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ASSESSMENT OF CONSTRAINTS TO CLIMATE CHANGE ADAPTATION STRATEGIES AMONG RICE FARMERS IN TARABA STATE, NIGERIA

Z.B. Agyo[1] and H. Ornan[2]

[1]Federal College of Education, Zaria.
[2]Adamawa State Polytechnic, Yola, Nigeria

ABSTRACT

This study assessed the constraints faced by rice farmers in adapting climate change adaptation strategies. Multistage sampling technique was employed to select sample size of 251 in the study area. In the first stage, Taraba State was stratified into three Agricultural Zones, the second stage involved purposive selection of two Local Government Areas from each of the Agricultural Zones based on high concentration of rice farmers, and the third stage involved selection of two communities from each of the selected Local Government Areas using the random sampling technique. The last stage involved proportional allocation of 10% across board to select the total sample size of 251 respondents. Data were collected by the use of structured questionnaire. Descriptive statististics and factor analysis were used to analysed the data. Based on the findings from factor analysis on the constraints to climate change adaptation strategies in the study area, factors that were highly loaded under socio-economic category were: inadequate capital (0.64), poor access to information (0.42), low level of education (0.71), lack of credit facilities (0.61), low level of awareness (0.60), inadequate extension service delivery (0.61) and high cost of farm inputs (0.77). Factors that were highly loaded under agronomic category were: land tenure system (0.60) and lack of improved agricultural technology (0.54). Under politico-infrastructural category: poor infrastructural facilities (0.66) and absence of government policies on climate change (0.75) were highly loaded. The study concludes that rice farmers in the study area were constrained with inadequate capital and land for farming. Effective and frequent extension services are required for farmers awareness on adaptation strategies. The study recommended that farm inputs should be made available at subsidized rate and at the appropriate time so as to help farmers overcome some of the problems associated with climate change adaptation and extension programs on how to adapt effectively to climate variability should be embarked upon by relevant authorities.

Keywords: Factor analysis; constraints; climate change; adaptation strategies

INTRODUCTION

Agriculture in the tropical countries like Nigeria is more vulnerable to climate change; many of these areas are less favored agricultural zones and are facing increasing challenges

ranging from marking to environmental conditions. Despite technological advances such as improved rice varieties and irrigation systems, weather and climate are important factors which play a significant role in rice production (Wassmann, 2010). The sustainability of rice production is further threatened by a vicious cycle of climate change, declining soil fertility and increasing problems of pest, diseases and weeds. In addition, gradual increase of global temperatures affects the growth of rice production in developing countries. Lack of money hinders farmers from getting the necessary resources and technologies. However, lack of information to adaptation options could be attributed to the fact that researchers on climate change and adaptation options have not been strengthen in the country hence, information is lacking in this area. The fact that adaptation strategies are costly makes farmers vulnerable to the negative effects of climate change. This cost could be revealed through the need for intensive labor use. Thus, if farmers do not have sufficient family labor or the financial means to hire labor, they cannot adapt easily to climate change (Chah, Odo, Asadu and Enwelu, 2012; Apata, Samuel and Adeola, 2009).

Most adverse effects of climate change are felt mainly by developing countries especially those in Africa due to their low level of coping capabilities (Nwafor, 2007; Jagtap, 2007). The capacity of local communities to adapt to climate change and mitigate its impacts will also depend on their socio-economic and environmental conditions and on the available resources.

Adaptation is the adjustment of practices, processes and structures to reduce the negative effects particularly, the unavoidable ones, and advantage of any opportunities associated with climate change (FAO, 2008). Adaptation to climate change refers to adjustment in ecological, social and economic systems in respond to the effect of change in climate (Smith and Pilifosova, 2001). It is identified as one of the options to reduce the negative impact of climate change (Kurukulasuriya and Mendelsohn, 2006). Adaptation is the key factor that will shape the future severity of climate change impacts on food production (Lobel, Burke, Tebaldi, Mestrandrea, Falcon and Naylord, 2008). It can largely reduce the potential harmful impacts of climate change and thereby alleviate variability of crop yields and farmers' income (Reidsma, Ewert, Lansink and Leemans, 2010).

Adaptation strategies are those methods that enable the individual or the community to cope with or adjust to the impacts of the climate change in the local areas (Nyong, Adesina and Elisha, 2007). Such strategies will include among others; the adoption of efficient environmental resource management practices such as the planting of early maturing crops, and adoption of resistant varieties in areas where rainfall declined. Adaptation measures also include the use of technologies that enables the individual to function in the prevailing situation (Nyong, Adesina and Elisha, 2007). Oyekale, Bolaji and Olowa (2009) observed that agricultural adaptation strategies involved two types of modifications in production systems. The first is increased diversification that involves engaging production activities that are drought tolerant and/ or resistant to temperature stress as well as activities that makes efficient use and takes advantage of prevailing water and temperature conditions, among other factors. Crop diversification can serve as insurance against rainfall variability as different crops are affected differently by climate events. The second strategy focuses on crop management practices geared towards ensuring that critical conditions do not coincide with very harsh climatic condition such as mid-season drought. Crop management practices that can be used include modifying the length of growing period and changing planting and harvesting dates.

World Bank (2010) provides a summary of types of adaptation activities: autonomous (private) and planned (public) adaptation strategies. Autonomous adaptation strategy involves adaptation action of farmers, communities and others in response to the threats to climate change perceived by them, based on a set of available technologies and management options. FAO (2007) described autonomous adaptation as the reaction of, for example, a farmer to changing precipitation pattern, in that he/she changes crops or using different harvest and planting (sowing) dates.

Planned adaptation strategies involved action by local, regional and/or national governments to provide needed public goods and incentives to the private sector to fit the new condition. Example includes deliberate crop selection and distribution across different agro-climatic zones, substitution of old crops with new ones and resources substitution induced by scarcity. Others includes; transport and storage infrastructure, modernization or development of new irrigation infrastructure and training for private and public sector capacity building (Rosenzweig and Tubiello, 2007). Over the years, efforts were made to combat the effects of climate change by government, non-governmental organizations and good individuals through several campaign and advocacy. Farmers have also been responding to climate change through adaptation which is the process by which ecological, social and economic systems adjust in response to actual or expected climate stimuli and their effects or impacts. Farmers in the study area often select crop combination that will survive harsh conditions such as maize-beans, cowpea-sorghum and millet-groundnut. These have not helped them much. Probably, their inability to attain sustainable adaptation strategies could be due to their cultural practices.

Small-scale farmers who constitute the majority in Africa have been experiencing tragic crop failure, reduced agricultural productivity, increased hunger, malnutrition and diseases as a result of climate change (Zoellick, 2009). Farmers are also facing problems of extreme weather conditions such as flood, drought and low soil fertility which are responsible for low rate of rice production. These challenges called for adaptation to climate change or variability in order to maintain optimum level of production (Arimi and Jenyo-Oni, 2014). The objective of the study is to ascertain constraints encountered by the rice farmers in adapting to climate change adaptation strategies.

MATERIALS AND METHODS

The Study Area

This study was conducted in Taraba State, situated in the North Eastern part of Nigeria. According to the NPC (2006), the population of the State is 2,294,800 million people and has a land area of 54,428km2 spread over different ecological zones. The State is divided into sixteen Local Government Areas with Jalingo as its capital. Taraba State lies between latitude 6º30'N and 9º36'N and between longitude 9º30'E and 11º45'E. It shares boundaries with five states, to the west by Plateau, Nasarawa and Benue, to the East by Adamawa and Republic of Cameroon and to the North by Gombe State (TADP, 2007).

The State is inhabited by Jukuns, Mumuyes, Jenjos, Mambillas, Wurkums, Fulanis, Tiv, and Chamba ethnic groups among others. Its strategic location in the transitional belt between the forest area of the South and grassland of the South affords it tremendous potentials in Agriculture. Agriculture is the major occupation of the people of the State, employing about 70% of the total population. Thus, the State's great capacity to grow a wide

range of crops has accorded her the "Nature's Gift to the Nation". Apart from rice farming, farmers in Taraba State indulged in producing other staple and cash crops like maize, millet, yam, cassava and among others. However, Taraba State is the leading producer of rice in the North-East, Nigeria.

Sampling Technique, Data Collection and Analysis

The State is divided into three zones, the Northern zone comprising Ardo-kola, Jalingo, Lau, Yorro, Zing and Karim-Lamido, the Central zone comprised Gassol, Bali, Gashaka, Sardauna and Kurmi, while the Southern zone comprised Ibi, Wukari, Donga, Takum and Ussa Local Government Areas. Multistage Sampling technique was employed to select sample size of 251 in the study area. The first stage Taraba State was stratified into three Agricultural Zones, the second stage involved purposive selection of two Local Government Areas from each of the Agricultural Zone in the State based on high concentration of rice farmers, and the third stage involved selection of two communities from each of the selected Local Government Areas using the random sampling technique. The last stage involved proportional allocation of 10% across board to select the total sample size of 251 respondents.

The study adopted the survey design and collected information (data) through interview schedule and observations with the aid of a questionnaire from 251 respondents in the study area. Data were analyzed using factor analysis.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Rice Farmers

The results of the socio-economic characteristics of rice farmers as shown in Table 1 revealed that 75% of the respondents were males whereas 23% were females, suggesting that rice farming was dominated by male farmers. The mean age of the respondents was 44 years. This implied that majority of the farmers were still in their productive age and may likely be willing to adapt effectively to climate change variability in order to increase rice production. The results further revealed that 74% of the respondents were married whereas 11% were single implying that rice is the source of livelihood for the farm families. The mean household size was 7 members. This implied that the higher the number of household sizes of the respondents, the more the availability of the family labor for farm activities. Banmeke and Omoregbee (2009) observed that large household size serves as an important source of farm labor supply and a strong base to adapt improved technologies so as to be able to improve productivity in order to meet up with the needs of the family.

The results on level of education showed that the average years spent in school was 10 years. This showed that most of the farmers were literate and the implication is that educated farmers were likely to be more receptive to changes that can enhance their productivity and help them in adapting efficiently to climate change. According to Maddisa (2006) educated and experienced farmers have more knowledge and information about climate change and agronomic practices that can adopt in response.

Table 1: Socio-economic characteristics of rice farmers (n=251)

Variable	Frequency	Percent	Mean
Sex			
No response	6	2.4	
Male	188	74.9	
Female	57	22.7	
Total	251	100.0	
Age (years)			
21 – 40	93	37.1	
41 – 60	149	59.4	
>60	9	3.6	
Total	251	100.0	44.09
Marital status			
No response	3	1.2	
Single	28	11.2	
Married	185	73.7	
Divorced	21	8.4	
Widowed	14	5.6	
Total	251	100.0	
Household size			
1 – 5	81	32.3	
6 – 10	131	52.2	
11 – 15	35	13.9	
>20	2	0.8	
Total	251	100.0	7.18
Years spend in school			
No response	8	3.2	
1 – 6	44	17.5	
7 – 12	131	52.2	
13 – 17	67	26.7	
>18	1	0.4	
Total	251	100.0	10.27
Primary occupation			
Farming	185	73.7	
Civil service	24	9.6	
Hunting	5	2.0	
Trading	37	14.7	
Total	251	100	
Farm Size (Ha)			
No response	2	0.8	
1 – 5	116	46.2	
6 – 10	76	30.3	
11 – 15	47	18.7	
16 – 20	10	4.0	
Total	251	100	3.0
Farming experience (years)			
1-5	11	4.4	
6-10	73	29.1	
11-15	58	23.1	
16-20	38	15.1	
>20	71	28.3	
Total	251	100.0	16
Membership of any cooperative			
No response	1	0.4	
Yes	97	38.6	

No	153	61.0	
Total	251	100.0	
Annual income (₦)			
No response	4	1.6	
₦1 – ₦200000	17	6.8	
₦200001 – ₦400000	70	27.9	
₦400001 -₦600000	61	24.3	
₦600001 – ₦800000	47	18.7	
₦800001 – ₦1000000	31	12.4	
>₦1000000	21	8.4	
Total	251	100	₦595,667.04

Field survey, 2018

The results also showed that majority (74%) of the respondents were engaged in farming as their primary occupation. The mean farm size of the respondents stood at 3 hectares. This showed that farmers in the study area were farming rice on a small scale. The mean farming experience was 16 years indicating that the farmers were experienced in rice farming. The implication is that, with such number of years in rice farming, the farmers were in a better position to know the limitations associated with cultural practices, the effects of climate change and the need to adapt and cope with these effects.

The results further showed that 61% of the respondents were nonmembers of an association, whereas 39% were members of associations. Farmer's organizations are effective channels of communicating information to farmers and access to credit facilities. This implied that most of the farmers may not gain easy access to information and credit facilities to combat climate change. The mean annual income was ₦595, 667.04 indicating that most of the farmers were low income earners. The implication is that the farmers may be willing to seek for information on climate change adaptation strategies but may not have the financial strength to do so. This agrees with the report of Abolagba (1997) which explained that farmers with high income level are in better position to afford communication facilities and therefore tend to be more informed of farm technologies and other climate related issues.

Constraints Encountered by Rice Farmers in Adapting to Climate Change Adaptation Strategies

Analysis to investigate the inter dependency between constraints to climate change adaptation strategies and summarized the constraints into manageable size using factor analysis showed a significant relationship (x^2=301.70; $p< 0.01$) between the constraints identified. Specifically, the result showed that the categories could be summarized into three factors, namely; socio-economic, agronomic and politico-infrastructural factors.

According to the Stevens (1958) rule of thumb any factor that has a loading of 0.30 and above is said to be highly loaded, hence, significant. Based on this rule of thumb, the factors that were highly loaded under the socio-economic category were, inadequate capital (0.639), poor access to information on climate change (0.416), low level of education (0.713), lack of credit facilities (0.613), low level of awareness (0.591), inadequate agricultural extension service delivery (0.613) and high cost of farm inputs (0.767). The factors that were highly loaded under the environmental category were, land tenure system (0.604) and lack of improved agricultural technologies (0.537). Under the politico-infrastructural category,

poor irrigation facilities (0.659) and absence of government policy on climate change (0.746) were highly loaded.

Table 2: Factor analysis of constraints to climate change adaptation strategies by rice farmers

Variables	Factor 1	Factor 2	Factor 3
Inadequate capital	.639*	-.200	.389*
Poor access to information on climate change	.416*	.319*	-.168
Poor infrastructural facilities	.250	-.185	.659*
Land tenure system	-.127	.604*	.077
Low level of education	.713*	.289	-.022
Lack of improved agricultural technologies	.171	.537*	.051
Lack of credit facilities	.613*	.072*	.386*
Absence of government policy on climate change	.102	-.145	.746*
Low level of awareness	.591*	.112	.000
Inadequate agricultural extension service delivery	.613*	.127	.130
High cost of farm inputs	.767*	.257	-.083

Source: Field survey, 2018 Rotation method: Varimax with Kaiser Normalization
Factor 1 Socio-economic factors; Factor 2 Environmental factors; Factor 3 Politico-infrastructural factors

The implication of this finding is that inadequate capital and lack of credit facilities as seen in factor 1, limits the strategies that farmers can employ, since many of these have costs implications for instance, construction of dams, use of chemicals, irrigation etc. Also, inadequate extension services, low level of farmers' education and low level of climate change awareness may limit farmers understanding of information about climate change adaptation strategies. Deressa (2008) observed lack of information pertaining climate change, lack of money, shortage of labour and land as constraints to climate change adaptation strategies.

The implication for the finding of factor 2 is that land tenure system affects the size of land available to the farmers. Despite technological advances such as improved varieties of rice, lack of money hinders famers from getting the necessary technologies which assist them to adapt to climate change (Onyeneka and Madukwe, 2010). Finally, the poor infrastructural facilities such as irrigation facility and dams as shown in factor 3 mitigate against climate change adaptation strategies. According to Salau *et al.,* (2012) the perceived serious constraints faced by farmers were low income, poor technological status, low level of education, poor access to information on climate change unfavourable land tenure system and poor physical and social infrastructures in rural areas. Also, absence of government policy on climate change posed a constraint to adaptation strategies. Nzeadebe *et al.,* (2011) stated that inadequate information, low awareness level, poor government attention to environmental issues and lack of improved varieties of crops were the major constraining factors to climate change adaptation in Niger Delta region. Others included ineffectiveness of indigenous methods, limited knowledge of adaptation measures, low institutional capacity and absence of government policy on climate change.

CONCLUSION

Rice farmers in the study area were constrained with inadequate capital and land for farming among others. These farmers would be more resilient and adapt to climate change effectively if there is efficient information network from the extension workers about climate

change, more extension visits, and adequate capital. Based on the findings of this study, the following recommendations were made;

Adequate credit facilities should be made available to help the farmers cope with the adverse effects of climate change, farm inputs should be made available at subsidized rate and at the appropriate time through well-coordinated system so as to help farmers overcome some of the problems associated to adapting to climate change, extension programs on how to adapt effectively to climate change variability should be embarked upon by relevant authorities this would boost farmers' resilience against the adverse effects of climate change and also farmers should come together pool their resources and encourage one another to stand the adverse effects of climate change using the available adaptation strategies within their communities.

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