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AUTHORS	Funmi G. Otene Mercy Akeredolu C.P.O. Obinne Oladimeji I. Oladele

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Funmi G. Otene (Nigeria), Mercy Akeredolu (Nigeria), C.P.O. Obinne (Nigeria) and Oladimeji I. Oladele (South Africa)

Post-harvest handling of rubber coagula and constraints to use of indigenous climate change adaptation techniques by small-scale rubber farmers in Edo and Delta States of Nigeria

Abstract

This study examines post-harvest handling of rubber coagula and constraints to use of indigenous climate change adaptation techniques by small-scale rubber farmers in Edo and Delta States of Nigeria. A sub-set of the population of 63 rubber farmers in Iguoriakhi Farm Settlement, Edo State were examined for post-harvest handling of rubber coagula. Data were collected from 286 small-scale rubber producers using questionnaire and analyzed using frequency distribution, mean scores. The findings show that majority (73.33%) of respondents dispose their rubber coagula once a month to middlemen using auto coagulation means of preservation. The findings also reveal that the price of coagula per kg is N130, which is very low. The average annual income of respondents from the sale of rubber coagula is between N40,000-N50,000 which is low. Major indigenous climate change adaptation techniques employed by respondents include 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%). Major constraints to respondents' use of indigenous climate change adaptation techniques include 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 recommends that farm inputs should be made available to rubber farmers at subsidized rate and at appropriate time through a well-coordinated system.

Keywords: constraints, climate change, indigenous, adaptation, techniques, rubber farmers.
JEL Classification: Q00, Q01, Q05.

Introduction

Natural rubber is a tree that could grow up to 25 m tall and it takes 6-7 years to mature for tapping. It belongs to the family Euphorbiaceae (Abolagba et al., 2003). Aigbekaen et al. (2000) reported that natural rubber thrives well where the climate is humid with temperature ranges of 23-45°C, well-distributed rainfall of 1800 mm to 2000 mm and on a well-drained soil. Production statistics indicated that Nigeria has a total of 247,100 hectares of land under natural rubber cultivation where over 70% are owned by small-scale farmers (Delabarre and Serier, 2000; Aigbekaen et al., 2000).

According to Giroh et al. (2006), quality of rubber produce depends on the purity of the latex/coagula obtained from the rubber trees. The presence of any form of foreign body in them can adversely affect the quality of the end product which offered low price for the coagula/latex. Nakayama (1991) noted that impurities such as leaves, sticks, tree barks among others have been recovered from latex/coagula due to carelessness and unacceptable practices (deliberate adulteration) by farmers resulted to poor pricing of rubber.

The non-compliance with good quality of coagula produce by small-scale farmers resulted to the under valuation of African rubber in international market which led to a great loss in foreign earning to the continent. The setting up of African Natural Rubber Association (ANRA) in 1996 was to address the quality of the African rubber, but it is unfortunate that up till now quality of coagula produce by small-scale rubber farmers remain low quality as a result of poor handling (Mgbeje, 2005). A major factor in the quality of the coagula is the prevailing weather conditions under which the management activities were carried out. In recent times, the variability of the weather conditions has aggravated these management activities and consequently the quality of the coagula.

Climate change has been defined by the Intergovernmental Panel on Climate Change, IPCC (2001) as statistically significant variations in climate that persist for an extended period, typically decades or longer. One of the sectors most sensitive to global warming is agriculture (Zoellick, 2009). It affects agriculture, for instance, in several ways, one of which is its direct impact on food production. Besides, almost all sectors in agriculture (crop, livestock, forestry, fishery, etc.) depend on weather which variability has meant that rural farmers who implement their regular annual farm business plans risk total failure due to climate change (Ozor et al., 2010).

According to Giroh et al. (2006), natural rubber is cultivated primarily for the production of latex or coagula, which is of economic importance especially in

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Funmi G. Otene, Research Outreach Department, Rubber Research Institute of Nigeria, Nigeria.
Mercy Akeredolu, Ph.D., Winrock/SAFE, Abuja, Nigeria.
C. P. O. Obinne, Professor, Agricultural Extension and Communication Department, University of Agriculture, Nigeria.
Oladimeji I. Oladele, Professor, Department of Agricultural Economics and Extension, North West University, South Africa.

the provision of raw materials for agro-based industries for the production of rubber-based products such as tyres, surgical gloves, balloons, condoms and erasers. It serves as foreign exchange for Nigeria as a country and offers employment for it teeming population. Planted rubber (budded stumps) is grown between latitudes 15°N and 10°S where the climax vegetation is humid with temperatures ranging from 23 to 45°C 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 is a problem that can affect planted rubber (budded stumps) not to germinate (dormant, dried up), eaten up by pests and diseases (e.g., 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, survival rate of Rubber Research Institute of Nigeria RRIN-developed clones and some exotic Hevea clones in Southern Nigeria, and found that survival rate of planted rubber is very low (Giroh et al., 2010). The main objective of the study is to examine the post-harvest handling of rubber coagula and constraints to use the indigenous climate change adaptation techniques by small-scale rubber farmers. The specific objectives are to: determine the socioeconomic characteristics of small-scale rubber farmers; ascertain mode of handling of rubber coagula, determine income derived from the sales of rubber coagula and identify the problems facing rubber farmers in the production and handling of coagula; ascertain indigenous adaptation techniques used by small-scale rubber farmers for mitigating climate change and identify barriers to climate change adaptation techniques used by small-scale rubber farmers in the study.

1. Methodology

The study was conducted in Edo and Delta States, Nigeria. Edo State lies between longitudes 05° 04′ and 06° 43″ East and latitudes 05°44′ and 07° 34″ North. It is bounded to the North by Kogi State, to the South by Delta State, the West by Ondo State and the East part by Kogi State and Anambra State (Edo State 2011). Edo State has a population of 3,218,332 which approximates to 2.4% of the total population of the country (National Population Commission, 2006) and with land area of 17,802 km^2. The region lies within the rainforest zone and has a temperature range of 21-30°C with a well distributed rainfall of 2000 mm annually (Aigbekaen et al., 2000). There exists a brief dry spell in August commonly referred to as “August break”. From December to February, the dry harmattan wind blows over the state. It has ultisol soil with a pH range of 4.5-5.5 which is favorable for the production of natural rubber (Vine, 1956 in Aigbekaen et al., 2000).

Delta State lies roughly between longitudes 05° 00′ and 06° 45″ East and latitudes 05° 00′ and 06° 30″ North. It is bounded on the North by Edo State, on the North-West by Ondo State, Anambra State on the East and Rivers State on the South-East. It has a population of 4,098,391 (NPC, 2006) and with a land area of 17,698 km^2. The state has a tropical climate marked by two distinct seasons, the dry and rainy seasons. The dry season occurs between November and April, while the rainy season begins in April and last till October. There exists a brief dry spell in August commonly refereed to as “August Break”. From December to February, the dry harmattan wind blows over the State. The average annual rainfall is about 266.7 cm in the coastal areas and 190.5 cm in the extreme north. Rainfall is heaviest in July. It has a high temperature, ranging between 29°C and 44°C with average of 30°C. It has ultisol soil with pH range of 4.5-5.5 favorable for the production of natural rubber (Aigbekaen et al., 2000).

2. 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 was selected using multistage, purposive and simple random sampling techniques. However, 286 respondents 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). Primary data were generated for the study using a structured questionnaire, which was designed to capture necessary information about the research objectives. Data for this study were analyzed using both descriptive and inferential statistics. The descriptive statistics such as percentage, frequency distribution and mean were employed to analyze the objectives. A sub-set of the population of 63 rubber farmers in Iguoriakhi Farm Settlement, Edo State were examined for post-harvest handling of rubber coagula and the remaining respondents on the use of Indigenous Climate Change Adaptation Techniques.

3. Results and discussion

Table 1 shows that most respondents (39.5%) belonged to the age bracket of 51-60 years, 29% was 41 to 50 years old, 10.8% was 31-40 years while 19.2% was above 60 years of age. 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. This age condition may have implications for adoption of rubber technologies and seeking for solution on climate change effects since older persons are known to be reluctant to adoption of new technologies/ideas. Among the respondents, males constituted the majority (99.3%) whereas 0.7 percent was 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, showed that majority of the respondents (93.7%) were married. Few (2.8% and 3.5%) were respectively divorced and widowed. The predominance of married persons in rubber production implies that it is a source of livelihood for the farmers and their family, since marriage is often associated with occupational stability and responsibility. 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 respondents had a household size of 9-12 persons, 38.4% had less than 9 persons, whereas 21% had above 12 persons. The result shows that the respondents had a large household size. This implies availability of family labor for rubber production. 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, which may be considered to be small indicating that respondents were small scale rubber farmers. 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 of the rubber farmers (40.9%) 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 average farming experience was 19 years. The result showed that the farmers were experienced in rubber farming. The income distribution of the respondents (31.5%) was ₦250,001 – ₦500,000, 10.5 percent had an income of less than ₦250,001 – ₦500,000, whereas 24.5 percent had an income range of ₦ 500,001-750,000. About 11.5% earned over 1.5 million naira whereas 8 percent earned 1.1 to 1.25 million naira. The mean income was ₦733,035. For a farmer with a household size of ten to live on average income of ₦733,035 per year is low. The implication is that farmers may not have enough income to source for information particularly on climate change. This result agrees with Abolagba (1997) who noted that farmers with high income level are in a better position to afford communication facilities and therefore tend to be more informed of farm technologies and other issues such as market prices.

Table 1. Socioeconomic characteristics of respondents

Characteristics	Categories	Delta		Edo		Pooled	
		Freq	%	Freq	%	Freq	%
Age (years)	≤ 30	2	1.5	2	1.3	4	1.4
	31-40	17	12.8	14	9.2	31	10.8
	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
	Widower	5	3.8	5	3.3	10	3.5
Level of education (years)	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

Table 1 (cont.). Socioeconomic characteristics of respondents

Characteristics	Categories	Delta		Edo		Pooled	
		Freq	%	Freq	%	Freq	%
Annual income (₦)	≤ 250,000	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	21	13.7	33	11.5
Household size (number)	≤ 4	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	36	23.5	60	21.0
Farm size (ha)	≤ 2	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	14	9.2	23	8.0
Farming experience (years)	≤ 10	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	2	1.3	3	1.0

Source: Field survey, 2014.

Table 2 indicates that majority (61.67%) clean latex cups before tapping. About (93.33%) stored rubber coagula under rubber trees before sales. The implication is that the tendency for coagula to be contaminated will be high with attendant consequence of low prices. This finding is in agreement with Nakayama (1991) who noted impurities and careless handling of coagula. All respondents (100%) preserved their rubber coagula locally through auto-coagulation i.e., they leave it inside tapping cup for days. The practice is unacceptable because dirt and leaves can contaminate the latex and coagulate together. Majority (100%) of the respondents are aware that careless handling contaminates rubber coagula, quality and price.

Table 2. Percentage distribution of respondents based on handling of rubber coagula before sales

Situational factors/handling	Frequency	Percentage
Cleaning of latex cups before tapping		
Yes	18 30.00	-
No	37	61.67
No response	5 8.33	-
Storing of coagula before sales		
Under rubber trees for days	56 93.33	-
On raised bamboo bed	4 6.67	-
Local method of preserving coagula		
Yes	60	100.00
No	-	-
Means of preservation		
Auto-coagulation i.e. leave for days	60	100.00
Use of chemical (Formic acid)	-	-
Careless handling contaminate coagula		
Yes	57	95.00
No	-	-
No response	3	5.00
Careless handling reduce quality/price		
Yes	60	100.00
No	-	-

Source: Field survey, 2014.

Almost 99.33% of the respondents sold their rubber coagula once or twice a month. Majority (71.66%) of respondents sold between 91-300 kg of rubber coagula per annum. About (96.67%) sold their rubber coagula at the rate of N130 per kg. The annual income from the sales of rubber coagula by the majority (71.7%) of respondents is between N40,000 and N50,000.

Table 3. Income derived from sales of rubber coagula by respondents

Income	Frequency	Percentage
How frequent do you sell coagula		
Once a month	15	25.00
Twice a month	44	73.33
Anytime	1	1.67
Kg of coagula sold / annum		
91-200	23	38.33
201-300	20	33.33
301-400	9	15.00
401-500	8	13.33
501 and above	-	-
Current price of coagula/kg/naira		
130	58	96.67
No response	2	3.33
Income/annum/naira		
≤ 18, 999	8	13.33
19, 000-30, 999	9	15.00
31, 000-40, 999	23	38.33
41, 000-50, 999	20	33.33
51, 000 and above	-	-

Source: Field survey, 2014.

Results in Table 4 indicated that all respondents encountered labor scarcity problems (rank 1^{st}), while 98% indicated low market price (rank 2^{nd}) and 96.6% indicated inadequate capital (rank 3^{rd}) among the problems encountered in the production and handling of rubber coagula. Majority (95%) of the respondents indicated lack of loan from government as problem encountered, 93% of respondents indicated high cost/scarcity of chemical. Other problems encountered were poor infrastructure facilities (91.67%), lack of training (88%), inadequate and untimely information (83%).

Table 4. Ranking of problems encountered by respondents in the production and handling of rubber coagula

Constraints	Frequency *	Percentage	Rank order
Inadequate capital	58	96.67	3^{rd}
Lack of training	53	92.31	7^{th}
Lack of loan form government	57	90.00	4^{th}
Labour scarcity	60	100.00	1^{st}
Low yield/low market price	59	98.33	2^{nd}
High cost/scarcity of chemical	56	93.33	5^{th}
Inadequate and timely information	50	83.33	8^{th}
Poor infrastructure facilities	55	91.67	6^{th}

Notes: * Multiple responses recorded.

Table 5 revealed the indigenous climate change adaptation strategies used by the 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 findings suggest that most respondents used indigenous climate change adaptation strategies to cope with the effects of climate change on their production activities.

Table 5. Indigenous climate change adaptation strategies used by respondents

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

Source: Field survey, 2014.

Barriers to respondents' use of climate change adaptation techniques are shown in Table 6. The major constraints include 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%) and government ineptitude and unresponsiveness to climate change issues as they affect agriculture and rubber farming in particular (66.4%). Land tenure was not considered very serious as only 33.6% of the respondents identified it as a problem or barrier to use of climate change adaptation techniques. The implication of this finding is that inadequate capital limits strategies that the farmer can employ since many of these have cost implications, for example, the use of palm kernel and diesel oil. This situation is further worsened with the absence of credit facilities. Access to credit would have greatly assisted respondents to employ those adaptation strategies requiring financial investment. Where agricultural extension service is lacking, inadequate or ineffective, farmers may be limited as to the comprehensiveness of information they may receive on climate change. Sometimes information from family and friends may be highly unreliable as some authors have noted that such channels of farm information may not be held in high credibility by farmers (Deressa, 2008; Ozor et al., 2010). High cost associated with some strategies may constrain farmers' ability to use them as climate change adaptation strategies. Many of the identified strategies place a heavy demand on labor i.e. have high labor requirement. Unfortunately, hired labor may be expensive and/or sometimes unavailable thus constraining farmers' ability to use such adaptation strategies. Studies by Benhin (2006) and Ozor et al. (2010) revealed that farmers are constrained from adopting climate change adaptation strategies by several factors notably among which are limited availability of land, poor extension service delivery, small farm size, lack of access to weather information, high cost of adaptation strategies, lack of access to credit facilities, government irresponsiveness to climate change risk management, credit constraints, high cost of inputs, labor and income constraints. This implies that with all these constraints faced by farmers there may be difficulty in adapting to climate change effects.

Table 6. Barriers to respondents' use of climate change adaptation techniques

Barriers	Delta		Edo		Pooled	
	Freq	%	Freq	%	Freq*	%
Poor/low income	124	93.2	137	89.5	261	91.3
Poor infrastructure facilities	109	82.0	136	88.9	245	85.7
High cost of farm inputs	116	87.2	124	81.0	240	83.9
Poor/inadequate climate change information	91	68.4	144	94.1	235	82.2
Poor credit facilities	105	78.9	112	73.2	217	75.9
Poor/inadequate agricultural extension service delivery	92	69.2	112	73.2	204	71.3
Inadequate labor	86	64.7	116	75.8	202	70.6
Government irresponsiveness to climate change risk	95	71.4	95	62.1	190	66.4
Land tenure problem	31	23.3	65	42.5	96	33.6

Notes: *Multiple responses.
Source: Field survey, 2014.

Conclusion

Small-scale rubber farmers do not pay much attention to the quality of latex/coagula produced by them. The study also revealed that majority of farmers have not been trained in the handling and quality of latex/coagula. The study found that indigenous coping strategies exist in the study area, which farmers adopt to mitigate the harmful effects of climate change on their rubber enterprise, but there are so many barriers hindering them. The study recommends that farm inputs should be made available to rubber farmers at subsidized rate and at appropriate time through a well-coordinated system. This will help to overcome the barriers faced by the respondents. Rubber farmers should be encouraged to go into large scale rubber production by ensuring that the price of rubber is looked into by the government, so that there will be better price for their output. Also other barriers should be looked into by the government in other to promote and integrate these indigenous strategies used by the rubber farmers in the study area.

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