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Effect of climate smart agricultural practices on food security among farming households in Kwara State, North-Central Nigeria[1]

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ABSTRACT

Climate change brings a huge threat to the sustainability of food production and other livelihood activities in vulnerable areas like Nigeria, because it relies majorly on rain-fed agriculture. This study aimed to evaluate the effect of climate smart agricultural practices (CSAP) on food security of farming households in the Kwara State, North-Central Nigeria. A three-stage sampling technique was used to select ninety farming households, and a structured questionnaire to obtain information for the study. The collected data were analyzed using the food security index, adaptation strategy use index and logistic regression model. The result revealed that crop rotation is the most used CSAP in the study area, and that 16.67 % of the respondents are low users, 53.33 % medium users and 30 % high users of CSAP. It was also observed that 58.9 % of the farming households are food secured, while 41.1 % are food insecure. The logistic regression showed that the food security of the farming households is significantly affected by education, access to extension visits, farm size, off-farm income and CSAP.

KEYWORDS: Climate change, rain-fed agriculture, crop rotation.

RESUMO

Efeito de práticas agrícolas inteligentes para o clima na segurança alimentar entre famílias agricultoras no estado de Kwara, centro-norte da Nigéria

A mudança climática traz uma enorme ameaça à sustentabilidade da produção de alimentos e outras atividades de subsistência em áreas vulneráveis como a Nigéria, a qual depende, principalmente, da agricultura de sequeiro. Objetivou-se avaliar o efeito de práticas agrícolas inteligentes para o clima (PAIC) na segurança alimentar de famílias agricultoras no estado de Kwara, centro-norte da Nigéria. A técnica de amostragem em três estágios foi usada para selecionar noventa famílias agricultoras, e um questionário estruturado para obter informações para o estudo. Os dados coletados foram analisados por meio do índice de segurança alimentar, índice de uso da estratégia de adaptação e modelo de regressão logística. O resultado revelou que a rotação de culturas é a PAIC mais utilizada na área de estudo, e que 16,67 % dos entrevistados são pequenos usuários, 53,33 % médios usuários e 30 % grandes usuários de PAIC. Também observou-se que 58,9 % das famílias agricultoras dispõem de segurança alimentar, enquanto 41,1 % não dispõem. A regressão logística mostrou que a segurança alimentar das famílias agricultoras é significativamente afetada pela educação, acesso a visitas de extensão, tamanho da fazenda, renda fora da fazenda e PAIC.

PALAVRAS-CHAVE: Mudança climática, agricultura de sequeiro, rotação de culturas.

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).

The regions 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,

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and they have inadequate capital for adopting and implementing adaptation measures (Fischer 2001). 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.

To combat the challenges posed by climate change, especially on agriculture, it is evident that agriculture across susceptible areas must experience a major change to tackle the various consequences of hunger, food insecurity, malnutrition, poverty and also environmental degradation. As a result of this, agricultural experts, policy makers and other actors highly concerned with rural livelihoods, poverty alleviation and food security proposed the adoption of climate-smart agriculture as a means of reducing the effects of climate change and variability in smallholder farming (FANRPAN 2012, Lipper et al. 2014, Nepad 2014, World Bank 2016), since existing technologies and current institutional structures seem inadequate to achieve the mitigation needed to adequately slow climate change effects, while also meeting needed food security, livelihood and sustainability goals.

Climate-smart agriculture entails an agriculture that sustainably increases productivity and resilience, reduces greenhouse gases and enhances the achievement of national food security and development goals (FAO 2010). 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).

Agriculture is said to be climate smart when it realizes three major objectives: a) sustainable increase in agricultural production and income; b) building of resilience to climate change; c) reduction of greenhouse gas emission (Fanen & Adekola 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 & Mutengwa 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).

Agriculture as a mainstay of the Nigerian economy employs 72 % of the people, regardless of its declining role in providing foreign exchange income to the government (Ogbalubi & Wokocha 2013). The main players in the Nigerian agriculture are the rural dwellers, who are faced with a lot of challenges, such as low productivity, inadequate access to capital, transportation, storage and processing facilities, and are more vulnerable to the negative impact of climate change.

Several studies have been carried out on climate change and food security (Ringler et al. 2010, Okoli & Ifeakor 2014, Osuafor & Nnorom 2014, Iduma et al. 2016, Ani et al. 2021, Ngukimbin & Shinku 2021), but there is scanty empirical evidence on the effect of climate smart agricultural practices (CSAP) on food security status of farming households in North-Central Nigeria, especially in the Kwara State. Thus, this study aimed to: identify the socio-economic characteristics of farming household heads; examine the level of CSAP usage among farming households; analyze the food security status of farming households; and determine the effect of CSAP on food security of farming households in the study area.

MATERIAL AND METHODS

The study was carried out in the Kwara State (8º30'N and 5º00'E), Nigeria, in 2019. The State has a land area of about 32,500 km^2, population of around 2.37 million people (density of 42.5 km^2), sixteen local government areas and four main ethnic groups (Yoruba, Nupe, Fulani and Baruba) (Nigeria 2008, KSG 2013). There are two major climatic seasons (wet and dry), with annual rainfall of 1,000-1,500 mm, while the average temperature ranges between 30 and 35 ºC. The state has sizeable expanse of arable and rich fertile soils, which are used for the cultivation of a wide variety of staples which include maize, cassava, yam, rice groundnut, sorghum, melon, cowpea, okra, pepper and some leafy vegetables, yet small-scale farmers in the State face the issue of poor access to land, due to the form of land tenure system practiced (KSG 2013).

Primary data were used for this study and were collected through the use of a structured questionnaire. The population was made up of farming households in the State which majorly practice subsistence farming. A three-stage sampling technique was used in the selection of the respondents: the first stage involved the random selection of zones A and B out of the four agricultural zones in the State; the second the random selection of five villages from each zone using the Agricultural Development Project village listing; and the third nine farming households randomly selected from a list of farming households generated in each village. In all, a total of 90 respondents were interviewed for this study.

The collected data were analyzed with descriptive statistics, adaptation strategy use index, food security index and logistic regression model. Descriptive statistics such as frequency, percentage and tabulation, use of central tendency and dispersion (mean, mode, median and standard deviation) were used to describe the socio-economic and demographic characteristics of the respondent.

The adaptation strategy use index (ASUI) was employed to determine the frequency of use of CSAP. The ASUI was adapted from Ojoko et al. (2017), and the frequency of use of CSAP was expressed using a four-point Likert scale. The formula is given as: ASUI = [(N1 x 3) + (N2 x 2) + (N3 x 1) + (N4 x 0)]/M, where: N1 is the number of farm households that frequently used a particular CSAP; N2 the number of farm households that occasionally used a particular CSAP; N3 the number of farm households that rarely used a particular CSAP; N4 the number of farm households that did not use a particular CSAP; M = n x 3; and n = total number of respondents.

The use of CSAP was also grouped into high, medium and low users, using a composite score that ranges between 0 and 1.

The food security index (Fi) was used to examine the food security status of farming households, given as: Fi = (*per capita* food expenditure for the ith household)/(2/3 mean *per capita* food expenditure of all households), where Fi > 1 means food secure for the ith household and Fi < 1 food insecure for the ith household.

Food secure household is the household whose *per capita* monthly food expenditure falls above or equals to two thirds of the mean *per capita* food expenditure, while food insecure household is that whose *per capita* food expenditure falls below two thirds of the mean monthly *per capita* food expenditure (Omonona et al. 2007). Also, the number of food secure/insecure households in the study area was determined by taking the frequency of the food secure/insecure households. The headcount ratio (H) is given as: H = M/N, where M is the number of food secure/insecure households and N the number of households in the sample.

The logistic regression model was employed to analyze the effect of the CSAP usage on the food security status of farming households in the study area. The relationship of this dependent variable may be examined with the independent variables. It is specified as: $Li = (P_i / 1 - P_i) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_{10} X_{10} + e_1$, where Li = Logit or log of odds ratio; P = food secure; $1 - P_i$ = food insecure; β_1 to β_{10} = coefficients to be estimated; α = constant term; e_1 = error term; X_1 = gender of the household head (binary variable: 1 = male; 0 = female); X_2 = number of people per household (adult equivalent); X_3 = farm size (ha); X_4 = extension contact - government and private (binary variable: yes = 1; no = 0); X_5 = education (years of schooling); X_6 = farming experience (years); X_7 = farm income, considering the Nigerian currency (Naira; NGN; 1 USD = 238 NGN); X_8 = off-farm income (Naira; NGN); X_9 = access to credit (binary variable: yes = 1; no = 0); X_{10} = CSAP (low users = 0; medium users = 1; high users = 2).

RESULTS AND DISCUSSION

Table 1 shows the result of socio-economic characteristics of the farming household heads, pointing out that the households in the study area are mostly (86.67 %) headed by males, with the majority (66.89 %) being below 49 years, thus revealing that they are in their active years and, therefore, strong enough to engage in agricultural practices. It also shows that about 70.01 % of the household heads have at least primary education, 96.67 % of them are married, 64.55 % have less than 2.5 ha of farmland, and about 90 % of them have more than ten years of experience in their farming enterprise. Farming experience is very important in farming activities, as it helps the farmer in the area of proper farm management to maximize profits.

The result of the climate smart agricultural practices revealed that crop rotation is the CSAP most used in the study area and that 16.67 % of the

Table 1. Socio-economic characteristics of the farming household heads.

Characteristics	Frequency (N = 90)	Percentage (100)
Sex		
Male	78	86.67
Female	12	13.33
Age (years)		
30-39	27	30.00
40-49	35	38.89
50-59	20	22.22
≥ 60	08	08.89
Education level		
Non-formal	27	30.00
Primary	34	37.78
Secondary	24	26.67
Tertiary	05	05.56
Marital status		
Single	03	03.33
Married	87	96.67
Number of people per household		
01-05	30	33.33
06-10	52	57.78
11-15	08	08.89
Farming experience (years)		
01-10	09	10.00
11-20	18	20.00
21-30	31	34.44
≥ 31	32	35.56
Farm size (ha)		
0.1-1.0	28	31.11
1.1-2.0	31	34.44
2.1-3.0	13	14.44
3.1-4.0	13	14.44
> 4.0	05	05.57
Farm income (NGN*)		
< 50,000	10	11.11
51,000-100,000	18	20.00
101,000-150,000	32	35.56
151,000-200,000	14	15.56
201,000-250,000	11	12.22
> 250,000	05	05.56
Off-farm income (NGN*)		
< 10,000	18	20.00
10,000-20,000	39	43.33
21,000-30,000	12	13.33
31,000-40,000	08	08.89
41,000-50,000	07	07.78
> 50,000	06	06.67
Credit access		
Yes	23	74.44
No	67	25.56
Extension contact		
Yes	68	75.56
No	22	24.44

Source: field survey (2019). * 1 USD = 238 NGN.

respondents are low users, 53.33 % medium and 30 % high users of CSAP (Table 2).

Households were profiled into food secure and food insecure groups based on their *per capita* food expenditure. The food insecurity line is defined as two thirds of the mean *per capita* food expenditure of the total households studied. Therefore, households whose *per capita* food expenditure falls below NGN 2,900.38 were designated as food insecure, while those that equal or are greater than NGN 2,900.38 were considered food secure. It was observed that 58.9 % of the households were food secure, while 41.1 % were food insecure (Table 3).

Table 4 shows that the food security of the farming households is significantly affected by education, access to extension visits, farm size, off-farm income and CSAP.

The coefficient of farm size was also found to be positive and significant at 10 %. This shows that the larger the farm size of a household the more the

Table 2. Climate smart agricultural practices (CSAP) and level of usage.

CSAP	ASUI	Ranking
Agroforestry	0.2667	12th
Conservation agriculture	0.6852	5th
Crop rotation	0.9629	1st
Crop diversification	0.5667	7th
Mulching	0.3074	11th
Use of organic manure	0.5407	8th
Use of fadama land (wetland)	0.4852	9th
Planting crops with early maturity	0.9333	2nd
Planting drought-tolerant crop varieties	0.8815	3rd
Planting of cover crops	0.6296	6th
Intercropping	0.7963	4th
Irrigation	0.3778	10th
Level of CSAP usage	**Frequency (N = 90)**	**Percentage (100)**
Low user	15	16.67
Medium user	48	53.33
High user	27	30.00

Source: Field survey (2019). ASUI: adaptation strategy use index.

Table 3. Food security status of farming households.

Variables	Food secure	Food insecure
Percentage of households	58.90	41.10
Number of households	53.00	37.00
Head count ratio	0.59	0.41

Source: Field survey (2019). 2/3 of the mean *per capita* food expenditure are NGN 2,900.38.

Table 4. Logistics regression result of the effect of climate smart agricultural practices (CSAP) on food security.

Variables	Coefficient	p > Z
Gender	0.0136034	0.845
Education	0.2279202*	0.079
Number of people per household	-0.3034467	0.292
Extension contact	0.9529241*	0.082
Farming experience	-0.0455022	0.160
Farm size	0.3068481*	0.087
Farm income	8.28e-07	0.440
Off-farm income	1.191377**	0.050
Access to credit	-0.2940412	0.610
CSAP	1.068196**	0.045
Constant	-2.234489	0.140

Source: Field survey (2019). ** Significant at 5 %; * significant at 10 %. Number of observations = 90; LR chi (10) = 17.14; prob > chi = 0.0000; log likelihood = -52.383279; pseudo R = 0.4106.

likelihood of being food secure. The coefficient of education was positive and significant at 10 %, what implies that educated household heads are more likely to be food secure.

The coefficient of access to extension service and training was positive and significant at 10 %, implying that an increase in access to extension service increased the likelihood of being food secure. The coefficient of off-farm income was also positive and significant at 5 %, implying that farming households that have other sources of income have a higher likelihood of being food secure than those who do not have. The R^2 implies that the explanatory variables explain about 41.06 % of the variations in the logistics regression model of the effect of CSAP on food security.

CONCLUSIONS

1. The use of climate smart agricultural practices (CSAP) improved the food security of farming households, with 58.9 % of them being food secured and 41.1 % being food insecure;
2. With crop rotation being the most used CSAP in the study area and with 16.67 % of the respondents being low users, 53.33 % medium users and 30 % high users of CSAP, it is, therefore, recommended that the adoption of CSAP that ensure the sustainability of agricultural practices should be encourage and promoted in agrarian communities mostly consisting of small-scale farmers by both governmental and non-governmental agencies that are into mitigating the effect of climate change. Furthermore, farming households should be encouraged to diversify their source of livelihood, that is, to engage in other forms of income generating activities aside farming, as this will help to adopt the various forms of CSAP without lacking income for the sustenance of their households.

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