JOURNAL OF AGRICULTURAL ECONOMICS, EXTENSION & SCIENCE ISSN (Print) 2545-5179, ISSN (Online) 2714-5018
Official Journal of the College of Agricultural Economics, Extension & Science JAEES Vol. 7 No. 4 2021, Pages 14 - 28
www.jaees.org

BARRIERS TO CLIMATE CHANGE INDIGENOUS ADAPTATION TECHNIQUES BY SMALL-SCALE RUBBER FARMERS IN EDO AND DELTA STATES OF NIGERIA.

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Abstract

The study evaluated Barriers to climate change indigenous adaptation techniques by small-scale rubber farmers in Edo and Delta States of Nigeria. Barriers to and factors facilitating the utility of these adaptation strategies were analysed. Data were collected from 286 small-scale rubber producers using questionnaire. Data were analysed using percentages, frequency distribution, mean and Multivariate probit regression model. Major indigenous climate change adaptation techniques employed by respondents included inter-cropping (100%), changing/adjusting dates of planting (90.2%), use of firewood ash to control white root rot (62.2%) and application of palm kernel oil around tree to control termites (52.4%). Probit analysis revealed that age (b = 0.036), sex (2.843), household size (0.017), farm size (0.102), Major constraints to respondents' use of indigenous climate change adaptation techniques included low capital (91.3%), poor infrastructural facilities (85.7%), high cost of inputs (83.9%), inadequate information on climate change (82.2%), inadequate credit facilities (75.9%), poor contact with agricultural extension agents (71.3%). In view of these, the researcher recommended that, in promoting indigenous climate change adaptation strategies/techniques among small-scale rubber farmers in the study area, the local adaptation measures should be examined more closely to the understanding of the rationale behind their utility and how they can be integrated with scientific approaches to enhance their effectiveness.

Keywords: Barriers, climate change, Indigenous, adaptation, rubber farmers

Introduction

Climate change has become a phenomenon in the world in recent times and the world has been experiencing its impacts. Climate change emanating from Global Warming has a lot of impact on the society and various institutions. The world has been experiencing unpredictable change in season, very high temperatures, and unreliable rainfall pattern.

Today, there is no doubt that climate change is occurring, and that negative consequences are beginning to emerge. Many observers point to the increasing number of severe storms, floods, and heat waves in recent years as indicators of changing climatic conditions. One of the sectors most sensitive to global warming is agriculture (Zoellick, 2009 (Ozor *et al.*, 2010). (Oladipo, 2010). According to Obinne (2010), possession of a wealth of indigenous knowledge should not be underestimated when it comes to small-scale farmers' ability to withstand climate change.

Statement of the problem

Planted rubber (budded stump) is grown between longitudes 15^0N and 10^0S where the climax vegetation is humid with temperatures ranging from 23 to 45^0C and a well- distributed rainfall of 1800 mm to 2000 mm on a well- drained soil (Aigbekaen *et al.,* 2000). Anything above or short of these pose a problem that can affect planted rubber (budded stumps) not to germinate (dormant, dried up),eaten up by pests and diseases(eg termite and white root-rot). Temperature has a great role to play in the flow of latex during tapping of mature rubber plant. According to Giroh *et al.* (2010), the survival rate of planted rubber (budded stumps) in southern Nigeria is very low because of pests and diseases infestation, variation in rainfall pattern and high temperature. This gives a pointer that climate change is already having negative effects on natural rubber production. Consequently, there is a need to develop an indigenous strategy to be able to cope with the effects of climate change. No research work is known to have been conducted on the evaluation of sustainable agriculture through indigenous adaptation techniques to climate change effects by small-scale rubber farmers in Edo and Delta States. It is against this background that this study was conducted.

The broad objective of the study is to evaluate sustainable agriculture through indigenous adaptation techniques by small-scale rubber farmers in Edo and Delta States of Nigeria.

The specific objectives are to:

- identify the socio-economic characteristics of small-scale rubber farmers in the study area;
- ascertain indigenous adaptation techniques used by small-scale rubber farmers for mitigating climate change in the study area; and
- identify barriers to climate change adaptation techniques used by small-scale rubber farmers in the study area.

Hypothesis: Ho_1 Socio-economic characteristics of small-scale rubber farmers have no significant effects on their practice of indigenous adaptation techniques to climate change.

Methodology

The study area

The study area for this research consists of Edo and Delta States of Nigeria. The region lies within the rainforest zone and has a temperature range of 21 – 30^{0}C with a well distributed rainfall of 2000 mm annually (Aigbekaen*et al.*, 2000). It has ultisol soil with a pH range of 4.5 – 5.5 which is favourable for the production of natural rubber (Aigbekaen *et al.*, 2000).Agriculture is the predominant occupation of the people in these states.

Population and Sample Size Selection: The population of this study comprised all small-scale rubber farmers in Edo and Delta States. A sampling proportion of 50% of the population of rubber farmers were selected for the study. Due to the enormity of this population (602), a sample size of 301 respondents were selected using multistage, purposive and simple random sampling techniques. However, 286 respondents were the ones that accurately filled and returned their questionnaire for the analysis.

In the first stage of sampling, six Local Government Areas namely; Ikpoba-okha, Ovia South West, Uhunmwonde in Edo State and Ika-North, Ethiope West and Aniocha North in Delta State were selected purposively based on their high involvement in rubber production. In the second stage of sampling, six major rubber producing communities from each Local Government Areas were selected. The final stage was the use of simple random sampling techniques in selecting farmers from each selected communities in proportion to the population. The list of rubber farmers was obtained from research outreach and training services division of Rubber Research Institute of Nigeria (RRIN), the Tree Crop Unit in Edo and Delta States' Ministry of Agriculture and Natural Resources. The sampling plan for the study was presented in Table 1.

Table 1: Sampling Plan

States	LGAs	Communities	Population of rubber farmers	Sample size (50% of the population)
Edo	Ikpoba-okha	Obayantor	12	6
		Imasabor	32	16
		ObagieN'evbnosa	16	8
		Uroho	16	8
		Okha	18	9
		Ologbo	20	10
	Uhunmwonde	Errua	12	6
		Iguezomo	16	8
		Ugha	8	4
		Igieduma	10	5
		Ehor	14	7
		Okeze	12	6
	Ovia South-West	Iguoriakhi	60	30
		Iguelaiho	12	6
		Osse	16	8
		Okomu	20	10
		Udo	8	4
		Ora-siluko	14	7
Delta	Ika North	Emuhu	8	4
		Uhumunede	18	9
		Mbiri	64	32
		Owerri-Olubor	12	6
		Ute-Ogbeje	8	4
		Ekwuoma	10	5
	Aniocha North	Isseleuku	20	10
		Idumuje-Unor	12	6
		Idumuje-Ugboko	16	8
		Ogodor	10	5
		Onitcha-Ugbo	12	6
		Ugbodu	14	7
		Jesse	12	6
		Boboroku	12	6

Method of data collection

Primary data were generated for the study using questionnaire and interview schedule. A structured questionnaire was designed to capture necessary information about the research objectives. The information included socio-economic characteristics of respondents, indigenous adaptation techniques to mitigate climate change effects and barriers to use of climate change adaptation techniques by small-scale rubber farmers.

Data for this study were analyzed using both descriptive and inferential statistics.

Model specification

Multivariate Probit Regression Model. This model was used to test the hypothesis. It is represented below:

Where:

Z = use of indigenous climate change adaptation strategies

b_s= coefficients of explanatory variables which increase or decrease z

X_1 = age (in years)

X_2 = sex (dummy variable: 1, if male, 0, if female)

X_4 = educational status (measure in years spent in school)

X_5 = farm size (in hectares)

X_6 = family size (number of people in household)

X_7 = farming experience (number of years involved in rubber production and sales).

Results and Discussion

Socio-economic characteristics of respondents

Table 2 shows that few (19.2%) respondents were above 60 years of age; most (39.5%) respondents belonged to the age bracket of 51 – 60years, 29% were 41 to 50 years old while 10.8% were 31-40 years. The results suggest that rubber farming is associated with moderately older persons. Similar finding has been reported by Abolagba *et al.* (2003) who found that those engaged in rubber production were fairly old farmers. Among the respondents, males constituted the majority (99.3%) whereas 0.7 percent were females. The predominance of males in rubber production may be attributed to the tedious nature and hard work involved in the production process. The distribution of respondents according to their marital status, majority of the respondents (93.7%) were married. Analysis of the educational level of respondents revealed that farmers with formal education were in the majority (81.4%) whereas 18.5% had no formal education. Specifically, among those with formal education, most (50.3%) had primary education, 22.4% had secondary education whereas 8.7% had tertiary education. This implies that rubber farmers can go a long way to seek for vital information on climate change effects, because an educated mind is able to readily accept positive change. The result for household size showed that (40.6%) of the respondents had a household size of 9 – 12 persons, 38.4% had less than 9 persons, whereas 21percent had above 12 persons. The result shows that the respondents had large household size. This implies availability of family labour for rubber production. Banmeke and Omoregbee (2009) noted that large household size serves as an important source of farm labour supply.

Many (49%) of the respondents had a farm size of 2.1 – 4 hectares, 43% had less than 2 hectares, whereas 8% had more than 4 hectares. The mean size of the respondents' farm was 2.8 hectares. Seeking for information on climate change effects may be affected by small hectares and might be a disincentive in the acquisition of credit facilities from commercial banks. This supports the assertion of Delabarre and Serier (2000) that most Nigerian rubber farmers operate on less than four hectares and that the bulk of natural rubber production in Nigeria is in the hands of small-scale producers. Many (40.9%) of the rubber farmers had a farming experience of 11 – 20 years, 26.2% had less than 10 years, 25.2 % had 21-30 years whereas 1% had over 40 years. The result showed that the farmers were experienced in rubber farming. Similar findings was reported by Ugwa and Abubakar (2006) who found that most rubber farmers have a benefit of long years of accumulated experience in rubber farming.

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		Ugha	8	4
		Igieduma	10	5
		Ehor	14	7
		Okeze	12	6
	Ovia South-	Iguoriakhi	60	30
	West	Iguelaiho	12	6
		Osse	16	8
		Okomu	20	10
		Udo	8	4
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		Onitcha-Ugbo	12	6
		Ugbodu	14	7
		Jesse	12	6
	Ethiope West	Boboroku	12	6
		Mosogar	16	8
		Oghara	24	12
		Aghor	8	4
		Atighor	10	5
		Total	602	301

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Primary data were generated for the study using questionnaire and interview schedule. A structured questionnaire was designed to capture necessary information about the research objectives. The information included socio-economic characteristics of respondents, indigenous adaptation techniques to mitigate climate change effects and barriers to use of climate change adaptation techniques by small-scale rubber farmers.

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Table 2: Socio-economic characteristics of respondents

Characteristics	Categories	Delta (n = 133)			Edo (N = 153)			Pooled (n = 286)		
		Freq	**%**	**Mean**	**Freq**	**%**	**Mean**	**Freq**	**%**	**Mean**
	30 & below	2	1.5		2	1.3		4	1.4	
	31-40	17	12.8		14	9.2		31	10.8	
Age (years)	41-50	36	27.1		47	30.7		83	29.0	
	51-60	57	42.9		56	36.6		113	39.5	
	61-70	21	15.8		34	22.2		55	19.2	
Sex	Female	1	0.8		1	0.7		2	0.7	
	Male	132	99.2		152	99.3		284	99.3	
Marital status	Married	126	94.7		142	92.8		268	93.7	
	Divorced	2	1.5		6	3.9		8	2.8	
	Widow(er)	5	3.8		5	3.3		10	3.5	
Education	No formal education	22	16.5		31	20.3		53	18.5	
	Primary school certificate	68	51.1		76	49.7		144	50.3	
	WASC/GCE/ NECO	32	24.1		32	20.9		64	22.4	
	Tertiary education	11	8.3		14	9.2		25	8.7	
Income (N) (annual)	250,000 & below	12	9.0		18	11.8		30	10.5	
	250,001-500, 000	45	33.8		45	29.4		90	31.5	
	500,001-750, 000	38	28.6		32	20.9		70	24.5	
	750,001-1M	10	7.5		23	15.0		33	11.5	
	1.1-1.25M	12	9.0		11	7.2		23	8.0	
	1.25-1.5M	4	3.0		3	2.0		7	2.4	
	>1.5M	12	9.0	684504	21	13.7	812608	33	11.5	733,035
Household size	4 & below	14	10.5		29	19.0		43	15.0	
	5-8	35	26.3		32	20.9		67	23.4	
	9-12	60	45.1		56	36.6		116	40.6	
	>12	24	18.0	9	36	23.5	9	60	21.0	10
Farm size (ha)	2 & below	51	38.3		72	47.1		123	43.0	
	2.1-4.0	73	54.9		67	43.8		140	49.0	
	4.1-6.0	9	6.8	2.4	14	9.2	2.2	23	8.0	2.8
Farming experience (years)	10 & below	30	22.6		45	29.4		75	26.2	
	11-20	53	39.8		64	41.8		117	40.9	
	21-30	43	32.3		29	19.0		72	25.2	
	31-40	6	4.5		13	8.5		19	6.6	
	>40	1	.8	20	2	1.3	18	3	1.0	19
Total		**133**	**100**		**153**	**100**		**286**	**100**	

Indigenous climate change adaptation strategies used by respondents

All the respondents (100%) employed intercropping technique as a strategy to adapt to climatic change. This was closely followed by changing dates of planting (90.2%), use of firewood ash around tree (to control white root rot) (62.2%) and as well as palm kernel oil around tree (budded stump) (to control termites) (52.4%). Very few employed change of farm sizes (5.9%) and planting of tolerant clones (3.8%). The results therefore revealed that rubber farmers in the study area actually employed indigenous strategies to adapt to the effects of climate change. This is in line with the finding by Obinne (2010), who reported that Africa should build on its strengths that is, its land, local resources, indigenous plant varieties, indigenous knowledge, limited use of agrochemicals in order to attain food security and reduce the impact of climate change. Firewood ash is commonly spread around the base of rubber trees as a control measure for white root rot, which is a common rubber disease associated with heavy rains. To prevent termite attack palm kernel oil is poured around budded stumps since the oil is known by rubber farmers to repel termites. United Nations Environmental Programme (UNEP) (2008) identified dire need to apply science and technology that is environmentally friendly in the field of agricultural productivity by using sustainable agricultural practices that minimize harm to the environment and build soil fertility. The implication of this finding is that respondents with low income can cope/ adapt with the effects of climate change with little or no reduction in their output. The result agrees with Mekelle (2010) who found that most common adaptation strategies include use of different crop varieties, soil and water conservation, changing planting dates, and use of short

Table 3: Indigenous Climate Change Adaptation Strategies Used byRespondents

Strategies	Delta		Edo		Pooled	
	Freq	%	Freq	%	Freq	%
Inter-cropping	133	100.0	153	100.0	286	100.0
Changing of planting dates	120	90.2	138	90.2	258	90.2
Use of firewood ash around tree (to control white root rot)	84	63.2	94	61.4	178	62.2
Use of palm kernel oil around tree (budded stump) (to control termites)	69	51.9	81	52.9	150	52.4
Use of diesel oil around tree (budded stump) (to control termites)	42	31.6	41	26.8	83	29.0
Changing farm size	4	3.0	13	8.5	17	5.9
Planting different and more tolerant clones	6	4.5	5	3.3	11	3.8

Relationship between respondents' socio-economic characteristics and use of indigenous climate change adaptation strategies

The test of hypothesis that socio-economic characteristics of small-scale rubber farmers have no significant effect on their use of indigenous adaptation techniques to climate change was tested using probit analysis as shown in table 5.

The results show the estimated coefficients of factors affecting farmersresults were discussed as follows: The coefficient for age was positive and significant (b = 0.036) implying that the older farmers were likely to be high users of indigenous climate change adaptation strategies. It is possible that experience arising from age has made older rubber farmers appreciate the use of the indigenous adaptation strategies in coping with effects of climate change. Respondents attitude towards climate change also was positively and significantly (b = 0.221; $p<0.050$) related to their use of indigenous climate change adaptation strategies. The positive relationship means that farmers with positive attitude towards climate change were likely to be high users of indigenous climate change adaptation strategies. An explanation for this could be that farmers having a positive disposition to climate change issues are more likely to engage any efforts that will mitigate or solve the problems caused by climate change.

Awareness of climate change effects by respondents was positively and significantly (b = 0.132) related to their use indigenous climate change adaptation strategies. The positive sign implies that respondents having high level of awareness of climate change effects were likely to be higher users of indigenous climate change adaptation strategies. This is because such level of awareness will make the farmers seek for coping measures to deal or manage the harmful effects of climate change. Farm size (b = 0.102) was another significant determinant of the use of indigenous climate change adaptation strategies by respondents. Its positive sign implies that larger farm holders were more likely to be high users or make more use of indigenous climate change adaptation strategies.

Household size of the farmers was, also, a major determinant affecting their use of indigenous climate change adaptation strategies. Results shows that household size (b = 0.017) was positive signed indicating that farmers with larger families were likely to be high users of indigenous climate change adaptation strategies. An explanation for this may be that they have access to family labour and therefore do not need to pay for use of labour in carrying out some of the adaptation strategies. Giroh *et al.*(2006) reported the positive impact of household size on farmers' use of adaptation strategies. Respondents contact with extension agent (b = 0.125) had a positive and significant relationship with their use of indigenous climate change adaptation strategies. The positive sign by this study suggests that those having contact with the agents were more likely to be high users of indigenous climate change adaptation strategies. Olaniyi (2010) noted that contact with extension agents'

Table 5: Relationship between respondents' socio -economic characteristics and their use of indigenous climate change adaptation strategies (Probit analysis)

Independent variables	coefficients (b)	Z	prob. Level
Age (years)	0.036	11.032*	0.000
Sex	2.843	2.801*	0.005
Education	-0.007	-0.188	0.851
Household size	0.017	3.068*	0.002
Farm size	0.102	3.148*	0.002
Farming (rubber) experience	-0.001	-0.367	0.713
Income	0.005	0.218	0.827
Awareness of climate change effect	0.132	8.601*	0.000
Respondents' contact with extension agents	0.125	2.088*	0.037
Attitude towards climate change	0.221	9.683*	0.000
Intercept	-13.017	-11.258	0.000
Pearson Goodness-of-Fit Test (Chi-Square Tests = 1167936.376; df = 275; p<0.050)			
**Significant at the 5% (critical t = 1.96)*			

Conclusion and Recommendations:

Major indigenous climate change adaptation strategies employed by respondents included inter-cropping (100%), changing/adjusting dates of planting (90.2%), use of firewood ash to control white root rot (62.2%) and palm kernel oil around tree to control termites (52.4%). Based on the adaptation strategies used majority of the respondents were classified as high users (72%) of indigenous climate change adaptation strategies. In view of these, it was recommended that in promoting indigenous climate change adaptation strategies/techniques among small-scale rubber farmers in the study area, the local adaptation measures should be studied more closely to understand the rationale behind their utility and how they can be integrated with scientific approaches to enhance their effectiveness.

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