56th Inaugural Lecture

Are We Living In A Dying Earth?

DELIVERED BY
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LAGOS STATE UNIVERSITY
ON TUESDAY 13TH OF DECEMBER 2016

ARE WE LIVING IN A DYING EARTH?

Vice- Chancellor

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Gentlemen of the Press

Ladies and Gentlemen

SHORT PROLOGUE

EPILOGUE AS INTRODUCTION

When finally you wake up on a certain day and the earth refuses to shine her sun, and you wait for the night to fall so that you can savour the beauty of the moon in its glory, or when you require water and you find so much of it and none to use, or when you till the soil and it bleeds blood in return, or when all your air conditioners and fans can no longer cool your body day or night and then you drive your vehicles and the smog won't let you see beyond your nose, or when you try to buy your usual food and the mama tells you, *Eja ti won*, and you ask, "Is it not that you just catch them in the seas and oceans for free?" And the seller then

perhaps retorts, *Won ko ri eja pa lomi mo*. Then you panic and wonder if the Second Coming of Christ is at hand. It is then you look up and hear a voice saying, "*Omo eniyan, omo eniyan, omo eniyan*, why thou persecuteth me?"

Introduction

My Vice-Chancellor, sir, I am constrained to start the 56th Inaugural Lecture which is the fourth from my faculty and actually the third from Geography Department on this grizzly note. Professor Oladele Arowolo the pioneer Dean of the Faculty of Law and Humanities had delivered the very first in the university on behalf of the Department of Sociology which was then a unit under the Department of Social Sciences. For the past 31 years that I have been involved with academic world and investigating the nature and structure of the earth and studying man's actions, I have found man to be guilty of monumental and monstrous sins against mother earth. It is certainly perhaps okay for us to continue to live our lives the way we have been living variously, but it is not proper to live our lives in a way that takes all and leaves nothing behind for the future generation. I believe it is the duty and indeed it is an imperative, for those of us who are practitioners in the field of natural living earth to draw the attention of the consuming "bogjogs" (*jegudu-jera*) to the cataclysmic end that the earth may suddenly come to if we continue to pursue our agenda for living in this carefree and unabashedly destructive manner. Ladies and gentlemen, the earth cries

every day for justice, it cries every day for fairness, it cries every day for understanding, and it warns us every time of our infractions against her. But is man listening? Do we even have the capacity to listen or see? Even if we can hear the earth and feel her pains, can we act to assuage her? Can we understand her? Can we feel her hues and cries? Indeed, the question perhaps is; What exactly is the matter with the earth?

What is Mother Earth?

I grew up like every other person to hear the use of the phrase "Mother Earth." We hear it, we say it, we have grown into the use of the phrase, but have we for once pondered on what exactly it might mean? After all we all have mothers and we know who our mothers are or were (if you happened to be an "orphan" like me). Certainly I will not blame anyone here who sees the use of the phrase in its casual form. Most times we a take a cursory view of the term and we cannot find any meaning for it beyond thinking of it in such casual terms. I have not traced the origin of the phrase but, I certainly know that it is not an imposition on us because, as you shall soon see, the earth is the first mother of everyone and everything that comes into existence in whatever form.

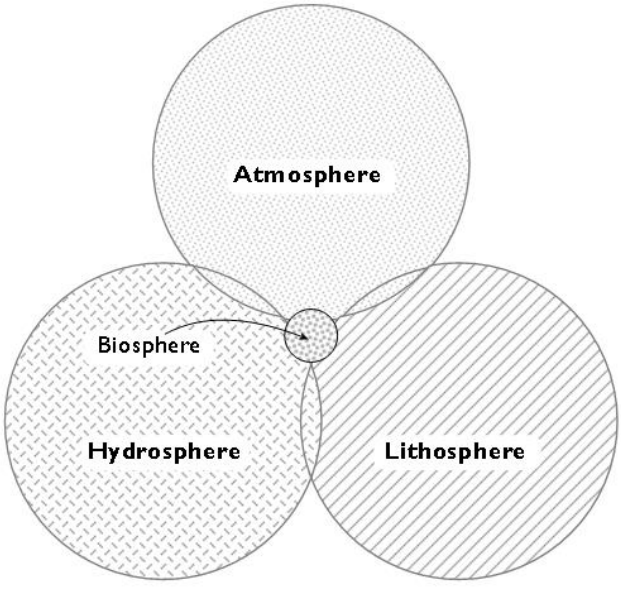
Let me therefore define Mother Earth from the perspective of the earth-science practitioner, this time as a geographer. I emphasize the word *geography* because, in the past and even in the recent times, most sub-study aspects of the discipline have gone on to take on a life of their own, to the extent that most, if not all, have been taken over by some small

communities of learners who have gone ahead to develop them into other viable disciplines, that one wonders if they even had much to do with geography anymore. Today we have geographers giving themselves titles such as urban planners, meteorologists, climatologists, hydrologists, environmental resource managers, etc. I must say, however, that all these are certainly sub-disciplines under the broad subject of geography; they would always be and shall remain known as it is: *geography*. I ask that you pardon my digression, Mr. Vice-Chancellor.

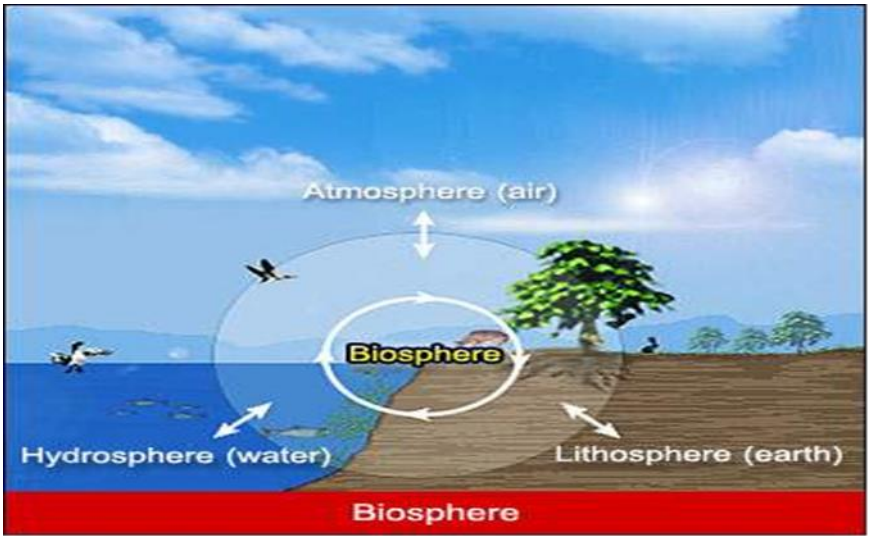
"Mother Earth" refers to the intangible control systems that handle the way and manner in which the major components and subcomponents of the earth, both internal and external, are interconnected in an intricate web of functionalities that are so complex to figure out, and understanding how such a system functions and remains in equilibrium. Indeed it is the magnitude of the interconnection and the extent of the influence it exerts in making us as entities function in our own little way that got the earth to be seen as a "mother" to begin with. We all know who mothers are and we all can appreciate all they do in spite of our petulance as they try to keep us "up."

How the Earth Works

Let me try to give us a vivid description of what the earth is and how it functions:



Source: Internet



Note: All of these parts are interconnected and are dependent upon and affect one another, as visible in the diagram above. You can see that the spheres of the earth are complex.

Source: http://greenforecast.com/spheres-of-the-earth-understanding-how-we-model-earth/

This shows us the state of a pristine Earth, the way God created it. The question now is, What exactly has man been doing to wrong the earth? I had earlier spoken about Mother Earth (ME) asking for justice, fairness, understanding, etc. With the current state of things and given that man lives in the system, we must accept that man obviously will be a player; and indeed he is the major player. In this next section we shall be looking at a set of factors captured under the term "anthropogenic reasons." In the parlance of earth resources discipline, anthropogenic factors are understood to be representing the actions of man and its agents in affecting an outcome of change in the earth system as a result of man's action and sometimes inaction. Given the current state of things, it is believed that man is affecting man in a way that may result in Earth's demise. However, the question remains dialectical. Is man killing her or is she (ME) just set up to die?

At this stage we need to address three questions: Does man have a right to his actions? What exactly are those actions?, and What are the consequences of his actions? However, before we look at that it is pertinent to quickly delve into theory and state the principles under which most of my studies were carried out. This is necessary because it enables us address the question if indeed Mother Earth was set up to live forever.

The Theory of Dynamic Equilibrium

The dynamic equilibrium theory presupposes that a system will continue to be in a state of equilibrium because the integrated feedback subsystems will operate in a self-regulatory manner and enrich the system by providing it with greater flexibility of response. In light of more recent literature, the equilibrium end-state of such adjustments is termed as "stationary state" (Montgomery, 1989). Provided the constraints remain constant, the entropy of the system may remain constant, and as long as the energy exchange continues, this state will be maintained indefinitely. The equilibrium state of such systems can be viewed in probabilistic terms (Marowitz, 1968: p. 123; Langbein and Leopold, 1964; Suheidegger and Langbein, 1966). Montgomery (1989) introduced the concept of structural stability to distinguish between far-from-equilibrium systems and equilibrium systems.

A focus on equilibrium perspectives of course echoes much longer, deep-rooted cultural understanding in the west about the relationships between people and nature. The somehow elemental, natural "balance of nature" has become so deeply accepted that it guides both public discourse and policy thinking, informing in turn the way academic debates are framed. Notions of balance or equilibrium in nature have a long tradition in western thought, traceable to Greek, medieval Christian and eighteenth-century rationalist ideas (Worster 1977, 1993 a, b). The main idea is that when there is a disturbance in any part of the system, the earth will begin to work, to requilibrate the system, so to say. George Perkins Marsh, in 1864, captures it thus:

> Nature, left undisturbed, so fashions her territory as to give it almost unchanging permanence of form, outline and proportion, except when shattered by geological convulsions; and in these comparatively rare cases of derangement, she sets herself at once to repair the superficial damage, and to restore, as nearly as practicable, the former aspect of her dominion (Marsh 1864, p. ???).

So, as in the case of a geological perturbation, we observe that when there is a human pertubation, nature tries to find a new equilibriun in order to keep the earth system in a steady state. In a way, since man is a major actor in the process, he will always disturb the equilibrium and then the earth components must try to adjust. Let us see whether man has the right to anything in the first place.

Does Man Have the Right to Live?

No doubt, Mr. Vice-Chancellor, that this is a rhetorical question. However, the question must be put so that I can build my case perhaps in favour of man or Mother Earth. Certainly God created man for a purpose and according to the book of Genesis in the bible,

God blessed them; and God said to them, "**Be fruitful and multiply, and fill the earth, and subdue it**; and rule over the fish of the sea and over the birds of the sky and over every living thing that moves on the earth" (Gen.1: 28).

It is indeed the commission of man therefore to inhabit Earth. So we see very clearly here that man must inhabit the earth in order to fulfil God's purpose in life while here. In doing this therefore, he must make use of the earth's resources. In any case, God says they are meant for him. So what on earth is the matter with Earth's complaints about man's activities on it? Man is only fulfilling a purpose for which he was created. While therefore accepting that it is the case for man to live, we find on the other hand that the type of living man has been engaged in is the one that brings him into conflict with the Mother Earth. So the problem is not, Should man not live? It is more like, "How is he living"? How is he carrying on with his responsibilities? To what extent is this in conformity with what the creator wanted to begin with? I'm no pastor or imam, but I doubt if man is willing to live according to God's expectations. ARE YOU? Mr. Vice-Chancellor, Ladies and Gentlemen.

Some of the works I have done clearly show that man's actions have rather gone irresponsibly too far and as such ME can complain. When we get to the section on my contributions to knowledge, I shall clearly enunciate this. So, ladies and gentlemen, let me conclude here that man has the right to live on Earth to fulfil the purpose of God, but it is the way that man has lived on earth that is a problem to nature and indeed mankind itself. Man's actions no doubt continue to put the earth under persistent need to find a new steady state. In any case, the theory of dynamic equilibrium has confirmed that the earth does not really want to die, and would find ways to sustain itself.

What are those Actions of Man that are Considered Deleterious?

In the last section I stated that man has the right to live on Earth and I justified this using biblical precepts. I am sure that if I had asked my Muslim colleagues they would also have shown me Quranic principles to justify same. I chose to use religious principles because all knowledge emanates from God and he is the owner of all things so any other justification to me may be unnecessary and is indeed like riding a horse on one spot. I will therefore not engage in any geographical equestrianism at this time.

Several of man's actions over the centuries have had dire consequences on the pristine equilibrium that came with the earth system at the time of its creation. It will not be possible for me to state all of these in a scientifically deep manner because of the traditionally short time allotted to this unique lecture (Mr. Vice-Chancellor, sir, I believe you will agree with me that it is tough to say everything I have done in terms of 30 years' research in under 45 minutes.) I will therefore simply just mention them for the sake of our enlightenment.

The pictures below show some of the actions of man that are considered deleterious: (pollution of the air, water and soils, deforestation, ozone layer destruction, use of hydrocarbons, unabated urbanization, etc.)

As we can see thus far, it is clear that in our quest to live the way we want we have inadvertently engaged in actions that have led and that still are leading to the degradation and destruction of the earth system. Some of the damages are unfortunately irreversible and they have dire consequences for the health of our Mother Earth going forward.

Mr. Vice-Chancellor, ladies and gentlemen, it is pertinent for me to state here that we all should look at all of these and ask ourselves the hard questions. What exactly have I contributed to this? How did I contribute to this? In what way and manner am I also guilty? No doubt, that there are ethical questions to ask and indeed some of them border directly right on the essence of life itself. Can man live through this earth without committing any of these infractions? As a scientist, I will say yes and that is only if we are all ready to make the necessary commitment to change the way we live and pursue our goals and desires; the world can change and become a better place. I make bold to say that, for everything we are currently doing wrong, there are several better alternatives that are earth-friendly.

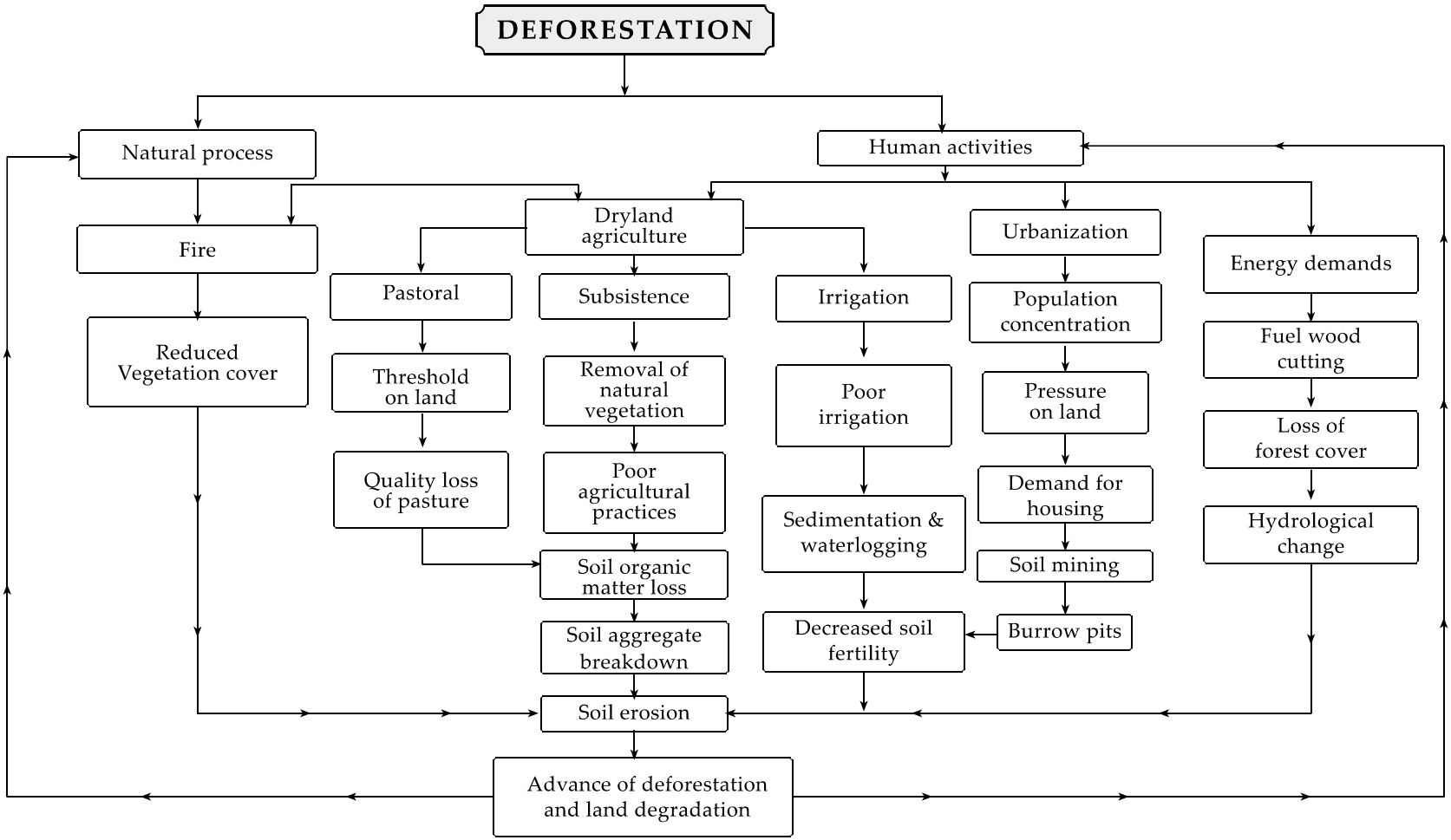
What Are the Direct Consequences of Man's Many Actions?

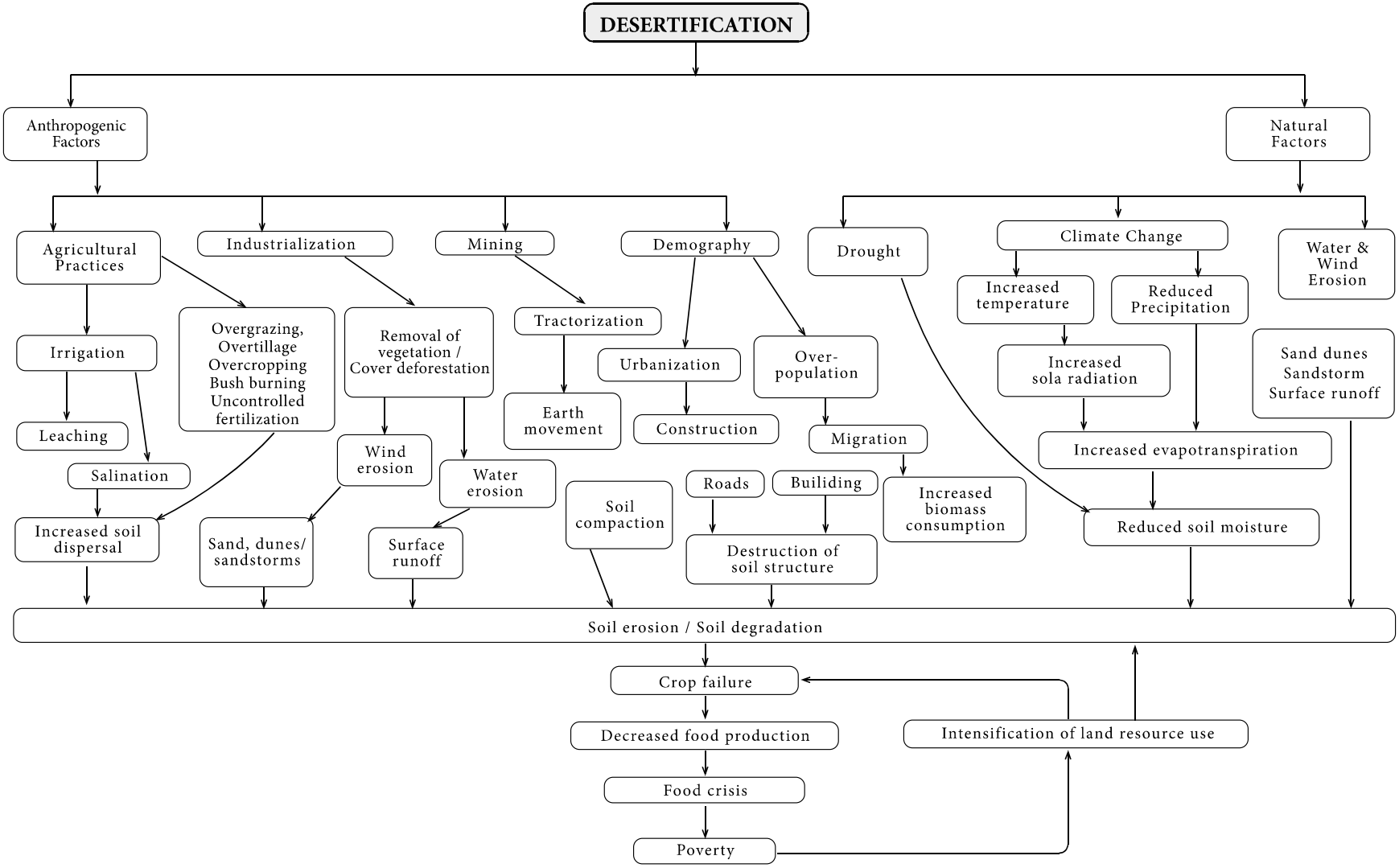
Mr. Vice-Chancellor, sir, in the course of my sojourn in this special area of geography and in carrying out researches in order to make

contributions to knowledge, I have found the following as being of important consequences of man's actions and activities:

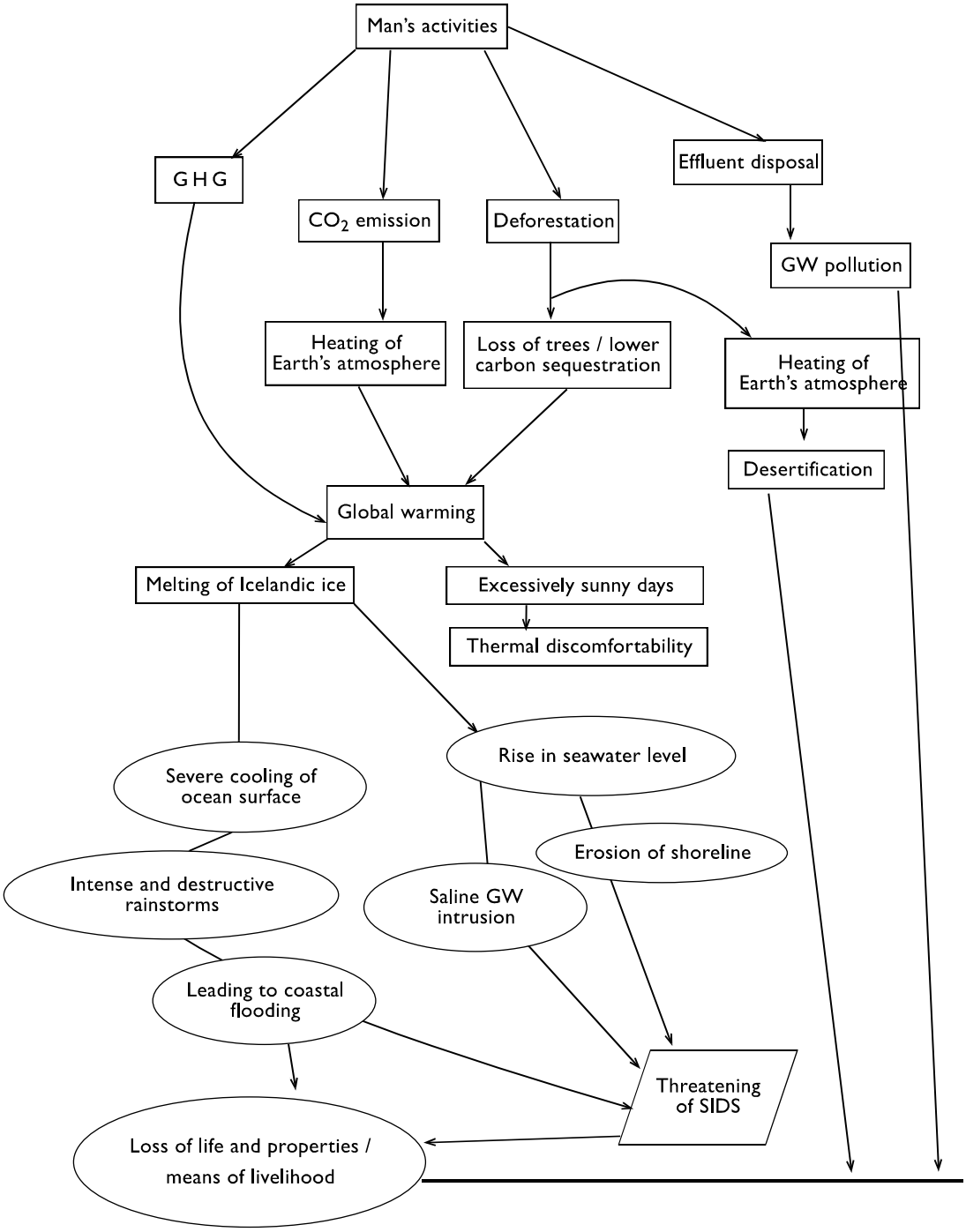
In the quest to better understand the earth system, I here summarize, for ease of enquiry, the pathway diagrams for the cascading "system earth." The schemes are outcomes of intensive research work. The first two schemes came out of the works of my PhD students, in 2012 and 2016, respectively, even though I have modified them somewhat since then.

The schematic here shows the cascades for deforestation once it begins to happen. The second diagram shows that of desertification. I acknowledge Drs. Afolabi of the Lagos State Ministry of Environment and Eze Ifunaya who is into entrepreneurship lending at this time. I am sure you will come back. You home is in the university.


DEFORESTATION
Natural process
Human activities
Fire
Dryland agriculture
Urbanization
Energy demands
Reduced Vegetation cover
Pastoral
Subsistence
Irrigation
Population concentration
Fuel wood cutting
Threshold on land
Removal of natural vegetation
Poor irrigation
Pressure on land
Loss of forest cover
Quality loss of pasture
Poor agricultural practices
Sedimentation & waterlogging
Demand for housing
Hydrological change
Soil organic matter loss
Soil mining
Soil aggregate breakdown
Decreased soil fertility
Burrow pits
Soil erosion
Advance of deforestation and land degradation


DESERTIFICATION
Anthropogenic Factors
Natural Factors
Agricultural Practices
Industrialization
Mining
Demography
Drought
Climate Change
Water & Wind Erosion
Irrigation
Overgrazing, Overtillage Overcropping Bush burning Uncontrolled fertilization
Removal of vegetation / Cover deforestation
Tractorization
Urbanization
Over-population
Increased temperature
Reduced Precipitation
Increased sola radiation
Sand dunes Sandstorm Surface runoff
Leaching
Salination
Wind erosion
Water erosion
Earth movement
Construction
Migration
Increased evapotranspiration
Increased soil dispersal
Sand, dunes/ sandstorms
Surface runoff
Soil compaction
Roads
Builiding
Increased biomass consumption
Reduced soil moisture
Destruction of soil structure
Soil erosion / Soil degradation
Crop failure
Decreased food production
Food crisis
Poverty
Intensification of land resource use

PATHWAY FOR ENVIRONMENTAL CONSEQUENCES



The third diagram shows the comprehensive pathways upon which the concept of sustainable development hinges. As is made clear, every action of man has consequences on all other components of the earth system. The principle of dynamic equilibrium presupposes that the system is not static and that it is actually a living entity. Thus, if it is living it means there must be changes and when those changes occur the system uses a complex but ordered sets of feedbacks to restore equilibrium so that continuity of the system will be assured. It is when severe and unexpected changes occur continuously in a component that the system becomes thrown out of sync. When that happens, the earth system will reset itself and that is when we experience several unexpected occurrences of events and consequences that are not usual.

Unfettered Urbanization and Industrialization

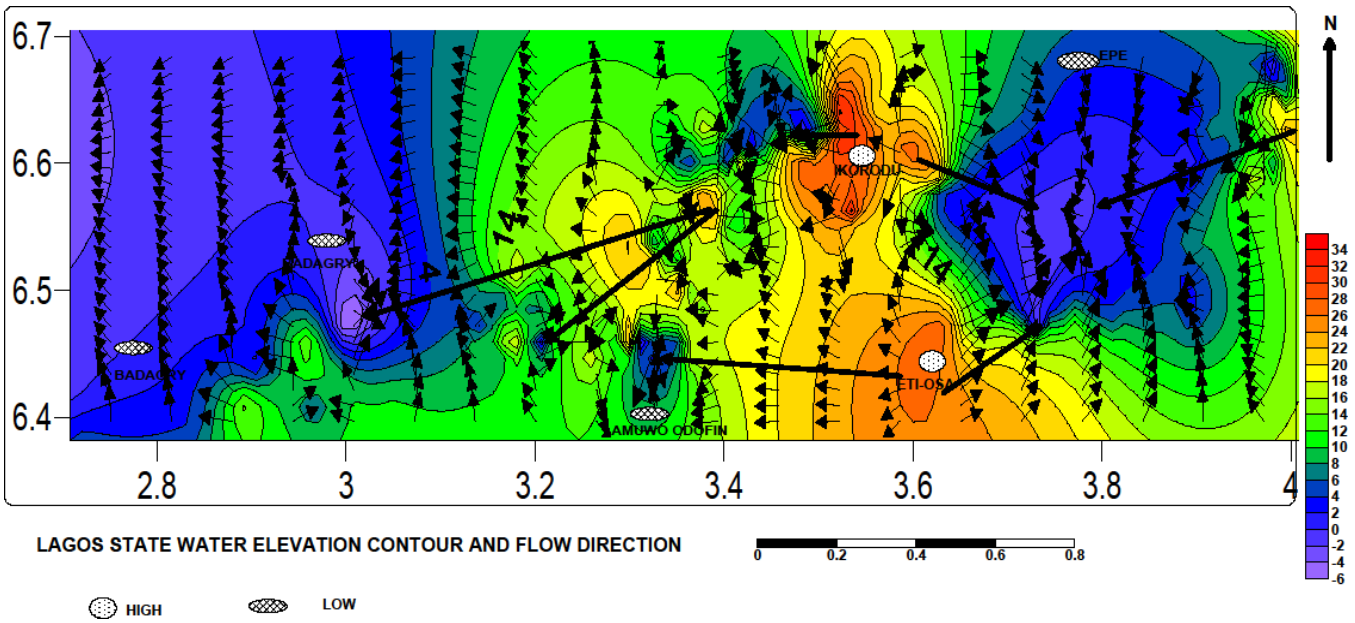
This happens as a result of policy failures. There is certainly no need for people to leave ancestral land of comfort to join in the rush of the city that boasts promises that it can hardly deliver. Everywhere, especially in Nigeria as concerns us here primarily, the city sprawls on and on and in the process it usurps rural land, so much so that they hinder agricultural production as ruralites are made to sell off their farm lands to estate developers, who are indeed far from ready to carry out any development. Governments have failed to implement policies that have been made to stem this tide.

Consequences of these are found in overcrowding, over-population, lack of water, sanitation, and health (WASH), poor environmental upkeep, water and air pollution, and overall degradation of the city that eventually leads to the disruption of urban ecosystems. As we speak, most of our cities are growing at unsustainable rates. Unfortunately, by 2050 almost 50 percent of Africans will live in cities (UNEP report,

2015). With this it is clear that we must begin to take steps to ensure that we build resilient cities that can withstand the challenges of the future.

Pollution of Water Sources

As a result of the above, we find it increasingly difficult to meet the demand for clean freshwater in our cities. A research funded by Lagos State government and carried out by a team that I led, found the level of contamination of Lagos's underground sources to be intolerable. The following diagrams show the status of the vulnerability of the sources. I present here a few of the diagrams showing the outcome of that research.



Generalised Water Elevation Contour and Flow Direction

Fig: Water Elevation Contour

5.2.4 Generalised Nitrate Level

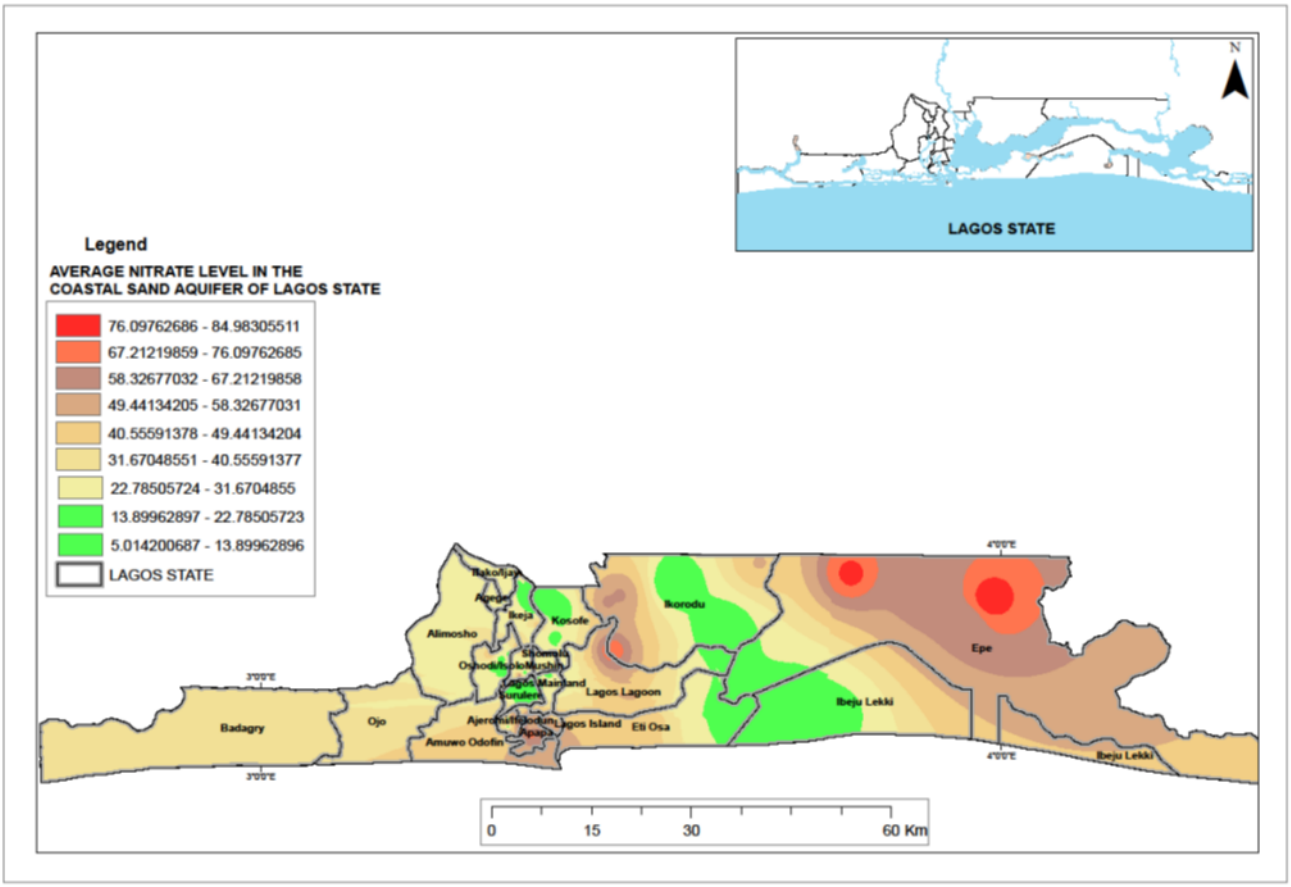


Fig: Nitrate

Generalised PH Level

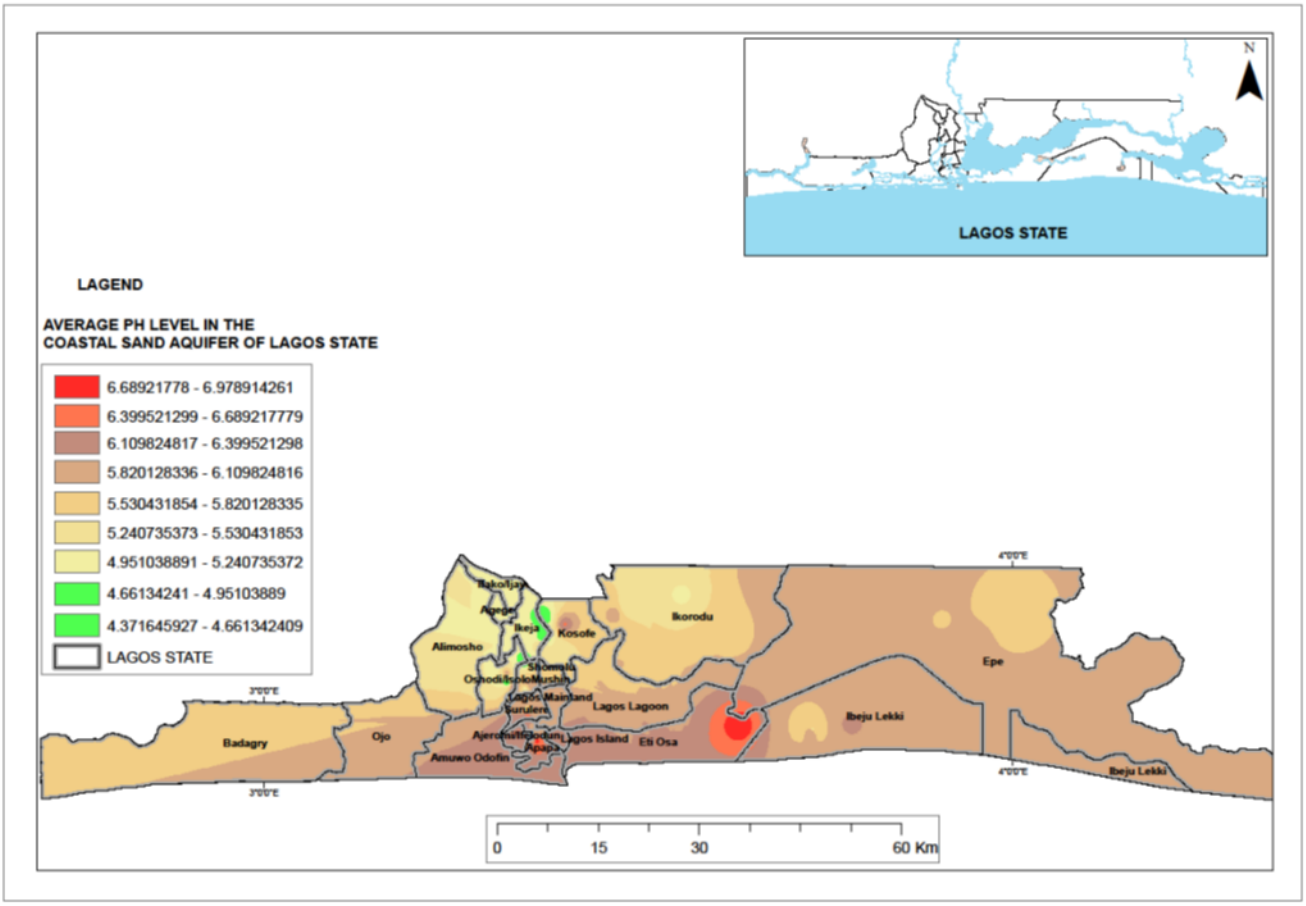


Fig. . PH Level

This might be of more interests to us since our university is located in Ojo LGA.

Ojo LGA Static Water Level and Flow Direction

The results from the field work were used to generate base contour maps and flow directions of the study area. Both manual and computer-aided methods were adopted in performing this task. The hand-dug well locations were surveyed within Ojo area and the values of the static water levels were contoured on the map of the same Ojo

area by joining equal values of static water levels and making sure that none of the lines overlapped or cut across each other. This was plotted and upgraded electronically with the aid of Surfer 9 software tool and the survey locations of the hand-dug wells triangulated using another software, Arc GIS 9.3, such that the computation results are available to all, as shown in figure () below.

The map reveals the water table of the area and shows at what depth at the subsurface water can be encountered at any point relative to the surface elevation(s). It also reveals the point(s) of recharge and discharge. The map further reveals the presence of a double aquifer system and the flow of groundwater within them. The water elevation contour map of Badagry area reveal that groundwater flow directions of the double aquifer system, with the one at the northeastern part of the region, some distance from Iyana-School, flowing towards Ilogbo (southwesterly direction) and the other aquifer, located south-centrally (behind Ajangbadi Police Station and Church bus stop) flowing bi-directionally southeasterly (Igbede), and due east (Ariyo) (from a subsurface elevation of 18 meters to the lowest elevation at 2-meter contour intervals). The direction of flow of the groundwater is always from higher hydraulic heads (recharge point[s]) to lower hydraulic heads (discharge point(s)). Thus, from the map, the points of recharge in the area are central and northeasterly, while the points of discharge are the southwest and due east directions of the area.

The results also indicate that any inordinate land-use activities (such as could lead to land/soil pollution) in the region would be more detrimental for communities lying within the southwestern and eastern zones of the study area. It can be further recommended that such land-use activities like dumpsite be situated northwest or northeast of the study area to reduce contamination of groundwater in the sub-surface.

Fig. Ojo Study Area

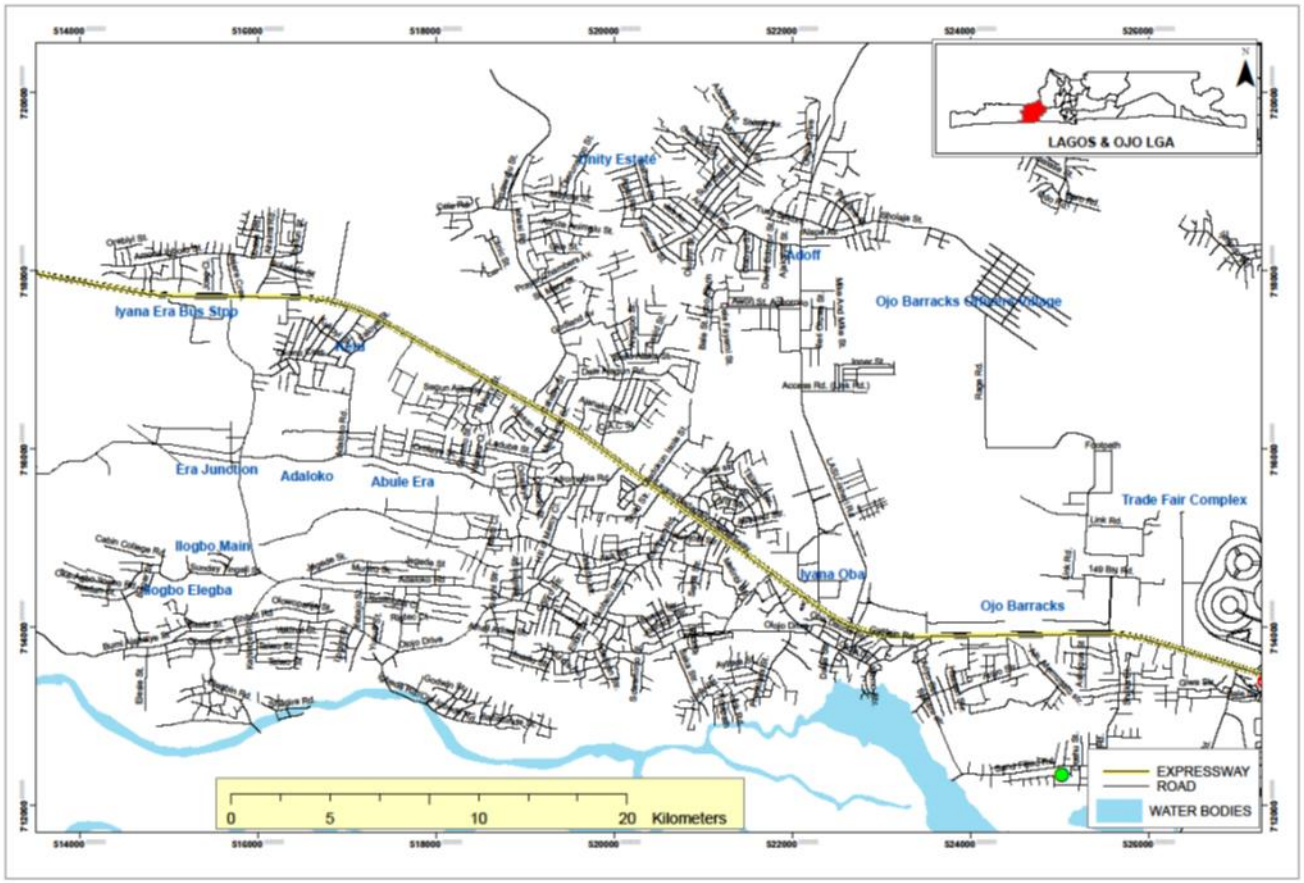


Fig. Ojo Water Table Contour

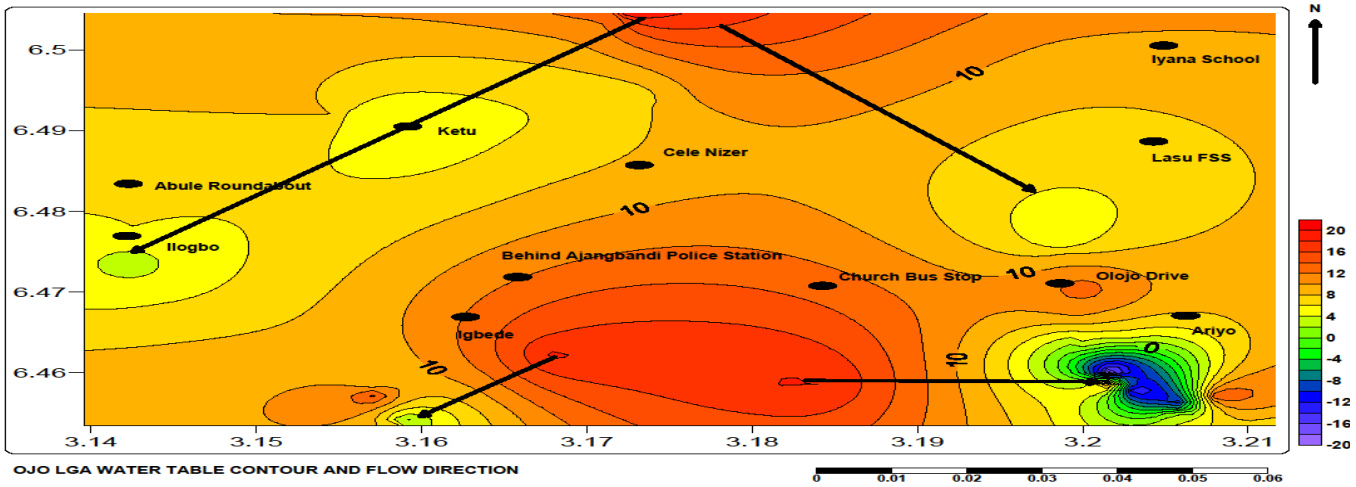


Fig. Ojo Grid Vectors

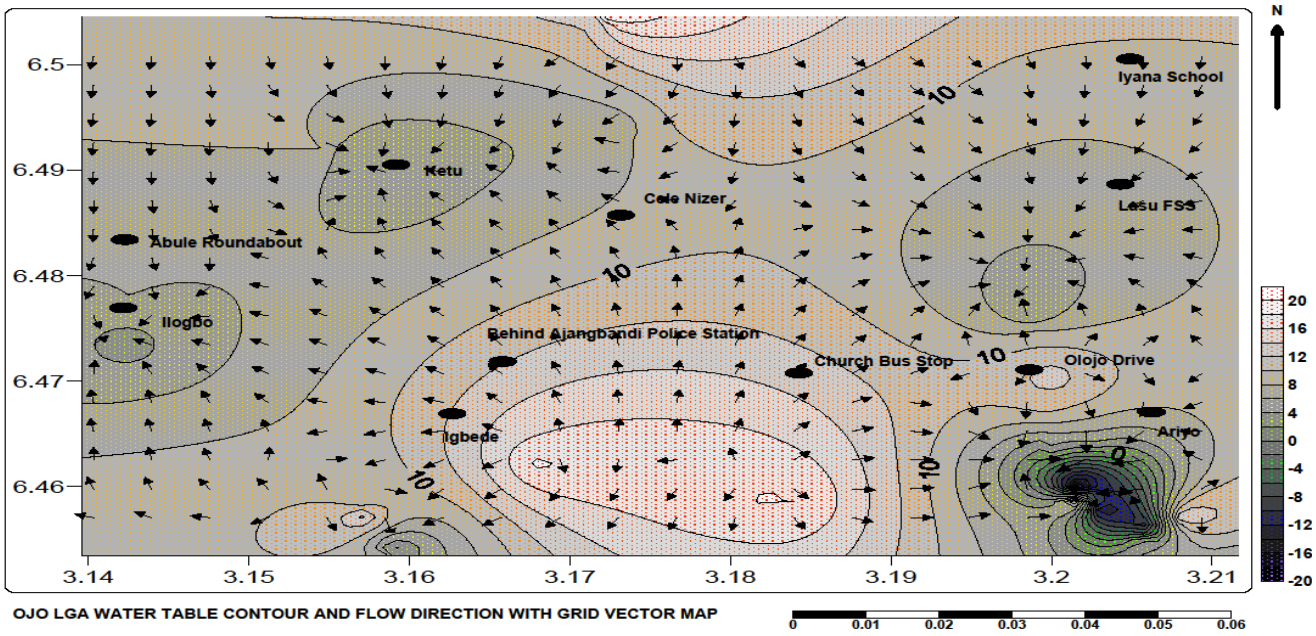
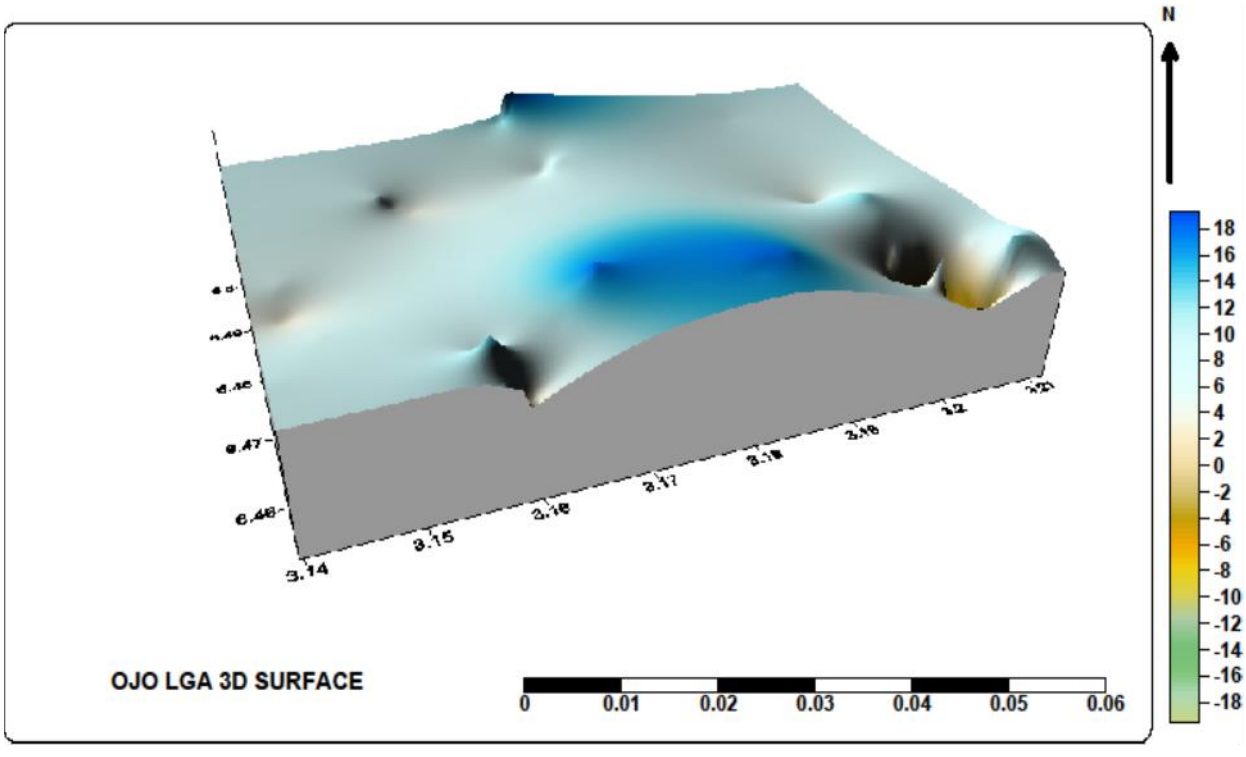
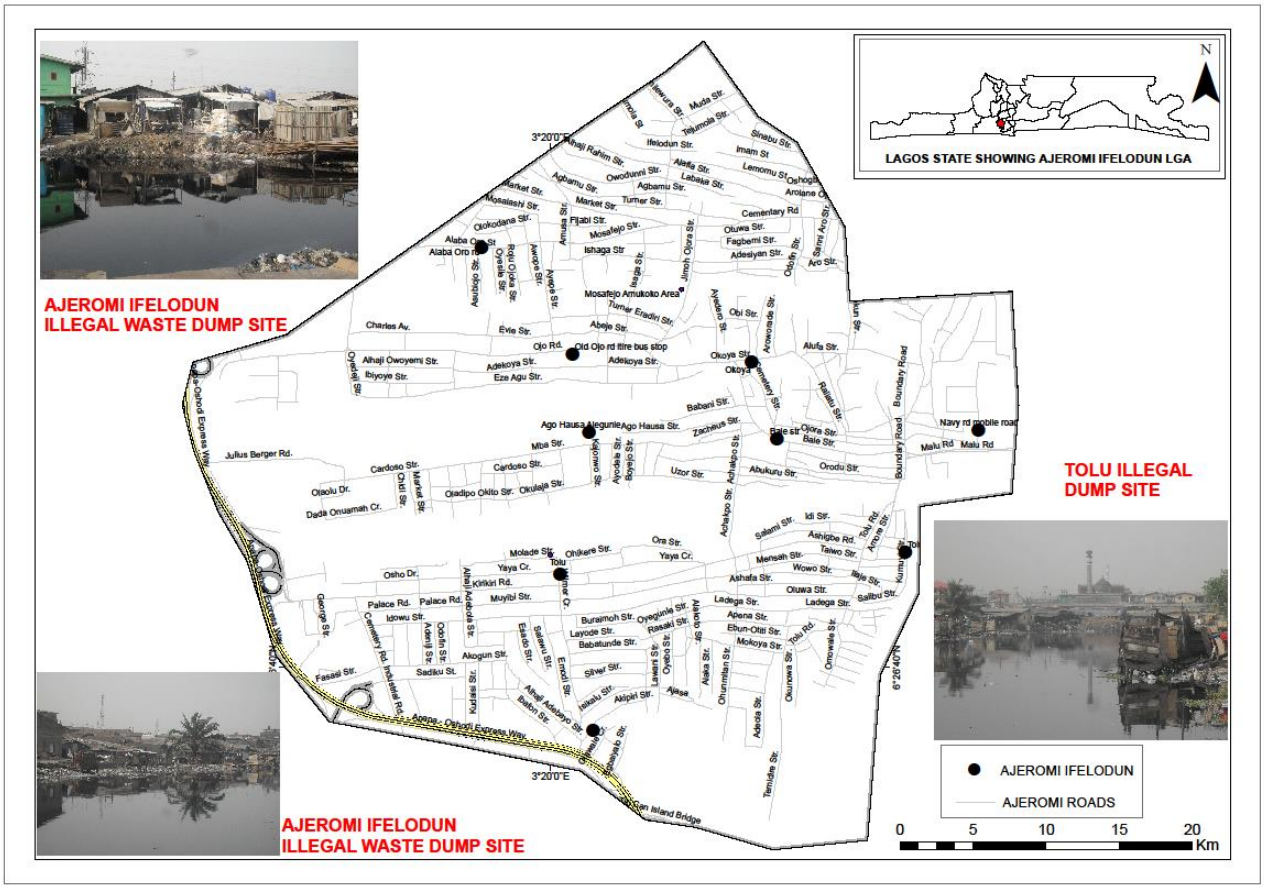


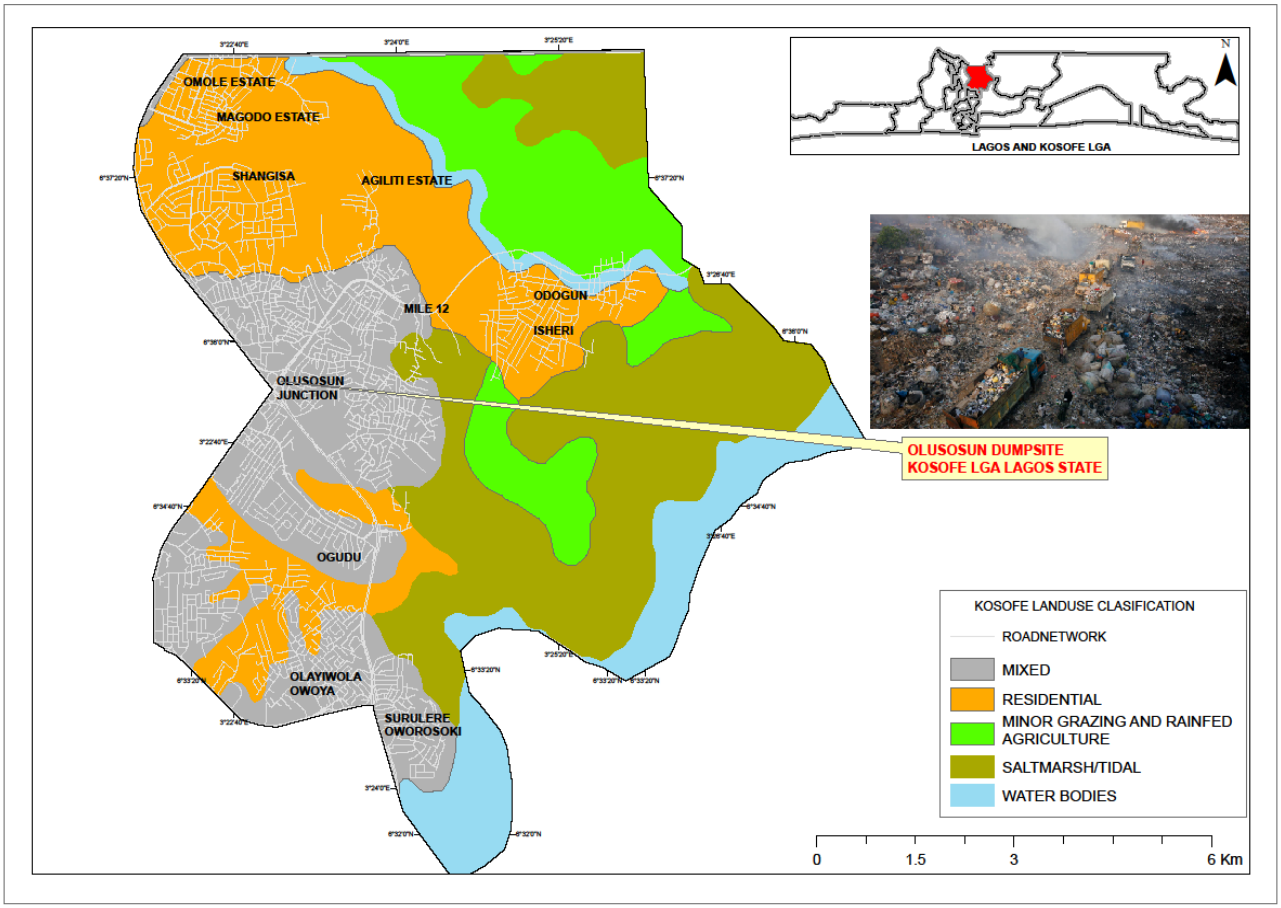
Fig.27. Ojo 3-D Surface



Quality of our Built Environment

Where there is overcrowding as a result of unplanned urban growth, then the urban area in question will suffer from low level of environmental upkeep where the wastes are rarely hauled away, the drains rarely flow and therefore providing the perfect habitat for all invidious insect vectors and germ-carrying rodents. A study which is yet to conclude has found that Ajeromi LGA has the highest per-capita rodent rate in Lagos. The diagram below shows parts of Lagos with poor environmental quality.





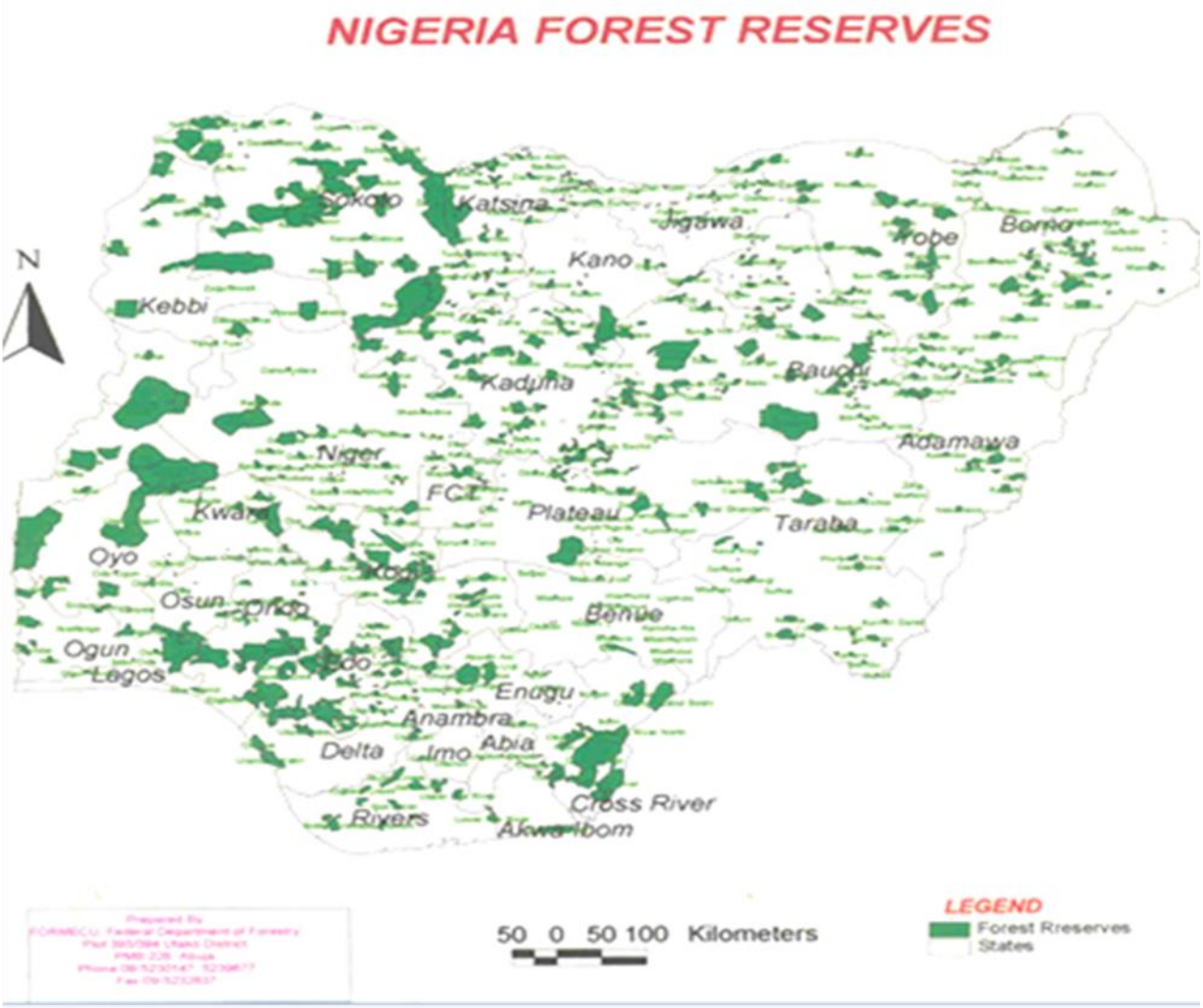
Deforestation

There is scientific evidence to show that large scale destruction of tropical forest has severe consequences on climate (Myers, 1989). Unfortunately one of the outcomes of man's unbridled and ravenous appetite for resources of the forest has been the loss of our very natural tropical rain forests that have existed for over 500 years. All over the forested zones of Nigeria, as in the other parts of the world, several acres of forest have been laid bare by the actions of man in his quest to satisfy several of his wants. In Nigeria alone, we see that only about 10% of nearly 10 million hectares of pristine forest land remains. A study reveals that 445 forest-reserve regulations and legislations have been gazetted so far in Nigeria (Afolabi, 2008). This, to a large extent, shows that at least government recognizes the importance of forest as an important component of

the ecosystem. We know that apart from serving to protect our watershed, prevent soil erosion and sequester the carbon yield, they also serve economic, cultural and certain spiritual purposes. If *Igbo Irunmole* is not really real, I'm sure that Lisabi Forest in Egbaland exists and serves both cultural and spiritual ends. The work of Tella (2013) clearly shows that. We must state very strongly that they are the major source of biodiversity that we all talk about. Different animals, birds, insects and very primitive plant species hide away in forest zones. Unfortunately, the Boko Haram insurgency is also making the forest reserve infamous. We are all aware of Sambissa Forest in the Northeast and what atrocities go on there. The figure below shows patches of what is left of our natural forest.

Today, the Nigerian rain forest is rapidly changing as a result of anthropogenic activities. These changes have led to the loss of several plant and animal species and a decline in biodiversity. There is a forest herbarium in Ibadan and I'm sure a visit to the place will enrich the knowledge of anyone who is interested in a thorough and scientific list of threatened species.

There is the need to begin to take drastic steps to ensure that we prevent over-exploitation of our forest resources, which the work I carried out with Ogundele in 2008 shows is threatening the livelihood of forest communities. A national survey in which I was involved reveals that where the forest cover has been removed, the vulnerability level for the inhabitants of such places to fall into poverty becomes suddenly increased. It should be noted that just as animal species face extinction the same goes for plant species. According to Afolabi (2010), IITA in Ibadan lists the following trees as being endangered already: *Millicea excelsa*, *Xylopia Africana*, *Anthonatha fragans*, *Guareea sp.*, *Pterocarpus osun*, *Lanea himills*, *Funtumia elastica*, *Dicphapetalum fructuousm*, *Hibiscus manihot*, *Morus mesozygia*, *Mansonia altissima*, *Zanthozylum leprieuri (Fagara leprieuri)*, *Zanthozylum zanthoxyloides (Fagara zanthoxyloides)*, *Antiaris Africana*, and *Caesalpinia bonduc* – the very same vine that produces the seeds used in the popular Yoruba traditional game of "Aayo."



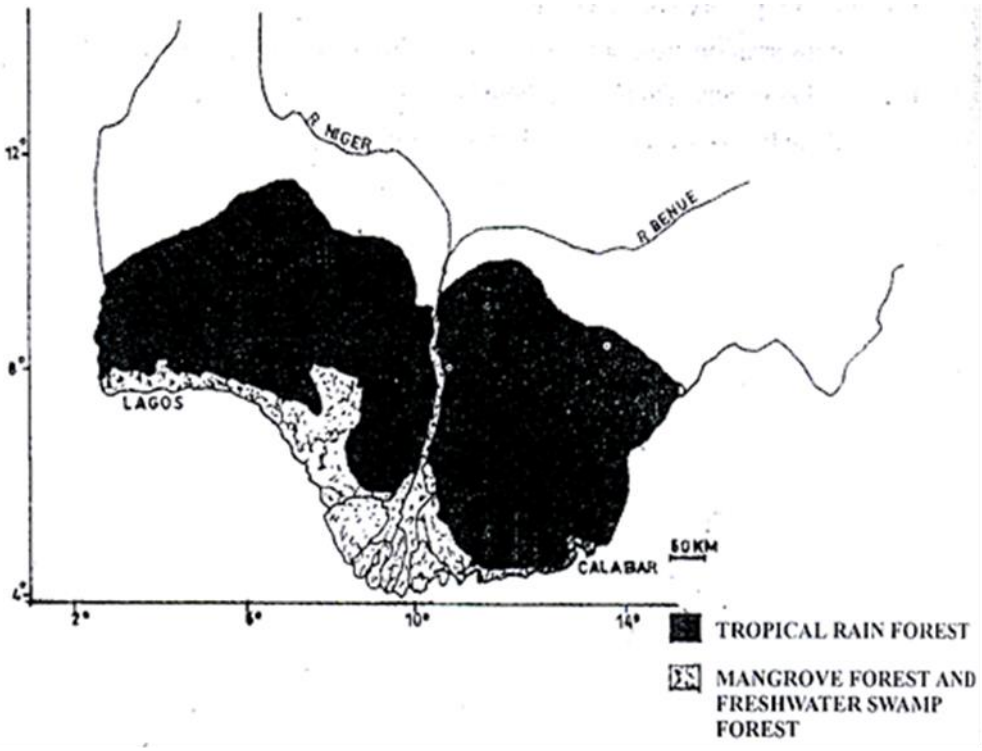
Source: Popoola (2008)

Brief on the Tropical Rain Forest

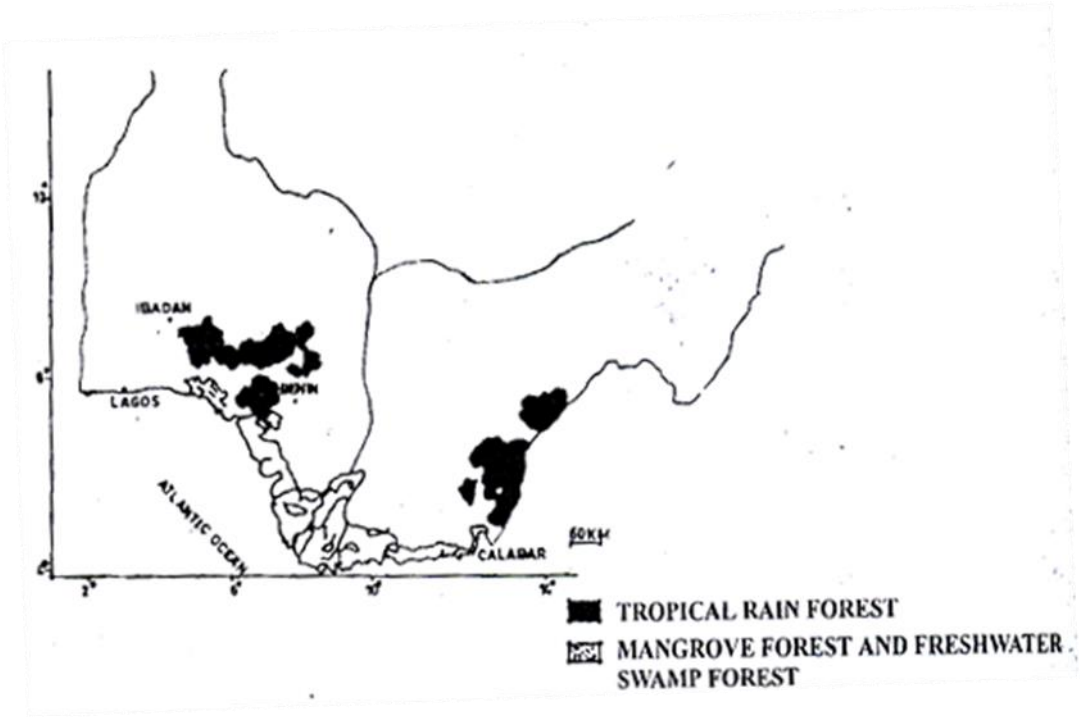
The rain forest is a different type of vegetation by virtue of its very nature. Because of the climatic conditions in places where they exist they sometimes are referred to as *wet* or *moist* forest. They hold the largest reserve of biodiversity in the world and as such are of special interest. We have to draw attention to the fact that if we continue to exploit the rain forest at the rate at which we are currently carrying on, our children will never grow to experience their allure. The figures??? below show the state of affairs of the tropical rain forest.

I am tempted to ask if we are all guilty in this current scenario, and the answer is yes. Continued use of wood for furniture, roofing, paper and fuel wood does not augur well for the future of our forests. Mr. Vice-Chancellor, Sir, let me say I appreciate your decision to take our University Senate from the orthodox paper presentation senate to an e-Senate, where I am sure we have reduced our paper footprint by about 80%. Such action not only saves costs but goes a long way to save our environment. I want to call on all institutions, government agencies at all levels to adopt what I call the "Fagbohun Initiative" on saving the environment via e-meetings.

The figures below show where the forested south was in 1900 and where we are today:



Map of Southern Nigeria showing the distribution of tropical rainforest and mangrove forest (including freshwater swamp) 1900 **Source:** *Akachukwu (2006)*



Map of Southern Nigeria showing what remains of tropical rainforest and mangrove forest and freshwater swamp forest in 2001 resulting from excessive exploitation and deforestation. The remains of the rainforest have now been converted to completely protected areas (National Parks)

Source: *Akachukwu (2006)*

I have devoted a considerable amount of space to the matter of the forests because they are the most important component that drives climate change and global warming after the depletion of the ozone layer, which is basically caused by the excessive use of HFCs (hydrofluorocarbons) and other toxic gases. These trees have been removed for fuel wood and charcoal, as seen below:

Fig : Fuel wood ready to be loaded for the market. Fig : Charcoal already bagged, ready for the market.

In the next section I will dwell briefly on trees as urban infrastructure because we all are city people and I have to draw our attention to what exactly that tree you have refused to own can do for our environment.

Trees as Urban Infrastructure

Researchers and professionals in the urban forestry field agree that our environment, especially the urban environment, may be made better if perhaps we kept enough trees. What is clear is that while majority of the trees in rural areas of Africa have been cleared for farming and other purposes, the urban areas have suffered almost a total annihilation of the tree population. This demonstrates a thorough lack of understanding of what roles trees play in our environment. Trees are not just amenities that we must keep in our urban environments, they play multiple fundamental roles in the continued health of urban communities and should be regarded in the same light as other urban infrastructural elements such as roads, drains and schools . . . the fact remains that few urban politicians view these issues as central to their agendas (Kuo, 2003).

In order for our urban environments to be sustainable and resilient, we must acknowledge that urban forests are integral to the public infrastructure. If we are to sustainably manage our cities, a routine management schedule would be needed to manage a green infrastructure programme. Part of what we need to do is to deepen our understanding of the behaviour of specific tree species in terms of what role we require them to serve. For example, it is not specifically clear why Lagos chose the Ashoka tree as urban Lagos's tree of choice. Could it be for aesthetics reasons only? The different species serve different roles and we should ensure we match roles with tree-specie capabilities. My unpublished work on some of the benefits of trees, especially in our urban areas, is listed below:

To combat floods i.e., delay runoff (aspects of urban hydrology)

Reduced levels of storm water runoff

In cities receiving large amounts of rain, or infrequent yet heavy rainstorms, storm

water drainage is costly and extremely important. Storm water hits the ground and rapidly finds its way into storm drains because of the ever-increasing amount of impervious surfaces, instead of infiltrating into the ground, resulting in large amounts of pollutants entering our water channels. The works I did on urban flooding in Ibadan in 1983 and repeated in Lagos in 1988, clearly show this. No doubt, urban trees afford an opportunity for cities to significantly reduce the costs of storm water management because they act as nature's water-storage system. In Lagos, for example, it is calculated that the city tree canopy (If the right specie is chosen) has a potential to lower water runoff significantly. This could be by approximately 10% for a 4-h, 1-year storm event. This has huge implications for inner-city flooding that we experience in Lagos perennially.

Other significant ways urban trees can help:

- Drain swamps—i.e., reduce intra-city cesspools and ponds;
- Remove air pollutants from urban atmospheres;
- Sequestering atmospheric carbon yield;
- To combat urban heat island effect;
- *Help with energy conservation;*
- Beautify urban environment;
- *Further strengthen community ties;*
- Help improve *mental health and well-being;*
- Cover up open and exposed spaces that lead to poor infiltration capacity and flash-floods;
- Further social cohesion, reduce crime and levels of urban violence.

The fig below shows a well-lined street with tres on either side.

Ozone Layer Depletion and Global Warming

It is a proven fact that the earth has been warming up beyond the usual in the last 100 years. One of the several causes of this has been traced to the depletion of the ozone gas (**O_3**) as a result of the interaction of certain gases called greenhouse gases (GHG) that man's activities let into the atmosphere untreated. The diagram below shows the state of affairs concerning the warming of the earth. The continuous warming of the earth in this manner has been implicated as being mostly responsible for the climate change phenomenon. We shall quickly look into this in the next session.

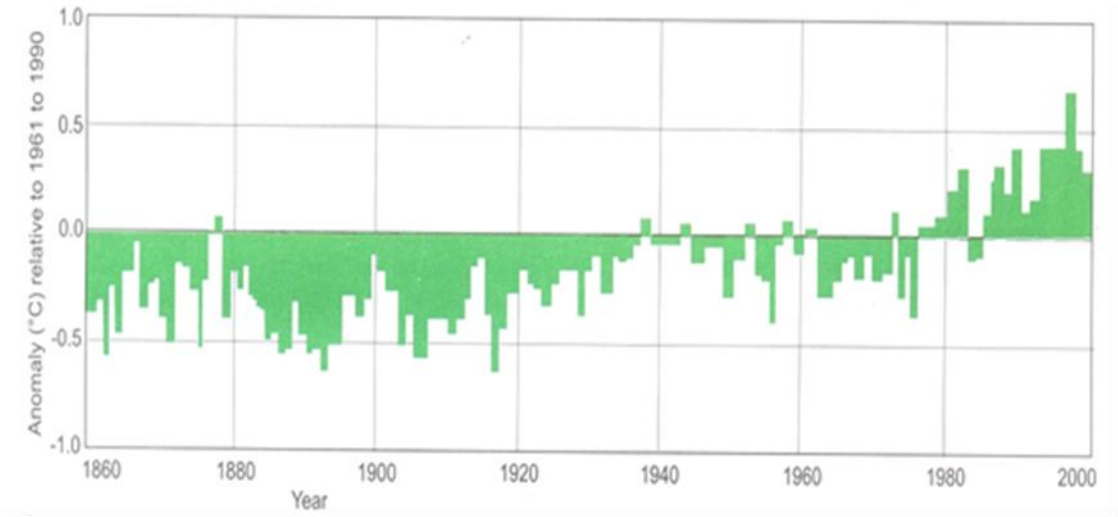


Fig : *Annual anomalies of global average land–surface air temperature, 1861 to 2000, relative to 1961 to 1990 values. Source:* TAR 2001

Climate Change

What climate change infers is no longer new to us. Ojo (2005) clearly shows how climate change has impacted on the earth system. In this lecture, it will be necessary to take a cursory look at how climate change drives the surge of interest in the discourse of environmental sustainability. Suffice it to say here that this discourse only became a subject of serious debate as a result of concerns the climate change matter brought. We must emphasize that the issue of environmental sustainability goes beyond the most popular component of it, which is climate change, which science has shown to emanate substantially from global warming. The figure above clearly shows this. The figure below also shows the state of affairs concerning the concentration of certain gases fingered in the earth warming debacle. We also must observe that since global warming became endemic globally, the number of natural disasters has increased tremendously. See the figure ???

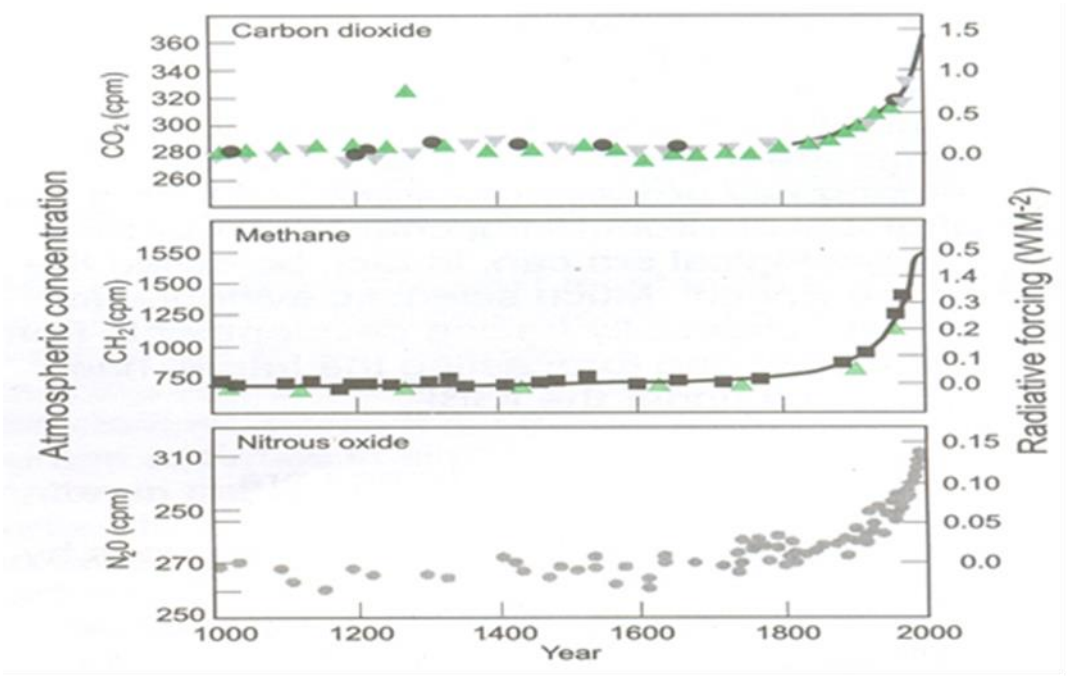


Fig: Long records of past changes in global atmospheric concentrations of three well mixed greenhouse gases

Indicators of human influence on the atmosphere during the industrial era.* * Source: *Okali (2004)

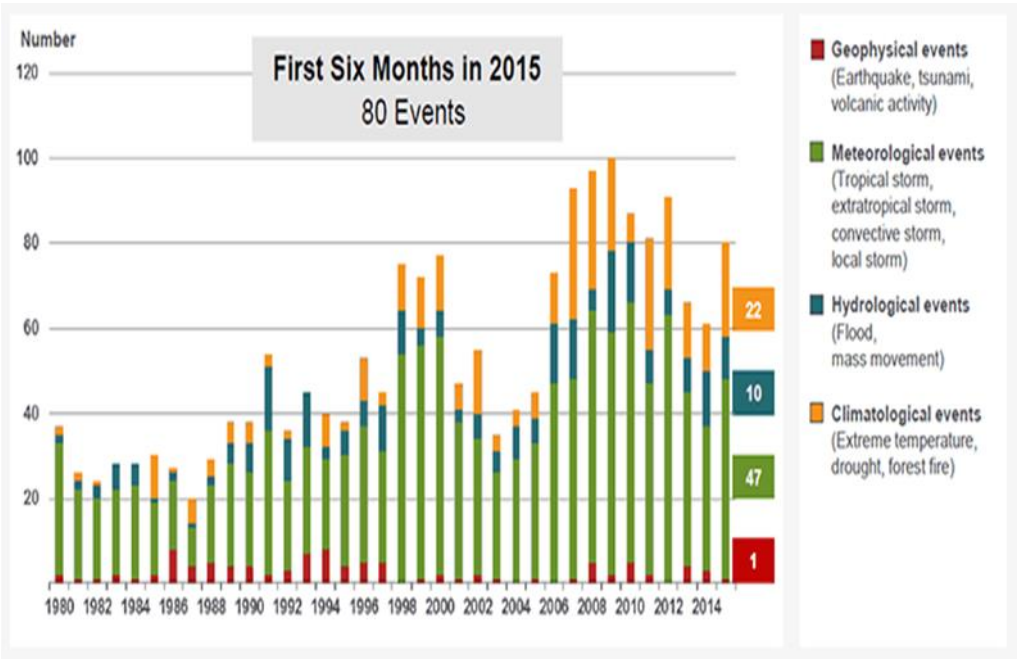


Fig : *Climate-related disasters (1996–2006. Popoola, 2008*

WHAT IS GOIN ON IN LAGOS STATE?

Mr Vice-Chancellor, sir, ladies and gentlemen, I must at this juncture draw our attention to what the works that we have done in Lagos have found.

Impacts of climate change on small-island developing state (SIDS)

SIDS are defined as tiny islands, usually with a high population density, that are close to the continent, but direclty abutting the sea without any viable physical shelters, which opens them up to total blanket of any single meteorological or geologic event. They are thought to need special attention because, given their smallness, they can be wiped out in a single natural event. While not being officially labelled as a SID becuase it is not a sovereign state, Lagos qualifies to be classified as such because of the characteristic featires that it shares with the state that have been so categorised. The distinction between observed impacts of climate change and projected impacts is often unclear in the small islands literature and discussions. Publications frequently deal with both aspects of impact interchangeably, and use observed impacts from, for instance an extreme event, as an analogy to what may happen in the future due to climate change (e.g., Lo-Yat et al., 2011).

The key climate and ocean drivers of change that impact small islands include variations in air and ocean temperatures, wind sea-levels, wind strength and directions, ocean chemistry, rainfall, and the characteristics of the tides and waves. Also of importance are the extreme events such as hurricanes, tropical cyclones, drought and distant storm-swell events. All of these have varying impacts, depending on the frequency, magnitude and spatio-temporal coverage of the specific events. It also depends on the bio-physical characteristics of the island and its social-economic, political and cultural settings. There is need to continually review the extent to which the projected impacts have been observed in reality.

It is widely acknowledged that sea-level rise is one of the most widely recognized climate-change threats to low-lying coastal areas (Church and White 2011). This is particularly important in small islands such as Lagos, where the majority of human communities and infrastructure are located in coastal zones with limited on-island relocation opportunities. Over much of the 20th century, global mean sea level rose at a rate between 1.3 to 1.7 mm yr-1, and since 1993, at a rate between 2.8 to 3.6 mm yr-1, and acceleration is detected in longer records since 1870 (Merrifield et al., 2009; Church and White, 2011). The rates of sea-level rise are however not uniform across the globe and large regional differences have been detected. Even in the Indian Ocean and tropical Pacific, it has been observed that in some parts rates have been significantly higher than the global average (Meyssignac et al., 2012). Based on my continuous observation of the Bar Beach area of Lagos it is clear that there have been significant sea-level rises (Omotayo, 2014).

There are few long-term sea-level records available for individual small-island locations as Lagos. Reported sea-flooding and inundation is often associated with transient phenomena, such as storm waves and surges, deep ocean swell, and predicted astronomical tidal cycles (Haigh et al., 2011). For example, damages caused by high spring tide floods on all the islands around Lagos have been well publicized and it is known that areas of the central portion of Kuramo are already below high spring-tide level.

However, rates of relative sea-level rise at Okun Lekki between 1970 to 2012 have been approximately about two times higher than the global average. A study carried out by Omotayo in 2009 shows that saline flooding of internal low-lying areas occurs regularly, and is expected to become more frequent and may become extensive over time. It helps to explain the frequent presence of salt water fish species in interior inter-tidal coastal inlets which in yoruba is referred to as *oso* (pronounced *awshaw*).

Documented cases of coastal inundation and erosion often cite additional circumstances such as vertical subsidence, engineering works, development activities

or beach mining as the causal process. Four examples can be cited: first, the Alpha Beach and Ilado communities have been displaced due to increasing inundation of low-lying settlement areas due to a combination of tectonic subsidence and sea-level rise (Ongoing Observation). Second, in the Badagry area, in the Ologe Lagoon we find beach-aggregate mining was a major contributing factor influencing rapid beach erosion. Third, the intrinsic exposure of rapidly expanding settlements and in the low-lying flood-prone Igbologun and Igbo Eseyore, popularly known as Snake Island, is shown by research to place populations in increasingly severe conditions of vulnerability to flooding and marine inundation. Fourth, we recall a 2011 widespread coastal inundation event that displaced some 15,000 people in the Ogogoro community (the small wave bar off Kuramo waters) alone. That event was primarily caused by remotely generated swell waves, and the severity of flooding was greatly increased by anomalously high regional sea levels linked with both ENSO and the ongoing sea-level rises. Such examples serve to highlight that extreme events superimposed on a rising sea-level baseline are the main drivers that threaten the habitability of low-lying islands such as Lagos as sea levels continue to rise. I must state that at different fora where I drew attention to long term consequences of the Atlantic City project, I always receive a total press blackout.

Empirical studies in other parts of the world document historical changes in island shorelines. Historical shoreline position change over 30 – 100 years on the Badagry beach islands show that total land area remained relatively stable in 35 percent of islands, whilst another 43 percent had increased in area, and the rest showed a net reduction in land area (Omotayo, 2010). LASU Geography Department has been observing changes on Badagry Beach since 1987.

Dynamic responses were also found in a five-year study of the active Bar Beach islands that sea-level rise was likely to be the main influencing factor in these shoreline changes. The changing patterns of human settlement and direct impacts on shoreline processes have been presenting immediate erosion challenges in many of the island

communities in the Lagos coastal zones. A study commissioned by CERUD (2014) and carried out by the LASU Department of Geography, has revealed that several coastal rural communities are under serious threat of erosion and there have been severe losses of physical infrastructure and fishing piers.

Other Consequences of Sea-Level Rise

Sea-level rise, a direct consequence of climate change, has serious implications for survival of the earth. It leads to coastal erosion that is an existential threat to small-island states like Lagos. It also leads to loss of biodiversity and threatens wetlands severely.

Coastal Erosion

The effect of coastal erosion on the earth's resources is indeed better imagined than experienced. The work that I carried out on the quality of underground water in collaboration with some of my colleagues—namely: Dr. Akoteyon, Kunle Ogundele and other junior researchers—shows the grave state of the underground water resources in Lagos as an example. This is not only because our underground water sources, which provides the city of Lagos over 60% of its daily requirement, have been heavily polluted at depths that are far beyond normal levels by our industrial and commercial activities but majorly by the intrusion of sea water into our water-bearing aquifers. The extent to which man should be blamed here is clear. Our actions in heating up the earth has been causing global warming, which in turn has caused the Icelandic ice to melt, and of course this has led to sea water level rises, which lead to coastal flooding, with implications for intrusion of seawater to underground water sources. The figures here show examples of this.

According to the Inter-Governmental Panel on Climate Change (IPCC), projected increases to year 2100 (RCP 4.5: 0.35m to 0.70m), superimposed on extreme sea-level

events (e.g., swell waves, storm surges, ENSO), will present severe sea-flood and erosion risks for low-lying coastal areas and islands especially those constituted of lacustrine deposits. The landmass around Lagos are mainly depositional islands.

One of the instructive findings of IPCC that may also impart the island around Lagos is the likely influence of sea water accretion into the underground water sources of its major settlements. Already it is a known fact that all the underground water sources at Lekki–Ajah axis carry intolerable amounts of salts. IPCC report is in consonance with this observance that there is high confidence that wave overwash of seawater will degrade fresh groundwater resources and that sea surface temperature rise will result in increased coastal erosion and (de)gradation. The disappearance of Alpha Beach in Lekki in the last ten years is a pointer to this. The islands around Lagos are certainly exposed to several environmental stressors given their inherent physical characteristics as small islands. IPCC concludes that for island communities the risks associated with existing and future invasive species and human health challenges are projected to increase in a changing climate. The studies on Lagos is still on and we cnnot conclude at this tme. However, we should remember that the mence of water hyacinth is unconnected with this. No doubt the water hyacinth that now occupies all our water ways is an invaive specie.

Coastal Ecosystem Change on Small Islands: Coastal Wetlands

Wetlands are an important resource in small tropical islands and the wellbeing of many island communities is linked to their functionality and productivity. Sand bars play a significant role in supplying sediments to island shores and in dissipating wave energy, thus reducing the potential foreshore erosion. They also provide habitat for a host of marine species upon which many island communities are dependent for

subsistence foods, as well as underpinning beach-based tourism and economic activity (Bell et al., 2011)

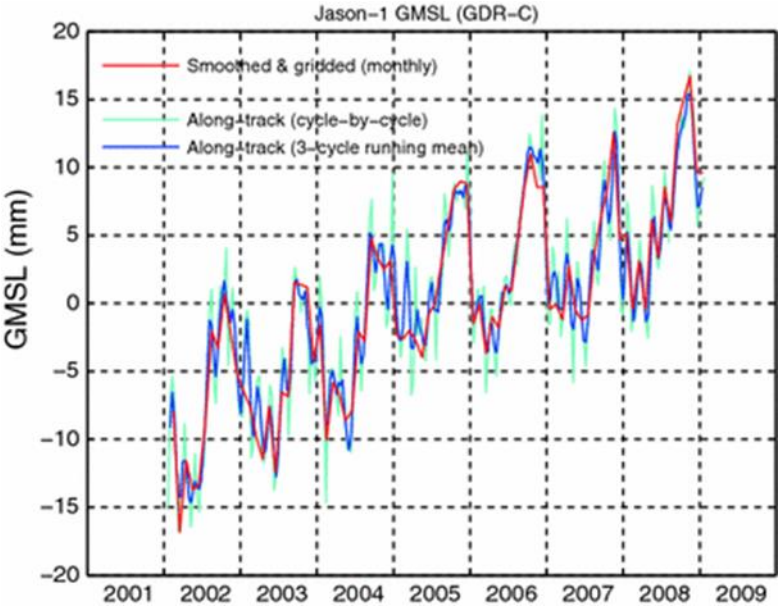
Observed Impacts on Terrestrial Systems: Island Biodiversity and Water Resources

Climate change leading to sea-level rise impacts on terrestrial biodiversity on islands, as it frequently interacts with several other actors (Didham et al., 2005). The important drivers of the experienced impacts are:

i. ecosystem and species horizontal shifts and range decline; and
ii. exotic and pest species range increase and invasions, mainly due to temperature increase and sea-level rise on the islands.

Given that the spatial extent of these islands are limited and are of isolated nature, these effects are in most cases magnified when compared with adjoining continental areas. This, in most cases, may lead to species loss, especially in tropical islands with a large stock of endemic species. For example, in low-lying islands in the Epe area, an on-going study starting from 2011, found that during periods of reduced rainfall, the shallow freshwater lens subsides and contracts landward and ocean water infiltrates further inland, negatively impacting on coastal strand vegetation.

Sea-level rise has also been observed to threaten the long-term persistence of freshwater-dependent ecosystem within low-lying islands in Epe and Ikorodu region, with replacement of forest vegetation with the saline-tolerant species such as the red mangrove. This is mainly observed on the small islands on the offshore sections of the Epe region and the Majidun flat shoals on the way to Ikorodu. The fig below shows the golbal status of seal level rise.



Comparison of the satellite-altimeter estimates of GMSL from the along-track data (including all ocean areas where valid data are available) and the mapped data (for a fixed grid) for the duration of the Jason-1 altimeter mission. Source: Hansen 2015

Implications for small-island states

- Coastal flooding,
- inner-city flooding,
- contamination of underground water sources,
- disruption of the urban ecology, and
- alteration to city morphology.

From the foregoing, Mr. Vice-Chancellor, ladies and gentlemen, I want to ask if we are beginning to see why on earth the discourse on environmental sustainability matters, especially in Lagos State.

What can be done in Lagos?

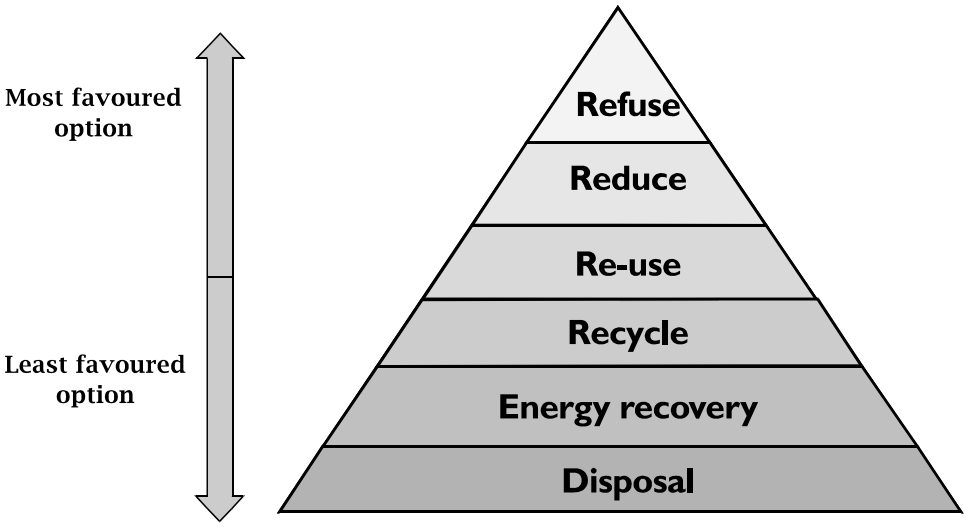
- Clearing of coastal inlets,
- dredging of tidal inlets,
- foreshore buffering,
- shoreline sand replenishment,

- hardening of shorelines,
- green and other soft solutions, and
- modification of land-use policies, especially at the waterfronts.

Integrated Waste Management Hierarchy

Waste generation and disposal has been one of man's inevitable stressor. One of the intractable challenges of sustainable development has been the issue of disposal of waste. The questions is: Who cleans up after man? The inability of man to remove very safely the end-product of the consumption process has been a sticky point in the discourses. This has led to the indiscriminate dumping of waste. The consequences have been dire. Our rivers are filled with waste such that our oceans have plastics in them that cannot degrade in two hundred years. A report predicts that by 2030 there would be more plastics in the oceans than fishes. If we are going to keep our oceans clean and safe, then we have to get rid of the plastics and other wastes that may have been deposited in them. We also must find ways and means of discouraging the generation of any unnecessary waste.

The concept of hierarchy of waste management highlights the principles of integrated waste management and defines this in terms of the integration of six functional elements (Tchobanoglous 1993), viz:



(Modified from Wiliams, 1998)

Refuse: This is the first in the hierarchy**.** This is the deliberate step taken by consumers just to refuse to generate waste. This can be done successfully but is not easy in reality. You may, for instance, go about with your chinaware and ask that your food, as bought from the fast food restaurants, be served on the plate, ensuring you buy only what you can eat and leaving no leftovers. Where you inevitably have leftovers, you pack it in your reusable duffy and take home to your dog or give to a friend with a pet. Or you take it home and dump in your compost hole. You could also insist on reading your news online and not buying the printed version.

Reduction: the second in the hierarchy shows that there is an imperative to reducing waste production. This can be achieved by retrofitting machinery and employing clean and more efficient technology during the production process. Can we, for example, advocate that materials used in the process of manufacturing be reduced? Can individuals consciously avoid generating waste?

Re-use: the third step in hierarchy demands that we endeavour to reuse any materials that may eventually turn into a waste. Examples of suitable re-use technologies

abound. They include; tyre re-treading, glass bottles (e.g. from beer and milk), metal furniture and some grades of plastic. Re-use is not profitable in every case, but environmental concerns sometimes outweigh immediate benefits. Can we as individuals go back to the grocery store with the last bag you went with?

Recovery: The last step in the hierarchy actually has to do with materials recycling. Technology now exists to change used materials from a particular production process to another one. This may end up in the same product of a new one or may go on to be used for another product entirely. For example, glass can be ground to produce another form of bottle. In most developed countries, and to some extent in some of the emerging economies, PET (Polyethylene terephthalate) bottles and other materials are usually recycled to make other products (for example, load-dependent carpets), car parts (steering wheel, dashboard), plastic chairs, toys, fillings for sportswear, etc. Used newspapers can be recycled into egg crates.

Energy recovery

Where it is possible we should find ways and means of diverting materials to other uses such as in energy generation. Current technologies can generate energy from waste incineration through the combustion of landfill gas. The challenge here is that sophisticated incinerator installations require high initial capital costs.

Composting

This is usually done by separating organic wastes from non-organic wastes and then keeping them in a decomposition pit until they are stable enough to produce a stable compost similar to fertilizer. The challenge with this is the likely presence of heavy metals and toxic organic compounds.

Disposal

Where all the above have taken place or have partly happened, the last phase in the process of integrated waste management system (IWMS) is the disposal of the waste

materials that make it down to the last level. The most common method is to dump whatever is left in a landfill site. This is the predominant method of waste disposal in the developed economies of Western Europe and North America. In most of the developing countries landfill sites are a feature of cities and big towns. Most of the smaller towns and rural settlements simply dump their wastes either into the streams and rivers or on open refuse mounds. This of course has serious implications for the environmental health of such places. The landfill sites are subject to the direct discharge of gas effluents emanating from the several interactions taking place among the materials disposed (Hagi 2010). For example, problems arise when such a gas such as methane is produced. It has implications for air pollution so there may be need for gas emission controls to prevent potential air pollution. In Lagos, where we have worked extensively on landfill sites, the result is not different and it has shown that the Soluos site, unfortunately, contaminates the groundwater sources around its location. Mr. Vice-Chancellor, ladies and gentlemen, we can clearly see from the foregoing that not only does man consume Earth's resources voraciously, but also does not know how to dispose of the waste, thereby returning it right back to Mother Nature.

Desertification and Desertization

One of the negative effects of man's activities have been the increasing rate at which the desert is advancing in the Sudano–Sahara region of West Africa. It is a process of land degradation in arid, semi-arid, dry sub-humid areas caused by changes in climatic factors, human and animal activities (UNCCD 2004). This definition by UNCCD seems to have been adopted as the operational definition as it appears to command huge acceptability (Eze 2016). It is necessary, however, to point out that while desertification may be a natural phenomenon engendered mainly by natural forces, desertization is mainly caused and accelerated by man's many infractions. Le

Houerou (2002) draws attention to the fact that deserts are beginning to emerge in areas where they never existed in the recent past. This phenomenon is occasioned by anthropogenic factors in areas other than arid, semi-arid or dry sub-humid, and should be called desertization (Eze 2016). Desertization as "the seemingly irreversible extension of desert landforms and conditions to areas where they did not occur in a recent past" (Le Houerou 1962). With this definition, it is possible, by our actions, to desertize anywhere by removing vegetation cover and permanently destroying the flora. Evidences of this are beginning to show up in several parts of the North, where even desert-like conditions did not present themselves before.

Example of a scotched surface as a consequence of badly-managed irrigation practice in Zamfara State. This is an example of desertization. Source: Eze (2016)

So, What is Environmental Sustainability?

Having taken time to explore what my works have found in terms of the consequences of man's actions on our environment, we now need to look at how these sit within the purview of sustainability or destruction of the earth. The word *sustainable* has fully

crept into discourses in the last few years. Scholars in the field of development over time have come to the conclusion that efforts at developing critical control aspects of world growth yield better results when the outcomes of such efforts can be continuously experienced in such a manner that does not impact negatively on any other aspects of human existence. However, the most popular definition of sustainable in this context is: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

The concept of sustainability has never been a new one, even though it may never have been so called. It has been with us in our field for a long time. Geographers have from time immemorial focused on describing the earth as the main focus. When it appeared that there were no longer many new things to describe, the practitioners started focusing on explaining what things, objects and phenomena, and occurrences they have been describing. For centuries we have as practitioners agreed on certain explanations and others, like in all sciences, have been subjects of extensive queries and debates.

In all of these we have come to show the world the complex nature of the earth system and have come to realize the role that man has been playing rather inadvertently in shaping the way the earth responds. We have found that for all actions of man that disrupts the equilibrium, the earth responds in its usually natural ways and manners. Some of these responses have not been savoury and have been of great significance and consequences to mankind. The figures below show some unwanted action of the earth

A flooded street. Source: Internet

Approaching sea water surge. Source: Internet

Indeed the earth system responds in cascades from one level to the other introducing reactions which we study as feedbacks that lead to different paths of responses in a continuous web of cycles that are continuously fed with more and more perturbations (mostly by man) that in most cases had moved from perturbations to permanencies. When several occurrences thought to be perturbations now became permanent features as a result of the earth's inability to quickly readjust itself and maintain things as they should be, geographers had to cry out and as such asked hard questions: Can the earth sustain itself with all these going on? Won't Earth die? It is this that has brought about the concept of environmental sustainability.

Mr. Vice-Chancellor, sir, ladies and gentlemen, I must state here that there are pathways for bringing about actions. These are simply shown here:

The Science ---> the (discourses) ---> and the Policy.

The pathway is simple to explain; when the idea has come into being, the science must be explained, there must be discourses and then finally the aspects of policy formulation that will seek to roll back the deleterious effects, or at least maintain status quo so that there will be no further damage. In all of these, Mr. Vice-Chancellor, purpose and action must therefore come together and unify (the idea of unity of knowledge as given by Wilson is indeed not a fallacy) in order for mankind to save the earth and itself. It is that that has seemed to happen that has led to the universality and the acceptance of the tenets and principles or the concept of environmental sustainability. The scientists have proved their case, and other practitioners in the fields of education, communication, law (such as your humble self, Mr. Vice-Chancellor), politics and governance and economics have taken over and are certainly now at the forefront of actions.

Today we have environmental-law experts, environmental educationists, environmental income accountants, environmental journalists such as Mr. Ayo Tella, and environmental economists, among others. Recall most specifically that Al Gore, the former Vice-President of the United States under President Clinton, won the Nobel Prize in year 2008 for his work on climate change in. For what exactly? He simply drew attention of the world to the findings of hardworking scientists such as my humble self. While discourses will never cease, actions have gone on, so the world has moved on to do the needful with several conferences, treaties and enactments to bring the issue to the fore of discussions at several international fora, all with the agenda to ultimately save man from himself.

In rounding up this section therefore, I proffer that environmental sustainability requires that we use up resources today, engage in actions today in such a manner that

leaves future generations with a bit of everything. The question is: Does it not matter that we do not consume all of our future today? Mr. Vice-Chancellor, ladies and gentlemen, I ask again, Why on earth does it matter that we do this? Why? So that the earth may not die. The principle of sustainable development is therefore the mantra around which global actions have been built.

Global Actions on Environmental Sustainability

Among other things, and in recognition of the challenges and the importance of sustainable development, the United Nations took note and set out a broad-based agenda, the Millennium Development Goals (MDGs), at the turn of the new century. Several goals and targets were set, but the one of concern to us here is the Goal # 7, set with the intent of ensuring environmental sustainability. Let us briefly review this goal and examine the extent to which it has met the set objectives.

Goal 7: Ensure environmental sustainability

Target 7A: Integrate the principles of sustainable development into country policies and programs; reverse loss of environmental resources

Target 7B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss

- Proportion of land area covered by forest;
- CO_2 emissions, total, per capita and per $1 GDP (PPP);
- Consumption of ozone-depleting substances;
- Proportion of fish stocks within safe biological limits;
- Proportion of total water resources used;
- Proportion of terrestrial and marine areas protected;
- Proportion of species threatened with extinction.

Target 7C: Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation.

- Proportion of population with sustainable access to an improved water source, urban and rural.
- Proportion of urban population with access to improved sanitation.

Target 7D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum-dwellers.

- Proportion of urban population living in slums must be reduced.

Critiquing the Millennium Development Goals

While the U.N. set up the MDGs to address specific issues affecting human development globally, we find that the successes recorded on agenda 7 are not enough to stop the slide of the environment into a cataclysmic abyss. I will mention a few of those facts that may have indirect impact on the environment if not well-managed. These have to do with ownership of programmes, gender matters and the indebtedness of very poor countries.

According to Tella (2015), generally, MDG is perceived to lack analytical power and justification behind the chosen objectives. It did not take into consideration the significant disparities existing within developing countries. This then means that its objectives and indicators for within-country equality are operationally not strong enough. Further critique of the MDGs is that the mechanism being used to introduce local change through external innovations supported by external financing has not been effective. However, the counter view is that these goals could be better achieved

by community initiative, building from resources of solidarity and local growth within existing cultural and government structures (Tella, 2015.pp13).

Women's issues

The reason women issues is key is due the fact that they form the first line of contact with the resources of the environment in most developing countries. In most of Asia, Africa and largely South America, they are responsible for domestic water and energy provision into the homes, relying on direct exploitation of earth's resources for these. They are therefore a veritable conduit for keeping the homefront going in much of the Third World. As such their health and those of the family members hinge on how they tap the resources they have access to and keeping child mortality very low. The two plates below show women inadvertently engaging in destructive resource exploitation.

Multilateral Debt Reduction

One of the ways by which the third world environment can be saved from unsustainable exploitation is to institute a mechanism that will dissuade over exploitation of resources. In my work on the effect of the structural adjustment

programme on the African environment, I found that African countries were being forced to give up natural exploitation rights to developed countries in order to pay off debts. Most often the negotiations always leave the countries poorer. Therefore if debt relief is not sought, most of the HIPCs (highly indebted poor countries) will lose their resources and may never recover from what I call "exploitation overhang" for a very long time.

In June 2005, in preparation for the Gleneagles Summit in July, the G-8 Finance Ministers met in London and agreed to provide enough funds to the World Bank, the IMF and the African Development Bank (AfDB) to cancel the remaining HIPC multilateral debt estimated to be in the neighbourhood of $40 to $55 billion.(Tella, 2015). The recipients were obliged to re-channel debt payments to health and education sectors in their countries.

What Can Be Done?

In the midst of all these problems and challenges, we must ask ourselves: What can be done to stem this seeming slide to environmental perdition? There are four broad ways by which I propose that we tackle these challenges: Through the instrumentality of the law, international and multilateral actions, national policy making and individual efforts. Let us now examine how these can be accomplished.

Can the Law Be of Help?

Mr. Vice Chancellor, sir, in the course of my sojourn to find a "magic bullet" that will solve all environmental sustainability problems, I journeyed into that aspect of control and regulations. As far back as 1988, I had written a paper on environmental law and geographical irreconcilables, querying and investigating the actions of man and the status of the law. It concerned itself with how the earth would fair given the way man's laws work (our statute books and regulations, the adjudication process) and the natural laws of the environment. The findings were clear: they conflicted, not because man is wont to make laws that do not favour the earth, so to say, but certainly because

natural laws do not conform to such simplistic understanding. They come as simple, sometimes as complex and in most cases convoluted and ever-evolving, leaving the law behind as man's actions and activities continue to bring in perturbations into the system and then causing the earth to have to dynamically re-equilibrate at all times.

We conclude, then, that while the law has been of help, it certainly has not done enough in helping to roll back the negative consequences of environmental degradation. Not because the law does not want to help, but certainly because the laws of nature does not offer too many congruencies to the laws of man. In order for the law of man to be more helpful, it must lend itself to learning and accepting the law of nature for what they are: juxtaposed, subject to change at short notice and inherently variable. I ask our legal people here what laws man can make that will bring into congruence the laws of nature as described. Mr. Vice-Chancellor, the question again is, What law on earth can we make for the earth? Certainly, ladies and gentlemen "What on earth is the matter even in law? If we do not find answers we may as well be living in a dying earth.

The Place of International Law and Regulations in Sustaining the Environment

Mr. Vice-Chancellor Sir, Ladies and gentlemen, I am sure that you all will be wondering if there are no international organizations that are charged with such common problems or that may have oversight functions over the preservation of our environment. Indeed there have been several attempts by the world bodies and several multilateral arrangements and agreements, treaties and conventions on the various issues that challenge our environment as sovereign beings. Some of them are here listed, for the constraint of time we will not be able to go through their major objectives their findings and outcomes of implementation. Suffice it to say that each has been an improvement over the other and they have been targeted at solving the problems of environmental challenges as they arise.

Summary of Multilateral Environmental Agreements

Tella (2016), in his book *Critical Issues on Environmental Sustainability*, states that environmental agreements are established to tackle contemporary and emerging global environmental problems. Principle 12 of the Rio Declaration favours the adoption of over 200 agreements in combating transboundary or global problems such as:

- **Agreements that cover biodiversity and wildlife,** including the 1946 Convention for the regulation of whaling; the 1971 Ramsar Convention on Wetlands of International Importance, which protects wetlands, especially as waterfowl habitats; the 1973 Convention on International Trade in Endangered Species (CITES); the 1979 Bonn Convention on the Conservation of Migratory Species; the 1992 UN Convention on Biological Diversity and its protocol; the 2000 Cartagena Protocol on Bio-safety; and the 1994 International Tropical Timber Agreement.
- **Agreements that address the marine environment** and which include the 1972 London Convention on the prevention of marine pollution by dumping of wastes and other matters; the 1973 convention for the prevention of pollution from ships and its protocol; the 1978 Marpol Protocol; the 1982 U.N. convention on the law of the sea; the 1995 agreement on conservation and management of straddling fish stocks and the highly migratory fish stocks.
- **Agreements dealing with the protection of the atmosphere** including the 1979 U.N. Economic Commission for Europe (UNECE) convention on long-range transboundary air pollution; the 1985 Vienna Convention for the protection of the ozone layer and its protocol on substances that deplete the ozone layer and its protocol; the 1987 Montreal Protocol on substances that deplete the ozone layer; the 1992 U.N. framework convention on climate change and its protocol; the 1997 Kyoto Protocol.
- **Agreements regulating the use of chemicals**, which include the 1998 Rotterdam Convention on the prior informed consent procedure for certain

hazardous chemicals and pesticides in international trade; and the 2001 Stockholm Convention on persistent organic pollutants.

- **Agreements covering wastes,** including the 1989 Basel Convention on the control of transboundary movement of hazardous wastes and their disposal.
- **Other agreements** include the 1991 Espoo Convention on Environmental Impact Assessment; the 1992 U.N. convention to combat desertification; and the 1998 Aurous convention on access to information, public participation in decision making and access to justice for environmental matters.

A number of regional environmental agreements are established to address regional environmental issues.

Conventions	**Purpose**	**No of parties**	**Date**	**Take-off date**
Vienna	Protection of the ozone layer	Universal	1985	2009
Montreal	Ban on substances depleting the ozone layer		Sept. 1987	Jan. 1988
Basel	Transboundary movement of wastes		March 1989	
Stockholm	Persistent organic Pollutants	152		May 2011
Rotterdam	Control of trade on hazardous chemicals	152	Sept. 1998	Feb. 2004
Minamata	Anthropogenic emission/release of mercury		Oct. 2013	
UNCED (Paris)	Combating desertification	196	June 1994	Dec. 1996

International Response to climate change challenges

According to Tella (2015), the international response to the challenge of climate change is overwhelming. For instance, the IPCC, which functions under the auspices of the U.N. Framework Convention on Climate Change (UNFCCC), provides rich and

incisive data and analyses on the causes, processes and response to climate change from a global perspective.

The UNFCCC was opened for signature on May 9, 1992, after an Intergovernmental Negotiating Committee produced the text of the framework convention as a report, following its meeting in New York from April 30, 1992. It entered into force March 2, 1994. As at May 2011, UNFCCC had 194 parties.

In order to assess the progress in dealing with climate change, the parties to the convention have met annually from 1995 in Conference of the Parties (COP).

The following are the COPs held till date:

Year	**COP No.**	**Venue**
1995	COP 1	The Berlin Mandate
1996	COP 2	Geneva, Switzerland
1997	COP 3	Kyoto, Brazil (Protocol on climate change)
1998	COP 4	Buenos Aires, Argentina
1999	COP 5	Bonn, Germany
2000	COP 6	The Hague, Netherlands
2001	COP 6	Bonn, Germany
2001	COP 7	Marrakech, Morocco
2002	COP 8	New Delhi, India
2003	COP 9	Milan, Italy
2004	COP 10	Buenos Aires, Argentina
2005	COP 11/MOP 1	Montreal, Canada
2006	COP 12/MOP 2	Nairobi, Kenya
2007	COP 13/MOP 3	Bali, Indonesia

2008	COP 14/MOP 4	Poznan, Poland
2009	COP 15/MOP 5	Copenhagen, Denmark
2010	COP 16/MOP 6	Cancun, Mexico
2011	COP 17/MOP 7	Durban, South Africa
2012	COP 18/MOP 8	Doha, United Arab Emirates
2013	COP 19/MOP 9	Warsaw, Poland
2014	COP 20/MOP 10	Lima, Peru
2015	COP 21/MOP 11	Paris, France
2016	COP 22	Marrakech, Morocco

The Stockholm Conference on the Human Environment

The U.N. Environment Programme (UNEP) was formed as an outcome of the Conference on the Human Environment held in Stockholm, Sweden, in 1972. It demonstrated the intricate relationship between economic development and environmental degradation. Today, UNEP continues to play strategic critical roles in the management of the earth's environment.

Rio Summit (1992)

In 1992, close to 40,000 partcipants, including leaders of 130 countries, gathered in Rio de Janeiro, Brazil, for the U.N. Conference on Environment and Development (UNCED). The meeting was meant to address issues of global environmental concern such as deforestation, pollution, desertification and depletion of natural resources.

Rio +20 (Rio Earth Summit of 2012)

Because it was 20 years after the first conference in Rio, this one was named Rio +20. It was based on the realization that climate change which was a contentious science to accept, and was now seen as a major threat to sustainable development. This caused the U.N. to make climate change a serious emerging issue and included it in the Conference on Sustainable Development (Rio +20) in Brazil in June 2012. It presented a historic opportunity for

participants to define pathways to a safer, more equitable, cleaner, greener and more prosperous and liveable world for all.

List of Gases at Issue

The targets cover emissions of the six main greenhouse gases, namely:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride (SF6)

Steps Nations Can Take

International Symposium on the Post-2015 Agenda and the Sustainable Development Goals

In September of 2013 it was announced that a major symposium on the post-2015 Agenda would hold in Sydney, Australia, on November 12 and 13 of 2014. Timed to coincide with Australia's hosting of the G-20 Summit that same year, the focus was collaboration between business and industry, civil society, institutions and governments.

We should not relent in our efforts in achieving sustainable development through a climate-resilient green economy. Promoting the green economy is a major element of the outcome of Rio +20. According to UNEP (2011), green economy is “an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.” At the operational level, the

green economy is seen as one whose growth in income and employment is driven by investments that:

- Reduce carbon emission and pollution
- Enhance energy and resource efficiency; and
- Prevent the loss of biodiversity and ecosystem services.

To operationalize green economy in the context of a stable climate regime and to enable developing countries overcome the challenge of poverty, nations must advocate that the green economy concept be guided by and enshrined with a number of principles, including, but not limited to, the ones proposed by Stoddart et. al. (2011):

- Common but differentiated responsibilities to promote climate justice.
- Equitable distribution of wealth within nations and among nations.
- Economic equity and fairness guided by the principle of common but differentiated responsibilities.
- Intergenerational equity in which environmental resources and ecosystems are carefully managed.
- Precautionary approach in which science is utilized to enhance social and environmental outcomes.
- The right to development in which human development is in harmony with the environment.
- International cooperation not only to avoid unfair protectionism, but also to ensure that trade supports sustainable resource use.
- International liability that acknowledges that actions within national boundaries can cause environmental impacts beyond national jurisdictions.
- Information, participation and accountability that will make all citizens have access to information concerning the issues of sustainable development.
- Sustainable consumption and production with sustainable and equitable resource use.

- Strategic, coordinated and integrated planning to deliver sustainable development.
- Just transition that will facilitate adequate financial and technical support to developing countries to enable them transit to low carbon green economy in the context of sustainable development, particularly to enable citizens and communities have access to "green" skills and jobs.
- Human wellbeing (not GDP) and quality life, and environmental health are the guiding objectives of economic development.
- Gender equality and equity are prerequisites to the transition to a green economy and the achievement of sustainable development.
- Safeguard biodiversity and prevent pollution of any part of the environment as an integral part to development and human wellbeing within a system of governance that protects the resilience of ecosystems to prevent irreversible damage.

It is necessary that we proceed to implement these and establish a revolution that will restore and preserve the earth's environmental systems. There are indications that if this environmental revolution succeeds, it may rank high up with the agricultural and industrial revolutions as one of the great economic and social transformations in human history. This is because it is capable of re-establishing a balance between people and the natural systems on which they depend. Unlike the industrial revoultion that was based on the exploitation of fossil fuels (oil, coal and natural gas), this new transformation will be based on a shift away from fossil fuels and concentrate on the use of renewable energy.

The environmental revolution, while it will obviously use new technologies, will be driven primarily by the restructuring of the global economy so that it does not destroy its natural support systems. Its success will be metered by the extent to which it is able to transform the global economic system into an environmentally sustainable development path that leads to preservation of ecosystem services (arrest soil erosion,

pollution, deforestation, global warming etc), greater economic security, healthier lifestyles, and a worldwide improvement in human living conditions.

What Can I do as a A Private Citizen?

As a private citizen, the first step we must take is to get educated properly on matters of the environment. Once armed with the needed education, we could choose two courses of action: to be an advocate for nature, or to become a loyal and humble adoptee of all that has and that would be asked of us to take as actions in order to prevent our earth from dying. However, as from today we can start with these simple steps.

- Reduce the use of fossil fuels
- Turn off your lightbulb when not needed; use energy-saving bulbs.
- Use only refrigerators with approved refrigerants.
- Don't cut a tree; instead, plant one.
- Where possibe, use the BRT bus and leave your car at home.
- Don't waste water.
- Ask your mechanic to dispose used oil properly.
- Reuse the newspapers in your homes
- Return to your stores with the last carrieage bag
- Avoid plastic bottles as they may end up in the seas.
- Talk to a child about saving the planet.
- Support any fund meant to educate women to save the environment.
- Join the fight against ignorance and poverty.

Will the World Come to An End, or will the Earth die?

This no doubt poses a tough challenge because there are several dimensions to it—the religious, the philosophical, and the scientific. The bible tells us there will come a

rapture that will take all the saints away and then thereafter the world will come to an end. Then we quickly remember that in the doxology of some Christian prayers we end the prayer with "world without end (Amen)." There starts the controversy. As a practitioner I have to balance scientific findings and my religious belief and endeavour to not conflict myself. I certainly must accept some things that religion has taught me. But even with that my religion has conflicted me, as you can see. Indeed, does the doctrine of the rapture not in conflict with the doxology that says "world without end"? I certainly want to make heaven so I will rather not say nothing on this any further.

I will choose to ignore the matter of the philosophers for obvious reasons and look at the scientific pontifications. I will make my pronouncement early. *The world may end, but the earth will remain*. This is because, the world in the paradigms of our work as earth-science practitioners, consists mainly of all the living things and their artefacts, the intangibles of belief systems, culture, customs, ideas actions, activities and interactions and how they affect the earth upon which they stand. While simply put, we say that the physical spaceship that floats in the universe with all its components and systems that contain life as they occur in their natural form and as they interact with other cosmic bodies is what we call "Earth." Given this we are able to make a distinction between Mother Earth and the world that we live in. The world we live in, as represented by the biosphere, may come to an end certainly if we continue to assail the earth as we currently do. The system will throw back at us what we have thrown at it, and our world will begin to change and glide towards a steep slope on a fast pace, as a man on roller skates going downhill. The table shows where we are with things and where we are likely headed.

Based on this, I predict that if we continue at this rate of current consumption of earth's non-renewable resources and we continue to not have regard for curtailments of our excesses the world will end. Indeed we know the world is said to have been destroyed before and certainly we are set on the same next path. The world will end in small bits

when those whose livelihood depends on forest resources have no more forest, then their world ends. When artisanal fishermen go days and nights toiling in the huge waters of the oceans and bringing in no appreciable catch, then their world ends. When our surface water sources can no longer give us unpolluted fresh water and we drill boreholes and we pump contaminated water, then our world ebbs away. When we no longer can tolerate the extreme daily temperature, then our world begins to end. Mr. Vice-Chancellor, sir, ladies and gentlemen, the world will end for us if we do not change our ways and attitude to the earth. We simply can now see why on earth it matters that we change our ways; if not, the answer again to that question is, "Yes the world will end." Just may not be in our current cycle of existence on earth.

Conclusions

Mr. Vice-Chancellor, sir; ladies and gentlemen, I actually opened this inaugural with my conclusions. Suffice it to say that man can rescue himself, by rescuing Earth. In conclusion, I want to propose that given the present situation of things, it is clear that the biosphere, which is the sphere where man is most active, faces perilous times. Of all the major components, it is the most threatened and man must begin to take actions to ensure that the biosphere does not "die." I have to end by addressing the problem of the Nigerian environment. However, to do this we have to acknowledge that the challenges we face in terms of environmental degradation is indeed a global one. No country, no matter how great, can single-handedly solve the problem. We must realize, most importantly, that we must act locally while thinking globally.

In order to save our immediate Nigerian environment, four actions must be taken. The first is for government to reorder its educational priorities via a new curriculum to stress an appreciable understanding of the environment by adopting geography as a compulsory subject at primary- and secondary-school levels. The second is to constitute a national conference on environmental law and sustainable development. The meeting will help resolve the several conflicts that we face in the enactment of environmental law, the judicial process and the natural law as they really are. The next

is to take serious steps to eradicate poverty, especially as it exists in rural areas and the third is for government to begin a re-industrialization of the country along safe and sustainable development paths. We must state that the countries that will make it in the future are those who will be able to benefit from the use of free renewable energy sources that nature bequeaths us. Over 90% of Nigerian factories are running very inefficient energy systems, and in a few years' time they will not be able to compete at all globally.

Acknowledgments

May I humbly seize this opportunity to thank the Vice-Chancellor, Prof. Olanrewaju Fagbohun, and the entire University Management and indeed the whole university community for the support given me towards today's Inaugural. I thank all my colleagues in the Faculty of Social Sciences for electing me as their Dean and giving me all the support to succeed. I thank members of the Department of Geography for their brotherly love at all times. In the course of this journey I have met several people and they have made impacts on my life. My PhD supervisor, Prof. Festus Olufemi Akintola, who passed on to greater glory about two years ago, ranks very high in the list. He was a strong tower of support for me in my formative years as he gave me unfettered access to all his academic materials. I thank my other teachers too. I remember very fondly the late Prof. Sylvester Abumere also of the Department of Geography at the University of Ibadan who exposed me very early to the use of computer and the logic of programming when several years ago he taught us the rudiments of geographical information systems and FORTRAN programming language. I came to LASU because Prof. Akin Mabogunje, who is my role model, encouraged me to come and pursue my academic career here. I will always remember Prof. Oladele Arowolo for mentoring me at the early times. To members of my church, Christ Chapel, Ojokoro, pastored by Dr. Ayo Ayodele of the English Department here in LASU, I appreciate your spiritual friendliness and support. I recall when I was shot

by armed men about ten years ago, they prayed so hard and encouraged me to trust in the Lord for complete recovery in spite of the enormity of the AK-47 bullet wound to the vital areas of my body.

I am most grateful to members of my immediate family for being an outstanding family in terms of their ever-unflinching support at all times. My sister, Mrs. Oluwasola Idedia, I thank you because you suddenly became our mother when Mom passed on when we all were still trying to find our ways in life. To my able brother, Prof. Seun Omotayo, who likes to lead from the front, I thank you for all your inspiration and support. I appreciate all my other younger siblings: Mr. Tola Omotayo, a staff of Northampton University; Mrs. Tosin Hameed, of the Lagos State Health Management Services; Mr. Segun Omotayo, a staff of the Department of Health in the U.K.; Mrs. Labake Akanbi, a farmer; and Dr. Tope Omotayo of Tai Solarin University of Education, Ijebu-Ode.

I want to specially thank my wife, who in a way made today happen. I also thank all the members of her immediate family for letting me be their *Egbon*. I recall it was my wife that went to report to my sister that she married me not because she thought I was going to make billions of naira, but because she wanted to marry a professor. Of course I had to retrace my steps and I re-ordered my priorities. And here we are today! I thank you for all your support and the putting-up with. I know I am just always a "naughty boy"; I'm not easy to put up with. To my little queen, Sefunmi, my best friend and daughter, thanks for being so there at all times. The fact that I knew you were always going to pass your examination and never get into troubIe with anyone meant I had all the time to get going with my academic and other callings. To those who know me closely, they know I am a man of many parts with a finger in as many pies.

I thank my parents Mr. Oriola Omotayo and Mrs. Dorcas Olubisi Omotayo (neé Oyefeso) who are both watching over us in heaven (I'm sure) for giving me the education that I got. One lesson I must share with you that I learned from Mum is that

yesterday's achievements are not worth dwelling upon. You have to go on for the next challenge. You are only as good as your next achievement; she would always tell me then. Those lessons I took with me and they made the difference.

Finally to the Creator of Mother Earth and everything that dwelleth on it, I give glory.

Mr. Vice-Chancellor, Ladies and Gentlemen. I rest my case.

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