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Difficulties in adaptation to climate change by oil palm farmers in Southern Nigeria

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There is an increasing concern that climate change is already having an impact on poor, small scale oil palm farmers in Southern Nigeria. Researchers have shown that Nigeria is already being plagued with diverse ecological problems which have been linked to climate change. More so, increase in the severity of extreme weather events, sea level rise, coastal erosion, changes in weather pattern that affect oil palm production and changes in water availability are affecting vulnerable farmers and limiting their means of earning a living. The effect on families and communities can be devastating and adapting to these changes is essential. The paper highlights measures taken by famers to manage losses caused by climate change and difficulties encountered. A purposive and multi-stage random sampling technique was adopted in selecting 171 farmers from three states (Imo, Ondo and Delta). Both descriptive and inferential statistics were used in analyzing data. The constraints encountered by farmers in adopting climate change adaptation strategies were: high labor cost (0.759), land tenure (0.64), poor access to information (0.740), lack of training (0.767), lack of capital (0.820), limited availability of land (0.798) and lack of improved oil palm production technologies (0.438).

Key words: Constraints, climate change, oil palm farmers and adaptation.

INTRODUCTION

Empirical evidence shows that climate change is emerging as one of the most important challenges to mankind in the 21st century. The world's climate has always been changing between hotter and cooler periods due to various factors such as human (anthropogenic) and natural factors (biogeographic). These changes which constitute major challenges to humanity have been occurring for at least a century (Erda et al., 2007; Pender, 2008). Climate change affects crop production in many ways (IPCC, 2007) for instance, uncertainty and variations in the patterns of rainfall and flood cause pest and disease in response to climate change. However, recent evidence and predictions indicate that climate changes are accelerating and will lead to wide-ranging shifts in climate variables. Specifically, in 2007, the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) effectively put to rest many of the debates surrounding the science of climate

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change, rendering evidence solid enough to impel action. It was found that the warming of the climate system was “unequivocal and that a number of attendant effects were already observable (Pender, 2008; UNCTD, 2009). The impact of climate change is however spatially heterogeneous across a diverse range of geopolitical scales. For instance at the international level, the risk is generally believed to be more acute in developing countries because they rely heavily on climate-sensitive sectors, such as agriculture and fisheries, and have a low gross domestic product, high levels of poverty, low levels of education and limited human, institutional, economic, technical and financial capacity, etc. (IPCC, 2007; UNFCCC, 2007; WBGU, 2008). At the national level, various ecosystems, sectors and sub-populations within a country have been identified as being more or less at-risk in a changing climate depending on length of coastline, level of emergency preparedness and economic and livelihood sensitivity to climate related elements such as rain, wind, etc (NEST, 2004; Allen Consulting, 2005; IPCC, 2007).

Uncertainty and variations in the patterns of rainfall and flood, cause cash crops like oil palm to suffer setbacks under reduced photoperiods leading to flower, fruit abortion trends that reduce yields, cause pest and disease invasion, because of climate change. The United Nations Framework Convention on Climate Change (UNFCCC, 2007) defines climate change as a change of climate which is attributed directly or indirectly to human activity, that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. Nigeria has been reported to be vulnerable to the impacts of climate change largely because about 70% of Nigerians are engaged in small holder rain-fed agriculture. For Nigeria, agriculture is important because about 42% of the country’s GDP comes from agriculture and related activities. The impact of climate change is very visible in most communities in Nigeria, from the Sahel in the north to the rainforest and coastal zone in the south. The high population coupled with high poverty levels and rapid economic growth, are making huge demands on Nigeria's natural resources. Climate change impacts compound existing pressures on these resources. Nigeria’s risk are particularly high due to its low lying coastline that is highly populated with a heavy concentration of GDP generating industry and infrastructure (Nest and Woodly, 2011; DFID, 2009).

There is a possibility that risk and uncertainties which are common characteristics of farmers in Nigeria and in weather patterns, rainfall, drought and flooding events have meant that rural farmers who implement their regular annual farm business plan, risk total crop/ livestock failure due to climate change effects. These farmers are in most cases subject to climate shocks.

Mitigation and adaptation remain the most popular options to manage the impacts of climate change on agriculture in the world today. However, while neither adaptation nor mitigation actions alone can prevent significant climate change impacts, taken together; they can significantly reduce food security risks. While mitigation is necessary to reduce the rate and magnitude of climate change, adaptation is essential to reduce the damages from climate change that cannot be avoided (Ozor and Cynthia, 2010).

Adaptation options by farmers are limited by some constraints which could be economic, environmental, social or otherwise. Some of these constraints are yet to be fully understood. Accordingly, little is known in the oil palm industry about these constraints and this limits policy formulation and decision making. This prompted this paper.

The analytical framework

Adaptation measures help farmers guard against losses due to increasing temperatures and decreasing precipitation. This section identified the constraints encountered by farmers in adapting to climate change effects, in other to provide policy information on factors to target and how to encourage farmers to increase yields and incomes. The analytical approach used is exploratory factor analysis.

Principal component analysis (used to group constraint variables into constraint factors) with iteration and varimax rotation was used, the factor loading under each constraint (beta weight) represent a correlation of the variables (constraint areas) to the identified constraint factor and has the same interpretation as any correlation coefficient. However, only variables with loadings of 0.40 and above (10% overlapping variance) (Comrey, 1962) were considered in naming the factors. All significance was tested at 5% level of probability. Only variables with factor loadings of 0.40 and above at 10% overlapping variance were used in naming the factors. Variables that have factor loading of less than 0.40 were not used while variables that loaded in more than one constraints were also discarded (Madukwe, 2004). The approach has been used to identify major constraints to adaptation (Ozor and Cynthia, 2010; Enete et al., 2011; Ozor et al., 2010).

Factor analysis is used in this study to simplify the multivariate dataset in order to understand the trends and associations more clearly. Factor analysis clusters variables into similar terms, generating fewer variables (called components or factors) that explain a large percentage of the variability of the original variables. Factor analysis also removes multi-collinearity between variables and combines those that are highly correlated (positively or negatively) to reduce redundancy in the variables (Cox et al., 2006).

The problems enumerated by the respondents were grouped using principal component analysis with iteration and varimax rotation. The model is presented as:

Y1 = a11X1 + a12X2 + * * *+ a1nXn
Y2 = a21X1 + a22X2 + * * * + a2nXn
Y3 = a31X1 + a32X2 + * * * + a3nXn
*= *
*= *
*= *
Yn = an1X1 + an2X2 + * * + annXn

Where: Y1, Y2,. …., Yn = observed variables/constraints to adaptation strategies; a1 – an = constraint loadings or correlation coefficients.

X1, X2, … Xn = unobserved underlying problems constraining farmers from adapting to climate change (Enete et al., 2011). The objectives of this study were to i) Identify the socio-economic characteristic of the farmers in the study area, and ii) investigate and examine the constraints to the implementation of climate change adaptation measures by farmers in Southern Nigeria.

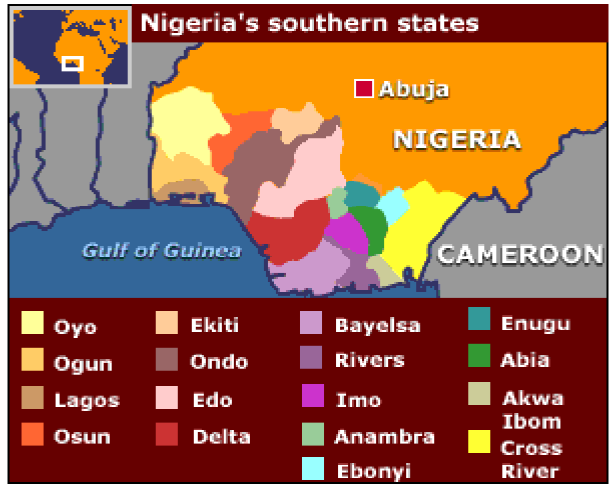

Figure 1. Map of states in Southern Nigeria.
Source: BBC News (2012)

METHODOLOGY

The study area

The study area comprises south east, south west and south south zones (Figure 1). Nigeria's geographical coordinate lies between 4°15´ to 7°N and 5 °49´to 30´E. The area towards the north of this region is largely deforested by human activities. The vegetation is characterized by median semi deciduous forest interspersed by savannah belts that support large expanses of farmlands.

Rainfall is the key climatic variable and there is a marked collection of wet and dry seasons in most areas. The rainy season usually begins in February or March as moist Atlantic air, known as the south west monsoon, invades the country and at the beginning of rains, usually marked by the incidence of high winds, heavy, but scattered squalls (Ozor et al., 2010). By April or early May in most years, the rainy season is under way throughout most of the area. The usual peak of the rainy season occurs through most of southern Nigeria in July with a dip in precipitation during the month of August (Ozor et al., 2010).

It is particularly difficult to state the requirements of the oil palm in seasonal climates, where monthly water deficits vary widely (Kee et al., 2000), and a large annual rainfall may not compensate for poor distribution, if rainy months have little sunshine. The general conclusions are as follows.

The ideal requirements are (Hartley, 1988):

1. Annual rainfall of 2000 mm or greater evenly distributed, without a marked dry season, and preferably at least 100 mm in each month
2. A mean maximum temperature of about 29-33°C and a mean minimum temperature of about 22- 24°C
3. Sunshine of 5 – 7 h/day in all months and solar radiation of 15 MJ/m² per day. Goh (2000) made a similar general list:
a. Annual rainfall of 2000- 2500mm
4. Relative humidity above 85%
5. Low vapour pressure deficit
6. No extreme temperatures or windspeed
7. Adequate sunshine hours and solar radiation of 16-17MJ/m² per day.

Climate and soil constitute the major aspect of the environment that greatly determines the yield of any crop. For oil palm cultivation in Nigeria, rainfall is clearly the most important climatic factor. As a result, oil palm cultivation is restricted to the southern one quarter (approximately) of the country with an annual rainfall of ≥ 1250 mm (Ogunkele, 1989).

The greatest total precipitation is generally in the south –south along the coast around bonny (South of Port Harcourt) and east of Calabar in cross river state, where the mean annual rainfall is more than 4,000 mm. Most of the south-south and south east receives between 2,000 and 3,000 mm of rainfall per year, and the south west receives generally between 1,250 and 2,500 millimeters per year (Ozor et al., 2010). The distribution of vegetation in Southern Nigeria is dependent on the climate, which becomes increasingly drier further inland from the coast. Climatic zones, therefore run parallel to the coast, widening or narrowing as geographical features alter the steepness of the climatic gradient. This climatic zoning, comprising the rain forest zone, the mixed deciduous and the parkland zone.

The study adopted the survey design. Multi-stage random sampling technique was adopted for this study to select respondents from 3 states, (three) southern states of Nigeria comprising one state from each of the geopolitical zone which includes: south west (Ondo), south east (Imo) and south–south (Delta) which was purposively chosen based on the fact that they are major oil palm producing areas in the zone (Oritsejafor, 1989). From each state, 2 predominantly oil palm growing agricultural zones were chosen. From each agricultural zone, a random selection of 2 local government areas each was done. Next, 2 farm communities were randomly selected from each local government area. 2 villages were then selected from each community. Lastly was a random selection of 4 oil palm farmers from each village. Out of 192 oil palm farmers selected, the enumerator retrieved information from 171 respondents representing a response rate of 89%.

Primary data (field survey data) were obtained using personal interview and administering of questionnaire to oil palm farmers in the study area. Data collected were analyzed using both descriptive and inferential statistics. Objective one was achieved using frequency and mean scores; objective two was achieved using factor analysis at 5% probability level. In this analysis, the factor loading under each constraint (beta weight) represent a correlation of the variables (constraint areas) to the identified constraint factor and has the same interpretation as any correlation coefficient. However, only variables with loadings of 0.40 and above (10% overlapping variance) (Comrey, 1962) were considered in naming the factors.

RESULTS AND DISCUSSIONS

Age distribution of the respondents

Table 1 shows that 56% of the respondents were within 46 – 55 years of age. They were aged about 52 years on the average. This suggests that the farmers were within the economically active age of below 60 years. With the current high rate of unemployment, young people may have been resorting to farming.

Marital status of respondents

Table 1 shows the marital status of the respondents. Majority (99%) were married while the remaining 1% was single. The table shows that oil palm production is mainly an enterprise of the married class. It is possible that most of the respondents were family men and women who require family income to carter for their families. The implication is that, with increase in family income, there will be improvement in their standard of living.

Educational level of respondents

The frequency distribution according to educational attainment is shown in table 1. About 4% of the respondents had no formal education, while majority (46%) had tertiary education. About 13% of them had primary education, 36% had secondary education. The result shows that about 95% of them had formal education showing that they were literate.

Farming experience

The frequency distribution of respondents according to farming experience is shown in Table 1. On farming experience, 50% of oil palm farmers had farming experience ranging from 11 to 20 years. Average years of farming experience were 15 years. Farmers in the study area were very experienced in the actual practice of oil palm farming.

Household size

Table 1 reveals the distribution of respondents according to household size. The table shows that 17.5% of farmers had household size of 1 - 4 persons, majority (62.6%) had household size of 5 - 8. The mean household size was 7.45. Large household size encourages adoption of adaptation methods (Nyangena, 2007; Dolisca et al., 2006; Birungi, 2007). The implication of this large household size implied available labor which can be provided at lowest cost.

Entries in Table 2 show the level of implementation of climate change adaptation strategies by respondents. The table shows that 50.29% of the respondents did nothing in their farm to respond to climate change effects. Climate change adaptation measures with low level of implementation include: mulching (12.28%), purchase of water for irrigation (21.63%), planting trees (12.28%), multiple intercropping (9.94%), crop diversification (12.28%), changing planting date (10.52%) and migration for income (13.45%). There was a moderate implementation of one of the measures which was use of resistant varieties (23.39%). Many farmers (50.29%) did nothing to respond to climate change effects. The low implementation of these adaptation options is expected in light of the constraints encountered by farmers in communities of Nigeria. Farmers lack capital/funds and information which if available can go a long way in tackling some climate change issues. Most of the problems or constraints encountered by farmers in adapting to climate change are associated with poverty (Ojemade, 2015).

Difficulties in adaptation to climate change impacts

Results in Table 3 show the difficulties farmers encounter in adapting to climate change impacts in southern Nigeria. Table 3 shows the Varimax rotated factors constraining farmers in the area from climate change adaptations.

Extraction method: Principal component analysis.
Rotation method: Varimax and Kaiser normalization.

From the entries in Table 3, only four factors were extracted based on the responses of the respondents. Only variables with factor loadings of 0.40 and above at 10% overlapping variance were used in naming the factors. Following this, each factor is given a denomination according to the set of variables or characteristics it was composed of. In this regard, the variables were grouped into four factors as: factor 1 (production: labor and land tenure constraints), factor 2 (information and training constraints), factor 3 (input: poor access to capital and land constraints) and factor 4 (technology constraints).

Under factor 1 (Production: labor and land tenure constraints), the specific constraining variables against climate change adaptation include high cost of farm labor (0.759) and inherited system of land ownership (0.654). Land tenure system is one major constraint that does not permit holders of capital to invest in large scale farming. In his own contribution, Benhin (2006) reported that one of the factors determining the speed of adoption of climate change adaptation measure is land tenure status. It has also been observed that high cost of farm labor is a constraint to adaptation by farmers (Adger et al., 2001; Deressa, 2008).

Under factor 2 (information and training constraints),

Table 1. Socio-economic characteristics of respondents in the study area.

Variables	Frequency	Percentage
Age (years)		
35-40	7	4
41-50	18	11
46-50	48	28
51-55	48	28
56-60	33	19
61-65	17	10
Gender		
Male	162	95
Female	9	5
Marital status		
Married	169	99
Single	2	1
Widow	0	0
Divorced	0	0
Educational level		
No Formal	7	4
Primary	22	17
Secondary	62	36
Tertiary	80	46
Occupational distribution		
Major		
Farming	149	87
Trading	14	8
Paid job	8	5
Secondary		
Agro processing	3	46
Basket weaving	3	2
Carpentry	1	1
Catering	3	2
Typing	9	5
Craftsmanship	15	9
Driving	9	5
Transportation of goods	3	2
*Multiple responses		
Farming experience		
1-5	10	6
6-10	17	10
11-15	42	25
16-20	42	25
21-15	24	14
26-30	3	2
41-45	3	2
No response	30	18

Table 1. Cont'd

Farm size		
< 1	37	22
1-3	74	43
4-6	42	25
7-9	9	5
10-12	9	5
Distance of farm		
1-5	60	35
6-10	14	8
11-15	42	25
16-20	21	12
No response	34	20
House-hold size		
1-4	30	17.5
5-8	107	62.6
9-13	32	18.7
14-18	2	1.2
Annual income		
< 300,000	39	22.8
300,001-600,000	77	45.0
600,001-900,000	32	18.7
> 900,000	11	6.4
Missing	12	7.0
Extension visit		
0	136	79
1	25	15
2	10	6
Total	171	100

Source: Field survey data 2012.

Table 2. Frequency distribution of respondents according to adaptation strategies.

Choice of practices	*No. of respondent	Percentage
Use of resistance varieties	40	23.39
Mulching	21	12.28
Purchase of water for irrigation	37	21.63
Planting trees (afforestation)	21	12.28
Multiple/intercropping	17	9.94
Crop diversification	21	12.28
Changing planting dates	18	10.52
Migration for income	23	13.45
Did nothing	86	50.29

*Multiple responses indicated; Source: Field survey data, 2012

Table 3. Constraints to climate change adaptation (rotated component matrix).

Variables	Constraints			
	Production constraints (labor and land tenure)	Information and training	Lack of inputs (poor access to capital/land)	Lack technology
Labor	0.759	0.054	0.164	-0.055
Land tenure	0.654	0.074	-0.151	0.298
Poverty	-0.581	-0.507	0.100	0.232
Lack of improved oil palm technologies	0.181	0.264	0.319	0.438
Poor access to information and knowledge	0.332	0.740	0.128	-0.044
Lack of training	-0.152	0.767	-0.106	0.068
Lack of capital	-0.079	0.128	0.820	-0.212
Poor agricultural practices	0.034	0.016	0.047	-0.915
Land	0.070	-0.152	0.798	0.304

the constraining variables against climate change adaptation were: poor access to information and knowledge (0.740) and lack of training (0.767). In their own contribution, Mark et al., (2008), Enete and Amusa (2010) and Maddison (2006) argued that lack of adaptive capacity due to constraints on resources like information may result in further food insecurity. The factors that loaded under factor 3 (Inputs: poor access to capital and land) include lack of capital (0.820) and limited availability of land (0.798). In his own contribution, Deressa (2008), in the analysis of barriers to adaptation to climate change in the Nile Basin indicates that lack of money is a major constraint to adaptation by farmers. Consequently, Benhin (2006) noted that farm size is a major determinant of speed of adoption of adaptation measures to climate change.

Under factor 4 (Technologies), only one variable was loaded: lack of improved oil palm technologies (0.438). Rural farmers are generally poor, do not have adequate technology, related skills, and cannot afford to invest in technologies to adapt to climate change or sustain their livelihood during harsh climate conditions such as drought (Sofoluwe et al., 2011; Alam et al., 2011). Technology is one of the crucial factors to adapt to climate changes (Alam et al., 2011). Poor agricultural practices were not significant under factor 4 (lack of technology). This is counter intuitive because one could expect that poor agricultural practices could be an important constraining factor in terms of technology.

RECOMMENDATIONS

Oil palm farmers have already started responding to climate change through adaptation strategies/ measures they believe are helping them counteract its negative impact. The study also observed that adaptation measures have cost implications on farmers who are the most vulnerable group because of their poor financial base.

The study revealed that respondents were using some adaptation measures which include mulching (12.28%), purchase of water for irrigation (21.63%), planting trees (12.28%), multiple intercropping (9.94%), crop diversification (12.28%), changing planting date (10.52%) and migration for income (13.45%). The study also examined constraints to the implementation of climate change impacts in southern Nigeria and observed that the major constraints to climate change adaptation in southern Nigeria were: production problems, information and training, lack of inputs and lack of improved oil palm production technologies.

The oil palm sector is largely dominated by smallholders who produce 80% of Nigeria's output. Several million smallholders are dispersed over an estimated area of 1.65 million hectares in the southern part of Nigeria, where they inter-crop oil palm with food crops such as cassava (*Manihot* spp.), yam (*Dioscorea* spp.) and maize (*Zea* mays).

Based on the results of analysis, there is need for improvement in all areas of agricultural technology in order to provide effective adaptation/coping strategies to sustain livelihoods. While the availability of inputs and labor are adequate, smallholder oil palm farmers have limited access owed to the prohibitively high costs for each. The prices of inputs- insecticides, herbicides and fungicides are increasingly high and beyond the reach of the meager earnings of small-scale, poor resource, oil palm producers. In the past, the government subsidized inputs, thus facilitating acquisition. In order to solve the problem of low input usage, provision of credit by government and other NGOs for purchasing inputs and for hiring labor could be made.

The government, research and extension, the private sector and non-governmental organizations (NGO's) can improve annual farm performances for small holder farms by ensuring increase in farmer training and more access to credit and aid facilities and by helping farmers acquire livestock and important farm assets can improve farm performance. Ensuring the availability and accessibility of fertilizers and crop seeds before the onset of the next cropping season can also significantly improve annual farm performances across households. Consequently, innovative specific adaptation strategies/projects that aim to climate-proof the different agro-ecologies, and develop resilience to climate change effects should be carried out so that farmers can respond to climate change effects.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Adger WN, Kelly PM, Nguyen HN (2001). Environment, Society and precipitous change. In: Adger WN, Kelly PM, Nguyen HN (eds). Living with environmental change: Societal vulnerability, adaptation and resilience in Vietnam, Routledge, London 314 p.

Alam MM, Siwar C, Molla RI, Toriman ME, Talib B (2011b). Climate Change and Vulnerability of Paddy Cultivation in North-West Selangor, Malaysia: A Survey of Farmers' Assessment. Voice Academia 6(1):45-56.

Allen Consulting (2005). Climate Change risk and Vulnerability. Australian Greenhouse Office, Department of the Environment and Heritage, Canberra, Australia 159 p.

BBC News (2001). Nigerian south seeks more autonomy. Available at: http://news.bbc.co.uk/2/hi/africa/1246719.stm

Benhin JKA (2006). Climate change and South African agriculture: Impacts and adaptation options. Centre for Environmental Economics and Policy for Africa (CEEPA) Discussion paper No. 21. CEEPA, University of Pretoria, South Africa.78 p.

Birungi PB (2007). The linkages between land degradation, poverty and social capital in Uganda. PhD thesis, Department of Agricultural Economics, Extension and Rural development, Faculty of Natural and Agricultural Sciences, University of Pretoria, South Africa 160 p.

Comrey AL (1962). The minimum residual method of factor analysis. Psychological Reports 11:15-18.

Cox JR, Rosenweig C, Solecki WD, Goldberg R, Kinney PL (2006). Social vulnerability to climate change: A neighbourhood analysis of the North East US mega region. Prepared for collaborators of the union of concerned scientist, North East climate change impact study 21 p.

Department for international development-DFID (2009). Impact of Climate Change on Nigeria's Economy. Final Report Feb. 2009. Available at: www.erm.com.

Deressa T (2008). Analysis of perception and adaptation to climate change in the Nile Basin of Ethiopia. An unpublished Ph.D. Thesis, Centre for Environmental Economics and Policy for Africa (CEEPA), University of Pretoria, South Africa. 20 p.

Dolisca F, Carter RD, McDaniel JM, Shannon DA, Jolly CM (2006). Factors influencing farmers' participation in forestry management programs: A case study from Haiti. Forest Ecology and Management 236:324-331.

Enete AA, Madu II, Mojekwu JC, Onyekuru AN, Onwubuya EA, Eze F (2011). Indigenous agricultural adaptation to climate change: A Case study of South East Nigeria. Published by African technology policy studies network Kenya. ATPS Working Paper Series 53:38.

Enete AA, Amusa TA (2010). Challenges of agricultural adaptation to climate change in Nigeria; a synthesis from literature. Journal of Field Actions Science Reports 4:22.

Erda LI, Yinlong X, Shaohong W, Hui JI, Shiming M (2007). China's National Assessment Report on Climate Change (II): Climate change impacts and adaptation. Advances in Climate Change Research 0006-06:1673-1719.

Hartley CWS (1988). The oil palm, (3rd edition). London, Longman Scientific and Technical.127 p.

Intergovernmental Panel on Climate Change-IPCC (2007). Climate Change: Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Intergovernmental Panel on Climate Change: Summary for Policymakers. IPCC Secretariat: Geneva, Switzerland. 976 p.

Kee KK, Goh KJ, Chew PS (2000). Water cycling and balance in mature oil palm agro ecosystems in Malaysia. In: Proc. Int. Planters Conf. Plantation tree crops in the new millennium: the way ahead (Ed. By Push P), Incor. Soc. Planters, Kuala Lumpur pp. 251-275.

Maddison D (2006). The perception of and adaptation to climate change in Africa. CEEPA Discussion Paper No. 10. Centre for Environmental Economics and Policy in Africa. Pretoria, South Africa: University of Pretoria 47 p.

Madukwe MC (2004). Multivariate Analysis for Agricultural Extension Research. In: Terry AO (ed). Research methods in agricultural extension pp. 206-236.

Mark WR, Mandy E, Gary Y, Lan B, Saleemul H, Rowena VS (2008). Climate change and agriculture: Threats and opportunities. Federal Ministry for Economic Cooperation and Development, Germany 26 p.

Nest- Nigerian Environmental Study/Action Team (2004). Regional Climate Modeling and Climate Scenarios Development in Support of Vulnerability and Adaptation Studies: Outcome of Regional Climate Modeling Efforts over Nigeria. Nigerian Environmental Study/Action Team (NEST), Ibadan, Nigeria 63 p.

NEST, Woodly E (2011). Reports of pilot projects in community based adaptation in climate change in Nigeria, Building Nigeria's response to climate change (BNRCC). Ibadan, Nigeria. Nigerian Environmental study/action team (NEST) 235 p.

Nigerian Environmental Study /Action Team-NEST (2004). Regional Climate Modeling and Climate Scenarios Development in Support of Vulnerability and Adaptation Studies: Outcome of Regional Climate Modeling Efforts over Nigeria, Nigerian. Environmental Study/Action Team (NEST), Ibadan, Nigeria 142 p.

Nyangena W (2007). Social determinants of soil and water conservation in rural Kenya. Journal of Environment, Development and Sustainability 10(6):745-767.

Ogunkele AO (1989). The suitability of Nigerian land for oil palm cultivation. A case study of NIFOR main station soils. NIFOR International Conference on Palms, and Palm Products 1:278.

Ojemade CA (2015). The effects of climate change on oil palm production in Southern Nigeria. Unpublished Ph.D thesis, University of Nigeria, Nsukka 121 p.

Ozor N, Madukwe MC, Enete AA, Amaechina EC, Onokala P, Eboh EC, Ujah O, Garforth CJ (2010). Barriers to Climatic Change Adaptation among Farming Households of Southern Nigeria. Journal of Agricultural Extension 14(1):114-124.

Ozor N, Cynthia N (2010). Difficulties in adaptation to climate change by farmers in Enugu state, Nigeria. Journal of Agricultural Extension 14(2):106-122.

Oritsejafor JJ (1989). Status of the oil palm vascular wilt disease in Nigeria. NIFOR: International conference on palms and palm product. pp. 329-331.

Pender JS (2008). What is Climate Change? And how it will affect Bangladesh. Briefing Paper (Final draft) Dhaka Bangladesh. Church of Bangladesh Social Development Programme 70 p.

Sofoluwe NA, Tijani AA, Baruwa OI (2011). Farmers' perception and adaptation to climate change in Osun State, Nigeria. African Journal of Agricultural Research 6(20):4789-4794.

United Nations Frame Work Convention on Climate Change-UNFCCC (2007). Climate Change: Impacts, Vulnerabilities and Adaptation In Developing Countries. Bonn, UNFCCC Secretariat 68 p.

United Nations Conference on Trade and Development (UNCTD) (2009). Developing Country Interests in Climate Change Action and the Implications for a Post-2012 Climate Change Regime. United Nations New York and Geneva 52 p.

German Advisory Council on Global Change (WBGU) (2008). World in Transition-Climate Change as a Security Risk, German Advisory Council on Global Change, Earth scan, London and sterling, VA. 271 p.