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EFFECT OF CLIMATE SMART AGRICULTURAL PRACTICES ON LIVELIHOOD STATUS OF FARMERS IN KWARA STATE

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Abstract
Livelihood sustainability is one of the benefits of climate smart agriculture. Both primary and secondary data were collected and used in this study. Structured questionnaire was administered to 240 tuber farmers in Zone B of the Agricultural Development Project Zone in Kwara State but only 218 were used for the analysis. The study highlighted the socio-economic features of the tuber farmers, their awareness about climate smart agriculture, extent and usage of climate smart practices, their livelihood sustainability, motivating factors and challenges encountered in the use of climate smart agriculture. Livelihood sustainability was examined with four approaches namely, the sustainable livelihood approach, the IPCC-LVI framework, the livelihood effects index and a gendered comparism. Livelihood analysis was done on two levels namely whole sample analysis and household level analysis. The study reveals that the most used climate smart agricultural practice was mulching while the least used is permanent residue soil cover. Sustainable livelihood index reveals that majority of the respondents had a moderately livelihood status with an index ranging from 0.500273 to 0.598192. The livelihood effects analysis shows that human capital has the greatest effects on household livelihood sustainability.

Keywords: Effects, climate smart, agriculture, livelihood, farmers.

Introduction

Agricultural production has been and is still a major source of livelihood for majority of people in Nigeria (UN, 2010). The sustainability of this livelihood source has been severely threatened by climate change that has negatively affected the agricultural sector. According to literature, the economic situation of rural Nigerians has been characterized by high level of poverty, vulnerability and unsustainable livelihood. Climate change has been labelled as security threat that has come to stay as it influences all component of livelihood and food security. The IPCC Project Report (2014) projected that there will be changes in rainfall patterns, temperature, and other extreme weather events, which will lead to increase in crop failures, pest and disease outbreaks, and degradation of land and water resources. These impacts are likely to hit rural communities hard because of their high dependency on climate sensitive sectors as cropping, livestock, fishing etc. coupled with low adaptive capacity hampering their livelihoods. Increasing climate uncertainties are also likely to lead to risk-averse behaviour among farmers, forcing them to depend on low-input and low-risk agricultural technologies. The main objective of this study is to explore the effects of climate smart agricultural practices on the livelihood status of tubers farmers. The ability to cope with the impacts of climate induced shocks and natural disasters depend solely on the resilience of the households (Wineman *et al.,* 2017), hence building up adaptive capacity and resilience to climate change is quite important in order to protect livelihoods. The use of climate smart agricultural (CSA) practices is a major means for mitigating the effects of climate change, reducing susceptibility and vulnerability to climate risk (FAO 2010, FAO 2013, and Arslan *et al.,*2015). It is important as it has quadruple benefits of improved productivity, increased income, reduction of greenhouse gases, and improved household food security.

In line with the foregoing, this study seeks to answer the following pertinent questions:

1. What are the climate smart agricultural practices used by farmers?
2. What are the effects of the climate smart agricultural practices on the livelihood status of the farmers?
3. What are the motivating factors behind the use of climate smart agriculture?
4. What are the challenges encountered in the use of climate smart agriculture practices (CSAPs)?

Research Methodology The study was carried out in Kwara State, Nigeria. The state has 4 Agricultural Development Project (ADP) zones – labelled A, B, C and D. the study adopt two-stage sampling technique to select 240 tuber farmers in Zone B of the ADP zone in Kwara state. Structured questionnaire was administered to them but only 218 was used for the analysis due to incomplete information supply in the questionnaires. Descriptive analysis such as mean and frequency distribution was used to describe the socio-economic characteristics of the respondents, describe the climate smart agricultural practices used by the farmers, the motivating factors behind the use of CSA and the challenges encountered in the use of CSA practices.

Analytical techniques:

The Adaptation Strategy Use Index (ASUI) was used to determine the frequency of use of CSA practices by the respondents.

$$FASUI = \frac{(N_1 \times 3) + (N_2 \times 2) + (N_3 \times 1) + (N_4 \times 0)}{M} \quad \ldots\ldots (1)$$

Where:

FASUI= farmers adaptation strategy use index

N_1 = Number of farm households that constantly used a particular Climate Smart Agricultural practice;

N_2 = Number of farm households that occasionally used a particular Climate Smart Agricultural practice;

N_3 = Number of farm households that rarely used a particular Climate Smart Agricultural practice;

N_4 = Number of farm households that did not use a particular Climate Smart Agricultural practice;

M = n x 3;

n = Total number of respondents Climate Smart Agricultural practice;

In exploring effect of the climate smart agricultural practices on the livelihood status of the farmers, the following sets of analysis were undertaken: the sustainable livelihood approach, the IPCC-LVI framework, the livelihood effects index and gendered analysis.

The sustainable livelihood framework (SLA) consists of eight major components: Socio-demographic profile, Livelihood Strategies, Social Networks, Health, Food and Water, Natural disasters climate smart agriculture and Climate Variability (Hahn et al., 2009). Values for each of the eight major components for each respondent were averaged and standardized using Eq. (1):

$$\frac{Index_{sb} = s_b - S_{min}}{s_{max} - s_{min}} \quad \ldots\ldots\ldots (2)$$

Where S_b is the observed value of indicator *s* for household *b*,

S_{max} and S_{min} are the minimum and maximum values of S_b for population under study.

After standardization, the sub-components were averaged using equation 2 to calculate the value of each of the major components.

$$\frac{M_{b} = \sum_{i=n}^{n} index_{sbi}}{n} \quad \ldots\ldots\ldots (3)$$

Where: M_b is one of the eight major components, index sbi represents the sub-components indexed by *i* that make up each major component, n is the number of sub-components

The SLI was calculated using equation 3

$$SLI = \frac{\sum_{i=1}^{8} w_{mi} \quad M_{di}}{\sum_{i=1}^{8} w_{mi}} \quad \ldots\ldots (4)$$

Which is explicitly expressed as

$$SLI = \frac{w_{sdp}\ SDP_b + w_{ls}\ LS_b + w_{sn}\ SN_b + w_h\ H_b + w_f\ F_b + w_w\ W_b + w_{ndc}\ NDC_b + w_{csa}\ CSA_b}{w_{sdp}\ + w_{ls}\ + w_{sn} + w_h + w_f\ + w_w\ + w_n + w_{ndc} + w_{csa}} \quad \text{.......................... (5)}$$

In exploring effect of the climate smart agricultural practices on the livelihood status of the farmers, the following sets of analysis were undertaken: the sustainable livelihood index , the IPCC-LVI index, the livelihood effects index and gendered analysis .

The SLI was calculated using equation 1

$$SLI = \frac{\Sigma_{i=1}^{8} w_{mi}\ \ M_{di}}{\Sigma_{i=1}^{8} w_{mi}} \quad \text{......... (1)}$$

Where:

SLI is the livelihood status index

W_{mi} are determined by the number of subcomponents that make up each major component.

The LVI–IPCC index was calculated using equation 2:

$$LVI - IPCC = (e_B - \ a_B) * \ s_B \quad \text{...... (2)}$$

Where:

IPCC–IPCC is the SLI expressed using the IPCC vulnerability framework,

$\mathbf{e_b}$ is the calculated exposure score

$\mathbf{a_b}$ is the calculated adaptive capacity score

$\mathbf{s_b}$ is the calculated sensitivity score (equivalent to weighted average of the Heath, Food, and Water major components).

The LEI was calculated using equation 3;

$$LEI = \frac{\Sigma_{i=1}^{4} w_{mi}\ \ M_i}{\Sigma_{i=1}^{4} w_{mi}}$$

Where:

LEI is the vulnerability index for one of the four livelihood assets, equals the weighted average of major components that form that livelihood asset;

Wmi the weights of each major component as determined by the number of subcomponents that make up each major components/or each capital.

M*i* is the major components indexed by i.

Results and Discussion

This section present results and discussion of the study in line with stated objectives. The socio-economic characteristics of the farmers in the study area such as age, sex, educational level, farming experience etc. were described using frequency distribution table. Descriptive statistics was also used to describe the climate smart agricultural practices used by tuber farmers. The Adaptation Strategy Use Index (ASUI) was used to determine the frequency of use of CSA practices by the respondents. The index reflected the ranking of each of the identified CSA practices in the study area in terms of frequency of usage. Composite score was used to classify the farming households based on the level of use of CSA practices among the farming households. The effect of the climate smart agricultural practices on the livelihood status of the farmers was analysed using the sustainable livelihood approach, the IPCC livelihood vulnerability index framework. The challenges encountered and the motivating factors behind the use of climate smart agricultural practices was analysed using descriptive statistics.

Socioeconomic Characteristics of the Respondents

The socio-economic characteristics of tuber farmers considered in this study include age, gender, marital status, educational status, household size, access to extension and farming experience.

Details of the socio-economics characteristics of the tuber farmers in the study area are presented in Table 1. Majority of the respondents (87.6%) were males while 12.4% are females with 25.2 % of the respondents are within the age bracket 31-40 years, 49.5% are between 41-50 years. 9.6% were between the ages of 51 to 60 years. The mean age of the tuber farmers is 44 years. This suggests that the farmers belong to the economically active population category, which is between 25-59 years and forms the active years of the farmers, and therefore, they are strong enough to engage in agricultural practices (Ogunniyi *et al.,* 2016). Majority (84.9%) of the respondents are married, 3.7% are single, while those who are divorced and widowed are 5.0% and 6.4% respectively. This indicates that majority of the respondents are likely to make use of family labour for their activities. Furthermore, the study shows that majority (21.1%) of the respondents has primary education, 24% has no formal education, and 39.4% had secondary education while only 15.1 % had tertiary education. Therefore, majority (75.6%) of the respondents had one form of or the other of formal education. The implication of this is that the farmers are likely to be open to various techniques or strategies that will help mitigate the effects of climate with majority (74.8%) of the respondents indicating that farming is their major source of income while 25.2% uses it as a secondary source of income, it can be observed that the majority (57.34 %) had household size of between 6-10 while 36.69% the respondents had household size of between 11 and above, 20.04% had less than 5 household members. The household size therefore suggests that respondents are likely to enjoy family labour readily. The size of the family may thus influence the amount of hired labour employed, as a large household size is a source of family labour in rural Nigeria where farming is a major occupation. It also revealed that majority (89.9%) of the respondents has contact with extension officers who give them advice and information while 10.1% does not have contact with extension agents.

The analysis also reveals that 24.32% of the respondents had between 10 and 20 years of experience, 2.75% had less than 10 years of experience, while 72% had more than 20 years of experience. The average year of experience for tuber farmers was 28 years. This indicates that the respondents are well versed in the farming system. In addition, the experience coupled with acceptance and adoption of climate smart agriculture will probably have direct relationship with increased sustainable livelihood. Farming experience is very important in farming activities, as it helps the farmer in the area of proper farm management to maximize profit.

Climate Smart Practices and the Climate Smart Adaptation Strategy Index

Awareness about Climate Smart Agriculture

From Table 2, it can be observed that 98.6% of the respondents are aware about climate smart strategies with 97.71% of the respondents' actually practicing one form of CSA strategies or the other. This result is contrary to the findings of Tiamiyu *et al.,* (2017). From their study. They found out that generally farmers' adoption rate of the climate smart agricultural practices was very low in North Western Nigeria which corroborates Saguye's (2017) who stated that low adoption of climate smart agriculture in Ethiopia led to their low farm productivity.

Table 1: Distribution of tuber farmers by their socio-economic characteristics

Socioeconomic characteristics	Frequency	Percentage
Gender		
Female	27	12.4
Male	191	87.6
Age (years)		
<=30	22	10.1
31-40	55	25.2
41-50	108	49.5
51-60	21	9.6
61 and above	12	5.5
Marital Status		
Single	8	3.7
Married	185	84.9
Divorced	11	5.0
Widowed	14	6.4
Religion		
Christianity	84	38.5
Islam	131	60.1
Traditional religion	3	1.4
Educational	53	24
Status	46	21.1
No Formal	86.6	39.4
education	33	15.1
Primary Education		
Secondary Education		
Tertiary		
Household size		
(Numbers)	45	20.64
<=5	125	57.34
6-10	80	36.69
11and above		
Farming		
Experience(yea	9	2.75
rs)	53	24.32
<=10	156	72
11-20		
21 and above		
Access to		
Extension	196	89.9
Yes	22	10.1
No		
Access to	137	62.8
credits	81	37.2

Source: Field Survey 2019

Although practices such as planting of early maturing, drought tolerant, intercropping, cover crops with main crop(s) to improve soil fertility were fairly adopted.

The result further revealed that about (49.08%) of the respondents obtained information about climate smart agriculture from extension agents while 47.71% receive adequate CSA information from their respective farmers association. This shows there is an effective communication channel between the respondents and the extension agents and also farmers association or social groups is an effective channel in dispensing information to farmers.

It was discovered during, the course of interview that some of the respondent's mistook traditional practices as climate smart practices and this shows that there is still more to be done in terms of educating the farmers. This tallies with the work of Smith (2006), where the study observed that climate change affected the farmers negatively in terms of food security and this was due to lack of adequate technical know-how and lack of climate service information. However, if there is adequate training for the smallholder farmers and appropriate information in implementing CSA practices effectively the farmers are able to adapt better to climate change. Their results show the importance of effective communications between the farmers and research institutes. Ekpa *et al.,* (2018) also recommended that massive campaigns be carried out in educating the youths regarding the importance of agriculture production activities and how sustainable it can be when using CSA practices.

Table 2: Distribution of respondents according to awareness of CSA

Awareness variable	Frequency	Percentage
Awareness of climate smart agriculture		
No	3	1.4
Yes	215	98.6
Primary source of information		
Extension agents	107	49.08
Farmers association	104	47.71
Mass media	1	0.458
Neighbouring farmers	4	1.834
Practicing CSA		
Yes	213	97.71
No	5	2.29

Source: Field Survey 2019

Table 3: Descriptive analysis of usage of climate smart agricultural practices

Group	Percentage of users	Components
Integrated crop management	80.26	Planting of improved crop varieties (early maturity and drought resistant). Use of organic manure and fertilizer Intercropping with leguminous crop
Conservation agriculture	82.4	Use of mulching Zero tillage Crop rotation Flat planting
Agricultural water management	80	Rain water harvesting Mini irrigation (use of pumping machine to pump water before commencement of rain fall)
Indigenous knowledge	93.61	Local knowledge (prediction of when it will rain).

Source: Field Survey, 2019

Descriptive analysis of usage of climate smart agricultural practices

Table 3 presents the descriptive statistics of composition of each component (climate smart agricultural practices). The most commonly used group apart from indigenous knowledge is conservation agriculture with 82.4% of the farmers using at least one of its components. Its components are use of mulching, zero tillage that is minimal soil disturbance, crop rotation and flat planting. Flat planting although not synonymous with tuber production is used for rice production as rice planting is common in the study area.

The next most used group is integrated crop management with 80.26% and agricultural water management with exactly 80% of the respondents using at least one of its components. This has components such as planting of improved crop varieties (varieties that are early maturing, drought n resistance) yam minisetts. Use of organic manure and fertilizer, intercropping with leguminous crop. Yam and cassava varieties planted by the respondents vary and have different local names. The yam minisetts is commonly known as white yam and has many local names such as *Ekati, Kunma, Ewagi, Wutsuo, Buhafin, Ebuogi, Okunmaduo* etc.

Four major cassava varieties are planted namely tme 419, tms 0581, nr 8083 and tms 30572. The respondents stated that they use these varieties because they mature early and are quickly due for harvesting.

Use of indigenous and local knowledge is the most used components with 93.61% of the farmers using it. According to the famers, use of indigenous knowledge is used in collaboration with other practices to effectively adapt against climate change, for instance in forecasting the weather conditions for proper timing of their planting but that at times due to the constantly changing climate their prediction is not always accurate.

According to Chinedum *et al.,* (2015) local knowledge although not always correct has over the years guided most of the farming practices in Nigeria and can be used successfully to strengthen farmers' adaptive capacity to climate change. Field experience also confirmed that the farmers adopt other CSA adaptation methods and the most used include change in planting dates, and substituting less resistant crops for a more resistant crop. This result was also similar to the findings of Bright *et al.,* (2018) whose result show that crop rotation, mulching, use of improved varieties, use of cover crops, changing planting dates are some of the most used climate smart practices by farmers in Kenya.

Climate smart adaptation strategy index and frequency of usage

Table 4 show the result of the frequency of use of CSA practices and the corresponding index for each strategy. The result presents the most used CSA practices in ranking order. The top five (5) most used CSA practices in the study area are mulching, local knowledge, use of improved crop varieties, use of organic manure, and crop rotation while permanent soil cover was ranked 9^{th} and flat planting and pumping machine took the 10^{th} and 11^{th} position and they were known to be the least used CSA practices.

The result also showed that the farmers are climate smart and CSA practices was being practiced at different usage levels, which might be a result of type of crops planted and some other factors that might be influencing their usage. This result corroborate the findings of Emmanuel *et al.,* (2017) where their study showed that conservation agriculture, use of organic manure, crop diversification, use of wet land (Fadama) and planting of drought and heat tolerant crops in descending order were the top five (5) most used CSA practices. It also tallies with the study of Wekesa *et al.,* (2018) where crop management practices with practices such as: use of improved crop varieties, use of legumes in crop rotation, use of cover crops, changing planting dates and efficient use nitrogen fertilizers are some of the most commonly used CSAP practices.

Composite Score Analysis

The result from the composite score was used to classify the respondents into three users group's namely high, medium and low users. The results showed that 15.5% of the respondents were low users as the composite score values ranges from 0 to 6 (the difference between the mean and standard deviation) while 21.1 % of the respondents were classified into medium users with a composite score range of 7 to 8. The high user group had a composite score range of 9 to 10 (the sum of the mean and standard deviation) with a total percentage of 63.3%.

Table 4: Frequency of use of CSA practices and the TUSUI index

CSAP	TUSUI	RANKING
1. Use of mulching for young seedlings	0.9862	1st
2. Local knowledge	0.9587	2nd
3. Planting crop varieties with early maturity and drought resistance species	0.9205	3rd
4. Use of organic manure and fertilizer	0.6881	4th
5. Crop rotation	0.5780	5th
6. Rainwater harvesting	0.5749	6th
7. Zero tillage	0.5489	7th
8. Intercropping with leguminous crops	0.500	8th
9. Permanent soil cover	0.4312	9th
10. Others 1 (flat planting)	0.0749	10th
11. Others 2 (pumping machine)	0.0535	11th

Source: Field Survey, 2019

Table 5: Distribution of respondents according to users classification (n=218)

User group	Frequency	Percentage
High user	138	63.3%
Medium user	46	21.1%
Low user	34	15.6%
Mean: 8.0688		
Standard deviation: 1.859		

Source: Field Survey, 2019

Livelihood Analysis

In exploring the livelihood status of the respondents, four sets of analysis were undertaken:

(1) calculation of a balanced weighted average which is the SLA

(2) calculation of a LVI based on the IPCC framework

(3) Gendered analysis utilizing both models 1 and 2.

(4) Livelihood effects analysis

The data was analysed at two different levels namely whole sample-level analysis of the data and household level. This section presents and discusses the livelihood status of the respondents.

Livelihood Analysis According to the IPCC-LVI Approach

The IPCC-LVI index was scaled from -1 (most sustainable) to 1 (least sustainable). Results showed that 49.54% of the respondents had a moderately sustainable livelihood, 11.93% had a least sustainable livelihood with 38.53% of the respondents having a high sustainable livelihood. The whole sample index for IPCC-LVI is 0.34831. This indicates a low livelihood sustainability and high vulnerability to climate change and climate variability. Figure 2 shows the contributing factors based on the IPCC-LVI framework. From the whole sample index, it was observed that sensitivity is the highest contributing factor to vulnerability of livelihood (i.e. unsustainable livelihood) with a value of 0.89825. This explains why figure 2 is tilted towards sensitivity. Exposure with a value 0.440809 is the next most contributing factor while adaptive capacity with a value of 0.102977 is the least contributing factor. The adaptive capacity value of 0.102977 implies that there are some good capacities to cope with climate change and climate variability that reduces the livelihood vulnerability (i.e. unsustainable livelihood) but not good enough to decrease the exposure and the sensitivity. The high sensitivity value can imply that the high exposure and a low adaptive capacity cause their livelihood to be so sensitive to climate changes and invariably, negatively affecting their livelihood sustainability.

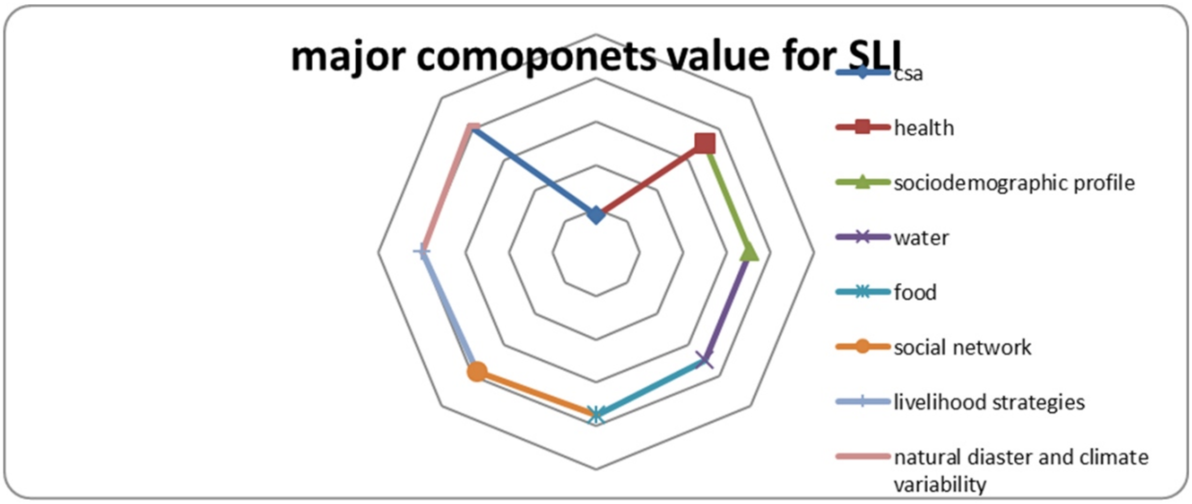

Figure 1: Radar chart of major components of SLI

Table 6: Results of SLA gender comparism

Components	Male headed (n=206)	Female headed(n=12)	Difference between male headed and female headed households
Socio demographic profile	0.369837	0.669897	-0.30006
Livelihood strategies	0.403378	0.369976	0.033402
Food	0.352751	0.33333	0.019421
Water	0.249669	0.453125	-0.20346
Social network	0.793018	0.80375	-0.01073
CSA	0.431345	0.321429	0.109916
Health	0.569445	0.585648	-0.0162
Natural disasters and climate variability	1.019707	0.728229	0.291478
SLA index	0.524098	0.54107	-0.01697
t-value	0.001	0.000	

Source: Field Survey, 2019

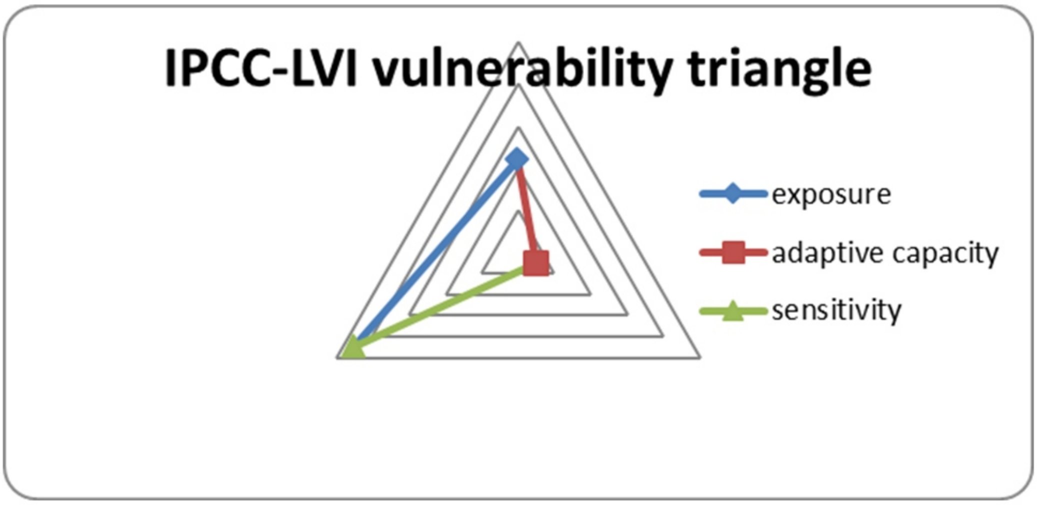

Figure 2: Radar chart of major components of IPCC-LVI

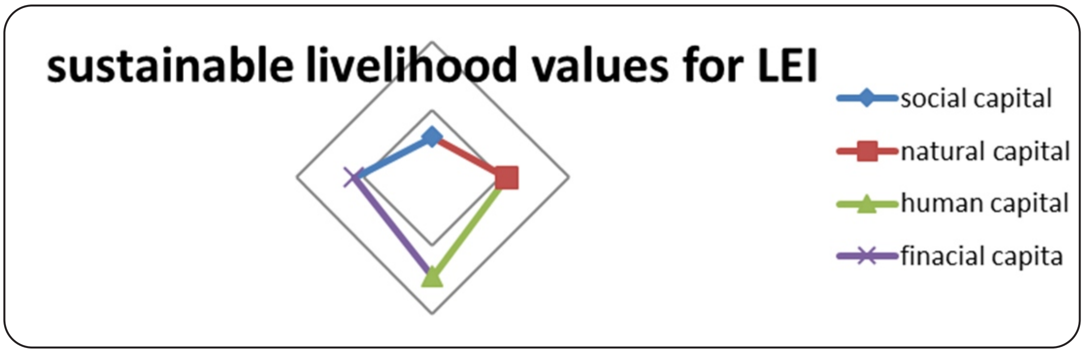

Figure 3: Radar chart of major components of IPCC-LVI

In terms of the IPCC- LVI approach, the female-headed household had a higher exposure score than the male-headed household with a difference of -0.00151 while the male-headed household has a higher sensitivity score than the female-headed household with a difference of 0.017848. Similarly, the male-headed household has a higher adaptive score than the female-headed household with a difference of 0.341873. The result of the t-test also shows a significant difference between male and female-headed household.

Livelihood Effects Analysis

The livelihood effect index was scaled from 0 (least vulnerable) to 1 (high vulnerable). The results of the LEI showed that 76.61 % of the respondents had a moderately sustainable livelihood, 9.17% had a least sustainable livelihood with 16.05% of the respondents having a high sustainable livelihood. From Figure 3, it can be observed that human capital is the most important factor and has the greatest effect on household livelihood sustainability with a value of 0.734919.

Financial capital is second most important factor having a great effect on household livelihood vulnerability. Natural capital is the next highest with a value of 0.549789. According to the respondents, there has been a change in rainfall and shorter raining cycle with more flooding and longer dry spells. Decline of rainfall and its variability has grown considerably, provoking the increase of droughts. Likewise, good water supply is a major problem in the area.

Social capital with a value of 0.290812 is the least of the household vulnerability having a low effect.

Analysis showed that major challenges encountered in the use of CSA include financing, difficult access to improved varieties and insufficient knowledge. Similarly, the motivating factors for the use of CSA include increased output, efficiency and effectiveness leading to increase in their income. These motivating factors are linked as increased yield leads to more income and is an attestation of the effectiveness of CSA.

Conclusion and Recommendations

The conclusion drawn from the study shows that being climate smart has the capacity of improving the livelihood status of tuber farming households if properly practiced. The study therefore recommends that farmers should be encouraged to join and participate in farmer associations for the benefits of knowledge sharing. This may also help with networking and linkages with extension service providers, farming organizations and farm financing agents. They should be encouraged to incorporate and practice as many CSAs as possible to have a higher effect on sustaining their livelihood. Likewise, farmers should be empowered as insufficient credit facilities will not encourage farmers to be climate smart as some of them cannot afford hybrid seeds and other forms of climate smart agricultural practices.

References

Arslan, A; McCarthy, N; Lipper, L; Asfaw, S; & Catteneo, A. (2014). Adoption and intensity of adoption of conservation farming practices in Zambia. *Agric Ecosyst Environ.,* 187:72–86

Bright, M.W. (2017). Effect of climate smart agricultural practices on household food security in smallholder production systems: Micro level evidence from Kenya. An unpublished thesis

Chinedum, N; Tambi, N.E; & Bangali, S.F (2015). *State of Knowledge on CSA in Africa: Case Studies from Nigeria, Cameroun and the Democratic Republic of Congo. Forum for Agricultural Research in Africa, Accra, Ghana*

Ekpa, D; Oladele O.I; & Akinyemi, M. (2017). Poverty status of climate smart agricultural farmers in North West Nigeria. Application of Foster Greer and Thorbecke Model. *American Journal of Rural Development, 5(*5):138-143. doi:10.12691/ajrd-5-5-3.

Emmanuel, A.O; James, A.A; Sulaiman A.Y; & Omobowale A.O. (2017). Factors influencing the level of use of Climate-Smart Agricultural Practices (CSAPS) In Sokoto State, Nigeria. *Journal of Agricultural Sciences 62(*3):315-327 Doi: Https://doi.Org/10.2298/Jas1703315o

FAO (2010). *Food and Agriculture Organization. Climate Smart Agriculture: Policies, practices and financing for food security. Rome: Adaptation and Mitigation.*

FAO (2013). Climate-Smart Agriculture Sourcebook.

Hahn, M.B; Roederer, A.M; and Foster, S.O. (2009). The Livelihood Vulnerability Index: A pragmatic approach to assessing risks from climate variability and change—a case study in Mozambique. *Global Environ Change 19*(1):74–88.

IPCC (2014). Food security and food production systems. In: Climate Change 2014: *Impacts, Adaptation, and Vulnerability. IPCC Working Group II Contribution to AR5*. Geneva: IPCC Secretariat, World Meteorological Organisation.

Ogunniyi, L.T; Fanifosi, G.E; and Adeosun, A. (2016). Strategies for Adapting to Climate Change among Fisher Folks in Eti-Osa Local Government Area of Lagos State, Nigeria. *Proceedings from International Conference on Climate Change, Ladoke Akintola University of Technology Ogbomoso, Nigeria 18-20 May, 2016 pp203-212*

Saguye, T.S. (2017), Assessment of Farmers" Perception of Climate Change and Variability and its Implication for Implementation of Climate-Smart Agricultural Practices; the case of Geze Gofa District, Southern Ethiopia, *Journal of Geography & Natural Disasters, 7*(191):1-9

Smith, B; & Wandel, J. (2006) "Adaptation, Adaptive Capacity and Vulnerability". *Global Environmental Change* (16):282-292.

Tiamiyu, S.A; Ugalahi, U.B; Fabunmi, T, Sanusi, O.R; Fapojuwo, O.E, & Shittu, M.A (2017). Analysis of Farmers Adoption of Climate Smart Agricultural Practices in Northern Nigeria. *Proceedings of the 4th International Conference on Agriculture and Forestry, 3:* 19-26. ISSN 2362-1036 online DOI: https://doi.org/10.17501/icoaf.2017.3104

Wineman, A; Mason, N.M; Ochieng, & J; Kirimi, L. (2017). Weather extremes and household Welfare in Rural Kenya. *Food Secur. 9*(2):281–300.