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Effects of Climate Change on Rice Farming in Ardo Kola Local Government Area of Taraba State, Nigeria

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Abstract: The study examined effects of climate change on rice farmers in Taraba State. Purposive and multi-stage random sampling techniques were used in selecting 350 respondents. Data were collected using structured interview schedule and analyzed using descriptive statistics. Result showed that 80.0% of the respondents were male, 34.0% were in the age range of 34-40 years, 48.0% married and 48% single while 4.0% had no formal education. About 80.0% of the farmers had >20 years of farming experience; while, the average household size was 9 persons with 64.0% within the range of 6-10 persons per household. The findings further showed that mobile phones (96.0%) was the major source of information on climate change. However, stunted growth of rice plant ($\bar{X}$ = 3.95) and drying up of streams ($\bar{X}$ = 3.85) were perceived as major effects of climate change in rice production. Changing from upland rice farming to livestock keeping (88.30%), use of climate change resistant rice varieties (85.47%), development and adoption of climate resilient rice varieties and changing from rice farming to marketing and processing of paddy (83.51%) were the major adaptation measures to climate change in rice production among farmers. Adaptation strategies perceived by farmers included need for extension services/training on recent climate change ($\bar{X}$ = 3.15), treating rice seeds against pests/diseases before planting ($\bar{X}$ = 3.08). The study recommends the need for government to provide farmers with rice technologies which are adaptive to climate change in the study area.

Key words: Climate change, climate change adaptation strategies, rice, production, Taraba State

INTRODUCTION

Intergovernmental Panel on Climate Change (IPCC, 2007) indicated that climate change threatens agricultural production through higher and more variable temperatures, changes in precipitation patterns and increased occurrences of extreme events like droughts and floods. Increased concentrations of carbon dioxide through use of fertilizers, pesticides and burning of rice crops residues (straws and husks) might be beneficial to the enhancement of productivity of major rice varieties but increases methane emission (International Rice Research Institute (IRRI, 2011)). Methane is up to 30 times more harmful for the environment than CO_2 and much of the methane by human activity (300-400 million ton a year) originates in rice fields (Fuehrer, 2011).

Rice cultivation seems to be carried out in all regions having necessary warmth and abundant moisture favourable to its growth mainly subtropical rather than hot or cold areas. Nigeria has the capacity to be self-sufficient in rice production as virtually all ecologies in the country are suitable for rice cultivation (Erenstein *et al*., 2003). Though, agriculture in tropical countries like Nigeria is more vulnerable to climate change, many of these areas are less-favoured agricultural zones and are facing increasingly challenging market and 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 pests, diseases and weeds. In addition, gradual increase of global temperatures affects the growth of rice production in developing countries.

In developing countries, rice is the staple of growing population; the rise in domestic demand/consumption of rice far exceeds local production, precipitating an increase in rice importation bill to as high as $695 million US dollars in 2007 (Emodi and Madukwe, 2008). The average rice yield in the sub-continent of sub-Saharan Africa (SSA) is

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the lowest in the world compared to Asia's average of 4 ton (>6 ton in China). Rice production in Nigeria rose from 2.4 million metric ton in 1994 to 3.4 million metric ton in 2007. This is below the average of Nigeria's rice demand of 5 million metric ton of rice per year, representing 9% of caloric intake (IRRI, 2001; Emodi and Madukwe, 2008). According to Fuehrer (2011), rice farmers are hard hit by climate change with the season less predictable by 2100; average temperatures will increase by between 1.4-5.8°C and with high temperature there will be decreasing rice yield in tropical climate areas (Peng *et al*., 2004). In the face of changing environmental and economic realities, it is imperative to increase rice production in order to meet the increasing consumption (Sanginga *et al*., 2004). An empirical study carried out in six ecological zones of the country (Ajetumobi and Abiodun, 2010) found that increase in temperature will reduce net revenue for dry land rice farms; while, net revenue rises with increase in temperature for irrigated rice farms. Precipitation had similar effects on rice net revenue. They also noted that increase in precipitation will cause reduction in revenue for dry land rice farms whereas it will cause increase in revenue for irrigated farms. There is, therefore , the need to gain information on rural farmers' position on climate change effects; their needs and what they know about climate change. Therefore, it is important that adaptive and mitigating strategies on climate change should constitute the cornerstone in efforts to develop rice production and improve the livelihood strategies of farmers in Nigeria, especially owing to its huge population and rice farming potentials and sub-Sahara African (SSA) in general.

Purpose of study: The broad objective of the study was to examine effects of climate change on rice farmers in Taraba State. Specifically, the study was designed to:

- Identify source of information on climate change among rice farmers in the study area
- Ascertain the perceived effect of climate change on rice production among farmers in the study area
- Identify adaptive measures on climate change in rice production among farmers in the study area

MATERIALS AND METHODS

Ardo kola local government area of Taraba State is located in the North East zone of Nigeria. In the area, rice cultivation is mostly under rain-fed conditions. The area receives annual rainfall of between 1000-1600 mm which occurs from mid April to October ending. Average monthly temperature ranges from 25-38°C. The area falls within latitude 8°50'-9°10' North and longitude 11°20'-11°25' East with the estimated population of 86,921 people. The major farming practice among the people is mixed farming involving the rearing of small ruminants (sheep and goats) and cultivation of arable crops such as rice, maize, guinea corn (sorghum), cowpea, groundnuts and yam (TADP, 1998).

The population for the study consisted of about 1,750 rice farmers cultivating an average of 2 ha of farmland yearly (often in two or more separate parcels) who reside close to river valley and streams thereby taking advantage of the fertile soils along the banks of these rivers and streams. The study area consisted of only one extension block divided into eight extension cells out of which five (Kofai, Tau, Mayorenewo, Kasuwan Ladi and Sunkani) were purposively selected for the study due to concentration of rice farmers in these extension cells. In each cell (or community), seventy rice farmers were randomly selected giving a total of 350 respondents for the study.

Data were collected through a semi-structured interview schedule. To examine the socio-economic characteristics of the rice farmers, respondents were required to provide responses on variables regarding their age, sex, marital status, educational level, years of farming experience and household size. To ascertain sources of information on climate change among rice farmers, a list of information sources was presented to the respondents with response options of Yes and No to indicate which of the sources were major sources of information on climate change in rice production. A 4-point Likert-type scale with options ranging from serious, moderate, less and no effect was used to ascertain the effect of climate change on rice production among farmers and strongly agree, agree, disagree and strongly disagree to identify adapted measures on climate change in rice production among farmers and adaptation strategies to mitigate the effect of climate change on rice production among farmers in the study area and were scaled 1-4, respectively.

Responses of the 4-point scales were later categorised according to their mean scores using the methodology of Agwu and Adeniran (2009). In terms of reliability, mean scores of 2.5 and above were classified as effective or agreed to while those with mean scored <2.5 were regarded as being otherwise. The data were analysed by means of descriptive statistics such as percentage, frequencies and means.

RESULTS AND DISCUSSION

Socio-economic characteristics of rice farmers in the study area: About 18.0% of the respondents were <35 years while 30.0% were in the age range of 41-45 years.

This shows that participation in rice farming cuts across all age range. The average mean age of the farmers was 36 years. This implies that rice farmers in the area were within the active and innovative years and are likely not to leave anything to chance towards making a success of their rice farming enterprise (Table 1).

About 80.0% of the respondents were male while 20.0% were female idicating that rice farming in the study area was a male dominated enterprise though the females still have their role to play in rice farming. A large proportion of the respondents (54.0%) had tertiary education, 28.0% of the respondents had secondary school education, 14.0% had primary school education and only 4.0% had no formal education. This revealed that cumulative proportion (96.0%) were literate, could read, write and could, therefore, exploit various sources of information of climate condition to enhance rice production.

Data further reveal that majority of the farmers (80.0%) had >20 years of farming experience. This implies that most of the farmers are experienced and can impact expertise in rice production. The average household was 9 persons with majority (64.0%) within the range of 6-10 persons in a household while minimum of 0.2% household had 16-20 persons and 31-35 persons in a household, respectively. This conforms to Ozor and Cynthia (2011) who observed 20 persons per farm household among farming household in Enugu State, Nigeria. The implication is that with large household, farm families will have various avenues to source information on climate change in rice farming.

Table 1: Socioeconomic characteristics of farmers (n = 350)

Variables	Frequency (F)	Percentage	Mean
Sex			
Male	280	80	
Female	70	20	
Age (years)			
<35	63	18	36 years
36-40	119	34	
41-45	105	30	
46-50	49	14	
≥51	14	4	
Marital status			
Single	168	48	
Married	168	48	
Separated	14	4	
Experience (years)			
<20	70	20	11 years
21-25	126	36	
26-30	70	20	
31-35	63	18	
36-40	14	4	
≥41	7	2	
No. of household			
1-5	49	14	9 persons
6-10	224	64	
11-15	49	14	
16-20	7	2	
21-25	14	4	
26-30	0	-	
31-35	7	2	

The results in Table 2 reveal that respondents' major sources of information on climate change were: Telephone calls (96.0%), text messages (70.5%) and talking drums (56.0%). Other sources identified by few of the respondents were distributed between leaflets (44.0%), internet (40.0%), radio (29.1%), television (26.0%), fellow farmers (18.0%) and extension officers (14.0%). Interpersonal interaction through telephone calls is in no doubt of help to the farmers in being informed on changing environmental condition (Table 2).

Farmers' perceived effects of climate change on rice production

Effects of climate change as perceived by farmers: Data in Table 3 reveal that the farmers perceived the following as serious effect of climate change in rice production: Drying and withering of rice seedlings ($\bar{X}$ = 2.61), difficulty in predicting planning rice seasons ($\bar{X}$ = 2.95), delayed rainfall ($\bar{X}$ = 2.58), drying up of streams ($\bar{X}$ = 3.85), longer days and shorter nights ($\bar{X}$ = 2.71), too much heat which evaporates water from rice plants ($\bar{X}$ = 2.80), wide spread of pests and disease ($\bar{X}$ = 2.81) and stunted growth of rice plants ($\bar{X}$ = 3.95).

On the other hand, late flowering of rice plants ($\bar{X}$ = 1.75), chemicals (insecticides and pesticides) no longer effective in rice farms ($\bar{X}$ = 1.59) and low rice

Table 2: Sources of information on climate change among farmers

Information source	Yes	No
Internet	40.0	60.0
Text messages	70.5	29.5
Leaflets	44.0	56.0
Telephone calls	96.0	4.0
Television	26.0	74.0
Extension officers	14.0	86.0
Fellow farmers	18.0	82.0
Radio	29.1	70.9
Talking drums	56.0	44.0

Table 3: Mean distribution of effect of climate change as perceived by farmers

Perceived effects	Means
Drying and withering of rice seedlings	2.61*
Difficult in predicting rice planning seasons	2.95*
Delayed rainfall	2.58*
Drying up of streams	3.85*
Longer days and shorter nights	2.71
Too much heat which evaporates water from rice plants	2.80*
Wide spread of pests and diseases	2.81*
Chemicals (insecticides and pesticides) no longer effective in rice farms	1.59
Low rice yield	1.75
Stunted growth of rice plant	3.95*

*Serious effect

Table 4: Percentage distribution of respondents based on the adapted measures to climate change in rice production (n = 350)

Adaptive measures	Percentage scores
Abandoning rice farm to non-farm activities	98.16
Change from upland rice farming to livestock keeping	88.30
Use of climate change resistant varieties	85.47
Change from rice production to marketing and processing of paddy	83.51
Increase in irrigation farming system	76.45
Change from rice farming to (Guinea corn, cowpea) other crops production	71.83
Abandonment of rice farm	56.66
Mean	
Extension and service training on recent climate change	3.15
Treating rice seeds against pests/diseases before planting	3.08
Government to introduce policies to educate farmers on climate condition	2.80
New chemical preferred for treating pests/diseases in the rice farm	2.68
Varieties of rice that are adaptive to climate condition	2.68
Water conservation	2.54
Organic (farm-yard manure) to replace inorganic (NPK) fertilizer	2.50
Prefer shifting to another farm land	2.05
Increase irrigation process in rice production	2.30

yield ($\bar{x}$ = 1.75) were all perceived as of less effects of climate change on rice production. According to IPCC (2007), many natural systems seem affected by increasing temperature; in tropical regions, high temperature is a constraint to rice production; it greatly influences not only the growth duration but also the growth pattern and the productivity of rice crops; especially in developing countries that are vulnerable to climate change with low adaptive capacity (Table 4).

Data in Table 4 indicates farmers' perceived adaptive measures on climate change in rice production. These include: Abandoning rice farming to non-farm income earning activities (78.16%), increase in irrigation farming system (76.45%), change from rice farming to other (guinea corn, cowpea) crops production (71.83%), change from upland rice farming to livestock keeping (88.30%), change from rice farming to marketing and processing of paddy (83.51%), abandonment of rice farm (56.66%), use of climate change resistant rice varieties (85.47%).

All the items were overly considered as adapted measures to climate change in the study area. It is important to select suitable climate change resistant rice varieties which contributes to increase in rice production. This may resolve the problem of pest and disease infestation recognized as the most significant effects of climate change (Maddison, 2006; Ozor and Cynthia, 2011).

Other important adaptive measures agreed to by the farmers to be appropriate in climate change adaptation include building capacities of farmers through improved extension and service training on recent climate change effects (Mean = 3.15), government to introduce policies to educate farmers on climate variability or condition (Mean = 2.80), development and use of new chemicals for treating pests/diseases on rice farms (Mean = 2.68) and development/adoption of climate resilient rice crop varieties.

CONCLUSION

Evidence from this study has indicated that major sources of information on climate change among rice farmers are through mobile cell phones (96.0%) and short message services (70.5%). This finding is expected due to the presence of Global Systems for Mobil (GSM) services in every nook and cranny of Nigeria. Farmers easily obtain information from each other on flooding, dry spell, pest and disease outbreak among others. The finding underlies the need for government and agricultural development authorities to encourage farmer to utilize cell phones in sharing of information among themselves and the relevant authorities. Farmers can save through rotator savings or cooperative schemes in order to purchase mobile phones to facilitate communication that will advance their rice entrepreneurial activities. On the effect of climate change on rice production, result has clearly shown that farmers have been experiencing stunted rice growth , widespread of pests and diseases and difficulty in predicting rice planting season among others. This implies that rice production has been experiencing adverse effects due to climate change. It is, therefore, important for government and agricultural development authorities to promote the use of extension services and other media (example, electronic media such as TVs and radios) to teach farmers the appropriate adaptive strategies to be used by farmers in adapting to deleterious effects of climate change in the study area. There is also need for government to provide irrigation facilities to farmers so as to inundate them from vagaries of weather, especially rainfall variation and drought. Generally, it can be concluded that climate change seem to be exerting adverse effect on rice production. Therefore, the need for extension service to play more assertive role by helping the farmers to use proactive measures in mitigating climate change effects cannot be overemphasized.

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