Special Session convened in June 1997 for the purpose of conducting an overall review and appraisal of the implementation of Agenda 21 The 1992 United Nations' Conference on Environmental and Development (UNCED) held at Rio de Janeiro marked a significant turning point in the history of mankind especially on matters relating to environmental protection and sustainable development.

It will be recalled that one of the documents adopted at the UNCED by nations of the world including Nigeria was this Agenda 21. This document expresses a new thing about sustainable development which calls for political commitments at the highest level and a global consensus on the need for extensive cooperation with respect to the environment and development issues. The global Agenda 21, consists of four main sections with 40 strategies designed to achieve sustainable development into the 21st century. Consequently, the implementation of Agenda 21 will not only help individual counties to embark on the path to sustainable development, but will also represent a means of forging grater international co-operation, realization of faster economic growth and a better and safer global environment. The global Agenda 21 calls on all nations to develop and pup into effect their own national strategies, legislation, plans and policies for sustainable development and to be prepared to deal with the common challenges of

mankind.

Thus, following the global initiative, Nigeria developed her own Agenda 21. But to what extent will the country be able to further the laudable programme, in this Nigeria's Agenda 21 bearing in mind particularly the 'human factor" in the country?

Mr. Vice Chancellor Sir Can we effectively fulfill the Mission Statement of implementing Nigeria's Agenda 21, namely to attain sustainable development in the country?

(i) Can we effectively integrate environment into development and decision-making?
(ii) Can we effectively strengthen the legal basis for sustainable development?
(iii) Can we effectively create and improve capacity for sustainable development?
(iv) Can we effectively involve key stakeholders in sustainable development activities through participatory approach?
(v) Can we explore innovative means of funding for sustainable development?
(vi) Can we adequately manage environmental information and education to generate adequate public awareness for decision making?
(vii) Can we effectively strengthen/establish mutually beneficial relationships with bilateral and multilateral environmental bodies including regional and international NGOs?
(viii) Can we effectively promote an integrated approach to the conservation and management of resources for development?
(ix) Can we effectively adopt and promote the use of proven environmentally friendly technologies?
(x) Can we effectively promote research and development of environmentally sound technologies?

Mr. Vice Chancellor Sir, which is the way forward in answering these questions which are very pertinent to solving the problems of the climatic dilemma?
No doubt, these tasks are daunting but they are nonetheless necessary and must be performed, if the problems associated with the climatic dilemma are to be effectively addressed. It is my considered view that we should be able to perform these tasks, otherwise, the problems of Climatic Dilemma will continue to linger on and Nigeria's Developmental Agenda as contained in the 2005 Millennium goals may never be met.

May the Good Lord help and deliver us in this country.

Mr. Vice Chancellor Sir, Ladies and gentlemen I thank you all for your patience and attention.

ACKNOWLEDGEMENTS

Mr. Vice Chancellor Sir, distinguished Ladies and Gentlemen, let me now move to the more difficult task of expressing gratitude to all those who have contributed in one way or the other to my development. Without seeking to offend anyone, I will only offer broad thanks to all. I do hope that others will see those mentioned as representing them.

First and foremost, I give thanks to the Almighty Father for taking me this far in my career. I acknowledge His power in my life. Many honour, glory adoration, dominion, majesty and power be unto his Holy Name (Amen).

My thanks also go to my wonderful parents (both of blessed memory), Pa Gabriel Ojo and Madam Comfort Aina Ojo. May their gentle souls continue to rest in perfect peace.

I thank and appreciate all my teachers at all levels of my education. At the secondary modern school level, I wish to specially acknowledge Chief H.O Fafiyebi and Mrs. D.T Aina (nee Olubunmo) for their roles in my formative years. I wish to specially appreciate my tutors at Wesley College Ibadan particularly my principal, Chief J.O. Odeyale, Mr. S.B Faturoti, Miss. Joy Fletcher, Chief Dare Olajubu and Chief Supo Akinola.

Thanks are especially due to all my Professors at the Department of Geography University of Lagos for exposing me to a very sound academic tradition. If there is any one who has continued to profoundly influence me even after my University education, it is no other person than my academic mentor, Professor Oyediran Ojo. May the Almighty Father continue to bless you and your family.

At this point I wish to acknowledge with immense gratitude, the support and co-operation of the entire members of staff of the Faculty of Social Sciences since my assumption of office as the Dean and particularly, for their solidarity and affection during the preparation of this inaugural lecture.

Special thanks go to all my colleagues in the department of Geography and

Planning for their continued support and encouragement. In the course if preparing this lecture, I have enjoyed tremendous good will from many colleagues. I want to openly acknowledge the support of the following: Prof. Tayo Odumosu, Prof. Siyan Oyeweso, Dr. Ayo Omotayo, Dr. T.O Bawa-Allah, Dr. S.G Odewunmi, Mrs Yemi Soladoye, Messrs M.O Lawal, Kunle Ogundele, Bidemi Aina, Rafiu Olorunnibe, Wale Taiwo and Depo Adejobi.

I wish to specially appreciate, Mrs Bose Amoo, the Acting Director of the Educational Technology Centre and her team for handling this lecture with dexterity and proficiency. I also acknowledge the assistance of the following in typesetting of this lecture. Miss Bose Oladapo, Mrs. Lucky Olaleye and Miss Aishat Yakubu-Ogu.

Special thanks also to members of Club 20 Otan-Ile, WESCOL 72 Club and the Christian Improvement Association of Estate Methodist Church Oke Afa some of who have spared time to grace this occasion.

My thanks go to my Brothers and Sisters within the Methodist Church Nigeria, from the Diocesan, to the Circuit down to my local church, Estate Methodist Church Oke Afa. I value most sincerely, your love, prayers and support. I also wish to acknowledge the support and encouragement received from members of the Apostolic Church, Oke Afa Assembly.

My family members, brothers, sisters, classmates and in-laws have been a great source of joy to me in terms of the love and fellowship we share I shall continue to cherish our togetherness. I appreciate you all.

Of course, I now wish to particularly appreciate my nuclear family starting with my wife, friend, sister and confidant, Deaconess R.O. Ojo I thank you for your continued support, prayers and encouragement. I also thank God for the wonderful children He has given to us: Mrs Funke Adekoya (Nee Ojo) and her husband Mr. Dayo Adekoya, Tosin Ojo, Ayo Ojo and Tunde Ojo. I thank God Almighty for the gift of such a wonderful family.

Finally, I generally duly acknowledge and appreciate everybody who is here on this occasion of my Inaugural Lecture, even when I might not have mentioned your names directly; and may the Good Lord bless you, and grant you journey mercies back to your respective places of domicile.

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