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Prospects of Sustainable Soil Management to a Green Economy

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ABSTRACT

This paper examines the predominant role of soil resource as an integral factor that could influence the prospective contributions of agriculture to the green economy. It identifies soil as a natural resource that must be sustainably managed to maximize the contribution of agriculture to the production of food to feed the bourgeoning human population in Nigeria as well as reduce poverty level of the people. If agriculture is to contribute meaningfully to the transition to green economy, the soil issue must be taken seriously. To this end, the paper highlights certain factors that affect soil productivity which must be addressed to enhance the contributions of agriculture towards the realization of a green economy. These include soil erosion, soil salinity, perennial flooding, desert encroachment and drought, soil mismanagement and misuse which result in the decline in soil fertility. The paper therefore recommends pragmatic actions that must be taken to address these problems such as land–use management system like agroecology, agroforestry, scientific crop rotation system, no-till cultivation and appropriate application of soil improvement fertilizer, among others.

The need for a paradigm shift from "brown economy'' characterized by heavy reliance on fossil fuels to green economy has taken a central stage in both local and international discourses. Green economy has recently become a policy debate topic due to its promise of exemplar shift from the earth climate, food and economic crises to sustainable green growth. Conceptually, a green economy is one that results in improved human well-being and social equity, while significantly reducing environmental risks and natural inadequacies. In its greenest expression, a green economy can be thought of as one which is low carbon which provides a better quality of life for all within the ecological limits of the planet. It is also seen as a way to sustain development thereby eradicating poverty in the environment for the social and economic well-being of man (UNEP, 2010).

Habitually, the transition to green economy entails moving away from a degenerating system to that which proactively addresses and prevents the crises endangering earth's degeneration. That means that our natural resources e.g. soil, water, flora and fauna should be managed and tied together in such a way to make more meaningful aids to national development. It is good to know that the concept of green economy is not a substitute for sustainable development; rather, it is a path to sustainable development, (Idumah *et.al.,*2013). Green economy tries to find and address the disparity between present economic practices and the ecological actualities of the varied economic environment (Damme, 2012). Green economy has the prospects to increase natural wealth that have been depleted or degraded under the "current russet" economy over social and natural resources development (Akinwole, 2013).

Green economy is characterized by storing asset in agricultural knowledge that enhances the usage of soil natural resources, improvement distribution and benefit in renewable form of energy, lower carbon emission, promoting sustainable ingestion and manufacture pattern with the industrialized countries taking the lead, promoting sustainable communal housing by using healthy skills in building and creating industrial job breaks, proper management of chemical products, biologically viable waste management, understanding of the growth of economic activity with sustainable resource management and robust environmental protection UNEP (2010).

The Prospects of Agriculture towards the Realization of Green Economy in Nigeria

Agriculture is well placed to contribute to a transition towards a green economy as many agricultural activities potentially offer solutions to the social, economic and environmental challenges that humans are currently faced with. Specifically, there are opportunities for agriculture to provide livelihoods and food security for a rapidly expanding population, reduce the risks from climate change, and meet increasing demands for energy in the face of dwindling reserves of fossil fuels (Jensen et al., 2012). The relationship between agriculture and the green economy has been summarized by the United Nations Food and Agriculture Organization (FAO) in a concept note prepared for the Rio+20 conference as "the single largest sector using 60% of the world's ecosystems and providing livelihoods for 40% of today's global population, the food and agriculture sector is critical to greening the economy. There will be no green economy without agriculture (FAO, 2012). Furthermore, given the increasing demand for food and other commodities for a burgeoning human population, expected to reach nine billion by 2050, it is imperative that the efficiency of agricultural systems should improve.

To improve efficiency, the agricultural sector has to investigate how best to meet demands for increased outputs in a way that is more efficient in its use of resources, and less damaging to the environment (i.e., to decouple agricultural production from resource use and environmental degradation). In addition, agriculture should also create sustainable livelihoods for farmers and others along the supply chain (Farming First, 2013). It is critical to investigate how the sector can best contribute towards a green economy, through agriculture-based green economy initiatives, i.e., initiatives in the agriculture sector which can support a green economy

The Role of Soil in Agriculture and Food Production

Healthy soils are the foundation of the food system. Soils are the basis for agriculture and the medium in which nearly all food-producing plants grow. Healthy soils produce healthy crops that in turn nourish people and animals. Indeed, soil quality is directly linked to food quality and quantity. Soils supply the essential nutrients, water, oxygen and root support that our food-producing plants need to grow and flourish. They also serve as a buffer to protect delicate plant roots from drastic fluctuations in temperature. A healthy soil is a living, dynamic ecosystem, teeming with microscopic and larger organisms that perform many vital functions including converting dead and decaying matter as well as minerals to plant nutrients (nutrient cycling); controlling plant disease, insect and weed pests; improving soil structure with positive effects for soil water and nutrient holding capacity, and ultimately improving crop production.

A healthy soil also contributes to mitigating climate change by maintaining or increasing its carbon content. Nutrient exchanges between organic matter, water and soil are essential to soil fertility and need to be maintained for sustainable production purposes. When the soil is exploited for crop production without restoring the organic matter and nutrient contents, the nutrient cycles are broken, soil fertility declines and the balance in the agro-ecosystem is destroyed. Food availability relies on soils as nutritious and good quality food and animal fodder can only be produced if our soils are

healthy living soils. Over the last 50 years, advances in agricultural technology and increased demand due to a growing population have put our soils under increasing pressure. In many countries, intensive crop production has depleted the soil, jeopardizing the soils productive capacity and ability to meet the needs of future generations FAO (2015).

Soil, Agriculture and Green Economy Nexus

The quality and health of soil determine agricultural sustainability, environmental quality and as a consequence of both plant, animal and human health. Hence, the need for farmers and other users of land to develop strategies for sustainability that conserve renew natural resources such as soil. Much attention has been paid in recent decades to mitigating soil erosion through physical conservation measures and providing supplementary nutrients and water to meet crop needs. Less consideration has been paid to the soil as a dynamic living resource, although its condition is vital to both the production of food and fiber and to global balance and ecosystem function. A healthy soil has the ability to perform or function according to its potential, and to change over time due to human use and management or to natural events. Soil health is enhanced by management and land-use decisions that consider the multiple functions of soil and that take into account that soil is a living organism. It is impaired by overuse of one input factor in order to reach the maximum crop yield potential. The time scale is an important consideration as seasonal and yearly changes in crop/land use patterns can be effectively managed to compensate for changes in soil condition and to restore a healthily functioning soil. Without maintenance of biodiversity, the soil's capacity to recover from natural or anthropogenic agitations may well be reduced. Similarly, maintenance of the soil's capacity to perform functional processes, such as those associated with nutrient cycling and the breakdown of organic matter is important in order to sustain plant growth in the long-term (FAO, 2016).

Factors Affecting Soil Resources towards the realization of Green Economy

In Nigeria, one of the reasons for the failure of agricultural plans is underestimating the importance of soil status and, therefore, mismanagement of the nation's soil. The lack of soil knowledge by Nigerian farmers has led to a lot of soil damage and abuses. However, the factors affecting soil towards the realization of green economy is not only management but climatic and environmental as well. They include:

1. Soil Erosion

Soil losses through erosion continue unabated in the modern world at ten times the estimated sustainable rate of soil losses. More than 10 million hectares per year are lost to erosion which results from actions of wind and rain upon the soil (Moran, 2006). Deforestation is one of the major human activities that cause soil erosion and land degradation. In Nigeria forest are being lost at a very rapid rate. Should the current rate of loss persist, the sustainability of Nigeria's forest will be threatened. One of the effects of deforestation is to set in motion different types of soil erosion, depending on the ecological zone under consideration with the resultant soil erosion considerably affect agricultural production

Table: Soil Erosion impacts in selected states in Eastern Nigeria

S/N	State	No of Gully Sites	Status	Control Measures
1	Anambra	700	Mostly Active	Not Successful
2	Abia	30	Some Active and Some Dormant	-
3	Ebonyi	250	Mostly Minor Gully Sites	No Record
4	Enugu	600	Some Active and Some Dormant	Not Successful

2. Soil Salinity

Excessive soil salinity affects production of many agricultural crops, especially vegetables that are particularly sensitive throughout the ontogeny of the plant. Salinization does not result to immediate treats but its effects on soil are obvious on crops after a period of time (Nwankwoala, 2011). According to the Department of Agriculture United States (USDA), crops such as onions are sensitive to saline soils, while cucumbers, eggplants, peppers, and tomato are moderately susceptible. Also, salinity affects crop and vegetable growth, leaf length, and number of leaves, which reduce yields and, in severe cases, total loss of crop yield. The coastal areas of Nigeria are gets affected heavily by salinization. Saline soils occur in small patches in the

semi-arid belt of northern Nigeria. Such soils rarely occur in the southern parts of the country where high rain fall affords considerable leaching of the salts beyond root zone.

3. Flooding

Flooding occurs throughout Nigeria in three main forms: coastal flooding, river flooding and urban flooding. Coastal flooding occurs in the low-lying belt of mangrove and fresh water swamps along the coastal Floods and landslides are mainly natural hazards intimately related to soil and land management practices although their impact is often exacerbated by unusual environmental conditions. Landslides have a predominantly local impact on food production although they may temporarily impact food distribution through the disruption of communication networks. Flooding may cause soil erosion with the loss of soil, seed and in extreme cases crops and pollution with sediments. Often in addition to the damage to soil and the natural environment there are also major impacts for human activities and human lives, damage to buildings and infrastructures, and loss of agricultural land.

River flooding occurs in the flood plains of the larger rivers, while sudden, short-lived flash floods are associated with rivers in the inland areas where sudden heavy rains can change them into destructive torrents within a short period.

Urban flooding occurs in towns located on flat or low lying terrain especially where little or no provision has been made for surface drainage, or where existing drainage has been blocked with municipal waste, refuse and eroded soil sediments. Extensive urban flooding is a phenomenon of every rainy session in places like Lagos, Maiduguri, Aba, Warri, Benin and Ibadan.

Virtually every Nigerian is vulnerable to disasters, natural or man-made. Every rainy season, wind gusts arising from tropical storms claim lives and property worth million of Naira across the country. Flash floods from torrential rains wash away thousands of hectares of farmland . Dam bursts are common following such flood . Flooding is a result of two factors; environmental factor (climate change and man-made factor. Since the climate change is not just a result of practices in Nigeria but a trans-continental factor.

4. Desert Encroachment and Drought:

Desertification is a complex process of land degradation through natural and human induced impacts (e. g. as a result of environmental responses to climate change), expressed in increased periods of droughts or overuse of natural resources, especially vegetation covers, by grazing or fuel wood collection, with subsequent soil degradation and losses, including salinisation (Latowski, et.al., (2010). Desertification increases the pressure on still productive land and soils for food production and may even cause social conflicts (Blum, 2009).

5. Soil Nutrient Mining

Soil nutrient mining is possibly one of the most significant threats to food production in large parts of the tropics. Agricultural production in much of Africa is threatened by nutrient mining (Hartemink, 1997). The context of agricultural production in much of the continent is one of fragile ecosystems, low inherent soil fertility and low use of modern inputs such as mineral fertilizer and improved crop varieties. The traditional practice in Africa and in particular Sub-Saharan Africa is one of fallow systems, where soil is left uncultivated to allow "recovery". Increasing pressure on land through both rising population and in some countries exclusion of indigenous populations from parts of the landscape through land grabbing has resulted in a reduction in the length of fallow periods and in some cases their removal.

Nutrient balances which consider the inputs and outputs from the system have been used to estimate the magnitude and extent of nutrient mining. During the period of 2002 —2004 85% of African agricultural land (1. 85 million km^2) had annual nutrient mining rates of over 35 kg (N, P and K) per hectare, and 40% had annual rates greater than 60 kg per hectare. There are of course wide variation in the observed rates across the continent with an annual rate of 8 kg ha^{-1} in Egypt and 88 kg ha^{-1} in Somalia.

6. Declining Soil Fertility

Soil fertility is an intrinsic ability or capability of the soil to provide plant nutrients and water in adequate amount and when required, for good growth and development of the crops. On the other hand, soil fertility decline (also described as soil productivity decline) is a deterioration of chemical, physical and biological soil properties and subsequent reduction in providing the crops with adequate nutrients and water. The main contributing processes, besides soil erosion, are:

- Decline in organic matter and soil biological activity;
- Degradation of soil structure and loss of other soil physical qualities.

  Reduction in availability of major nutrients (N, P, K) and micro-nutrients, and
- Increase in toxicity, due to acidification or pollution, among others

According to FAO (2001), Nigeria is one of the countries with high declining soil fertility. The country was estimated to be losing an average of 24 kg nutrients/ha per year (10 kg N; 4 kg P2O5, 10 kg K2O) in 1990 and 48 kg nutrients/ha per year in 2000, that is, a loss equivalent to 100 kg fertilizers/ha per year. However this figure is postulated to have dropped appreciable since

the government and other foreign organizations started investing heavily on fertilizer. Soils in most of Nigeria have inherently low fertility and do not receive adequate nutrient replenishment. The nutrients in a fertile soil are nitrogen, phosphorus, potassium, organic carbon, zinc (DTPA), and pH level.

7. Soil Mismanagement and Misuse

Human-induced soil degradation is now a major problem and one of the leading causes of environmentally induced displacement. Environmental consequences of poor farming are currently visible in the country. Examples of mismanagement of land in Nigeria are

a. Deforestation: Uncontrolled logging and tree felling from without restocking and rampant bush burning are the order of the day in many parts of the country; these increase the leaching of precious soil nutrients.
b. Inappropriate agricultural practices such as lack of crop rotation, adoption of maximum tillage, inadequate or total lack of fallowing, inadequate fertilization, overgrazing, and absence of mulching the destruction of watersheds, and the opening up of riverbanks and other critical areas have led to silting of riverbeds and loss of watercourses. In addition, uncontrolled use of agro-chemicals and the concomitant problems of chemical persistence in the soil in humid areas and soil-crust formation in arid climates have contributed to salinization and destruction of vast agricultural lands.
c. Oil pollution (including spills, oil well blow-out, oil blast discharges, improper disposal of drilling mud) has created problems that has resulted in destruction of vast farmlands in the Niger Delta (Etuonovbe, 2009).
d. Overpopulation has brought about conversion of rich farmlands into buildings and construction site (Nwankwoala, 2011) thus reducing the area available for food production.

RECOMMENDATIONS AND CONCLUSION

To enhance the productivity of soil in Nigeria as well as reduce its degradation, reliable and proven soil conservation technologies could be adopted and these include ridge planting, no-till cultivation, crop rotation, mulches, living mulches, agroforestry, terracing, contour planting, cover cropping and installation of wind breaks. Soil salinity can be controlled by use of irrigation system that supplies the farmland with large quantity and quality of (fresh) water and also installing drainage systems to reduce the high water table of saline waters will also reduce the salinization of farm lands during rainy season. Declining soil fertility can be adequately managed by proper practice of rotation, bush fallow, application of the right fertilizer and general proper management of the farmlands. Problem of farmers' mismanagement of the soil could be mitigated by agricultural extension services. Soil extension services aimed at educating farmers on improper soil management practices have been on for decades but need reactivation. Though agricultural extension can be traced to the colonial era, it has however grown in strength till date, yet many of the rural farmers still behave in uninformed manner with regards to general soil management attitudes (Arokoyo, 2003; Olajide, 2004). There is a great need for government at all levels to increase their extension budget since World Bank withdrew funding on agricultural extension services. This is to enable soil management education reach every farmer in the country. Petroleum corporations' adherence to environmental laws of the federation on spill clean-ups and land reclamation will greatly reduce their mining operations causes to the soil.

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