Proceedings of the Annual Conference of the Agricultural Extension Society of Nigeria
Number: Twenty-Seventh Annual Conference
Theme: Enhancement of E-Agricultural Extension Systems
Date: 26-28, September 2022
Venue: Nnamdi Azikiwe University Awka
ISSN: 1595 – 1421.
Website: http://info@ajol.org .
Email: agricultural.extensionnigeria@gmail.com; editorinchief@aesonnigeria.org

Role of Institute for Agricultural Research Zaria in Dissemination of Climate Smart Agriculture Practices to Crops Farmer in Kaduna State, Nigeria

https://dx.doi.org/10.4314/jae.v27i1.14S

Suleiman, R[1]., Owolabi, J.O[1] and Awotodunbo, A. A[2]

[1]Department of Agricultural Extension and Rural Development, Ahmadu BelloUniversity/Institute for Agricultural Research, Zaria, Nigeria
[2] Leventis Foundation Nigeria
*Corresponding author e-mail: rabiu.suleiman@yahoo.com. Phone +2348033576713,
orcid: http://orcid.org/0000-0002-4873-3719

Abstract

This study examined the role of a research institute in the dissemination of climate-smart agricultural (CSA) practices the in enhancing productivity of farmers in Kaduna State. Multi-stage sampling technique was employed to elicit information from 120 respondents with the use of a structured questionnaire and interview schedule. Data collected from respondents were analysed using frequency distribution, percentages, rank and regression analysis to achieved objectives of the study. Results revealed that uses of improved varieties seed tolerant to heat, drought, pests and diseases were some of the roles played by the research institute towards enhancing CSA. Result of socio-economic factors influencing the practice of CSA revealed that the coefficient of age was negative and statically significant at 1%, education, household size and membership of association was positive and statically significant at 5% respectively. Insecurity, Inability of the research institutes to reach -out to large number of farmers on CSA, Financial in-capability of farmers on CSA. were some of the constraints to the practice of CSA in the study areas. The study recommends that maximum security network should be provided by the government security agencies involving all and local vigilante. Also, the research institutes should be adequately funded by the government to enable them function effectively by reaching out to farmers through extension agents on CSA.

Keywords: Research- institute, climate- smart agriculture, crop -farmers,

Introduction

Agriculture is one of the pillars and most vital production sectors of any Nation's economy. The roles of the Nigerian agricultural sector include provision of food for the population. The sector has been the largest employer of labour with more than 75% of the nation's population involved in one form of agriculture-related activities or another. The sector provides income for the farming households as well as being a major source of foreign exchange earnings for the nation. Against this backdrop of the agricultural sector's contribution to employment creation, poverty and hunger reduction, reduction in rural-urban migration (Suleiman *et al*., 2017)

Agricultural research in Nigeria started more than 100 years ago with the establishment of a botanical garden in Lagos during the late 19th century. By 1903, the Forestry and Botanical Department was renamed Agricultural Department for Southern Nigeria was created. By 1912, the latter was divided into Northern and Southern regions. By 1914, the Forestry and Veterinary Departments were created.

The Fishery Department evolved in 1951. In a nutshell, by the 70's and 80's, different research institutes and departments of agriculture had emerged. Presently, Nigeria has the largest and most elaborate national agricultural research systems in sub-Saharan Africa. By 2006, the government set up an umbrella body known as the Agricultural Research Council of Nigeria (ARCN) which was established to address the challenges faced by the agricultural research system. ARCN's mission is to significantly improve agricultural productivity, marketing and competitiveness through the generation of appropriate technologies, policy options and knowledge management of the 2 agricultural research systems. ARCN is able to achieve their mission through the adopted village studies and the Agricultural Research Outreach Centres (AROC)

Unfortunately, like every other activity in the agricultural sector, crop production and yield are threatened by changing climatic conditions. Climate change affects agriculture in several ways, including changes in average temperature, rainfall and climate extremes (Adebayo *et al*., 2019). Though climate change is experienced worldwide, it impacts on agriculture are varied over space and time, the effects are heterogeneous across countries and highly uncertain. It is alleged that its effect on developing countries will be worst due to two key reasons: most of them are highly agriculturally based and hence rely on climatic conditions for survival; second, they lack the technological capacity to adequately forecast, mitigate and adapt to these changes collectively and nationally (Peter *et al*., 2019)
Climate-smart agriculture (CSA) can be defined as an approach for transforming and reorienting agricultural development under the new realities of climate change Andohol, (2012). The most commonly used definition is provided by the Food and Agricultural Organization of the United Nations (Obayelu *et al*., 2014), which defines CSA as "agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes Green House Gases (mitigation) where possible, and enhances achievement of national food security and development goals". In this definition, the principal goal of CSA is identified as food security and development (Ekpa *et al*., 2017)

As populations grow, the pressure on land resources will only increase. Unsuitable or especially biodiverse land such as rainforest will be claimed for farming and will become more vulnerable to degradation as a result. The largest increase in food demand is expected in the poorest regions, where the most people live. Smallholder farmers suffer the most because poor soil conditions, climate and weather variability, land tenure insecurity, and limited access to markets pressure them to make short-term trade-offs that compromise long-term gains. Feeding the growing population in the coming years will require ingenuity and innovation to produce more food on less land in more sustainable ways. Considering the low and dwindling crop turn over in the Nigeria, there is a need for a comprehensive approach that incorporates the abilities to increase agricultural productivity and incomes sustainably now and in the future; adapts and build resilience to climate change and reduces or removes greenhouse gases emission using local knowledge and initiatives. Moreover, despite the drastic forecasts of the possible effect of climate change on agriculture, there has been inadequate evident empirical assessment of the level of mitigation of climate change as a result of CSA in northern Nigeria.

Evidently, many studies (Matanga and Jere, 2011; Suleiman, 2019 and Unganai 2009) have shown that various adaptation strategies were adopted by farmers against the effect of climate change, little is specifically known about farmers‟ practice of Climate Smart Agricultural practices in Nigeria. At this point, it is clear to see why the role of research institution become paramount in dissemination of climate smart agricultural practices in enhancing productivity of crop farmers. Also, the impact of climate change is important for all sectors in Nigeria.

Methodology

The study was conducted in the four agricultural zones namely Maigana, Samaru, Birni-gwari and Lere of Kaduna State, Nigeria. Kaduna State occupies part of the central position of Northern Nigeria (with Kaduna as its Capital). The global location of the State is between Longitude 30'' east of the Greenwich Meridian and also between Latitude 090 00'' and 110 30'' North of the equator. The State occupies an area of approximately 48,473.2 square kilometers and has a population of more than 6 million (NPC, 2006). The grassland is a vast region covering the southern part of the State to about latitude 1100'' North of the equator. The prevailing vegetation of tall grass and big trees are of economic importance during both the wet and the dry season. Kaduna State Agricultural Development Agency (2018).

Primary data used for the study were collected with the aid of structured pre-tested questionnaire administered to the respondents by the researcher and trained enumerators. A multistage sampling technique was used for the study. The first stage involved a purposive selection of two local government areas (LGAS) that were free from insecurity from the State namely: Kudan and Zaria LGAS in Maigana. Kachia and Jama'a in Samaru. Kaduna North and Kaduna South in Birnin Gwari. Also, Igabi and Lere LGAS were randomly selected in all the Agricultural zones in the State respectively. The second stage involved random selection of two communities in each of the selected LGAS. In the final stage 5% of the sample frame of farmers from each of the communities were randomly selected for the study. (As shown in Table 1).

Agricultural Zones	Selected LGAS	Communities Selected	Sample frame	Number of respondents selected
Maigana	Zaria	Zango	281	14
		Samaru	292	15
	Kudan	Kudan	186	9
		Likoro	122	6
Samaru	Kachia	Kachia	166	5
		Kurmi-biri	112	6
	Jama'a	Kafanchan	318	16
		Dutse	126	6
Birnin -Gwari	Kaduna- North	Hayin-baki	102	5
		Ungwa dose	108	5
	Kaduna- South	Makera	126	6
		Ungwa Muasu	114	5
Lere	Igabi	Igabi	108	5
		Sabon-birni	98	5
	Lere	Lere	124	6
		Garu	128	6
Total			**2401**	**120**

Table 1: Sampling of respondent from the study

Percentages, means, rank and inferential statistics of multiple regression were used to achieved objectives for the study. The explicit form of the regression model is expressed thus

$Y_i = f(X_{i,} \beta) + e_i$ ....(1)

$Y^*_i = \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\ldots B_7X_7+ e$..............(2)

Where;
Y = dependent variable (output of crop in Kg)
β_0 = constant
β_1- β_7 = coefficient of the variables
e= error term

X_1 = Age (years), X_2 = Marital status (yes=1, no=2), X_3 = Education (in years), X_4= Household size (number of household members), X_5 = Farm size (number in hectare, X_6 = Access to credit (amount in naira), X_7 = Membership of association (yes=1, no=2)

Result and Discussion

Sources of Information on Climate Change

Table 2 shows that radio was rank as 1st among all the sources of information available to respondents on climate change. The findings are commensurate with that of Omotayo *et al.* (2017) whose finding revealed that 60 - 70% of those who had access to radio, obtained information on climate change through it. It may be attributed to differences in programmes aired by radio stations. This implies that radio messages are fully utilized as sources of information on climate change among the respondents. The result also shows that fellow farmers were ranked as 2nd as respondents' sources of information on climate change. Fellow farmers are becoming one of the major sources of information among most farmers in developing countries as most the respondents used information obtained from their fellow farmers daily. The result is congruent to the finding of Anthult (2014) who earlier found that, there is rise in farmers preferring other farmers as the first-hand information source on climate change and agricultural production. Result further shows that farmers association, family and friends were ranked as 3rd and 4th. Other source of information as revealed by the respondents includes television and extension agents which were ranked as 5th and 6th respectively. Television as sources of information was rarely used by the respondents, this may be due to erratic power supply, and most of the rural dwellers have no television in their houses nor connected to electric power supply. In the same vain respondent did not get enough information from extension agents. This implies that, respondents did not have access to information from extension on climate change. This may be due to the apparent ineffectiveness of the public extension service in most developing countries.

Table 2: Respondents sources of information on climate change

Sources of information on climate change	Percentage	Rank
Extension agents	38	6th
Farmer association	64	3rd
Friends and family	58	4th
Radio	89	1st
Television	43	5th
Fellow farmers	69	2nd

*Multiple response allowed

Role of Research Institutions in Dissemination of Climate Smart Agriculture in Enhancing Crop Productivity among Farmers

CSA is gaining momentum in Nigeria. This is attributed to the fact that agriculture is recognized as a sector with great potential for contributing to the achievement of a range of development goals related to food security, nutrition, poverty reduction, and climate change adaptation and mitigation. The goal of Nigeria's Climate Change Policy (2021-2030) recognises critical CSA practices such as agroforestry, conservation tillage, the limited use of fire in agricultural areas, cultivation of drought-tolerant crops, water harvesting, and integrated soil fertility management, among others

Development of improved seed varieties tolerance to drought, weeds, diseases and pests

The use of improve seed varieties and drought tolerance, including both herbaceous and tree crops is suggested by the Food and Agriculture Organisation Statistics (FAOSTAT) (2010) among the climate-smart practices for risk reduction, soil and water conservation, and efficient water management. The use of adapted crops and varieties (either annual or perennial) helps to reduce the negative impacts of climate change on agricultural systems and at the same time to ensure stable agricultural production. Introducing new crops or varieties, or bringing back heritage crops, leads to diversification of agricultural production, with positive effects on biodiversity and ecosystem services, in particular if cultivated in association with conservation agriculture practices, including: minimum soil disturbance, permanent soil organic cover and crop species diversification.

Variations of temperature and rainfall unpredictably influence pest and disease incidence and extremeness on major crops. It is because of climate change that will inherently affect the relationship of pest / weed, the host population and pest / weed hosts interactions. Some possible adaptation techniques include:

1. Development of cultivars resistant to diseases and pests,

2. Integrated pest management (IPM) adoption having more dependence on the biological control and change in cultural practices.

3. Adoption of substitute crop production and techniques, as well as places that are resistant to pests and other hazards. (Agbamu, 2016)

Diffusion of techniques on crop modelling

The use of modelling of crop to optimize management practices, assist in breeding programs, develop new crop rotations and maximize the value of seasonal climate forecasts. In order to meet the increasing demand for assessment of climate change impact, crop models need to be further improved and tested with climate change scenarios involving various changes in ambient temperature and CO_2 concentration. Current knowledge gaps include limited understanding and modeling of the interactive impact of climate factors, the impact of extreme events (e.g. heat stress, frost and excess water) occurring at different crop stages, sink–source relationships, and changes in yield quality of crops under future climates. Crop modelling is a creative and newly developed tool for dealing risks in Agriculture. Crop modelling can guide to find out the possible risk of climate variation on future crop yields, climate smart agriculture development and mitigation procedures. Comparable to new management options and suitable genotypes which are important factors for better yield, crop modelling are essential tools in field experiments to create new crop management approaches. In this point of view, two crop modelling management systems are APSIM (Agricultural Production System Simulator) and DSSAT (Decision Support System for Agro Technology Transfer) mostly used in the whole world (Ahmad *et al*., 2014).

Orientation on the crop switching/ relocation

Crop switching and relocation of crop production to different states could prevent up to half of predicted losses in agricultural profits from climate change impacts. The research applied a new approach to maize, corn, cotton, soybeans, rice, and wheat crops. It found that if crop locations are held constant in the future, total agriculture profits for most crops will drop by 31 percent. But if crop lands are reallocated to avoid yield decreases, and take advantage of yield increases, half of these losses are avoided. (FAOSTAT, 2010). There is need to better understand the potential for adaptation for farmers and policymakers to make long-term decisions. This show that adaptation through the movement of crops can reduce climate change losses.

Training of farmer on the Institutional Irrigation facilities

Irrigation constitutes an important adaptation option which farmers might adopt. In crop farming, it increases yield levels and decreases yield variability under current and future climate conditions. The differences in yield levels and yield variability between irrigated and rainfed farming systems will be even higher with more pronounced climatic changes. Indeed, evidence shows that the economic benefits of the adoption of institutional irrigation facility in crop farming are not only sensitive to changes in climatic conditions but also to the development of output. The subsidization of irrigation systems might even lead to an inefficient use of other adaptation measures even though these other measures might be more cost effective and less environmental harmful. For instance, the adoption of an alternative crop that is more suitable for warm and dry climatic conditions might be hindered if crop irrigation systems are subsidized.

Dissemination of Information and communications technologies on climate change

Information on climate change could influence attitude and there could be an attitudinal change to do the right thing by reducing emission and not to engage in businesses where fossil fuel which emits carbon dioxide are hugely consumed. To avert consequences, one way to intervene is for the government to engender mitigated behaviours which would be to introduce regulation that forces green behaviour (which compels sifting from fossil energy to renewable sustainable energy) in order to fight global emissions. The information from metrological unit, farmer help-line centres, print and television media as a ‘public arena together with various social media platform have shaped interaction to improve understanding of how scientific information being disseminated through this platform have shaped interaction at the interface with climate change policy and the society at large

The weather forecast and early warning systems will be very helpful to minimize the threats of climate losses. Information and Communications Technology (ICT) can efficiently help administrators and researchers in planning the contingency programs. In the field of forecasting a new technique Multi Criteria Analysis (MCA) tool has implemented to evaluate climate change policy alert on mitigation and adaptation options (De-Bruin et al., 2019)

Table 3: Role of research institutes in climate -smart agricultural practices

Role of Research	Climate -Smart Agricultural Practices
Development of improved varieties tolerance to drought, weeds, diseases and pests	i. Using quality seeds and planting materials, including diseases and pests resistant of well-adapted varieties is good agricultural practice and is climate-smart. ii. Uses of variety of striga control method
Diffusion of techniques on crop modelling	i. Growing of genetically diverse portfolio of improved crop varieties, suited to a range of agro-ecosystems and farming practices ii. Farmers and plant breeders collaborate in crop varietal development
Orientation on the crop relocation	i.Growing a single crop, using a mixture of appropriately chosen genotypes of a given species, such as a mixture of high-yielding hybrid varieties and traditional varieties.
Training of farmer on the Institutional Irrigation facilities	i. Usage of irrigated systems, increasing the efficiency of irrigation ii. Application of precise water for crop using high-efficiency pumps iii. Reducing water losses and improving water allocation and the management of water demand iv. Implementing soil and water conservation techniques such as: soil mulching, rainwater harvesting in enhances crop productivity.
Dissemination of Information and communications on agricultural innovation and technologies	i. Use of Information and communications technologies that support the need to respond adequately to climate change adaptation/ mitigation strategies ii. Making the right decisions about the production and management of crop through the information dissemination from weather forecast Prioritize the information the face of competing demands

Socio-economic factors influencing the practice of CSA

The maximum likelihood estimates of the multiple regression presented in Table 2 indicate an indirect and significant relationship between socio-economics factors influencing the practice of climate smart agriculture. The coefficient of age is negative and statically significant at 1% level of probability. This shows that an increase in the age of the respondents will lead to corresponding decrease in the practice of CSA. In other words, young-rural farming household have more knowledge about CSA practice than the older members. This is true because the younger people are more inquisitive to acquire new knowledge on innovation than the older people. The level of education influences positively and significantly influences the practice of climate smart agriculture, this suggesting that education endues respondents with greater intellectual capacity and know-how to dissect and assimilate the strengths and drawbacks of new technologies agriculture and in deciding to adopt or not (Abadi *et al*., 2015).

The variables of household size were positive and statistically significant at 5% level of probability. This suggests that household size influence the practice of climate smart agricultural practice, this indicating that farmers with larger households have a higher probability of embracing innovation especially if it is labour-intensive, as farmers could harness labour from household members at little or no cost. Suleiman *et al*. (2017)

Result also indicated that the variable of membership of association was positive and statistically influencing the practice of climate smart agriculture albeit at 5% level of probability, indicating that farmers who are member of association have a higher probability of embracing innovations such as climate smart agriculture. Ojo *et al*. (2014) confirmed this finding for adoption of agricultural innovation in Ekiti State, Nigeria while Baruwa *et al*. (2015) found membership of association as the only predictor of probability of intensity of adoption of improved innovation in Osun State, Nigeria

Table 4: Socio-economic factors influencing the practice of CSA

Variables	Coefficient	Standard Error	t-value
Age	-0.3087***	0.0919	3.3603
Education	0.657**	0.123	2.112
Marital status	-0.8363	0.5628	1.4858
Households size	0.017**	0.010	2.020
Farm-size	-0.0738	0.3376	0.4571
Membership of association	0.241**	0.100	2.43
Amount of credit received	-0.0449512	0.02708	0.0602
Diagnostic statistics			
Constant -	-0.0001213	0.9705213	-0.00012
Model x^2	32.56**		

**P≤0.05, *** P≤0.01

Constraints to the practice of climate smart agriculture

The result from Table 6 reveals the constraints to use of climate smart agriculture in the study areas. The result shows that lack of capital (94%) rank as 1st, inability of the innovation to cover large number of farmers (*88*) rank as 2nd, lack of incentive from government toward climate smart agriculture (74%) rank as 3rd. Others problem associated with the use of climate smart agriculture include: poor extension visits to farmers (72%), Insecurity (*64* %) and labor - intensiveness toward CSA (*60*), which were rank as 4th, 5th and 6th respectively. Chandio *et al*. (2016) and Fatima and Khan (2015) identified paucity of capital, lack of incentive from government and poor extension visits to farmers as constraints to practice of most innovation in agriculture in most rural communities in adoption of improved agricultural innovation in Pakistan.

Table 6: Constraints to the practice of climate smart agriculture

Constraints	Percentage	Rank
Insecurity	64	5th
Inability of innovation on CSA to cover large number of farmers	88	2nd
Lack of capital	94	1st
Labor intensiveness toward CSA	60	6th
Poor extension visits	72	4th
Lack of incentive from government to support CSA	74	3rd

Source: Survey, 2021

Conclusion and Recommendation

The use of improve seed varieties and drought tolerance, use of modelling of crop to optimize management practices, Crop switching and relocation of crop production to different states, training of farmer on the institutional irrigation facilities and dissemination of information and communications technologies on climate change were some of the role of research institutions in dissemination on climate smart agriculture.

The research institution should be encouraged to expand coverage and improve delivery of extension services and strengthen farmers' association to foster innovation in agricultural. The link between researcher institution and the farmers who are the off-takers of innovation should be reinforced to increase crop productivity in order to satisfy national demand and promote food security

References

Abadi T, Damas, P, Moti J (2015). Factors that affect the adoption of improved maize varieties by smallholder farmers in Central Oromia, Ethiopia. *Journal of Agricultural Extension and Rural Development* 5(15) pp:468-474

Adebayo, A.E and Ojogu, E. S (2019): Assessment of the use of climate smart agricultural practices among smallholder farmers in Ogun State *Acta Scientific Agriculture 3 (6), 23-31*

Agbamu, J. U. (2016). A Study on Agricultural Research-Extension Linkages: With Focus on Nigeria and Japan. Ph.D. thesis, Tokyo University of Agriculture, Tokyo, pp. 194-195.

Ahmad, M. I., Ali, A., Ali, M.A., Khan, S.R., Hassan, S.W. and Javed, M.M. (2014). Use of Crop Growth Models in Agriculture: A Review. *Journal of Science International*, 4(11) pp: 26.

Anthult, C.N. (2014). Getting ready for the twenty first century. Technical Change and institutional Modernization in Agriculture. World Bank Technical Paper 217, Washington D.C.

Baruwa, O., Kassali, R. and Aremu, F. (2015). Adoption of improved maize varieties among farming households in Osun State, Nigeria.*Journal of Agricultural Technology* December, 2015. 11(2):1-9.

Chandio, A.A., Jiang, Y, Magsi, H. (2016). Agricultural sub-sectors performance: An analysis of sector-wise share in agriculture GDP of Pakistan. *International Journal of Economy and Finance* 8:156.

De Bruin, K., Dellink, R. B., Ruijs, A., Bolwidt, L., Van Buuren, A., Graveland, J., De Groot, R.S., Kuikman, P. J., Reinhard, S. Roetter, R. P., Tassone, V. C., Verhagen, A., Van Ierland, E. C. (2019). Adapting to climate change in The Netherlands: An inventory of climate adaptation options and ranking of alternatives. Climatic Change, 95: 23-45.

Food and Agriculture Organisation Statistics (FAOSTAT) (2010). Climate- Smart Agriculture: Policies, practice and financing for food security, adaptation and mitigation. Retrieve October 18, 2016 from *http://tinyurl.com/65nfr7k*

Kaduna State Agricultural Development Agency. (2018). Agricultural Production Survey in Kaduna State, Nigeria.

Peter M. K., Neal W. M., Peng, W., Brigid, A. M and Enzo LI (2019): Soil and the intensification of agriculture for global food security. Journal of *Environmental International* 12 (1). Pp 132

Suleiman, R. (2019). Assessment of perceived effects of climate change on livelihood activities of agro-pastoralists in three States of North-West Nigeria. Ph, D thesis submitted to the Department of Agricultural Extension and Rural Development, Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria

Suleiman, R., Mahmud, A.M., Oladimeji, Y.U, Olarewaju, T.O and Ojeleye, O. (2017). Effects of Socio-economic characteristics on the profitability of poultry production among poultry farmers in Kaduna State, Nigeria. In Proceeding of 20nd Annual National Conference of the Agricultural Extension Society of Nigeria held at the University of Port Harcourt, River State, Nigeria. 23rd - 26th April, 2017.