

Climate Smart Agriculture and Extension Services in Oyo State Nigeria

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Abstract: *Climate change poses significant threats to agricultural productivity and rural livelihoods, particularly in developing countries such as Nigeria where agriculture remains a major source of income and food security. In Oyo State, increasing variability in rainfall patterns, rising temperatures, and frequent extreme weather events have intensified the vulnerability of smallholder farmers. In response to these challenges, Climate Smart Agriculture (CSA) has emerged as a sustainable approach aimed at enhancing productivity, building resilience, and reducing greenhouse gas emissions. The study therefore examined the roles of extension services in promoting climate smart agriculture in Oyo state Nigeria. A multistage sampling technique was used in selecting 90 respondents for this study. Data were collected with the aid of a well-structured interview schedule while ordered probit regression was used to test the hypothesis. The study concluded that improved technologies and improved seeds were the major roles of extension services to promoting climate smart technologies in the study area. It was recommended that stakeholders such as Government, Non-Governmental organization, and individuals involved in agriculture should make policies that will enhance adequate support to promote, access, and afford inputs needed for the promoting climate smart agriculture practices among farmers in the study area.*

Keywords: roles, extension services, climate, smart agriculture, agriculture

INTRODUCTION

Climate change is real, with clear evidences such as high temperatures and changes in rainfall, which have distressing effects on humanity, especially on its livelihood (IPCC 2014). Climate change is recognized as one of the greatest threats to agricultural productivity in several regions of the world (Niang *et al.*, 2014). The region's most vulnerable to climate change are the developing countries, especially the African countries, which are characterized by a high level of poverty, subsistence food production and land degradation problems (Lal *et al.* 2015). This is because their economies depend to a large extent on agriculture, and they have inadequate capital for adopting and implementing adaptation measures (Willett *et al.*, 2019).

Climate change is a worldwide event that poses one of the most serious risks mankind has ever faced, generating floods and droughts and hurting farmers' livelihoods by influencing ecosystems, water supplies, food security, settlements, and human health (Food and Agriculture Organization of the United Nations [FAO], 2016). Climate and agriculture are strongly interrelated universal processes and thus variations in climate influence agricultural activities. Improving the accumulations of carbon dioxide (CO₂) will have a lot of prospective effects on plants and may also have a lot of indirect threats on herbivores and all other food chain members. Dangerous climate conditions such as influential rainstorms, high wind pressures, and high temperatures have much influence on agricultural activities (Amin *et al.*, 2015). According to IPCC, in several regions of the world, climate change commonly affects agriculture production more negatively than positively and unindustrialized countries are highly vulnerable to further adverse impacts. In other words, climate change brings a huge threat to sustainability of food production and other livelihood activities in vulnerable areas like Nigeria, because it relies majorly on rain-fed agriculture.

Climate change poses significant challenges to agricultural productivity and food security (Willett *et al.*, 2019; Okoronkwo *et al.*, 2024) particularly in Southeast Nigeria, where agriculture serves as a cornerstone of livelihoods and sustenance. Climate change is evolving as the most vital environmental challenging problem confronting the modern society. Climate is an important factor for agricultural productivity and any variation in these factors is bound to result in a larger impact on crop yield (Ashalatha *et al.*, 2012). The world population is projected to be about 8 and 10 billion in 2020 and 2050 respectively (Serdeczny *et al.*, 2016). With such a population trend, agriculture will require a significant transformation to ensure adequate food supply for the growing population and meet the challenges of climate change (Kaczan *et al.*, 2013).

Climate-smart agriculture (CSA) entails an agriculture that sustainably increases productivity and resilience, reduces greenhouse gases and enhances the achievement of national food security and development goals (FAO 2016). It is not a new set of practices, but rather an integrated approach to the implementation of agricultural development programme policies (Lipper *et al.* 2014). Climate smart agriculture promotes the transformation of agriculture systems and agricultural

policies, in order to increase food production, enhance food security and ensure that food is affordable, hence reducing poverty while preserving the environment and ensuring resilience to a changing climate (Mnkeni and Mutengwa 2014). CSA is not a novel production scheme; rather, it's a technique for guiding actions to convert and redirection systems of agriculture to successfully and sustainably improve development, environment, and food security in a changing climate (Kanamaru *et al.*, 2013; Lipper *et al.*, 2014). Evidences show that Nigeria is already overwhelmed with various ecological problems which have been directly connected to the on-going climate change (Adefolalu 2007). The southern ecological zone of Nigeria, mostly known for high rainwater, is currently confronted by abnormality in the rainfall pattern, also Guinea Savannah under going slowly increasing temperature, while the northern zone faces the menace of desert encroachment at a very wanton rate per year induced by fast reduction in the volume of surface water, vegetation and wildlife resources (Nigeria 2012). The study described the socioeconomic characteristics of the respondents, identified the roles of extension services in promoting climate smart agriculture and investigate the constraints faced in promoting climate smart agriculture among respondents. It was hypothesized that there is no significant relationship between the selected socio-economic characteristics of the respondents and roles of extension services in promoting climate smart agriculture.

METHODOLOGY

This study was conducted in Oyo State, located in the South-Western geopolitical zone of Nigeria. The state lies between latitudes 7°03' and 9°12' North and longitudes 2°47' and 4°23' East. It is bounded in the north by Kwara State, in the east by Osun State, in the south by Ogun State, and in the west by the Republic of Benin. The state capital is Ibadan, a major commercial and administrative centre in southwestern Nigeria. Oyo State covers approximately 28,454 square kilometres of land area and is characterized by a tropical climate with distinct wet and dry seasons. The rainy season usually occurs between March and October, while the dry season spans November to February. Annual rainfall ranges from about 1,000 mm to 1,500 mm, and average temperatures range between 25°C and 35°C. Vegetation varies from rainforest in the southern part of the state to derived savannah in the northern areas, creating favourable conditions for diverse agricultural activities.

Agriculture constitutes a primary livelihood activity among rural households in the state. Major crops cultivated include maize, cassava, yam, cocoa, and vegetables, while livestock production such as poultry, goats, and sheep is also prominent. The state is served by agricultural extension agencies, including the Oyo State Agricultural Development Programme (OYSADEP), which facilitates the dissemination of improved agricultural technologies and climate-related innovations to farmers. According to the 2006 National Population Census conducted by the National Population Commission, Oyo State had a population of 5,580,894 people, with projected estimates placing the current population at over 8 million due to annual growth rates. The large farming population and the prominence of agriculture in the state make it an appropriate location for examining the roles of extension services in promoting Climate Smart Agriculture practices.

A multistage sampling technique was employed in selecting the 90 respondents for this study in Oyo State. Oyo State is divided into four Agricultural Development Programme (ADP) zones, namely Ibadan/Ibarapa, Ogbomoso, Oyo, and Saki. The first stage involved random selection of two zones Ibadan/Ibarapa and Ogbomoso Agricultural zones from the four zones in the state. The second stage involved random selection of two Local Government Areas from each of the selected agricultural zones, making a total of four LGAs. In the third stage, two farming communities were randomly selected from each of the selected LGAs, making a total of eight communities. Lastly, 12 farming households which were randomly selected from the selected villages to make a total of 90 respondents that constitute the sample size for the study.

RESULTS AND DISCUSSION

Socioeconomic characteristics of the respondents

Table 1 reveals that 64.4% of the respondents were between the age of 31-50 years while 15.8% and 14.4% indicated they were above 50 years of age and not more than 30 years of age respectively. The mean age of the respondents was revealed to be 43.2 years, an indication that farmers in the study area are still young, energetic, and still in the productive years. Their economically active status due to their age is expected to influence their usage of climate smart agriculture due to the inquisitiveness of the youth and their zeal to make optimum profit from agricultural venture. This supports the findings of World Bank (2015) emphasized that younger and economically active farmers are better positioned to respond to climate-related advisory services and adopt climate-smart innovations due to their longer planning horizon and greater exposure to information networks. Almost half (48.9%) of the respondents indicated they spent between 7-12 years in school; 21.1% indicated they spent not more than 6 years while 18.9% and 11.1% indicated they do not have formal education and spent above 12 years in school respectively. The mean years spent in school by the respondents is revealed to be 8.7 years. This result implies that majority of the respondents are literate though with low educational background. The exposure of the respondents to education is expected to aid the roles of the extension agents to promoting climate smart agriculture in the study area, as they are likely to have the requisite knowledge to demand for clarification about the use of climate smart agriculture from the extension agent or agencies. This aligns with (Ojo and Olagunju, 2015) that in Nigeria have shown that farmers with higher educational levels are more receptive to extension messages and more likely to adopt improved agricultural practices. Majority (77.8%) of the respondents are male while 22.2% were female. This result is an indication that male dominates agricultural production though female are also major stakeholders in agriculture though with limited roles which might be as a result of their access to agricultural inputs. The limited participation of women in certain agricultural activities may be attributed to challenges in accessing productive resources such as land, credit, and inputs (Akinbile and Oladele, 2016). Majority (71.1%) of the respondents are married while 15.6% and 13.3% are widow and single respectively. The result implies that agricultural production is a profitable venture that can be practiced irrespective of the marital status of individuals. Majority being married is expected to contribute to the usage of climate smart agriculture, hence they might

influence the rate at which extension agents contribute to promotion of climate smart agriculture in the study area.

Table 1 further revealed that 45.6% of the respondents have accumulated between 11-20 years of experience in farming while 27.8% and 26.7% indicated they have garnered experience of not more than 10 years and above 20 years of experience in farming. The mean years of experience garnered by respondents is revealed to be 17 years, an indication that respondents in the study area have vast experience in farming, hence they are expected to be equip with climate smart agriculture and this experience in it is expected to influence the roles played by extension agents in promoting climate smart agriculture. This supports the findings of (Ojo and Olagunju, 2015) who reported that extensive experience is expected to enhance their understanding and adoption of Climate Smart Agriculture (CSA) practices, as experienced farmers are often more capable of integrating new technologies into existing farming systems. Above half (51.1%) of the respondents indicated they have not more than 5 members in their household while 48.9% indicated they have above 5 members in their household. The mean household size in the study area is revealed to be 6 members. This result is an indication that respondents in the study area have a fair large household size. This is expected to influence their knowledge about climate smart agriculture as their respective household have access to various sources of information due to their large size, hence the extension agents are faced with numerous questions and enquiry from the farmers about climate smart agriculture, hence it aids the roles played by the extension agents/ agency.

Above half (53.3%) of the respondents indicated farming as their primary occupation; 25.6% indicated civil service while 12.2% and 8.9% indicated they artisan and traders respectively. This result implies that respondents in the study area are engaged in various economic activities and this is expected to influence the rate at which they relate with extension agents which is expected to influence the roles played by extension agents to promote climate smart agriculture in the study area. Majority (76.7%) of the respondents have farming as their secondary occupation while 23.3% indicated trading as their secondary occupation. This result is an indication that farming is a dominant profession in the study area, hence the need for extension agents to optimally play their role in promoting smart agriculture in the study area. Majority (86.7%) of the respondents indicated they have contact with extension agents while only 13.3% indicated they do not have contact with extension agents. This is an evidence that extension agents and services exist and function in the study area, hence this is expected to influence the role extension agents play in promoting climate smart agriculture in the study area. Almost all (70.0%) of the respondents indicated they cultivates between 11-20 hectares of land while 20.0% and 11.1% indicated they cultivates not more than 10 hectares and above 20 hectares of land respectively. The mean hectares of land cultivated by the respondents is revealed to be 15.1 hectares of land. This result implies that farmers in the study area are into commercial farming though not on a very large scale. Roles played by extension agents on the promotion of climate smart agriculture is expected to influence the size of farmland cultivated by farmers in the study area.

Table 1: Distribution of respondents according to socioeconomic characteristics n=90

Socioeconomic characteristics	Frequency	Percentage	Mean
Age (years)			
≤ 30	13	14.4	43.2
31-50	58	64.4	
Above 50	19	21.1	
Years spent in school			
No formal education	17	18.9	8.7
≤ 6	19	21.1	
7-12	44	48.9	
Above 12	10	11.1	
Sex			
Male	70	77.8	
Female	20	22.2	
Marital status			
Single	12	13.3	
Widow	14	15.6	
Married	64	71.1	
Years of experience in farming			
≤ 10	25	27.8	17
11-20	41	45.6	
Above 20	24	26.7	
Household size			
≤ 5	46	51.1	6
Above 5	44	48.9	
Primary occupation			
Farming	48	53.3	
Trading	8	8.9	
Artisan	11	12.2	
Civil service	23	25.6	
Secondary occupation			
Farming	69	76.7	
Trading	21	23.3	
Contact with extension agents			
Yes	78	86.7	
No	12	13.3	
Farm size (acres)			
≤ 10	18	20.0	
11-20	62	68.9	
Above 20	10	11.1	

Source: Field Survey, 2025

Roles of extension services in promoting climate smart agriculture

Table 2 reveals the roles of extension services in promoting climate smart agriculture in the study area. This was measured on a 5 Likert type rating scale of major roles, moderate roles, minor roles, slight roles and no roles which was scored 4, 3, 2, 1 and 0 respectively. The result reveals that extension service said the access to financial resources was ranked first (1st) with weighted mean score (WMS) of 3.2 while extension services aid the access to improved seeds and extension service aid the access to improved technologies were both ranked 2nd with each having a WMS of 3.1 based on the roles extension services plays in promoting climate smart agriculture to farmers in the study area. This result is an indication that extension service/agents in the study area are well and adequately informed about innovation in agriculture to curb the effect of climate change through the promotion of climate smart agriculture. Furthermore, training on the use of available climate smart agriculture was ranked 4th, an indication that extension service train farmers on the expertise use of available climate smart agriculture to achieve optimum benefit to be derived from the usage. Also, provision of demonstration farm to aid the usage of climate smart agriculture and development of policy to aid availability and accessibility of climate smart agriculture were both ranked 5th with weighted mean score of 2.7 based on the rate at which extension agents contribute to the promotion of climate smart agriculture in the study area.

Lastly, dissemination of improved technologies on climate smart agriculture was ranked 7th with weighted mean score of 2.4. This result implies that extension services aid the diffusion of climate smart agriculture among the farmers in the study area. Generally, this result implies that extension services contribute their role to the promotion of climate smart agriculture among the farmers by guiding the farmers on the appropriate usage of the climate smart agriculture, provide pathways to ease accessibility and enhance their knowledge about the expertise use of the available climate smart agriculture in the study area, hence extension services plays a major roles in the promotion of climate smart agriculture in the study area. This is consistent with findings from Adetunji *et al.* (2025), who reported that extension services in Oyo State significantly improved farmers' access to resources and technologies for climate-smart practices.

Table 2: Distribution of respondents according to roles of extension services in promoting climate smart agriculture

Roles of extension services in promoting climate smart agriculture (CSA)	WMS	Rank
Training on the use of available CSA	3.0	4 th
Provision of demonstration farm to aid the usage of CSA	2.7	5 th
Dissemination of improved technologies on CSA	2.4	7 th
Development of policy to aid availability and accessibility of CSA	2.7	5 th
Extension service aid the access to improved seeds	3.1	2 nd
Extension service aid the access financial resources	3.2	1 st
Extension service aid the access to improved technologies	3.1	2 nd

Source: Field Survey, 2025:

WMS: Weighted Mean Score

Constraints faced in promoting climate smart agriculture

Result in table 3 revealed the severity of problems faced in promoting climate smart agriculture in the study area. This was measured on a 4 point rating scale of very severe, severe, mild and not severe which was scored 3, 2, 1 and 0. Inadequate government support, poor extension system/service and restricted access to climate smart agriculture inputs were ranked 1st, 2nd and 3rd with each having a weighted mean score (WMS) of 3.0, 2.5 and 2.4 respectively. Also, poor access to climate information was ranked 4th with WMS of 2.1 while insufficient training for extension agents on climate smart agriculture practices and insufficient funding for extension programme were both ranked 5th with each having a WMS of 2.0 respectively. Lastly, poor access to credit facilities and inadequate availability of climate smart agricultural inputs were ranked 7th and 8th with weighted mean score of 1.8 and 1.5 respectively.

Generally, this result is an indication that the availability of climate smart agricultural practices in the study area is met with problems which have hindered the usage of climate smart agriculture. Nevertheless, it is affirmed that climate smart agriculture is available in the study area and the farmers are aware of it though the promotion of the climate smart agriculture is faced is various severe problems as indicated by the respondents. This is consistent with findings by Salisu (2022), who reported that limited government support, inadequate extension services, and restricted access to inputs are major barriers to CSA adoption in northern Nigeria.

Table 3: Distribution of respondents according to severity of constraints faced in promoting climate smart agriculture

Constraints faced in promoting climate smart agriculture	WMS	Rank
Inadequate government support	3.0	1 st
Poor extension system/service	2.5	2 nd
Insufficient funding for extension programme	2.0	5 th
Inadequate training for extension agents on climate smart agriculture practices	2.0	5 th
Poor access to climate information	2.1	4 th
Inadequate availability of CSA inputs	1.5	8 th
Restricted access to smart	2.4	3 rd
Poor access to credit facilities	1.8	7 th

Source: Field Survey, 2025

WMS: Weighted Mean Score

Relationship between selected socioeconomic characteristics of the respondents and roles of extension services in promoting climate smart agriculture (CSA)

Ordered probit and marginal effect regression estimate regression from the fitted model (which follows a standard normal distribution) in which the response variable is the roles of extension services in promoting climate smart agricultural practices among farmers, while the explanatory variables are the selected socioeconomics characteristics of farmers. Ordered probit regression was used to determine specific roles of each independent variable in explaining the variance among the

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farmers. The roles of extension services in promoting climate smart agricultural practices among farmers represents the dependent variable while the independent variables regressed include age, sex, marital status, years spent in school, household size, years of farming experience, primary occupation, contact with extension agent and farm size. The coefficients of the variables are very important in discussing the results of the analyzed data. These coefficients represent the variation in the percentage change in the dependent variable (roles of extension services in promoting climate smart agricultural practices among farmers) that occurred as a result of change in independent variables in the ordered probit regression model. The estimate revealed from the pooled result in table 4.7; an LR χ^2 (9) of 19.62, $\text{prob} > \chi^2$ of 0.0204 and pseudo R^2 of 0.1112.

The coefficient of age is negative and statistically significant at 5%, which suggests that the involvement of each age category in the roles of extension services in promoting climate smart agricultural practices among farmers would have a likelihood to influence roles of extension services in promoting climate smart agricultural practices among farmers by 4.0%. This result implies that either of the age groups influenced the roles played by extension services in roles of extension services in promoting climate smart agricultural practices among farmers. Also the coefficient of marital status is negatively and statistically significant at 5%, which suggests that roles of extension services in promoting climate smart agricultural practices among farmers would have a likelihood to influence the promotion of climate smart agricultural practices by 4.1% while the coefficient of years spent in school is negatively and statistically significant at 10% which implies that the level of literacy have significant influence on the roles of extension services in promoting climate smart agricultural practices among farmers by 8.7% while the coefficient of sex is positively and statistically significant at 5% which suggests that involvement of either sex in the roles of extension services in promoting climate smart agricultural practices among farmers would have a likelihood to influence their promotion of climate smart agricultural practices by 5%.

Generally, these results implies that all the aforementioned selected socio-economic variables (age, marital status, years spent in school, sex) have decisive influence on the roles of extension services in promoting climate smart agricultural practices among farmers. Therefore, the null hypothesis stated is rejected; hence alternative hypothesis is accepted in like manner.

H₀1: There is significant relationship between selected socio-economic characteristics of the respondents and the roles of extension services in promoting climate smart agricultural practices among farmers in the study area.

Table 6 : Ordered probit regression showing significant relationship between the selected socio-economics characteristics of the respondents and roles of extension services in promoting climate smart agricultural practices among farmers in the study area.

Socio-economics characteristics	dy/dx	Standard error	Z-Value
Farm size	-0.487324	0.5699	-0.86
Age	0.040811	0.0229	1.78**
Household Size	0.019722	0.0645	0.31
Marital status	-0.844355	0.413	-2.04*
Years spent in school	-0.087475	0.0483	-1.81**
Sex	0.795774	0.4559	1.75**
Years of experience in farming	0.001794	0.00052	0.34
Primary occupation	0.246885	0.5219	0.47

Source: Computed Data, 2025

Significant level *Significant at the 0.05 level
 **Significant at the 0.1 level
 ***Significant at the 0.01 level

Pseudo R of 0.1112

CONCLUSION AND RECOMMENDATION

It was concluded that improved technologies and improved seeds were the major roles of extension services to promoting climate smart technologies in the study area. It was recommended that stakeholders such as Government, Non-Governmental organization, and individuals involved in agriculture should make policies that will enhance adequate support to promote, access, and afford inputs needed for the promoting climate smart agriculture practices among farmers in the study area.

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