International Journal of Agricultural Extension and Rural Development Studies
Vol.10, No.1, pp.47-59, 2023
Print ISSN: ISSN 2058-9093,
Online ISSN: ISSN 2058-9107
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development -UK

Evaluation of Rural Households Practices For Climate-Smart Agriculture Technology In Zamfara State, Nigeria

[1]Alhassan, Y.J, [2] Sanchi, I.D, [3]Ikpe, E [4] and Norbert, S.

1. Department of Agricultural Economics and Extension, Federal University, Wukari, Taraba State, Nigeria.
2. Department of Agricultural Economics and Extension Federal University of Agriculture Zuru, Kebbi State, Nigeria.
3. Department of Geography, Federal Collage of Education Odugbo Benue State, Nigeria
4. Department of Agricultural Economics and Extension, Kebbi State University of Science and Technology Aliero, Nigeria

doi: https://doi.org/10.37745/ijaerds.15/vol10n14759 Published April 2, 2023

Citation: Alhassan, Y.J, Sanchi, I.D, Ikpe, E., and Norbert, S. (2023) Evaluation of Rural Households Practices for Climate-Smart Agriculture Technology in Zamfara State, Nigeria, *International Journal of Agricultural Extension and Rural Development Studies*, Vol.10, No.1, pp.47-59

ABSTRACT: *This study assessed the Climate Smart Agricultural Practices (CSAP) adopted by arable crop farmers in adapting to climate change and environmental issues in Zamfara State, Nigeria. Multistage sampling techniques was used to select six local government areas in the state. Three hundred and fifty (350) farmers were randomly selected and administered questionnaire. Sets of standardized questionnaires survey and interview were used to elicit information on CSAP from the farmers. The data were analyzed using descriptive statistics, Total Factor Productivity (TFP), and Least Squares Regression (LSR). The analyzed results were presented on tables and charts. The results show that the prevalent CSAP adopted by the farmers were: cover cropping, application of organic manures, adoption of minimum tillage, practice of crop rotation with legumes, usage of mulching, application of inorganic fertilizers and planting of improved seed varieties. Results of the determinants of TFP estimate reveals that age (-1.328), education (0.427), farm size (0.41), organic fertilizer (0.48), access to extension services (0.342), cover cropping (0.023), inorganic fertilizer (.47), improved seed varieties (0.503), crop rotation with legumes (0.54), access to credit facilities (0.273) significantly contribute to productivity at different levels of significance in the study area. While age impacted negatively on productivity, all others impacted positively on productivity. The study concluded that CSAP had positive impacts on crop productivity. The study recommends the adoption of sustainable CSAT such as the use of organic and inorganic fertilizer, cover cropping, and the use of improved seed varieties; provision of agricultural credit facilities to the farmers and availability of extension workers in the study area.*

KEYWORDS: climate change, csap, farmers, productivity

INTRODUCTION

Climate change is no longer a news, but a reality. It is a well-established fact that climate change is one of the greatest challenges to humanity. Climate change is a change in the average pattern of weather over a long period of time. Greenhouse gases play an important role in determining climate and causing climate change (Intergovernmental Panel on Climate Change [IPCC] 2007). Climate determines the crops to be cultivated and the yield especially in Nigeria where farmers depend on rainfed agriculture (Ahmed, 2016). A change in climate such as drought can make the soil barren and infertile, consequently, the nutrients are not available for crop cultivation due to increased scarcity of water. Climate change is already influencing food production, particularly cereal such as rice, wheat, sorghum, and maize (Maplecroft Report, 2013; Khatri-Chhetri, *et al*., 2017). Through changes in the adaptability of crops grown and agricultural biodiversity, climate change distorts agricultural production. Additionally, it results in a decline in input usage efficiency and a rise in the prevalence of pests and pathogens (Sanogo, *et al*., 2017). Nigeria's long coastline, tropical climate, reliance on agriculture, and low family capacity for climate change adaptation all contribute to the country's vulnerability to shocks, particularly those related to climate change (Adepoju and Salman, 2013). Akintayo and Rahji (2011) states that "agriculture is the most prevalent income-generating activity in many Nigerian households," which is consistent with the Maplecroft Report (2013) finding that countries susceptible to climate change depend significantly on agriculture. As a result, rural livelihoods in Nigeria are extremely sensitive to climate change.

There are two responses to global climate change namely mitigation and adaptation. Mitigation refers to intervention or policies to reduce the emissions or enhance the absorption of greenhouse gases while adaptation refers to responses to the changing climate and policies to minimize the predicted impacts of climate change. Because of the speed at which change is happening due to global temperature rise, it is urgent that the vulnerability of developing countries to climate change impacts is reduced while their capacity to adapt is increased and national adaptation plans are implemented (Women and Children Development Initiative (WACDI), 2011). According to Mitchell and Tanner (2006), adaptation is crucial to reducing vulnerability to climate change. Adaptation tackles the effects of climate change. A successful adaptation can reduce vulnerability by building on and strengthening existing coping strategies. The Climate Smart Agricultural Practices (CSAP) are new agricultural approaches to guide against the effect of climate change on agriculture. It is aimed at enhancing farmers' adaptive capacity to climate change and variability order to boost agricultural production (Opeyemi, Opaluwa, Adeleke, & Ugbaje, 2021). According to Food and Agricultural Organisation (FAO, 2013), CSA, is an integrative approach to addressing food security and climate change threat, which ensures food sufficiency despite unsuitable climatic conditions through several soil management practices that sequester carbon in the soil, reduce greenhouse gas emissions and intensify production.

Nigeria's economy is still mostly dependent on agriculture, which generates 22.36 percent of the nation's GDP and employs almost 70 percent of the labour force (Bernard & Adenuga, 201).

Agricultural sector grew at the rate of 4.1 percent in 2016 and it accounted for 75 percent of non-oil exports. To improve the sectoral performance, the "Federal Ministry of Agriculture and Rural Development" (FMARD) has approved Agriculture Promotion Policy (APP), building on the Agricultural Transformation Agenda (ATA) developed under the administration of President Good luck Ebele Jonathan. The key themes of this policy are supporting productivity enhancements; crowding in private sector investment and FMARD's institutional realignment with a focus to improving the ease of transacting business in Nigeria's agricultural space (Oredipe, 2017). Also the National Agricultural Resilience Framework (NARF) paper was created by the Nigerian government in 2013. This was done in order to deploy "new agricultural production strategies and risk management mechanisms," both of which aimed to increase resilience in the agriculture industry.

Climate change affects agriculture in several ways, one of which is its direct impact on the yield of grain crops. It brings additional perspective to the national and state challenge of increasing agricultural production to keep pace with the rising population, while keeping high standards of environmental protection. Negative effects on agricultural yields will be exacerbated by more frequent extreme weather events (Commission of the European Communities [CEC] 2009).

Shams and Garforth (2013) opined that despite the policies and research outputs, there are still many areas where there is a lack of understanding regarding climate-smart adaptation measures. Crop-specific methods, their frequency of use, and their efficacy in relation to farm productivity and the types of climatic hazards farmers in Nigeria confront are of interest. Information about the various climate-smart adaptation techniques used by smallholder farmers of arable crops appears to be scarce (Himanen *et al*., 2016). Such information is essential for crop targeting for both farmers and policymakers because using the wrong tactics would have detrimental effects on the farmer's cost and yield. Findings in the literature suggest that farmers have long used climate-smart practices. Empirical evidence, however, is still lacking regarding how these tactics affect farm productivity and how this affects farmer welfare (Fakayode et al.,2008). Thus, this study therefore enumerates the different CSAP that farmers employ in relation to the production of arable crops in Nigeria, and the effects of CSAP choices on farm productivity in the study area. The study's central hypothesis is that, in light of a changing climate, climate-smart agriculture is a strategy for assuring and boosting sustainable agricultural production. Also, the development and implementation of policies for climate-smart agriculture in Nigeria require information to assist the government and international organizations. The study's findings will offer so much useful knowledge

METHODOLOGY

The Study Area

Zamfara State is situated in the North West zone of Nigeria. The headquarters is at Gusau. The state located between Latitude 10 21′ to 13 15′ North and Longitude 60 20′ East (see Figure 1) (Google maps, 2019). Zamfara State was carved out of Sokoto State. It comprises of fourteen (14) Local Government Areas, with an area landmass of 38,418 sq. km. Zamfara Sate is bordered to the North by Niger Republic, to the South by Kaduna State, to the East by Katsina State and to the West by Sokoto, Kebbi and Niger States respectively, the state lies in the Sudan Savannah Agro Ecological Zone of Nigeria. The state was established in 1996 by the then military administration of the Late General Sani Abacha. It has a population of 4,515,400 according to (NPC, 2006).

Statistics have shown that more than 80% of the people living in Zamfara State engage in various forms of agricultural activities ranging from crop production of millet, guinea corn, maize, rice, groundnut, cotton, tobacco and beans to livestock and fish farming. The climate exhibits a definite mark of wet and dry seasons. Tropical continental air mass predominates during the dry season while harmattan last from December to February and wet season June to mid-October. Rainfall distribution varies from 675mm to 1000mm with an average annual temperature of between 26 and 30 degree centigrade (Tasie et al., 2011).

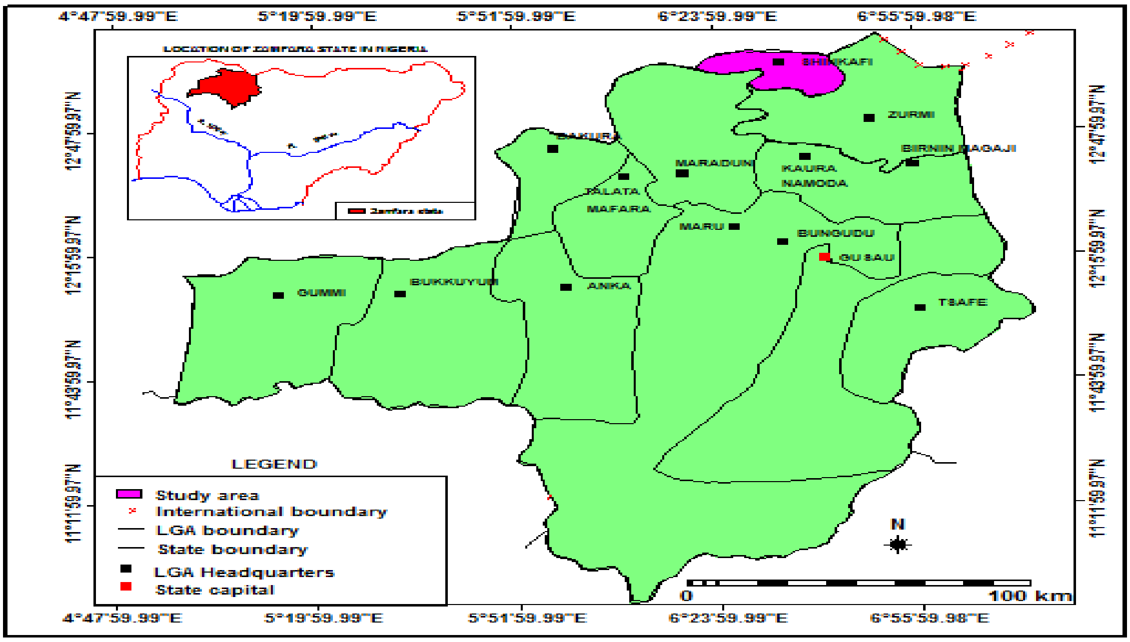

FIGURE 1: LOCATION OF STUDY AREA
Source : Administrative Map of Zamfara State, 2010

Sampling Procedure

Farmers of arable crops who resided in the study area made up the study population, and the information used came from production season 2021. A "three stage sampling technique" was used in the study. At the first stage, the LGA were arranged according to the agricultural Developmental Programmes (ADP) Zones – A, B and C. At the second stage, three LGA were randomly selected from each zone. At the third stage, 40 farmers were randomly selected from each LGA. 360 farmers in all were selected and administered questionnaire and interviewed for the study, only 350 questionnaires were actually used because 10 questionnaires could not be recovered and had inaccuracies.

Table 1: Sample outlay design of the study

ADP ZONE	Local Government Area (LGA)	No. of Households
A	Anka	40
	Bakura	40
	Bukkuyum	40
B	Bungudu	40
	Birnin Magaji	40
	Gusau	40
C	Gummi	40
	Kauna Namoda	40
	Maru	40
Total	**9 LGAs**	**360**

Analytical Technique

Based on the study's goals, a variety of analytical tools were used. The tools include multiple regression, total factor productivity, and descriptive statistics. A total factor productivity model, as used by Adepoju and Salman (2013), was used to estimate the productivity value of the farming household heads based on the most commonly used. Descriptive statistics were used to describe the socioeconomic characteristics of the farmers and the CSAP adopted by the farmers. The "Total Factor Productivity" (TFP) method compares an index of agricultural inputs to an index of outputs to determine agricultural productivity (Jean-Paul, 2009). This is the ratio of outputs in naira value to the total variable cost (TVC) of production. According to Peterman *et al.*, (2011), TFP measures that employ physical quantities rather than revenue as output measures actually exhibit even greater volatility than do revenue-based measures.

$$TFP = \frac{Y}{TVC} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where Y = Output (Naira)
TVC = "Total Variable Cost"

$$TFP = \frac{Y}{P_i Q_I} \quad i=1,2,3\ldots, n \ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Where:
Y = quantity of output in Naira,
P_i = unit price of ith variable input
Q_i = quantity of ith variable input

In line with Fakayode *et al.*, (2008) the inputs that considered in this study are: cost of labour, cost of planting materials, cost of inorganic fertilizer, Cost of herbicide and cost of pesticide. Following Akintayo and Rahji, (2011) to examine the effect of some socio-economic variables as well as Climate smart techniques on the "Total Factor Productivity" (TFP), the TFP estimate was subjected to ordinary least square regression to obtain the coefficient of multiple determinations (R^2), F- Statistics, standard error and their values. The ordinary least square regression model is a best linear unbiased estimator whose estimate possesses the desirable properties of unbiasedness, efficiency and consistency.

Model Specification

$Y = f(X_1, X_2, X_3, X_4 \ldots.., X_{14}, u) \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$

Where:
Y = TFP estimate
Based on the view of Adepoju and Salman, (2013) the following factors were hypothesized as the determinants of TFP of arable crop farmers in the study area:

X_1 = Age of household heads (years),
X_2 = Number of years of formal education,
X_3 = Household size (number),
X_4 = Farming Experience (years),
X_5 = Amount of credit accessed (Naira),
X_6 = Farm Size (ha),
X_7 = Extension contact (Dummy Variable; Yes = 1 otherwise = 0),
Vector of index of Climate smart Strategies (Dummy Variable; Yes = 1 otherwise = 0),
X_8 = Mulching,
X_9 = Organic fertilizer,
X_{10} = Cover cropping,
X_{11} = Inorganic fertilizer,
X_{12} = Improved varieties,
X_{13} = Minimum tillage,
X_{14} = Crop rotation with legumes
U = error term which is assumed to be normally distributed and with mean zero and constant variance.

Table 1: Socioeconomic Characteristics of the Respondents

S/N	Variables	Frequency	Percentage	Mean	SD
	Age				
a.	≤ 30	21	6.00	54	11
b.	31 – 40	40	11.43		
c.	41 -50	102	29.14		
d.	51 – 60	176	50.29		
f.	>60	11	3.14		
	Household size				
a.	≤ 5	202	57.71	5	2
b.	6 – 10	143	40.86		
c.	>10	5	1.43		
	Educational Status				
a.	No formal Education	92	26.29		
b.	Primary Education	93	26.57		
c.	Secondary Education	141	40.29		
d.	Tertiary Education	24	6.86		
	Years of Farming Experience				
a.	≤ 10	113	32.29	12	4.3
b.	11 – 20	211	60.29		
c.	>20	26	7.43		
	Farm Size (ha)				
a.	<1.00	39	11.14		
b.	1.00 – 5.00	194	55.43		
c.	5.1 – 10.00	86	24.57		
d.	>10.00	31	8.86	5	3.5
	Primary Occupation of rural household head				
a.	Farming	279	79.71		
b.	Non-farming	71	20.29		
	Cooperative membership status				
a.	Member	223	63.71		
b.	Non-Member	127	36.29		
	Extension Visit on Climate change				
a.	No	265	75.71		
b.	Yes	85	24.29		

Source: Field survey (2022)

Table 2: Socioeconomic Characteristics of the Respondents *continued*

Characteristics	Category	Frequency (n=350)	Percentage	Mean	Standard Deviation
Gender of Household head	Male	301	86	50.0	
	Female	49	14		
Marital Status	Single	9	2.6	24.5	
	Married	319	91.2		
	Divorced	3	0.85		
	Widow(er)	12	3.43		

Source: Field Survey (2022)

Table 3: Climate smart Techniques in the Study Area

S/N	Climate smart Technique	Frequency	Percentage(s)
1.	Cover crop	73	20.86
2.	organic fertilizer/manure	56	16
3.	Minimum Tillage	53	15.14
4.	Crop rotation with legumes	52	14.86
5.	Mulching	51	14.57
6.	inorganic fertilizer	42	12
7.	Improved varieties	23	6.57
	Total	**350**	**100.00**

Source: Field survey (2022)

Table 4: Regression Results of the Factors Influencing crop Productivity in the study area

1.	Access to extension	0.342	0.198	1.73*	0.076
2.	Minimum tillage	0.034	0.186	0.18	0.824
3.	Cover cropping	0.023	0.011	2.09**	0.073
4.	Inorganic fertilizer	0.47	0.192	2.45**	0.051
5.	Improved varieties	0.503	0.213	2.36**	0.060
6.	Crop rotation with legumes	0.54	0.186	2.90***	0.004
7.	Amount of credit Accessed	0.273	0.163	1.67**	0.050
8.	Constant	1.066	0.936	1.13	0.261
9.	R^2	0.657			
10.	Prob>F	0			
11.	F(13 147)	581.71			
12	N	350			

*** 1% significance level; ** 5% significance level; * 10% significance level

Source: Field survey (2022)

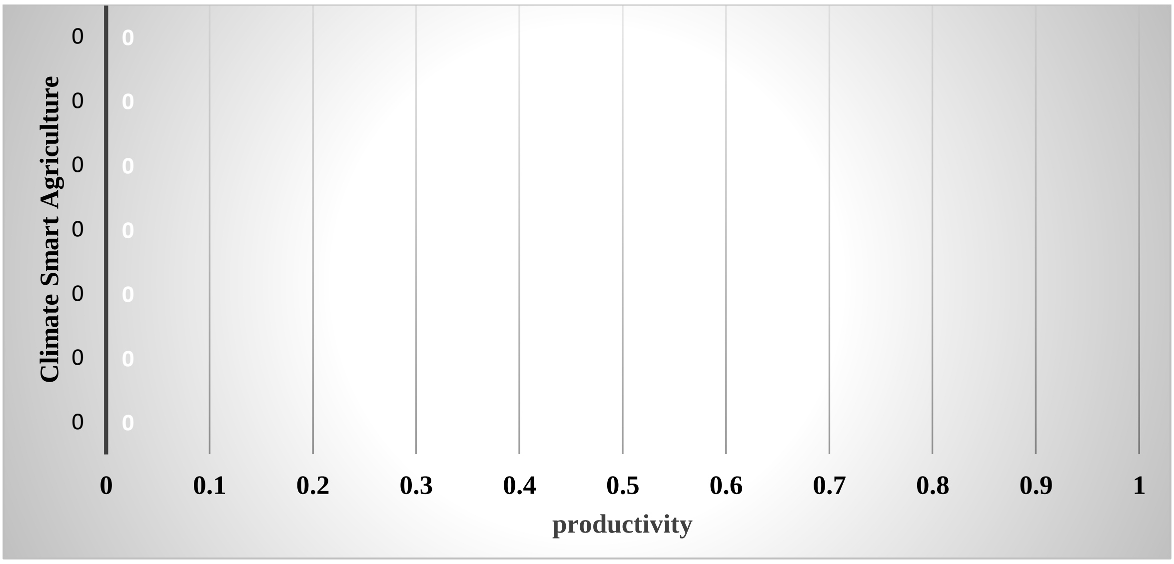

Figure 3: Bar Chart Showing the Mean Productivity Estimates Across the different CSA practices by crop farmers
Source: Authors computation (2022)

TABLE 5: FACTORS AFFECTING PRODUCTIVITY OF FOOD CROP FARMERS

S/N	Variables	Coefficients	Standard error	T	P> | t |
1.	Age	-1.328	0.2	-6.64***	0.000
2.	Education	0.427	0.158	2.70***	0.006
3.	Household size	0.005	0.016	0.32	0.658
4.	Farming experience	0.006	0.014	0.43	0.648
5.	Mulching	0.033	0.102	0.33	0.742
6.	Farm size	0.41	0.074	5.54***	0.001
7.	Organic fertilizer	0.48	0.182	2.63***	0.002

Source: Field Survey, 2022.
Note: *** 1% significance level; ** 5% significance level; * 10% significance level

DISCUSSION

Socioeconomic characteristics of the farmers

The socioeconomic characteristics of the farmers are presented in Table 1. Results on the gender of the farmer's shows that 86% of respondents are male while 14% are female. This shows that farming is a popular hobby among both sexes in the study area. However, the higher percentage of men suggests that more men than women are engaged in farming in the study area. This result is consistent with Africa's cultural environment, where men have greater access to farms and other agricultural resources than the females. Gender has an impact on how rights and privileges are exercised in the family and society, as well as how resources, money, employment, decision-making, and political power are distributed (Fakayode, *et al*., 2008). According to the age distribution, the majority (50.29%) of respondents were between the ages of 51 and 60, followed by those between the ages of 41 and 50. Over 60-year-old respondents made up about 3.14% of the sample. About 40% of the respondents have up to secondary education while 26.6% are shown to have no form of formal education, with an average age of 54 and an average educational background of roughly nine years (equivalent to completion of Junior Secondary School level). The average household size is eight (5), with most households (57.71%) having a household size of fewer than six people. Following this are those with six to ten and more than ten people, which represent 40.86% and 1.43%, respectively.

Table 1 further shows that 24% of the respondents got knowledge about climate change by interacting with local extension workers. Since extension contacts may boost the availability of knowledge and technical help required to foster climate-smart adaptation strategies, this may have an impact on how often adaptation practices are used. Adoption of agricultural technology has been demonstrated to be significantly influenced by social capital or networks among farmers (Shams and Garforth, 2013). Most responses (63.71%) are from various socioeconomic, cultural, and agricultural groups.

Identified Climate Smart Agricultural Techniques adopted by the farmers

The identified CSAT adopted by the farmers in the study area in order of the usage as shown in Table 3 are: cover crop, organic fertilizer, Minimum tillage, crop rotation with legumes, mulching, inorganic fertilizer and using improved varieties. Inorganic fertilizer and improved varieties are the least used strategies by the farmers under study with 12% and 6.57% of the farmers respectively adopting their usage. The frequency of climatic risk occurrence, crop physiology, cost of use, technical know-how, local knowledge/experience, and their perceived contributions to yield all influence the decision of which strategy to employ. These selections reveal farmers' preferences for low-input, easily-accessible inputs, which are readily available because they are accessible locally or at comparatively low costs when compared to external inputs like fertilizers and improved varieties. This result is in consonant with Himanen, *et al.*, (2016). Level of education had a positive and significant coefficient at 1%, indicating a considerable boost to productivity from the variable. This suggests that an increase in the level of education have the probability of generally leading to an increase in productivity. This is consistent with Sango *et al.*, (2017) results that education raises farmers' productivity.

Based on the results on the coefficient of farm size, which was positive and significant at 1% level, a unit increase in farm size will typically lead to 0.41 unit rise in production. This is probably the case since farmers who own big farms typically benefit from economies of scale when purchasing their inputs and selling their output, which lowers the unit cost. The outcomes are consistent with those of Nuno and Baker (2021).

Least Square Linear Regression Results of the factors influencing crop productivity

The positive coefficient for household size, and farming experience, is an indication that an increase in each of these factors tends to boost productivity by 0.005, 0.006, respectively, even though they were not statistically significant.

Furthermore, the TFP was positively correlated with all the CSA strategies, suggesting that higher adoption of any of CSA Strategies boosted productivity. It was only mulching and minimum tillage that was not statistically significant among all the CSAP adopted by the farmers.

Mean Productivity Estimates Across the different CSA practices by the farmers
The mean productivity estimate of the different Smart Agricultural Practices on the farm productivity as shown in Figure 2, indicated that practices of minimum tillage gave the highest farm productivity of 3.38, followed by crop rotation with legumes with productivity estimate of 3.33 while cover crop strategy had the least productivity estimate of 1.647

Factors Affecting Total Factor Productivity (TFP)
Table 4 shows the regression results of the factors influencing crop productivity in the study area. The result show that the coefficient of determination (R^2) for food crop farmers (0.657) indicates the presence of a high degree of association between productivity (dependent variable) and all independent variables. This implies that 75.8% of the variation in the farmers' productivity is explained by the variations in the independent variables. The F-statistics of the farmers (F-test= 581.71, $P<0.001$) was found to be highly significant, implying that the independent variables were collectively important in explaining Phe variation in the dependent one. Of the fourteen explanatory variables specified, eight were statistically significant. These were age, education, farm size, mulching, crop rotation, inorganic fertilizer application, minimum tillage and organic manure application. The negative coefficient ($p<0.01$) of age suggests that farmers were less productive as they age, older farmers are not physically able to produce as much as younger household heads because productivity is countered by declining physical strength and perhaps by negative attitudes toward innovation. The negative coefficient, which implies that a unit increase in farmers' age decreases productivity by 1.46, agrees with the findings of Ahmed and Elrasheed (2016).

Conclusion and Recommendations.
The study concluded that the farmers in the study area are using various CSAP to adapt to the effects of Climate change and environmental issues on their farm productivity. The identified strategies are cover cropping, organic manuring, and use of minimum tillage, practice of crop rotation with legumes, usage of mulches, and application of inorganic fertilizers and planting of improved seeds varieties. Findings showed that all the techniques the farmers adopted positively correlated with the farm productivity. The factors driving productivity of the farmers are the CSAP, education of household heads, farm size and extension contacts. Based on these findings, the following recommendations were presented:

1. There are very few farmers who have interacted with extension agents. It is crucial to send additional extension agents to rural regions to inform and educate farmers about the usage of CSAP. Accordingly, the farmers would be able to increase their output and profit. Their output and income from their farms will consequently increase as a result.

2. Age is inversely correlated with productivity; hence it is advised that youth empowerment programmes in the area should be accorded top-most priority in order to encourage relatively young farmers to grow arable crops.

3. Since the level of formal education seems to contribute to the farmers' overall factor production, education is a variable that enhances productivity. This will not come as a surprise because education has a way of encouraging farmers to allocate their resources to any profitable endeavor and to embrace new technologies/adoptions in a reasonable manner, leading to an increase in productivity. Therefore, it is advised that farmers should be encouraged to pursue basic education or adult literacy.

4. Farmers' organizations/Cooperatives could be used as a forum to encourage the implementation of CSA practices should be intensified.

5. Since all the CSAP techniques adopted by the farmers positively contributed to the farm productivity, offering informal education to the farmers in the research area, should be encouraged, so that they can have access to information on ecologically friendly and climate-smart techniques.

REFERENCES

Adepoju, A. A., & Salman, K. K. (2013). Increasing Agricultural Productivity through Rural Infrastructure: Evidence from Oyo and Osun States, Nigeria. International Journal of Applied Agricultural and Apicultural Research, 9 (1&2),1-10

Ahmed, M. H. (2016). Climate Change Adaptation Strategies of Maize Producers of the Central Rift Valley of Ethiopia. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, *117*(1), 175-186.

Ahmed, N. S. E., & Elrasheed M.M.M. 2016. Socioeconomic Factors affecting Sorghum Productivity in the Rain-fed sector of Gadarif State, Sudan. Asian Journal of Agricultural Extension, Economics & Sociology,10(2),1-6.

Akintayo, O. I., & Rahji, M. A. Y. (2011). Determinants of Total Factor Productivity in Rainfed Lowland Rice Production System in Nigeria. Journal of Agriculture, Forestry and the Social Science (JOAFSS), 9(1), 33- 38.

Arimi, K. (2014). Determinants of Climate Change aAaptation Strategies used by Rice Farmers in Southwestern, Nigeria. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, *115*(2), 91-99.

Bernard, O. A, & Adenuga, O. (2017) Agricultural Sector Development as a Panacea for Employment Generation in Nigeria. International Journal of Economics, Business and Management Research,1(2), 251-257.

Burja, C. (2012). Determinants of Agricultural Productivity Growth among Romanian Regions. *Annals Universities Apuleius-Series Oeconomica*, *14*(1).

Fakayode, S.B., Babatunde, R.O., & Ajao, R. (2008). Productivity Analysis of Cassava-based Production Systems in the Guinea Savannah: Case study of Kogi State, Nigeria. American-Eurasian Journal of Scientific Research, 3(1), 33-39.

Food and Agricultural Organisation (2013). Climate-Smart Agriculture Sourcebook. Food and Agriculture Organization of the United Nations, Rome. http://www.fao.org/docrep/018/i3325e/i3325e04.pdf 22/12/16

Himanen, S. J., Mäkinen, H., Rimhanen, K., & Savikko, R. (2016). Engaging Farmers in Climate Change Adaptation Planning: Assessing intercropping as a means to support farm adaptive capacity. *Agriculture*, *6*(3), 34.

Intergovernmental Panel on Climate Change (IPCC)(2007). Climate Change 2007: Synthesis Report. In Pachauri, R.K and A. Reisinger, A. (Eds.). Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (104 pp). Intergovernmental Panel on Climate Change, Geneva, Switzerland.

Khatri-Chhetri, A., Aggarwal, P. K., Joshi, P. K., & Vyas, S. (2017). Farmers' Prioritization of Climate-smart agriculture (CSA) Technologies. *Agricultural systems*, *151*, 184-191

Maplecroft Report (2013). Climate Change Vulnerability index 2013 – Most at risk cities. Available online at https://www.preventionweb.net/english/professional/ maps/v.php?id=29

Mitchell, T. and Tanner, T. M. (2006). *Adapting to Climate Change: Challenges and Opportunities for the Development Community*. Teddington, UK, Tearfund Publishers

National Population Commission (NPC) 2006 (Nigeria): Report on the Survey of Demographic and Health survey.

Nuno, D. B., & Baker, M. M. (2021). The Determinants of Agricultural Crop Productivity among Smallholder Households in Haramaya Distinct, Eastern Ethiopia. Grassroots Journal of Natural Resources, 4(4), 146-153.Doi: https://doi.org/10.33002/nr2581.6853.040410-

Opeyemi, G., Opaluwa, H., Adeleke, A., and Ugbaje, B. (2021). Effect of Climate Smart Agricultural Practices on Farming Households′ Food Security Status in Ika North East Local Government Area, Delta State, Nigeria. *Journal of Agriculture and Food Science*, 19 (2), 30-42.

Oredipe, A. A. (2017). Concept Integrated Safeguards Data Sheet-integrated Safeguards Document - Livestock productivity and resilience support project - P160865 (English). Washington, D.C. World Bank Group. http://documents.worldbank.org/curated.

Peterman, A., Quisumbing, A., Behrman, J., & Nkonya, E. (2011). Understanding the Complexities Surrounding Gender Differences in Agricultural Productivity in Nigeria and Uganda. *Journal of Development Studies*, *47*(10), 1482-1509.

Sanogo, K., Binam, J., Bayala, J., Villamor, G. B., Kalinganire, A., & Dodiomon, S. (2017). Farmers' Perceptions of Climate Change Impacts on Ecosystem Services Delivery of Parklands in Southern Mali. *Agroforestry Systems*, *91*(2), 345-361.

Shams, M., & Garforth, C. (2013). Agricultural Adaptation to Climate Change: Insights from a Farming Community in Sri Lanka. *Mitigation and Adaptation Strategies for Global Change*, *18*(5), 535.

Tasie, L. S., Kuku, O., & Ajibola, A. (2011). *Review of Literature on Agricultural Productivity, Social Capital and Food Security in Nigeria* (No. 21). International Food Policy Research Institute (IFPRI).

Women and Children Development Initiative (WACDI), (2011). Gender Dimensions and Indigenous Knowledge for Adaptation to Climate Change in South East Nigeria. A Research Report. www.imostate.gov.ng