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ANALYSIS OF THE CHALLENGES OF CLIMATE SMART AGRICULTURAL PRACTICES AMONG CROP FARMERS IN NORTH-WEST, NIGERIA

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ABSTRACT

This study analyses the challenges of crop farmers in using climate smart agricultural practices (CSAPs) in Katsina and Sokoto states, Northwest Nigeria to target policy effort. A multi-stage sampling technique was used to select three hundred (300) farming households in the study area who provided the relevant primary information for the study through a set of structured questionnaires. Data was analyzed using descriptive and inferential statistics. The findings shows that lack of access to credit (80%), lack of access to high quality breeds (79%), lack of awareness of climate smart agricultural practices (80%), high cost of labour (89%), high cost of inputs (88%), lack of demonstration/training on climate smart agricultural techniques (86%), and lack of processing technology (93%) were very serious constraints to the users of climate smart agricultural practices in North-West Nigeria. The chi-square result indicates that access to formal education, access to means of communication and extension contact were significantly associated with higher use of climate smart agricultural practices in the study area. The study therefore suggests that massive campaign be made by government, civil societies, and the media to create awareness and encourage the use of climate smart agriculture and to proffer indigenous solutions that would address the constraints being faced by the farmers. It is recommended that the extension agents should educate farmers on the benefits of climate smart agricultural practices in order to promote farmers resilience to climate change.

Keywords: Constraints; Climate-Smart; Agriculture

INTRODUCTION

The earth is warming. This is the unequivocal conclusion of the Fourth Assessment Report of the IPCC (2007), which offers a complete investigation into how climate change is affecting natural and human systems. This has led to a growing concern about the likely consequences of climate change on poverty, economic growth, ecosystem services, livelihood prospects, as well as overall human development. Smith *et al.* (2007), anticipated that the poorest populations in developing countries are expected to bear the brunt of the impacts of climate change, with costs on individuals (e.g. livelihood, agriculture or water) estimated to exceed billions of dollars in some countries. Direct and indirect effects of climate change on poverty are enormous.

According to IPCC (2007) the relationship between agriculture and climate change is a topic of increasing interest. Worldwide agricultural production is expected to decrease under climate change projections, posing a threat to global food security. According to FAO (2014) climate change is likely to cause considerable crop yield losses thereby adversely affecting small holder livelihoods in Africa. As a result, food security and income generation opportunities for the farming households that are most reliant on agriculture may be in jeopardy (FAO, 2014). However, it is also important to note that agriculture contributes a significant amount of global emissions annually, which would increase with the intensification or expansion of production to meet higher demand. In addition, estimates attribute as much as 80% of global deforestation to agriculture (Fanen and Adekola, 2014). The IPCC 4th Assessment Report predicts that climate change could cause yields to decrease by as much as 50% in some highly vulnerable areas, including sub-Saharan Africa (Fanen and Adekola, 2014). According to this report "warming in Sub-Saharan Africa including Nigeria (SSA) is expected to be greater than the global average and rainfall will decline in certain areas. Also, cereal production growth for a range of crops in SSA is projected to decline by a net 3.2 % in 2050 as a result of climate change. Reddy and Hodges (2000). Have stated that under climate change, the largest negative yield impacts are projected for wheat followed by sweet potatoes. However, millet and sorghum yields are projected to be slightly higher under climate change, probably given their higher tolerance to higher temperatures and drought stress in Sub-saharan Africa (SSA). Assunção and Chein Feres (2009) evaluated that in Brazil, on average, agricultural productivity per hectare could decline by 18 % by 2040 as a result of climate change, but that, at the city level, impacts could range from a decrease of 40 percent to an increase of 15 percent. Climate change equally leaves many more people vulnerable to poverty. IFRC (2000) estimated that above half of the world's population as well as most of the productive lands and urban areas are situated in coastal and delta regions where the climate related disasters are prominent. These areas are predominantly found where the highest number of the deprived households live, especially in Sub-Saharan Africa. Therefore, consequences of climate change such as submerging, droughts, landslides amongst others, will not only reduce farm yields for many, but will also leave them vulnerable to poverty in the short, medium or long term. It is therefore imperative to design policies as well as enforce practices that adapt to the current observed changing climate.

In the developing world, climate change information and adequate response could be regarded as luxury especially at the national level. However, community sensitization/awareness and community-based adaptations are important aspects of climate change mainstreaming. Community-focused susceptibility and adaptation valuations are significant tools in sustenance of community established adaptations. True integration and/or training on climate change adaptations strategies at the sub-national level will result in wider ownership of climate response and allow sketch on a wider pool of financial and human resources for execution, while promoting extra extensive dimensions and institutional structure. Agriculture must therefore incorporate climate change effects to ensure sustainability. The use of high resilient varieties is another exercise that could advance or increase income leading to reduced poverty by households and increasing their efficiency.

According to Kijima (2011), Climate-Smart Agriculture (CSA) is defined as agriculture that sustainably increases production and income, resilience as a result, eliminates greenhouse gases emission (mitigation), which heightens the accomplishment of national food security, developmental objectives and reduced poverty (FAO, 2010). Agriculture is considered to be climate smart when it achieves three main goals: (i) The sustainable increase in agricultural production and income, (ii) The acclimatizing and building resilience to climate alteration and (iii) The reduction or eliminating greenhouse gas (GHG) emission, (Fanen and Adekola, 2014). Climate smart farming promotes the transformation of agricultural systems and agricultural policies to increase food production to enhance food security and ensure that food is affordable (low input-cost) hence reducing poverty while preserving the environment and ensuring resilience to a changing climate (Mnkeni and Mutengwa, 2014). Climate change adaptation, particularly at the local or sub-national levels, matter for two reasons: First, the impacts are best felt and understood at the local level; climate change impacts are also observed at the low level areas where the vulnerability and adaptive capability are very much specific. Second, most adaptation alternatives, for the need of being effective, involve implementation at the local level and fruitful initiatives pioneered at the local level may be replicated and scaled-up nationally. It is on this note that this research seeks to ascertain the influence of climate smart agricultural practices on poverty status among farmers in Northwest Nigeria. The Nigerian story presents a contradiction because the country is rich, but the individuals are poor. In Africa, climate-smart agriculture offers multiple benefits in line with attainment of the goals of: sustainable increase in reliability and productivity of agricultural systems, increase in smallholder farmers' resilience and adaptation to effects of climate change and reduction in greenhouse gas emissions from agricultural practices (Naess, 2011). Therefore, CSAP focuses on contributing to economic development, poverty reduction and food security; maintaining and enhancing the productivity and resilience of natural and agricultural ecosystem functions (Ojoko *et al*., 2017), thus building natural capital; and reducing trade-offs involved in meeting these goals". This stresses the need for farmers to adopt the use of CSAP, which will help in boosting agriculture to produce more on the same amount of land while adapting to a changing climate. Terdoo and Adekola (2014), opined that, though many nations will be expected to embrace climate smart agriculture, its applicability in an African perspective is not a very clear situation, neither has its sustainability been evaluated. Farming in northern Nigeria is mainly rural, with about 80 percent of the farmers involved in rain-fed agriculture and subsistence in nature. It is the major sources of income for many households in North-West Nigeria (Obayelu, 2010), Climate plays a significant role in ensuring sustainable agricultural production in many parts of Northern Nigeria. In addition, low level of improved agricultural technology compels wide use of traditional farming system. The latest discrepancies in the climate and weather of the region have taken severe toll on crop production with some crop yields now declining in Nigeria (Reddy and Hodges, 2000). In 2010, conventional climate smart agricultural practices were introduced to farmers through a programme called International Institute for Environment and Development (IIED) by the aid of Katsina State Agricultural and Rural Development Authority (KTARDA) and Sokoto Agricultural Development Project (SADP). The climate smart agricultural practices introduced were usage of organic manure, agro-forestry, and conservation agriculture, the usage of improved varieties and breeds, integrated crop/livestock management as well as irrigation for small-holder farmers.

The adoption of various CSA practices among crop farmers in Sub-Saharan Africa have been constraint by socio-economic, policy and institutional framework and cultural barriers. Moussa *et al*. (2012) and Collins *et al*. (2022) found that farmers face socio-economic, institutional, biophysical and climate related challenges in the adoption of CSAPs in Mali. In another recent study Antti *et al*. (2021) examined the constraints for adopting climate-smart agricultural practices among smallholder farmers in Southeast Kenya and also found dissonance in the perceived awareness of CSA practices and utilization of CSA technologies between state actors and farmers. While state actors emphasize lack of awareness as a barrier to adoption, farmers express knowledge ability regarding environmental change and climate-smart practices but are confined by limitations and restrictions posed by market mechanisms, land tenure issues and lack of resources. These restrictions include uncertainty in product prices, lack of land ownership, scarcity of arable land, and simply lack of capital or willingness to invest. Farmers are further challenged by the emergence of new pests and human–wildlife conflicts. Numerous studies have been done on CSAP adoption at National, Regional and State levels (Ogwumike and Akinnibosun, 2013; Anyanwu, 1997), however, spatial heterogeneity in agro-ecological conditions on a regional level necessitate locally appropriate responses to climate change adaptation. Ekpoh (2010); Ekpa *et al.* (2017); Ojoko e*t al*. (2017) assessed the effect of climate change and adaptation on agriculture by rural farmers in North-Western Nigeria., they examined factors influencing the level of use of climate-smart agricultural practices (CSAPs) in Sokoto state, Nigeria and found that conservation agriculture was the most predominantly climate smart agricultural practice in the area. Analysing the challenges of climate smart agriculture practices among small holder farmers in North West Nigeria is yet to be given attention. However, the current study contributed to this information gap by analysing the challenges that crop farmers faced in the use of climate smart agricultural practices in Northwest Nigeria. Our research questions to investigate constraints CSAP adoption are: (1) which climate change -related challenges do crop farmers face in the study area? (2) What factors restrains the use of climate-smart practices? (3) Is there any association between socio-economic factors and the use of CSAP in the study area? This study adds to the body of literature on the climate change adaptation in Northwest, Nigeria, specifically it provides insight regarding target extension programme design that supports sustainable agricultural development

METHODOLOGY

Study Area

The study area is North-Western (NW) Geopolitical zone of Nigeria. This comprises of seven (7) States namely: Katsina, Kano, Kaduna, Kebbi, Jigawa, Sokoto and Zamfara States. The region is located between latitude $9^{0}10^{1}$N and $13^{0}50^{1}$N and longitude $3^{0}35^{1}$E and $9^{0}00^{1}$E and covers about 168,719 km^2 of the country's total land mass (Ekpa *et al.*, 2017). The zone is blessed with population of 35,786,944 million (NPC, 2006). North-West zone is categorized by abundant diminutive grasses of about 1.5 – 2m and few stunted trees hardly above 15m. It is by far the most densely human inhabited zone of Northern Nigeria. The agricultural sector forms the basis of the overall development thrust of the zone. This region is described by a relatively hot climate with seasonal rainfall and a marked dry season.

(Draper and Maureen, 2009). The soils in the northern region of Nigeria are characterized as reddish brown or brown soils of the semi-arid and arid areas and are known as tropical ferruginous soils which are made up of about 85% sand with pH values that varied between 6.0 and 7.0 (Harris,1999). It is therefore evident that changing climates (increasing droughts or floods) will influence agricultural productivity and imperative to examine the impact of climate smart agriculture practices on poverty status among farmers in North-West Nigeria. The main source of livelihood of the people in this zone was agriculture. Although variation occurs among the States**,** off-farm activities include trading, tailoring, bricklaying and carpeting among others. Farming practices used in the States include shifting cultivation, mixed farming, mixed cropping and pastoral farming. The climate makes the farmers to cultivate a very wide range of crops such as cereals, legumes and vegetables. Livestock such as cattle, goats, sheep, and poultry like chicken, turkey, pigeon and ostriches etc are produced and the livestock are reared extensively (Ojoko *et al.*, 2017).

Sampling and Data Collection

The target population of the study is the maize farming households. A multi-stage sampling procedure was employed for the collection of data and information from the rural farming households. The first stage involved a purposive selection of Katsina and Sokoto States due to high prevalence rate of poverty (NBS, 2013). The researcher also selected the two States based on the location which connected the other five States together hence, probably because of similar religion and cultural practices. For example, Sokoto State having boundaries with Kebbi and Zamfara States while Katsina State shared the same boundaries with Kaduna, Kano and Jigawa States. The second stages involved a random selection of three (3) Local Government Areas from each of the three agricultural zones in Katsina State, and random selection of three (3) Local Government Areas from three (3) out of the four agricultural zones in Sokoto State, making a total of six (6) Local Government Areas in all. The third stages also involved random selection of ten (10) communities from each Local Government Areas to bring the total to sixty (60) Communities. Lastly, five (5) farming households were randomly selected from each of the communities, making a total of three hundred (300) respondents, who were utilized for this analysis. However, only 294 instruments were returned and used for the analysis. The unit of analysis was the household head because of the practice of “purdah” system of religion not allowing their women to go outside the house.

Data Analysis

To measure the level of constraints facing household farmers using climate smart agricultural practices, a 5-point Likert rating was employed. The five points scale was weighted as very serious = 5, serious = 4, undecided = 3, not serious = 2 and not very serious = 1. Osuala (1982) observed that it is more likely that a researcher would report the mean score on the scale. Based on this weight, the constraints face by the rural household farmers will be rank using weighted mean ($\ddot{X}$).

$$X_w = \frac{n_5(5) + n_4(4) + n_3(3) + n_2(2) + n_1(1)}{n}$$

Where: $\ddot{X}_w$ = Weighted Mean Score of challenges of climate smart agricultural farmers.

n = No: of household climate smart agricultural farmers.

The mean score of respondents based on the five points scale is 5 + 4 + 3 + 2 + 1 = 15/5 = 3.0 Using the interval scale of 0.05, the upper limit cut-off point was 3 + 0.05 = 3.05; the lower limit will be 3 – 0.05 = 2.95. On the basis of the limit, any mean score below 2.95 (ie ms < 2.95) was taken as “not serious”, those between 2.95 and 3.05 were considered “serious” (i.e. 2.95 < ms ≤ 3.05), while any means score that is greater than or equal to 3.05 (ie ≥ 3.05) will be consider “very serious”. We further classify the farmers into high users and low users of climate smart agricultural practices based on the number of CSAP utilized following (Ojoko *et al.*, 2017 and Ekpa *et al.*, 2017). The study examined the socioeconomic characteristics of respondents. Summary statistics such as means, percentages, and t-test were employed to fully understand the socio-economic characteristics of the farmers. We further perform a chi-square test of hypothesis that some categorical variables are independent of intensity of use of CSAPs in the study area.

RESULTS AND DISCUSSION

Description of the Socioeconomic Characteristics of the Respondents

Table 1 shows the analysis of socio-economic characteristics of the crop farmers who practice CSA in the study area. The result show that the mean average age of high-users of CSA in Katsina State was 54.6 years old but that of Sokoto State was 51.7 years. This shows that more experienced farmers are into CSAP in Katsina State than Sokoto State which had lower average age. These results aligned with that of years of farming experience variable wherein, average mean years of farming experience for high-users of CSAP in Katsina State (27.44 years) was higher than that of Sokoto State which was (24.64) years. Nevertheless, there was no significant difference between high-users and low-users across household sizes in Sokoto State and for the whole samples. In addition, in terms of expenditure, high-users of CSA had consistently higher expenditure amounts for both Katsina and Sokoto States. The survey suggested that high-users of CSA spent much more than low-users of CSA. This result apparently supports the findings of Fanen and Adekola (2014) that, there was a wide outcome disparity among the participants of the climate smart agricultural practitioners in Nigeria. This might be due to the fact that the operational level of each farmer differs. The results of the analysis also indicated that, the average number of extension service contact was approximately two (2) which is inadequate, especially considering the large population in the North-West Nigeria and the international standard best practices. According to Adetunji, (2013) extension contact in Nigeria is gradually diminishing owing to non-compliance of government to the primary demand of the farmers. Other variables were not significantly different between high-users and low-users of CSA as shown by the t-test table. Therefore, considering the actual (continuous) variables for Katsina State, Sokoto State and the pooled data, we found that the high-users of CSA were more in Katsina State than Sokoto State while the low-users of CSA were more in Sokoto State than Katsina State.

Table 1: Summary statistics of some socio-economic characteristics variables

Variable	Katsina state		Sokoto state		Pooled		t-value (p-value)	
	Mean High Users	Mean Low Users	Mean High Users	Mean Low Users	Mean High Users	Mean Low Users		
Age (years)	54.57 (9.51)	52.89 (9.16)	51.67 (8.38)	53.00 (7.90)	52.90 (8.97)	52.92 (8.78)	0.02 (0.98)	
Household size (No:)	9.97 (2.29)	8.89 (3.06)	8.24 (2.83)	8.25 (2.83)	8.97 (3.00)	8.72 (3.00)	-0.64 (0.52)	
Expenditure (₦)	34,274 (11,523.26)	31,299 (13,698.28)	33,153 (12,986.84)	30,050 (13,007.99)	33,627 (13,374.40)	30,961 (13,438.24)	-1.57 (0.12)	
Farm Size (ha:)	7.18 (3.35)	7.45 (3.40)	7.73 (2.99)	6.70 (2.76)	7.50 (3.15)	7.25 (3.24)	-0.59 (0.56)	
Experience (years)	27.44 (9.23)	25.67 (8.10)	24.64 (8.39)	26.00 (8.50)	25.82 (8.84)	25.76 (8.15)	-0.06 (0.96)	
Extension contacts (No)	1.59 (1.11)	1.93 (1.43)	1.73 (1.02)	1.75 (1.16)	1.67 (1.06)	1.88 (1.35)	1.34 (0.18)	
Variable	Katsina State		Sokoto State		Both States		Pooled	Percentage
	High Users	Low Users	High Users	Low Users	High Users	Low Users		
Sex								
Male	119	18	88	50	207	68	275	93.54
Female	8	2	5	4	13	6	19	6.46
Education								
Arabic education	66	12	54	32	120	44	164	56
Primary education	26	5	16	12	42	17	59	20
Secondary education	23	2	10	5	33	7	40	14
Tertiary education	12	1	13	5	25	6	31	10
Marital status								
Married monogamy	54	12	29	16	83	28	111	38
Married polygamy	69	6	62	32	131	38	169	57
Divorced	3	0	0	3	3	3	6	2
Singled	0	1	1	1	1	2	3	1

Widowed	1	1	1	2	2	3	5	2
Farmland ownership								
Yes	120	20	86	51	206	71	277	94
No	7	0	7	3	14	3	17	6
Land acquisition								
Rent	6	2	6	4	12	6	18	6
Inherited	88	12	63	38	151	50	201	68
Purchased	26	4	22	7	48	11	59	20
Gift	7	2	2	5	9	7	16	6
Types of Labour								
Family	9	2	9	8	18	10	28	10
Hired	26	3	23	11	49	14	63	21
Both	92	15	61	35	153	50	203	69
Membership of Association								
Yes	73	8	40	18	113	26	139	47
No	54	12	53	36	107	48	155	53
Communication Equipment								
Radio	40	10	45	32	85	42	127	43
Television	2	0	0	0	2	0	2	0.7
GSM	84	10	48	22	132	32	164	56
Video	1	0	0	0	1	0	1	0.3

The results in Table 1 further show that males were more involved in CSAP than female. These results signified that majority (94%) of the respondents were male, while 6% were female. As such, the implication drawn from the investigation is that there were conspicuously more male farmers practising CSA than their female counterparts in the study area. Therefore, male dominated the CSAP. This wide-gap distribution could be attributed to the religious and cultural beliefs in the study area which are not favourable to women. Evidently, socio-cultural and religious values disfavour women, especially in northern Nigeria, where the 'Purdah' system is more pronounced (Adereti, 2005). Similarly, the result corroborates Mtsor and Idisi, (2014) findings; they reiterated that the participation of women in agriculture is very low in some parts of Northern Nigeria because of the values and traditions of the people coupled with the religious upholding. Also, Oduwole and Fadeyi, (2013) asserted that ignorance and lack of exposures were the main causes of women indifference to agricultural activities. However, effective sensitization and education can be antidotes to these gender disparity and low involvement.

The practice of CSA can be enhanced by a sound educational attainment of respondents. The levels of education play an important and prominent role in economic development and skill acquisition. It enhances one's ability to understand and apply new ideas, technological innovations as well as his or her ability to plan and take risk. The results showed that all the respondents were knowledgeable, having one form of education or the other. The result revealed that 56% of the respondent had Arabic education, 20% had primary education, and 14% had attended secondary school, while 10% had tertiary education. There was no farmer without some level or form of education, although the Arabic education was an informal type of education which every household was expected to attain in the study area being an Islamic environment. This result tallied with Oluade and Seriki's (2013), which reported that majority (57%) of the respondents had only informal education. Accordingly, Appleton and Balihuta, (1996) stated that, it is essential for a farm manager to go through a four-year basic formal education, irrespective of gender. They found out that, education of at least four years of formal schooling engaged in by the investigated farm manager did raise production by 7%. Therefore, the level of education may influence the performance of the respondents if acquired formally. Relatedly, Appleton and Balihuta's (1996), submission maintained a parallel with this current research, because the high-users of CSAP are those who are literates in primary, secondary and tertiary education, than those who had Arabic education. Probably, this low formal educational level prevalent in the study area is one of the major factors responsible for high rate of poverty in the area (Aremu, 2011). The importance of education in the process of using CSAP cannot be overemphasised, because according to Adeyemo et al., (2005) education improves the quality of labour and ability to evaluate information which can also expose the farmers to more opportunities and production profitability.

Marital status is classified in this study into five categories: polygamous marriage, monogamous marriage, divorce, single and widow categories. The illustration on marital status distribution presented in Table 1 indicates that majority (57%) of the respondents were in a polygamous marriage. 38% were monogamously married giving a total number of married people to be 95% while 2% were divorced, 1% were single and 2% widows. This result showed a parallel with the findings of Umar, (2009) which reported that majority (97%) of sesame organic farmers (CSA) were married. The result implied that majority of the respondents were married in a polygamy form of marriage which was in tune with the religious and cultural beliefs attached to marriage in the study area, however it doubles as a source of increase in labour. It could also imply that majority of the respondents were married probably due to the importance attached to marriage institution in the study area which was a symbol of responsibility and respect in the community hence such responsible farmers can advise others who had respect for them. In this study, the married (both monogamy and polygamy system of marriage) seems to contribute much to the CSAP than those who are not married hence, it is ideal to encourage the farmers in the study area to get married in order to enhance agricultural productivity.

Farmland ownership refers to the area or location of land portion owned by the farmers for his/ her farm activities. The investigation, as presented in Table 1 showed that 94% of the respondents owned the land they are using for farming activities while 6% did not. From the foregoing, it is obvious that most of the respondents are land owners and consequently have access to the land because they were inherited through their parents from their ancestors and also because some of them purchased the land as shown in this particular study. Subsequently, there is a correspondence with Enujeke and Ofuoku’s (2012), findings that majority (62%) of the farming households are more or less landlords than tenants. It is significant to note that about 70% of the respondents who are the land owners were high-users of CSAP as expected, so, it is apparent that ownership propels farmers to manage the land carefully and sustainably.

Table1 further shows that farmland ownership is acquired through many processes which include inheritance, purchase, as a gift or rent by the landlords. The result proved that 68% of the farmland owned by the respondents are acquired through inheritance while, 20% are acquired by purchase, 6% of the farmland are acquired via gifts and 6% as rent. This implied that, most of the farmlands were acquired through inheritance rather than being bought or sold out for other usage. Hence this can lead to land fragmentation among the locals as the population increases. And this shows that those who acquired their land through inheritance are found to use CSAP more than those who acquired their own land through other means may be, because much vast available land via inheritance without spending much to acquire the land, hence, have enough resources to invest into the CSAP. This result equally substantiated Umar’s (2009) work, which postulated that majority (85%) of sesame organic (climate smart agriculture) farmers acquired their farmland through inheritance.

As presented in Table 1, 70% of the respondents acquired their labour from their families, while 21% of the respondents hired other labourers who were not their family members; while in contrast, 69% used both family and hired labourers. The employment of both family and hired labourers probably hinged on the fact that the farm sizes are usually very large as evident in the average mean farm size of about 7.5 ha. Ipso facto, family labour might not suffice, and therefore the need for hired labourers. This means that, the greater proportion of CASP have been carried out by households that practice both family and hiring labourers. In like manner, the result equalled the findings of Adedeji *et al*. (2013). They confirmed a high support of the family labour in agricultural production, aside emphasising the negative effect of using child labour and its future detrimental consequences both in the agricultural and socioeconomic status of the nation. In addition, Oluranti *et al*. (2016) also obtained similar results and explained that the poverty status of the family was the determining factor that demonstrated how effective family labour was utilised in the rural farming households. However, they argued that the composition of the hired and family labour can be more useful in the polygamous setting which characterised Nigerian rural areas particularly in the northern region.

Table 1 also illustrates the disaggregation of membership of an association which refers to a group aimed at cooperating and helping one another in terms of agricultural and financial needs of individuals in the association. The result showed that 53% of the respondents did not belong to any group or association while 47% of the respondents belonged to an association. This implied that most of the farmers do not belong to any association probably because of mismanagement of resources and corruption of the leaders holding positions in the various leadership offices (portfolio) in the association. This shows that those who are members of one society, or the other are found to use CSAP more than those who are not members of any association. And these results maintained a parallel with Obayelu, (2010) which submitted that membership of an association was lower (40%) in North-West Nigeria. Nonetheless, it is imperative for farmers to belong to associations because it creates a forum for information sharing and networking among the farmers.

Respondents' distribution according to communication equipment as presented in Table 1 used denotes that the respondents used different communication equipment as means of information transfer amongst one another. These results clearly portrayed that 43% of the respondents used radio as their means of communication, while 0.7% of the farmers used television whereas, 55% of the farmers used Global System Mobile (GSM) and 0.3% used videos as their means of communication in the study area. This implied that (GSM) was the most acceptable means of communication in the study area because it possessed almost all the other features of communication like the radio, television and video package in one system called handset hence, those farmers with GSM communication equipment's have more access to information related to CSAP than any other means of communication because the synergy characteristic of the GSM possessing the other features in radios, television and videos. These results aligned with Adeyemi et.al. (2013) report, for they averred that majority (98%) of the respondents used GSM as their means of communication.

Challenges of Using Climate Smart Agricultural Practices in the Study Area

The second objective aims at investigating constraints faced by respondents in climate smart agricultural activities. The respondents in the study area were faced with numerous constraints. These constraints range from lack of access to credit, lack of access to extension services etc. A five (5) point likert rating scale was applied to rank the constraints in order of their mean sizes. This was necessary to enable us to identify which of these constraints were major and posed a serious challenge to the practice of climate smart agriculture in the study area and the result is presented in Table 2. We found that lack of modern processing technology, lack of demonstration of climate smart agricultural techniques, lack of social interaction, lack of cost of input, cost of labour, lack of awareness of climate smart agricultural practices, lack of technical know-how, lack of time to practice climate smart agriculture, lack of access to high quality breed, lack of access to improved crop varieties, lack of access to education, and lack of access to credit were very serious problems in terms of climate smart agricultural practices in the study area and their mean scores were above 3.05. However, lack of demonstration of climate smart agricultural practices and lack of processing technology were the two major constraints in the study area because their mean score were 4.03 and 4.04 respectively. This implies that, there are no personnel trained to help the rural farmers in the technical demonstration of climate smart agricultural practices and lack of industrial factories to process the large quantity of agricultural products like the grains and animals produced by the farmers in the study area. In addition, lack of access to market was not a major problem in the study area, because there are many marketing channels to dispose most of the harvested agricultural products. Other challenges faced by farmers in adopting CSAPs includes inadequate access to extension services, inadequate information from radio, and lack of willingness of farmers to practice climate smart agriculture. Access to market was not a serious constraint (2.95) because most of the farmers sell their farm produce at the farm gate and at daily and weekly rural markets in the communities. Analysis of the challenges of the farmers based on the use of CSAPs, we found that high-users of climate smart agricultural practices in the study area, lack of access to market and was higher among household farmers in Sokoto State than in Katsina States and this can be as a result of poor and inadequate market infrastructures as observed in Sokoto State. In addition, the high-users of climate smart agriculture lack adequate access to extension services in Sokoto state than in Katsina State. This can be as a result of more population of farmers in Sokoto than in Katsina state. Overall, looking table, we found that lack of the processing technology (4.04) was identified as very serious challenged. In Katsina State 40% of the high-users of climate smart agriculture face this problem and 7% of low-users. While in Sokoto State, 29% of the high-users of climate smart agriculture and 17% of low-users faced this problem. Considering the pooled data from the two group of users, 69% and 24% of high-users and low-users respectively faced this challenged. Hence, policy makers from the two states should invest more in agro-industrial infrastructure to enhance farmer's agricultural income. Moreover, Insufficient credit facilities will not encourage farmers to practice climate smart agriculture as some of them can barely afford seeds and tools more or less of hybrid seeds and other forms of climate smart agricultural practice.

Table 2: Challenges as perceived by the high-users and low-users of climate smart agriculture (n = 294)

Frequency who said Yes (%)	Katsina		Sokoto		Both States		Overall		Average Extent (Mean)	Remark
	High user	Low user	High user	Low user	High user	Low user	Yes	No		
Lack of access to market	46 (15.65)	8 (2.72)	30 (10.2)	22 (7.48)	76 (25.85)	30 (10.2)	106 (36)	188 (64)	2.69	Not Serious
Lack of access to credit	102 (34.69)	16 (5.44)	76 (25.85)	40 (13.61)	178 (60.54)	56 (19.05)	234 (80)	60 (20)	3.88	Very Serious
Lack of access to education	86 (29.25)	7 (2.38)	54 (18.37)	32 (10.88)	140 (47.62)	39 (13.27)	179 (61)	115 (39)	3.39	Very Serious
Lack of access to extension services	73 (24.83)	9 (3.06)	40 (13.61)	23 (7.82)	113 (38.44)	32 (10.88)	145 (49)	149 (51)	3.04	Serious
Lack of access to improved crop varieties	89 (30.27)	12 (4.08)	51 (17.35)	33 (11.22)	140 (47.62)	45 (15.31)	185 (63)	109 (33)	3.37	Very Serious
Lack of access to high quality breeds	97 (32.99)	16 (5.44)	74 (25.17)	44 (14.97)	171 (58.16)	60 (20.41)	231 (79)	63 (21)	3.80	Very Serious
Lack of time to practice CSA	74 (25.17)	16 (5.44)	61 (20.75)	39 (13.27)	135 (45.92)	55 (18.71)	190 (65)	104 (35)	3.46	Very Serious
Lack of technical know how	108 (36.73)	16 (5.44)	74 (25.17)	47 (15.99)	182 (61.9)	63 (21.43)	245 (83)	49 (17)	3.60	Very Serious
Lack of information from radio	79 (26.87)	11 (3.74)	50 (17.01)	19 (6.46)	129 (43.88)	30 (10.2)	159 (54)	135 (46)	3.02	Serious
Lack of awareness of CSA practices	94 (31.97)	16 (5.44)	77 (26.19)	47 (15.99)	171 (58.16)	63 (21.43)	234 (80)	60 (20)	3.84	Very Serious
High cost of labour	116 (39.46)	18 (6.12)	82 (27.89)	45 (15.31)	198 (67.35)	63 (21.43)	261 (89)	33 (11)	3.80	Very Serious
High cost of inputs	114 (38.78)	17 (5.78)	84 (28.57)	43 (14.63)	198 (67.35)	60 (20.41)	258 (88)	36 (12)	3.82	Very Serious
Lack of social interaction	88 (29.93)	17 (5.78)	58 (19.73)	37 (12.59)	146 (49.66)	54 (18.37)	200 (68)	94 (32)	3.26	Very Serious
Lack of willingness	67 (22.79)	12 (4.08)	37 (12.59)	29 (9.86)	104 (35.37)	41 (13.95)	145 (49)	149 (51)	2.97	Serious
Lack of demonstration of CSA techniques	111 (37.76)	19 (6.46)	79 (26.87)	43 (14.63)	190 (64.63)	62 (21.09)	252 (86)	42 (14)	4.03	Very Serious
Lack of processing technology	118 (40.14)	20 (6.8)	85 (28.91)	50 (17.01)	203 (69.05)	70 (23.81)	273 (93)	21 (7)	4.04	Very Serious

Note: numbers in bracket indicate percentages

Association between some Categorical Variables and Use of CSAPs

The third objective examined the association between some categorical variables and use of CSAPs and the result is presented in Table 3. The result shows a statistically significant association between use of CSAPs and extension contact($P \leq 0.1$), ownership of house($P \leq 0.05$), access to formal education ($P \leq 0.001$)and access to means of communication($P \leq 0.05$). we observed a strong association between access to formal education and ownership of means of communication and CSAPs in the study area. This is not surprising because education is an important factor in changing attitudes and motivation of the farmers and higher education is associated with effective communication and access to information about the available innovation and technology for improved productivity. This result tallied with Oluade and Seriki's (2013), which reported that majority (57%) of the respondents had only informal education. Education creates awareness and knowledge about CSAPs thereby encouraging farmers to adopt such practices. The importance of education in the process of using CSAP cannot be overemphasised, because according to Adeyemo *et al*., (2005) education improves the quality of labour and ability to evaluate information which can also expose the farmers to more opportunities and production profitability. There is the need for more research on the type of education farmers required to improve their use of CSAPs in the study area.

Table 3: Test of association between selected categorical variables and use of CSAPs

Discrete Variables	Df	t-value	p-value	Decision
Membership of association	1	1.521	0.218	Not significant
Extension contacts	6	10.736	0.098	significant
Access to credit	1	0.160	0.899	Not significant
Access to means of communication	1	7.770	0.005	significant
Access to means of transportation	1	0.042	0.838	Not significant
Own a house	1	4.491	0.034	significant
Acquire land	1	2.018	0.155	Not significant
Ownership of farmland	1	1.801	0.180	Not significant
Marital status	1	0.115	0.734	Not significant
Access to formal education	2	14.164	0.001	significant
Religion of household head	1	0.419	0.517	Not significant
Access to farm labour	1	2.328	0.127	Not significant

Source: field survey, 2016

CONCLUSION

Pooling data from Sokoto and Katsina states, we found that 80% and 20% of the sampled farmers were identified as high-users and low-users respectively. The pooled mean age of the farmers was 52.92 years. While the mean age of the farmers was 54.6 and 51.7years on average for both high and low users of CSAPs. The average age of farming experience for high and low users was 27.44 and 25.76 respectively with an average household size of 8.34 and 8.24 members for high and low-users respectively. 93.54% respondents were male with 56% of them whose highest level of education is Quaranic education and 95% are married with 69% of them who utilizes hired and family labour and 47% being members of association in the study area. Lack of training/demonstration on various CSAPs and poor processing technology were the most serious constraints to the use of CSAPs. The result from chi-square test of independence showed that access to formal education and means of communication are significantly associated with the use of CSAPs. *The study calls for policy makers to enact policies and plans that promote CSA-practices.* The recommended that (i) Sensitization of farmers on reality of climate change and the need to adopt climate smart practices towards reduction of adverse effect of climate change should continue. (ii) Policy and support that would enhance dissemination of Climate-Smart Agricultural practices to a larger proportion of farmers is recommended, (iii) policy factors such as extension service delivery can be triggered to enhance CSA use.

REFERENCES

Abadi, A., Lefroy, T., Cooper, D., Hean, R. and Davies, C. (2003). *Profitability of Medium to Low Rainfall Agroforestry in the Cropping Zone*. Barton, Australia, Rural Industries Research and Development Corporation Publication No. 02.

Abayomi, Y.A., Fadayomi, O., Babatola, J.O. and Tian, G. (2001). Evaluation of selected legume cover crops for biomass production, dry season survival and soil fertility improvement in a moist Savanna location in Nigeria. *African Crop Science*, 9(4): 615-628.

Achem, B.A. (2013). A comparative assessment of the profitability of cassava processing enterprises in Kwara State, Nigeria. *Global Journal of Current Research,* 1(2): 57-61.

Action Aid Nigeria (2009). Fighting Poverty in the midst of Plenty II. *Country Strategy Paper* 2009 – 2013, Action Aid Nigeria.

Adedeji, O.S, Du, H and Opoku Afari (2013). Inclusive Growth: An Application of the Social Opportunity Function to selected African Countries. IMF-Working Paper (Vol. 139). Washington, DC.

Adefolalu, D.O.A. (2007). Climate Change and Economic Sustainability in Nigeria. *Paper Presented at the International Conference on Climate Change, Nnamdi Azikiwe University, Awka* 12-14 June.

Adeyemi, V.A., Alonye, G.O. and Owolade, E.O. (2013). Awareness and usage of Modern Information and Communication Technology by Agricultural Extension workers in Oyo State, Nigeria. *Global Journal of Human Social Science*, 13(8). 30-41

Adekoya, O.A. (2014). Analysis of farm household poverty status in Ogun State, Nigeria. *Asian Economic and Financial Review*, 4(3):325-340.

Adepoju, A.A., Ogunniyi, L.T. and Olapade-Ogunwole, F. (2011). Comparative analysis of poverty and income inequality among food crop and livestock farmers in Ilesa metropolis, Osun State, Nigeria. *Global Journal of Human Social Science*, 11(5). 23-34.

Adewuyi, K.A. and Hayatu, Y. (2014). Effect of Poverty on Food Security of Rural Households in Adamawa State, Nigeria. Department of Crop Production, School of Agriculture Technology Federal Polytechnic, Mubi Adamawa State.

Ahmed, S.A., N. Diffenbaugh, and T. Hertel. (2009). Climate volatility deepens poverty vulnerability in developing countries. *Environmental Research Letters,* 4 (3): 1–8.

Ahn, P.M. and Hintze, B. (1990). No Tillage, Minimum Tillage, and Their Influence on Soil Properties. *In*: *Organic-matter Management and Tillage in Humid and Sub-humid Africa*. pp. 341-349. IBSRAM Proceedings No.10. Bangkok: IBSRAM.

Aigbe, F.O. and Isiorhovoja, R.A. (2013). Crop productivity, land degradation and poverty nexus in Delta North agricultural zone of Delta State, Nigeria. *Journal of Agricultural Science,* 12(3):30-41

Ajakaiye, D. Olu and V.A. Adeyeye (2001). The Nature of Poverty in Nigeria. Technical Report, NISER, Ibadan.

Ajani, E.N., Mgbenka, R.N. and Okeke, M.N. (2013). Use of indigenous knowledge as a strategy for climate change adaptation among farmers in sub-Saharan Africa: Implications for policy. *Asian Journal of Agricultural Extension, Economics & Sociology*, 2(1): 23-40.

Ajayi, O., Akinnifesi, F., Mullila-Mitti, J., Dewolf, J., Matakala, P. and Kwesiga, F. (2008). Adoption, Profitability, Impacts and Scaling-up of Agroforestry Technologies in Southern African Countries. *In*: Batish, D., Kohli, R., Jose, S. and Singh, H. (Eds.) *Ecological Basis of Agroforestry*. Taylor and Francis Group, Boca Raton, Florida.

Akinleye, S.O., Olubanjo O.O. and Soremekun, W.A. (2007). Poverty determinants among farmers in Ogun State, Nigeria. *Agriculture Journal*, 2(2): 2275–2280.

Akinnifesi, F., Makumba, W. and Kwesiga, F. (2006). Sustainable maize production using *gliricidia*/maize intercropping in southern Malawi. *Experimental Agriculture*, 42: 441–57.

Akinnifesi, F., Ajayi, O., Sileshi, G., Chirwa, P. and Chianu, J. (2010). Fertilizer trees for sustainable food security in the maize-based production systems of east and southern Africa: A review. *Agronomy for Sustainable Development*, 30: 615–629.

Aku, P.S., Ibrahim, M.J. and Bulus, Y.D. (1997). Perspective on poverty alleviation strategies in Nigeria. *In: Proceedings of the Nigeria Economic Society Annual Conference on Poverty Alleviation in Nigeria 1997. Ibadan: NES: 41-54*.

Alayande, B. and Alayande, O. (2004). A Quantitative and Qualitative Assessment of Vulnerability of Poverty in Nigeria. *Being a paper submitted for presentation of CSAE conference on poverty reduction, growth and human development in Africa*, March, 2004.

Allen, R.G., Pereira, L.S., Raes, D. and Smith, M. (1998). Crop Evapotranspiration, Guidelines for Computing Crop Water requirements. *Irrigation and Drainage. Paper,* No. 56, FAO, Rome, Italy.

Amaghionyeodiwe, L.A. and Osinubi, T.S. (2004). *Poverty in Nigeria*. The Nigerian Economic Society, Ibadan.

Ani, D.P., Umeh J.C. and Weye, E.A. (2013). Profitability and economic efficiency of groundnut production in Benue State, Nigeria. *African Scholarly Science Trust*, 13 (4): 6-19.

Anyanwale, K.C. (2007). *Climate Dynamics of the Tropics*. KAP: Dordrecht. 488 pp.

Aondover, T. and Ming-Ko, W. (1998). Changes in rainfall characteristics of Northern Nigeria. *International Journal of Climatology*, 18:1261-1271.

Anyanwu, J.C. (1997). Poverty in Nigeria: Concepts, measurement and determinants. *In: Proceedings of the Nigerian Economic Society Annual Conference on Poverty Alleviation in Nigeria 1997. Nigerian Economic Society,* Ibadan. PP.93-120.

Assunção, J., and F. Chein Feres (2009). Climate Change, Agricultural Productivity, and Poverty. Working Paper, Department of Economics, PUC-Rio de Janeiro, and Brazil.

Adetunji, M. A. (2013). Assessment of the quality of urban transport services in Nigeria. *Academic Journal of Interdisciplinary Studies (AJIS),* 2 (1): 49 – 58.

Adereti, F.O. (2005). Coping mechanisms of rural women in poverty alleviation in Osun State in a democratic and deregulated economy: Implications for agricultural extension as a discipline. *Journal of Agricultural Extension*, 8 (2.): 56-72

Appleton, S. and Balihuta, A. (1996). Education and agricultural productivity: Evidence from Uganda. *Journal of International Development*, 8(3): 415-443.

Aremu, M.A. and Adeyemi, S.L. (2011). Small and medium scale enterprises as survival strategy for employment generation in Nigeria. *Journal of Sustainable Development,* 4(1): 23-40.

Adeyemo, R. and Bamire, A.S. (2005). Saving and investment patterns of cooperative farmers in Southwestern Nigeria. *Journal of Social Science*, 8(3): 183-192.

Adeyemi, V.A., Alonye, G.O. and Owolade, E.O. (2013). Awareness and usage of modern information and communication technology by agricultural extension workers in Oyo State, Nigeria. *Journal of Agricultural Extension,* 12 (2.): 56-72

Collins, M. M., Milka, K., Joseph, M., Onesmus, K.N., David, K.K., Betty, M., Michael, O. and Felix, K. (2022). Adoption of climate-smart agricultural practices among smallholder farmers in Western Kenya: do socioeconomic, institutional, and biophysical factors matter? *Heliyon,* 8 (2):1-12

Draper, D. and Maureen, G.R. (2009). *Our Environment: A Canadian Perspective*. United States: Nelson Education Ltd.

Ekpa, D., Oyekale, A.S. and Yuni, D.N. (2017). Poverty decomposition for high and low users of climate smart agricultural techniques in Northwest Nigeria. *International Journal of Environment and Pollution Research*, 5(2): 26-41

Enujeke, E. and Ofuoku, A. (2012). Determinants of adaptation to climate change among arable crop farmers in Edo state, Nigeria and its implications for extension service. *International Journal of Advance Biological Research*, 2: 220-227.

Fanen, T. and Adekola, O. (2014). Assessing the role of climate-smart agriculture in combating climate change, desertification and improving rural livelihood in Northern Nigeria. *African Journal of Agricultural Research*, 2014. 12(3) 42-56

FAO (2010). The State of Food and Agriculture 2010: Food Aid for Food Security? Policy brief. Rome.

FAO (2014). Adoption of Climate-Smart Agricultural Practices: Barriers, Incentives, Benefits and Lessons Learnt from the MICCA Pilot Site in Kenya. Final Report prepared by Morgan C. Mutoko for MICCA Programme in December, 2014.

Harris, F. (1999). Nutrient management strategies of small-holder farmers in a short-fallow farming system in North-East Nigeria. *The Geographical Journal*, 165 (3): 275-285.

IPCC (2007). Inter-Governmental Panel on Climate Change. Fourth Assessment Report: Climate Change 2007 (AR4). Geneva: IPCC.

IFRC (2000). International Federation of Red Cross. World Disasters Report 2000. Geneva.

Kijima, Y., K. Otsuka and D. Serunkuuma, (2011). An inquiry into constraints on a green revolution in Sub-Saharan Africa: The case of NERICA rice in Uganda. *World Dev.*, 39: 77-86.

Korsi, A. and David, R.S. (2001). Livelihoods of the Poor in Ghana: A Contextual Review of Ghana-wide definitions and Trends of Poverty and the Poor with those of Peri-Urban Kumasi. Centre for the Development of People (CEDEP) Kumasi, Ghana.

Mnkeni, P. and Mutengwa, C. (2014). A Comprehensive Scoping and Assessment Study of Climate Smart Agriculture (CSA) Policies in South Africa.

Mtsor, Y.G. and Idisi, P.D. (2014). Gender inequality and women participation in agricultural development in Nigeria. *Merit Research Journals of Education*, 2(11): 296 – 301.

Naess L.O. (2011). Climate smart agriculture: The new holy grail of agricultural development, Future Agricultures. Online at: http://www.future-agricultures.org/component/article/38- .

National Bureau of Statistics (2013). *In:* Uduma Kalu (2015). February 18. Sokoto is the Poorest State. Vanguard *Retrieved* from htt://www.vanguardngr.com

NPC (2006). Federal Republic of Nigeria, 2006 Population and Housing Census. National Population Commission, Abuja Nigeria.

Obayelu, O.A. (2010). Spatial dimension of inequality and poverty in rural Nigeria. *Journal of Economic Development*, 39: 4. *23-32*

Ogwumike, F.O. and M.K. Akinnibosun (2013). Determinants of poverty among farming households in Nigeria. *Mediterranean Journal of Social Sciences. 16(6): 56-72*

Osuala, E.C. (1982). *Introduction to Research Methodology*. New York Exposition Vocedu–UNN.Com/Osuala-publications.

Ojoko, E.A., Akinwunmi, J.A., Yusuf, S.A. and Oni, O.A. (2017). Factors influencing the level of use of climate-smart agricultural practices (CSAPs) in Sokoto state, Nigeria. *Journal of Agricultural Sciences (Belgrade)*, 62(3): 315-327.

Oluranti, I.O. and Alege, P.O. (2016). Micro-Credit and Micro-Enterprise Development: An Analysis of some Rural based Enterprises in Nigeria. Covenant University, Ota, Ogun State, Nigeria. https://www.researchgate.net/publication/215447834.Retrieved on 24/7/2017

Obayelu, O.A. (2010). Spatial dimension of inequality and poverty in rural Nigeria. *Journal of Economic Development*, 39(4): 77-99.

Obayelu, O.A. and Awoyemi, T.T. (2010). Spatial dimension of poverty in rural Nigeria. *Journal of Development and Agricultural Economics*, 2(6): 231 – 244.

Obayelu, O.A. and Olufunke, R.O. (2015). Rural livelihood and food poverty in Ekiti State, Nigeria. *Journal of Agriculture and Environment for International Development – JAEID,* 109(2): 307-323.

Reddy, K.R. and H.F. Hodges (2000). *Climate Change and Global Crop Productivity*. CABI Publishing, Wallingford.

Terdoo, F. and Adekola, O. (2014). Assessing the role of climate-smart agriculture in combating climate change, desertification and improving rural livelihood in northern Nigeria. *African Journal of Agricultural Research*, 9(15): 1180-1191.

Totin, E., Segnon, A.C., Schut, M., Affognon, H., Zougmoré, R.B., Rosenstock, T. and Thornton, P.K. (2018). Institutional perspectives of climate-smart agriculture: A systematic literature review. *Sustainability*, 10(6): 19-30