ANALYSIS OF COPING STRATEGIES ADOPTED AGAINST CLIMATE CHANGE BY SMALL SCALE OIL PALM FARMERS IN ABIA STATE, NIGERIA.

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ABSTRACT
This study identified and analyzed the choice of coping strategies (short term activities that farmers engage in to reduce risk and vulnerability to food insecurity and loss of income after encountering climatic and non-climatic shocks) adopted against the effects of climate change by small scale oil palm farmers and analyzed the factors affecting the choice of coping mechanisms for climate extreme events by taking the case in Abia State, Nigeria. This study adopted the multinomial logit model to analyze factors affecting the choice of coping strategies in response to climate extreme events. Results from the multinomial logit model show that different socioeconomic factors affect coping with climate extreme events. The findings revealed that the smallholder farmers in the study area practice a range of climate change coping strategies which include selling productive assets ,selling livestock and agricultural produce, borrowing from friends/ relatives, taking loans, eating less and temporary migration. House hold size, credit access and cost of coping strategies were the factors influencing adoption of coping strategies.
The paper observes that Understanding the coping strategies against climate change is vital for developing novel cultivation practices and assuring food security in the oil palm oil industry.
Keywords: coping strategies, climate change, oil palm, small scale farmers, socio economic characteristics, Abia state.

INTRODUCTION

Agriculture is extremely vulnerable to climate change, the agricultural sector in developing countries is particularly vulnerable to adversities of weather, not only because farmers are dependent on rain but because farming is subsistence oriented and is practiced not only with relatively basic knowledge but also using technologies on small pieces of land. The small holder farmers already practice farming under pressure from food insecurity, increased poverty and water scarcity (Oxfam 2010, Regassa et al., 2010).
While there is still much uncertainty surrounding the potential magnitude and likely impacts of climate change, there is consensus in the global scientific community that some climate change is already occurring and that further change is inevitable. Climate change is evident in both a change in average temperature and rainfall, as well as changes in the frequency and severity of extreme weather events, such as frosts, heat waves, droughts and floods (IPCC 2001). It is considered likely that continued greenhouse gas emissions at or above current rates will result in further global warming in this century. Moreover, even if the atmospheric concentrations of all greenhouse gases and aerosols are stabilized at 2000 levels, global temperatures are projected to continue rising (IPCC 2007).
Although informative, factors affecting the choice of any of or the combinations of coping methods were not clearly identified .Knowledge of the factors dictating the use of coping methods would assist in targeting intervention windows toward effective coping mechanisms to reduce the harmful impacts of climatic extremes.
Oil palm is scrutinized for its environmental effects, but sustainable cultivation may be possible (Samedani et al., 2015) .Reducing unnecessary expansion of plantations and ensuring existing ones are managed optimally are crucial. The large CO2 fluxes from tropical peat lands play an important role in global CC and promoting policies and strategies to manage them more sustainably is important. Mechanisms such as (1) reduced emissions from deforestation and forest degradation, plus conservation, sustainable management of forests, and enhancement
of forest carbon stocks (REDD+), (2) national greenhouse gas accounting, and (3) accurate emission factors for C dynamics are essential (Comeau et al., 2016) .
Coping with climate change is an integral part of oil palm production now and will become more important into the future as climate change become more pronounced. In developing a strategy for coping with climate change, one key challenge is dealing with uncertainty. Significant uncertainty relates to the nature and extent of climate change effects across oil palm industries and impacts over time.
The challenge for stakeholders is to deal with these uncertainties through further research and the development of policies and farm management approaches that are flexible enough to deal effectively with a range of potential climate change outcomes.
Due to the importance of Oil palm to the Nigerian economy, coping with climate change is therefore crucial. Coping strategy is widely recognized as a vital component of any policy response to climate change. Effective coping strategies need to make vulnerable people resilient, and able to return to

normal status quickly even after a major impact shock.

The negative consequences of climate change in Africa are already happening as prevalent in frequent floods, droughts and shift in marginal agricultural systems (Collier *et al*,2008) . The climate change impact on agriculture is believed to be stronger in sub-Saharan Africa Kurukulasuriya and, Mendelsohn (2007) .

In response to climatic change and variability, farm households over the years have developed different coping strategies in the aftermaths of climate change induced shock. Literature has shown that coping and adaptive capacity of people vary from region to region. They are related to changes in societal aspects such as land use and cultural practices, (Mengistu,2011) reveals that coping with climatic changes requires a combination of various individual responses at the farm-level and assumes that farmers have access to alternative practices and technologies available in their locality. The coping capacity is related to environmental changes which take into consideration aspects such as land use and cultural practices.

Many smallholder oil palm farmers in the oil palm industry in Nigeria depend on oil palm for their livelihood, yet there is little knowledge of coping measures in the light of climate change in the oil palm producing communities in the region and in Nigeria.

Moreover, studies (Ojemade ,2016 ; Enete and Amusa ; 2010; Mendelsohn and Dalfelt, 2000; Enete and Thorton,2011; Okoh *et al*,2011 ; Fonta et al,2011; Ozor and Cynthia, 2010 ; Zahid *et al*, 2010) on the science of climate change, its effects and adaptation measures have received much attention but coping strategies of oil palm farmers on climate change, in the oil palm industry are given very little or no attention. *It is in this context that oil palm farmers coping strategies merits a closer look.*

However, the impact of climate change on oil palm cannot be overlooked. It is therefore important to access oil palm farmers' current coping strategies related to climate change. This would help identify knowledge gap of oil palm farmers on climate change and help equip them with the requisite knowledge and skills on climate change and improve yields of oil palm.

Therefore, the main objective of this paper is to identify and analyze the factors affecting the choice of coping mechanisms for climate extreme events by taking the case of small scale oil palm farmers in Abia state.

Most farmers in Abia state, Nigeria are highly sensitive to variations in climatic factors most especially rainfall and temperature. Hence, the coping strategies adopted against climatic induced shocks as well as the socioeconomic factors that predisposes the farmers to adopt those strategies need detailed assessment. Thus the study has the following specific objectives; to:

i. examine the socioeconomic characteristics of oil palm farmers in the study area;

ii. ascertain the coping methods adopted by the farmers in adjusting to the impact of climate change and

iii. estimate the effect of farmers' socioeconomic characteristics on the number of coping methods adopted;

Hypothesis of the Study

The following hypothesis was tested.

Ho. Farmers' socioeconomic factors do not have any significant effect on the adoption of coping strategies against climate change .

ADAPTATION AND COPING STRATEGIES TO CLIMATE CHANGE

Farmers' short-term and long-term responses to climate variability and food insecurity can be distinguished. Short-term responses to a decline in food availability and income in abnormal years are referred to as coping or coping strategies, while longer-term or permanent changes in the ways in which food and income are acquired are referred to as adapting or adaptation strategies, after the work of Davies (1993).

Adaptation are adjustment to or interventions, which take place in order to manage the losses or take advantage of the opportunities presented by a changing climatic (IPCC, 2001)[3]. In his own contribution, Ojemade (2016) studied some adaptation strategies which include use of resistant varieties, purchase of water for irrigation (for nursery), crop diversification, migration for income, mulching, changing planting dates, planting trees and multiple intercropping.

Following Holzmann & Jorgensen, (2001) coping strategies are strategies designed to relieve the impact of the risk once it has occurred. The main forms of coping consist of individual saving/borrowing, migration, selling labor (including that of children), reduction of food intake, or the reliance on public or private transfers.

Snel and Staring (2001) use the term coping strategies to refer to all the strategically selected acts that individuals and households in a poor socioeconomic position use to restrict their expenses or earn some extra income to enable them to pay for basic necessities (food, clothing, shelter) and not fall too far below their society's level of welfare. Coping strategies are thus series of strategic acts based on a conscious assessment of alternative plans of action. Within the limited options they sometimes have, households in a poor socioeconomic position choose the plans of action that are proportionately the most useful to them. This does not necessarily mean that these plans of action always serve the purpose they were intended to serve.

METHODOLOGY

Area of study

This study was conducted in Ikwuano and Umuahia North Local Government Areas (LGAs) of Abia State Nigeria. The LGAs were purposively chosen because of intensity of oil palm cultivation. Ikwuano and Umuahia North LGAs are two of the five LGAs that constitute Umuahia Agricultural Zone of Abia State Nigeria. The LGAs are located within Latitudes 05030' N and 05040' North of the Equator and longitudes 07025' E and 07032' East of the Greenwich Meridian. Its population stood at 361,127 people who are predominantly rural farmers, of which 48.0% are females and 52.0% are males, on a land mass of about 521km2 (FRN, 2006) . Farmers that predominate these areas produce food crops such as yam, cassava, plantain, banana, vegetables and cash crops such as oil palm, and cocoa.

SAMPLING PROCEDURE AND DATA COLLECTION

A Two Stage random sampling technique was adopted in the selection of panel of farmers involved in this study. First, 4 communities each, were randomly selected from the LGAs (Ikwuano and Umuahia North), making a total of 8 communities. In the second stage, 25 oil palm-based farm households were randomly selected from each of the chosen communities giving a total sample size of two hundred (200) oil palm farm households involved in this study. The sampling frame used was provided by the Agricultural Extension Agents (EAs) of the Agricultural Development Programme (ADP) serving in the study area. Instrument of data collection was a pre-tested structured questionnaire which was administered to Oil Palm farmers across sexes and their farming households by personal interview method. However ,out of the 200 questionnaires administered, the researcher was able to retrieve information from 172 respondents representing a response rate of 86.%. The analytical technique comprised the use of descriptive statistics which was used to collect information using questionnaires administered to oil palm farmers who constituted the respondents. logit regression model was used to determine the socio economic factors which drive farmers to adopt or not to adopt coping strategies.

That is, the model is based on the cumulative logistic probability function. The probability is expressed as:

$$\text{Prob}(Y_i = 1) = F(Z_i) = \frac{1}{1 = e^{-zi}} \quad \frac{e^{zi}}{= e^{zi} + 1}$$

(Pindyck and Rubinfeld, 1976)

Note: Z_i is a theoretical or an observable variable. That is, an index not generated from the field. To obtain the value of Z_i the likelihood of observing the sample needs to be formed by introducing a dichotomous response variable Y_i such that:

$$Yi = \begin{cases} 1 \text{ if } 1^{th} \text{ farmer adopted/used coping strategies} \\ O \text{ if } i^{th} \text{ farmer did not adopt/use coping strategies} \end{cases}$$

For this study, Z_i will be expressed as

$Zi = a + b_1X_1 + b_2 X_2 + b_3X_3$----------$b_9X_9) + e$

Z_i = cumulative logistic distribution

X_i = Age (years)

X_2 = farming experience (years)

X_3 = Household size (no of people living and feeding together)

X_4 = Farm size (Ha)

X_5 = Education (years)

X_6 = Income (in naira)

X_7 = Cost of coping strategy (in naira)

X_8 = contact with extension agent/company agents/other agents

(Number of visit to farmers in the last 1 year)

X_9 =Access to credit (1 if the farmer has access to credit, 0 otherwise)

$b_1 - b_9$ = regression coefficients

e = constant term

RESULTS AND DISCUSSION

Descriptive analysis of socio-economic characteristics of respondents

The results of the descriptive analysis (Table 1) reveal that 74.7% of respondents were within 40-59 years of age. The mean age of the oil famers was 49 years. Farmer's in the study area were within the economically active age of below 60 years while the mean farming experience was 15 years. Farmers in the study area were very experienced in the actual practice of oil palm farming. The mean farm size was 3.2 hectares. According to Awoke and Okorji (2004) small holder farmers produce on a small scale, subsistence level, and cultivate less than five hectares of land annually on the average. The result below shows differences in income levels of respondents and shows that highest proportion (80.8%) of farmers earned below N300, 000, 5.2% earned more than,N600,000 per annum. The above result of inequality in income levels has implications for vulnerability, adaptive capacity and coping with climate change. More than half (95.35%) of the respondents received not more than six extension visits during the 2016 farming season, implying that more than half of the respondents had very low extension contact. According to the Food and Agriculture Organization (FAO) recommendation, farmers are expected to receive at least one extension visit every week during a farming season, which translates to a minimum of 15 extension contacts in a farming season.

Table 1: Socio-economic Characteristics of Respondents.

Variables	Abia (n=172)
Age (Years)	
30 – 39	24 (14.0)
40 – 49	62 (36.0)
50 – 59	66 (38.4)
60 – 69	19 (11.0)
70 – 79	1 (0.6)
Mean	49 years
Gender Distribution	
Female (0)	82 (47.7)
Male (1)	90 (52.3)
Marital Status	
Single (0)	22 (12.8)
Married (1)	90 (52.3)
Widow (2)	17 (9.9)
Widower (3)	2 (1.2)
Divorced (4)	41 (23.8)
Educational status	
No formal education	48 (27.9)
Primary school	61 (35.5)
Secondary school	41 (23.8)
Tertiary school	22 (12.8)
Mode	Primary school
Household size	
2 – 4	7 (4.1)
5 – 7	45 (26.2)
8 – 10	66 (38.4)
11 – 13	38 (22.1)
14 – 16	16 (9.3)
Farming experience	
1-5	10 (5.8)
6-10	17 (9.9)
11-15	56 (32.6)
16-20	54(31.4)
21-25	24(13.9)
26-30	6(3.5)
41-45	5(2.9)
Annual Income(N)	
< 300,000	139(80.8)
300,001-600,000	9 (5.2)
600,001-900,000	0(0.0)
> 900,000	0(0.0)
Missing	24 (13.9)
Extension visit	
<3	119 (69.19)
4-6	45 (26.16
7-9	5 (2.91)
>9	3 (1.74)

Figures in parenthesis ( ) are percentages
Source: Author survey data, 2016

CHOICE OF COPING STARATEGIES

For this study, the identified coping strategies used in the study area include:

(1) selling productive assets,
(2) selling livestock and agricultural products,
(3) temporarily or permanently migrating,
(4) Taking loans
(5) Borrowing from relatives/ friends
(6) Eating less

Table 2. ADOPTION AND NON ADOPTION OF CLIMATE CHANGE COPING STRATEGIES BY RESPONDENTS.

	Did not adopt coping methods		Adopted coping methods	
	Frequency	%	Frequency	%
selling productive assets	89	51.7	83	48.3
selling livestock and agricultural products	152	88.3	20	11.6
Borrowing from relatives	93	54.1	79	45.9
Taking loans	139	80.8	33	19.2
Eating less	13	7.6	159	92.4
Temporary migration	73	42.4	99	57.6

Source: Field Survey Data, 2016

Coping Methods Adopted by Farmers against climate change effects

The coping measures adopted by farm households to deal with low food and income availability (due to impacts of climate change on their livelihood activities) are shown in table 2, results show that 92.4% ate less. This finding agree with that of Edeh and Gyimah-Brempong (2015) , Mayanja *et al.* (2015) who observed that food security coping strategies utilised in Nigeria involved forms of dietary changes, limit portion size at meal times, and reduce number of meals eaten in a day and food rationing strategies. Few farmers (19.2%) took loans, this could be because oil palm farmers seeking credit to mitigate these impacts would be unable to do so due to financial exclusiveness. About 51.7% of farmers did not sell productive assets to cope with climate change effects. It is possible these farmers did not have productive assets like dividends that serve the key purpose of increase in cash flow to counter the impacts of climate shocks. Few farmers (11.6%) sold livestock probably because they had no alternative livelihood options and economic opportunities such as pastry and soap making.

Most of the farmers (54.1%) did not borrow from friends, relatives. This may be attributed to the fact that Low endowment households will not borrow and invest in capital until its return in expected utility terms is equal to the cost of borrowing.

57.6% of farmers migrated temporarily. Reasons for this might be that Migration in search of alternative livelihoods has partly been driven by unreliable rainfall and increasing incidence of dry spells and drought in the communities. Many farmers indicated that temporary migration for jobs is a crucial coping measure.

Effect of Farmers' Socioeconomic Factors on the Number of Coping Strategies Adopted

The socioeconomic variables of the farmers were examined to isolate those which could enhance increased number of coping strategies adopted by the farmers against the consequences of climate factor variations. Multiple Regression Analysis was applied as the analytical tool. The number of coping strategies adopted by the farmers formed the dependent variable while the various socioeconomic factors of the farmers were the independent variables. The multiple regression equation was run in four functional forms of linear, semilog, double log and exponential forms as previously explained. The lead equation was chosen on the basis of the magnitude of the coefficient.

Multiple regression analysis was done to determine the relationship between coping strategies and income. Three (3) functional forms were tested to determine the best-fit model. The linear function was selected based on the adjusted R square value, significance of explanatory variables, standard error, expected signs of coefficients and F-ratio.

4.1 SOCIO-ECONOMIC CHARACTERISTIC OF FARMERS AND THEIR LIKELIHOOD OF ADOPTING/ USING CLIMATE CHANGE COPING STRATEGIES

The socio-economic characteristics included in the study were age, farming experience, household size, farm size, education, contact with extension agent, cost of strategies, credit access and income.

Table 4:13: **Maximum likelihood estimates of the logit model**

Independent variables	Coefficient (B)	S.E	Odd Ratio	t value
Age	-0.008	0.040	0.992	0.200
Farming experience	0.090	0.059	1.094	1.525
Household size	-0.954	0.324	0.385	2.949*
Farm size	0.019	0.113	1.019	0.168
Education	0.204	0.409	1.225	0.499
Contact in extension agent	0.209	0.238	1.232	0.878
Income	0.005	0.011	1.005	0.455
Cost of coping strategies	-0.058	0.019	0.945	3.000*
Credit access	-0.233	0.093	1.205	2.513*
Constant	-2.097	3.539	0.123	0.593

Model chi square = 33.681
Pseudo R^2 = 0.462
Nagelkerke R square = 0.462
* Significant at 5% (tabulated t = 1. 860)
Source: computed from field survey data, 2016

Table 4:13 show the relationship between socio-economic characteristics of the farmers and their likelihood of coping strategies against climate change impacts. The model X^2 ($X^{2=}$ 33.68) shows that the model is significant at the 5% level since it is greater than the tabulated X^2 (3.84). The pseudo R2 (0.462) indicates that about 46.2% of the variation in coping strategies used by farmers is explained by the independent variables in the equation.

The odd ratio for age of farmers (0.99) suggests that older farmers are 0.99 times less likely to adopt coping strategies than younger farmers. The implication is that the farmers ability to use coping strategies decreases with age. The reason for this is not difficult to ascertain. Typically, younger farmers are more willing to take more risk than older farmers, which is consistent with findings of Asiabaka, Morse, and Kenyon (2001)], Igben (1988) and Olomola (1988). More so, oil palm production is highly laborious (Eseigbe et al, 2007), requiring a lot of energy, strength and stamina (Ighere 2002). Similarly the odd ratio for household size (0.385) suggests that farmers with large household size are 0.38 times less likely to use coping strategies against climate change effects than farmers with small household size. This implies that the larger the household size, the fewer are the number of household members involved in oil palm production, which resulted in less use of coping strategies. It is possible that where household size was in abundance, use of coping strategy might decrease since it would no longer be cost effective to use it. The result is significant at 5% level since computed t (2.94) is greater than tabulated t (1.860).

The odd ratio for farm size (1.019) is positive and suggests that farmers with large farm size are 1.02 times more likely to use coping strategies than those with smaller farm size. These results are in consonance with the findings of Nnadozie (2016).

The odd ratio for education (1.22) is positive and means that farmers with higher education are 1.2 times more likely to adopt coping strategies than those with lower education. This implies that education is an important determinant of farmers' adoption behavior. The more educational opportunities a farmer has experienced, the more likely she/he is to look for new information. This means that an educated farmer has the capacity to adopt more strategies to deal with variations in climatic factors. The results are in consonance with the findings of Asiabaka and Owens (2002) , Ekwe and Nwachukwu (2006), Njoku (1991)[33] who observed that education had a positive influence on the use of the technology. Nnadi and Akwiwu (2005) stated that educated farmers excel in their adoption/use of innovations.

The odd ratio for contact with extension agents (village extension agents) (1.23) is positive and means that farmers with frequent more contact with extent agents are 1.2 time more likely to adopt more coping strategies than those with less frequent contacts. These findings are consistent with earlier studies (Basabrain, 1983; Obinne and Anyanwu, 1991), which found that contact with extension agents was positively and significantly related to adoption.

However, the odd ratio for cost of coping strategies (0.94) suggests that strategies /innovations that are costly/ expensive are 0.94 times less likely to be adopted by the oil palm farmers. In other words costly coping strategies reduce the farmer's tendency to adopt such innovations. This lends credence to the findings of Ewuola (1995) who noted that adoption is synonymous to transfer of technology and that for adoption to take place, it must embrace input support advice and other essentials so that the farmer will

have no reason for rejecting the technology. Consequently, the technologies that require few assets, have a lower risk premium, and are less expensive have a higher chance of being adopted by smallholder farmers (Muzari, Gatsi, & Muvhunzi, 2012).

Also the conditional odds for income (1.005) suggest the oil farmers with higher income are likely to adopt the coping strategies than those with less income. These findings are consistent with earlier studies (Olayide; 1980 and Okoye, 1989) who reported that most agricultural technologies were too expensive to acquire and that the income of farmer were low in Nigeria, which might limit their extent of adoption.

Moreso, Shiferaw and Holden (1998) explained that while wealth is believed to reflect past achievement of households and their capability to tolerate risks, thus, households with higher income and greater assets are in a better position to adopt new farming technologies and strategies, non-farm income increased the likelihood of animal rearing and petty trading where there is a certain degree of outcome assurance.

The odd ratio for credit access (1.205) suggests that farmers are 1.205 times less likely to adopt coping strategies than farmers with access. The implication is that the farmer's ability to use coping strategies decreases with credit access. It is possible the farmers did not engage in famer credit schemes that are friendly and also had constraints such as high interest rate, no collateral, lack of land title.

In their own contribution, Muzari *et al*.,2012 observed that access to credit has been found to be gender biased in some countries where female headed households are discriminated against by credit institutions and as such they are unable to finance yield raising technologies leading to low adoption rates.

Credit to farmers from this study does not enable them purchase the needed inputs required for oil palm production hence its negative influence on farmer's use of coping measures. Access to credit therefore has no impact on the farmer's decision to cope with climate change shocks.

Three of the nine independent variables included in model where found to be significant. These included household size, credit access and cost of coping strategies which where both significant at 5% level of probability. The signs of both the three significant parameters, where consistent with a priori expectation.

CONCLUSION

Farmers in Abia state have developed strategies to cope with the aftermath of climate change induced shocks. Rural communities across the developing world use various coping strategies in response to poverty, food insecurity, conflict as well as environmental stresses; all challenges which are compounded by climate change and variability.

Farmers' socioeconomic factors affect the number of these strategies adopted amongst which are household size, access to credit and cost of coping strategies.

The assessment of coping strategies adopted by Oil palm farmers to sustain adverse effect imposed on oil palm production by climate change will be to formulate policies that enhance coping strategies as tool for managing a variety risks associated with climate change and it also provides information that increases the capacity of farmers to survive external shocks or changes.

Coping with climate change is an integral part of oil palm production now and will become more important into the future as the impacts of climate change become more evident. In developing a strategy for coping with climate change, one key challenge is dealing with uncertainty. Significant uncertainty relates to the nature and extent of regional climate change impacts, impacts across the oil palm industries, and impacts over time.

The challenge for governments and oil palm industry stakeholders is to deal with these uncertainties through further research and the development of policies and farm management approaches that are flexible enough to deal effectively with a range of potential climate change outcomes.

1. The study therefore recommends that farmers with large household's size should all be encouraged to be actively involved in adoption of coping measures since large household's size can provide labour at the least cost.
2. High cost of coping strategies reduced the farmer's tendency to adopt the strategies. Consequently, the provision of credit to farmers would help in adoption of these coping strategies. Farmers should engage in credit schemes that are friendly to enable easy access to credit to boost oil palm production since coping strategies may be depend on input (fertilizer, tractor, labour) availability. Inputs can easily be sourced if the farmer has access to credit. Policy makers should improve small holder credit schemes to enable small holder farmers have a wider spectrum to access credit
3. There is need to focus on government research and extension goals on how to improve on the low level of use of the coping measures by the farmers. Technological inputs for coping with climate change induced shocks must be made available and at subsidized rate, bearing in mind, that you are dealing with predominantly poverty stricken resource farmers.

Coping strategies should be adopted while encouraging high adoption of the strategies which have not been highly adopted. These should be done in search of new innovations for reducing climate change effects on oil palm production which in the long run increase profits for farmers in the study area.

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