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Climate Change

Adaptation to climate change among rubber farmers in delta state, Nigeria

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ABSTRACT

The study analyzed the adaptation to climate change among rubber farmers in Delta state, Nigeria. A multistage random sampling technique was used to select 50 rubber farmers. Data were analyzed using descriptive and inferential statistics. Results revealed that 40% of the respondents were 56 years of age and above. Majority were male and married and 46% had secondary school education. The result of the adaptation measures employed includes fire tracing (85%), mulching/cover cropping (80%) and off-farm activities (72.5%). Analysis of the relationships between some selected socio-economic variables and the use of climate change adaptation measures revealed that age, years spent in school, household size, extension visit and distance of farmers' residence to farm land had significant relationship with coping strategies employed. The main constraints to the use of climate change adaptation measures by farmers in the study area were poor financial resources (95%) and poor access to weather information (90%). The study concluded that there should be awareness creation of climate change and possible adaptation method to be used by rubber farmers. Also, extension service should be strengthened through organizing adult education programmes for rubber farmers to expose them to climate change coping strategies.

Key words: climate change, adaptation measures, rubber farmers

1. INTRODUCTION

Climate change is perhaps the most serious environmental threat facing mankind worldwide. Current climatic variation has significant impacts on agricultural production, constraining agricultural income and forcing farmers to adopt new agricultural practices in response to altered conditions (Molua et al. 2010). The growing problem of climate change is becoming more threatening to sustainable economic development and the totality of human existence (Adejumo 2004). There is observed decline in crop production and yield due to reduction in rainfall and relative humidity and increase in temperature in Nigeria. Over time, farmers had adjusted agricultural systems and practices to changing economic and physical conditions. This has been accomplished by adopting new technologies, changing crop mixtures and institutional arrangement. Such flexibility is suggestive of human potentials to adapt to climate change (CAST, 1992; Rosenberg, 1992). The risks of future climatic changes such as higher temperatures, changes in precipitation and increased climate variability can result in significant impacts on agriculture and rural areas (Williams 2004, IPCC, 2007; Mesike et al 2007; Ayogu et al. 2015). Such changes may manifest in the reduction in land quality and low agricultural yields (Mesike and Esekhade 2014).

The IPCC (2001), reports in its Fourth Assessment Report that the earth's climate is changing and the rate of change is accelerating with man's economic activity having a discernible effect on the climate. The best judgement of the Intergovernmental Panel on Climate change IPCC (2007) is that if emissions of Green House Gases (GHG) continue to grow as currently projected, the global mean will increase over the current century. These changes in green house gases may not only lead to changes in temperature, precipitation and other climate variables, but may also result to global changes in soil moisture and increase in global mean sea level and prospects for more severe extreme temperature events, flood and droughts in some places.

The Nigerian rubber farmers are experiencing climate change even though they have not considered its deeper implication. This is evidenced in the late arrival of rain, the drying-up of stream and Small Rivers that usually flows year round, excessive rainfall and flooding. Rubber plants have an inherent relationship with climate and environment. Global environmental changes in atmospheric carbon dioxide, land transformation and anthropogenic nitrogen fixation, affect plant photosynthesis, respiration and decomposition thus leading to changes in plant carbon dioxide fixation and the carbon stocks in vegetation and soils (Melillo et al., 1993; Schimel et al., 1994; Vitousek et al., 1997). Thus, the risks of changing weather conditions in relation to higher temperatures, changes in precipitation, increased climate variability and extreme weather events can result in strong significant impacts on agriculture, forestry and rural areas.

Carter (1997) pointed out that farmers react to climate change through adaptation. Adaptation to climate change refers to the adjustments in ecological, social and economic systems in response to climatic conditions and their effects (Tol, 1998). The capacity of farmers to adapt to climate change can be significantly influenced by the level of awareness of climate change in their communities. In an analysis of adaptation to climate change in the drought-prone areas of Bangladesh Selvaraju *et al.* (2006), found that the main adaptation strategies practiced by small-scale farmers were in the form of modification of agronomic practices and in the choice of crop varieties that tolerate the new regime. Stated differently, assessment of adaptation strategies for climate change impact refers to the identification and evaluation of possible options or changes in policies, practices and technologies as well as actual or expected climate hazards, or their actions designed to adapt to or take advantage of new opportunities that become possible as a result of climate change. Adaptation is not new to human history as man has had to adapt to changes in climate and the environment. A new dimension to adaptation with the pace at which the climate is changing is faster and poses a greater challenge to humans requiring a much faster adaptation than before. Delaying action will certainly lead to increased cost and eventually greater risk to the vulnerable communities. This study therefore seeks to find out the extent to which these are being achieved by addressing the following research objectives to:

i) identify the socio-economic characteristics of the respondents;
ii) examine the perceptions of climate change among respondents in the study area;
iii) analyze the adaptive mechanisms to climate change being used by the respondents in the study area;
iv) identify the factors that influence adaptation to climate change by the respondents; and
v) identify the constraints to adaptation to climate change by small-scale farmers in the study area.

2. MATERIALS AND METHODS

The study was carried out in 5 Local Government Area of Delta state namely Ndokwa East, Ndokwa West, Ika North-East, Isoko South and Patani. The general climate is characterized by a long rainy season from March/April through October. There is an increase in precipitation from the north of the Niger-Delta which records an average of 2500mm to the extreme coasts where mean annual rainfall averages 4,000mm approximately. Relative humidity rarely falls below 60%, fluctuating between 90% and 100% for most of the year. Temperature is high ranging from 28°C to 34°C with average annual temperature of 30°C. The vegetation of Delta state is low land tropical rainforest and swamp forest vegetation.

A multistage sampling technique was used to select respondents for the study. The first stage involved a purposive selection of six local government areas based on the population of rubber farmers in the States. The second stage involved purposive selection of rubber growing communities while the last stage was a simple random selection of fifty rubber farmers from a list of rubber farmers in each community. Interview schedule with the use of structured questionnaire was used to obtained information from the respondent. Secondary data were used to provide back-up for the survey.

Descriptive statistics such as frequency count and percentages were used to summarize the data. Also inferential statistics, such as Tobit model was used to test the relationship between the variables used in the study. The dependent variable was the adaptation measures of respondents and this was measured in terms of the number of strategies used by a respondent. Independent variables include age, marital status, level of education, extension visit and distance of farmer's residence to farm land.

3. RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

Table 1 show that 40% of the respondents were within the age range of 56 years and above, mean age of respondents was 52 years. This indicates that majority of the respondents were not within their productive age. Aging farmers are less able to source information and engaged in modern agricultural practices. The table further shows that majority of the respondents were married. This is in line with their age distribution as most of them are adult. Table 1 also indicates that majority (94%) of the respondents are male while remaining 6% are female. This result showed that rubber farming was mostly carried out by males and this indicates that females are usually involved as helpers or suppliers of labour in "light" farm operations such as weeding, tapping and processing in rubber industry. Majority (46%) of respondents have completed minimum of secondary education. This makes them to read and write. This shows that majority of the respondents are literate. Earlier studies (Asfaw and Admassie, 2004; Bamire *et al.*, 2002) reported that education affects agricultural productivity by increasing the ability of farmers to produce more output from given resources and by enhancing the capacity of farmers to obtain and analyze information. Education could also influence the ability of farmers to adjust quickly to disequilibria. Only few (8%) had no formal education. Table 1 further reveals that majority of the farmers were small holders and this makes them vulnerable and less able to cope with the consequences of climate change. More than half (70%) of the respondents received between two to three extension visits per year. However, majority (56%) of respondents had between 21 to 30 years of farming experiences. Extension contact determines the information that farmers obtain on production activities and the application of innovations through counselling and demonstrations by extension agents. The effect of exposure to extension programmes is enormous. For instance, Nhemachena (2007) also opined that exposure to extension services influences the capacity of farmers to adapt to climate change.

Table 1

Distribution of respondents based on their socio-economic characteristics

Variable	Frequency	Percentage	Mean
Age(years):			
≤25	2	4.0	
26-35	3	6.0	
36-45	13	26.0	52
46-55	12	24.0	
56 and above	20	40.0	
Marital status			
Married	43	86.0	
Single	7	14.0	
Sex			
Male	47	94.0	
Female	3	6.0	
Educational qualification:			
No formal education	4	8.0	
Primary education	16	32.0	
Secondary education	23	46.0	
Tertiary education	7	14.0	
Farm size (ha.):			
≤1.0	2	4.0	
1.1-2.0	6	12.0	
2.1-3.0	9	18.0	
3.1-4.0	17	34.0	3.4
4.1-5.0	11	22.0	

5.1 and above	5	10.0	
Farming experience			
1-10	3	6.0	
11-20	14	28.0	23.6
21-30	28	56.0	
Above 30	5	10.0	
Number of extension visit per year			
≤1	12	24.0	
2-3	35	70.0	2.6
>3	3	6.0	

Perceived causes of climate change in Delta state

According to the perception of the respondents presented in Table 2, deforestation with associated bush burning and overgrazing by livestock is the highest contributor to global warming and climate change in the study area. Deforestation is followed by gas flaring at 80%, burning of fossil fuel (77.5%), industrialization (42.5%), uses of pesticides/aerosols and herbicides at (37.5%) and (15.0%) respectively. However, about 30% believes that climate change is caused by the "gods" who should be appeased to avoid further disruptions and hazards in the future.

Table 2

Human activities contributing to climate change as perceived by Respondents

Perceived cause	Frequency*	Percentage
Industrialization	17	42.5
Deforestation, bush burning and overgrazing by livestock	34	85.0
Gas flaring	32	80.0
Burning of fossil fuel	31	77.5
Use of insecticides/pesticides	15	37.5
Use of fertilizer	5	12.5
Use of herbicides	6	15.0
Natural process destined by God	12	30.0

*multiple response indicated

Respondents were not altogether ignorant of climate change. Over 70% were aware of changes in the climatic variables albeit their inability to express their feelings about the unfolding event as the years rolled by. Majority of the respondents perceived that there have been changes in climatic variables and events over the past 30 years. It is clear from table 3 that changes in climatic variables and events had profound adverse impacts on climate dependent livelihoods such as uncertainties in the onset of the farming seasons, extreme weather/climate events (e.g storms, high temperatures), crop pests, weeds and land degradation increases.

Table 3

Direction of change of climate phenomenon in the last 30 years

Climate change events	Increasing (%)	Decreasing (%)	No change (%)	Remarks
Uncertainties in the on-set of the farming seasons	74.2	23.7	18.7	Increase
Extreme weather events	71.8	16.4	9.6	Increase
Crop pest and diseases	77.4	7	12	Increase
Weeds	78.8	8.1	13.1	Increase
Land degradation viz	82.7	6.8	11.3	Increase

*multiple response indicated

Developing adaptation measures to climate change

Figure 1 and Table 4 presents the result of adaptation measures practised by the respondents against climate change. Fire tracing was ranked first having been selected by 85% of the respondents followed by mulching/cover cropping (80%), off-farm activities (72.5%), intensive manure application (70%), irrigation to augment short fall in rain (67.5%) ranked second, third, fourth and fifth respectively. Other adaptation options identified include soil conservation (62.5%), early planting (45%), planting deeper than usual (42.5%), integrated mixed farming (40%) and insurance (15%). This result suggests that respondents employed one form of adaptation measures or the other in order to reduced effect of climate change on rubber production. This findings support Apata *et al.* (2009), who reported that main strategies for reducing climate risk is to diversify production and livelihood system. Also, 10% of respondents felt that there was no need to take action as they attributed climate changes to God the creator and saw themselves incapable of doing anything.

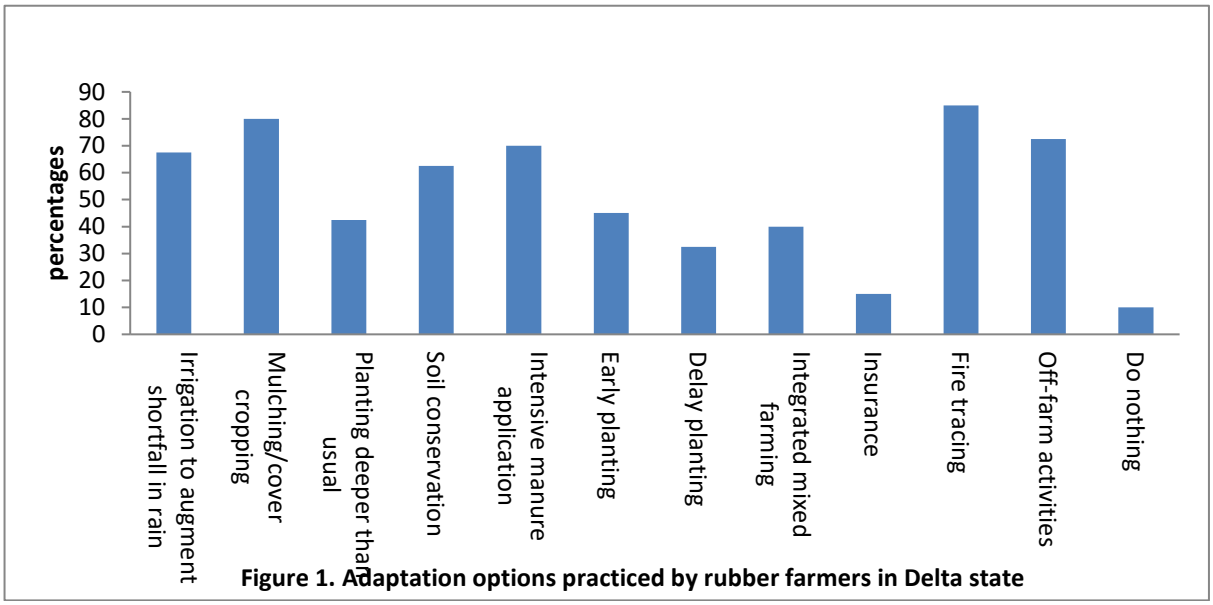

Figure 1. Adaptation options practiced by rubber farmers in Delta state

Table 4

Identified adaptation options practiced by respondents

Adaptation measure	Frequency*	Percentage	Rank order
Irrigation to augment shortfall in rain	27	67.5	5th
Mulching/cover cropping	32	80.0	2nd
Planting deeper than usual	17	42.5	8th
Soil conservation	25	62.5	6th
Intensive manure application	28	70.0	4th
Early planting	18	45.0	7th
Delay planting	13	32.5	10th
Integrated mixed farming	16	40.0	9th
Insurance	6	15.0	11th
Fire tracing	34	85.0	1st
Off-farm activities	29	72.5	3rd
Do nothing	4	10.0	12th

*multiple response indicated

Factors influencing the use of adaptation measures to climate change

The estimates of the Tobit analysis are presented in Table 5. Adaptation measure was measured in terms of the number of strategies used by a respondent. The strategies are listed in Table 4. The more the number of such strategies used by a respondent, the more he ranks in adaptation status. The results revealed that the five variables considered in the model had significant coefficients at the 1%, 5% and 10 % level of significance. This result suggests that for every 1 unit increase in these variables there is probability of increase in adaptation measures employed. Age was negatively significant at 5%, implying that the younger respondents used more of the adaptation measures compared to their older counterparts. This is in line with Adesina and Zinnah (1993) who postulate that younger farmers have greater tendencies to improvise and adopt new technologies because they are relatively more knowledgeable, more open to risk taking and have longer planning horizons than their older counterparts. Level of education was significant at 5%. The Positive significant of education implies that education creates a favourable mental attitude for the acceptance of new practices especially of information-intensive and management-intensive practices. Household size also positively influenced the use of adaptation measures among the respondents at 5% significant level. Household size could be a measure of available labour for farming activities. Some of the adaptation measures to climate change such as mulching, manure application and fire tracing are labour-intensive and this explain why the capacity of farmers to use these technologies depends on availability of family labour which is the main source of labour in subsistent agriculture. Extension visit was positively significant at 1% level. This shows that exposing farmers to information not only stimulate adoption, but can also counter balance the negative effect of lack of years of formal education. The distance of farmer's residence to farm land was significant at 10% and the sign of the coefficient was negative, implying that as the distance of farmer's residence to farm land decreases, the capacity to use the adaptation strategies correspondingly increases.

Table 5

Tobit estimate of factors Influencing adaptation to climate change

Adaptation to Climate Change	Coefficients	Standard Error	Z-statistic	Probability
Constant	0.211238	0.089336	2.364526	0.0181
Age	-0.156413	0.066813	-2.341066	0.0192
Level of education	0.156322	0.067356	2.320833	0.0203
Household size	0.217936	0.109257	1.994708	0.0461
Extension visit	0.248447	0.065011	3.821640	0.0001
Distance of farmer's residence to farm land	-0.179701	0.102372	-1.755382	0.0792

** Significant at 5%

*** Significant at 1%

Constraints to adaptation

Considering the magnitude of impact of climate change in Delta state, the adaptation to climate hazards is expected to be face with many challenges. The result of constraints to adaptation to climate change among the respondents is presented in Table 6. The most critical constrain factor that hindered the adaptation to climate change was poor financial resource base having been selected by 95% of the respondents. This is followed by inadequate access to extension service (90%), lack of credit facilities (87.5%), high cost of fertilizer and other inputs (75%) and poor agricultural extension service delivery (72.5%). Poor access to weather information, poor access to technologies necessary for adaptation and poor information and absence of early warning systems were among the constraints that militated against adaptation to climate change as reported by 67.5%, 65%and 52.5% of the respondents respectively. According to Oyekale (2009), small-scale farmers, having low resource base are more vulnerable and less able to cope with the consequences of climate change and such farmers also have less likelihood of accessing weather information or capacity to develop technologies on their own.

Table 6

Constraints to adaptation of climate change by respondents

Constraints	Frequency*	Percentage
High cost of irrigation facilities	34	75.0
Inadequate financial resource	38	95.0
Inadequate access to extension service	27	67.5
Lack of credit facilities	35	87.5
Poor access to the technologies necessary for adaptation	26	65.0

High cost of fertilizer and other inputs	30	75.0
Poor access to weather information	36	90.0
Poor agricultural extension service delivery	29	72.5
Poor information and absence of early warning systems	21	52.5

*Multiple responses indicated

4. CONCLUSION AND RECOMMENDATIONS

The study indicated that a large proportion of the respondents were 56 years of age and above. Access to extension service was also very low in the study area even though extension service played a significant role in providing information about climate change. Impacts of climate change events on climate dependent livelihoods such as uncertainties in the onset of the farming seasons, extreme weather/climate events (e.g storms, high temperatures), crop pests, weeds and land degradation was on the increase for over years. Respondents cope with climate change by using different adaptation methods. Major constraints that militated against the use of adaptation measures include inadequate financial resource and poor access to weather information. Based on the findings of this study the following recommendations were suggested; there should be awareness creation on climate change and possible adaptation method to be used by rubber farmers. Extension service should be strengthened through organizing adult education programmes for farmers to expose them to climate change coping strategies. Lastly, programme should be put in place to attract young people especially young school leavers into rubber cultivation.

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