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Determinants of small-holder farmers' adaptation to climate change in a Nigerian coastal settlement of Oron

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Abstract
The study investigated the determinants of small holder farmers' decisions to adopt climate variability measures in Oron, a Nigerian coastal settlement. Ideally, the study sought to establish the influence of farmers' socio-economic characteristics on their choice of climate variability mitigation measures. The study hypothesized that farmers' socio-economic characteristics such as gender, education, age, household size, marital status, income level, exposure to information on climate change, access to credit and farming experience all positively influence farmers' decisions to adapt to climate change. The study used cross sectional data collected between December 2020 and January 2021 farming season through the administration of 200 structured questionnaires to 8 randomly selected farming communities based on probability proportional to size. The data was complemented by information obtained through focus group discussions, and direct field observations. The results of the Stepwise Regression Model revealed that education, non-farm income, farming experience, access to climate information and credit facilities significantly influence farmers' decisions to adapt to climate change mitigation measures in the study area as these variables accounted for 36%, 21.23%, 13.42% and 9.49% respectively. This leads to the suggestion that there is need for the establishment of adult literacy programme in the farming communities as means of improving the literacy levels of the farmers as well as the need for government to develop and strengthen institutional mechanisms that support the farmers to adapt to climate change/variability through increase access to credit from micro finance institutions and other formal channels.

Keywords: stepwise regression, climate variability, socio-economic factors and smallholder farmers

Introduction

Agriculture is the most important sector in Sub-Saharan Africa (SSA) and is said to be severely impacted by climate change. This has been confirmed by several studies (Deressa 2006; Moussa *et al*. 2006; Jain 2006; Hassan *et al*. 2008; Molua *et al*. 2006; and Mano *et al*, 2006) [4, 18, 12, 11, 16, 17] which established significant effects of climate change on agricultural development. Climate change according to the Intergovernmental Panel on Climate Change (IPCC) report of 2007 represents one of the greatest threats facing the earth. Climate change is the result of many factors including the dynamic processes of the earth itself, external forces including variations in sunlight intensity and more recently human activities or anthropogenic factors (Seiz and Foppa (2007) [24]. Steinfeld (2006) [26] identified the most anthropogenic factors that induce climate change include increase carbon dioxide (CO_2) level due to emissions from fossil fuels and combustion followed by aerosols, cement manufacture, ozone layer depletion, animal, agriculture and deforestation. The UNFCC (2007) [29] defines climate change as a change of climate which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere and, which are in addition to natural climate variability observed over comparable time periods. In most situations, climate change is used to cover anthropogenic activities which lead to an increase in emissions of greenhouse gases thereby causing global warming (Amos, Akpan and Ogunjobi, 2014).

Climate change manifests in variations in different climatic parameters such as cloud cover, precipitation, temperature ranges, sea levels and vapor pressure (Ministry of Environment of the Federal Republic of Nigeria (MoEFRN, 2003). This manifestation contributes to the rise in ocean level and affects many coastal countries (Garg, Skukla and Kapshe, 2007). Incidences of climate change include changes in soil moisture, soil quantity, crop resilience and timing/length of growing seasons, yield of crops and animals, atmospheric temperatures, weed insurgence, flooding, unprecedented droughts, sea level, spread of virus among others. A projection of increase in rainfall accompanied with increases in cloudiness and rainfall intensity, particularly severe storms, in humid regions of southern Nigeria where this study is carried out has been established by Adeyanju and Esin (2013). Climate change hazards mostly affect the poor, destroying homes and livelihoods and affecting participation in development process itself. In both developed and developing societies, these hazards lead to food and water shortages and disease outbreaks (Tjaronda, 2007) among other effects/impacts.

Small holder farmers' have been observed to be the most vulnerable to climate change impacts such as desertification, coastal erosion, deforestation, loss of forest quality, sea level rise, woodland degradation, reduced fresh water availability, coral bleaching, the spread of malaria and dengue fever and impacts on food security. This is so because small holder farmers' are heavily dependent on the ecosystem services and therefore most severely affected by deteriorating environmental conditions. Study has shown that in the Southern Nigeria, the Atlantic Ocean is threatening coastal cities particularly the Niger Delta, while increased storms and floods have degenerated agriculture, infrastructure and human habitat in the East (Eze, 2008) [8]. Offor (2008) [20] identified a declining rainfall in the Nigerian Sahel savanna since the 1960s resulting in the loss of farmlands, and conflicts between herdsmen and farmers over land resource. The attendants' risks associated with climate change impacts thus calls for the urgent need to evolve effective adaptation measures to curtail the effects of changing climate conditions.

Generally, adaptation entails anticipating the adverse effects of climate change and taking appropriate action to prevent or lessen the damage they can cause, or taking advantage of opportunities that may arise. According to Kitano (2002) [14] adaptation is the process of responding or adjusting to actual and potential impacts of changing climate conditions in ways that moderate harm or take advantage of any positive opportunities that climate may afford. It includes policies and measures to reduce exposure to climate variability and extremes and the strengthening of adaptive capacity. It is discovered that well-planned and early adaptation action has the propensity of saving money and lives later. Local adaptation strategies represent those practices and knowledge which local people in various regions have developed over the years, through indigenous knowledge systems (IKS) which have enabled them to adapt and mitigate extensively from climate extremities (Nyong, Adesina and Elasha, 2007) which vary from population to population and region to region and, are thus 'location-specific'.

Adaptation enables the small holder farmers' to live or cope with the social and physical impacts of climate change. For example, local farmers now delay their planting in order to reduce crop failure (Kelbessa, 2008). According to BNRCC report 2008, while ruthless mitigation activities are critical to tempering the progression of climate change, science shows that the volume of heat-trapping gases already emitted into the atmosphere has sufficient potentials to provoke climate change for decades to come. In other words, climate change and its many impacts will persist for some time. However, anticipating and adapting to climate change impacts in order to minimize their attendants human and environmental cost is a significant challenge for Nigeria and other most vulnerable countries.

Adaptation is defensible when the approaches taken to lessen climate change impacts are holistically appropriate to the prevailing conditions and can serve for a reasonable time period. Adaptation measures comprise all forms of activities including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of climate change or climate-induced hazards.

Although climate change may affect the agricultural sectors of different countries in different scales, what is clear is that these changes will result in considerable welfare losses, especially for smallholder farmers whose main source of livelihood is dependent on rain-fed agriculture. To avert the adverse effects of climate change on agriculture, there is a need for countries to develop policies towards control. Adaptation seems to be the most efficient way for farmers to reduce the negative impacts of climate change (Füssel *et al*. 2006), which can be achieved by the smallholder farmers' themselves taking adaptive actions or by governments executing programs designed at stimulating appropriate and effective adaptation measures. Central to the development of adaptation policies is the need for the government to identify the factors influencing the choice of specific adaptation measures by the small-holder farmers. In choosing specific adaptation measure, there is a need to understand the drivers of adaptation, particularly amongst smallholder farmers' who are more vulnerable and sensitive to the adverse impact of climate change. Such knowledge will help in designing policies that enhance farmers' adaptive capacity in order to ensure sustainability of food security of the farmers. Against this background, this study investigates the determinants' of small-holder farmers' choice of specific climate change adaptation measures in Oron LGA, of Akwa Ibom State. Specifically, the study is designed to ascertain the level of smallholder farmers' awareness of climate change, determine their knowledge of the perceived causes of climate change and establish the socio-economic factors influencing the farmers' choice of specific adaptation measures in the study area.

Materials and Methods

The Study Area

The study was carried out in Oron Local Government Area of Akwa Ibom State. The Local Government Area is located at appropriately between latitudes $4°46^{1}$-$4°52^{1}$ North and Longitudes $8°12^{1}$-$8°18^{1}$ East with a landmass of about 309.27km^2. Oron LGA is a coastal settlement that is located at the right bank estuary of the Cross River close to the Atlantic Ocean. It is both a river port with a ferry or packet station, linking Calabar and other rivers and coastal ports in the region and the Cameroun and Equatorial Guinea outside Nigeria. It also forms a terminus for roads linking important towns in the mainland – Uyo, Eket and Ikot Abasi. Oron LGA is bounded by Okobo LGA in the North West by Urueoffong/Oruko Mbo and Udung Uko LGA in the South and South-West respectively. To the East and the South-East, it is bounded by the Cross River, close to the Atlantic Ocean. The LGA is situated in the coastal areas of Akwa Ibom State with gentle rolling coastal plain sands typified by sedimentary basin formation of largely unconsolidated deposits. Rainfall is heavy and last about 10 months in the year. The LGA has two different seasons, namely; wet and dry seasons. The wet seasons last for about 10 –

11 months. The wet seasons start about February – March and last till mid – November. The raining seasons are also characterized by the little dry spell, which occurs about two weeks in August. The rate of development in the LGA is indeed very tremendous. Own LGA is made up of four clans with 17 gazetted villages. The economy of the LGA is predominantly dominated by farming and fishing. Although the inhabitants are also engaged in petty trading and production, farming and fishing still remain the most important and primary occupation of the people as other activities are carried out on part time basis.

Methods of Data Collection

Data for the study were collected through interview guided by the use of structured questionnaire. This was complemented by data obtained through focus group discussions, in-depth interviews and direct observation. Focus group discussions (FGDs) were employed to bring together all the farming households in the selected communities. Each focus group consisted of 5 farming head of households'. Effort was made to ensure that the focus group discussions were as representative as possible, while particular attention was paid to gender representation and age differential. The study population covers all the farming household heads in the study area. Through a random sampling technique, 200 respondents were drawn from ten farming communities (Esuk oro, Esin Ufot, Udung Okung, Eyusotai, Udung Ulo, Udung Ekung, Ukpata, Eyetong, Uya-oro and Ine-Edekekpu) proportionally to their population size. Multi-stage sampling technique was employed in selecting the representative respondents. The first stage was the purposive selection of ten (10) farming communities noted for large scale farming in the study area, while the second stage involves the simple random selection of 200 farming head of households in the selected communities. The study interviewed only heads of households, but where relevant information could not be provided by the head of households (assumed to be the decision-maker), their spouse or other household members were asked to provide such information.

Earlier research findings have shown that logit models are the most suitable econometric models to apply to the evaluation of qualitative dependent variables that have dichotomous groups (i.e. 'adapted' and 'not adapted') while the independent variables are categorical, continuous and dummy ((Long and Freese, 2006). These models are commonly and widely used since they guarantee that the estimated probability increases lie within the range of 0 to 1 and display a sigmoid curve conforming to the theory of adoption. Contrarily, the Step-wise Regression Model was employed in analyzing the data generated for this study. The justification for its application rest in the fact that it is possible to select the independent variables that are most correlated with the dependent variable. The second most important variable is entered next into the analysis. This procedure continues in this stepwise manner, entering at each stage the "best" independent variable in terms of ability to reduce the remaining unexpected variance. Only the independent variable that significantly accounts for or contributes to reduction of the total unexplained variance were chosen while others were dropped.

Definition of Model Variables

The choice of independent variables employed in the study is influenced by literature reviewed on factors that influence farmers' decisions to adapt to climate change, previous research findings and the knowledge about adaptation to climate change in the study area. From the questionnaire administered, nine factors (independent variables) that determine farmers' choice of climate change mitigation measures in the study area were identified. These variables were used in the stepwise regression procedure and include:

X_1 = (education of the household head)**.** This is the number of years spent by the head of the household acquiring education. The variable was in four categories coded 1 if the farmer had not attained primary education, 2 if the farmer attained primary education 3 if he/she reached secondary education and 4 if the farmer attained tertiary education.

X_2 = (*Farm household size)***.** Farm household size is measured by the number of members in a household. The variable is continuous.

X_3 = (*Age of the household head).* These are the number of years of the household head and the variable is continuous.

X_4 = (*Non- farm income).* This is income derived from activities that are not associated with farming. Examples include piece jobs, retailing, earnings from relatives and earnings from formal jobs among others.

X_5 = *Access to credit (cred).* This *increases and rekindles the income potential of the farming households which in turns enhances their capacity to adopt climate change mitigation measures.* Examples include access to financial institutions such commercial banks/micro-finance banks, Cooperative Society, Individual money lenders, Thrift (Osusu) and Relatives.

X_6 = (*Exposure to information on climate change).* This variable measures the farmer's awareness to climate change information. Sources of information include media weather reports from the Department of Meteorological Service, extension officers and social networks such as farm to farm extension among others.

X_7 = (*Farm size).* Farm size is the total landholding of farming household. This variable is measured in hectares. The bigger the farm size, the more likely the farmer is to adopt suitable strategies. The variable will be continuous recording the number of hectares of the farm.

X_8 = (*Soil fertility).* Soil fertility includes the soil quality on the farm where the farmer carries out his/her farming activities. Poor soil fertility is hypothesized to increase the probability of a farmer to make conservation decisions in order to adapt to climate change and vice versa. This is a dummy variable taking values 1 if the soil is fertile and 0 otherwise.

X_9 = (*Farming experience).* Farming experience is the total number of years the household head has spent making farming decisions and the variable is continuous.

Results and Discussions

Table 1: Demographic Data of the Sampled Respondent.

Gender	No of Respondent	Percentage
Male	89	44.5
Female	111	55.5
Total	200	100
Age distribution		
15-21	1	0.5
22-35	10	5
36-60	77	38.5
61 and above	112	56
Total	200	100
Duration of stay		
1-20 years	9	4.5
21-40 years	139	69.5
41-60 years	45	22.5
60 years and above	7	3.5
Total	200	100
Duration of farming		
1-20 years	26	13
21-40 years	139	69.5
41-60 years	35	17.5
60 years and above	----	-----
Total	200	100
Educational qualification		
Formal education	19	9.5
Primary school completed	24	12
Primary school incomplete	56	28
Secondary school completed	45	22.5
Secondary school incomplete	11	5.5
Tertiary school completed	40	20
Tertiary school incomplete	4	2
Total	200	100

Source: Fieldwork (2021)

The demographic characteristics of the respondents such as occupation, duration of stay in the village, duration of farming, and educational qualifications play a significant role in determining the knowledge of climate change as well as the possible adaptation measures they employed. Table 1 show that in all the ten (10) villages sampled, majority (55.5%) of the respondents are females while 44.5% are males. Studies have shown that women are more likely to view potential environmental hazards as more risky than male (Forthergill, 1996) and are generally more vulnerable to climate change (Dankelman, 2002) [3]. That considerable percentages of the household heads are females suggests that they are more likely to perceive risk from climate change. The dominance of female-headed households in the study area is due to the fact that the culture of the people annexes farming activities to womenfolk with men playing supportive roles. This confirmed findings by Taylor (1985) in his study of 74 developing countries which indicates that women now head over 20percent of the household in Africa and the Caribbean, and 15percent of those in Latin America and the Middle East. The figures are much higher in Kenya, Botswana, Ghana and Sierra Leone where about 50percent of the households are headed by women.

Virtually 94% of the respondents were aged 35 years above (Table 1) which constitutes the focal target group for the study. This is so because farming/fishing in the study area are solely carried out by the elderly; which indicates a dearth of youths in the sampled villages. This is mostly likely due to out-migration to urban centers in search of livelihoods leaving behind aged women/men to contend with the adaptation challenge of climate change risk. The absence of youthful population in the sampled villages will, to a very large extent, limit the capacity of the small holder farmers' to adapt to climate change risks especially in terms of the application of indigenous practices that are often times laborious in the mitigation of climate variation challenges. Literacy and schooling are important indicators of the quality of life as well as being key determinants of rural households' ability to better comprehend their culture and other social factors as reflected in their understanding and interpretation of information received from the surrounding environment and transforming same into

physiological awareness. It is revealed in Table 1 that majority (62%) of the respondents had formal education which is very important in developing climate change adaptation measures. The relatively high literacy level among the small holder farmers' is a positive factor that should be exploited in their choice of specific adaptation measures and in formulating policies and programs for adaptation to climate change threats and for harnessing indigenous knowledge practices for climate change adaptation, especially in terms of environmental education campaigns and awareness. Based on IPCC definition of climate change as changes in climate variable that persist for an extended period, typically decades or longer (Solomon, Quin, Manning, Chen, Marguis and Averyt, 2007), it is assumed in this study that small holder farmers' who have lived and engaged in farming activities in the study area for decades would be more likely to observe changes in climate variables, especially changes in the onset and end of the raining season among others. Table 1 shows that majority of the sampled small holder farmers' have lived in the study area and engaged in farming for over 20 years. Specifically, about 95percent of the small holder farmers' have lived and engaged in farming in the study area for over 20 years, which suggests that they are likely to have noticed changes in climate variables in the study area which could influenced their choice of climate change specific adaptation measures.

Level of Climate Change Awareness

A number of questions concerning climate change were asked using the small holder farmers' questionnaire complemented by issues raised during the focus group discussions in order to expound the farmers' understanding of climate change. Majority of the participants in the focus group discussions and respondents' in the small holder farmers' questionnaires consistently agreed that though they had never heard of climate change, they were however, aware of changes in climate variables and pattern. This corroborates the affirmation of the Southern African Catholic Bishops' Conference (SACBC) (2010) [25] that most Africans are aware that weather and climate patterns are changing but their understanding of global climate change is limited and with findings by Enujeke and Ofuoku (2012) [7] who argued that one of the greatest limitation to climate change adaptation in Africa is lack of climate information. It could, however, be said that although the small holder farmers' had never heard about climate change, they did understand the concept, recognizing that there were changes in their local climate which they point to myths and superstition. The awareness of climate change has been documented in a finding by Ozor, *et al*. (2010) [21] who observed that most farmers in Southern Nigeria are aware of climate change issues. Awareness of climate change will enable farmers to prepare themselves to adapt to the status quo by evolving numerous strategies to cope with the attendant adverse impacts of climate variation within their locality.

On the level of awareness of climate change by the small holder farmers', both participants in the focus group discussion and respondents in the small holder farmers' questionnaires totally displayed a high level of climate change awareness as they all agreed that wide-ranging climate and ecological changes had occurred over the period that they have lived in the locality. Some noted that the changes centered on rainfall and temperature variability, using the significant changes in the length of the average rainy seasons, which usually start from March/April and ends on November in their locality to buttress their position. This shows that many farmers in the rural area have observed that there are noticeable changes in climate pattern but they do not know much about the drivers. The sampled respondents in the focus group discussion were further unanimous in their observation that rainfall pattern had changed considerable with notable increased in the amount of precipitation in the study area. They pointed out further that the rainfall pattern and the seasons had become unpredictable. The widely held belief among the participants in the focus group discussion is that the rainfall amount has increased significantly, which has impacted negatively on their socio-economic wellbeing as several expanse of their farmlands are made vulnerable to flooding with attendant decrease in crop yield. This validates the position of Aklilu (2007) [1] that information about climate change in Africa is still confined within the academia and research institutes and as a result many local farmers though aware of it, lack sufficient knowledge about it.

The farmers' also noted that floods which result from increase in the amount and duration of rainfall have continued to pose a serious threat to lives and property in addition to crop production in the study area exposing the locality to high risks of submergence. Flooding is also known to cause leaching of nutrients far away from plants' roots which will lead to low crop yields (Offor, 2001) and could as well cause erosion which reduces soil fertility and crop yields (BNRCC, 2008).

Besides the evidence of increase rainfall amount and duration, there is also the issue of increasing temperatures which the farmers' associated with increased heat wave or stress which is detrimental to humans and agricultural production generally. The small holder farmers' asserted that increase temperature in the study area enhances the spread of vector borne diseases in the locality and the higher night-time temperatures observable in recent time could adversely affect grain formation and other aspects of crop development asides increasing the rate of evapo-transpiration which leads to excessive water loss in plants and also lowers soil moisture levels. Variations in rainfall pattern and temperature intensity have as well been observed to be the major cause of year-to-year fluctuations in production in both developed and developing countries. According to FAO (1996) the largest reduction in cereal production will occur in developing countries averaging about 10%. A projected 2-3% reduction in African cereal production for 2020 is enough to put 10 million people at risk. Unpredictable rainfall pattern has adversely affected agricultural production in developing countries. Owing to lack or inadequate weather forecast techniques, farmers can hardly predict the start and end of rains and as a result become muddled on the best time to cultivate. The implication of the aforesaid is that since the small holder farmers' have

considerable knowledge of climate change with its attendants risk on their livelihood and socio-economic wellbeing, they will likely develop and use adaptation strategies which would enable them to cope with the vagaries of changing climate and weather pattern.

Adaptation Strategies to Climate Change

Table 2: Climate Change Adaptive Measures Employed by Small Holder Farmers'

Adaptive measures	Ranking
Planting deeper into the soil to avoid heat stress	18
Changing variety of crop planted	5
Changing in timing of planting	2
Planting cover crops	4
Planting on molds and ridges	9
Irrigation and digging of wells	12
Use of land augmented inputs	8
Terracing/sand filling	15
Planting and use of wood bricks	13
Planting and use of shed trees	7
Roof harvesting	19
Planting early maturing seedlings	3
Crop rotation	6
Changing harvesting dates	14
Use of climate information	10
Planting of resistant crop varieties	1
Adaptation of new techniques	11
Use of drainage systems	16
Increased land area	17

Source: *fieldwork (2021)*

Data in Table 2 show that the most important local adaptation measures to climate change adopted by the small holder farmers' in the study area included: planting of resistant crop varieties (1), changing in timing of planting (2), planting early maturing seedlings (3), planting cover crops (4), changing variety of crop planted (5), crop rotation (6), planting and use of shed trees (7), use of land augmented inputs (8), planting on molds and ridges (9) and the Use of climate information (10) among others.

Determinants of Small Holder Farmers' Choice of Adaptation Strategies

Table 3: Zero Order Correction between the Independent Variables Employed

Variables	1	2	3	4	5	6	7	8	9
Education	1.00	0.510	0.452	0.613	0.356	0.721	-0.822	-0753	-0.815
Farm Household Size		1.00	0.842	0.711	0.501	0.643	-0.713	-0.620	-0.701
Age of Household Head			1.00	0.624	0.512	0.735	-0.631	-0.572	-0.659
Non- Farm Income				1.00	0.871	0.621	-0.552	-0.471	-0.520
Access to Credit					1.00	0.487	0.391	-0.514	0.313
Access to Climate Information						1.00	0.664	-0.221	0.572
Farm Size							1.00	-0.543	0.413
Soil Fertility								1.00	0.681
Farming Experience									1.00
	0.861	0.732	0.544	0.693	-0.356	-0.632	0.534	0.420	

Source: Data Analysis (2021)

Table 4: Result of Stepwise Multiple Regression Model

Independent Variable	Specification	Regression Coefficient	Standard Error	R^2%	R^2% Increase	T-value
1	Educ	251,64130	35,09057	43.21	36.01	9.101
4	Nfinco	898,79633	217,6821	60.33	21.23	7.482
9	Fexp	743,42371	29,66513	68.56	13.42	7.009
6	Inforc	63,76415	32,43621	78.12	9.49	4.573
3	agehh	6867071	330,03162	85.42	6.26	4.940
5	Accdt	431,2000	3074,0110	98.20	2.14	4.356

*Significant at the 1 percent level

Source: Researchers Fieldwork (2021)

Table 5: Test for Significance of the Variance Regression Model

Variation Due	Sum of Square	Mean Square	DF	CF	R^2%
Regression	437765283.731	734693252.620	5	297.52	0.961
Residual	8562720.747	520671.50	6.01		

*Significant at 0.01 level

Source: Researchers Data Analysis (2021)

Table 2 shows that of all the variables included in the analysis, only six variables significantly contribute to the explanation of the determinants of the choice of climate change adaptive strategies by the sampled households. The strongest and of course the most important variable is the level of educational attainment of the heads of the farming households. The variable explains 36% of the variation in terms of the magnitude of the adaptation methods employed by the sampled households. This implies that education is very fundamental to farmers' choice of climate change adaptation techniques. This corroborates findings by Sarker, et.al (2008) [23] and Prager and Posthumus (2010) that adoption of climate change mitigation measures depends on education as well as physical factors of the land and institutional factors, this is contrary to Maddison (2006) [15] findings that education diminishes the probability that no adaptation is taken.

The second most important variable is farming experience. This variable has a positive co-efficient of 13.42% explanation to the determinants of the smallholder adaptation to climate change in the study area. What this suggests is that the more experienced the farmer is, the more he/she is better informed about temperature and precipitation changes and the more he/she is likely to employ adaptation measures that reduce the impact of climate change on his/her agricultural activities. This informed the assertion by Hassan and Nhemachena (2008) [11] that it is farming experience that matters more than merely the age of the farmer when it comes to adaptation to climate change while Studies by Maddison (2006) [15] and Hassan and Nhemachena (2007) indicate that more farming experience increases the probability of a farmer adapting to climate change. The third most significant variable as revealed by the results of the analysis is non-farming income. The variable significantly contributed 21.23% to the explanation of the determinants of smallholder farmers' adoption of climate change mitigation measures. The variable has surprisingly a positive co-efficient which enhances our understanding of the link between the impacts of non-farm income on smallholder farmers' adoption of climate change mitigation measures. This is so because adaptation to climate change requires sufficient financial well- being (Deressa *et al*, 2009) - as higher income farmers may be less averse to the negative externalities pose by climate change. The effect of non-farm income is to boost the farmer's financial resources and hence his/her ability to adopt new and better technologies.

The co-efficient for access to climate information dummy variable is also statistically significant. It however, accounts for 9.49%. Therefore, there is a positive relationship between access to climate information and the choice of climate change mitigation strategies in the coastal settlement of Oron. This is explained by the fact that access to climate information influences the farmers' awareness to changes in climate which creates opportunities for the farmer to adopt suitable strategies that best suit the changed climatic conditions, aside providing the farmer with information about the agricultural adaptation practices that are most suitable to their farms. Thus exposure to such information increases the farmer's awareness of the best possible adaptation options available to the smallholder farmers. This confirms findings by Hassan and Nhemachena (2007), who noted that access to information about climate change forecasting, adaptation options and other agricultural activities remain important factors determining use of various adaptation strategies.

The result of the analysis also indicates that the age of the farm household heads play significant impact in farmers' adaptation to climate change. This variable contributes 6.26% explanation to the determinants of adaptation to climate change impacts by the smallholder farmers. Contrary to the negative relationship between age of farming head of households and adoption of climate change mitigation measures found by (2009) and Hassan and Nhemachena, (2009), Deressa *et al.* (2010) established a positive relationship between these variables. This is so because age of the household head represents experience in farming; the older the farmer, the more experienced he/she is in farming and the more he or she is exposed to past and present climatic conditions over longer horizons of his/her life spans. These findings further re-consolidate the efficacy of the regression analysis result with respect to the determinants of climate change adaptation methods by the farming households.

The analysis also unfolds the significance of access to credit facilities as determinants of climate change adaptation strategies by the smallholder farmers'. This variable accounts for 2.14% explanation to the variables entered in the analysis. Access to credit easies the financial constraints faced by the farmer, while the availability of credit enhances the probability of a farmer to adapt strategies that reduce the negative impact of climate change as the farmer will be in a position to finance adoption of new technologies such as improved crop variety, improve seedings and fertilizer. Findings by Gbetibouo (2009) [10], Deressa *et al* (2009) and Fosu- Mensah *et al* (2010) [9] show that access to credit significantly influences the farmer to adapt to climate change.

The third analysis in the regression model involves the testing of the overall significance of the five variable models, as shown in Table 3. These six variables collectively explain about 96% of the variation in the relationship between climate change and the smallholder farmers choice of adaptation methods (R^2=96.1%). Hence, the variation in the choice of climate change adaptation methods among the sampled population is

significantly influenced by the farmers' educational attainment, non-farm income, farming experience, access to climate information, age of the farming heads of households and access to credit facilities.

Conclusion/Recommendation

The study has revealed that education, non-farm income, farming experience, access to climate information and credit facilities significantly influence farmers' decisions to adapt to climate change mitigation measures in the study area as these variables accounted for 36%, 21.23%, 13.42% and 9.49% respectively. This leads to the suggestion that there is need for the establishment of adult literacy programme in the farming communities as means of improving the literacy levels of the farmers as well as the need for government to develop and strengthen institutional mechanisms that support the farmers to adapt to climate change/variability through increase access to credit from micro finance institutions and other formal channels.

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