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Green Economy-A Panacea for the Devastating Effects of Climate Change on Agricultural Productivity in Southeast Nigeria

I.U.O. Nwaiwu*¹; C.C. Asiabaka² and D.O. Ohajianya¹

1. Department of Agricultural Economics, Federal University of Technology, Owerri Nigeria

2. Department of Agricultural Extension, Federal University of Technology, Owerri Nigeria

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*I.U.O. Nwaiwu Department of Agricultural Economics, Federal University of Technology,
P.M.B. 1526 Owerri Nigeria: e-mail: niuche2004@yahoo.com

Abstract

The study was carried out in southeast Nigeria. It focused on green economic path and the severe implications of the alternative development pathways as typified by the devastating effects of climate change on agricultural productivity. Multi-stage sampling technique was used to select a sample of 312 cassava based food crop farmers. Data were collected with the aid of structured questionnaire. Total factor productivity was used as an index of agricultural productivity. The effects of climate change on productivity were determined using ordinary least square regression method. Results showed that the mean age, household size, annual household income and farm size of farmers in the study area were 51 years, 8 persons per home, ₦391,530.64 and 0.84 hectares respectively. It was also found that factors such as excessive heat (Eh), frequency of dry spell (Ds) and frequency or incidence of flooding and erosion (Fd) negatively affected agricultural productivity while volume of rainfall positively affected productivity. The study concluded that extreme poverty is a threat to the quest for green economy and safe environment. Hence the need for a synergy among nations towards poverty reduction, cleaner and more sustainable development strategies and enlightenment campaign on the need for low carbon technologies.

Keywords: *Agricultural Productivity, Climate, Green economy, Poverty, and Carbon.*

JEL Code: Q13, O1. O2, O3, O4

1.0 Introduction:

According to United Nations Environmental Programme UNEP (2008), a green economy is one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which minimizes the rate of carbon emission, efficient in resource use and is socially inclusive. However, the observed instability in international markets with respect to fossil fuel prices, the food price crisis, and the unfolding impact of climate change on human existence have pushed the concept in various directions and given it different definitions and agenda. The approach varies according to who is behind it.

The International Energy Agency (IEA)(2011) warned that reliance on non-renewable energy like coal and fossil fuel are expected to increase to 65 percent by 2035 and will “lock” the world in the next five years on a path that could see global temperatures soar by two degrees Celsius and beyond by the turn of the century. Energy experts point out that to prevent this scenario, all future energy needs would have to be zero-carbon. The Intergovernmental Panel on Climate Change (IPCC) and other climate scientists regard global warming of two degrees Celsius as catastrophic, bringing water stress to arid and semi-arid countries, more floods in low-lying coastal areas, coastal erosion in small island states, and the elimination of up to 30 percent of animal and plant species.

Each year until 2030, at least 150 million people will be entering the middle class. This will bring almost 60% of the world’s population into a middle income bracket. Over the same period energy demand is projected to increase by 40%, and water demand is expected to outstrip supply by 40% (West and Ghosh,2010). These will also exacerbate the already degraded environment in diverse ways. Providing for the next generation of consumers in a sustainable manner presents

both a challenge and an opportunity. Leaders can position themselves to succeed in this changing framework by redefining their strategies.

Greening economic growth is the only way in which sustainable and inclusive development that will satisfy the basic needs of the over 7 billion world population (GeoHive, 2014) and provide them with equal rights to material prosperity can be achieved. A key challenge to achieving this is the urgent need to reduce carbon emissions to avoid the catastrophic impacts of global warming. Another imperative is the need to increase natural resource productivity to meet unprecedented demands for clean water, food and urban development. The scale and frequency of weather shocks, combined with long-term economic forecasts of climate change effects and fossil fuel costs, are having a political as well as an economic impact. Many pragmatic developing country governments are changing their approach to infrastructure and industrial planning, choosing to design more sustainable, resilient pathways to economic growth. They are developing comprehensive national investment programmes in clean energy, energy efficiency, water management, climate-resilient agriculture, smart grids and low-carbon transport systems. This strategic shift has been termed “greening the economy” or making a “green growth” transition. Currently, significant private investment is not being attracted to these plans due to a range of perceived risks and the relative novelty of the market. However, through public-private partnership initiatives and the direction of public funds to key risks investment areas by leveraging a step into green infrastructure projects these situations could be tackled.

The foregoing has brought to the fore the issues and challenges associated with green development pathway and the dangers of unguided development path which is consequential to climate change and global warming. As a catalyst to the quest for greener economic growth, this

paper focuses on showcasing the ravaging effects of the fast changing climate system on agricultural productivity which is a good index of measuring economic growth in an agrarian economy like Nigeria.

2.0 Materials and Methods

This study is centered in Southeast (SE) Nigeria. SE lies within Latitudes 5°N to 6° N of the equator and Longitudes 6°E and 8°E of the Greenwich (prime) meridian (M.S corporation, 2009). Southeast Nigeria is made up of five (5) States namely Abia, Anambra, Ebonyi, Enugu and Imo. The zone occupies a total land mass of 10,952,400 hectares with a population of 16,381,729 people (NPC, 2006). Multi-stage sampling technique was used to select a sample of 312 respondents across two Southeast States purposively selected based on their positions under topographic and vegetation delineations of the five states.

Data for the study were collected with the aid of well-structured and validated questionnaire. The type of data collected included those that bothered on the socio-economic characteristics of farmers like (age, sex, level of education, household size, annual income, etc.). Others were quantities of inputs and outputs used and produced respectively in physical and value terms and the perceived indicators of climate change and how they have changed over time. The soul objective of determining the effects of climate change on agricultural productivity was achieved by firstly determining the total factor productivity per hectare amongst the farmers (as an index of agricultural productivity) and hence regressing it against the identified climate variables as perceived by farmers. Here Total Factor Productivity (TFC) was computed using the model

$$\frac{V_{T_0}}{V_{T_n}} = \frac{\sum_{i=1}^n P_{qi} Q_i}{\sum_{t=1}^n P_{xt} X_t} \dots\dots\dots 2.1$$

Where V_{T_o} = Value of Total Output in naira/ha

V_{T_n} = Value of Total Input in naira/ha.

P_q = Price per unit of output in naira

Q = Quantity of Output

i = Type of output (i ranges from 1- n^{th} output type)

P_x = Price per unit of input in naira

X = Quantity of input

t = Type of input (t ranges from 1 – n^{th} input type)

Adapted from Lynam and Herdt,(1989); Ehui and Spencer (1990); Ali and Byerlee, (2000), Sidhu and Byerlee, (1992); Spencer and Swift, (1992) and Cassman and Pingali, (1995).

Finally, multiple regression analysis with the model;

TFP = f (Ds, Eh, Hss, Fd, Re,Rv, e).....2.2

Where TFP = Total Factor Productivity as a measure of agricultural productivity and Ds = Frequency of dry spell, Eh = Excessive heat/temperature, Hss = hours of sunshine, Fd = frequency or incidence of flooding, Re = Erratic nature of rainfall, and Rv = volume or amount of rainfall, are indicators of climate change and were measured using ordinal scale values ((0 = no change, 1= low, 2 = moderate, 3 = high) to elicit from the farmers their various perceptions on these indicators and e = stochastic error term adapted from (Etiosa and Agho, 2007; Okon and Egbon, 1999; French *et. al.*, 1995; Awosika, *et. al.*,1992; Oladipo,1995).

The a priori expectations were as follows; Ds, Eh, Fd, Hss, Re <0 while Rv >0.

3.0 Results and Discussions

3.1 Socio-economic Characteristics of the Respondents

Table 3.1 shows the distribution of respondents according to their socio-economic characteristics.

Table 3.1 Distribution of Respondents According to their Socio-economic Characteristics

Socio-economic Characteristic	Mean	Standard deviation	Range
Age(years)	51.3	9.65	28-75
Household size(persons)	8	2.86	2-8
Annual Income(₦)	391,530.64	0.000022	113290-1634271
Level of Education (years)	9.6	5.94	0 – 22
Farming experience(yrs)	20.96	9.28	2-60
Farm size(hectares)	0.84	0.83	0.05- 5.00
Number of extension Contact(no. of visits)	0.73	1.2	0.00- 12.00

Source: Field Survey Data, 2012.

According Table 3.1, the mean age of cassava producer farmers in Southeast Nigeria was 51.3 years. This implies that they were still within the productive age limit during which they could fully and efficiently engage in all forms of productive labour especially farm labour. The mean household size, annual household income and farm size of farmers in the study area were 8 persons per home, ₦391,530.64 and 0.84 hectares respectively. These categorized the farmers in the study area as smallholder and resource poor farmers because they farm on land between 0.1-5.99 hectares (Olayide,1980; Ogungbile and Olukosi, 1999, and Nwaiwu, *et.al.*, 2010a). This implies that they were mainly subsistence farmers who have very limited capacity to practice commercial farming. Consequently, they are also expected to have very weak capacity to practice clean and green technology as the only way to ameliorate the fast degrading environment which has adversely affected agricultural productivity and made food security difficult to achieve. Furthermore, the farmers are said to be food insecure because according to the world Health Organization WHO, an individual is said to be food insecure if that person subsists on below \$1.25 dollar per day (Todaro and Smith, 2011). This is currently equivalent to approximately (₦195.00) Nigerian naira per day at current exchange rate of ₦155.73/\$ (CBN, 2014). From Table 3.1 the per capita income of the farmers per day was about one hundred and thirty-four naira (₦134.00). This implies that they leave below \$1.25 USA dollar per day. Obviously, resource poor farmers do rarely uphold the tenets of a typical green economy because they lack the capacity to acquire and use low carbon technologies, which are said to be efficient and socially inclusive. Rather they strive to meet their daily food needs irrespective of the severe consequences on the environment. The Table also shows that the mean frequency of extension visits to the farmers was 0.73 times. This implies that extension education in the study area was very poor as such farmers would be lacking a lot in terms of availability and use of innovations

that would have been more technically and economically efficient in use for production while ensuring a sound and green economy. Finally, the mean level of education of farmers in the study area was approximately ten (10) years. This implies that they would have acquired post-primary education which makes them enlightened enough to be able to adopt available innovations that could ensure a clean and green economy when introduced to them.

3.2 Multiple Regression Result Showing the Effects of Climate Change on Agricultural Productivity

Table 3.2 shows the multiple regression result on effects of climate change on agricultural productivity (TFP).

Table 3.2: Result Showing the Effects of Climate Change on Agricultural Productivity.

Predictor	Linear	Semi-log	Double-log	Exponential
Variables	function	function	function	function
Excessive heat/ temp(Eh)	-0.041 (-4.498)*	-0.187 (-4.766)*	-0.177 (-5.742)*	-0.041 (-5.824)*
Freq.of Dry Spell(Ds)	-0.018 (-3.551)*	-0.116 (-3.361)*	-0.078 (-2.858)*	-0.013 (-3.403)*
Freq./Inci. of Flood/eros(Fd)	-0.093 (-6.183)*	-0.262 (-6.399)*	-0.226 (-6.980)*	-0.086 (-7.425)*
Hours of sunshine(Hss)	-0.009 (-1.713)	-0.055 (-1.758)	-0.045 (-1.823)	-0.006 (-1.688)
Vol.or Amt. Of rainfall(Rv)	0.034 (8.961)*	0.178 (6.880)*	0.148 (7.225)*	0.027 (9.114)*

Erratic nat.	-0.014	-0.112	-0.061	-0.007
of rainfall(Re)	(-1.865)	(-2.800)*	(-1.938)	(-1.298)
R ²	0.510	0.432	0.455	0.554
Std.error	0.37978	0.40874	0.32265	0.29189
F-value	52.920	38.739	42.439	63.139
TSS	89.787	89.787	58.261	58.261

Note: Figures in parenthesis are t-ratios. * Significant at 1%

Source: Field Survey Data, 2012.

Table 3.2 shows that the exponential function provided the best goodness of fit based on all the econometric, statistical and economic a priori criteria used for selecting a lead equation. The R² of 0.554 implies that 55% of the variations in the endogenous variable, total factor productivity(TFP) as a measure of agricultural productivity were explained by the independent variables and this is significant at 1% level (F-value 63.13). This result also shows that out of six explanatory variables, five of them (Eh, Ds, Fd, and Rv) were significant at 1%. This implies that each of these variables has great influence on agricultural productivity.

Furthermore, it would be observed from the result of exponential function that excessive heat (Eh), frequency of dry spell (Ds) and frequency or incidence of flooding and erosion(Fd) were inversely related to the agricultural productivity. This means that the higher the frequency of dry spell or longer period of drought, excessive heat and incidence of flooding or erosion, the lower the agricultural productivity. The negative sign on these variables agrees with the a priori theoretical expectation that the higher the Ds, Fd, and Eh, the lower the agricultural productivity.

According to the IPCC (1990), working with records over the last 100 years, have shown that a strong correlation exist between greenhouse gases emission and climate change and between global temperature and sea level rise. Global temperature is expected to rise by between 0.2⁰C to 0.5⁰C per decade. The rise in temperature is expected to cause thermal expansion of sea water and melting of polar ice. These will cause the sea level to rise for about 3-10 cm per decade during the next century. Another report by the IPCC (2001b) revealed that the large scale loss of land ice and thermal expansion of sea water has very likely contributed to the observed sea level rise. According to the International Federation of Red Cross (IFRC, 1999), sea level rise and flooding are already affecting millions of people worldwide. IFRC report revealed that an estimated 10 million people are at constant risk of coastal flood and floods in general are making 3 million people homeless every year, and that the number of people affected by sea level rise is on the increase annually. These worrisome scenarios are currently being suffered in the Niger Delta regions of Nigeria other coastal areas close to oceans and rivers. These analogies shows how the changing climate system leads to sea level rise and coastal flooding and erosion which were found to have drastically affected agricultural productivity.

It would be agreed that prolonged drought or higher frequency of dry spell leads to shortening of crop growing seasons and loss of farm crops, hence lower yields. This is in consonance with the opinion of Monteith, (1981) which says that if temperatures continue to increase beyond a specific threshold, a crop's productive summer growing season could become shorter, thus reducing the yield. When yields of crops are low, that means that total physical product (TPP) will be low, hence low total value product (TVP) and consequently low total factor productivity (TFP) which is the yardstick for measuring agricultural productivity in this study. However, with the knowledge of the concept of green economy and the implementation of clean development

mechanisms as encapsulated in the Kyoto protocol of the UN in 1997 (Bhardwal and Vashist, 2007), the rate of damage to our environment will reduce and increases in food production and agricultural productivity will be sustained.

Furthermore, excessive heat (Eh) increases or fastens the rate of decay, rotting or spoilage of mature or harvested farm crops (like cassava tubers and stems, yam, cocoyam, etc.). When this happens, there is loss of yield, hence lower TVP and TFP. Excessive heat also reduces labour use efficiency and when labour efficiency is reduced, agricultural productivity is also reduced. This situation can also be averted or minimized by adopting environmentally friendly and green economic development practices like, use of renewable energy sources of power as against use of fossil fuels, reforestation and afforestation programs instead of unguided deforestation, and minimizing the use of chlorofluorocarbons and aerosols. These substances/attitudes aggravate the already degraded environment by increasing the load of greenhouse gases in the atmosphere which results to global warming or increased heat load of the atmosphere near the earth surface.

The Table also shows that volume of rainfall (Rv) is positively related to TFP. This implies that the higher the volume of rainfall, the higher the TFP. Obviously, food crops grown in southeast Nigeria which is dominantly a rainforest zone requires high amount of rainfall. Cassava particularly requires about 1000-1500mm of rainfall for optimum production (Wheatley *et. al.*, 1995). Therefore as the volume of rainfall increases, total physical product increases resulting to higher total value product and agricultural productivity. However, according to IPCC (2001a), water demand by and water supply to crop plants will be modified to the detriment of crop yield as global warming progresses. With the same level of precipitable water, a higher temperature will reduce the relative humidity, and increase the sink strength of the atmosphere. As a result, more water will be withdrawn from the soil through evaporation and less optimal functioning of

the plant since flowering, pollination and grain filling will be hindered by moisture stress. These suggest that green economy is still the answer because it is all about low carbon technologies.

4.0 Conclusion

The resource poor status of the farmers in southeast Nigeria and the observed food insecurity predominant there in, are serious threats to the quest for a greener economy. These features make the region and indeed the world vulnerable to the cataclysmic consequences of the fast changing climate system. These calls for a synergy between the developed, foods secure economies of the world and the less developed countries like Nigeria to follow a more sustainable and cleaner development path. This could be achieved by strict adherence to the agreements emanating from the Rio De Janerio earth summit that gave birth to the Kyoto protocol. In this process extreme poverty will be eradicated or ameliorated in poverty stricken areas like Nigeria and the world economy will grow faster and more sustainably.

The deteriorating climate system indicated by excessive heat/temperature, flooding and torrential rains seriously and adversely affect agricultural productivity as have been shown in this study. Therefore the need to invest in cleaner and green economic development processes need not be over-emphasized. This could be encouraged among farmers and all stakeholders through massive enlightenment campaign against engagement in activities that lead to excessive emission of greenhouse gases and chlorofluorocarbons that exacerbate the fast degrading climate system and encouragement to adopt more sustainable and greener economic approaches. These include restrictions in the use of aerosols, fossil fuels and reduction in the rate of deforestation. Others are emphases on the need for afforestation and reforestation, adoption of energy saving and low-carbon technologies and the need for value re-orientation on the side of stakeholders and the citizenry

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