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# AN ASSESSMENT OF THE PERCEIVED EFFECTS OF CLIMATE CHANGE AMONG SMALL-HOLDER RUBBER FARMERS IN EDO AND DELTA STATES OF NIGERIA

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**Abstract**

The study assessed the perceived effects of climate change by small-holding rubber farmers in Edo and Delta States, Nigeria. Data were collected from 286 small-scale rubber producers using questionnaire. Data were analysed using percentages, frequency distribution, mean scores, logit regression, as well as Chi-square. Majority (73.85) of the respondents had over 10 years of experience in rubber farming. Respondents' perceived uncontrolled weeds (81.9%), increased diseases infestation e.g. white root rot (81.1%) and high intensity of early morning sun which affects latex flow (80.4%) as climate change effects. Others include reduction in latex production (low yield) (74.5%), increased pests infestation e.g. termite (73.8%), dried budded stumps (69.6%) and dormancy of budded stumps (63.6%). Respondents perception on the effects of climate change is high, this may be as a result of long time farming experience. Respondents' major source of information on climate change effects was family/friends (74.8%). Respondents' contact with extension agents was low, with 73.1% having no contact. Logit regression revealed that size of farm holdings ($\beta = 0.209$) and income ($\beta = 0.177$) were significant factors affecting rubber farmers' likelihood of being highly aware of climate change effects. However, a non-significant association (chi-square = 0.723; $p>0.050$) existed between respondents contact with extension agents and their awareness of the climate change effects suggesting the little role played by the agents in awareness creation on climate change effects. In view of these, the researcher recommended that, there is need for the extension service to target specific socio-economic groups such as farmers with small income, farmers with small farm sizes, younger rubber farmers in disseminating climate change information, while information should be communicated to farmers through channels they assess most.

**Keywords:** Assessment, Perceived effects, Climate change, Rubber farmers

**Introduction**

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. It includes shifts in the frequency and magnitude of sporadic weather events as well as the slow continuous rise in global mean surface temperature (Ozor*et al.,* 2010).

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 whose 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). The vulnerability of the developing countries like Nigeria is worsened by heavy reliance on renewable natural resources for livelihoods, employment and incomes (Obinne, 2010). Agriculture contributes about 40% to Nigeria's Gross Domestic Product (GDP) to the economy, it is the main source of food, employs 70-80% of the population and production in most of the sectors is dependent on weather and climate (Ozor, 2009). Climatic change, which is attributable to natural climate cycle and human activities has adversely affected agricultural productivity in Africa (Ziervogel*et al.,* 2006). As the planet warms, rainfall patterns shift, and extreme events such as droughts, floods, and forest fires become more frequent (Zoellick, 2009). This results in poor and unpredictable yields, thereby making farmers more vulnerable, particularly in Africa (United Nations Framework Convention on Climate Change, UNFCCC, 2007). Farmers (who constitute the bulk of the poor in Africa) face challenges of tragic crop failures, reduced agricultural productivity, increased hunger, malnutrition and diseases (Zoellick, 2009). It is projected that crop yield in Africa may fall by 10-20% by 2050 or even up to 50% due to climate change (Jones and Thornton, 2003), particularly because African agriculture is predominantly rain-fed and hence fundamentally dependent on the vagaries of weather. In Nigeria, crop production is dependent on rainfall. Even where irrigation facilities exist, irrigation water supply is directly related to even rainfall distribution pattern. Furthermore, pests and crop diseases migrate in response to climate variations (Obinne, 2010).

Planted rubberis grown between longitudes $15^0$N and $10^0$S where the climax vegetation is humid with temperatures ranging from 23 to $45^0$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 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. Butno research work is known to have been conducted on the assessment of the perceived effects of climate changeamongsmall-holding rubber farmers in Edo and Delta States.It is against this background that this study focuses on the assessment of the perceived effects of climate changeamongsmall-holdingrubber farmers in Edo and Delta States, Nigeria.

The broad objective of the study is to assess the perceived effects of climate change effects amongsmall-holding rubber farmers in Edo and Delta States, Nigeria.

The specific objectives were to:

i. describe the socio-economic characteristics of small-scale rubber farmers in the study area;
ii. ascertain small-scale rubber farmers' awareness of the effects of climate change in the study area;
iii. determine the perceived effects of climate change by the respondents in the study area;
iv. identify respondents' sources of information on the effects of climate change in the study area and
v. determine respondents' contact with extension agents on the effects of climate change in the study area.

**Hypotheses of the Study**

$Ho_1$ Socio-economic characteristics of small-scale rubber farmers have no significant effects on the awareness level of the effects of climate change in the study area.

**$Ho_2$**: There is no significant relationship between respondents' extension contact and awareness of the effects of climate change.

**Methodology**

***The study area***

The study area for this research consists of Edo and Delta States, Nigeria.

**Edo State:** 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 a land area of 17,802km$^2$. 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 this state. The major economic trees produced are rubber and oil palm. In addition, the state produces such crops as yams, cassava, rice, plantain, guinea-corn, assorted types of fruits and vegetables.

**Delta State:**Delta State has a population of 4,098,391 (NPC, 2006) and with a land area of 17,698 km$^2$ and a tropical climate marked by two distinct seasons-the dry and rainy seasons. The average annual rainfall is about 266.7 cm in the coastal areas and 190.5cm in the extreme north. Rainfall is heaviest in July. It has a high temperature, ranging between 29$^0$C and 44$^0$C with average of 30$^0$C. It has ultisol soil with pH range of 4.5 – 5.5 favourable for the production of natural rubber (Aigbekaen*et al.*, 2000). The vegetation varies from the mangrove swamps along the coast, to rain forest in the middle and Savanna in the north. Economic trees, which abound in the state, include Sapele wood, Iroko, Mahogany, Raffia palms, rubber and palm trees.

***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, namely: Obayantor, Imasabor, ObagieN'evbnosa, Uroho, Okha and Ologbo from Ikpoba-oha LGA; Errua, Iguezomo, Ugha, Igieduma, Ehor and Okeze from Uhunmwonde LGA; Iguoriakhi, Iguelaiho, Osse, Okomu, Udo and Ora-siluko from Ovia South West LGA. These three Local Government Areas are from Edo State. Other were Emuhu, Uhumunede, Mbiri, Owerri-olubor, Ute-ogbeje and Ekwuoma from Ika-North LGA; Jesse, Mosogar, Boboroku, Atighor, Oghara and Aghor from Ethiope West LGA; Issele-uku, Idumuje-unor, Idumuje-Ugboko, Ogodor,

Onitcha-Ugbo and Ugbodu from Aniocha North LGA. 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 |
| | Ethiope West | Jesse | 12 | 6 |
| | | Boboroku | 12 | 6 |
| | | Mosogar | 16 | 8 |
| | | Oghara | 24 | 12 |
| | | Aghor | 8 | 4 |
| | | Atighor | 10 | 5 |
| | | Total | 602 | 301 |

***Method of data collection***

Primary data were generated for the study using questionnaire and interview schedule. A well structured questionnaire was designed to capture necessary information about the research objectives. The information included socio-economic characteristics of respondents, awareness of the effects of climate change, perceived effects of climate change, sources of information by the respondents and contact with extension agents by the respondents in the study area.

***Method of data analysis***

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 objectives i, ii, iii, iv and v. Logit regression model was employed in testing the stated hypothesis 1 and Chi-square was also employed in testing hypothesis 2.

***Model specification***

Logit Regression Model is a probability model used to analyze the effect of several independent variables on a dichotomous dependent variable (Vasisht, 2012). It is a uni/multivariate technique which allows for estimating the probability that an event occurs or not, by predicting a binary dependent outcome from a set of independent variables. Logit analysis produces statistically sound results by allowing for the transformation of a dichotomous dependent variable to a continuous variables ranging from -∞ to +∞; the problem of out of range estimate is avoided and it assumes logistic distribution of errors in a set of data. The uniqueness of this model is that the dependent variable is dummy or dichotomous i.e. having only 2 values (Vasisht, 2012).

This model was used to test hypotheses 1 and 2. It is represented below:

$$Z = \frac{e^{a+\beta_1 X_1 + \ldots + \beta_7 X_7}}{1 + e^{a+\beta_1 X_1 + \ldots + \beta_7 X_7}}$$

Where:

Z = awareness of the effects of climate change (dummy: 1= aware, not aware = 0)

$\beta_s$ = 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).

Chi-square was used for testing hypothesis 2:

This statistic tests the association between two categorical variables.
The formula is given as:

$$\chi 2 = \sum \frac{(f_o - f_e)^2}{f_e} \text{Where:}$$

$\chi^2$ = Value of chi-square

$F_o$ = Observed frequency

$F_e$ = Expected frequency

**Results and Discussion**

***Socioeconomic 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. 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. At the state level, farmers in both States shared similar age with the average being 51 and 52 years respectively for Delta and Edo state respondents. Among the respondents, males constituted the majority (99.3%) whereas 0.7 percentwere 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. Few (2.8% and 3.5%) were respectively divorced and widowed. The proportion of married persons involved in rubber production was high for both Delta and Edo States with a percentage of 94.7% and 92.8%, respectively. 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. The proportion of those with secondary

school certificate was slightly higher for Delta(24.1%) than for Edo (20.9%) States.This can make them favourably disposed to improved technologies since education enhances the capacity of individuals to understand and work with new ideas. 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. Availability of family labour will ease rubber production, as rubber farmers will not have to spend much capital to hire labour. Banmeke and Omoregbee (2009) noted that large household size serves as an important source of farm labour supply and a strong base to adopt improved technologies so as to be able to improve productivity in order to meet up with economic needs of the family.

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 (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 average farming experience was 19 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. This implies that with such number of years in the production process, the farmers are in a better position to know about the limitations associated with traditional rubber production practices, many have noticed the harmful effects of climate change and therefore better appreciate the need to adapt and cope with these effects.

**Table 2: Socioeconomic 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** | |

### *Categorization of respondents based on awareness of climate change effects*

The farmers were categorized into two on the basis of their awareness of climate change effects (Table 3). Results showed that most (57.3%) of the farmers fell under the low

awareness category while 42.7% fell under the high awareness category. The result implies that, on the average, majority of the respondents had a low awareness of the effects of climate change on rubber production.

**Table 3: Categorization of respondents based on awareness of climate change effects**

| Awareness | Delta | | Edo | | Pooled | |
|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % |
| High awareness (Yes) | 64 | 48.1 | 58 | 37.9 | 122 | 42.7 |
| Low awareness (No) | 69 | 51.9 | 95 | 62.1 | 164 | 57.3 |
| **Total** | **133** | **100.0** | **153** | **100.0** | **286** | **100.0** |

Respondents' perceived effects of climate change on rubber production

The respondents' perceived effects of climate change on rubber production are shown in Table 4. The farmers perceived the following climate change effects: uncontrolled weeds (81.9%), increased diseases infestation e.g. white root rot (81.1%), high intensity of early morning sun which affects latex flow (80.4%). Others include reduction in latex production (low yield) (74.5%), increased pests infestation e.g. termite (73.8%), dried budded stumps (69.6%) and dormancy of budded stumps (63.6%). Respondents showed low level awareness for the following effects as being caused by climate changes: destruction of mature plantation by heavy winds (49%), stunted growth of rubber tree (45.1%), prolonged dry season (23.1%) and difficulty in predicting rainy season (20.3%). Respondents perception on the effects of climate change is high, this may be as a result of long time farming experience. A study by Oladipo (2010) showed that reduced yield of agricultural crops including delayed/reduced rainfall and short and heavy rains were perceived by farmers as a major negative impact of climate variability.

***Respondents' sources of information on climate change***

Table 5 shows the respondents sources of information on climate change. The result indicated that most respondents (74.8%) sourced their information on climate change from friends/families. This was true for both Delta (72.3%) and Edo (77.1%) states respondents. About 33.3%, 32.6% and 31.1% sourced their information from cooperative societies, RRIN extension agents and radio respectively. Few respondents sourced their information from Michelin agents (13%), TCU/ADP extension agents (9.6%), print media (2.6%) and TV(1.1%). The implication of the result is that friends/family source was the major channel of getting information on climate change by the respondents.

| Production Perceived effects | Delta Aware | | Edo Aware | | Pooled Aware | |
|---|---|---|---|---|---|---|
| | Freq* | % | Freq* | % | Freq* | % |
| Uncontrolled weed | 111 | 83.5 | 123 | 80.4 | 234 | 81.8 |
| Increased diseases infestation e.g. white root rot | 109 | 82.0 | 123 | 80.4 | 232 | 81.1 |
| High intensity of early morning sun which affects latex flow | 111 | 83.5 | 119 | 77.8 | 230 | 80.4 |
| Reduction in latex production (low yield) | 100 | 75.2 | 113 | 73.9 | 213 | 74.5 |
| Increased pests infestation e.g. termite | 107 | 80.5 | 104 | 68.0 | 211 | 73.8 |
| Dried budded stumps | 102 | 76.7 | 97 | 63.4 | 199 | 69.6 |
| Dormancy of budded stumps (i.e. not dead, not germinated) | 91 | 68.4 | 91 | 59.5 | 182 | 63.6 |
| Heavy wind destroyed mature plantation | 73 | 54.9 | 67 | 43.8 | 140 | 49.0 |
| Stunted growth of rubber tree | 64 | 48.1 | 65 | 42.5 | 129 | 45.1 |
| Prolonged dry season | 35 | 26.3 | 31 | 20.3 | 66 | 23.1 |
| Difficulty in predicting raining season unpredictable rainfall season) | 29 | 21.8 | 29 | 19.0 | 58 | 20.3 |

**Multiple responses*

**Table 5 Respondents' sources of information on climate change**

| Sources | Delta | | Edo | | Pooled | |
|---|---|---|---|---|---|---|
| | Freq* | % | Freq* | % | Freq* | % |
| Friends/family | 94 | 72.3 | 108 | 77.1 | 202 | 74.8 |
| Cooperative societies | 46 | 35.4 | 44 | 31.4 | 90 | 33.3 |
| RRIN extension agents | 44 | 33.8 | 44 | 31.4 | 88 | 32.6 |
| Radio | 39 | 30.0 | 45 | 32.1 | 84 | 31.1 |
| Michelin agents | 19 | 14.6 | 16 | 11.4 | 35 | 13.0 |
| TCU/ADP extension agents | 14 | 10.8 | 12 | 8.6 | 26 | 9.6 |
| Print media | 3 | 2.3 | 4 | 2.9 | 7 | 2.6 |
| Tv | 1 | .8 | 2 | 1.4 | 3 | 1.1 |

**Multiple responses*

***Respondents' contact with extension agents***

The respondents contact with extension agents is shown in Table 6. Most (73.1%) of the respondents had no contact with extension agents, while 26.9% of them had contact with the agents. This result was true for both Delta (72.9%) and Edo (73.2%) States, where the level of extension contact can be best described as very low indeed. This low contact with agricultural extension workers may affect the extent of farmers adoption of rubber technologies since contact with agents facilitate farmers adoption of farm innovations(Damisa*et al.*, 2014).

**Table 6: Respondents' contact with extension agents**

| Contact | Delta | | Edo | | Pooled | |
|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % |
| Yes | 36 | 27.1 | 41 | 26.8 | 77 | 26.9 |
| No | 97 | 72.9 | 112 | 73.2 | 209 | 73.1 |
| Total | 133 | 100.0 | 153 | 100.0 | 286 | 100.0 |

***Effects of respondents' socioeconomic characteristics on their awareness level of the effects of climate change***

Logit regression model was used to analyse this hypothesis. Table 7 shows the estimated parameters of socio-economic characteristics affecting the awareness of the effects of climate change by the respondents. The -2Loglihood test (Chi-square = 68.841) is significant, implying that the model with the independent variables is better at predicting the dependent variable compared to the model without independent variables. This implies that the socioeconomic characteristics of respondents significantly influenced the probability of being aware of climate change. Farm size ($\beta = 0.209$) and income ($\beta = 0.177$) were found to be factors with significant influence on the farmers' awareness status of the climate change effects at the 5 percent level of significance. The coefficient for farm size was positive ($\beta = 0.209$), indicating that farmers with larger farm holdings were more likely to be highly aware of the effects of climate change on rubber production than those with smaller farm holdings. It is possible that farmers with larger farms may be more proactive in seeking information on climate change effects or are more likely to be affected by climate change

effects hence their probability of being more highly aware.

Farm income equally was positively related to the probability of the farmers being more highly aware of climate change effects. The positive coefficient (β = 0.177) suggest that farmers with higher income were more likely to be highly aware of climate change effects than those with lower income. This could be adduced to the fact that farmers with higher income have the capital to source for information on the effects of climate change on their production activities. Abolagba (1997) 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 7: Logit Analysis for the Effects of Respondents' Socioeconomic Characteristics on their Awareness Level of Climate Change Effects**

| Parameter | Coefficient (b) | t value | Decision |
|---|---|---|---|
| Age | 0.006 | 0.644 | Not significant |
| Sex | 4.613 | 0.381 | Not significant |
| Education | -0.026 | 0.229 | Not significant |
| Household size | 0.001 | 0.041 | Not significant |
| Farm size | 0.209* | 2.006 | Significant |
| Farming(rubber) experience | -0.012 | 1.144 | Not significant |
| Income | 0.177* | 2.372 | Significant |
| Intercept | -10.518 | 0.867 | Not significant |

*-2 Log Likelihood (68.841; df = 7; p<0.001)*

*Pearson Goodness-of-Fit Test (Chi-Square Tests = 259.89; df = 278; p>0.050)*Significant at the 5% (critical t = 1.96)*

Relationship between respondents' contact with extension agents and their awareness of the effects of climate change.

Table 8 shows the relationship between respondents' contact with extension agents and their awareness of the effects of climate change. This was analysed using Chi-square statistic. The estimated chi-square value (0.723) was lower than the critical value (3.84) at the 5% level, implying that there was no significant association between contact with extension agents and farmers awareness of climate change effects. The findings suggest that extension agents played little and/or non-significant role in informing farmers of the effects of climate change effects in the study area. Studies by Damisaet al., (2014) also reported a non-significant relationship between farmers contact with extension agents and their awareness of climate change issues.

**Table 8: Relationship between respondents' extension contact and awareness level of the effects of climate change**

| Awareness status | Contact with extension agents | | | |
|---|---|---|---|---|
| | Yes | | No | |
| | Freq | % | Freq | % |
| High awareness | 36 | 46.8 | 86 | 41.1 |
| Low awareness | 41 | 53.2 | 123 | 58.9 |
| Total | 77 | 100.0 | 209 | 100.0 |

*Estimated Chi-square = 0.723; df = 1; critical chi-square = 3.84*
*Decision = Not significant*

**Conclusion and Recommendations**

Majority of the respondents had over 10 years of experience in rubber farming.The respondents perceived the following climate change effects: uncontrolled weeds (81.9%), increased diseases infestation e.g. white root rot (81.1%), high intensity of early morning sun which affects latex flow (80.4%). Others include reduction in latex production (low yield) (74.5%), increased pests infestation e.g. termite (73.8%), dried budded stumps (69.6%) and dormancy of budded stumps (63.6%). Respondents' perception on the effects of climate change is high.The size of farm holdings and income were significant factors affecting the rubber farmers' likelihood of being highly aware of climate change effects.Chi-square analysis found no significant association (chi-square = 0.723; $p>0.050$) between respondents contact with extension agents and their awareness of the climate change effects suggesting the little role played by the agents in awareness creation on climate change effects in the study area.

Based on the findings of the research, it was recommended that:

1. There is need for relevant agencies such as the ADP and other government agencies e.g. RRIN to employ the use of mass media such as television and/or radio in disseminating information on climate change effects and mitigation strategies to rubber farmers in the study area.
2. There is need for the extension service to target specific socio-economic groups such as farmers with small income, farmers with small farm sizes, younger rubber farmers in disseminating climate change information. There is need for availability of extension agents in the study area.

3. Information on climate change should be communicated to the farmers through friends and neighbours, since it is the major source of information to the farmers.

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