Economic Analysis of Climate Change Effects on Arable Crop Production in Nigeria

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Abstract
The study was designed to evaluate the effects of climate change on arable crops' productivity, in Nigeria. It estimated the influence of climate factors on farm productivity (net revenue variability) in the country. The study relied mainly on institutional (NIMET) and primary data for its analysis. Data were obtained using a set of structured questionnaire administered in a multi-stage, stratified random sampling manner on arable crop farmers producing maize, rice, cassava, yam and cowpeas. Sixty (60) farmers each were randomly selected from 5 states in each of the five agro-climatic zones in Nigeria giving a total sample size of 300. Data collected were analyzed using Ricardian model. It was found that rainfall and temperature variations, planting materials costs, household size and labour cost exerted statistically significant effects on level of gross margins. Their elasticities were 1.199 ($p < 0.01$), 8.219 ($p < 0.01$), 0.108 ($p < 0.05$), 0.097($p < 0.01$) and 0.124 ($p < 0.05$) respectively.
Keywords: Climate variability, climate change risks, arable crop productivity, Ricardian Model

1. Introduction

Climate change refers to any variation in climate over time, whether due to natural variability or as a result of human activity (Intergovernmental Panel on Climate Change, IPCC, 2001a; 2001b). Climate change in the form of higher temperatures, reduced rainfall and increased rainfall variability, reduces crop yields, reduced net farm revenues and threatens food security in low income based economies including African countries (FAO, 2007 & TerrAfrica, 2009). At the recently concluded 10th Session of IPCC WG II and 38th Session of IPCC in Yokohama, Japan, the world was warned that climate change impacts are leading to shifts in crop yields, decreasing yields overall and sometimes increasing them in temperate and higher latitudes... In light of these, some indigenous communities are changing seasonal migration and hunting patterns to adapt to changes in temperature (IPCC, 2014).

According to Sha, Fischer and van Velthuizen (2009) the adverse consequences of climate change will take an irreplaceable toll on food production and food security especially in developing countries which have a low capacity to cope and adapt to these challenges. Evidence from World Bank (2010); Schlenker and Roberts (2009) confirmed the effects of climate change on farm net revenue in different parts of the globe through rainfall and temperature variability. These probably underlie the reason why International Food Policy Institute's (IFPRI, 2014) 2013 Global Food Policy Report observed that current discussions on the post-2015 agenda is emphasizing the need to expand beyond the Millennium Development Goals (MDGs) by incorporating climate change alongside urbanization, conflict, and sustainable consumption and production patterns into the development framework.

With nearly 65 percent of Nigeria's population dependent on agriculture and the sector contributing nearly 40 percent of the country's GDP, Nigeria remains vulnerable to climatic variability and long term climate change (Ajetumobi, Abiodun and Hassan, 2010 & Madzwamuse, 2010). A decline in rain fed agriculture could be as high as 50 percent in some parts of Nigeria, noted Madzwamuse. Unfortunately credible reports from Nigerian Meterological Agency, NIMET (2012a) offered no much hope. The report indicated that Nigerian climate had shown considerable temporal and spatial shifts in its variability and change making extreme climate and weather event (drought, flood, heat waves, ocean surges, etc) a more regular event exemplified by destructive flood of 2012 which occurred in many parts of Nigeria. Eboh et al (2006) observed that, while data limitations made it difficult to estimate cost of possible crop land degradation, the historic crop yield data showed that economic cost of degradation and poor management of renewable natural resources was at least 6.4 percent of GDP in Nigeria. They found that the annual cost of yield decline as a result of environmental or land degradation from 1995-2004 to Nigeria was estimated at N210 billion. More than 60 percent of this cost was attributed to roots and tubers. The economic effects of the climate change at the micro enterprise level can be gleaned from effects on farm net revenues which is a focus of this study. In a similar vein, IPCC (2014) warned that climate change adaptation could cost $100 billion globally.

The emphasis is on smallholder farmers because they dominate the Nigerian agricultural sector, engaging about 65% of the population and contributing between 30-40 percent of the nations' GDP (Ajetumobi, Abiodun; & Hassan, 2010). Morton (2007) noted that although recently, climate change issues were receiving a lot of empirical and documentary attention, especially as they affect rural areas of developing countries, there have been relatively insufficient discussions engaging with the science of climate change impact on agriculture with the specificities of smallholder and subsistence systems. Most related studies that would have addressed the issues (e.g. Enete & Amusa, 2010; Enete et al, 2011; Umoh & Eketekpe, 2010, etc) were either too location specific, used qualitative approach or just reviewed related literature only.

The study's focus on staple crops (especially rice, yam, cassava, cowpea and maize) was instructive. IFPRI and Nigerian Strategy Support Programme's report (Nkonya et al, n,d,) indicated that despite the fact that cereals, roots and tubers dominated Nigerian crop production at a time when Nigeria is the world's leading producer of cassava, yams and cowpea, their productivities were still below potential yields while profitabilities varied across three broad agro-ecological zones of the country. IFPRI (2009) also asserted that Nigeria was characterized by high reliance on food imports amidst growing level of malnutrition across the country with rural areas being especially vulnerable to chronic food shortages, malnutrition, unbalanced nutrition, erratic food supply, poor quality foods, high food costs and even total lack of food. This situation can be exacerbated by risks of climate change if Nigeria remains aloof.

1.1 Objectives

Against the foregoing backdrop this study was designed to assess the economic effects of climate change on arable crops' productivity in the varied agro-climatic regions of Nigeria. Specifically the study: estimated the influence of climate-factors on arable crop productivity variability (i.e. net revenue variability) in the agro-ecological zones.

1.1.1 Theoretical/Analytical Frameworks

This study largely benefits from the concepts of farm risk theory and Ricardian models. The farm risk theory is related to the Modern Portfolio Theory, MPT, (Chaves-Schwinteck, 2011) which holds that the return of any kind of investment is conditioned by a determined level of risk. The existence of risk means that investors no longer associate a single number of payoff to the investment in a determined asset. In the practice of assets management, the payoff of an investment is described by a set of outcomes, each associated with a probability of occurrence (frequency or return distribution). Risks can and do create inefficiencies in markets (Skees, n.d). Having effective risk-sharing markets is important for improving the efficiency of the farm sector. Kenneth Arrow as cited in Skees (n.d) demonstrated long ago that society can gain from insurance (and other contingent claims) markets. When decision makers are risk averse, they are willing to give up some income to protect themselves from future events that may cause them to lose large amounts of income.

Ricardian models measure the impact of climatic factors through their contribution to farmland-prices and have been extensively used for incorporating farm level adaptation (Mendelsohn et al, 1996). However, problems of availability of land prices as well as non-existence of efficient land markets are two major obstacles in applying the Ricardian method to most of the developing countries, Hence, semi-Ricardian models using data on average profits instead of land prices are now being used as exemplified in two major studies on India and Brazil (Seo & Mendelsohn 2007) and Dinar et al (1998).

Yield and net revenue are both indices of farm productivity that can be applied in determination of effects of climate variability on farm productivity. The Ricardian approach uses net revenue as the dependent variable in climate change effects' modeling. Other productivity indices (which may not be applied in this present study) include technical, allocative, economic and total efficiencies (See Coelli, Prasada Rao & Battese, 1998; Onoja, Ibrahim & Achike, 2009).

The Ricardian method is a cross-sectional approach to study agricultural production. The method was named after Ricardo because of his original observation that land rents would reflect the net productivity of farmland (Mendelsohn & Dinar, 2004; Seo, Mendelsohn & Munasinghe, 2005). Net revenue (NR) consequently reflects net productivity and costs. It is represented by GM, gross margin. The Ricardian model assumes that each farmer wishes to maximize income subject to the exogenous conditions of their farm. Specifically, the farmer chooses the crop or livestock and inputs for each unit of land that maximizes income, as is expressed thus (Mendelsohn et al., 1994):

$$\text{Max } \pi = \sum Pqi\, Qi\,(Xi, Li, Ki, IRi, C, W, S) - \sum Px\, Xi - \sum PL\, Li - \sum PK\, Ki - \sum PIR\, IRi \quad 1.$$

where π is net annual income, Pqi is the market price of crop (or livestock) i, Qi is a production function for crop i, Xi is a vector of annual inputs, such as seeds, fertilizer, and pesticides for each crop i, Li is a vector of labor (hired and household) for each crop i, Ki is a vector of capital, such as tractors and harvesting equipment for each crop i , C is a vector of climate variables, IRi is a vector of irrigation choices for each crop i, W is available water for irrigation, S is a vector of soil characteristics, Px is a vector of prices for the annual inputs, PL is a vector of prices for each type of labor, PK is the rental price of capital, and PIR is the annual cost of each type of irrigation system. If the farmer chooses the crop or livestock that provides the highest net income and chooses each endogenous input in order to maximize net income, the resulting chosen net income will be a function of just the exogenous variables (Mendelsohn et al., 1994):

$$* = f (Pq, C, W, S, Px, PL, PK, PIR). \quad 2.$$

With perfect competition for land, free entry and exit will ensure that excess profits are driven to zero. Land rents will consequently be equal to net income per hectare (Ricardo, 1817 in Mendelsohn et al., 1994). Land value will then reflect the present value of net income for each farm. The Ricardian model was developed to explain the variation in land value per hectare of cropland over climate zones (Mendelsohn et al., 1994). Household characteristics were included in the model following Mendelsohn Nordhaus and Shaw (1996) and Seo, Mendelsohn and Munasinghe (2005) who got interesting results about farmer household characteristics in their studies.

2. Research Methods

The study was carried out in Nigeria. Nigeria has a total area of 924,000 square kilometers (approximately 92.4 million ha) (Federal Ministry of Agriculture, Water Resources and Rural Development, FMAWRRD, 1989; and African Development Bank, ADB, 2010). Relatively recent population estimate by World Bank (2012) indicated a population of 162.47 million in 2011 with a mean annual growth rate of 2.2 percent. Nigeria is bounded on the West by the republic of Benin and the republic of Niger; on the East by the republic of Cameroon; on the north by Niger and Chad republics and on the South by the Gulf of Guinea. With a GDP of $510, Nigeria is Africa's biggest economy. The climate is equatorial and semi-equatorial. About 20 percent of Nigeria's land area is in the humid (Swamp Forest) to sub-humid forest zone (Tropical Forest), with annual rainfall ranging from over 3000 mm in the coastal South to 1150 mm in the North and three months of dry season. The remaining 80 percent of the country is savannah subdivided from South to North, into derived or Guinea Savannah (sometimes sub-divided further into southern and northern Guinea Savannah with rainfall ranging from 1000-1500mm, and 4-5 months of dry season), Sudan Savanna (rainfall 500-1000mm, and 5-7 months dry season) and Sahel savannah along the north-eastern corner in Borno State (rainfall 250 – 500mm, and 7-8 months dry season) (see Figure 3.1). In Figure 1, the agro-climatic regions of Nigeria were clearly demarcated into five belts following NIMET (2012): Swampy Forests, Tropical Forest, Guinea Savannah, Sudan and Sahel Savannahs. According to Intermeco (2007), the midland areas and those in the north east especially show greater climatic extremes. Here temperatures could rise as high as 44oC before the commencement of rains, but they could also drop to as low as 6oC, as cold air flowed in from the North, mainly between December and February. A report by ADB (2010) indicated that arable crop land use as percentage of land area in Nigeria was 33.35 percent. FMAWRRD further noted that agricultural land use correlated broadly with the agro-ecological zones demarcated above. Such that tree and root crops along with timber production dominate the humid tropics forested South, while grain crops and pastoralism prevail in the dry northern savannah zone. Both root and grain crops co-exist while livestock is grazed seasonally in the sub-humid belt between the humid and dry zones. In the southern belts tree crops (such as oil palm, cocoa, kola, rubber, citrus) or roots (cassava, yam, cocoyam), maize, rice and vegetables are also grown. In the middle belt there is surplus output of yam, cassava, guinea corn, cowpea, groundnut and soybeans. In the north where water balance (with short rainfalls) is a critical factor, cereals (maize, sorghum, millet, acha, sesame, rice) and pulses (cowpea, groundnuts, soya-beans, ; the flood plain (fadama) are widely cultivated where garden vegetables (e.g. tomatoes, onions, pepper, ginger), cotton and tobacco are grown for cash.

A multi-stage stratified random sampling method was used to select the arable crop farmers in 5 agro-climatic zones. There were 4.2 million registered farmers in Nigeria (Aiyetan & Pindiga, 2013). From each of the agro-ecological (or agro-climatic) zones, one state each was randomly sampled giving a total of 5 states from the country. Three (3) Local Government Areas (LGAs) were purposively selected from each state (i.e. 3LGA × 5 States = 15 LGAs). The reason for the purposive random sampling was to ensure that farmers engaged in production of the five crops of interest to this study were reached in the LGA. In each LGA one (1) farming community was purposively selected based on the availability of arable crop farmers in the zone bringing to 15 the total number of communities sampled. A list of arable crop farmers (especially crop that cut across agro-climatic zones in Nigeria such as root crops (cassava and yam), vegetables (cowpea), and cereals (maize and rice) was obtained from the Agricultural Development Projects offices in each state. From the lists, 12 farmers each were selected based on type of crop produced (i.e. 12 x 5 crop types = 60 farmers) while a maximum of 20 farmers each were selected from each local government area. Since in each state 3 LGAs each was sampled, it brought the total number of farmers in each state or agro-climatic zone to 60. This gave a total sample size of 300 farmers across all the agro-climatic zones of the country (i.e. 60 x 5 agro-climatic zones). A total of 5 enumerators were engaged in the enumeration process. Each state had one enumerator covering it. They worked hand in hand with one supervisor while the researcher did the overall coordination of the entire survey process. The 5 supervisors were experienced agricultural extension experts and postgraduate students of agricultural economics & extension, environmental sciences and geography. The enumerators and supervisors were well trained on the techniques of interview and questionnaire administration by the researcher before they went to the field. The community leaders were contacted and briefed about the intent of the research before commencement of the field work.

Primary and secondary data were used in this survey. Secondary data for the data analysis were collected from the office of Nigerian Meteorological Agency (NIMET), Headquarters at Abuja in addition to some found on their website. The data provided useful information on climatic variables including mean temperature and precipitation levels in the various agro-climatic zones and weather stations of the Nigeria over a period of one year (2012) and some other information from their bulletins and archives. Primary data covering one year (based on 2012 production year) were obtained using a set of structured questionnaire and interview schedule. In addition to these, focus group discussion was conducted in some communities to identify the specific adaptation measures used in the area of study.

The econometric approach used in this study was an integrated modeling approach. The influence of climate-factors on arable crops' productivity variability was determined using Ricardian model.
Empirical models for Objective ii are as follow:

$GM = \beta 0 + \beta 1\ Rain + \beta 2\ Temp + \beta 3\ Sex + \beta 4\ Age + \beta 5\ Edu + \beta 6HHSz + \beta 7Farmsz + \beta 8Adaptn + \beta 9\ Ext + \beta 10Plantmatcst + \beta 10labcst + u$ …Linear Form 3.

$lnGM = \beta 0 + \beta 1\ Rain + \beta 2\ Temp + \beta 3\ Sex + \beta 4\ Age + \beta 5\ Edu + \beta 6HHSz + \beta 7Farmsz + \beta 8Adaptn + \beta 9\ Ext + \beta 10Plantmatcst + \beta 10labcst + u$ …Semi-Log Form 4.

$lnGM = \beta 0 + \beta 1\ lnRain + \beta 2\ lnTemp + + \beta 3\ lnSex + \beta 4\ lnAge + \beta 5\ lnEdu + \beta 6lnHHSz + \beta 7lnFarmsz + \beta 8lnAdaptn + \beta 9\ lnExt + \beta 10lnPlantmatcst + \beta 10lnLabcst + u$ …Double-Log Form 5.

GM = Gross Margin (a measure of profitability in Naira),

$GM = TR – TVC$ 6

Where TR = Total farm Revenue (in naira derived by multiplying unit output by unit output price, qi x pi); TVC = Total Variable Costs (including cost of labour, fertilizer, planting materials and pesticides in Naira); P = mean annual precipitation in the state in mm; T = Mean annual temperature of the state in degree celcius (oC); Sex = Gender of the farmer (Dummy variable , 1 = Male, and 0.0001 = Female); Age = Farmers age in Years; Edu = Years spent on formal education; HHSZ = Household size (count), Farmsz = Farm size in Hectares; Adaptn = Index of adaptation measures; Ext = frequency of extension visits during the year; Plantmatcst = amount spent on planting materials in Naira during the year; Labcst = Cost of farm labour dring the year in naira; β0 = intercept of the model; β1 – β8 = coefficients of the respective variables; μ = stochastic error term and ln = logarithm to base e.

An index of conservation measures adopted was computed following Kaliba and Rabele, (2009) and used as proxy for conservation measures (including irrigation, mulching, crop rotation, terracing, countour planting, intercropping, cropping along flood plains, bonding, changing timing of planting, planting early maturing crop varieties etc. as chosen from the list in World Bank's list of adaptation measures and validated by farmers during focus group meeting.

Ordinary least square (OLS) estimation procedure was used to fit the models. To overcome the problems of heteroscedasticity and multicollinearity, a robust estimation of the standard error was undertaken as well as the tests for severity of multicollinearity in the models. Where heteroscedasticity were detected the White's heteroscedasticity-corrected standard errors regression model (White, 1980) was ran with the original model using EViews econometrics package following Gujarati and Sangeetha (2007). Correlated variables with high were Variance Inflation Factor (VIF) were dropped from the model. Some variables were dropped from the model on the basis of low significance level and low contribution in improving the overall significance of the estimation model but most importantly on the basis of its Akaike Information Criteria (AIC). The lower this value is compared to other models the better is its overall fitness (Gujarati, 2008). The advantage of this empirical approach is that the method includes both direct effect of climate on productivity and the adaptation response by farmers to local climate variability.

3. Results and Discussions

The final results of the Ricardian model estimates are presented in Table 1. The initial proposed models which included the squared values of temperature and rainfall were fraught with severe multicollinearity and presence of heteroscedasticity. To solve this initial challenge the two affected variables were dropped and White heteroskedasticity-consistent standard errors & covariance were applied in running the final regression model. The outcome of the final model gave desirable OLS properties and so the researcher had to select the best out of linear, semi-log and double log forms of the model. The selection of the lead equation was informed by the low value of estimated VIF (1.37), high value of F-ratio at low p value and

number of variables whose slope coefficients returned values and signs that were more in sync with theoretical expectations. These criteria appeared to agree with the criterion of choosing the lowest AIC too. For instance, the double log model had the lowest AIC (2.568) and at the same time recorded the highest R-squared and adjusted R-Squared estimates of 0.48 and 0.46 respectively. The F-ratio was high at 22.738 and statistically significant at $p < 0.01$.

Five variables, rainfall and temperature variations, planting materials costs, household size as well as labour cost exerted statistically significant effects on the level of net revenue (gross margins) of farmers in the survey. The slope coefficients of these variables were 1.199 ($p < 0.01$), 8.219 ($p < 0.01$), 0.108 ($p < 0.05$), 0.097($p < 0.01$), and 0.124 ($p < 0.05$) respectively. Since the Cobb-Douglas model was applied to the variant of the chosen Ricardian model, the slope coefficients represent elasticities. This implies that a positive variation or increase in rainfall level by 1 percent would result in a net revenue increase of the farmers by approximately 1.20 percent. Similarly, a percentage upward change in temperature by 1 percent would result in net revenue increase by 8.22 percent approximately. Meanwhile increase in variabilities of planting materials' costs, household sizes as well as labour would increase net revenue gain by approximately 0.11, 0.10 and 0.12 percent respectively. It is well documented by Seo and Mendelson (2007) that rainfall and household size positively influence the level of farmers' net revenue. The fact that planting materials' and labour costs (wages) were positively influencing the variability in net revenue is pointer to the possibility of most farms operating at Stage 1 in their production cycle. At this stage the farmer can still maximize profit by increasing the marginal value of these farm inputs and still experience increasing returns. That cost appeared to be yielding positive returns to net revenue affirms the relevance of household size as a significant variable exerting positive influence on the net revenue of the farmers. Such positive effects could have resulted from the increase in cheaper labour that could have emanated from increase in members of farm household with their potentials for serving in providing farm labour. In deed all the statistically significant slope coefficients of the double log model returned expected theoretical signs except that of temperature which may be loosely said not to have agreed with Seo and Mendelson (2007) who recorded a negative effect of increased temperature on net revenue in their own study. That temperature had a positive effect on net revenue should not be too surprising as some crops could benefit from increased temperature especially if the marginal change is not so high. To support this school of thought, Ajetumobi, Abiodun and Hassan (2010) found that increase in temperature would reduce net revenue for dry land rice.

4. Conclusion

This study had, with the aid of feasible and appropriate econometric tools, explored prevailing climate and socio-economic factors impacting on arable crop farms' productivities in the agro-climatic zones of Nigeria. It was found that rainfall and temperature variations, planting materials costs, household size and labour cost exerted significant effects on level of gross margins in the country. The researcher would like to conclude that unless certain proactive and urgent measures are put in place to aid Nigerian crop farmers adapt to the present and looming threats of climate change effects in Nigeria the drive to attain food security, economically empower farmers and usher in sustainable development in Nigeria would remain a mirage

Based on the findings of this study the researchers recommend that climate change data management authorities such as NIMET should be encouraged to provide farmers with early warning signals via an organized extension service programme. Agricultural Development Programmes (ADPs) and the FADAMA III programme all over the country should establish weather stations to aid farmers access weather data and plan their production in a more climate smart way.

Irrigation facilities should also be built especially in the north where drought threatens food production. Private investors can delve into such services and allow farmers to pay since government failure had been the bane of agricultural development in Nigerian history.

The roles of costs of planting materials and labour in determining farmer's net revenue variability call for policy that will make farmers access credit facilities to adapt to the effects of climate change. It would also be expedient to help farmers in accessing drought-tolerant, flood and disease resistant planting materials to enable them cope with these effects of climate change. In this call, governments and donors through well-funded research programmes can make their inputs in this global problem.

Farmers need to avail themselves the opportunity of building capacities to adapt to climate change effects in their farm technologies. There are lots of indigenous technologies that can be applied in adapting to climate change effects. Through organized cooperative farmers can teach themselves such technologies and also recruit experts in climate change adaptation management and agricultural extension service to teach them new technologies available to adapt to climate change effects in their respective farms. The illiterate farmers in Nigeria can equally enroll in evening or part time formal education programmes to enhance their literacy level.

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Table 1 OLS Parameter Estimates of the Ricardian Model with Climate Factors and Socioeconomic Determinants

Dependent Variable: Gross Margin	**Linear Model (OLS)**			**Semi Log Model (OLS)**			**Double Log Model (OLS)**		
Variable	*Coeff*	*t-Stat*	*Prob.*	*Coeff*	*t-Stat*	*Prob.*	*Coef*	*t-Stat*	*Prob.*
Intercept	-1901215.000	-4.069***	0.000	0.481	0.230	0.818	*-26.467*	*-3.666****	*0.000*
RAIN	261.336	10.328***	0.000	0.001	10.324***	0.000	*1.199*	*9.260****	*0.000*
TEMP	57493.140	3.568***	0.000	0.308	4.273***	0.000	*8.219*	*4.000****	*0.000*
PLANTMATCST	-3.293	-1.951*	0.052	0.000	-0.196	0.845	*0.108*	*2.166***	*0.031*
SEX	-44467.520	-1.529	0.127	0.052	0.387	0.699	*-0.002*	*-0.167*	*0.867*
AGE	4074.144	3.941***	0.000	0.017	3.536***	0.001	*0.028*	*1.453*	*0.147*
FAMSIZ	30001.290	2.981***	0.003	0.069	1.503	0.134	*0.156*	*1.599*	*0.111*
EXT	-1578.208	-0.444	0.657	0.004	0.243	0.808	*0.022*	*1.709**	*0.088*
EDYR	1279.626	0.492	0.623	0.004	0.299	0.765	*0.019*	*0.699*	*0.484*
HHSZ	6185.109	2.390**	0.018	0.065	5.442***	0.000	*0.097*	*5.017****	*0.000*
LABCST	0.047	0.155	0.877	0.000	2.363**	0.019	*0.124*	*1.961***	*0.050*
ADAPTNINDEX	725.335	0.736	0.462	0.000	-0.061	0.951	*0.135*	*0.902*	*0.368*
R-squared	0.45			0.479			*0.483*		
Adjusted R-squared	0.432			0.458			*0.462*		
Akaike info criterion (AIC)	27.225			2.572			*2.568*		
F-statistic	21.751			22.738			*22.738*		
Prob(F-statistic)	0.000			0.000			*0.000*		
VIF (mean)	1.37								

***, ** and * indicate statistical significance at 0.01, 0.05 and 0.10 level respectively. *Source:* Field Survey (2013).

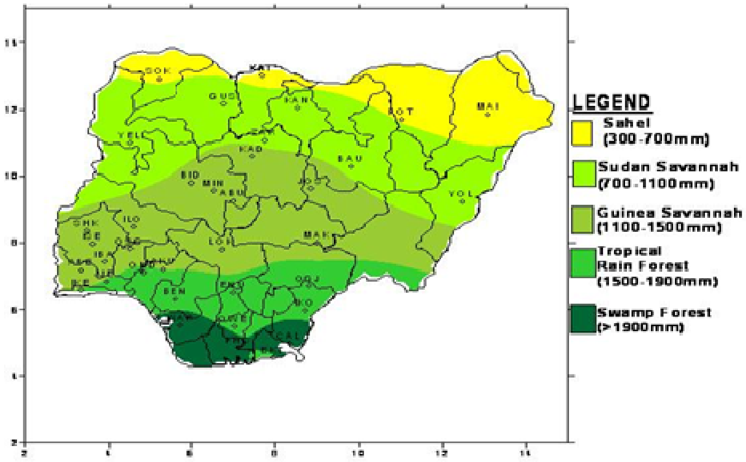

Figure.1. Map of Nigeria showing the various Agro-climatic Zones of the Country (Based on NIMET's classification. Source: Intechopen.com available at httpwww.intechopen.com/source/htmlslash41986/mediaslashimage6.png).

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