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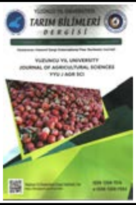

Research Article (Araştırma Makalesi)

Cowpea Farmers' Vulnerability and Adaptation to Climate Change in Iddo Local Government Area of Oyo State, Nigeria

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Article Info

Received: 11.02.2020
Accepted: 06.08.2020
Online Published 30.09.2020
DOI: 10.29133/yyutbd.687100

Keywords

Adaptation,
Climate-change,
Cowpea,
Vulnerability.

Abstract: Climate change is one of the factors affecting cowpea production in Nigeria**.** This paper assessed cowpea farmers' vulnerability to climate change and as well ascertained the adaptation strategies used in the Iddo local government area of Oyo state in Nigeria with the hope of achieving climate resilience for sustainable cowpea production. A survey of 108 randomly selected cowpea farmers revealed that the farmers in the study area were highly susceptible to climate change impacts. Most of the respondents (87.1%) had highly adopted climate change adaptation strategies for cowpea production. Their proactive solutions include combining various forms of adaptation strategies according to farm sizes and the intensity of their vulnerability. Significant relationship existed between farm size (r-values = 0.02, pv=0.0), vulnerability to climate change (r-values 0.1, pv = 0.01) and climate change adaptation strategies used by cowpea farmers. For effective climate change or variability resilience, adaptation policy for smallholder cowpea farming should require inputs from the local experts with understanding of local climatic variability and change of the farming community.

Börülce Çiftçilerinin Nijerya'daki Oyo Eyaleti, Iddo Yerel Yönetim Alanındaki İklim Değişikliğine Hassasiyeti ve Uyumu

Makale Bilgileri

Geliş: 11.02.2020
Kabul: 06.08.2020
Online Yayınlanma 30.09.2020
DOI: 10.29133/yyutbd.687100

Anahtar kelimeler

Adaptasyon,
İklim değişikliği,
Börülce,
Hassasiyet.

Öz: İklim değişikliği Nijerya'da sebze üretimini etkileyen faktörlerden biridir. Bu çalışma börülce çiftçilerinin iklim değişikliğine karşı hassasiyetini değerlendirmiş ve ayrıca sürdürülebilir börülce üretimi için iklim koşullarına direnç sağlama umuduyla Nijerya'daki Oyo eyaletinin Iddo yerel yönetim alanında kullanılan uyum stratejilerini belirlemiştir. Rastgele seçilen 108 börülce çiftçisi üzerinde yapılan bir araştırma, çalışma alanındaki çiftçilerin iklim değişikliği etkilerine karşı oldukça duyarlı olduklarını ortaya koymuştur. Katılımcıların çoğu (% 87.1) börülce üretimi için iklim değişikliğine uyum stratejilerini benimsemiştir. Çiftçilerin proaktif çözümleri, çiftlik büyüklüklerine ve hassasiyetlerinin yoğunluğuna göre çeşitli uyum stratejileri biçimlerini birleştirmeyi içermektedir. Çiftlik büyüklüğü (r-değeri = 0.02, pv = 0.0), iklim değişikliğine karşı hassasiyet (r-değeri 0.1, pv = 0.01) ile börülce çiftçileri tarafından kullanılan iklim değişikliğine uyum stratejileri arasında anlamlı ilişki bulunmuştur. Etkili iklim değişikliği veya direnç değişkenliği için, küçük ölçekli börülce yetiştiriciliği için adaptasyon politikası, yerel iklimsel değişkenlik ve tarım topluluğunun değişimini anlayan yerel uzmanlardan gelen girdileri içermelidir.

1. Introduction

Cowpea production and consumption play important role in achieving food security and nutrition for people in sub-Saharan Africa (Murtala and Abaje, 2018). Cowpea is one of the primary sources of protein to many households especially in low-lying areas of Oyo state, Nigeria. In spite of the economic importance of cowpea, its production has been hampered by climate change intersection; and its production is usually intercropped with cereals such as maize, sorghum, roots and with tubers such as cassava, yam and sweet potatoes (Kolayemi, 2019). Climate change has direct impacts on cowpea production through erratic rainfall pattern, pest and diseases infestation (Apata, et al., 2009; Murtala and Abaje, 2018). According to Asante and Amuakwe-Mensha (2015), the major effects of climate change on agriculture produce include changing rainfall patterns that trigger reduction in agricultural production, reduction in food security, worsen water availability, decreasing fish resources in large lakes due to rising temperature and shifts in vector-borne diseases (IPCC, 2018). Furthermore, rising sea level resulting from climate change affects low-lying coastal areas with large populations, leading to increased risk of conflict over scarce land and water resources. Many farmers in developing countries are vulnerable to climate change impacts (Asante and Amuakwa-Mensah, 2015). Vulnerability is the characteristics of an individual or group of people and their situation that weakly or negatively influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. This conceptualization of vulnerability shifts attention to the role that social connections and supports play in buffering people, processes, and places when confronted with exposure to natural hazards (Collins et al., 2017).

Vulnerability assessment and climate change adaptation are recent concerns of policymakers, development planners, engineers and researchers. Vulnerability assessments help in identifying hotspots, and helping policymakers to prioritize, allocate resources and develop better adaptation planning. A vulnerability assessment is the complex form of risk appraisal, which considers both bio-physical and socio-economic components of the environmental hazard (Eriksen and Kelly, 2007; El-Zeina and Tonmoy, 2017). In order to mitigate climate change impacts, the Intergovernmental Panel on Climate Change (IPCC) proposed a framework for vulnerability assessment that includes exposure, sensitivity and adaptive capacity. Exposure is the extent to which a socio-ecological system (SES) such as locality, region, community, infrastructure system) is exposed to the hazards in question (IPCC, 2014). Sensitivity is the propensity to damage resulting from exposure while adaptive capacity is the ability of the socio-ecological system to cope with, and recover from the damage.

To sustain cowpea production in Nigeria, there is a need to establish the extent of farmers' vulnerability to climate changes and to assess the adaptation measures used by farmers. Hence, this paper ascertains vulnerability and adaptation measures used by cowpea farmer in the study area. It is believed that a better understanding of farmers' vulnerability and adaptation measures will assist development planners and policy makers to take appropriate decisions on planning and implementation of adaptive measures.

2. Material and Methods

This study was conducted in Iddo local government area of Oyo state. Information was collected from 108 randomly selected registered and unregistered cowpea farmers (10% respondents out of 1080 total registered and unregistered cowpea farmers) in the study area.

Information collected from the respondents comprised farmers' socio-economic characteristics, vulnerability to climate change and adaptation strategies used. Respondents were asked whether they were vulnerable to windstorm, low rainfall or water shortage, erosion-related land loss, low temperature, high temperature, excess rainfall and flooding.

Vulnerability was measured as vulnerable =1, otherwise = 0, while adaptation to climate change strategies used was measured by asking the farmers to list various adaptation strategies used. This was scored as follows: adaptation strategies used =1, otherwise =0. Data collected were analysed by using descriptive and inferential statistical tools such as frequency counts, percentages, chi-square and product moments correlation at 5% level of significance.

2.1. The independent variables were measured as follows:

Age: actual age in years
Gender: male =1, Female = 0
Marital status: married 1, otherwise = 0
Education attainment: formal education = 1, no formal education = 0
Household size: large household size = 1, small household size =0
Farm size: Actual farm size
Monthly income: Actual income
Intensity of vulnerability: Highly vulnerable = 1, less vulnerable = 0
Types of adaption strategies used:
Frequency of use index was determined.

3. Results and Discussion

3.1. Age

Table 1 shows that 56.8 % of the respondents were over 40 years old. The mean age of the respondents was 49.9 years. As majority of the cowpea farmers consisted of the middle age and older people, they were expected to have adequate knowledge of the effects of climate change or variation on cowpea production and must have devised adaptation strategies over time. This finding corroborates Arimi (2014) which revealed that farmers in southwest Nigeria fall between the ages of 41 – 60 years. This is a clear indication that the farmers were old enough to give responses on climate change issues affecting cowpea over the years.

Sex: According to Table 1, majority (65.7%) of the respondents were male, while only 34.3% were female. As most of the cowpea farmers in the study area were male, this development may be due to the fact that farming activities requires much energy that the female farmers may not find easy to cope with. This is in line with research carried out by Apata et al. (2011) who observed that farmers in Nigeria were predominantly male.

Marital status: Majority (62.0%) of the respondents were married as shown in Table 1, 15.7% were widowed, while 16.7% of the respondents were divorced. As majority of the respondents were of middle age or older as shown in their socio –economic characteristics, they are expected to be married with children that would assist in farming activities. Married farmers with low income may have to consider their family welfare before investing in climate change adaptation technology that would improve their adaptation capacity. This finding is supported by Hoa et al. (2019) who observed women's marital status as a vital factor in determining her access to adaptation technology.

Farming experience: At least 37.7% of the respondents had a minimum farming experience of between 1 and 5years. Most (70.6%) of the respondents had over 5 years farming experience. It is expected that farmers with longer farming experience would have developed better skills towards climate change vulnerability that is likely to help their productivity improvement. This conforms to a study conducted by Molua and Lambi (2015), and Apata et al., (2009) who observed that farmers to a large extent have been able to develop some local adaptation strategies that enabled them to consistently cope with climate change impacts.

Educational attainment: Table 1 depicts that 32.5% of the respondents had no formal education, 17.6% had primary education and 25.9% had secondary education while 23.1% had tertiary education. This indicates that 67.5% of the farmers had formal education. Farmer's level of education and literacy is an additional factor gathered through knowledge from media sources that is expected to influence adoption of climate change adaptation technology. This is supported by Hoa et al. (2019) who observed that educated farmers tend to adopt improved farming technology than their uneducated counterparts.

Table 1. Distribution of socio- economic characteristic of the respondents (N=108).

Age	Frequency	Percentage	Mean
≥30	27	24.9	
31- 40	20	18.8	49.9
41 – 50	24	22.4	
51 – 60	17	15.8	
61 and above	20	18.6	
Total	108	100	
Sex			
Female	37	34.3	
Male	71	65.7	
Total	108	100	
Marital status			
Single	6	5.6	
Married	67	62.0	
Widowed	17	15.7	
Divorced	18	16.7	
Total	108	100.0	
Farming experience			
1-5 years	32	37.7	
6 – 10 years	35	32.5	
11-15 years	18	16.8	
16 and above	23	21.3	
Educational status			
No formal education	36	32.5	
Primary	19	17.6	
Secondary	28	25.9	
Tertiary	25	23.1	
Total	108	100.0	
Household size			
≥5	69	63.9	5.0
6-10	31	28.7	
11-15	8	7.4	
Total	108	100	
Primary occupation			
Farming	86	79.6	
Trading	15	13.9	
Teaching	3	2.8	
Artisan	3	2.8	
Others	1	0.9	
Total	108	100.0	
Secondary occupation			
Farming	69	63.8	
Trading	15	13.9	
Teaching	2	1.9	
Artisan	13	12.0	
Others	9	8.3	
Total	108	100.0	
Farm size (acres)			
≥5	67	62	7.2
6-10	22	20.4	
11 and above	19	17.7	
Total	108	100.0	
Land ownership			
Own	42	38.9	
Rented	26	24.1	
Community	25	23.1	
Farmers group	15	13.9	
Total	108	100.0	
Monthly income (₦)			Mean
5,000 -15,000	48	44.5	₦20,972.2
16,000-25,000	21	27.5	
26,000- 30,000	19	17.7	
33,000 and above	20	18.5	

Household-size: Table 1 reveals that 63.9% of the respondents had between 1 and 5 members per household while 28.7% of respondents had between 6 and10 members per household. This finding shows that most farmers had low family size. Incidents of smaller household size have serious implications in promoting climate change technology utilization for increasing cowpea production. This finding corroborates Kolayemi (2019) who observed that cowpea farmers in South-west Ethiopia have relatively small household size holders; and household sizes play crucial role in technology adoption for cowpea production.

Primary occupation: Farming was the primary occupation of 79.6% of the respondents. As most of them had farming as their occupation, they are likely to concentrate on farming activities and adopt measures to deal with factors that may hinder their productivity. This result reveals that some of the respondents were also involved in other occupations such as trading (13.9%) and other was artisans (12.0%). Occupational diversity into other income sources and livelihood activities creates additional financial resources to minimize their shock, shortage of cash and crisis evolving from climate change.

Farm size: Sixty-two point six percent (62.6%) of the respondent had at least 5 acres of land as shown in Table 1 while 17.7% had access to over 11 acres of land. This is an indication that many of the farmers were small farm-size holders. This corroborates Arimi (2015) who posited that most of the farmers in South west, Nigeria were small size holders' farmers. Farm size may affect farmer's technology adaptation or utilization. For instance, farmers with large farm size may adopt improved technology more than small farmers in order to reduce drudgery on the farm.

Land ownership: Thirty- eight point nine percent (38.9%) of the respondents were land owners, while others farmed on land that is rented (24.1%), owned by community (23.1%) or owned by farmers' group (13.9%). Land ownership may influence farmers' willingness to invest on technology that will improve their productivity. For instance, farmers' may not want to invest on new technology when using rented or borrowed land for fear of unknown.

Monthly income: Forty–four point five percent (44.5%) of respondents earned between ₦5000 to ₦15000 monthly as shown in Table 1. Farmers' income plays an important role in the adoption of climate change adaptation technology, as it is believed that the higher the income, the more the availability of financial resources to purchase or invest in new farming technology.

3.2. Description of farmers on vulnerability to climate change

Table 2 below reveals that 49.1% of the farmers were either highly or moderately vulnerable to erratic rainfall, 54.6% of the respondents were either highly or moderately vulnerable to low amount of rainfall. Most (62.0%) of the respondents indicated that they were either highly or moderately vulnerable to dry spell while 63.9% indicated that they were vulnerable to early cessation of rainfall. These results reveal that most of the farmers were vulnerable to climate change or variation in the study area.

Other climate change impacts which the farmers were vulnerable to include flood (42.6%) and windstorm (34.3%). This finding is supported by Kiprotich et al. (2015) who posited that flooding can damage seedlings on the field. Moreover, Fifty percent of the respondents were highly vulnerable to increased temperature. This finding is an indication that farmers were exposed to change in climatic parameters which affect their agricultural production. This conforms to Ajetomobi and Abiodun (2010) who concluded that climate change have adverse effects on cowpea production.

Table 2. Farmers vulnerability to climate change (N=108)

S/N	Perception of Climate Change	Highly vulnerable Frequency	%	Moderately vulnerable Frequency	%	Not vulnerable Frequency	%
1.	Rainfall Pattern						
A	Erratic Rainfall	20	18.5	33	30.6	55	50.9
B	Low level or rainfall	20	18.5	39	36.1	49	45.4
C	Late, onset of dry spell	39	36.1	28	25.9	41	38.0
D	Early cessation of rainfall	25	23.1	44	40.7	39	36.1
E	Decreased rainfall amount	17	15.7	28	25.9	63	58.3
F	Increased rainfall amount	55	50.9	28	25.9	25	23.1
G	Flood	46	42.6	40	37.0	22	20.4
2.	Windstorm	37	34.3	44	40.7	27	25.0
3.	Temperature changes						
i.	Increased temperature	19	17.6	35	32.4	54	50.0
ii.	Constant temperature						
iii.	Reduced temperature	40	37.0	42	38.9	26	24.1

3.3. Description of respondents according to their adaptation strategies used

According to Table 3 Forty-five point three percentages (45.3%) of the respondents occasionally plant cover crops, this may help to prevent flood and reduce land degradation. About 30.5% of the respondents occasionally adopt minimum tillage while 50.9% occasionally use mulching to preserve soil moisture. Mulching reduces soil moisture evaporation thereby making water available to the crop planted. Some respondents (41.6%) adopt crop rotation in order to maintain soil fertility. These results corroborate Kolayemi (2019) who confirmed that adoption of cover crop; minimum tillage and crop rotation were important systems of soil moisture management.

Table 3 also shows that 39.8% of the respondents occasionally increased the use of fertilizer. Farmers tend to increase fertilizer application in order to maintain soil fertility due to negative impact of climate change on soil. Twenty-nine point six percentage (29.6%) adopted agro- forestry in order to cope with climate change while some respondents (44.4%) occasionally listened to early warning information from radio, television and extension officers. Since the farmers make use of early warning information they may have prepared for negative impacts of climate change on their farms.

Other adaptation strategies used by the cowpea farmers include planting of trees as hedge **(**35.2%), plating of diseased resistance variety (25.9%), increased the use of pesticide (43.5%), and increased use of herbicide (38.0%). Farmers planted trees as hedges so as to help create a natural barrier to windstorm while some respondents make use of pesticides to control pest infestation. The use of herbicides helps in reducing or controlling of weeds. These findings are conformed to Kolayemi (2019) who concluded that farmers intensified the use of pesticides and herbicides to protect crops from pests, diseases and weeds emerging as a result of environmental change.

Twenty–nine point six percentages (29.6%) of the farmers make use of pumping machine for irrigation, 30.6% deviced water storage facilities in order to harvest rainfall for irrigation while 21.3% respondents constructed local dam to cope with water shortage. This is in line with Food and Agriculture Organization (2011) who observed that farmers have devised various means of irrigation (such as mechanized pump, reservoir, and water- lifting devices) on their farm to cope with climate change. In addition, Smallholder farmers in Africa are increasingly using small-scale irrigation to cultivate their land. This enables farmers to achieve more reliable, profitable and sustainable production, increase their resilience and, in some cases, transform their livelihoods.

About 34.3% of the respondents diversify into other crops or livestock due to negative impact of climate change. Diversification of the farmers into other livelihood activities was due to uncertainties that are likely to result from climate change. Diversification of the farmers to other activities may hinder sufficient cowpea production in the study area

Table 3. Distribution of respondents according to climate change adaptation strategies used (N=108)

S/N	Climatic change adaptation strategies	Level of Use Never use Frequency	%	Occasionally Frequency	%	Always Frequency	%
1	Planting cover cropping	27	25.0	49	45.3	32	29.6
2	Minimum tillage	20	18.5	33	30.5	55	50.9
3	Mulching to preserve soil moisture	43	39.8	55	50.9	10	9.3
4	Crop Rotation	28	25.9	45	41.6	35	32.4
5	Increase use of soil fertilizer	33	30.6	43	39.8	32	29.6
6	Adoption of Agro – forestry	40	37	32	29.6	36	33.3
7	Use of drought-tolerant crop Varieties	21	19.4	45	41.6	42	38.9
8	Listening to early warning information	14	13.0	48	44.4	46	42.6
9	Planting of trees as hedges	27	25.0	38	35.2	43	39.8
10	Planting of resistance to diseases crop	20	18.5	28	25.9	60	55.5
11.	Adoption of late or early planting	16	14.8	34	31.5	57	53.7
12.	Diversification into other crops or livestock	27	25.0	37	34.3	44	40.7
13.	Use of pumping machine or water pipe, watering for irrigation (Borehole)	29	26.9	32	29.6	47	43.5
14.	Use of water storage facilities/water harvester	27	25.0	30	27.8	51	47.2
15.	Construction of water harvester for water storage	25	23.1	33	30.6	50	46.3
16.	Construction of local dam	18	16.7	23	21.3	67	62.0
17.	Increase use of pesticides	11	10.2	47	43.5	50	46.3
18.	Increase use of herbicides	16	14.8	41	38.0	51	47.2

3.4. Category of respondents based on their climate change adaptation strategies used

Table 4 reveals that most of the respondents (87.1%) had highly adopted climate change adaptation strategies for cowpea production. Since, most of the respondents had adopted climate change adaptation strategies; it is expected that the farmers would overcome the adverse effect of climate change on cowpea production in the study area.

Table 4. Category of respondents based on their climate change adaptation strategies used (N=108)

Level of use	Frequency	Percentage	Mean
Low	13	12.0	
High	94	87.1	21.3
Total	108	100	

3.5. Relationship between socio – economic characteristics of the respondents and effectiveness of climate change adaptation strategies used.

Table 5 reveals that there is a significant relationship between marital status and climate change adaptation strategies used by cowpea farmers (x^2 = 9.7, p = 0.02) in the study area. This implies that farmers who were single easily acquired climate change adaptation technology than their married counterpart. Married farmers had to consider their family welfare before investing climate change adaptation technology in the study area. This finding corroborates Getachew et al. (2014) who observed that marital status influenced adoption of climate change adaptation technology used by farmers in Uganda.

There was a significant relationship between primary occupation and the climate change adaptation technology used (x^2 = 2.6, p = 0.02) for cowpea production. This implies that farmers who concentrate on cowpea production are likely to adopt adaptation strategies that will improve their farming system. However, that there was no significant relationship between gender and effectiveness of climate change technology used (x^2 = 1.5, p = 0.3) for cowpea production. This implies that both male and female cowpea farmers used climate change adaptation strategies as recommended by extension agents. Similarly, there were no significant relationship between educational attainment (x^2 = 5.6, p = 0.13), social group (x^2 = 3.5 p = 0.4) and climate change adaptation strategies used. This implies that both the literates and illiterates used climate change adaptation technology to improve their productivity.

Table 5. Relationship between social – economic characteristics of the respondents and effectiveness of climate change adaptation

Variable	Chi square (x^2)	Df	p-values	Decisions
Marital status	9.7	1	0.02	S
Primary occupation	2.6	4	0.02	S
Gender	1.5	1	0.3	NS
Educational status	3.5	4	0.4	NS
Social group	5.6	3	0.13	NS

3.6. Correlation between age, household size, farm size, monthly income, vulnerability to climate change, effects of climate change on cowpea production, adaptation to climate change and effectiveness of climate change adaptation technology used

Table 6 depicts that there was a significant relationship between farm size (r-values = 0.02, pv=0.0) and climate change adaptation strategies used by cowpea farmers. This implies that farmers with large farm size adopted climate change adaptation technology more than their counterparts with smaller farm sizes. There was also a significant relationship between the vulnerability of farmers to climate change and (r-values 0.1, pv = 0.01) climate change adaptation strategies used by cowpea farmers. This implies that the more the vulnerability the more the farmers would seek adaptation measures for resilience.

On the other hand, there were no significant relationship between age and (r-values, pv = 0.7), monthly income (r-values 0.3, pv = 0.7) and climate change adaptation strategies used by cowpea farmers. This finding shows that age did not influence adoption of climate change adaptation strategies as both the young and old farmers sought the use of adaptation technology that will reduce the impact of climate change on their farms. Also, both low and high-income earning farmers invest in climate change adaptation technology that will improve their farm productivity.

Table 6. Distribution of correlation between age, household size, farm size, monthly income, vulnerability, effects, adaptation and effectiveness of climate change adaptation technology used

Variables	r-values	Df	p-values	Decisions
Age	0.2	106	0.7	NS
Farm size	0.2	106	0.0	S
Monthly income	0.3	106	0.7	NS
Vulnerability to climate change	0.1	106	0.01	S

NS – Not significant, S – Significant
Source: Field survey, 2019.

4. Conclusion and Recommendations

Cowpea production in the study area is vulnerable to climate change impacts such as drought, flooding, and increased temperature. The negative consequences of climate change spurred the adoption of adaptation strategies. The farmers combined at least two or more adaptation measures according to the degree of their vulnerability. The adaptation strategies used included the planting of cover crops, use of minimum tillage, planting of disease-resistant tree variety, increased the use of pesticide, increased use of herbicide, use of pumping machine for irrigation, construction of water storage facilities to harvest rainfall for irrigation, building of local dam for irrigation and diversification into other crops or livestock farming. There was significant correlation between farm sizes (r-values = 0.02, pv=0.0), vulnerability of farmers to climate change (r-values 0.1, pv = 0.01) and climate change adaptation strategies used by cowpea farmers. Degree of farmers' vulnerability and farm sizes determined the adaptation measured used by cowpea farmers in the study area. Therefore, stakeholders who promote sustainable climate change adaptation would need to consider the prevailing climatic variables when implementing climate change adaptation policy for resilience.

Moreover, adaptation policy for smallholder cowpea farming should stipulate inputs from local experts who have better understanding of climatic variability and change of the farming community.

Acknowledgements

We sincerely appreciate the staff and authority of the National Open University of Nigeria, Ibadan Study Centre for giving us the opportunity to conduct the research and publish it. Thank you.

References

Ajetumobi, J. & Abiodun, A. (2010). Climate change impacts on cowpea productivity in Nigeria. *AJFAND, 10,* 3. 3-10

Apata T.G., Samuel K. D. & Adeola, A. O. (2009). Analysis of Climate Change Perception and Adaptation among Arable Food Crop Farmers in South Western Nigeria. Contributed Paper prepared for presentation at the International Association of Agricultural Economists' 2009 Conference, Beijing, *China, August 16-22,* 2009. .2-6

Apata, T. G. (2011). Factors influencing the perception and choice of adaptation measures to climate change among farmers in Nigeria. Evidence from farm households in Southwest Nigeria. *Environmental Economics, 2(4),* 74–83.

Arimi K. (2015). *Factors affecting utilisation of Federal Agricultural Research Oryza rice production technology among farmers in Ogun and Ekiti states, Nigeria.* A PhD thesis in the Department of Agricultural Extension and Rural Development, Faculty of Agriculture and Forestry, University of Ibadan. .44

Asante, F.A. & Amuakwa-Mensah, F. (2015). Climate change and variability in ghana: stocktaking. *Climate 2015,* 3, 78-99.

Collins, J.M., R.L. Ersing, & Polen, A. (2017). Evacuation Decision Making during Hurricane Matthew: An Assessment of the Effects of Social Connections. *AMS Weather, Climate and Society, 9 (4),* 769-776.

El-Zeina, A., Fahim, N., & Tonmoy F. N. (2017). Nonlinearity, fuzziness and incommensurability in indicator-based assessments of vulnerability to climate change: A new mathematical framework. *Ecological Indicators. (82),* 82–93

Eriksen, S., & Kelly, P., (2007). Developing credible vulnerability indicators for climate adaptation policy assessment. Mitig. Adapt. Strat. *Global Change 12,* 495–524.

Food and Agriculture Organization (2011). *Climate change, water and food security:* FAO Water Report. FAO Rome. Pp xxv11

Getachew, S., Tilahun, T & Teshager, M. (2014): Determinants of Agro-pastoralist Climate Change Adaptation Strategies: Case of Rayitu Woredas, Oromiya Region, Ethiopia. *Research Journal of Environmental Sciences, 8,* 300-317.

Hoa Le Dang, Elton Li, Ian Nuberg & Johan Bruwer (2019). *Factors influencing the adaptation of farmers in response to climate change: a review,* Climate and Development,

Inter-governmental Panel on Climate Change (IPCC). (2014). *Climate change 2014: impacts, adaptation, and vulnerability. part A: global and sectoral aspects. In: Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom and New York, NY, USA, Cambridge University Press. pp 11.

IPCC (2018). *Summary for policymakers. In: Global warming of 1.5°C. An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.* World Meteorological Organization, Geneva, Switzerland

Kiprotich M. J., Edward Mamati E., & Bikketi E. (2015). Effect of climate change on cowpea production in Mwania watershed: a case of Machakos county. *International Journal of Education and Research: 3(2),* 287-298

Kolayemi, M. F. (2019). *Precision farming and climate change adaptation strategies used among cowpea farmers in ido local government area of Oyo state: An undergraduate project* *submitted to the Faculty of Agriculture Science*, National Open University of Nigeria, Abuja, Nigeria: 11

Molua E.L & Lambi C.M (2015). "The economic impact of climate change on agriculture in Cameroon. *The World Bank Policy Research Working Paper"*. 5, 1-31.

Morakinyo J. A., & Ajibade S.R (2012). Characterization of the segregants of an improved cowpea line IT84K-124-6. *Nigerian Journal Science, 32,* 27-32.

Murtala, M. & Abaje, I.B. (2018). Effects of Climate Change on cowpea yield in Kaduna State, Nigeria: evidence from rainfall and temperature parameters. *Dutse Journal of Pure and Applied Sciences (DUJOPAS); 4 (2),* 2.