AGRICULTURAL PRACTICE IN A CHANGING CLIMATE: BEYOND INFATUATION TO DEVOTION

A Valedictory Lecture

By

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PROGRAMME

1. **GUESTS ARE SEATED**
2. **INTRODUCTION**
3. **THE VICE-CHANCELLOR'S OPENING REMARKS**
4. **CITATION**
5. **THE VALEDICTORY LECTURE**

The lecturer shall remain standing during the citation. He shall step on the rostrum, and deliver his Valedictory Lecture. After the lecture, he shall step towards the Vice-Chancellor, and deliver a copy of the Valedictory Lecture and return to his seat. The Vice-Chancellor shall present the document to the Registrar.

6. **CLOSING REMARKS BY THE VICE-CHANCELLOR**
7. **VOTE OF THANKS**
8. **DEPARTURE**

DEDICATION

To the Gang of Three,

Ogechi “Baby” Nefertiti,

Akunna “ Kiki” Kenyatta,

Chidi “Big B” Adonis II,

What a ride !

&

To Lady Chi, the Beautiful One,

I Will Always Love You.

PROLOGUE

The ability of a country to feed itself constitutes the most potent weapon in a nation's armoury to defeat poverty and ensure sustainable human development. A plus side of this self sufficiency is when it transitions to a capacity to export food and contributes not only to national economic growth but, also, to achieving global food and nutritional security.

Nigeria's immediate past Agriculture Minister and presently, President of the African Development Bank, Dr Akinwumi Adesina, puts it even more starkly. In a Speech titled, "Transforming Nigeria's Agriculture" at the inauguration of the Agriculture and Food Security Center of the Earth Institute of Columbia University, New York, USA, on September 10, 2013, he stated that, "Any nation that does not feed itself becomes a threat to its own sovereign existence. Growing our own food, processing what we produce, becoming competitive in export markets, and creating jobs all across our economy, are crucial for our national security" (Adesina, 2013).

This goal is, however, threatened dominantly by the vagaries of climate change and climate variability identified globally as, "the greatest challenge of our generation," with the greatest dislocations predicted in the agricultural sector.

According to FAO (2008), climate change will affect all four dimensions of food security: food availability, food insecurity, food utilization and food systems stability. Subsequently, it will have an impact on human health, livelihood assets, food production and distribution channels, as well as economic growth, employment and social stability.

During the Events marking the last World Food Day in October, 2016, the Minister of State for Agriculture and Rural Development, Senator Heineken Lokpobiri stated that Nigeria may lose up to 30 percent of its GDP by 2050 to climate change impacts causing a N69 trillion hole in the national treasury not to mention their negative implications for known indices of national development.

That is how dire the circumstances are for our country!

Speaking on November 04, 2016, the day the Paris Climate Change Agreement came into force, the just retired United Nations Secretary General, Ban Ki Moon, declared that, “we are the first generation to really feel the effects of Climate Change and the last that can prevent its worst consequences.”

Nigeria is in a fortunate position of having a National Agricultural Resilience Framework (NARF) launched in April, 2014 (see Adegoke, Ibe and Araba, 2014) which affords a vantage platform for building a “fire wall” to decrease vulnerability and increase resilience by mainstreaming adaptation measures against both the precipitous and insidious impacts of the changing climate.

It compels national adhesion to policies and practices that go beyond mere infatuation to devotion in regard to climate proofing agricultural production and the concomitant value chain developments. Climate change can become the stimulus for implementing difficult but necessary changes to the status quo in the agriculture sector.

INTRODUCTION

Our Earth is warming. Though there are still a handful of vociferous skeptics out there, the scientific evidence of global warming remain iron clad compelling all of our attention (US-EPA 2009; Ibe and Ibe, 2010; IPCC, 2007, 2014)

2016 was the hottest year ever since scientific measurements began.. Each of the last three decades has been much warmer than the decade before about

The identified impacts of global warming which is the driver for the changing climate include the increased frequency and intensity of extreme weather events, accelerated sea level rise, disruptions in the earth's natural resource systems, human displacement and famine on a staggering scale and prevalence of runaway diseases and epidemics, etc.

The paradox of Climate Change is that it would impact disproportionately on the already vulnerable parts of the globe- the Developing Countries. Nigeria is in the region with about the highest vulnerability to impacts of climate change.

While the challenges posed by climate change are all encompassing, straddling all sectors of socio-economic life, it is generally acknowledged that the Agriculture sector is the most vulnerable. The reason is not farfetched. Agriculture has a high dependence on climate and weather -to rising temperatures, variability of rainfalls both in terms of amount and pattern, extreme weather events on land and at sea, variations in relative humidity and solar radiation, etc. which are among the primary imprints of Climate Change and which render countries such as ours extremely vulnerable. It is also because the people involved in agriculture tend to be the rural poor

Climate change comes as a major additional layer of problems, putting a lot of pressure on traditional farming systems, food security, human health, safety and security.

According to IPCC (2011), agriculture is undoubtedly the most important sector in the economies of most non oil exporting African countries. It constitutes approximately 30% of Africa's GDP, 50% of the total export value, 70% of the population depending on it for their livelihoods. Even for an oil exporting country Nigeria, the realities are not drastically different. The debate on climate change and its impacts on agriculture is therefore very crucial to the very survival of the continent (read, country) and its people

Since the late 1960s , Nigeria in particular, and the West and Central Africa region in general, have faced a series of environmental and socio-economic consequences as a result of fluctuations and changes in climate, and most parts of the region have been subjected to a series of unusual episodic climatic and hydro-climatic events.

Such events like aggravated droughts and catastrophic floods with their consequent crop failures, losses in livestock including fisheries and spiraling desertification have caused famine and death in the affected areas and have led to mass migration of inhabitants and other socio-economic dislocations. Other effects have included, higher temperatures on land and sea, irregular patterns of rainfall, severe water shortages, accentuated soil erosion, accelerated sea level rise, increased occurrence of storm surges, decimation of wetlands, salinization of fresh waters, depletion of natural resources, etc (Abiodun, 2013; Adefolalu, 1986; Adegoke, 2010; Adegoke and Ibe, 2013, 2014a, b, 2015, 2016; Adegoke, Ibe and Araba, 2013, 2014; Ajayi and Findlay, 1989; Adesina, 2013; Ahanhanzoet al, 2014,Awosika and Ibe, 1989, Awosika et al, 1990; 1991;1993; BNRCC, 2011; Cervigni et al, 2013a; Folorunsho et al, 1993; Ibe, 1983; Ibe,1984; Ibe,1986; Ibe,1987; Ibe,1988 a,b,c: Ibe,1989 a,b,c,d,e,f; Ibe and Quellenec, 1989; Ibe,1990 a,b,c; Ibe,1991, Ibe, 1992a,b; Ibe,1993 a,b,c,d; Ibe and Ojo, 1994; Ibe, 1995; Ibe, 1998a,b, c,d,e;Ibe,2006; Ibe,2008; Ibe, 2010; Ibe and Ibe, 2010, Ibe, 2011; 2012;2013 a,b,c,d; Ibe and Adegoke, 2015, 2016; Ibe and Ahanhanzo, 2012; Ibe, Adegoke and Araba, 2015, 2016; Ifejika-Speranza, 2010; James et al, 2010; Mohamed and James, 2010;

Nwilo, 2000; Nwilo and Onuoha, 1993; Ogba and Utang,2010; Ojo, 1989; Ojo et al, 1993; Okali, D., 2010; Oladipo,1993; Portmann et al, 1989; Ukwe et al, 2006, 2008, 2019, 2011)

The unprecedented flood that ravaged several states of the country in 2012 was a vivid reminder of the force of extreme events, affecting over seven million people, displacing 2.3 million people, killing over 363 persons and destroying or damaging hundreds of thousands of houses not counting farmlands, industries, etc. Total value of losses across all sectors of the national economy was estimated at US$16.9 billion by the Federal Emergency Management Authority (FEMA, 2013).

Such events have caused a growing awareness of climate-society inter-relationships and of the socio-economic consequences of climate change and variability in Nigeria. The threat to National food security, social stability and economic prosperity is palpable and makes national action to adapt to the imposed and emerging risks imperative to ensure that the objective of government to eradicate extreme poverty and provide harmonious socio-economic and human development through improved and sustained agricultural production is not vitiated by the vagaries of climate change and climate variability.

To be efficacious, such action must be concerted in scope engaging not only governments at all levels(national, state, local) but incorporating the organized private sector, development partners, donors, non-governmental organizations (NGOs) and community based organizations (CBOs) to promote the interactions and synergy between all relevant stakeholders.

It is important also to bear in mind that **Agriculture is a villain as well as a victim in Climate change dynamics.** In other words, Agriculture is both a source and sink for greenhouse gases (GHG).A *source* signifies a net contribution to the atmosphere, while a *sink* denotes a net withdrawal of greenhouse gases. Fig 1 shows the global greenhouse emissions by economic sector.

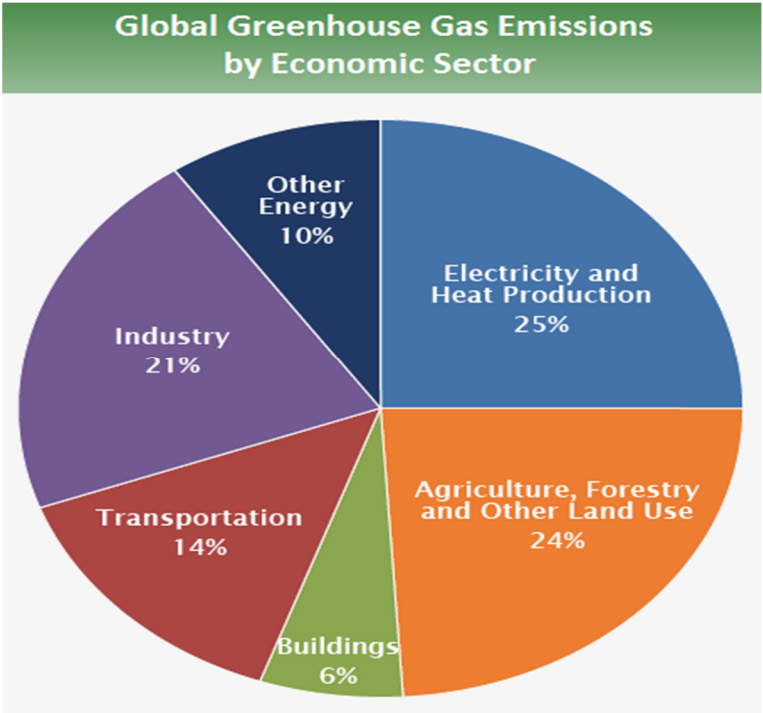
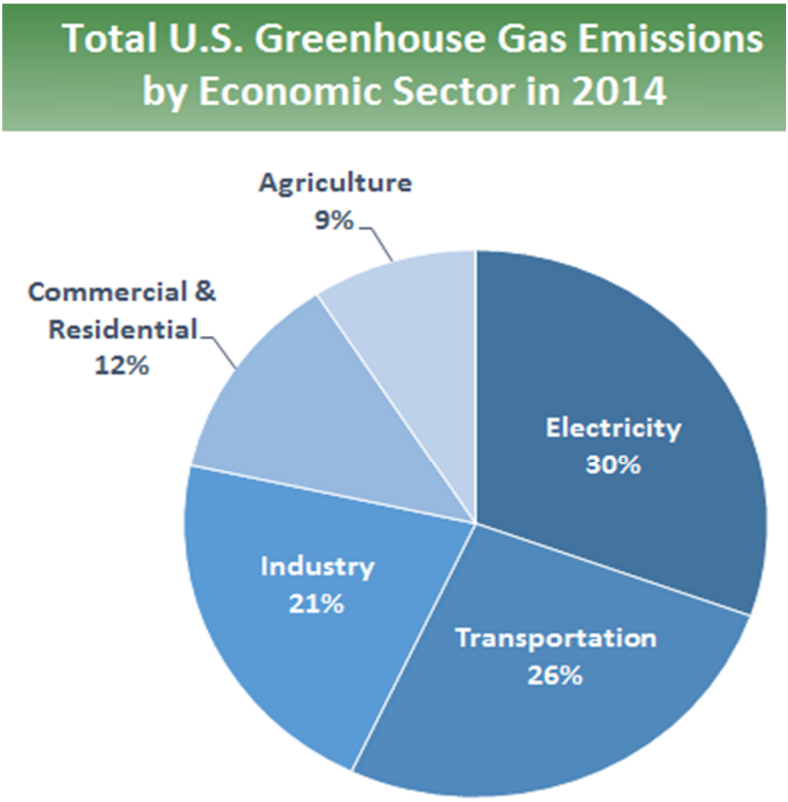


Fig 1.Source: IPCC (2014); based on global emissions from 2010. Details about the sources included in these estimates can be found in the *Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. (Wikipedia, 2016)

Agriculture, Forestry, and Other Land Use (24% of 2010 global greenhouse gas emissions): Greenhouse gas emissions from this sector come mostly from agriculture (cultivation of crops and livestock) and deforestation. This estimate does not include the CO_2 that ecosystems remove from the atmosphere by sequestering carbon in biomass, dead organic matter, and soils, which offset approximately 20% of emissions from this sector (Wikipidea, 2016).



U.S. Environmental Protection Agency (2014).
U.S. Greenhouse Gas Inventory Report: 1990-2014.

Fig 2. Greenhouse Gas Emissions by Economic Sector in 2014.

The proportions of GHGs differ between countries and regions depending on the importance of Agricultural production to the economy and the safeguards against GHG emissions that are deployed in agricultural production.

In the United States, for example, where precautions against production of GHGs are taken as part of routine farming practices,

agriculture is a relatively small contributor, averaging 9% of the total greenhouse gas emissions (Fig 2). It is generally higher in developing countries.

Most agricultural emissions originate from soil management, enteric fermentation (microbial action in the digestive system), energy use, and manure management. The primary greenhouse gases related to agriculture are (in descending order of magnitude) methane, nitrous oxide, and carbon dioxide (see Fig 3). (eXtension, 2016)

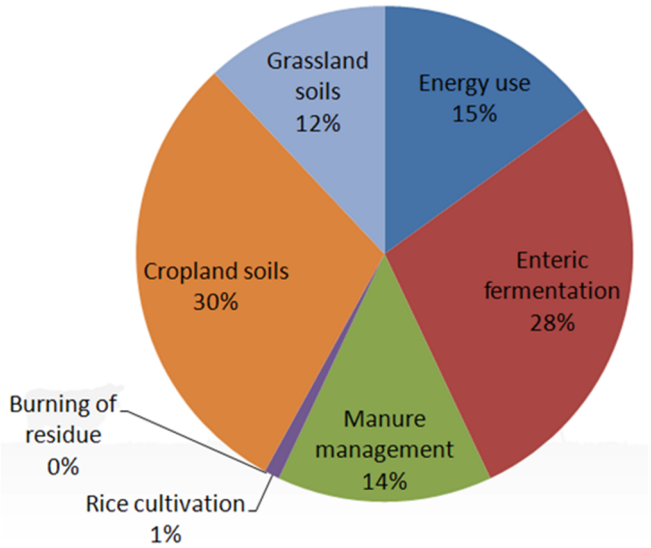


Figure 3: U.S. agricultural greenhouse gas sources (Adapted from Archibeque, S. et al., 2012; In Extension, 2016.)

According to Smith et al. (2007), emissions of carbon dioxide (CO2) are mainly from land use and clearing forests for agricultural use. Increased use of fertilizer and the growth of agriculture account for the nitrous oxide (N2O) emissions while fermentative digestion by ruminant livestock, stored manures, and swamp rice production cause Methane (CH4) emissions. Of global anthropogenic emissions

in 2005, agriculture accounted for about 58 percent of N2O and about 47 percent of CH4 while the net flux of CO2 (excluding emissions from electricity and fuel use in agriculture) between the atmosphere and agricultural lands is estimated to be approximately balanced (Smith et al. 2007).

Logically, Climate Resilient Agriculture should aim at reducing global greenhouse gases from agriculture. Very often, actions can achieve both resilience and low GHG emitting activities together. Although important, because agriculture and land use change account for 60% of Nigerian GHG emissions, reducing GHG emissions from agriculture Nigeria is generally perceived as a less urgent policy objective than increasing productivity and resilience. However, there is no running away from this reality. Therefore adaptations need to be climate-resilient and not contribute to GHG emissions.

ADAPTATION AS AN IMPERATIVE

In the light of the demonstrated impacts of climate change, the maxim is "Adapt or Perish". Well, there is Mitigation too under which, actions to minimize the so called greenhouse gases, are undertaken. And this is important. For the purposes of this discourse, Mitigation will be treated as the other side of the coin- again that comes with Adaptation.

IPCC (2007) defines Adaptation to climate change as: "adjustments in natural and human systems in response to actual or expected climatic stimuli or their effects, which moderates harm, or exploits beneficial opportunities"

Adaptation means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimize the damage they can cause, or taking advantage of opportunities that may arise. It has been shown that well planned, early adaptation action saves money and lives later.

Adaptation to climate change impacts is as complex a process as the phenomenon of climate change itself (Smit et al, 2001). It entails

understanding the hazards they generate as well as the appropriateness, including costs and benefits, of the various proffered coping strategies.

Conway(2012), recognizes that climate and other hazards manifest in two forms namely, Stresses which are more gradual and therefore more predictable (even if occasionally they can build up to have catastrophic consequences) and Shocks which are usually dramatic and are largely unexpected events. The differing nature of the two category of events often dictates a differentiation of selected responses.

The challenge is to decrease our vulnerability to the vagaries of the changing climate and build our resilience to the ensuing shocks and stresses through entrenching adaptation measures so that the well-being of people is improved in terms of increased food and nutritional security, enhanced protection of the natural resource base for agriculture and by achieving lower costs or better economic outcomes within the agricultural communities.

The target should be to mainstream climate change adaptation into all existing and new sectoral policies including the MDGs and SDGs but particularly in the key sectors of land, water, air ,energy, biodiversity, fishery resources and coastal resources**.** Policies and actions should be predicated on an ecosystems approach. Ecosystems perform several functions which provide key goods and services to the land and people. Adaptation to climate change must focus on the maintenance and enhancement of their ability to continue to perform these functions. Thus an ecosystem approach to climate change adaptation can contribute to reducing climate change impacts, reducing the vulnerability of people and infrastructures and increasing their resilience and adaptive capacity.

Examples of Adaptation measures include: using scarce water resources more efficiently; adapting building codes to future climate conditions and extreme weather events; building flood defences and

raising the levels of dykes; developing drought-tolerant crops; choosing tree species and forestry practices less vulnerable to storms and fires; and setting aside land corridors to help species migrate. From Literature Survey, other Measures would involve:

- raising the awareness of all stakeholders on climate change and the need to adapt to it
- formulation of a gender sensitive national climate change adaptation program of action that lays emphasis on ecosystem management
- periodic assessments of the status of biodiversity and of vegetation cover and land use
- a national policy to reduce population growth rate and stabilise it at about two percent
- promoting the switch to renewable energy
- putting an end to net deforestation and, especially, to encroachment on protected areas, namely, forest reserves, game reserves and national parks
- instituting a national REDD(reduction of emission due to deforestation and degradation)action plan and integrating REDD+ into national development efforts.
- sustainable management of upland wetlands for the maintenance of water flow and quality and the prevention of flood disasters
- coastal defence through the maintenance of mangroves and other coastland ecosystems to reduce coastal flooding and coastal erosion and provide livelihoods
- establishing land use zoning and control to keep development away from sensitive ecosystems, wetlands and flood plains
- integrating green or nature based infrastructure and technology into hard solutions to environmental problems wherever possible to avoid damage to ecosystems and maladaptation
- embracing the carbon market
- empowering communities by providing information on alternative livelihoods, facilitating cooperatives, providing micro-credit, etc. that will enable them to take control of their circumstances

- adopting appropriate policies and legislation to promote the development and maintenance of healthy and diverse ecosystems as a basis for adaptation to climate change.

The onus is on the Federal Ministry of Agriculture and Rural Development (FMARD) to harness inter-agency effort to provide, through extensive studies, in-depth data and information regarding the impacts of climate related catastrophic events and associated risks. The ultimate goal is to develop response mechanisms in terms of adaptation options that can be deployed at different levels (from government to farmers) to react to the challenges.

In 2013, the Ministry constituted an Advisory Committee for Agricultural Resilience in Nigeria (ACARN) of which This Author is the Co-Chair. The Committee consists of a panel of international and local experts, government representatives and other stakeholders, including NGOs, which together have developed a strategy document, termed the National Agricultural Resilience Framework (NARF). The Strategy includes short term, medium term and longer term actions. In addition to actions under the direct control of FMARD, the Strategy stresses the multi-sectoral dimension of climate resilient agriculture, and has involved participation of the Ministry of Water Resources, Ministry of Environment, Nigerian Meteorological Agency (NIMET), The National Space Development and Research Agency (NASDRA) under the Ministry of Science and Technology, bi lateral and multi-lateral development partners and a range of national and international academic institutions.

On the recommendation of ACARN, the Ministry in 2014 established an Environment and Climate Change Unit (ECCU) within its Department of Land Resources. A work programme for the Unit was finalized following adoption of the National Agricultural Resilience Framework.

Climate resilient agriculture aims to achieve two broad complementary objectives: Improved agricultural productivity and

food security; and climate resilient agricultural, livestock and fisheries production and processing systems, including reduced vulnerability from weather extremes). There are a number of outcome indicators as detailed in the NARF that can be used to measure progress towards achieving climate-resilient agriculture.

SMALL HOLDER FARMERS AS FIRST RESPONDERS

The shocks and stresses occasioned by the changing climate constitute an added pressure on farmers. From the interactions of This Author as co-Chair of the Advisory Committee on Agricultural Resilience in Nigeria (ACARN) with small holder farmers during Town Hall Meetings in the six geo-political zones in 2013, it was evident that farmers had recognized for a long while that "something had happened" to the climate they had known in the past –"that the center can no longer hold."Farmers reported on the various measures they had taken on their own initiative to cope with extreme events like droughts and floods as well as vagaries imposed by climate variability. Farmers described how they had begun growing different varieties of crops and modifying planting dates and practices to cope with the shorter growing season; employing water harvesting and flood abatement techniques; etc. Those in livestock rearing recounted how climate change had changed the pastures and feed stocks on which their animals depend and how rising temperatures have impacted on the vulnerability of these animals. Farmers engaged in Aquaculture told of the added concerns posed by changing availability of water and how losses occurred particularly during floods.

Indeed, Kurukulasuriya et al (2006), from a survey of eleven African countries, had concluded that famers are not only knowledgeable about climate change impacts but were already implementing certain adaptation measures such as growing different varieties and modifying planting dates and practices to account for shorter growing seasons.

However, it is obvious that because of the operation of small scale holders at or near subsistence levels and the enveloping poverty,

they are not generally able to implement their knowledge of adaptation independent of outside intervention of some sort. The expected intervention could be at the level of governments (local, state or federal) or non-governmental organizations, or through assistance from the Private sector via Corporate Social Responsibility (CSR) and other collaborative schemes. The strategies may be technological, others economic, social, or political but there is no doubting that there are clarifying lessons to be gleaned from people who have had to cope with repeated stresses and shocks as part of their individual and collective existence and struggle for economic emancipation. A tested approach is to develop resilient livelihoods through achieving a greater diversity of incomes.

WHY THE FOCUS ON SMALL HOLDER FARMERS?

In keeping with the progressive philosophy of Agriculture as Business as explicitly enshrined in the Agricultural Transformation Agenda (ATA), the principal **aim** of NARF is to support the small scale private sector particularly small holder farmers, fishers and livestock breeders who are by far the largest investors in agriculture nationally, in the adoption of climate adaptation practices and the entrenchment of climate smart agriculture (CSA).

Reality is that more than 90 percent of current agricultural production comes from small holders either as cooperatives or individuals. Consequently, implementation of identified actions should be targeted primarily at the farm level where they will produce the greatest benefits in terms of reducing vulnerability, building resilience and instituting adaptation measures. **BATNF agricultural strategy which emphasizes helping small holder farmers to feed Nigeria by lifting farmers out of poverty and improving rural communities, is a shining example of this approach**.

The policies enunciated in the NARF will afford small and growing agricultural businesses ample scope to acquire required goods and

services thereby providing opportunities to build value prosperity of small holder farmers. This strategy provides a veritable short cut to eradication of poverty on a grand scale and the concretization of a viable recipe for sustainable economic development.

It is only logical therefore that the emphasis for NARF implementation is hinged on the well being of small holder farmers.

The Challenge posed can be overcome in a number of ways, including:

- identifying the key decisions and practices in the production cycles in agricultural communities (farmers, pastoralists, fishers, foresters, etc.) to which adaptation measures may be applied in pursuance of agricultural resilience;
- Implementing agricultural development policies such as promoting agricultural markets, eliminating distortions in agricultural policies, ensuring sustainable land management, enhancing social protection and microfinance, promoting a weather indexed risk insurance culture, etc.
- improving the tactical and strategic responses to information; and
- education and effective communication.

The proper strategy would include the following objectives:

1) improve national Agro-Meteorological service's capability to issue credible sub-national weather forecasts for main agro-ecological zones including conducting tests for their realistic and reliable occurrence;

2) enhance the development by Agricultural Services in the country of decision/simulation tools incorporating next to "future climate" considerations;
3) promote enquiry by National (and International) Agricultural Research Institutions into mechanisms linking, climate change and variability and agricultural impacts;

4) encourage Agricultural Extension Services to reinforce their interactions with the media, government and civil society with a view to effectively communicating adequate warnings/advice to agricultural communities.

5) build the capacity of small holder farmers to integrate and reinforce "climate proofing" in their agricultural practices

It makes eminent sense, therefore, for these strategies irrespective of those initiating or financing them, to be farmer centered even if Toulmin (2007) has noted that such knowledge is being steadily eroded in many places under the impact of migration, family breakdown, famine relief, poverty and disease which have tended to make farmers to become dependent on outside aid. It is therefore, critical that the main thrust of outside help should be to enable farmers to rebuild and refine their adaptation strategies

PREFERRED APPROACHES

Conway(2012) points out that in a typical "top down" approach to agricultural development, farmers are generally perceived as recipients of inputs and knowledge whereas our interactions with small holder farmers reveal them as skilled, and knowledgeable and oftentimes highly innovative. He concludes that "where development has not worked, it is because their needs are not appreciated and their knowledge ignored".

Whereas the "top down" approach seemed to have worked during the Green Revolution, it is pertinent to point out that it was because the messages to be communicated were few and direct as against present day situations where the complexities of climate change impacts and associated risks are too variegated and disparate for their communities to compel a different approach. The alternative, therefore, is to encourage farmers to be analysts and innovators for their communities and for some to be formal and informal extension agents (Conway, 2012**).**

Under this scenario, a more incisive knowledge of local agro-ecological systems as well as more intimate and systematic insights of the circumstances and livelihoods of rural households especially small holder farmers will be achieved compared to the usual "training and visit" which rely on periodic visits and written questionnaires and which have been castigated as "rural development tourism"(Chambers, 1983). The preferred approach which has been described by an array of differing terminologies ranging from: participatory rural appraisal (PRA), participatory analysis and Learning Methods (PALM) to the French method accelere de recherche participative (MARP), reflect local ingenuity(Chambers, 1997)

It has been asserted that the realization by western scientists of the enormous potential of the dwarfing genes present in East Asian wheat and rice germplasm, a factor that underpinned the Green Revolution, was due, in no small part, to farmer's indigenous knowledge and their capacity to experiment even if this has been downplayed (Richards, 1985). Godell et al 1982) quotes a survey by an anthropologist at IRRI, Philippines who found that, of the technologies on offer at the Institute, 90 percent being promoted had been derived from Asian farmers.

Why a participatory approach? The need for farmers and scientists to work together.

As several authors have emphasized, many agricultural decisions are more uncertain than complex. In dry land farming, for example, there are often fewer 'levers to pull', but a lot of uncertainty. What research can do is put numbers on that uncertainty and discuss options with farmers. "Working with farmers on an issue as multifaceted as risk management is not a case of one way, unambiguous information flows to farmers, teaching farmers or even providing decision support for farmers. Nor is it a case of just listening to farmers and observing what they are doing. Rather, it is a case of intervening where both farmers and scientists are prepared to learn from each other and modify as they manage farming systems" (Hayman, 2001; Hayman and Fox, 2003).Huda (1994) and Huda et

al. (1994) demonstrated the benefits of working with farmers from the beginning of a project to evaluate alternate management strategies that minimize climatic risk to wheat production in low rainfall areas of southern Australia.

From similar studies in other parts of the world, it was found that trying to provide definitive answers using scientific knowledge and climate models was not what farmers wanted or needed most. Through dialogue with farmers, extension workers and researchers from other disciplines, it was realized that farmers have few options in their management processes to use this complex information. What they needed was "simple *rules of thumb* at critical points (often narrow windows) — such as for planting, harvesting, etc — to make better informed decisions that minimized their risk and maximized their opportunities as far as was possible, given the fact that the future may never be fully known."(Huda et al, 1994; Hayman, 2004,) Thus, participative approaches are required when applying scientific findings to complex social systems,

AGRICULTURAL DEVELOPMENT POLICIES

The Federal Ministry of Agriculture and Rural Development under the Agricultural Transformation Agenda, the main thrusts of which are embraced and reinforced by the current Administration, has formulated a number of development policies designed to provide the needed propulsion for achieving the food security and economic growth ambitions of the country under a changing climate and increased climate variability.

Key components of new and creative adaptation measures to climate change in agriculture include: (i) changes in agricultural practices to improve soil fertility and enhance carbon sequestration; (ii) changes in agricultural water management for more efficient water use; (iii) improving spatial targeting of investments, (iv) agricultural diversification toward enhanced climate resilience; (v) reducing greenhouse gas (GHG) emissions from agriculture and increasing the value of sustainable farming practices through the valuation of carbon and other forms of agricultural ecosystem services such as

water purification and biodiversity, (vi) agricultural science and technology development, agricultural advisory services, and information systems; and (vii) risk management and crop/livestock insurance.

It is appropriate to ventilate in this Lecture such policies aimed at climate proofing Nigerian Agriculture. The Account will be necessarily brief. It confines itself to early actions which could be undertaken to indicate adhesion to a Climate-Resilient Agricultural strategy. The interested reader would be well served to read the Nigerian Agricultural Resilience Framework (NARF) (Adegoke, Ibe and Araba, 2014; www.acarn.org; www.fmard.org) for full and critical discussions of these and other broader policies.

Despite national avowals on commitments to mechanization, the reality of Nigeria's agricultural production pattern is that small holder farmers who currently produce about 90% of its food, should be at the forefront of nationally designed strategies to build a bulwark against the ravages of climate change and climate variability.

Provision of Agro-meteorological Services.

It is often said that weather is both the best and worst friend of the farmer. Weather is capricious and has become more so under the changing climate. Mastery of the weather is therefore critical to the farmer for the management of climate-change related agro-ecological risks. In Nigeria, Agro-Meteorological services afforded by government agencies provide the required information on weather events and advisory services on adaptations and cropping systems. They serve as Early Warning Systems. There are current efforts on the part of these agencies which include the Nigeria Meteorological Agency (NIMET) to further refine and make precise their weather predictions.

According to an account in Adegoke, Ibe and Araba (2014), NIMET operates 54 manual synoptic meteorological stations located mainly in the state capitals and mostly at the airports because the network was originally designed to provide aeronautical services (see fig 4).

The present density of one agro-meteorological station every 17,100 km^2, however, is far short of WMO recommended standard of one station for every 50 km.[2.] Worse still, the stations are unevenly located with large data-sparse areas in the northern- and middle-belt states which presently constitute the bread basket of the nation.

There are indications that both the International Fund for Agricultural Development (IFAD) under its Climate Change Adaptation and Business Support Programme with FMARD and the World Bank, under the ongoing Nigeria Watershed and Erosion Control Project (NEWMAP), will support the upgrading of weather and hydrological monitoring stations (see Table 1).

However, the greater challenge seems to be in the dissemination of such information in a timely manner to farmers. Globally, improvements in technology are offering a variety of speedy ways to reach the farmer with weather predictions. Some of those advanced technologies have limited application in developing countries such as Nigeria. A much discussed option is the use of mobile telephony (GSM) to reach farmers with subnational daily forecasts in addition to the longer term predictions across all ecological zones. This will ensure direct information delivery to farmers in real time. It is known that FMARD already has in place an important dissemination tool through the E-wallet system which is currently used for providing input subsidies to farmers. The Ministry had proposed to include, beginning in2014, weather and climate information in the E-wallet system, in selected regions and in cooperation with the relevant ADPs, to test the efficacy of this mechanism.

It has also been suggested that farmers could be involved in network for weather data collection through capacity building and empowerment with simple weather equipment for collection of data at farm levels.

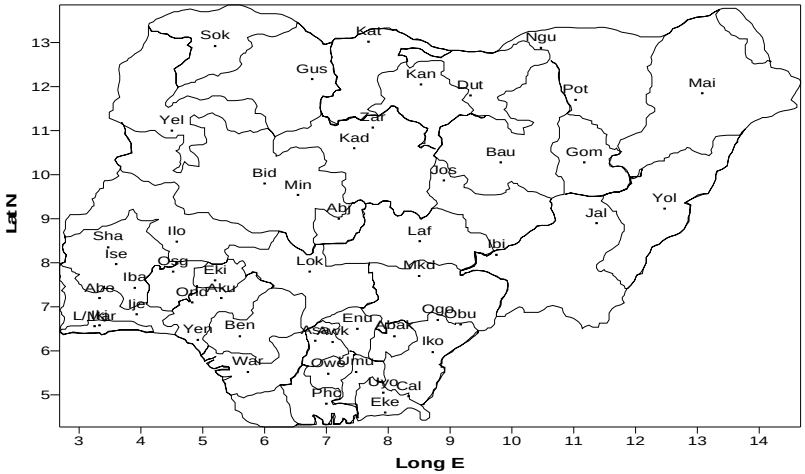


Fig.4: Map of Nigeria showing the existing 54 stations

Table 1: Network of Stations across the country and the proposed increase of stations

S/N	States	No. Of LGA	Current Number Of Stations	NIMET Stations	Recommended New GSM Enabled AWS
1	Abia	18	1	Umuahia	18
2	Adamawa	21	1	Yola	31
3	Akwa Ibom	31	2	Uyo Eket	31
4	Anambra	21	1	Awka	21
5	Bauchi	19	1	Bauchi	29
6	Bayelsa	8	1	Yenogoa	18
7	Benue	23	1	Makurdi	33
8	Borno	26	1	Maiduguri	36
9	Cross River	18	5	Calabar 1 Calabar 2 Ikom, Ogoja, & Obudu	18
10	DELTA	25	5	ASABA WARRI	25
11	Ebonyi	12	1	Abakaliki	22
12	Edo	17	1	Benin	27
13	Ekiti	16	1	Ekiti	16

14	Enugu	17	1	Enugu	27
15	FCT	6	2	Abuja Mararaba	6
16	Gombe	11	2	Gombe	21
17	Imo	27	1	Owerri	37
18	Jigawa	26	1	Dutse	36
19	Kaduna	23	2	Kaduna Zaria	23
20	Kano	45	1	Kano	45
21	Katsina	34	1	Katsina	34
22	Kebbi	21	1	Yelwa	41
23	Kogi	21	1	Lokoja	31
24	Kwara	15	1	Ilorin	25
25	Lagos	20	4	Ikeja Los Marine Los Roof Oshodi	20
26	Nasarawa	13	1	Lafia	23
27	Niger	25	2	Minna Bida	35
28	Ogun	20	2	Abeokuta Ijebu Ode	20
29	Ondo	18	2	Akure Ondo	18
30	Osun	29	1	Oshogbo	29
31	Oyo	29	3	Ibadan Iseyin Saki	29
32	Plateau	17	1	Jos	27
33	Rivers	22	1	Phc	22
34	Sokoto	23	1	Sokoto	33
35	Tarabe	16	2	Ibi Jalingo	36
36	Yobe	17	1	Potiskun	27
37	Zamfara	14	1	Gusau	34
Total (54 Active)				**58**	1002

Agricultural diversification

Although knowledge on Adaptation measures is ever evolving, there are still uncertainties in regard to which crop /livestock will do well and which wouldn't under the changing climate. One obvious way out of the implied risks is diversification – crop diversity, habitat

diversity, diversity in seed, etc. This can be achieved in a number of ways including:

- Crop diversification and genetic diversity help mitigate climate risks such as unpredictable dry spells and flash floods
- A more mixed farming system can exploit crop-tree/livestock synergies to increase livelihoods options and incomes while enriching and buffering water and nutrient supplies, protecting soils and moderating microclimates.
- The bio-reclamation of degraded lands (BDL) for instance may help farmers cultivate waste lands e.g. using an adapted agro-forestry system with high value annual crops like okras and drought-tolerant trees or bushes or oil-producing crops, and techniques of water and soil conservation techniques. The Land Institute is working on the development of mixed-perennial-grain crops to restore the planet's natural landscape. It asserts that "perennial crops, agroforestry, intercropping, and other agroecological practices can be more efficient methods, conserving soils, preventing erosion, and protecting water"
- Introduction of grain legumes, leads to better soil and pest management. Incorporating nitrogen-fixing legumes through rotation or intercropping with dry land cereals improves soil fertility, reduces nutrient mining, can help trap pests and could lead to a more diversified diet and better household nutrition.

Improved Varieties

In the face of difficult to predict changes in weather patterns, scientists have successfully pioneered crops to cope with the increased variability. Thus, there are drought or flood resistant plants, high salt tolerant crops and fish species, shorter growing season plants, heat tolerating livestock, pest repellant crops, etc. In addition, some of these produce higher yields than traditional varieties.

Faced with the changing climate, farmers must embrace new technologies and in particular higher yielding, disease resistant

crops/livestock, adverse weather tolerant plants/livestock, that will increase resilience and increase production and earnings.

Although conventional plant and animal breeding techniques have brought us this far in our quest for food security, it is increasingly recognized that they have practical limitations. More and more, the rapidly evolving field of biotechnology offer immense prospects of overcoming the limitations of conventional breeding through Marker assisted selection, or Cell and Tissue culture or Recombinant DNA also known as genetic engineering (GE) or genetic modification(GM).The future , it would seem, has never looked brighter.

As Conway(2012) elaborated, "---Genetic engineering can create new plant varieties and animal breeds that not only deliver higher yields but contain internal solutions to biotic and abiotic challenges, reducing the need for chemical inputs such as fungicides and pesticides and increasing tolerance to drought, salinity, chemical toxicity and other adverse circumstances."

However, there is disquiet in many quarters about this application including in the hallowed groves of Science and Technology Institutions.

The more widely known Genetically Modified Organisms (GMO) technique has become a hot button food issue at the global level often evoking sulphurous debates. USA's Tamar Haspel characterized these discussions as, "misguided and unconstructive." In a Public Opinion Column in the Washington Post, p.E8. of Nov. 11. 2015 titled, "Unearthed," he stated that "-- A complex set of interacting players and factors drives these problems and solutions tend to be commensurately complex. GMOs are, I think, often a proxy for the very big, very real problems in our agriculture and food supply. One reason we can't get past them is that, although GMO advocates point out , early and often , that GMOs aren't the problem(and I think they're right), they seldomgo on to say exactly what the problem is(and I believe they are remiss). (Haspel, 2015)

In Nigeria, the debate on GMOs has been largely emotive attracting mostly the uninitiated. The danger of this situation in a country where the loudest seem to win the debate is scary. Time to clear the fog and give the initiated center stage to try and decode the maze of opportunities and risks to enable uncluttered national vision in this regard. Fortunately, Nigeria has taken the appropriate steps of enacting a Biosafety Law and establishing a Biosecurity Agency that will, hopefully, guide national debate along "the straight and narrow"(read, productive)path.

Fig. 5: A new rice variety with 38% increase in yield known as UPIA was released to the public by the University of Port Harcourt in 2013. The new variety was developed in collaboration with the International Rice Research Institute (IRRA) and the AGRA with Dr. Andrew Efisue of the Department of Crop and Soil Science, Faculty of Agriculture, as the Programme Coordinator and Team Leader. UPIA is an acronym for University of Port Harcourt, International Rice Research Institute and AGRA. (Reported in UNIPORT Weekly; Williams Wodi, Editor)

Changes in Agricultural Water Management

The water resources potential of the country is estimated to be 250,000 million cubic metres (MCM) comprising 190,000 MCM of surface water with the balance in the form of groundwater (Gowon, 2013). This notwithstanding, water is still a limiting factor to

agriculture in much of the country but most especially in the northern semi-arid and dry sub-humid zones lying above latitude 11° North.

The goal of agricultural Water management is to enhance agricultural growth and development towards maximum yield and production and also to provide water for domestic use.

AWM is a key adaptation strategy for many Nigerian smallholder farmers particularly since the first severe drought of 1973 and thereafter that brought devastation to agricultural production particularly in the Northern parts of the country. The specific methods include collecting flood waters in dams or reservoirs, improving aquifer recharge system, monitoring and tapping underground water formations such as the "Rima and Gundumi formations." Others include direct water lift from rivers, ponds and lakes

A 2003 survey by Japan International Cooperation Agency suggest that 39% of the country's land mass is potentially suitable for agriculture and out of this between 4.0 and 4.5 million ha (approximately 4.5 to 5.0% of the land) are judged suitable for irrigated agriculture but only about a million hectare is currently irrigated in Nigeria(JICA, 2003). By contrast, India, which has about 3.5 times the land mass of Nigeria, irrigates nearly forty-five times as much land.

Attention should therefore be paid to increasing the extent of cultivated land under irrigation as Nigeria has some of the lowest percentage of its cultivated land under irrigation. Governments at all levels are investing in new dam infrastructure as well as resuscitating old ones. An excellent example of the use of dams to spur and sustain agricultural development in Nigeria is the Kano River Irrigation Project which has turned vast swathes of desert prone lands into veritable food baskets for the country.

Happily, the Ministry has signed a Memorandum of Understanding (MoU) with the International Irrigation Management Institute (IIMI) regarding cooperation on agricultural water management. It plans also to work with the Ministry of Water Resources to ensure that irrigation water made available through large-scale surface schemes is used effectively by farmers.

Sustainable Land Management

Land degradation problems are intertwined with the risk and vulnerability associated with climate change. Land degradation on one hand increases carbon emission and associated vulnerabilities to climate variability and change through decline in productivity, inefficient use of water resource, reduced forest cover and below ground carbon, soil compaction and other forms of degradation. Climate change on the other hand accentuates climatic stress and compounds land degradation through disruption of hydrological cycles and alteration in patterns of precipitation. Climatic stresses may result in dysfunctional adaptation or response that often erodes natural resource capital (Crepin, 2008).

In the light of the above challenges, Sustainable Land Management (SLM) is not to be regarded as an option, but a national development imperative, that must be aligned towards achieving long term economic growth, guaranteeing food security and conservation of the nation's resource capital.

The Federal Ministry of Agriculture & Rural Development is implementing the Nigeria Strategic Investment Framework for Sustainable Land Management (NSIF-SLM) to promote a multi-sector cooperation to reduce the risk posed by climate change on the livelihood of local farmers and ensuring the productive utilization of the nation's natural resource, promoting forest and watershed management as well as the development of the agricultural sector's investment programmes for national food and nutritional security.

Anchoring on soil

The concept of soil as "the pre-eminent component of Land, a medium for growth and development" is captivating. At the beginning of 2015, the President of the global Not For Profit Organization, "FOOD TANK", Ms Danielle Nierenberg in a circular letter to adherents, stated that, "Soil is vital to the health of both people and the planet. Unfortunately, it is often the most overlooked of all agricultural inputs."(Nierenberg, 2015)

According to the Land Institute, "---soil is every bit as non renewable as oil and it is essential to human survival. Healthy soil, [because] it stores and filters water, provides resilience to drought, plays an important role in the carbon cycle, is the foundation of agriculture and food production". I dare say that such declarations are only reiterations of views expressed early in the civilization of mankind by those who clearly understood, "the basis of sustainable Agriculture: THE SOIL" (Ash, 1941)

The President of the Land Institute and notable Plant Geneticist, Wes Jackson, went a few steps further when he recently stated. "---we're ploughing through our soil bank account and sending those riches downstream to the ocean---the loss of topsoil is the single greatest threat to our food supply and to the continued existence of civilization". (In Nierenberg, 2015)

Rev Father (Prof) Godfrey Nzamujo, Founder and CEO of the much celebrated Songhai farms puts it even more graphically,, "- –The Key to facing the present challenges of agricultural productivity is THE SOIL(capitalization is his)". He went on to espouse the imperative of developing healthy soils which he tags, "SUPER SOILS," in agriculture declaring that, "we believe that without this fundamental shift in our agriculture, our future will be seriously compromised" (Nzamujo, 2014)

According to the U.N. Food and Agriculture Organization (FAO), Director-General, Jose Graziano da Silva. "We must manage soils sustainably. There are many ways to do this. Crop diversification, which is used by most of the world's family farmers, is one of them.

This gives time for important nutrients to regenerate. This is only one example of the role family farmers have in producing food, preserving our natural resources, and safeguarding biodiversity."
In a Keynote Paper to the 39th Annual Conference of the Soil Society of Nigeria in March, 2015 which additionally celebrated the International Year of Soils (IYS) declared by the United Nations General Assembly to increase awareness and understanding of the many important roles of soil, This Author had avowed that, "--- my water roots as an Oceanographer notwithstanding, I am persuaded that SOIL is perhaps the most strategic asset in the nation's aspirations to achieve Agricultural Resilience in the face of the changing climate and must get the focus and investments it deserves."(Ibe, 2015a)

Financial Markets: Role of Micro-finance
Oftentimes, farmers starting out for the first time do not have the initial capital to invest or where they have the initial capital, they are scared that their investment would be lost should the crop or livestock fail especially as they do not have any insurance that would compensate them. This is where the role of microfinance/credit could make a huge difference.

There are many best practices to draw lessons from in forging credible micro-finance facilities in the country eg, the Grameen Bank founded by Muhammad Yunus in the 1970s for the rural poor in Bangladesh provides a veritable model.

The Growth Enhancement Scheme (GES) of FMARD that provided farm inputs to small scale farmers is a variant of the microfinance scheme and was very much appreciated by the beneficiaries.

For large scale farmers, the agriculture development programme tagged "Nigerian Incentive based Risk Sharing Agricultural Lending (NIRSAL)" scheme created by the Ministry of Finance, the Bankers Committee and the Central Bank with technical backstopping by FMARD, has proved salutary in breaking the lack of enthusiasm

Risk Management and Agricultural Insurance (e.g. Weather Indexed Crop, Livestock and Fisheries Insurance Schemes)
The climate-related risks faced by agricultural businesses include flooding (direct damage to assets and indirect damage via supply chain disruption), storms, heat waves, threats to water availability, pest invasion, crop failures, eutrophication, fish kills, mass livestock deaths, etc.

Responding to such precarious situations, governments and lending facilities in other climes have established a number of programs to create insurance or safeguard systems against disasters (index-based insurance) against which farmers have little defense.

The federal government created National Agricultural Insurance Corporation (NAIC) is far from delivering on its promise. The consensus is that private sector involvement would bring desired results. So far, it has been much talk and little "walk" in this direction.

One of Africa's first Weather Index Crop Insurance, Micro-Ensure, was introduced during the 2005-2006 growing season as a pilot in Malawi. The success of this pilot scheme, led to its extension to the introduction of similar schemes for farmers in Tanzania, Rwanda, India and the Philippines).

Secure property rights: Land tenure
Smallholder farmers who produce about 90 percent in Nigeria tend to be landless. In the rare cases where they own land, it is often in marginal lands and without irrigation. They are generally unable to improve their land either because of lack of income and access to credit or due to the precarious nature of land ownership which makes them perpetual tenants. This creates a reluctance to invest on improvements to the land.

Although land would seem to be abundant in Nigeria given the vast tracts of uncultivated lands, the customary systems of land ownership means that farmers feel landless and are pained by it. A

recent survey by JICA (2003) showed that at least 39 % of Nigeria's land mass is suitable for agriculture.

During the Town Hall Meetings convened as part of the ACARN process, the officials from the various River Basin Authorities in Nigeria described a system of land tenure in the 1980s when their mandate included Agriculture under which farmers within the jurisdiction of each River Basin Authority were "allocated" government land almost in perpetuity. Farmers agreed that the system was the next best thing to outright ownership of land.

Disaster Preparedness

Disaster preparedness is part of an adaptation measure that englobes other disaster management activities which range from disaster prevention, relief and rehabilitation to recovery and reconstruction.

The level of disaster preparedness depends on the existing capabilities at all levels including the establishment or improvement of monitoring and early warning systems. Though an important component of preventive development, the effectiveness of disaster preparedness is assured through the sensitization of the farmers about the potential danger of natural hazards and their being empowered to respond appropriately on a sustained basis.

Even with all their heroic and innovative adaptation to their rapidly evolving circumstances, it was evident that not all farmers may be able to respond on their own, that the vast majority may need the interventions of governments-federal, state and local-to build suitable protective infrastructure or to develop specific policies that will serve to mitigate the impacts of the shocks and stresses they are experiencing on their livelihoods.

Agricultural market development

A key complaint of farmers is that they are often forced to "sell off " their good harvests or watch them rot if they insist on fair prices for their produce. The lack of reliable markets kills the incentive to produce more food in line with ongoing campaigns by FMARD.

Farmers insist that it is imperative to create new Commodity Boards operating along free market lines as one way to guarantee markets and fair prices for their produce. Besides the commodity boards for high value produce, it is important to assure optimal trading conditions in the traditional markets. The traditional markets still remain important outlets for both producers and consumers, particularly for rural and peri-urban areas.

A recurrent suggestion to improve fair prices in these markets is the reduction in perishability of farm produce. Government has reacted positively to this by increasing storage facilities in the country.

Nevertheless,, most people argue that it is the success of the value chain (so called "farm to fork") that will assure favourable markets for small scale farmers. The consistency of the supply chain and volumes of produce implied will put more economic power in the hands of the farmers who produce the trigger in the chain of production, marketing and consumption.

Embedding Extension Services

The institution of robust Extension Services in the Agriculture sector is key to improved and sustainable agricultural development. For instance, UNFCCC (2008) found that farmers who had extension contact adopted farming technologies 72% greater than farmers who had no access to extension contact. Nhemachena and Hassan (2008) also emphasized that exposure to extension services influences the capacity of farmers to adapt to climate change

A "boots on the ground" interaction with small holder farmers by which direct assistance is rendered to them in the planning and implementation of food production schemes is critical to success. However, a top-down approach has characterized the process under which Extension workers tended to impose messages "from above" thereby missing out on the interaction that would have permitted the integration of the considerable body of knowledge retained by farmers (Chambers, 1983).

The arguments for the adoption of a participatory approach have been made in an earlier section titled Participatory Approaches to which the interested reader who desires greater insights on this subject matter is referred.

Conway (2012) has suggested an alternative extension system, which "encourages farmers to be analysts and innovators, and for some to be formal or informal agents."

FMARD is currently pushing a mix of both approaches by multiplying government extension agents on the ground while at the same time encouraging a motley of NGOs and the private sector at local level towards active engagement with farmers in the transfer of new technologies and climate proof farming practices. Farmer Field Schools (FFS), developed in the Philippines in the 1970s, are also being integrated in the cocktail of participatory approaches being promoted by FMARD and the States and which already show promise of achieving increased production, higher productivity and elevated incomes.

Musings on Sustainable Agriculture and the Changing Climate.

Decrying farming practices " which concentrate on monocultures and annual crops --- and which are accompanied by widespread use of chemical fertilizers and pesticides, altering the soil biota landscape and depleting its health", plant geneticist and president of The Land Institute, Wes Jackson, and farmer and author Wendell Berry state that "our present ways of agriculture are not sustainable, and so our food supply is not sustainable. We must restore ecological health to our agricultural landscapes" (In: Nierenberg, 2015).

Their views accords with those expressed by the very distinguished Founder and Director of the much celebrated and, I must add, much replicated, Songhai Farms, Fr (Prof) Godfrey Nzamujo who has argued that, "--- our industries, especially in the Agriculture Sector, are inefficient both in terms of output per unit input and in absolute terms as they end up generating a lot of wastes and entropy, and

depleting energy and other resources." He insisted that a way out of the log-jam is. "to stop viewing our problems from a 17th Century mechanistic consciousness that does not correspond to the realities and challenges of today" (Nzamujo, 2014),

One of those realities, I would submit, is Global Warming with the concomitant changing climate and intensifying climate variabilities.

It is incumbent on our generation to "step up to the plate" with viable solutions to obviate the disastrous consequences of inaction or wrong actions

"Songhai Farms---", Nzamujo posited, "develops and promotes a process that strives to harness the regenerative forces /elements in nature to [ensure] an agriculture that is not only multifunctional , but also enhances benevolent cycles and pathways" and concluded that " It is therefore clear that this agriculture will no longer be primarily a chemical process, like conventional agriculture. Instead, it will be largely a biological process where our incredible environmental and biological capitals are fully engaged and harnessed --- IT IS PRODUCING MORE WITH LESS."

The "ORACLE" has spoken !

On his part, Jerry Glover, an agroecologist for the U.S. Agency for International Development(USAID) asserts that, "--- In this new century, farmers will need to produce more from their lands as they have in the past, but with fewer chemicals, fertilizers, and nonrenewable energy sources; all while causing less harm to the soil, water, and surrounding environment," (In: Nierenberg, 2015)

The issue of the continued use of inorganic fertilizers and chemicals in our Agriculture will be among the greatest battle grounds in the face of the expected impacts from the changing climate.

Then, there is the issue of Agricultural Intensification and specifically Sustainable Intensification identified by the Montpellier

Panel as “A New Paradigm for African Agriculture” It is defined as, “--- a pathway which strives to utilize the existing land to produce greater yields, better nutrition and higher net incomes while reducing over reliance on pesticides and fertilizers and lowering emissions of harmful greenhouse gases. It also has to do this in a way that is both efficient and resilient and contributes to the stock of environmental capital.”(The Montpellier Panel, 2013)

The question often asked in Nigeria is, “Do we need Intensification?” when we have large tracts of unutilized land and seeming abundant water resources at least in the south? The truth is that inappropriate land use and poor management have led to an increasing decline in productivity of the land. Water scarcity is also a problem particularly with the recurrent droughts in the northern parts of the country. Unwholesome agricultural practices such as bush burning, inefficient fertilizer and pesticide use, heavy tillage, poor forage choice, deleterious environmental practices, etc have exacerbated the production of greenhouse gases. Yes, we need to subscribe to sustainable intensification to cope with the spiraling challenges of the changing climate.

One last word: The Population-Prosperity Nexus.
Agricultural Development cannot be discussed in isolation but must integrate socio-economic and Governance issues in consonance with the Sustainable Development mantra.

One such consideration is Population. Population is generally viewed as an asset in terms of available hands and market size. But there is always a turning point at which per capita considerations kick in and where population trends must match available national resources.

A look at population trends in Africa shows that in 1960, Africa and Asia were growing at about 2,5 % while Latin America had a 2.9 % population growth rate. By 1988, South Asia and Latin America had

dropped to 2.1 and 2.5% respectively while Africa had ballooned to 3.2% (World Bank, 1989).Today, population growth in Africa is still inordinately high at 2.5- 4.7%

Africa's population growth is the highest anywhere on the globe and balks any known trends. For example, whereas in Asia and Latin America, better health care and education have engendered falling population growth rates, the reverse seems to be the case in Africa.

The link between galloping population growth and environmental degradation is obvious and particularly alarming. Huge populations mean more mouths to feed, more conflicts over resource use, more energy to be consumed, more bodies to be clothed, more wastes to be generated, more health services to be deployed, etc (World Bank,1989,). By extension, there will be too little to be saved or invested to improve the economy, environment and living standards.

It is a truism that no region has ever developed with so high a population growth. So, the willingness to effectively tackle the population explosion in Africa (continent with youngest population!) will determine whether the degradation of natural ecosystems, which has direct negative implications for Agricultural development, will continue to threaten sustainable economic growth on the continent.

Nigeria, as the giant (due to its huge population!) of Africa must take heed to manage its population growth rates in a way consistent with the Sustainable Development mantra so that a demographic boon does not degenerate to a demographic disaster.

Conclusion

The linkage of agricultural adaptation to the changing climate is through changes from known (traditional) agricultural practices to different modes that afford coping mechanisms in regard to the impacts, actual and expected, of climate change while at the same time producing the expected improvements in yields. Changes in

agricultural practices involving several factors, such as relative costs, resource availability, and the institutional arrangement, will help determine the ultimate outcome, with sector developmental policies likely to play a critical role.

The methodologies involved in making management decisions taking into account climate change must be predicated as much on economic data as on agronomic impacts.

It is our responsibility and privilege across academic /professional disciplines to educate the public on this nexus between climate change Adaptation and Mitigation on the one hand and national food security, poverty eradication, gainful employment, economic prosperity, maintenance of ecosystem services and sustainable human development, on the other.

Obviously, the status quo is not tenable. Change is imperative. While Change will have significant costs, the implications of remaining on a business as usual path are already enormous and growing

We can achieve Change by supporting efficacious policies and actions for the sustainable management and protection of agricultural resources in the face of the changing climate.

Pursuant to building resilience into the Nation's Agriculture and its value chains via climate-resilient policies and programmes, Nigeria has produced, under the Agricultural Transformation Programme, a National Agricultural Resilience Framework (NARF) through the activities of the Advisory Committee on Agricultural Resilience in Nigeria created 2013. This road map, launched in April, 2014, describes pathways to climate change resilience, not only to underpin robust economic growth via sustainable agricultural production and development of its value chains, but so that the well-being of citizens is improved in terms of increased food and nutritional security, poverty eradication and durable livelihoods as

well as the enhanced protection of the natural resource base (the environment) for agriculture.

This is also consistent with the National Policy for Climate Change of the Federal Government of Nigeria which seeks the reinforcement of integrated agricultural intervention plans to reduce the sector's vulnerability to climate change and spiraling climate variability **(FMEnv, 2012)**

Formulation of the NARF was an effort that blazed the trail in Africa in regard to climate proofing Agriculture and its value chains in Africa and which led to solicitations for technical assistance from a number of countries on the continent for the formulation of similar platforms. Happily, the present Administration has adopted this road map as revealed by Senator Lokpobiri in his 2016 Food Day Events Speech in Abuja last November. Furthermore, in its Policy and Strategy Document entitled, The Agriculture Promotion Policy (2016 – 2020): *Building on the Successes of the ATA, Closing Key Gaps.*, FMARD declares,

"At the COP21 Summit, Nigeria presented its preexisting position on climate smart agriculture, the Nigeria Agriculture Resilience Framework (NARF). NARF has not been implemented and that will be a key focus area going forward" (FMARD, 2016, p.30).

The expectation, therefore, would be**, "all systems go!"**

However, the History of policy implementation and endearment, or the lack thereof, to transformational practices/actions, irrespective of Economic Sector, in Nigeria, is littered with summersaults, flip flops, and even 180^0 U turns. The challenges wrought by the changing climate may appear seemingly intractable but, realistically, they are resolvable.

It calls for uncluttered vision, tenacity of purpose and integrity of implementation of the **NARF.**

Evidently, SOMETHING HAS TO GIVE. But before imaginations begin to run amok to measures of herculean or draconian proportions, let me assure you that salvation lies in a rather soft option.

To borrow from the lyrics of an old Beatles ballad of the 1960s, **"ALL YOU NEED IS LOVE."** In this case, **LOVE FOR AGRICULTURE - AS A VOCATION!**

I was convinced of this option during one of my first visits to farms in rural USA in the mid 1970s, I was struck by the "love affair" between the farmers and their crops and livestock. The farmers seemed continually to "coax" their crops and "converse" with their livestock as if to will them to consistently higher yields. Somehow (yet to be elucidated!), the crops and livestock seemed happy to oblige with bumper harvests!

I took note of this TLC (Tender Loving Care) on the part of the farmers towards their crops and animals. I contrasted that with the tedium and drudgery etched on the faces, not to talk of the constant gnashing of teeth, of our rural farmers back home in Nigeria. I recall concluding then that LOVE for the occupation(more appropriately, Vocation!) made the difference in regard to why their farmers laugh all the way to the Bank while ours are steeped, almost inexorably, in poverty and deprivation. At the policy level, I learned note of the LOVE on the part of the Decision Makers (Local, State and Federal) for American farmers whose commitment guarantees national food security and ensures the availability of the raw materials that turn the wheels of their industries. This is a potent cocktail of LOVE!

There has been little in my experience ever since to contradict that earlier conviction.

YES, to implement defined policies and entrench identified agricultural practices to combat the worst consequences of the changing climate on Agriculture and its value chains,

ALL YOU NEED IS LOVE!

It is the kind of LOVE that goes beyond INFATUATION to DEVOTION.

There is little else to add!

ACKNOWLEDGEMENTS

Since 2013, I have enjoyed my "second coming" to UNIPORT which I left in 1976. Everyone that I have met, seemed to have gone out of his/her way to smoothen my path. For me, therefore, this occasion is not to say good-bye but rather, "au revoir." I am sure that our paths will continue to cross!

In the meantime, I am deeply indebted to the following:

A man of exceptional vision, impeccable integrity and beguiling intellect, indeed, **A man For All Seasons,** Eminent Prof Joseph Atubokiki Ajienka, FAEng, 7th Vice Chancellor, UNIPORT, who invited me back to the University following our chance meeting in 2012 and " gave me room to dance." His enlightened Diaspora policy and singular attachment to transforming UNIPORT into an Entrepreneurial University propelled the reverse emigration of accomplished Scholars to the Institution; see how they Illuminate the plains of the New Calabar River!

Present Vice Chancellor, the unflappable Prof Ndowa E.S. Lale, FAvH, frequently enquired about my well being and extended courtesies to me. One could not have asked for more. May his tenure continue to be innovative.

THE ORACLE, Prof Vincent Idemyor, ever surefooted and so dependable; in between his "comings and goings," he made my stay at the IPS Guest House(aka 'the dugout') less of a drudgery. I am proud to call him a friend.

Prof Enuvie G. Akpokodje, one of the "original 3 of 1976 UNIPORT Geology," kept close upon my return and has been helpful in various ways. The other "original", Ambassador (Dr) Biodun Olorunfemi, as Permanent Secretary of the Federal Ministry of Environment, fished me out in 2010 from the Diaspora to lead the task of formulating the National Policy on Climate Change for Nigeria which was finally adopted by the Federal Executive Council in 2012.His action will remain fresh on my mind.

Immediate past Nigerian Minister of Agriculture and Rural Development, and currently, President of the African Development Bank (AfDB), Dr Akinwumi Adesina, tapped me in 2013 to co-chair the Advisory Committee on Agricultural Resilience to Climate Change Impacts in Nigeria (ACARN), alongside another distinguished Diasporan, Professor Jimmy Adegoke, Director, Center for Applied Environmental Research(CAER), University of Missouri, Kansas City, USA. That assignment reinforced my insights into the Climate - Agriculture nexus. The Minister's Technical Adviser on Environmental Policy, Dr Debisi Araba, now Director, Africa Region, International Center for Tropical Agriculture (CIAT), Regional Office for Africa, Nairobi, Kenya, expertly guided the work of the Committee and co-edited the resulting National Agricultural Resilience Framework (NARF). I have leaned on the Report of our work in preparing this lecture.

Former HOD, Department of Plant Science and Bio-technology and presently, Director, Institute of Natural Resources, Environment and Sustainable Development, UNIPORT, Professor Benjamin Ndukwu, read the original version of this lecture and offered helpful comments.

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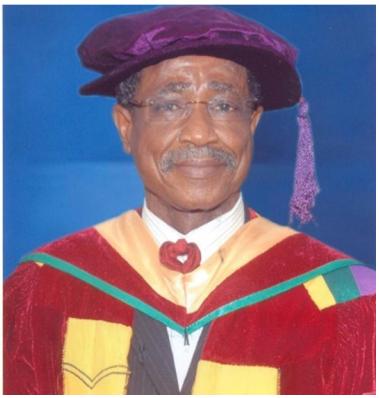
A Bridged Profile of



Professor A. Chidi Ibe FAS

With academic and professional qualifications in Geology, Engineering, Chemistry and Physical Oceanography including a 1980 Ph.D and DIC in Marine Organic Geochemistry & Sedimentology from the Royal School of Mines, Imperial College of Science and Technology, United Kingdom, A. Chidi IBE has pursued an illuminating career *inter alia* as a Petroleum engineer, Reservoir/production geologist, Research Organic geochemist, Oceanographer, University teacher, Technical editor, United Nations technocrat and diplomat.

In between, he has published extensively, singly and jointly, with 18 books/manuals, over 100 technical Papers in reputable journals and refereed Conference Proceedings, 15 Book Chapters and about 50 top flight Consultancy Reports for the Private Sector, United Nations Agencies, and Governments to his credit. His Technical Series, deriving from his Ph.D Thesis, which appeared in the Journal of Petroleum Geology, UK in the 1980s revolutionized the thinking on the Origin of Petroleum in Carbonate Rocks which hitherto had remained an enigma. His enquiry, in collaboration with Dan Lambert- Aikhionbare, into the Source Rocks of hydrocarbons in the

Niger Delta, published in the Bulletin of the American Association of Petroleum Geologists in 1984, detailed an alternative view point on the Origin which has since been classified and quoted as "A School of Thought." These exertions in decoding **SOURCE ROCKS** earned him the sobriquet of **"SORCERER"** in Oil Industry circles

His incisive research and benchmark publications on Ocean Dynamics and Coastal Erosion in Nigeria and Africa during his service at the Nigerian Institute for Oceanography and Marine Research (NIOMR) and as a founding Visiting Lecturer to the Institute of Oceanography (IOC), University of Calabar, in the 1980s brought him to national and international prominence.

A. Chidi Ibe was an early member of the Intergovernmental Panel on Climate Change (IPCC) in the late 1980s that revealed the dangers of Global Warming and Climate Change. In 1989, he coordinated UNEP's earliest Activities on Climate Change in Africa while a Senior Resident Consultant in UNEP Headquarters, Nairobi, Kenya. As Senior Assistant Executive Secretary and Head, Marine Pollution Research and Monitoring Unit in the Secretariat of the Intergovernmental Oceanographic Commission of UNESCO, Paris in the first half of 1990s, he led the Programme on Global Investigations of Pollution in the Marine Environment (GIPME) that prompted international focus on the dire state of the Oceans and published seminal Papers on Quality Assurance/ Quality Control procedures. He received a Plaque of Honour from the Kuwait based Inter-governmental Regional Organization for the Protection of the Marine Environment (ROPME) for coordinating the Oceanographic Studies (100 day-cruise on US-NOAA's RV Mt Mitchel) for the cleanup of the region following the First Gulf War in 1991. He also received, alongside IOC-UNESCO, Merit Awards from the Emirate of Kuwait, the Kingdom of Saudi Arabia and the Islamic Republic of IRAN for his efforts.

In 1998, the Director General of UNIDO, Vienna, which he had joined in 1995 as Regional Technical Advisor/Director nominated him for the prestigious Sultan Qaboz International Environment Prize for successfully promoting the innovative Large Marine Ecosystem (LME) Approach to Ocean governance especially in the Guinea current Region. In his last 2 years (2006 – 2008) as Regional Director GCLME, at UNIDO, he served concurrently as Executive Secretary, Interim Guinea Current Commission (IGCC).

A relentless University Teacher and avid Researcher cutting through his years in the UN system, Professor Ibe has trained and mentored generations of scientists/engineers both at home and abroad. He first joined UNIPORT (Department of Geology) in 1976 from Shell-BP Petroleum Dev Co.(Nig) Ltd but left in the same year because life was dull for junior academics. He returned in 2013, "with value added," as an NUC Distinguished Scholar in Diaspora.

In between teaching "everything" during this "second coming", including "Entrepreneurship and Management," and revising Course contents "within reach," Prof Ibe devoted time and resources, as a Member of the Governing Board of the Institute of Natural Resources, Environment and Sustainable Development (INRES) to establishing and stocking the Institute's Library (subsequently named, A. Chidi Ibe Library); to transforming INRES to an African Regional Training Centre by obtaining Funds for participating African Students from the Nigerian Technical Development Fund of the DTCA (Ministry of Foreign Affairs) administered by the AfDB; in addition to negotiating Memoranda of Understanding with such strategic technical Agencies as the National Space Research and Development Agency (NASRDA), the Office of the Surveyor General of the Federation (OSGOF) and the Nigerian Meteorological Agency (NiMET) among others which have made the prodigious data sets and training facilities of these Agencies accessible to UNIPORT staff and students. He has also expanded the horizon of both INRES and UNIPORT through associations forged with foreign Universities and International Organizations including relevant United Nations Agencies.

He is a USA based Independent Expert on Energy, Environment and Climate Change. He has been variously a University Pro-Chancellor and Chairman of Governing Council (IMSU); Chairman of a Presidential Visitation Panel to Federal Universities (ATBUT); Chairman of the House of Representatives National Panel of Experts on Climate Change Policy and Legislation; Lead Consultant to the Federal Ministry of Environment on National Climate Change Policy; Co-Chair of the Advisory Committee on Agricultural Resilience to Climate Change Impacts in Nigeria (ACARN) to the Federal Ministry of Agriculture; and Member, Technical Committee of BATNF; among other engagements in public service. A Fellow of the Nigerian Academy of Science (FAS) and Emerald Energy Institute Fellow (EEIF), he is an Adviser to the UN-Sustainable Development Solutions Network - Nigeria.

A published Poet and Knight Commander, UNN Lion and Government College, Umuahia Old Boy, Prof Ibe, born on February 23, 1947 to His Highness, Okaa Omee 1 of Mbieri, holds the Chieftaincy title of KPAKPANDO in Nekede Ancient Kingdom. He is a goodwill Ambassador of Cross River Sate, Nigeria.

Mr. Vice Chancellor, Distinguished Ladies and Gentlemen, it my special privilege and distinct honour to present to you,

THE SORCERER.

Prof. Vincent Idemyor
Orator