KEYNOTE ADDRESS

Nature Conservation for Sustainable Agriculture and Climate Change Response

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PROTOCOL

Your Excellency, The Executive Governor of Anambra State,

Mr Chairman of this Opening Ceremony,

Hon. Commissioner for Agriculture, Anambra State,

Vice-Chancellor, Nnamdi Azikiwe University, Awka

Principal Officers of the University Present,

Dean, Faculty of Agriculture, Nnamdi Azikiwe University, Awka

Deans of Faculty and Directors of Institute of the University,

Heads of Department and Professors Present,

My Lords Spiritual and Temporal,

Special Invitees and Guest Lecturers,

Members of the University Community,

Chairman and Members of Conference Organizing Committee,

Gentlemen of the Press

I warmly welcome you all to this historic and very eventful occasion. On receiving the invitation to present a **keynote address** of this 1st Faculty of Agriculture International Conference inthis University, my originalintentwas to make this address a mere welcoming of all of us participants in less than 10 minutes and, if permitted, to formally declare the event open. To my surprise, however, the Conference Organizing Committee assigned a **keynote address 'topic'**to me, allotting a whooping duration of 40 minutes to me for this task. I am not familiar with this style of appending a topic to a keynote address, and the intention of the Committee in doing so is not quite clear to me. If their intention is to use the opportunity of an academic conference in a university environment to test my ambidexterity in discharging my duties in my valuednoble profession of Soil Science and Agriculture and in university administration cum management as the current Vice-Chancellor of the University of Nigeria (UNN), then I hope to pass the test. Whatever their intention is, however,I do not see myself being able to keep to my original intent, in that I may end up disappointing them and perhaps you the audience by 'hybridizing' this otherwise simple task into a mini '**academic' keynote address**. With this, I say 'welcome' to you all once again.

The theme of this conference***Sustainable Agriculture, Nature Conservation and Climate Change Response***is apt and very timely as many seem to have lost the understanding of the intricate interdependence between agriculture, natural environment and climate, and that a kind of functional balance or equilibrium among them isneedednot just to sustain life on earth, but also to improve the economy thereby improving the welfare of mankind and making this life more meaningful. Each of agriculture, natural environment and climate influences or modifies the other two over time. All forms of agricultural malpractice constitute harm to and hence degradation of the natural environment the impact to which the climate must ultimately respond. This 'change' in climate would come back to reflect in agricultural productivity, and the attempts to adjust degrade the natural environment the more, and the cycle goes on and on. This undesirable relationship among agriculture and food production, environmental degradation and climate change could, therefore,be said to depict a vicious cycle(Amalu 2005; Lal 2011).I have to briefly explore this relationship between agriculture, natural environment and climate because my **keynote address 'topic', *Nature Conservation for Sustainable Agriculture and Climate Change Response,***would appear to confine me to discussing how conservation of the natural environment makes for sustainable agriculture and mitigates climate change without looking at the reverse phenomenon.

Widespread anthropogenic-related environmental degradation and the exacerbating role of climate change in tropical Africa It is widely acknowledged by policy-makers and soil specialists that agricultural productivity of tropical Africa is lowest in the world, and that soil degradation in expanding at an alarming rate (FAO 2015). Permit me to press home the undesirable relationship among agriculture and food production, environmental degradation and climate change in tropical Africa using soil erosion as the most perversive form of environmental degradation and our southeastern Nigeria as a case study. Though soil erosion is a long-standing problem in this ecozone,land misuse/mismanagement is a major factor driving this menace. The erosion problem often becomes accelerated and advances or escalates to life-threatening gullies (**Figure 1**).

Figure 1: A gullied farmland in southeastern Nigeria. Source: Igwe (2011)

In responding to these changes in the environment, the climate not only changes, affecting Earth's temperature, precipitation and hydrological cycles. Climate change has fundamentally altered the water cycle around the world. The result is shifting precipitation and evapotranspirationpatterns. In some cases, it is more frequent severe rain events which often lead to flooding; in some others, it is increased evapotranspirationleading to more severe droughts. In many areas, therefore, rainfall has become either increasingly abundant or in desperately short supply, relative to long-time averages. And this is the way climate change affects water availability for agriculture and hence agricultural productivity. But that is not at all, because the change in rainfall pattern and characteristics (amount, intensity and distribution) has implications for the environment. Increases in rainfall intensity will pose serious erosion threat particularly in erosion-prone areas such as our southeastern Nigeria.This push-pull nexusshows that soil erosion induces climate change which in turns is a significant factor exacerbating the soil erosion crises in recent times.

Nature Conservation for Sustainable Agriculture?Nature conservation as a concept involves preserving ecological systems to the extent of coming as close as possible to their original states for maintenance of healthy environments. In the strict sense of this concept, there is no room for agriculture even at the highest levels of sustainable practices. This is because, as we all know, agriculture

involves tampering with these ecological systems and hence the natural environment.As a profession that is primarily for food production, however, agriculture is inevitable for the survival of mankind. Sustainable agriculture is about judicious exploitation of natural resources and conservation of same.Conversely as it may seem, forestry promotes conservation of natural resources and judicious exploitation of same. Forestry is thus the profession that is closest to the concept of nature conservation. One could say that agriculture is to natural environments and their provisioning of ecosystem goods what forestry is to the same natural environments and their provisioning of ecosystem services. The inevitability and universality of agriculture has led to a situation whereby virtually all natural ecosystems are now **agroecosystems**. Also, the inevitability of agriculture and the indispensable roles of forestry in the survivability of mankind gave rise to the marriage between these two professions in the form of **agroforestry.**

If we now view realistic**nature conservation** as that which involvesthe 'inevitable' **agriculture**, let us look at how it contributes to making this agriculture **sustainable**before looking at the ensuing **response of climate change**. Without prejudice to the several definitions of agriculture that we are familiar with, Late Professor F.O.C. Ezedima defined agriculture simply as the use of **three *Fs***(farming, forestry and fishing) on land to produce **five *Fs***(food, feed, fibre, fuel and fun).

There have been dramatic increases in agricultural production since the end of World War II, thanks mostly to advances in technologies. But in the words of George B. Shaw, 'science is always wrong; it never solvesa problem without creating ten more'. Imagine the increases in greenhouse gases (GHGs) emissions and other forms of air pollution,increases in topsoil erosion, accumulation of heavy metals and toxic chemicals in the soil and water resources, plant and animal uptake of them enroute the food web, loss of biodiversity,groundwater contamination,etc.These changes in the atmosphere, lithosphere, biosphere and hydrosphere constitute new threats to biological systems,environmental safety andhuman health. This situation heightened during the **Green Revolution** of the 1960s which rested on the tripod stand of breakthroughs in biotechnology as applied to breeding for improved varieties, chemotechnology defined by increased use of agrochemicals mostly fertilizers but also herbicides and pesticides,and hydrotechnology in the form of surge in irrigation technology. The use of improved varieties often entails monocropping and hence loss of biodiversity and natural ecological balance. The adverse effects of agrochemicals in agriculture even when not abused are widely known. Irrigation often goes with a wide range of the so-called irrigation externalities including salt build-up, soil erosion and disease outbreak. These numerous adverse effects led to the realization of the importance of sustainability of agriculturalpractices.

The term "sustainable agriculture" was defined by the United States Department of Agriculture (USDA) in 1977 as an integrated system of plant and animal production practices having a site-specific application that will, over the long termsatisfy human needs; enhance environmental quality and the natural resource base supporting agriculture; use non-renewable and on-farm resources most efficiently;integrate, where appropriate, natural biological cycles and controls; sustain the economic viability of farm operations; and enhance the quality of life for all.

The call forsustainable agricultureis not entirely new if we recall the **Eleventh Commandment**proposed by Lowdermilk's (1953), Assistant Chief, Soil Conservation Service of USDA:

> Thou shalt inherit the Holy Earth as a faithful steward, conserving its resources and productivity from generation to generation.Thou shalt safeguard thy fields from soil erosion, thy living waters from drying up, thy forests from desolation, and protect thy hills from overgrazing by thy herds, that thy descendants may have abundance forever. If any shall fail in this stewardship of the Land thy fruitful fields shall become sterile stony ground and wasting gullies, and thy descendants shall decrease and live in poverty or perish from off the face of the earth.

Sustainability must cut across agroecosystems and the more encompassing food systems. For these systems to be sustainable, features such as post-disturbance **resilience, adaptability** and**diversity**must be present.This is because of the need to regain forms and functions after disturbance, adjustto the new form to continue functioning even without full regain, andto take advantage of available bioresources in the post-disturbance modification of forms and functions.

So, it is aboutusing natural and non-renewable resourcesin such a way that they can regenerate their productive capacity as well asskillful application of sound biological/ecological principlesto farming systems that have minimal or no adverse effects on the environment, thereby protecting the environment.The goal is to meet society's present food and textile needs without compromising the ability for current or future generations to meet theirs.This goal has three main interdependent components – environmental health, economic profitability, and social equity (**Figure 2**).

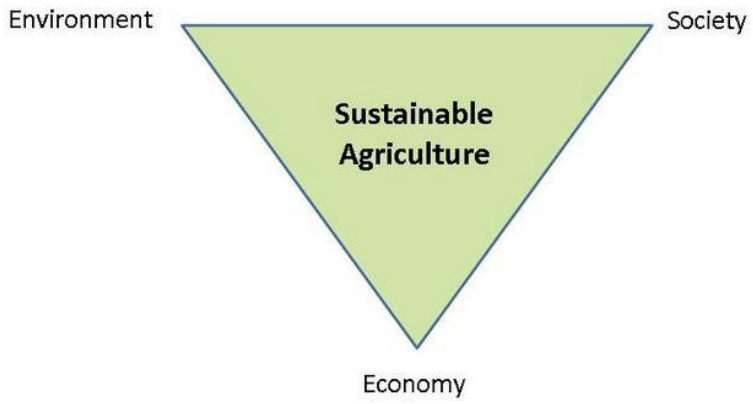

Figure 2: The three main interdependent components of agricultural sustainability

The expansion of industrial productionand the associated releases of GHGs causing climate has meant that agroecosystems and food systems need to be more sustainable. Agriculture's ability to adapt to climate change is now considered as part of what constitutes sustainableagriculture.

Sustainable agricultural practices and climate change response with focus on tropical region The prevailing high-intensity rainfall and temperatures in the tropics confer on this region high turnover rate of soil organic matter which defines soil quality. Also, most of the soil resources of sub-Saharan African are rather of sandy texture, with the majority of these soils constrained by low water retention capacity and excessive leaching of base-forming nutrient elements and hence low soil pH and low-fertility status (Igwe 2011). This situation, particularly the low levels of soil organic matter, makes for 'fragile' agroecosystems in the region. Yet, we overstretch these soils inour conventional farming systems.And these farming systems are largely characterized by a stack lack of clearly defined water control and management practices, translating into further loss of nutrients and productivity.The adverse effects of these poor water control/management systems on agriculture and the environment are pronounced in the more humid zonesof which oursoutheastern Nigeria is part of. These peculiarities of sub-Saharan Africa, among other factors, render the sub-region second to none in terms of vulnerability to climate change (Kotir 2011).

In view of the high spate and level of debilitating anthropogenic activities and the associated harm to the biophysical environment in sub-Saharan Africa, farming systems thatpromote build-up of soil organic matter are, more thanever before, needed in this sub-region.The required increases in soil organic matter translate into increased sequestration and storage of carbon in the soil, implying that such farming systems can help to reduce the concentration of carbon in the atmosphere in the form of CO_2, which is the most devastating of the three GHGs causing climate change. By improving the soil structure and hydraulic properties including infiltration and water retention, enhanced status of soil organic matter could also help toreduce wind and water erosion.

Common agricultural practices with great potentialto contribute to agricultural sustainability in tropical Africa towardsachieving global food and nutrition securityinclude:

- growing of indigenous species to restore natural ecological balance;
- mixed cropping for stratified extraction and enhanced use efficiency of water and nutrients;
- mixed cropping to enhance biodiversity that could deflect pests;
- integrated soil fertility management (ISFM) to enhance organic matter, water and nutrients;
- crop rotation to recycle nutrients and break the life cycles of pest and disease pathogens;
- cover cropping and live mulching to conserve soil organic matter and water;
- drip irrigation to save water and enhance water and nutrient use efficiency;
- rainwater harvesting to cope with water scarcity and quality issues in agriculture;
- growing of drought-tolerant crops with less irrigation and minimize irrigation externalities;
- integrated pest management (IPM) to minimize environmental pollution;
- small-scale diversified agriculture spatially integrating crop and animal productionin a mixed crop-animal production enterprise to recycle nutrients;
- increased use of renewable energy sources suchas solar and wind power, animallabour and biofuels to reduce the input of external of non-renewable energy sources, etc.

If you ask me to propose **three viable ways of achieving sustainability in agriculture** across agro-environments of sub-Saharan Africa (humid, sub-humid, semi-arid and arid), I would view the quest for sustainability through the lens of a Soil Scientist which I am. Soils must be restored otherwise high-yielding varieties would fail even with adequate rains (Lal, 2011). Because the soil is the

base of all forms of agriculture and the most diverse component of the environment, because most of the biotic and abiotic factors against agricultural productivity in the tropics are soil-related, and considering the aforestated peculiarity of agroecosystems and food systems of sub-Saharan Africa; my answer would be that **our agriculture at the level of primary production shouldfirst be made to conform to the use of sound ecological principles in allocating land resources to agricultural enterprises they are most appropriate for.**Then, stakeholdersshould focus on farming and food systems that enhance biodiversity and productivity by concurrently promoting:

- **(i)** soil organicmatter build-up, conservation and management;
- **(ii)** efficiency in water conservation, control, management and soil-water relations; and
- **(iii)** efficiency in nutrient cycling, recycling of agro-waste and resource use.

This is to say that, in the context of sub-Saharan Africa, the primary goal of sustainable agriculture should be to enhance soil quality/health through increased storage of carbon in the soil. By virtue of the high heat capacity of water, soil water plays a critical role in regulating the exchange of mass (water and carbon) and energy in the land–vegetation–water–atmosphere system. Adopting and maintaining good water control and management could thus complement this increased carbon storage by creating the enabling environment for decelerating the rapid loss of soil organic matter. The corresponding loweringof atmospheric CO_2 concentrationand the efficiency in recycling/use of resourcesimplyenhancement in quality of the **environment**, and the response of climate change would be palpable reductions ofits manifestations in the agroecosystems and impact on agricultural productivity. This situationwould lead to increased agricultural productivity to take care of human needs in the **society**and contribute to improvement in our**economy**.

This proposition of sustainable agricultural practices in sub-Saharan African will not be complete without mentioning the ***sawah* ecotechnology**, which is a viableecological engineering approach to agriculture for overcoming the perennially low and fluctuating agricultural productivity in this sub-region. This promising farming model draws its strength from the principle of allocating land resources to agricultural enterprises they are most appropriate for in a given watershed (**Figure 3**), while using the watershed approach to resource distribution in implementing site-specific good water control and management. *Sawah* plays multifunctional roles in tropical African agriculture, including ecological, agronomic, social and economic roles (Igwe and Wakatsuki, 2012). Space and time will not permit us to discuss *sawah*ecotechnologyand its prospects in detail here,but note that the efficiency in water control and managementdue to this farming model is indispensable if we must attain self-sufficiency in food production. In this quest of ours for sustainabilityof ouragricultural systems in the face of water-related adversities (be it water scarcity or flood) induced by climate change, such efficiency in water control and managementcould serveas an effective mitigation strategy for increased provisioning of ecosystem goods and services.

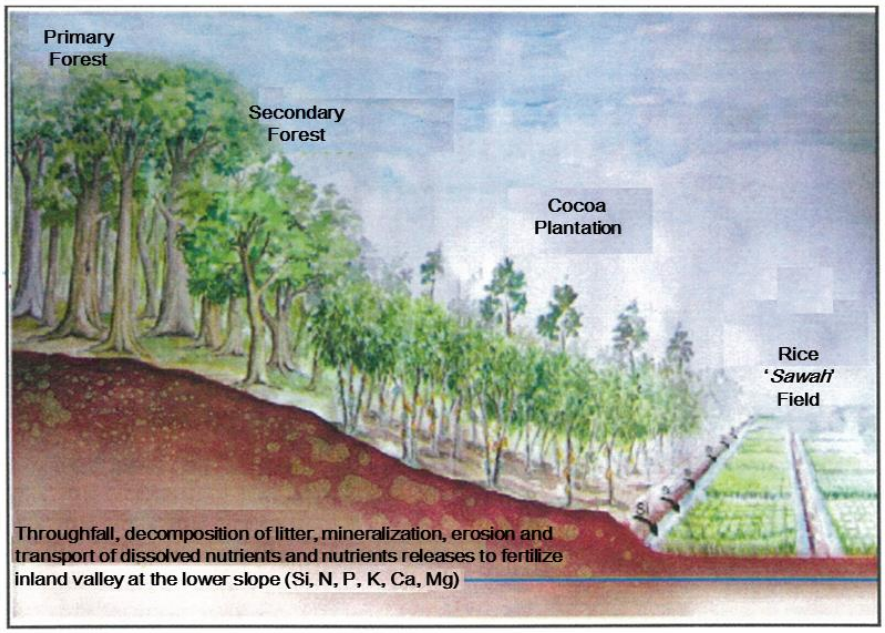

Figure 3: The conceptual illustration of *sawah* farming for tropical Africa model developed by the Forest Research Institute of Ghana.Source: Owusu-Sekyere *et al.*(2010)

Knowledge resource base of Nigeria in the quest for sustainable agriculture To use and manage theenvironment sustainably in the course of practicing agriculture, natural resources are not the only requirement; adequate knowledge is also needed, and this 'intellectual resource' should be such that would match the natural resources at the prevailing scale of agriculture. So, adequacy or otherwise of skilled human resource in this regard is critical. This is because until the largely uninformed masses living in remote

villages and communitiesare properly educated on the contributions of unsustainable agricultural practices to the contemporaryclimate changevis-à-vis the prospects of retracing their footsteps, sustainability may remain elusive. Knowledge is key, information is power. There is need to sensitize the people as doing so holds the key to success of the desire and bid to enthrone sustainability in our agriculture.

If the requisite knowledge rests with the skilled manpower in agriculture, then any country aspiring to attain sustainability must evaluate its skilled human resource base. In the case of Nigeria, my experience as a key player inthe training of future agriculturists is that such training under the various degree programmes in Agriculture has changed form. Low enrolment of students into these programmes was the problem in the recent past, but it is no longer so. The emerging problem is sheer lack of passion and interest in agriculture by those receiving training in Agriculture, and this is not a good development for us as far as the campaign for sustainable agriculture is concerned. Strategies are, therefore, urgently needed not only on how to entice young school leavers to opt to read Agriculture as suggested by the current move by the National Universities Commission (NUC) to revert from a five-year to a four-year programme,but also to change their ill-conceived perceptions about agriculture and truly make Agriculture their vocation. It is only by doing so that training of the youth in Agriculture would add value to the course of sustainable agriculture.

Looking into the future with hope It is hoped that our humble efforts in dutifully engaging in sustainable agricultural practices that are compatible with our sub-region of tropical Africa as well as in raising a sustainability-conscious upcoming generation of agricultural practitioners would yield the desired results. Besides the numerous local benefits to us in our immediate environment, such efforts would ultimately helpto advance the Paris declaration of 4 per Thousand (4PT) Initiative “Soils for Food Security and Climate” that strives to address global climate change via the aspirational goal of enhancing the carbon stock on a large portion of the world’s managed soils by an average annual increase of 0.4%. Such a level of adherence to the principles of sustainability in our agriculture would place us in the world map of environmental stewards, and the possibility of earning carbon credits in the distant future may not be ruled out.

I will round off by posing that there is great potential for agricultural sustainability in tropical Africa typified by Nigeria. Soil and water conservation and management practices in this regard must focus on soil organic matter as well as on water and nutrient resources, while concerted efforts are needed to increase the efficiency of recycling and use of agro-waste. Who says we cannot get to a point of zero agro-waste in our agriculture, translating into full operation of the trending concept of circular economy? With the ever-increasing pressure on land resources for agriculture,we should maximize production onavailable land for as long as possible – and that is what sustainable agriculture is all about. I urge us all, agriculturists, engineers, farmers and other relevant stakeholders including the general public to be involved. All hands must be on deck, otherwise the world will leaveus behind if we opt to lose ourenvironment and hence our future, thereby bequeathing hardship to our children and unborn generations. The task may look daunting, but the time to initiate action and/or consolidate on progresses so far made is now.

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