CLIMATE SMART ACTIONS (CSA) AQUACULTURE, AGROFORESTRY AND RESOURCES MANAGEMENT

GLOBAL ISSUES & LOCAL PERSPECTIVES

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PUPLISHED BY:

Society for Agriculture, Environmental Resources & Management (SAEREM)

SAEREM BOOK CHAPTERS First published 2026-- ISBN 978-978-60709-1-6@ SAEREM World

CLIMATE SMART ACTIONS (CSA) AQUACULTURE, AGROFORESTRY AND RESOURCES MANAGEMENT-- ISBN 978-978-60709-1-6

First published 2026

SAEREM World

Nigeria

Typeset in Times New Roman

CLIMATE SMART ACTIONS (CSA) AQUACULTURE, AGROFORESTRY AND RESOURCES MANAGEMENT--- ISBN 978-978-60709-1-6

Global Issues & Local Perspectives

Printed at: SAEREM World

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Preface

This book adopts an exegetical approach as well as a pedagogic model, making it attractive agriculture and environmental economics teachers, professional practitioners and scholars. It is eschews pedantry and lays bars the issues in such clarity that conduces to learning. The book elaborates on contemporaneous **Climate smart actions (CSA) aquaculture, agroforestry and resources management** issues of global significance and at the same time, is mindful of local or national perspectives making it appealing both to international and national interests. The book explores the ways in which **Climate smart actions (CSA) aquaculture, agroforestry and resources management** issues are and should be presented to increase the public's stock of knowledge, increase awareness about burning issues and empower the scholars and public to engage in the participatory dialogue **Climate smart actions (CSA) aquaculture, agroforestry and resources management** necessary in policy making process that will stimulate increase in food production and environmental sustainability. **Climate smart actions (CSA) aquaculture, agroforestry and resources management :** *Global Issues & Local Perspectives* is organized in three parts. Part One deals with The Concept of **Climate smart actions (CSA)**, Part Two is concerned with The Concept of **aquaculture,** and Part Three deals with the Concept of **agroforestry and resources management**

Eteyen Nyong; March 2026

Chapter 3:

Determinants of Climate Change Adaptation among Arable Crop Farmers in Akwa Ibom State, Nigeria

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1.1 INTRODUCTION

Agriculture plays important role in shaping the economy of many countries. In Nigeria, it is the highest employer of labor and serves as a major means of livelihood covering 70% of its population (World Bank, 2001). Agriculture provides over 90% of the food consumed locally and contributes 40% of the Gross Domestic Product (GDP) of Nigeria (Ozor, 2009). However, it is a major source of household income and provides raw materials for agro-based industries (Oluigbo, 2012). Agriculture enhances food security and impacts on the overall economic growth of the country. It also provides feed for domestic animals and most of its by-products are of economic importance. Although the agricultural sector is being transformed by commercialization at the small, medium and large scale enterprise levels, the country is still faced with a number of problems in which addition to these; climate and weather patterns have been changing. (Ziervogel G., A. Nyong, B. Osman, C. Conde, S. Cortes, and T. Dowing, 2006) observed in their studies that Climate change, which is attributable to the natural climate cycle and human activities, has adversely affected agricultural productivity in Africa.

According to (Nwafor 2007; Jagtap 2007), climate change is global, likewise its impacts; but the most adverse effects will be felt mainly by developing countries especially those in Africa, due to their low level of adaptation strategies and capabilities, Nigeria seems to be one of these developing countries that is involved. Agriculture places heavy burden on the environment in the process of providing humanity with food and fiber, while climate is the primary one of the determinant of agricultural productivity. A clear understanding of climate change is of critical importance in arable crop production because agricultural production in developing countries are climate dependent, this is because the impacts of climate change on agriculture could be devastating in many areas and subsequently tends to be an additional challenge couple with the poverty related problems faced the farmers. Many regions already feel these impacts, which will

get progressively more severe as mean temperatures rise and the climate becomes more variable. (Pearce *et al*. 1996, McCarthy *et. al* 2001) in their studies indicated that Africa's agriculture is negatively affected by climate change.

According to Intergovernmental Panel on Climate Change (IPCC) (2001; 2007) climate change is the average weather conditions of a given place over time. The classical period is 30 years as defined by the World Metrological Organization (WMO). Climate encompasses the statistics of temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric partial count and other metrological elemental measurement in a given region. On the other hand, climate change is a significant and lasting change in the statistical distribution of weather patterns over period ranging from decades to millions of years (Wikipedia, 2010).

Climate change and Agriculture are inter-related processes, both of which take place on a global scale.

Adaptation helps farmers achieve their food, income and livelihood security objectives in the face of changing climatic and socioeconomic conditions, including climate variability, extreme weather conditions such as droughts and floods, and volatile short-term changes in local and large-scale market (Kandlinkar and Risbey, 2000). In this perspective, Farmers therefore have the ability to reduce the potential damage by making tactical responses to these changes. Analyzing adaptation strategies is therefore important for finding ways to help farmers adapt in the rural economies. Some strategies that serve as an important form of insurance against rainfall variability are: increasing diversification by planting crops that are drought tolerant and/or resistant to temperature stresses; taking full advantage of the available water and making efficient use of it; and growing a variety of crops on the same plot or on different plots, thus reducing the risk of complete crop failure since different crops are affected differently by climate events. These strategies can also be used to modify the length of the growing season, for instance by using the additional water from irrigation and water conservation techniques (R. Hassan and C. Nhemachena, 2008).

Arable crops happens to be those crops in which the life cycle is within one year; from germination to seed production and maturity, examples are; yam, maize, cocoyam, cassava, and many others. The increase in food prices and food insecurity in various homes is connected with the challenges facing arable crop production in the rural areas.

Arable farming or farming as the case may be is subjected to various challenges ranging from scarcity of land and poor soil fertility, natural hazards, soil degradation, pests and diseases infestation, variations in rainfall and temperature, among others. Climate change has been observed to have serious direct impact on agricultural production, because of the climate-dependent nature of agricultural production systems (Enete et al., 2011). These has made climate change adaptation to become a popular agenda in research, policy making and program development in Africa as many people are becoming more aware that climate change is a real threat destabilizing social and ecological sustainability (Palmmah Gutu 2014). In agriculture it is essential that governments engage in adaptation efforts focused on implementing measures that help build resilience to adverse effects of climate change variability and disaster (Nelson 2009; Feyissa 2007). Africa's quest for sustainable development depends heavily on the ability to adopt proper adaptation strategies that are aimed at mitigating the impacts of climate change (Palmmah Gutu 2014). In Nigeria, increased agricultural production is the primary source for rural poverty alleviation. This is true due to the fact that adequate and normal weather condition is required for crop production in the tropics. However, almost every home derives satisfaction from the use of arable crops produce.

Sowunmi and Akintola (2010) in their studies observed that the decline in crop yield and food production could be attributed to reduction or changes in rainfall, increased temperature, increased relative humidity, among others which are agents of climate requires that farmers to perceive the changes in the prevailing climatic conditions and then identify useful mitigation practices or strategies. On this note, climate change adaptation practice has to do with those practices that will lead adjustments in the natural

or human activities in response to the actual or expected climatic changes and their effects which could cause harm or exploit the beneficial opportunities by the rural farmers (Efe, 2011).

Hence, this study is set to investigate the determinants of climate change adaptation among arable crop farmers in rural areas in Ikot Ekpene local government area, Akwa Ibom State, Nigeria.

1.2 Statement of the Problem

Adaptation to climate change entails the adjustments in the natural or anthropogenic activities in response to the actual or expected climatic changes and their effects which could cause harm or exploit the economic opportunities by the rural farmers (Efe, 2011). It has been predicted that the resultant increase in temperature due to climate change will accelerate physiological development resulting in hastened maturation and reduced yield. Growing seasons are expected to become shorter as temperature increases. It has also been noted that food production in Africa could half by 2020 (IPCC, 2007).

Nigeria is an Agrarian Economy with 75% small farmers accounting for the nation's agricultural output making arable crop farmers to depend largely on rainfall for high level of productivity. According to Sha, Fischer and van Velthuizen (2009) the adverse consequences of climate change will take an irreplaceable toll on food production and food security especially in developing countries which have a low capacity to cope and adapt to these challenges. Temidayo Gabriel Apata (2009) also asserted that climate change in the form of higher temperature, reduced rainfall and increased rainfall variability reduces crop yield and threatens food security in low income and agriculture-based economies like Nigeria. Evidence from Schlenker and Roberts (2009) confirmed the effects of climate change on farm net revenue in different parts of the globe through rainfall and temperature variability.

Observable determinants of adaptation also provide some evidence that institutional and social economic factors play an important part in allowing farmers to adapt. It may also be attributed that access to credit is associated with the decision to adapt. However, it appears that the type of credit affects the

propensity to adapt. Whereas informal credit is negatively related to the probability of adapting, formal credit is positively correlated with the probability of adaptation (Ashley Gorstet.al 2018). This underlines the need for a greater reach of formal credit.

In Ikot Ekpene local government area, effort have been made by small scale farmers to adapt to the changing climate but since it is at a local level, it seems unorganized and influenced by a set of factors. It therefore needs well integrated and holistic approach to the entire system of agriculture. The production of arable such as crops cassava, yam, maize, cocoyam, etc are declining drastically due to the effect of climate change in the rural area which could be seen physically through indiscriminate delayed rainfall, high temperature, infestation of pest and diseases and couple with other constraints such as low income level of the farmers, lack of credit facilities and many others. The researcher at this point was aimed at digging deep to find the determinants of climate change adaptation among arable crop farmers in the study area. The Broad Objective of the study was to analyze the determinants of climate change adaptation among arable crops in Ikot Ekpene local government area, Akwa Ibom State, Nigeria.The Specific Objectives of the study were to: identify the socio-economic characteristics of arable crop farmers in the study area.; identify farmers level of awareness of climate change issues;; examine the effect of climate change on crop production in the study area;; identify the degree of effectiveness of the adaptation measures used by the farmers;; identify the constraints to adaptation measures.

The importance of agricultural sector of any economy cannot be over emphasized as food security is a major issue in developing the economy of any Nation. Food security helps to promote self-sufficiency, healthy and efficient labor force. Considering the role played by agriculture in the country, which serves as a means of livelihood and source of income, the effect of climate change on the sector cannot be over looked. The effects of climate change require efficient adaptive measures in other to sustain crop production in the near future.

According to (Albert, Harry and Ishikaku, 2012) an adaptive strategy to climate change is human preventive or intervention methods used with the sole aim of reducing the direct effect of increase in greenhouse gases on agriculture. Adaption measures deals with the impacts of climate change and have the objective of reducing the vulnerability of human and natural system.

This study is expected to provide data/ information on the determinant of climate change adaptation among arable crop farmers in Ikot Ekpene local government area, Akwa Ibom State, Nigeria. Moreover, these would provide am empirical guide for the identification of the any gap that may exist in the current agronomic practices employed and the intervention that is required towards more sustainable development in the study area. Furthermore, it is hoped that the result of the study will serve as a guide for agricultural policy makers and the state Government to formulate policies that will help farmers with efficient adaptive measures and improve arable crop production in general. It is also expected that the result of the study will help the Federal Government formulate climate change policies for different agro-ecological zones of the country.

2.1 Concept of Climate Change

Agriculture seems not to be successful without the inclusion of climate change. These terms are mostly used inter-changeably due to fact that agriculture depends fundamentally on weather. So far, negative impacts have been felt adversely by some part of the world as a result of increasing severe weather patterns. The term climate change was proposed by the world meteorological organization in 1966 to encompass all forms of climatic variability on time-scale longer than 10 year, bit regardless of causes. During the 1970s, the term climate change replaced climate change to focus on anthropogenic causes, as it became clear that human activity had a potential to drastically alter the climate. Climate change occurs when changes in the global system result in new weather pattern that usually last for a few decades and probably for a million of years. There are five interacting parts that make up the climate system; they include

atmosphere air, hydrosphere water, cryosphere ice and permafrost, biosphere living things and lithosphere earth's crust and upper mantle. The climate system derives its energy predominantly form the sun and a very little from the internal earth cavity. There is a balance between the incoming energy and the outgoing energy which determines the earth's energy budget. When the incoming energy is greater than the outgoing energy, the earth's energy budget is positive and the climate system is warming, but if the energy is going out o the system, the earth's energy budget is negative and the earth is experiencing cooling weather (Wikipedia).

The Intergovernmental Panel on Climate Change (IPCC) (2007) defines climate change as statistically significant variations 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 The World Bank (2008) asserts that climate change is a long term change in the statistical distribution of weather patterns over periods of time ranging from decades to millions of years. This might be changes in weather conditions or changes in distribution of weather events with respect to an average either of a specific region or may occur across the whole earth. It is usually as a result of natural factors, natural processing and human activities. According to Food and Agricultural Organization FAO (2006) Climate change refers to any significant change in the measures of climate change lasting for an extended period in time. This includes the changes in temperature, precipitation and wind patterns among other factors that occur several decades or longer.

2.2.1 Nature of Climate Change

(Fredrick and Schwarz, 2000), opined that in European countries climate change has lead to temperature rises, shift in rainfall patterns, a rise in sea level, hazardous events such as floods and droughts. According to the Action Aid International (AAI) (2006) Climate change is likely to result in high frequency of drought and floods that is likely to challenge farmers eroding their

assets leaving them more vulnerable. Climate change is likely to cause hotter days and more frequent and larger heat waves. It might result in extreme events such as decrease in availability of fresh water and food, interact with health care services and also an enhancement of disease spreads as a result of increased rainfall and temperatures (Kelly and Adger, 2000). Changing climatic conditions cause high temperature, unpredictable rainfall pattern, floods, desert encroachment, excessive drought and depletion of the ozone layer by greenhouse gases. These events have tended to reduce agricultural production, hence affecting the means of livelihood of farmers, (Nkeme K. K, Onyia, C. C. and Ekereuke, H. E).

2.2.2 Climate Change and Agriculture

Ifeanyi-obi (2011) described climate change as a canker worm eating up the efforts made by farmers in Agricultural sector to enhance Agricultural productivity. According to her, the devastating effects of climate change on agricultural productivity are very significant and as such cannot be neglected. It has been estimated that 70% of the world population rely on rain fed agriculture FAO, (2010). According to Kurukulasuriya and Rosental (2003), changes in temperature and rainfall will result in adverse changes in land and water systems that is likely to affect agriculture production. Climate change effects are heterogeneous and region specific. According to Parry et al (2007) climate variability directly affects agriculture production, as agriculture is inherently sensitive and is one of the most vulnerable sectors to the impacts of global climate change.

According to IPCC (2007) agriculture is considered vulnerable to climate change due to its negative effect on agriculture which in turn worsens the conditions for rural famers. Moreover; this is because they lack assets and adequate insurance to combat the effects. In the short run the effects of climate change on agriculture such as carbon dioxide fertilization of plants could contribute to increasing

production and security. However, in the long run climate change is likely to increase water stress, reduce biodiversity, damage ecosystem and increase social conflicts due to increased competition of resources (IPCC 2007). The increase in temperature as a result of climate change will make agriculture inactive and fertile lands less productive and even make some completely barren (Rosenzweign and Solecki, 2010).

According to IPCC (2001) poorest countries, mostly tropical and sub tropical regions would experience a decrease in crop yield due to decreased water availability, new and changed pest incidence. A 50% decrease in rain fed yield of crops such expected in Pakistan, UKMO, Africa and Latin America. Most crops are at its maximum temperature tolerance thus a slight climate change is likely to result in a sharp decrease with an estimation of up to 31% in the 21C.

An increase in temperature has been found to decrease yield and quality of many crops. A decrease in precipitation will affect the semi arid and arid an area in a negative way as there is a decrease in soil moisture but in areas with excess water agriculture is improved (Mano and Nhemachena, 2006). Climate change has also brought about seed varieties that are more resistant to harsh weather conditions and short season varieties allowing for arable crop production to be cultivated all seasons.

2.2.3 Climate Change and Livelihood

According to the United Nations Joint Press Kit for Bali Climate change Conference (2007), climate change is likely to cause;

- an increase in hunger and malnutrition affecting the vulnerable and food insecure,
- New patterns of pests and diseases will emerge;

- Human plants and livestock will be exposed to new pests and diseases that will flourish only at specific temperatures and humidity, posing new risk for food security, food safety and healthy.

The IPCC (2007) also contributed that malaria in particular is expected to change its distribution as a result of climate change.

Shaw, Mendelsohn and Nordhaus, (2007) pointed out that climate change has an effect on the four dimensions of food security**;** availability, stability access and utilization.

- Availability takes into account direct impacts on the yield through crop, pests and disease, soil fertility and holding properties. Indirectly it affects the economic growth, income distribution and agricultural demand.
- Stability point of view focus is placed on the effects of consistent supply of yields and food supplies. Climate change is likely to affect supplies of yields with fluctuating supplies of yield and food supplies.

Climate change is likely to indirectly affect the physical, economic and social access to food. As agricultural production decreases food prices rise and purchasing power decreases (Rosenzweig and Parry, 2005). In this case food security is prone to kiosk, thereby strangling the economic growth of the country (Palmmah Gutu, 2014).

According to IPCC, 2017 climate change has led to environmental hazards to human health, weather patterns and biodiversity. Food borne diseases, water borne and animal diseases are likely to emerge at a rapid pace due to the changes in climatic conditions (Kumar and Parikhl, 2001). Floods may lead to the overflow from sewage treatment plants into fresh water reserves. It is believed that a greater percentage of the population is urbanized thus a majority of the nations' population is affected. As

temperature increases a range of ticks breeding is promoted and they later expand leading to Lyme disease in animals (Palmmah Gutu, 2014).

Maddison (2007) asserts that extreme climate changes lead to floods, droughts and earthquakes thus destroying infrastructure such as hospitals, schools, roads to mention but a few, this would affect the economic performance of the country an increased mortality rate an increased expenditure on the government as buildings need to be restored.

2.2.4 Climate Change and Adaptation

Adaptation to climate change should be prioritized by African governments as it is the only way to cushion the effects of climate change on food production (International Food Policy Research Institute, 2009). FAO (2011) indicated that to protect livelihood and food security in developing countries adaptation is a key requirement even under moderate climate change.

Although climate change adaptation has been proved to being key effective, numerous factors have been identified as barriers to adaptation. (Reidsma, Ewert, Lansink and Leemans 2009) elaborates that adaptation to climate change depends on technical and economic factors, farmers' attitude and the political framework. Choice of adaptation to a certain strategy depends on the variable positively or negatively affecting a particular adaptation strategy. For a developing country like Nigeria to obtain accurate scientific data, securing funding for agriculture, main streaming adaptation into existing work and communicating nature of the problem depends on the ability of the government and famer inter-relationship so as to perceive the need for climate change adaptation. To cope with the effects of climate changes farmers have adapted to irrigation, drought resistant seed varieties, shifting to other crops, conservation agriculture preserving both soil and water, dry and early planting, varying planting dates and others do nothing (Boko, Niang, Vogel, Githeko, Medany, Osmanelasha and Yanda, 2007).

2.3 Measuring the Impact

Adams and McCarl (2001) opined that in order to access the impact of climate change on agriculture, models can be used which include; Production function, Agronomic Economic Model (AEM), Agronomic Ecological Zone Model (AEZM), Ricardian cross-section Model (RM), Computable General Equilibrium model (CGE) and the Multinomial logit regression models. But more emphasis will be laid on multinomial logit regression model, as it pertains to the main objective of the study.

2.4 Theoretical Framework

The Ricardian Model is theoretically embedded in the theory of economic postulated by David Ricardo (1815) however, is application to climate change land value analysis drawn extensively from the work of Mendelsohn et al, (2000) examines how climate change in different places affects the net revenue and value of land. According to Soe and Mendelsohn (2006a) the model accounts for direct impacts of climate change on yield of different crops as well as indirect substitution of different input of different activities and other potential adoption by farmers to different climates. The Ricardian Model has an advantage in that it can incorporate changes that farmers would make to adapt in order to combat effects of climate change such as copying strategies (Mendelsohn et al, 2000). But however, the Ricardian model is criticized in that it is not subject to controlled experiments, it also does not take into account for future change in technology and policies. It assumes a constant price which is unrealistic since prices do change in the real world market and if these changes are significant enough they can invalidate the prediction of the model built on constant price (Mendelsohn, 2008) The model fails to account effects of factors that vary across space (Hassan 2008) and also does not recognize the fertilization effects of increased carbon dioxide (Maddison, 2006; Mendelsohn, 2008 and Kurukulasuriya and Rosenthal, 2006). Some crops might benefit from abundance of carbon dioxide and larger growing season. Ignoring such effects may cause an overestimation of climate change impacts.

Ricardian models or hedonic pricing models are used to answer the questions: What is the economic impact of climate change, and in some cases, how is this reduced by adaptation? Hedonic pricing models are used to isolate the price effects of various characteristics, for example, the amount a nearby green space increases the value of a home. For this project, Ricardian analysis would be used to quantify the costs of climate change through lower land values. Farm land values are used to estimate the long-term economic impacts of different climate conditions than those observed in the past.

This technique is derived from the writing of David Ricardo (1817), who stated that "net land value is equal to net productivity". The hedonic pricing technique assumes that land owners will maximize the productivity of their land and the price paid for a piece of land is equal to its productive capacity. The value of land is decomposed into its various components by regressing the price of land on historical climate data, land characteristics and agriculturally significant historical events. For example, the price of land without irrigation may be lower than land with irrigation. The hedonic pricing technique isolates the effect of irrigation on land price, holding all other characteristics fixed. Alternative regression approaches use farmer profits or net revenue in lieu of land values. Land values are then calculated from profits: they are assumed to be equal to the present discounted stream of rental rates. In other words, land values are the discounted sum of future profits from the use of the land. This technique assumes that farmers are actively adapting to climate change and findings are therefore net of autonomous adaptations. As a result, Ricardian models can be used to assess what would happen in the absence of a government intervention. Adaptations can be difficult to include in these models because they rely on historical information. In analysis of agriculture technology adoption Multinomial Probit (MNP) and Multinomial Logit (MNL) models are commonly used. According to Gujarati (2004) multivariate models are normally used when numbers of choices available to the household are more than two. They allow explaining of combination of choices and take care of self selection and interactions between alternatives. When there is more than one step in decision of choosing a

technique then there is need to use models like Heckmans two step models. The MNP assumes the minimum utility using a certain adoption model subject to given factors.

The MNL model has an advantage that it assumes that farmer maximizes perceived utility using a certain adoption model subject to given factors. It also assumes independent from Irrelevant Alterations (IIA) such as the choice of adding a strategy does not change relative probability of existing models. The model seem appropriate for the study as the number of adaptation strategies are more than two and allows explanation of combination choice made by the farmer. The MNL model has an advantage that it assumes that farmer maximizes perceived utility using a certain adoption model subject to given factors. It also assumes independent from Irrelevant Alterations (IIA) such as the choice of adding a strategy does not change relative probability of existing models. The model seem appropriate for the study as the number of adaptation strategies are more than two and allows explanation of combination choice made by the farmer.

Apata, Ogunyinka, Sanusi, & Ogunwande (2010) reported that the MNL is commonly used in adoption studies involving multiple choices because of its importance in analyzing farmers' adaptation decisions, which are usually jointly made, as well as appropriate, in evaluating alternative combinations of adaptation strategies, including individual strategies. The model operates on the assumption that the rural farmers face a set of discrete, mutually exclusive choices of adaptation measures. Tse (1987) reported that the model has computational simplicity in calculating the choice probabilities that are expressible in analytical form. In addition, the computational burden of the MNL specification is made easier by its likelihood function, which is globally concave (Hausman & McFadden, 1984).

However, the main limitation of this model is the Independence of Irrelevant Alternatives (IIA) property, which states that the ratios of the probabilities of choosing any two alternatives is independent of attributes of any other alternative in the choice set (Hausman & McFadden, 1984; Hassan & Nhemachena, 2008). This is however solved by making each ratio of probabilities a function of the attributes of all the alternatives (Apata et al., 2010). The parameter estimates of the MNL model only indicates the direction of

the effect of explanatory variables on the dependent variable, rather the actual magnitude of change is shown by the marginal effect. The marginal effect measures the expected change in probability of a particular choice being made with respect to a unit change in an explanatory variable (Greene, 2000). The signs of the marginal effects and respective coefficients may be different, as the marginal effects depend on the sign and magnitude of all other coefficients (Apata et al., 2010). Furthermore, past studies have argued that adaptation to climate change is a two-step process, which initially requires the perception that climate is changing and then respond to changes through adaptation. Fussel (2007) argues that emphasis should focus on adaptation because human activities have already influenced vagaries in climate fluctuation.

2.5 Multiple regression analysis (ordinary least square)

According to Wooldridge (2005), multiple regression analysis is a type of analysis that is used to describe estimation of/and inference in the multiple linear regression model. It is an econometric method used to study relationship involving a dependent variable and many independent variables. When the relationship is between one dependent and one independent, it is called simple regression. Multiple regression techniques can be applied to a set of data set in which the independent variables are correlated with one another and with the independent to varying degrees (Barbara and Linda, 2013). Most regression models are multiple regression models because few phenomena can be explained by only one variable (Gujarati, 2004).

Explicitly, the regression is stated thus:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots\ldots + \beta n Xn + \mu$

Where:

Y = dependent variable

β_0 = constant intercept

$\beta_1 - \beta n$ = parameter estimates (coefficients)

X_1 –Xn = independent variable

μ = error term.

2.6: Likert Type Scale

A psychometric response scale primarily used in questionnaires to obtain participant's preferences or degree of agreement with a statement or set of statements. Likert scales are anon-comparative scaling technique and are one-dimensional (only measure a single trait) in nature. Respondents are asked to indicate their level of agreement with a given statement by way of an ordinal scale. Dr. Rensis Likert, a sociologist at the University of Michigan developed the technique. His original report entitled "A Technique for the Measurement of Attitudes" was published in the Archives of Psychology in 1932. His goal was to develop a means of measuring psychological attitudes in a "scientific" way. Specifically, he sought a method that would produce attitude measures that could reasonably be interpreted a measurements on a proper metric scale, in the same sense that we consider grams or degrees Celsius true measurement scales (Ubersax, 2006).

Consequently, the objective of this study was to identify factors influencing the choice of adaptation measures to climate change in Ikot Ekpene local government area, Akwa Ibom State, Nigeria.

2.5 Empirical Framework

Climate change in agriculture is now a subject of concern globally, evidenced by the number of empirical literature available on the subject. Most of the studies pertaining the adaptation to climate change have been undertaken at a macro level (Jain, 2006) leading to difficulties in generalizing specific household adaptation option. Thus laying a foundation for the increasing number of developing country studies of factors affecting adaptation to climate change at micro level that are emerging (Mendelsohn, 1999).

According to the IPCC (2007) adaptation measures help farmers guard against losses that can be incurred by the farmer due to changes in weather patterns. Different factors affect different copying strategies at different level. Thus the researcher aimed to look at the factors affecting the dominating strategies in Ikot Ekpene local government area to help increase the adaptive capacity of the farmers so that they guard against losses that they can incur due to climate change. Yusuf et al (2008) confirmed that household wealth, non farm income and livestock ownership increase the likelihood of climate change adaptation. Deressa (2008) identified age, household size, information, social capital and agro ecological settings have significant impact on perception of adaptation.

On a general perspective it seems that adaptation is affected by different factors differently hence it was the aim of this study to analyze the factors that affect adaptation strategies.

2.5.1 Climate Change Adaptation Practices By The farmers

In a research conducted by (Nyong, et al., 2018), on analysis of climate change adaptation of farmers at Urue-Offong Oruko LGA, of Akwa Ibom State, Nigeria, they found out that from Adaptation practices similarly characteristics into a category, which included; weather management practices, crop management practices, land/soil management practices, water management practices and livelihood diversification. It was found out that off farm employment with 85% in livelihood diversification category was the most predominant adaptation measure used by the rural farmers across all the climate change adaptation categories. It was also added that Agricultural production is seasonal and so, most of the times, rural farmers engage in other economic activities to be active, productive and to earn additional means of living. This could have informed why majority of them where involved in off farm employment activities.

According to (Nyong, et al., 2018), other predominant adaptation measures practiced by the rural farmers were multiple cropping of 96% and crop diversification of 85% in crop management category; mulching of 93%, making of ridges across the farm of 85% and cover cropping of 88% in water

management category; as well as organic manure application 84% and making of mounds in farms 69% in land/soil management category. They went on to find out that Most of these measures are routine traditional agronomic practices and involves no new innovation or technology, and may therefore have been responsible for their high rate of usage by the rural farmers to adapt to climate change. All the adaptation practices in the weather management category had a general low usage below 3 percent consisting of: use of weather forecast 4%, change in harvesting dates 24% and change in planting dates 33%. Weather management practices involves state of the art technology for accurate studying, understanding and prediction of the weather, most of which are lacking in the rural areas. Also, most of the rural farmers have limited formal education to understand and appreciate the importance of weather management in agriculture. These may have accounted for the low frequency of their use of these adaptation practices. In the same vein, the least used climate change adaptation practice was migration 3% which is in livelihood diversification category. Most of the rural farmers are in their native environment with very low level of education, and in some cases, with no formal education at all. As such, labour mobility is very limited or absence resigning them to faith in their ancestral homes.

In a study conducted by (Rashid H., C. Nhemachena) on determinants of farmers' actual adaptation decisions, the various combinations of measures and practices were grouped into the following adaptation options: diversifying into multiple crops and mixed crop-livestock systems, and switching from crops to livestock and from dry land to irrigation. It is clear from the study that multiple cropping mixed with livestock rearing under dry land conditions is the dominant system in Africa (52% of farms). Multiple cropping with livestock under irrigation is the second most common strategy (14%), and multiple cropping without livestock under dry land (13%) comes third. Mixing livestock with crops is by far the most common practice of African farmers (79%), whether under irrigation or dry land. Also note that while about 24% of African farms irrigate, using irrigation to support specialized livestock production is rare.

2.5.2 Climate change adaptation and age of farmers

Literature has it that there has been a mixed influence of the age of household head on the adoption of a strategy, its influence varies. Some studies found that age had an influence on farmers' decision to participate in forest, soil and water management activities. A study in the Eastern Highlands of Ethiopia by Wegayehu and Drake (2003) found out that age had an influence on farmers' decision to participate in soil and water conservation activities.

But however, Bayard, Jolly and Shannon (2007) and Okoye (1998) found that age is negatively related to adoption of conservation agriculture. From the empirical evidence mentioned age seem to have mixed influence depending on copying strategy that is being employed, country and the norms and values. Therefore, age also has an effect on adaptation strategy, as an individual grows there are some strategies that they can easily accept, some may find it difficult to adapt to certain strategies basing on the socio-economic barriers. Thus the researcher was to find out the influence of age of household head on the dominating strategies in climate change adaptation.

2.5.3 Climate Change and Farm Size

According to Nhemachena and Hassan (2008) a larger farm size paves way for farmers to take labor intensive adaptation strategy. Nyangena (2007) objected this and concluded that farmers with small land are the ones that are likely to invest in soil conservation practices. Other studies found out those farmers with larger farms to allocate for the construction of soil bund (Anim, 1999). The researcher postulates that the effect of farm size is also dependant on the availability of cheap labor to the farmer. If the farmer has a larger piece of land and at the same time has readily available cheap labor there is a high probability of adaptation to labor intensive strategies and in contrary if there is no readily available cheap labor then the farmer is likely to shun labor intensive strategies. It is therefore seen that farm size can also have an independent influence on the adaptation of certain strategy.

Thus the researcher seeks to analyze the effect of farm size on the dominating strategies being employed by rural farmers.

Empirical evidence seem to base more on household size reflecting labor readily available to a farmer and that one can adopt to labor intensive adaptation strategy. The researcher suggested that the household farm size can affect adaptation strategy given the level of education of the households. Since Ikok Ekpene Local Government Area consist of the business areas and rural areas, some literate family members may look for other income generating projects reducing dependence on farming activities. The researcher also suggested that adaptation to a strategy is based on the availability of labor when most needed rather than it's readily availability. Thus the researcher seeks to analyze the effect of household farm size on adaptation strategy.

2.5.4 Gender Impact and Climate Change

Gender of the household head was seen as an important variable affecting adaptation decision at farm level (Deressa, Hassan, Teike, Mahmud and Ringler, 2009). According to Nhemachena and Hassan (2008) male headed households adapt more readily to climate change. But however Aymone (2009) found out that gender had an impact on the probability of choosing an adaptation technique. Females tend to adapt to resource management and conservation practices (Bayard et al, 2007; Dolisca et al., 2006; Burton et al., 1999). A study by Bekele and Drake (2003) found that gender was not a significant factor influencing farmers' decision to adopt to soil conservation measures. Literature has it that gender has a mixed influence at different level but the researcher hypothesizes that there are certain adaptation strategies that males are likely to adapt more rapidly compared to women and the opposite being true for women. Thus the researcher seeks to identify the influence of gender on the adaptation strategies being employed by rural farmers to observe if gender of the household head was to change what effect would that have on a given strategy, identify if there is going to be a change in strategy or one would continue using the strategy at hand.

2.5.5 Climate Change and Education of Farmers

According to Reardan and Kangasnieum (1998) education is an insignificant determinant in influencing adaptation measures to climate change. Okoye (1998) found out that education was negatively correlated with adaptation to climate change. Basing on these two studies, education's influence depends more on the type of education which may be formal, non formal and informal.

- Formal education is where one learns the basic, academic or trade skills,
- Non formal being maybe due to own study or from job skills, skills that are taught outside formal sector.
- Informal education involves information and teachings from magazines, other colleagues and from the mass Medias.

These levels of education have different influence on adaptation strategy; the increase in non formal and informal education might positively influence adaptation. Thus the researcher seeks to identify the effect of level of formal education on adaptation strategy employed by rural farmers.

Other studies have also found income as a factor that affects adaptation strategies. Income can be grouped into off farm income and farm income. Smallholder farmers' access to off farm income source increases the probability that they will invest in farming activities. Ownership of livestock is negatively related to adaptation, the marginal impacts are not significant (Aymone 2009).

2.5.6 Climate Change and Level of Information

Some farmers can rarely note the differences in amount of rainfall and temperature, access to agricultural services is a vital source of information on climate change and agricultural practices. Research conducted by Bekele and Drake (2003), Tizale (2007) showed that extension education is a motivating

factor on the use of soil and water conservation. Other studies however found out that extension was not a significant factor affecting adaptation of soil conservation measures (Pender et al 2004; Nkanya et al 2005). Madison (2006) also contributed that lack of information was a barrier to adaptation to climate change. According to Kandlinkar and Ribsey (2000) access to climate and agricultural information help farmers make cooperate decision to help farmers better cope with changes in climate.

Awareness of the problem and potential benefits of taking action is another important determinant of adoption of agricultural technologies. Maddison (2007) found that farmers' awareness of changes in climate attributes (temperature and precipitation) is important for adaptation decision making. Studies from (Gould et al., 1989; Traoré et al., 1998; Anim, 1999; Araya & Adjaye, 2001), have found that farmers' awareness and perceptions of soil erosion problems positively and significantly affected their decisions to adopt soil conservation measures. Therefore the researcher seeks to identify the level of awareness of climate change adaptation among farmers in the area of study.

5.2. Conclusion

It is absolutely very important to know the factors that affect climate change adaptation. This can help in the formulation of policies and investments strategies cushioning the effects of long term climate change. Since most rural farmers depend on rain-fed agriculture as their source of livelihoods and have a low capacity to adapt to changes in climate change, policies to help farmer adopt are of great importance. An understanding of the adaptation measures employed by the household will enhance policy towards tackling the effects of climate change. Adaptation strategies employed by households in Ikot Ekpene LGA included; Change planting and harvesting time , Prevent bush burning , Plant legumes, Practice crop rotation , Treatment of soil, Use improved /drought resistant variety, Control erosion.

5.3. Recommendation

- Based on the findings of this study, it was recommended that arable farmers should be provided with access to credit and inputs to be able to address the challenges of climate change. Adequate education and training should be encouraged among the arable crop farmers. Furthermore, government should make meteorological information on climate change available and accessible to arable farmers to guide them in their adaptation strategies on the farm.
- Government of akwa ibom state and other agricultural related bodies in the state should work to ensure that farmers have increased access to functional extension services, as this will provide less educated farmers with up-to-date information needed for better productivity and improved techniques.
- The state government, farming communities and farming households and other agricultural stakeholders should encourage and promote the formation of social group among farmers to strengthen interaction among practicing farmers. This will give them more access to relevant information on climate change adaption.
- There is need for multidisciplinary approach of extension so that there is an increased and strengthened adaptive capacity of the households. There is need to bring together farmers all stakeholders to develop common understanding of different perceptions to facilitate a better and acceptable strategy.
- To strengthen and increase adaptive capacity there is also need to improve the social and infrastructure and institutions dealing with climate related issues.

- Policy making, it appears that education would do most of the hasten adaptation and increase household decision regarding the key adaptation techniques. There is need to teach individuals the essence of agriculture and the contribution of rural farmers to the nation. There is also need to promote non formal and informal education to help farmers cope with climate change.
- In policy making there is need to include the elderly as they are well vested with weather patterns hence having an influence on adaptation and may increase the acceptability of a strategy by households.

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