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GENDER AND CLIMATE CHANGE ADAPTATION DECISIONS AMONG FARM HOUSEHOLDS IN SOUTHWEST NIGERIA

BY

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CERTIFICATION

AMUSA Taofeeq Ade, a postgraduate student in the Department of Agricultural Economics with registration number PG/Ph.D/10/57763 has satisfactorily completed the requirements for the award of Doctor of Philosophy (Ph.D) Degree in Agricultural Economics (Resource and Environmental Economics). The work embodied in this thesis, except where duly acknowledged, is an original work and has not been previously published in part or full for any other diploma or degree of this or any other University.

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DEDICATION

This research work is dedicated to my lovely parents Chief Amusa Folorunsho Jolaobi (of blessed memory) and Mrs Rabiat Modupe Amusa.

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Abstract

This study investigated gender and climate change adaptation decisions among farm households in Southwest Nigeria. In carrying out the study, five specific objectives and five hypotheses were developed to guide the study. Multi-stage random sampling techniques were employed in selecting the 348 farm units for the study. Data for the study were obtained from primary source using structured questionnaire. Data collected were analysed using descriptive and inferential statistics such as multinomial logit (MNL) model, vulnerability analysis, Heckmanôs double stage selection model, factor analysis, t-test and analysis of variance (ANOVA). Based on the data analyzed, the study found that majority (76%) of the farmers were males while 24% were females. The average year of education of the farmers was 7 years with an average household size about 8 persons. The average year of farming experience of the farmers was 36 years. The result on source of awareness of the farmers indicated that, greater percentage (79%) of the farmers were aware of climate change through personal observation, followed by 63% of the farmers that that indicated awareness through extension agents. The study identified 13 effects of climate change of agricultural production with mean values that ranged from 2.51 to 3.58 on a 4-point rating scale. Using household adaptive capacity approach, female headed farming households in southwest Nigeria were more vulnerable to effects of climate change with higher vulnerability index of 0.73 as against male headed households with vulnerability index of 0.43. The result of Heckmanôs double stage selection model with rho 0.61561, Wald^{2}G= 743.72 and pÒ0.0000 showed strong explanatory power of the model. The mean comparison of gender contribution to climate change adaptation decision in crop production activities showed that men had higher mean contribution of 3.42 than women with mean contribution of 2.67. On gender contribution to climate change adaptation decision making in livestock production, women had higher mean contribution of 3.55 against men with mean contribution of 3.27. The result of the parameter estimates from the multinomial logit (MNL) model was significant as indicated by G^2 statistics are highly significant at ($p<0.0000$). The explanatory power of the factors as reflected by Pseudo R^2 was high (69%). The factors that militate against women contributions to climate change adaptation decision as revealed by the result of varimax-rotated principal component factor analysis include: socio-infrastructural, financial/cultural, technological and institutional factors. The findings on analysis of variance (ANOVA) showed that there was no significant (pÒ0.05) difference in the mean ratings of farmers from Ekiti, Ogun and Oyo states on the intensity of the effects of climate change across the local ecological zones. The result of the t-test statistics showed a significant (pÒ0.05) difference in vulnerabilities of male and female headed households to the effects of climate change in southwest Nigeria. Based on the above findings, the study *inter alia* recommended that government should formulate specific policies providing increased women access to education, land and off-farm activities to alleviate the gender disparity in contribution to climate adaptation decision.

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Climate change is a global phenomenon undermining the achievement of the Millennium Development Goals (MDGs) and efforts to reduce extreme poverty. According to Intergovernmental Panel on Climate Change (IPCC) (2007), climate change is a change in the state of the climate that can be identified by using statistical tests, by change in the mean and the variability of climatic properties that persist for an extended period typically decades or longer. United Nations Framework Convention on Climate Change (UNFCCC) (1992) described it as a change which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere in addition to natural climate variability observed over comparable time periods. Climate change has become more threatening not only to sustainable environmental quality but also as a major challenge to the fight against hunger, malnutrition, diseases and poverty in Africa through its impact on agricultural production. Until recently, government and non-governmental institutions, donors and other actors in natural resource use in developing countries seldom considered the risks and uncertainties associated with climate change in their development planning. Hence, Mendelsohn, Dinar and Dalfelt (2000) stated that many countries in tropical and sub-tropical regions are expected to be more vulnerable to warming and other devastating effects of climate change.

The vulnerability of African farmers to the effects of climate change is expected to be most severe in Nigeria (Ayinde, Ajewole, Ogunlade and Adewunmi, 2010), where funding to agricultural research has been comparatively low (Nigerian House Committee on Agriculture, 2005), the current spread of agricultural information and training are poorest (Enete and Amusa, 2011), technological changes have been the slowest (Action Aid International, 2008), and where domestic economies depend heavily on rain-fed agriculture (Apata, 2008). The threats of climate change cut across all the sub-sectors of Nigerian agriculture such as livestock, crop production, agroforestry, fishery, agricultural products processing and so on. For instance, Valtorta (2009) noted that climate change affects animal production in four ways: (a) the impact of changes in livestock feed-grain availability and price; (b) impacts on livestock pastures and forage crop production and quality; (c) changes in the distribution of livestock diseases and pests; and (d) the direct effects of weather and extreme events on animal health, growth and reproduction. Crop production is also significantly affected by the changes in climate and atmospheric carbondioxide (CO_2) (Rosenzweig and Hillel, 1998). The changes in temperature and precipitation might further alter both arable and forest crop yields, water and nutrient budgets in the field thereby subjecting crops to stress (Tubiello, Rosenzweig, Goldberg, Jagtab and Jones, 2002). In addition, Khanal (2009) noted that heat stress might affect the whole physiological development, maturation and finally yield of cultivated crops. On the damages to aquatic lives, climate change will likely affect the metabolism, growth and distribution of many aquatic organisms as well influence diseases that afflict them. For agricultural processing, Canadian Grain Commission (2009) reported that the heat effect of climate change on processed agricultural products causes the growth and development of spoilage molds which affect products in storage by causing adverse quality changes, heat-damage, dull appearance, musty odours, visible moulds, production of toxins and allergens. This situation is worst in sub-saharan African countries; Nigeria inclusive.

Nigeria for instance, and other developing countries are already experiencing low crop yields and altered animal compositions as a result of extreme weather and climate change. Recent studies have also shown that there has been precipitation decrease in the humid regions of West Africa, including parts of southern Nigeria since the beginning of the century (Adebayo, Dauda, Rikko, George, Fashola, Atungwu, Iposu, Shobowale and Osuntade, 2011). This is evidenced by the late arrival of rains, drying up of streams and small rivers that usually flow year round. The seasonal shifting of rain and that of the fruiting period in Oyo State and the gradual disappearance of flood-recession cropping in riverine areas of Ondo State are among the effects of climate change in communities in the southwest Nigeria (Adebayo, *et al,* 2011). In addressing this global threat, Tubiello and Rosenzweig (2008) stated that a wide range of adaptations exist within farming system to help maintain or increase crop and livestock yields under climate change.

Climate change adaptation methods according to Nyong, Adesina and Osman-Elasha (2007) are those strategies that enable the individual or the community to cope with or adjust to the impacts of the change in climate. Climate change adaptation as described by IPCC (2001) is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or explores beneficial opportunities. In agriculture, adaptation helps farmers achieve their food, income and livelihood security objectives in the face of changing climatic and socio-economic conditions including climatic variability, extreme weather conditions such as droughts, floods and volatile short term changes in local and large-scale markets (Kandlinkar and Risbey, 2000). Adaptation practices are mostly at farm household level to combat climate change while mitigation implies implementation of policies to reduce Green House Gases (GHGs) emission and enhance sinking (FAO, 2008).

Such adaptation strategies for crop production among farmers in southern Nigeria include the adoption of efficient environmental resources management practices such as the planting of early maturing crops, mulching, small scale irrigation, adoption of hardy varieties of crops, tree planting, early planting, fadama and staking to avoid heat burns (Adebayo, *et al,* 2011 and Nyong, *et al,* 2007). Adaptation strategies that are employed by farmers for livestock rearing include the use of emergency fodder in times of droughts, multi-species composition of herds to survive climate extremes, culling of old livestock, de-stocking to reduce population and climatic inducing heat stress, expand rain harvest, shading, supplementary feeding, dip and dose, fence camp and provision of more opportunity for livestock for water among others (Oba, 1997; Nyong, *et al,* 2007 and Adesina, *et al,* 2008).

Adaptation and mitigation to climatic change in agriculture range from technological solutions to adjustments in farm management or structures and to political changes such as adaptation plans (Brussel, 2009). These measures are categorized into (i) technological development, (ii) government programmes and insurance, (iii) farm production practices, and

(iv) farm financial management. The first two categories are principally the responsibility of public agencies and agri-business; and adaptation here could be thought of as system-wide or macro scale. The last two categories of adaptation are the responsibilities of farmers at farm household level. The report of WEDO (2008) showed that, in the context of climate change adaptation practices among farmers, gender perspective is vital for effective policies.

The term ñgenderò refers to socially ascribed roles, responsibilities and opportunities associated with women and men, as well as the hidden power structures that govern relationships between them (UNDP, 2010). Gender issues focus not only on women but on the relationship among men, women and children and their roles, access to and control over resources and division of labour in meeting household needs (Barker, 2002). Gender in the context of this study relates to contributions of male and female farmers to decision making in climate change adaptation activities in crop and livestock production. Gender relation in agriculture is important for it determines household security, household well-being and many other aspects of life (Rota, Sperandini and Hartl, 2010) such as allocation of household resources through decision making. Risbey, Kandlikar and Dowlatabadi (1999) stated that the responses of farmers to cope with the associated challenges of climate change in food production result from their farming decisions.

Farm decision making according to Ilbery (1985) is an on-going process whereby farmers are continually making short and long-term decisions to manage risks emanating from variety of climatic and non-climatic sources. In addition, Smith and Skinner (2002) observed that adaptation to climate change is the result of individual farmerôs decisions influenced by climatic forces internal to the farm households and external forces that affect the agricultural system at large. Farming decision making is therefore a mental and intelligent process in which farmers use information available about farm resources to select and combine those farm resources they consider best for addressing their farming challenges and achieving farming objectives. Farmers constantly face such challenges as tragic crop failures, reduced agricultural productivity, increased hunger, malnutrition and diseases (Zoellick, 2009) which are mostly as a result of changes in climatic conditions. Climatic and agricultural challenges have placed many farmers in the position of making critical decisions about farming, financial security and well-being that has long term consequences. These farmers have developed intricate systems of gathering, prediction, interpretation and decision-making in relation to weather. To a very great extent, these systems of climate forecasts have been very helpful to the farmers in managing their vulnerability.

Farmers are known to make decisions on cropping patterns based on local predictions of climate, and decisions on planting dates based on complex cultural models of weather (Nyong, *et al,* 2007). Farmersô awareness and ability to cope with changes in climate attributes (temperature and precipitation) are important to adaptation decision making (Maddison, 2006). It is well documented in the literature that gendered divisions of labour and decision-making power may affect the farm householdsô ability to respond to the effects of climate change (WEDO 2008; Parikh, 2007; UNFCCC 2007, Commission on the Status of Women, 2008; BRIDGE, 2008). It is based on this background that this study therefore investigated issues surrounding gender, climate change adaptation and farming decisions using farm households in Southwest Nigeria as case study.

1.2 Statement of the Problem.

The realization of African Green Revolution, Millennium Development Goals (MDGs) with their expected contributions to food security and economic growth in sub-Saharan Africa is threatened by climate change. In this regard, the smallholder farmers are particularly vulnerable to changes in the climate that reduce productivity and negatively affect their weather-dependent livelihood systems. From the exacerbation of poverty to the breakdown of infrastructure, loss of environmental, political, economic and social security, the impacts of climate change are extensive. However, Obiora (2009) observed that a critical aspect that is usually missing when discussing climate change, especially during roundtable policy negotiations is the gender perspective. The author further observed that policy makers have identified the lack of gender disaggregated data as a major challenge in bringing gender on the climate change agenda.

Actions to reduce the impacts of climate change on agricultural production can only be effective with an understanding of gender differentiated impacts, vulnerabilities (Babugura, Mtshali and Mtshali, 2010); and contributions to climate change resilience so as to address the specific needs of men and women farmers (USAID, 2010). Effective gender-based participation and responsibilities in natural resources management ensure balanced, equitable and sustainable development in developing countries. This is because, gender and climate change are cross-cutting issues (USAID, 2010), but the current framework in which the threats of climate change on agriculture are being addressed often times neglects gender perspectives which are crucial for successful adaptation and mitigation (Parikh, 2007; Carvajal, Quintero and Garcia, 2008 and BRIDGE, 2008).

Gender approach (or analysis) takes into consideration the fact that women and men react to and participate in social, economic and environmental realities differently depending on their age, socio-economic status and culture (UNDP, 2008). For instance, Oluwatayo (2011) while assessing the gender considerations in decision making among households in Ekiti state found out that, out of the ten identified decisions bothering on food security, only three decisions concerning type of food to buy, when to take the food and food security coping strategies to adopt were taken by women. Other major decisions like input acquisition, house rent, keeping of proceeds from occupation and spending of the proceeds were the sole responsibility of men. The above evidence, suggests that the bulk of the decisions impacting on food security are taken by men, thus putting women at a disadvantaged position in spite of their prime importance in ensuring household food security.

In addition, Enete and Amusa (2010); Damisa and Yohanna (2007) reported that there are variations in gender contributions to farming decision across major farm activities from land preparation to agricultural processing and marketing of farm produce. According to Paul and Saadullah (1991), gender participation in decision making process of farm activities and investment cannot be looked at in isolation. The participation of men, women and children in decision making is so interdependent that they support each other in everyday life in a large number of social, productive and economic activities. Therefore, in the face of climate change, taking gender into consideration in decision making will provide better guidance for women and men who are building adaptive capacity in places where inhabitants depend on rain-fed agriculture and natural resources. Lambrou and Piana (2006) added that a critical view of gender dimensions of climate change using case studies across the globe will provide critical gender-disaggregated data on climate change impacts, gender vulnerability and roles in climate change resilience for policy makers, which had been neglected until recently.

Available studies recently conducted in vulnerable African countries (Nigeria inclusive), where gender and climate change adaptation are captured include the studies of Babugura, *et al,* (2010); Agwu, (2009); Okhimamhe, (2009); Aguilar, (2009); Haigh and Vallely, (2010); among others. None of these studies however focused on gender and climate change with regards to adaptation decisions. On the other hand, available empirical studies that estimated gender roles in farm decision making focused on crop and livestock production activities and never attempted to capture farming decision in relations to climate change adaptation. These are evident in Enete and Amusa, (2010); Damisa and Yohanna, (2007); Jill, Hema and Anuja, (2001); Kishor, Gupta, Yaday and Singh (1999). It is therefore imperative that gender roles in climate change adaptation decision making be empirically investigated for the development of effective climate change policies that are gender responsive. This is because, the study made available much needed data on gender desegregated contributions to climate change adaptation decisions in crop and livestock production, the determinants of climate change awareness and adaptation, the vulnerability of male and female headed households to effects of climate change and gendered factor-constraints of the farmers in making contributions to climate change adaptation decisions; thereby contributing towards filling the gaps that exist in knowledge.

1.3 Objectives of the Study.

The broad objective of this study was to assess gender and climate change adaptation decisions among farm households in southwest, Nigeria. Specifically, the study sought to:

i. estimate gender-based awareness and vulnerability to climate change among the farmers in the study area;
ii. estimate the determinants of farmersô adaptation and extent of adaptation to climate change in the area;
iii. make comparative analysis of gender contributions to climate change adaptation decision making in crop and livestock production activities among farming households in the study area;
iv. estimate the influence of socio-economic characteristics of the farmers on their contributions to climate change adaptation decision making in their farm households and
v. identify the major constraints militating against women farmers in climate change adaptation decision making in the study area.

1.4 Hypotheses of the Study.

i. There is no significant difference in the mean ratings of farmers from the three local ecological zones on the intensity of climate change effects in the study area.
ii. There no significant difference in gender-based awareness and vulnerability to the effects of climate change in the study area.
iii. Socio-economic characteristics of the farmers have no significant relationship on their adaptation and extent of adaptation to climate change in the study area.
iv. There is no significant difference in the mean ratings of men and women farmersô contributions to climate change adaptation decisions in crop and livestock production activities in the study area.
v. Socio-economic characteristics of the farmers have no significant influence on their contributions to climate adaptation decisions in the study area.

1.5 Justification of the Study.

Farmers constantly face such challenges as tragic crop failures, reduced agricultural productivity, increased hunger, malnutrition and diseases (Zoellick, 2009) which are often times due to changes in climatic conditions. Increase in farm output results from sound decision making in the management of associated farming challenges such as climate change and crop failure. Literature suggests that linking gender to farm decision making is important for formulation of gender sensitive policies (Kishor, *et al,* 1999). Gender and climate change adaptation are also regarded as cross cutting issues (USAID, 2010) but there is lack of empirical evidence in relation to gender differentials in climate change adaptation decisions among farming households. This study is therefore necessitated to bridge the gap that exist with regard to gender differentiated contributions to climate change adaptation decisions among farming households in South-western Nigeria.

The findings of this study will be found useful by States and Federal ministries of environment and agriculture especially in the review and formulation of environmental and gender related policies that will empower and moderate the contributions of men and women to climate change adaptation decision making at farm households level. The research findings will also be useful to local NGOôs and international agencies that are involved in agricultural development, gender mainstreaming in agriculture and climate change adaptation by farm households. This is because with the information that was made available by this study, the concerned NGOs and agencies will be more informed and focussed in formulating agricultural and gender sensitive policies especially in relating to climate change adaptation decision making at farm households level. Policy makers and extension agents will be more equipped with necessary information that will be made available towards addressing the major barriers facing men and women farmers in making contributions to householdsô adaptation decisions to climate change in the vulnerable African countries.

Finally, fellow researchers and research consult with research interest in gender related studies, intra farm households gender relations, climate change adaptation and farm decision making will be properly guided to be more focused based on the information that was provided by this study.

1.6 Limitations of the Study.

The study had the following limitations:

Firstly, the study was limited to investigation of gender and climate change adaptation decision in food crop and livestock production among farm household in southwest Nigeria. Therefore, gender and adaptation decision as regards other farm enterprises such as fishing, agroforestry and agricultural processing are not made focus of the study.

Secondly, out of 360 copies of the questionnaire administered, 348 copies were considered good for data extraction and were consequently used for the study. The high return rate of 348 was achieved due to extra effort to reprint additional copies of questionnaire for administration in zones where retrieval of the questionnaire was problematic. In addition, main sources of information provided by the farmers were memory recalls. Most of the farmers lacked the ability to keep comprehensive farm records, hence much persuasion was used to obtain as much information as possible.

Thirdly, attempt to bring together both the male and female farmers playing leading roles in order to capture gender disparity in decision making in some farm households was difficult than expected. In such few farm households, extra efforts were made to interview the men and women on different occasions at additional effort and cost.

CHAPTER TWO

LITERATURE REVIEW

1. Climate Change Adaptation Framework in Nigeria
2. Awareness of Climate Change among Nigerian Farmers
3. Climate Change Adaptation Practices in Crop and Livestock Production
4. Gender and Climate Change Adaptation.
5. Vulnerability of Nigerian Agriculture to Climate Change
6. Concept of Farming Decision
7. Climate Change Adaptation Decisions
8. Gender Factor in Farming Decision
9. Challenges of Farmers in Climate Change Adaptation Decisions
10. Conceptual Framework
11. Theoretical Framework
12. Analytical Framework
13. Related Empirical Studies

2.1 Climate Change Adaptation Framework in Nigeria.

Climate change adaptation is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2001). Nigerian government has made efforts to respond to the requirement of International Conventions on Climate Change (Adesina, *et al,* 2008). Such efforts include: (i) the production of Nigeria's first National Communication on climate change (FMENV, 2003), and (ii) the on-going effort to produce Nigeria's second National Communication and organisation of stakeholder workshops to get a critical mass of experts that can start a process of result oriented response to climate change. Climate change adaptation framework in the context of this study refers to the general underlying set of plans and background for climate change resilience in Nigeria under the auspices of the Federal Ministry of Environment.

In Nigeria, the role of the Federal Ministry of Environment as the focal point of climate change policy making is fairly well known (FMENV, 2003). The Government first created the Special Climate Change Unit (SCCU) in 2006 within the Federal Ministry of Environment. The SCCU is charged with implementing the Climate Convention and its Protocol, the Kyoto Protocol. It also coordinates the activities of the inter-ministerial committee on climate change whose membership is drawn from governmental and non-governmental organizations, the private sectors and the academia (Ibe, 2009). Despite this effort however, the Nigerian Environmental Study/Action Team (NEST) (2011) noted that Nigeria has not yet fully established an institutional and legal framework, systematic approach or policies targeted at combating, mitigating and adapting to the impacts of climate change. This is because, programmes, policies and activities of the ministry on climate change do not seem to have specifically targeted and involved farmers (Nzeadibe, Egbule, Chukwuone and Agu, 2011). Consequently, Nigerian farmers as key stakeholders in environmental resources management appear to have been left out in the climate change discuss and policy making.

Given the above factors, it is clear that Nigeria's long-term development goal of improved environmental quality and poverty reduction as a part of the Millennium Development Goals (MDGs) will be severely constrained if insufficient attention is paid to the issue of climate change in Nigeria (NEST, 2011). To build on the present action plan, and to ensure a truly national response to the significant and multi-facetted impacts of climate change, Nigeria needs an aggressive and widely supported strategy and action plan. This strategy and plan according to BNRCC (2011) must be integrated, comprehensive in scope, and inclusive of all stakeholders; such as actors within the formal sector and farmers taking into cognisance gender and specific need of men and women in building resilience.

Gender and climate change adaptation are cross-cutting issues. This is inadequately addressed in the Nigerian framework for climate change adaptation as documented in the literature. For instance, Obiora (2009) observed that gender perspective is a critical aspect that is usually missing during roundtable climate change policy negotiations and discussions in Nigeria. Recognising the significance of gender in climate change adaptation framework, Vincent, *et al,*

(2010) stated that the successful application of a gender approach in development requires a thorough understanding and appreciation of the involvement of both men and women in the development process. The authors stated further that an integrated gender approach in national and community-based adaptation facilitates the equitable participation of men and women alike and adequately addresses the sometimes differing strategic needs of both genders.

2.2 Awareness of Climate Change among Nigerian Farmers

Farmersô awareness of climate change in many studies has been of great concern (Mandleni and Anim, 2011). Climate change awareness is the aggregate of knowledge, attitudes or beliefs held by the society on climate change and global warming. According to Oruonye (2011) climate change awareness is a synthesis of the peopleôs conception, interpretation and perceptions of climate change related issues which affect their behaviour, and the quality of responses and reactions to the problems.

Literature on climate change adaptation makes it clear that awareness is a necessary prerequisite for adaptation (Madddison, 2007). Once climate change awareness and capacity start to increase, adaptation can then start to be fully integrated into national, sectoral and local development plans to ensure that development is climate proofed, and adaptive capacity is maximized across sectors and scales.

Nigerians has to be aware and be involved in climate change adaptation from individuals, to communities, local, state and the federal level in order to achieve the desired result in the struggle to cope in the face of deteriorated climatic conditions. Awareness and perceptions of changes in the climatic condition among farmers shape their adaptive and coping strategies in farming. In affirmation, Nzeadibe, *et al,* (2011) stated that the perception of climate change governance by stakeholders, such as farmers, is important as perception (awareness) can shape the preparedness of these actors to adapt and change or modify their farm practices.

Farmers perception of climate change is related to awareness level and availability of information on the phenomenon. The spatial behaviour and behavioural responses of individuals and communities are often framed around their awareness of climate change problems (Getis, *et al.* 2000). Farmers awareness of climate change phenomenon is shaped by a number of socio-economic and institutional factors. Maddison (2006) stated that the awareness of climate change appears to hinge on farmerӳ experience and the availability of extension services specifically related to climate change. Gbetibouo (2009) observed that farmers with access to extension services are likely to be aware of changes in the climate because extension services provide information about improved farm practices under the prevailing biophysical conditions such as climate and weather. Apart from extension services, other sources of information for improve awareness of climate change among the farmers include friends, radio/television, newspapers, researchers and farmersô cooperatives.

It is expected that improved knowledge through education and farming experience will positively influence farmers' awareness and decision to take up climate change adaptation measures. Improved education and disseminating strategies constitute important policy measures for stimulating awareness and local participation of farmers in various development and national resource management initiatives (Anley, Bogale and Haile-Gabriel, 2007). Farming experience improves awareness of change in climate, the potential benefits and willingness to participate in local natural resource management of conservation activities. However, Maddison (2006) affirmed that educated and experienced farmers have more knowledge and information about climate change and agronomic practices that they can adopt in coping with the change.

The coping capacity among Nigerian farmers like other developing countries is still low. This among other factors could be linked to the relatively low level of awareness of climate change in developing countries when compared to developed nations where people are more informed about issues surrounding climate change. The relatively low level of awareness about climate change in developing countries is an impediment to effective implementation of common undifferentiated commitments to the convention on climate change and the protocol processes, particularly, the Clean Development Mechanism (CDM) (Oruonye, 2011). One of the major constraints encountered by farmers in adaptation is lack of adequate information and consequently low awareness of climate change.

Inadequate information about climate change among the farmers limits their level of awareness of the global phenomenon. Although, Sofoluwe, Tijani and Baruwa (2011) confirmed that most Nigerian farmers are already aware of the changes in climate. In buttressing this fact, Maddison (2007) submitted that preliminary evidences from a number of studies across African countries revealed that large number of farmers already perceive that the climate has become hotter and the rain has become less predictable and shorter in duration. But despite this observations, there is still appreciable need for improved awareness among farmers and other major stake holders in natural resources exploitation and management about climate change. For instance, Enete, *et al,* (2011) emphasized the need for increased education and awareness creation among farmers as potent tools for climate change adaptation in Nigeria.

2.3 Climate Change Adaptation Practices in Crop and Livestock Production

Adaptation to climate change involves changes in agricultural management practices in response to change in climatic conditions. According to Nkemachena and Hassan (2007), climate change adaptation deals with a combination of various individual responses at the farm level and assumes that farmers have access to alternative practices and technologies. Adaptation to climatic change is therefore becoming critical and of concern in developing countries, especially in Nigeria where vulnerability is high because ability to adapt is low (Ayinde, *et al,* 2010) and where domestic economies depend heavily on rain-fed agriculture (Apata, 2008).

In agriculture, adaptation helps farmers to achieve their food, income and livelihood security objectives in the face of changing climatic conditions including climatic variability, extreme weather conditions such as droughts and floods and volatile short term changes in local and large-scale markets (Kandlinkar and Risbey, 2000). Farmers can reduce the potential damage by making tactical response to these changes. Agricultural adaptation options are categorized into technological development, government programmes and insurance; farm production practices, and farm financial management. The first two categories are principally the responsibility of public agencies and agri-business and adaptation here could be thought of as system-wide or macro scale. The last two categories mainly involve farm level adaptation practices by farmers for crop and livestock production.

2.3.1 Climate Change Adaptation in Crop Production

In the submission of Hassan and Nkemechena (2008) some of the climate change adaptation strategies farmers perceive as appropriate in crop production include; diversification of crops using different crop varieties, varying the planting dates, harvesting dates, increasing the use of irrigation, increasing the use of water and soil conservation techniques, shading and shelter, shortening the length of the growing season and diversifying from farming to non-farming activities. In addition, Adebayo, *et al,* (2011) highlighted the major climate change adaptation strategies in crop production to include; construction of drainages, small scale irrigation, mulching, tree planting, timely planting of crops, avoidance of bush burning, avoidance of tree felling and studying weather condition before planting crops.

Kurukulasuriya and Rosental (2003) noted that the short-term adaptation measures for climate change by farmers include crop insurance for risk coverage, crop/livestock diversification to increase productivity and protection against diseases, adjusting the timing of farm operations to reduce risks of crop damage, change crop intensity and adjust livestock management to new climatic conditions, food reserves and storage as temporary relief, changing cropping mix, permanent migration to diversify income opportunities, defining land use and tenure rights for investments. The findings of Ozor and Nnaji (2011) on climate change adaptation strategies include; the use of resistant crop varieties/species, use of organic manure, mixed farming, diversification in crop enterprise, changes in planting dates, changes in harvesting dates, processing of crops to reduce post harvest losses and enhance shelf life of crops, mulching/use of cover crops, changes in the timing of land preparation activities, prompt weeding and water storage in ponds among others. The choice of any of these adaptation practices among alternatives involves decision making in which the farmer considers the prevailing environmental condition and the available farm resources at the disposal of the farmer for wise allocation of resources.

2.3.2 Climate Change Adaptation in Livestock Production

In livestock sector, there are certain adaptation practices by farmers over the years to cope with the impact of climate change in livestock production. Brussel (2009) highlighted the possible short and medium term adaptation practices to changes in climate by farmers to include: technical solutions such as protecting overheads from frost damage or improving ventilation and cooling systems in animal shelters; maintaining landscape features, improving shelter of livestock, introducing more heat-tolerant livestock breeds and adapting diet patterns of animals under heat stress conditions. Mandleni and Anim (2011) recommended the following adaptation practices in livestock farming, these among others include: supplementary feeding, dip and dose, feed supplement in livestock production, the selling of stock to buy medicine in terms of disease spread, exchange stock, fence camps to protect livestock and water harvesting for livestock production.

Some of the findings of a study conducted by Ozor and Nnaji (2011) that specifically relate to climate change adaptation strategies as regards livestock production among farmers in south eastern Nigeria revealed that, the farmers used resistant animal varieties/species, construction of shelter for livestock using palms, grasses and other non-conductors of heat, increased range land for livestock, cull infected animals and, decrease in stocking rate of animals in coping with climate change. Adesina, *et, al,* (2008) suggested some of the appropriate adaptation strategies in livestock industry to include: intensive feeding, de-stocking, enrichment of range land with fast growing shrubs, expansion of rain harvest for livestock feeding, designation of more areas for feeding, provision of bore holes, regular culling of old animals and regular visits to veterinary clinics.

The adaptation practices listed above for livestock production are alternatives from which farming decisions on the choice of adaptation measures has to be made by the farmers subject to the available human and material resources of the farmers. Decision making is a mental processes (cognitive process) resulting in the selection of a course of action among several alternative scenarios.

2.4 Gender and Climate Change Adaptation.

Gender refers to the differences in socially constructed roles and opportunities associated with being a man or a woman and the interactions and social relations between men and women. According to Okimamhe (2009) gender influences social expectations, values and what society perceives as normal. The gender approach takes into consideration the fact that women and men react to and participate in social, economic and environmental realities differently depending on their age, socio-economic status and culture (UNDP, 2008).

Gender element in climate change and adaptation refers to the different ways in which men and women contribute to climate change, the different impact that climate change has on men and women, the different ways that men and women respond to and are able to cope with climate change, and the differences in how they are able to shift from short term coping mechanisms to resilience (Annecke, 2010). These differences should be acknowledged in the adaptation process to avoid further increases in gender inequality and to ensure the success of climate change adaptation policies and measures (Roehr, Alber, Skutsch, Rose and Heul, 2004). Aguilar (2009) substantiated that because climate change affects women and men differently, a gender equality perspective is essential when discussing policy development, decision making, and strategies for mitigation and adaptation to climate change.

Gender in climate change adaptation efforts recognizes the fact that men and women often hold different positions and have different responsibilities and decision-making authorities within the household and in the society (Brody, Demetriades and Esplen, 2008). The authors noted further that men and women share dissimilar control over and use of resources, and often times have different views and needs.

Gender roles and climate change adaptation technologies take into account that menôs and women's specific priorities and needs are met to ensure that the adaptive technologies are gender-sensitive, user-friendly, effective and sustainable (NEST, 2011). Brody, *et al,* (2008) added that an adequate integration of a gender perspective into climate change adaptation programmes considers the division of labour and sharing of benefits between men and women, so as to consciously distribute work and benefits to facilitate equal access to, and control of resources in climate change adaptation. In addition, Vincent, *et al,* (2010) stated that an integrated gender approach in community-based adaptation facilitates the equitable participation of men and women alike and adequately addresses the sometimes differing strategic needs of both genders. In the same way that gendered roles lead to differences in vulnerability between men and women, they also create opportunities for adaptation (UNDP, IUCN & GGCA, 2009).

Women farmers for instance are not just victims of adverse climate effects due to their vulnerability; they are also key active agents of adaptation (Vincent, et al, 2010). This is due to their often deep understanding of their immediate environment, their experience in managing natural resources (water, forests, biodiversity and soil), and their involvement in climate sensitive work such as farming, forestry and fisheries (Brody, *et al,* 2008). In affirmation, Vincent, *et al,* (2010) while assessing gender roles in climate change adaptation observed that women are often in charge of water management but, if they are not consulted about where to build new wells, the wells may be placed too far from their reach, thereby actually increasing their burdens. The report of UNDP (2008) showed that the complementarity of menôs and womenôs knowledge and skills is key for designing and implementing effective and sustainable adaptation initiatives, answering to their specific needs and ensuring that both benefit equally from the development process.

2.5 Vulnerability of Nigerian Agriculture to Climate Change

The term vulnerability has come to be widely used in recent years alongside effects of climate change on the rural poor most especially in sub-saharan countries Nigeria inclusive. The Intergovernmental Panel on Climate Change (IPCC) (2007) defined vulnerability to the threats of climate change as the extent to which climate change may damage or harm a system or group of people. It added that, vulnerability depends not only on a systemôs sensitivity, but also on coping ability of the people in a system and their level of exposure to the negative impacts of climate change.

Climate change is already having significant negative impacts in Nigeria, and these impacts are expected to increase in the future. In the absence of effective adaptation, climate change could result in a loss of between 2% and 11% of Nigeriaôs GDP by 2020, rising to between 6% and 30% by the year 2050. This loss is equivalent to between ك15 trillion (US$100 billion) and ك69 trillion (US$460 billion) (BNRCC, 2011). This large projected cost is the result of a wide range of climate change impacts affecting all sectors in Nigeria. For instance, the adverse impacts of climate change are expected to lead to production losses in the Nigerian agricultural sector, compromising the attainment of the Millennium Development Goals, especially Goal 1 ñEradicate Extreme Poverty and Hungerò and Goal 7 ñEnsure Environmental Stability (BNRCC, 2011).ò

This is because, the adaptive capacity to the effects of climate change among the farmers is grossly low thereby subjecting the sector into further threats. Ayinde, Ajewole, Ogunlade and Adewumi (2010) stated that Nigerian farmers are confronted by major environmental problems; and every climate study indicates that Nigeria is one of the countries that are vulnerable to climate change (Obioha, 2008). In addition, the report of Nigerian Environmental Study/Action Team (NEST, 2004) while assessing the vulnerabilities of Nigerian agriculture to climate change showed that:

i. Almost 2/3 of Nigeria's land cover is prone to drought and desertification;
ii. 2/3 of the Nigerian farmers depend on rain-fed agriculture and fishing activities;
iii. Nigerians are concentrated within an area of 923,000 square kilometers, and that Nigeria's population of approximately 140 million people is highly dependent on the physical environment for survival and livelihoods;
iv. To a large extent, climate affects the availability of water, which then impacts health, energy sources and ultimately the level of poverty among Nigerians. Water resources affect energy sources, such as the Kainji and Shiroro dams, which may lose their capacity to generate power if their levels decline;
v. Nigeria lacks the financial resources and technological capacity to address the current and predicted negative impacts of climate change; and
vi. That Nigeria has not yet fully established an institutional and legal framework, systematic approach or policies targeted at combating, mitigating and adapting to the impacts of climate change.

When discussing farmers vulnerability to the effects of climate change, three mutually exclusive elements are involved; these according to IPCC (2007), Füssel and Klein (2006) are exposure, sensitivity and adaptive capacity of the farmers to cope with climate change.

Exposure

Exposure is the degree of climate stress to which a particular unit or system is exposed (Adesina and Odekunle, 2011). The stress could be changes in climate conditions or variability in climatic behaviour including the magnitude and frequency of extreme events (O'Brien, Sygna and Haugen, 2004). Using farming households as illustration, the less dependent a farmer is to rain-fed agriculture, the less exposed the farmer to climate-induced threats such as drought and rainfall shifts. Unfortunately, FAO, (2008); Medugu, (2008) and IFAD, (2007) projected that the effect of climate change is expected to be worse on Nigerian farmers whose production is predominantly rain-fed. Irrigation system helps farmers in the face of severe drought to cope with devastating effects of climate change.

Three main categories of irrigation development exist in Nigeria today, namely public irrigation schemes, which are systems under government control (formal irrigation); the farmer-owned and operated irrigation schemes (informal irrigation) and residual flood plains fadama irrigated scheme. With the current one million hectare being irrigated in Nigeria, Madu, *et al* (2010) stated that Nigeria has not developed enough irrigation system to the same extent as other developing countries. For instance, India which has about 3.5 times the land mass of Nigeria irrigates almost forty-five 45% of its land (FAO, 2007). The consequences of this trend of inadequate irrigation effort in Nigerian agriculture are the increasing frequency and severity of drought which are likely to worsen the predicted crop failure, high and rising food prices, distress sale of animals, decapitalization, impoverishment, hunger and eventually famine.

Recognizing the significance of irrigated farming in adaptive measures to drought, Ayinde, *et al* (2010) recommended that if food production must be increased and sustained in Nigeria, irrigation as a constant water supply is the most suitable mode of water supply for agriculture which will have positive influence on the food security and Nigerian environment. Despite Nigeria vast fresh water resources which in excess of 20 million hectares, Nigerian farmers are highly vulnerable in the area of water supply for domestic and agricultural purposes as well as biodiversity maintenance (Adesina, *et al*, 2010). Inadequacy of water for agricultural processing often results to poor processing and consequently poor quality of the processed products. FAO (1995) exemplified that poor processing of cassava tubers for instance is a major cause of post harvest loses with special emphases on developing countries such as Nigeria. Portable water shortage in Nigeria is about (60% annually) due to floods and/or saltwater intrusion; storm surges result often in loss of post-harvest sheds and farmstead stores (Idowu, *et al,* 2011).

The heat effect of climate change on agriculture causes the growth and development of spoilage molds which affect products in storage by causing adverse quality changes, heat-damage, dull appearance, musty odours, visible moulds and production of toxins and allergens (Canadian Grain Commission, 2009); this result to food lost and shortage. The general estimated losses recorded in Nigeria for stored root and tuber crops for 1991 to 1997 was about 30% to 60% (FAO, 2008). This among others was due to Nigeria high level of exposure to the impact of climate change.

Sensitivity

Sensitivity is the degree to which a system is affected, adversely or otherwise, by climate-related stimuli (Adesina and Odekunle, 2011). It is the degree to which farmersô farming activities are modified or affected by an internal or external disturbance or set of disturbances induced by change in climatic condition. This measure, which reflects the responsiveness of a system to climatic influences, is affected by both socioeconomic and ecological conditions and determines the degree to which a system will be affected by environmental stress. For instance, the increasing severity of crop failure and loss of yields due to false start of the rains, frequent intervening dry spells during the growing seasons, early cessation of rains (Odukunle, 2004) are recent frequent occurrence in Nigeria. This worsen the condition of crop damages by storms and flooding, rising temperatures and pest infestations (Adesina, *et al,* 2008).

In addition, Adebayo, *et al* (2011) supported that Nigeria and all the developing countries are already experiencing low crop yields as a result of extreme weather and climate change. Describing the sensitivity of Nigerian agriculture to climate change, studies have provided evidences that since 1968, the start of rains has been getting progressively delayed over southern Nigeria as corroborated by the significant decline in April rainfall (Apata, *et al,* 2009). Adesina and Odekunle (2011) also added that the late arrival of rains, drying up of streams and small rivers that usually flow year round, the seasonal shifting of the ñMango rainsò and that of the fruiting period in the southern Oyo State and the gradual disappearance of flood-recession cropping in riverine areas of Ondo State are among the effects of climate change in communities in the southwest Nigeria. These inconsistencies in rainfall have made it generally difficult for farmers and scientists to predict precipitation patterns (IPCC, 2001).

Adaptability

Adaptability is the degree to which adjustments or modifications are possible in practices, processes, or structures of systems to anticipated or actual changes in climate (Adesina and Odekunle, 2011). It is a measure of the resilience or resistance to negative climatic stimuli as well as the coping capacity of farmers, community or nation to climate change. It refers to the degree to which systems or practices can be adjusted or modified to respond to changing climatic conditions. Adaptation is influenced by the quality of the resistance and resilience of a system. Available evidence shows that 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 coping capabilities (Nwafor, 2007; Jagtap 2007). Nigeria is one of these developing countries (Odjugo, 2010).

The poor, majority of who are rural farmers are more vulnerable to the impacts of climate change as they lack the capacity (e.g. education, financial, technical, access to information, human and institutional resources) to cope and adapt (IPCC, 2007). The report of IFAD (2007) confirmed that poor state of the Nigeriaºs education also has its effects on the poor people majority of who are farmers in rural areas. It is well documented in the literature that, farmersô level of education has significant influence on their level of awareness, perception and adaptation to the effects of climate change in their farming activities. Illiteracy for example hinders farmersô access to information to improve their livelihood enterprises and speed of recovery from a climatic disaster or constrain their options for livelihood strategies. Illiteracy may reduce farmerºs ability to take up opportunities such as employment and inhibits access to information or technical advice that could help them adapt to climate change in their farming activities.

Insecure access to other livelihood resources such as agricultural land, water, infrastructure and financial resources can limit peopleºs ability to facilitate adaptation to climate change. The vulnerability of a region depends to a great extent on its wealth and that, poverty limits adaptive capabilities.

Low levels of technology and limited information on climate change exacerbate farmersô inability (vulnerability) to adapt to climate change. This describes the situation of an average farming household in Nigeria. Corroborating this fact, the vulnerability of farmers to the effects of climate change is expected to be most severe in Nigeria. In a continent whose population is still largely rural and where agricultural practices are still traditional and rain-fed, there is increased likelihood of farmersô vulnerability to the effects of climate change (Kurukulasuriya and Rosenthal, 2003).

At institutional levels, a limited understanding of climate risks and vulnerabilities together with a lack of policy direction and regulatory guidance still account for constraints faced by local farmers resulting in their failure or inability to adapt to climate change (Boko, *et al*, 2007). Land tenure and fragmentation systems could also limit the adaptivity of farmers to climate change impacts. Among most African peoples, farmland is not owned but held in trust by the present generation on behalf of their future descendants. It could be held by individual families, extended families or entire village communities and then fragmented to individual farmers, who only enjoy user rights. Outright purchase of farmland is not common, but rental for a period of time could be possible (Nweke and Enete, 1999). This limits the level of individual farmerӽs investment in the development of a farmland, since the user right could be withdrawn anytime. The structural presentation of farm householdӽs vulnerability to the impacts of climate change is depicted in figure 2.1 below.

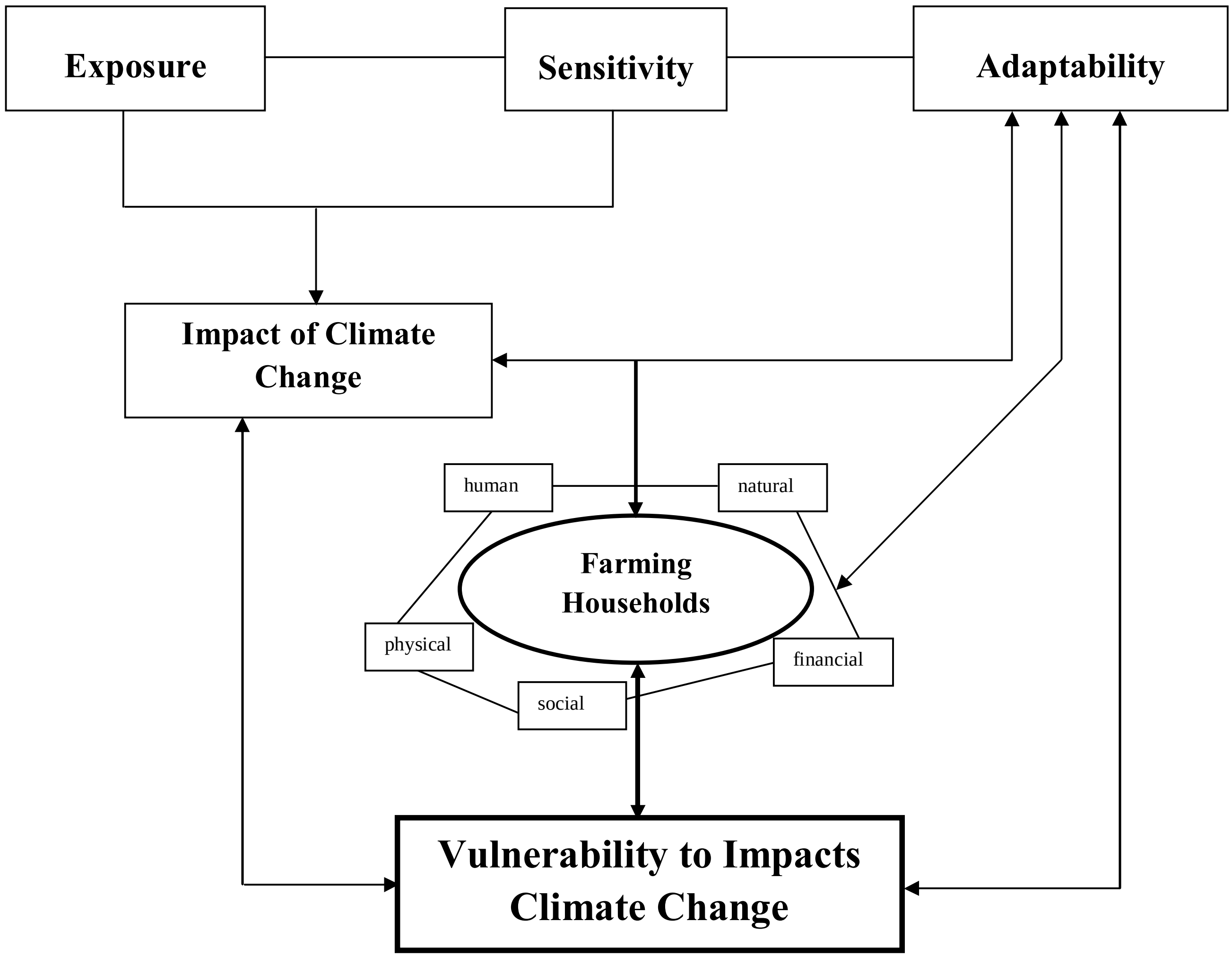

Figure 2.1: Vulnerability of Farm Households to Climate Change

Householdȏs vulnerability to climate change is a function of exposure, sensitivity, and adaptive capacity of the household (Allen Consulting Group, 2005). The adaptive capacity of the farming households is greatly determined by their livelihood assets which include: human, natural, financial, physical and social assets. In other words, these assets constitutes the socio-economic attributes of the farming households who are building adaptive responses to the impacts of climate change in their daily farming activities.

Vulnerability Analysis

This section reviews literature on econometric methodologies used to assess households vulnerability. The econometric approach to measuring vulnerability has most of its roots in poverty and development literature. The methodology uses household-level socioeconomic survey data to analyze the level of vulnerability of different social groups. According to Hoddinot and Quisumbing (2003) there are three different methodologies used to assess vulnerability, these include: Vulnerability as uninsured Exposure to Risk (VER), Vulnerability as low Expected Utility (VEU) and Vulnerability as Expected Poverty (VEP). All the three methods construct a measure of welfare (income) loss attributed to climate charge and other forms of physical or social shock.

Vulnerability as Uninsured Exposure to Risk (VER)

This method is based on *ex post facto* assessment of the extent to which a negative shock causes welfare loss (Hoddinot and Quisumbing, 2003) the impact of shocks is assessed using panel data to quantify the change in induced consumption.

Vulnerability as a Low Expected Utility (VEU)

Under this method, Ligon and Schechter (2003) defined vulnerability as the difference between utility derived from some level of consumption at and above, which the household would not be considered vulnerable. The limitation of VER and VEU methods is that, in the absence of panel data, estimates of impacts, especially from cross sectional data are often biased and thus inconclusive (Skoufias, 2003).

Vulnerability as Expected Poverty (VEP)

Under this framework, a farmerǿs vulnerability is considered as the probability of that farmer becoming poor in the future if currently not poor or the prospect of that farmer continuing to be poor if currently poor (Christiaensen and Subbarao, 2004). It is argued that pre-existing conditions and forces influences the magnitude and the ability of farming households or communities to reduce vulnerability to climate change impacts. Hence, under this scenario, vulnerability is seen as expected poverty, with consumption or income being used as the welfare indicator. In this conception, the vulnerability is measured by estimating the probability that a given shock, or set of shocks, moves consumption of an individual/household below a given minimum level (for example a consumption poverty line) or forces the consumption level to stay below the given minimum requirement if it is already below that level (Chaudhuri, Jalan and Suryahadi, 2002). In this case, vulnerability can be measured using the cross sectional data unlike the other methods that require panel data.

2.6 Concept of Farming Decision.

Farm management is concerned with decision making. A decision, according to Okoye (2002) is the selection of alternative course of action from available alternatives in order to achieve a given objective. Oji (2002) was of the opinion that decisions have to be made when persons having limited resources have alternative course of actions and therefore must make some choices. Farming decision making is therefore a mental and intelligent process in which farmers use available information relating to farming to select and combine farm resources they consider best for achieving their farming objectives. Farming decisions are not made in a random fashion; rather farmers pursue rational actions which imply that farming decisions are made to obtain farming objectives.

In practice, the farmer does not make all his farming decisions at a time (Upton, 1996); rather farming decisions are made in sequential process. Some of these decisions are routine because they are made every day while other decisions require much time and thought. Farmers make daily decisions about input use, seasonal decisions about what to plant, annual decisions about farmland rent and multi ï years decisions about ownership and upkeep of land. Farming decision can be classified on the basis of their frequency, importance, imminence, revocability and availability of alternatives (Castle and Becker, 1971). Therefore in all farm operations, farm decision is always at the core; it is at the central point of farm management functions. Whenever there is need to choose from among alternative course of actions, decision is made (Akibu, 2002).

The essence of farming decision making is to concretise farming activities planning that are geared towards accomplishment of a desirable future farm state. Since farming decision is futuristic, it is usually embedded in uncertainty. Invariably, farmers often times have to take decisions under uncertainties and under risky conditions. What is important is ability to weigh the chance of success or failure as well as the probable costs and benefits of each decision being taken (Akibu, 2002).

Therefore, as regards climate change, successful application of appropriate adaptation measures requires the ability of the farmers in managing their farms not to only make decisions but to make the right farming decisions while taking into consideration the prevailing economic and environmental condition of the farmers. Okoye (2002) stated that manager should be more conversant with what they want to take decision on. The farmers who are building adaptive capacity in responding to the effects of climate change through decision making must follow some steps.

2.6.1 *Steps in Farm Decision Making*

In making wise farming decision, careful decision making steps are followed. Such steps are described by Akibu (2002), Castle and Becker (1971), and Okoye (2002). The advantage of the similarities in their description of the decision making steps is well utilized in this study. The farming decision making steps according to the authors are sequentially arranged as;

i. Setting or formulating realizable farm objectives.

ii. Identifying the farm problems for which solutions have to be made.

iii. Identifying all possible / available alternatives cause of action.

iv. Gathering all required information and observation about farm resource (human and material resources)

v. Considering the alternatives of which a final choice has to be made.

vi. Selecting or making the farming decision.

vii. Taking action, that is implementing the farming decision on farm activities.

viii. Accepting responsibility for action taken

ix. Evaluating the final decision made.

Evaluation of the result of action taken ends the farming decision making process and it also acts as measuring stick which provides guide or standard for determining the effectiveness of decision made (Oji, 2002). The day to day activities of the farmers in taking adaptation decisions to cope with the effects of climate change in their farming activities is informed among others by their willingness to improve production and possibly minimise cost. Farmersô farming decisions affect agricultural production, prices and cost.

2.7 Climate Change Adaptation Decisions

Adaptive measures to climatic change in agriculture range from technological solutions to adjustments in farm management practices; as informed by farming decision. Another important issue that relates to adaptation in agriculture as pointed out by Bryant, *et al,* (2000) is how perceptions of climate change are translated into agricultural decisions.

Farmers make daily decisions about inputs use, seasonal decisions about what to plant or livestock to rear and the system of production to adopts with special consideration to the changing climate. The farmers are typically confronted with the pressure to act in response to problems that require immediate action such as the impact of climate change. Adaptation to climate change is a response that seeks to reduce the vulnerability of natural and human systems to climate change effects (Farber, 2007). Even if emissions are stabilized relatively soon, climate change and its effects will last many years, and adaptation will be necessary.

Climate change adaptation involves series of adaptive practices in which decisions has to be made. In making adaptation decisions about climate change, Olorunfemi (2009) pointed out that timely and useful information is necessary about the possible consequences of climate change, people's perceptions of those consequences, available adaptation options, and the benefits of slowing the rate of climate change. Downing and Watt (2008) stated that successful anticipatory adaptation requires the best available information concerning the nature of future climate risks.

Therefore, it is vital that climatic information is used more effectively in adaptation decision making. Maddison (2006) argued that farmer awareness of change in climate attributes (temperature and precipitation) is important for adaptation decision making. For instance, Araya and Adjaye (2001) and Anim (1999) exemplified that farmers awareness and perceptions of soil erosion problem as a result of changes in climate, positively and significantly affect their decisions to adopt soil conservation measures. Among farmers, applications of the existing downscaled data in decision making are limited to a few progressive and long-term farming schemes and agribusinesses. Climate change adaptation is, at its best, a social learning process that equips farmers in decision making to respond to a wide range of difficulties to predict contingencies brought about by perturbed climate (Downing and Watt, 2008).

For progress on implementing adaptations to climate change in agriculture, Smit and Skinner (2002) observed that there is need to better understand the relationship between potential adaptation options, existing farm-level decision-making processes and government policies in management frameworks. Climate change adaptation policies will be more efficient if they encourage private individuals and farmers to take explicit account of the economic costs of climate change in their decision-making. Oruonye (2011) stated that participatory development processes have the potential to increase adaptive capacity by improving vulnerable peopleǿs access to information and decision-making processes.

2.8 Gender Factor in Farming Decision

Gender is a concept used in social science analysis to observe the roles and differences between men and women and their experiences as members of society (Fakoya, Apantaku and Adereti, 2006). Gender is different from sex. According to Amaechina (2002), sex denotes the biological features bestowed by nature which characterize males and females while gender varies with culture. Riley (1997) reported that, gender in socio-economic realm refers to those aspects of males and females that are shaped by socio-cultural and economic forces.

The concept of gender often enters discussion within agricultural development programmes either through distinctions between male and female headed households or through distinctions between men and women roles in farm activities (Doss, 2002). The differences in gender factor in rural farming households vary widely across cultures but certain features are common. It is always the key variable defining access to and control over resources. Thomas-slayter and Sodikoff (2001) argued that women as well as men use and manage resources and have difference roles, responsibilities, opportunities and constraints in doing so both within the household and the community. In division of labour, right and responsibilities, gender is a determining factor and therefore affects sustainability of livelihoods and the equality of development (Mehra, 1993).

In agriculture, there are marked and persistent gender inequalities in decision making. In patriarchal societies, women are relegated to play second fiddles in homes and economy.

Kakooza, Kabasimba, Ssemakula and Musisi (2005) stated that the decision-making process in the farm household is influenced by the culture of the community to which the household belongs. Therefore, decisions making in patriarchal societies as regards climate change adaptation are more likely to be controlled by the household heads, men. In matriarchal societies, this may be true only to a lesser extent and only with respect to certain distinct responsibilities. Kakooza, *et al,* (2005) stated further that the personalities of the different household members will also affect their roles in household decision-making. Amaechina (2002) noted that women constitute about half of Nigeriaôs population, make essential and largely unacknowledged contribution to economic life and also play crucial roles in all sphere of society; but despite that, women are however largely excluded from economic decision making (Enete and Amusa, 2010).

Many crucial decisions even which affect farm women are made by men with little or no input from the women (URT/UNICEF, 1990). Women cannot on their own take farm decision even on some of the activities they perform on the farm. This could also be the situation among farming households in south-western Nigeria as regards gender roles in climate change adaptation decisions. Most farm women as reported by Anyanwu and Agu (1995) always refer to their husbands for confirmation and support before taking decision to try out some farm technologies. Such technologies could involved adaptation measures aimed at coping with the threats of climate change in crop and animal production.

There are gender imbalances in farmers access to land and decision making since colonial time most especially in the developing nations. Mosha (1992) decleared that in developing countries, there are problems of stereotypical model of society where men are conceived to be dominant over woman and therefore their needs and roles are different. In most cases, men are regarded as planners, thinkers and decision makers while women are the acceptors of the decisions. As regards climate change adaptation, many key decision-making institutions related to climate change have a male-dominated hierarchical structure. Mosha (1992) reported further that, gender difference is however based on the intensity of work, decision making on the farm and access to and control of farm resources. Men control farm resources and farm decision making is vested in them ñmenò (Ishengoma, 2005). Contributions of either a man or woman in a farming household to climate change adaptation decisions may be greater under such a condition of improved level of education, awareness, income, farming experience and access to climate change related information. For instance, Ngome (2003) exemplified that activities that confer more income earning power on women tend to increase their participation in decision-making in the household.

Decision-making within households has to do with bargaining, and this bargaining depends on the endowments of the parties. Incidentally, these endowments are not necessarily natural but often times human products (Ngome, 2003) inform of income capacity, education, experience and access to other resources that can help improve the coping capacity of men and women farmers in the face of inequitable impacts of climate change. Therefore, greater inclusion of a gender-specific approach in climate change adaptation and decision-making may reverse the inequitable distribution of climate change impacts. The report of WEDO (2008) showed that greater inclusion could also improve adaptive decision-making itself, reducing the negative impacts on the entire community, thus enhancing human security.

2.9 Challenges of Farmers in Climate Change Adaptation Decisions.

Nigeria, like some other developing countries is principally an agrarian nation. The agricultural sector plays an important role in Nigeriaôs economy, contributing about 40% of the GDP (Olomola, 2006) even in the face of climate change; and employing about 65% of the labour force (Adedipe, Okuneye and Ayinde, 2004). Despite this significance, the major actors in Nigerian agriculture, the farmers, who are building adaptive response to the effects of climate change are faced with challenges in effective decision making to cope with the established impact of climate change in their farming operations. Adaptation to climate change is made up of actions by individual farmers, groups and government. In essence, Dessai and Sluijs (2007) stated that climate change adaptation is a complex societal process of activities and actions involving decisions that reflect existing social norms and practices.

Making good decisions in an environmental protection context such as climate change adaptation constitute some challenges to the farmers because of the complexities in the issues of environmental management (Hammond and Raiffa, 1998), the conflict of interest of stakeholders and cost implications of environmental protection. Notable among these challenges are;

institutional, financial, technological, challenges of farm labour shortage and land tenure problems.

2.9.1 Institutional Challenges

Poor institutional framework of agricultural institutions in Nigeria has served as one of the greatest constraints faced by farmers in building effective response to climate change. Institutional barriers limit farmerőś access to farm support services such as extension, education, information services, cooperative and other relevant agricultural services. According to Migindadi (1992) relevant farm related information is needed for effective farm operations and decision making. Effective flow of information increases awareness about an issue of concern such as climate change. Hence, Maddison (2006) argued that farmers awareness of change in climate attributes (temperature and precipitation) is important to adaptation decision making. The evolution of farming system based upon increasing effects of climate change, specialization or integrated intensification has called for extra knowledge on the part of farm operators for success in climate change resilience. Inadequate education, information and training is frequently a key limiting factor to small holder development.

The report of IFAD (2007) showed that the poor state of the countryőś education has also had its toll on the poor people, majority of who are farmers in rural areas. For instance, agricultural technology delivery, the main activity of the agricultural extension programme in Nigeria as it is in many developing countries is on the brink of collapse. Out of the six extension programmes that operated in Nigeria in the last thirty years, only two; River Basin Development Authority (RBDA) and Agricultural Development Programme (ADP) still exist and are being operated in limited scopes (Chukwuone, Agwu and Ozor, 2006).

The inadequacy of extension visits or contacts to attend to the training needs of farmers are well documented in the literature. Sofoluwe, et al, (2011) stated that the inefficiency of extension service in the country is one of the problems being faced by majority of farmers in coping with climate change. In limited cases where such services are made available, Raffety (1988) noted that agricultural extension programme and other supporting service have traditionally concentrated more on educating male farmers while female farmers still depend largely on their husbands for farm related information. This is far from achieving the objectives of clarion call for sustainable climate change resilience and gender mainstreaming in agricultural development.

The emergence and wide acceptance of ICT in agro-information dissemination would have salvage the situation; unfortunately the view of Enete and Amusa (2011) showed that the alternative sources of agricultural information like the internet facilities are yet to expand to the rural areas, and may in fact not be able to because of language and cost barriers. This trend has consequently worsened rate of flow of technical information to the disadvantage of the farmers who are building adaptive response to impact of climate change. Supportive and technical information about climate change adaptation as a result of research efforts has to be made available to the farmers for quality farming decisions making. Sofoluwe, Tijani and Baruwa (2011) observed that the lack of information flow on appropriate adaptation options could be attributed to the dearth of research on climate change and adaptation options in the country. Hence, Akibu (2002) stated that the quality of a decision made is a function of the quality of information made available for it.

The weak institutional support of the government to the farmers through lack of functional policies and agricultural training has further weakened the farmers efforts to make concise adaptation decisions. Koppelman and French (2005) observed that, agricultural investment and production decisions are made by farmers and landowners based on key external factors which include; availability and access to market; availability and access to support services; availability and access to scientific and indigenous knowledge; presence of policies, rules and functional regulations.

2.9.2 Financial Challenges

Finance or agricultural credit enhances productivity and promotes standard of living by breaking vicious cycle of poverty of small scale farmers (Adebayo and Adeola, 2008). The financial constraints facing the small scale farmers in agricultural production most especially in coping with the impacts of climate change is well documented in the literature. The crucial role of finance in agricultural production can be appraised from the perspective of the magnitude of problems emanating from the lack of it as it holistically affects farming decision making process.

According to FAO (2005), a control factor affecting investment and production decisions is the farmersô level of control over his land and other farm resources such as capital. The amount and type of land under farm household determine their access to loan, the need for mechanisation, extent of market oriented production and saving (FAO, 2005). Therefore, a farming household income or wealth status is likely to influence its farm decision making in relation to adaptation practices to adopt in the midst of other alternatives. Ministry of Agriculture and Forestry New Zealand, (2000) reported that farm business characteristics such as farm size and financial capacity are influential on farmersô behaviours and decisions on the farm.

The resultant effect that income from farming among Nigerian farmers remain too low and the enterprises absolutely unattractive (Oni, 2009) constitute a major challenge for adaptation. The production cost of some important agricultural commodities in Nigeria is increasing and this is consequently affecting the daily farming decisions of the farmers as regards inputs use, the production system to adopt, the scale of production and other decisions to maximize output. For instance, IITA (2005) confirmed that production cost for cassava is relatively high. It is estimated that the cost of managing 1 ha of cassava from land preparation to harvesting is about ك70,000, if all recommended practices and input levels are followed (Taylor, *et. al,* 2005). This can pose a major challenge to farmers in coping with the changing climate. This is because, farm capital that would have been utilised for adaptation practices will be diverted into securing the costly farm inputs.

The application of agrochemicals, fertilizers and irrigation facilities are some of the important farm practices for farmers to cope with the changing climate. Phillip, Nkonya, Pender and Oni (2009) added that due to increasing cost of insecticide, agrochemical and fertilizers, the on-farm costs of crop production is very high at the small-scale level in Nigeria. Lack of financial assistance is a challenge to farmers in crop production. On livestock production, inadequate finance to expand herd size constitute a threat (Aphunu, Okoedo and Okojie, 2011). The increasing cost of farm inputs consequently affects farming decisions. This is because, the decision making in agricultural production deals with wise allocation of farm resources among alternatives.

In the view of Deressa (2008), most of the problems or constraints encountered by farmers in adaptation to climate change are associated with poverty. This also has a strong link with lack of finance in agricultural production. This affects most farmers inform of limited access to secure farmland for agricultural production and inadequate access to more efficient production inputs. The results of studies conducted by Maddison (2006) listed financial constraint in the use of recommended adaptation methods as one of the major barriers to climate change adaptation in Africa. This has an effect in the farmers decisions to adopt recommended adaptation measures or practices when the financial capacity of the farmers for adaptation is low.

2.9.3 Technological Challenges

Technological change in agriculture has played a major role as a leading engine of growth and poverty reduction in many developing countries over the past few decades. However, it is obvious that to transform Nigeriaꞌs largely traditional farming system to mechanised one, there is the need to inject in the system, substantial engineering and technological inputs that are properly managed in terms of both environment and existing/potential technologies (Asoegwu and Asoegwu, 2007).

For mechanised farming to succeed, agricultural production, processing and utilization must necessarily move from the present subsistence and crude nature to a wide acceptance of mechanical systems such as farm tractors, farm implements and associated equipment, and improved (high yielding variety) seeds, chemical fertilizers and herbicides, and better management techniques under a favourable climatic condition for enhanced productivity (Oni, 2009). According to CPD (2004) technological improvement in farm operations is generally a good effort. Its introduction in developing countries basically had the intention of reducing drudgery in farm operations as well as improving production (Lamming, 1983). These advantages seem not to have been well exploited in Nigerian agriculture as most Nigerian farmers are still facing some technological challenges in farming.

Deressa (2008) is of the opinion that lack of money hinders farmers from getting the necessary resources and technologies; such as irrigation facilities to adapt to drought effect of climate change. Poor irrigation potential is most likely associated with the inability of farmers to have water source close to their farms (Sofoluwe, *et al,* 2011). The shortage of land and poor potential for irrigation constitute major challenges in climate change adaptation (Deressa, *et. al,* 2008). The report of FAO (1997) further substantiated that the prevailing technological challenges and poor irrigation potential in most African countries can probably be associated with technological incapability of the farmers. Small scale farmers in Nigeria are generally poor and cannot afford to invest in farm technologies to adapt to climate change during harsh climatic extremes such as drought which often causes famine.

Poor production, processing and storage technologies are generally a bane on agricultural development in Nigeria. The resource poor farmers who produce the bulk of the food share the adverse impact of this problem. Therefore, in any farm activities and decisions that has to do with farm machineries or technologies, the resource poor farmers are likely to be grossly disadvantaged due to their associated low technical know-how.

In developing countries, Aguilar (2009) reported that new technologies are usually transferred through agricultural extension systems staffed by male officers who are more comfortable working with male farmers. In some cases, local cultural norms make it difficult or even impossible for male extension workers to interact with female farmers.

Taking into consideration womenós multiple roles in the household, they are often not available for training on new technologies and agricultural innovations which may help to improve their relevance and efficiency in their farming households (FAO, 1996; Nwaipopo, 1994). This creates a technological knowledge gap as regards gender and acquisition of technological skills in farming. Recognizing the significance of technological advancement among farmers in climate change adaptation, institutional capacity building to major actors in environmental issues is fundamental among the most important needs of developing countries; that, this is critical in their struggle to incorporate climate change policies within development strategies.

2.9.4: Shortage of Farm Labour

Farm labour is an important aspect of agricultural production. It is either supplied by the farm household members or hired as farm labourers at an agreed cost for farming activities. Activities relating to adaptation to climate change are costly and this cost could be revealed through the need for intensive labour use for activities like mulching, intercropping, water harvest for irrigation, agroforestry tree planting among others.

Unfortunately, the current trend of rural urban migration of youths to earn a livelihood in the cities has greatly reduced availability of farm labour in the rural areas. This has consequently worsened the vulnerability of the rural farmers who are building adaptive response to climate change. Thus, if farmers do not have sufficient family labour or the financial means to hire labour, adaptation to the impacts of climate change could be difficult (FAO, 2007). The findings of the studies of Deressa, *et. al,* (2008); Enete and Onyekuru (2011) and Sofoluwe, *et al,* (2011) showed that labour shortage is one of the major challenges facing farmers in climate change adaptation.

The shortage of farm labour or financial resources to pay for hired labour may affect farming decisions on activities that relate to climate change adaptation. For instance, as earlier pointed out, the planting of agroforestry trees is one of the major climate change adaptation practices. Hence, Arnold (1987) noted that one of the major factors influencing farmersô decision to plant agroforestry trees is labour requirement. The author noted further that a farmerôs decision to grow trees can be influenced by two main factors: one is the high cost of labour and capital and the other is the potential of income to be generated from tree as distinct from food production in farmersô production objectives.

Njoku (1991) in a study on factors influencing the adoption of improved oil palm production found out that a major constraint was high cost of labour. The strong competition for household labour with other activities in the farming system particularly during critical periods in the agricultural season would obviously influence farmersô decision about adopting agroforestry to cope with the threats of climate change. This according to Kang and Wilson

(2009) has been found to be true of alley farming where labour availability was found to significantly influence decisions to plant alley cropping.

2.9.5 The Challenges of Land Tenure System.

The challenges of land tenure system are a major problem in Nigerian agriculture. Land tenure according to Usman (2003) is a set of rules defining the customary and legal rights which govern the social relations between individuals or groups in their access to and use of natural resources. Land tenure, which refers to land use rights and security are among the recognised land related factors affecting environmental conservation practices.

The institutional arrangements under which a person gains access to land largely determines, among other things, the decisions on what crops he can grow, how long he can till a particular piece of land, his rights over the fruits of his labour and his ability to undertake long-term improvements on the land. Carlos, *et al,* (2006) declared that private land owners posses the decision making authority for most of their lands. A farmer with secure tenure and capital is much more likely to think of long term production decision than share croppers or migrant labourers (Koppelman and French, 2005).

Land use rights, which are temporal, create insecurity and therefore a disincentive to farmers in taking decisions to domesticate or plant fruit trees. Tenure insecurity is a characteristic of many farmers in many parts of the less developed countries. It arises from a number of sources, depending on the historical pattern of land acquisition and settlement (Meinzen-Dick, *et al*, 2002). Tenure insecurity is viewed as the landholdersô perception of the probability of loosing land within some future time period. Francis (1987) gave the assertion that patterns of tree planting adoption will be shaped by the structure of opportunities and constraints presented by the rules of tenure. Land ownership is one of the two predominant factors (the other was labour) affecting the decision to adopt long time land management such as agroforestry practices.

2.10 Conceptual Framework

Conceptual framework for research purposes is a schematic description and illustration of the causative mechanisms and relationship deducible from the research problems (Eboh, 2009). Conceptual framework depicts a schema providing structural meaning and linkages among major concepts or variables in a phenomena being investigated, their interdependence and relationship with each other. The conceptual framework of this study is built on factors influencing household farming decision. The farm household is the level at which most farm resources allocation decisions are made. FAO (2005) reported that these farm management decisions are continuously made on (i) investment and marketing decision, and (ii) production and conservation decision.

Farming decision making process requires a holistic perspective since many factors play a role. According to Koppelman and French (2005) the major factors that play significant roles in household farm decision making are classified into on-farm and off-farm factors.

2.10.1 On-Farm Factors Influencing Household Farming Decision

A framework for analysis of decision making is proposed where the farm household is used as the primary unit of analysis. At farm household level, decision making is influenced by some internal factors also known as on-farm factors. These are socio-economic and biophysical factors (FAO, 2005).

(i) Socioeconomic Factors

Socio-economic factors in a household are represented by the percentage of people with education, gender, level of income or earnings per year in cash, off-farm employment which represent whether a member of the household work outside of the farm or not, tenancy type among others (Carlos, Stephen and Richard, 2006). Damisa and Yohanna (2007) confirmed the influence of socio-economic characteristics of farmers on their farming decision making. These socio-economic factors that influence household farming decision is classified by FAO (2005) into; social setting, cultural setting, traditional setting/practice and economic capacity/setting of the farm household.

(a) Social Setting: This involves farm householdôs composition and allocation of responsibilities to different household members. According to Koppelman and French (2005) the social settings of a household plays important role in farm management and also in division of family chores by gender. The gender approach takes into consideration the fact that women and men react to and participate in social, economic and environmental realities differently depending on their age, socio-economic status and culture (UNDP, 2008). The concept of gender within a social setting in climate change adaptation efforts recognizes that men and women often hold different positions and have different responsibilities and decision-making authorities within the household and in the society.

(b) Cultural Setting: The farm household is guided by the norms and values of its members and that of their surrounding society. Gender roles in farming activities are determined by tradition and cultural beliefs of the people. As reported by Lally (1998) culture is one of the factors that influences womenôs participating equally with men.

(c) Traditional Setting/Practice: Traditional production and farm management practices play a significant role in the farm household decision making. In adapting to the changing climate, there are a good number traditional practices among farmers; for instance, (see Adesina, *et, al,* 2008; Enete, *et al,* 2011; Hassan and Nkemechena, 2008; Mandleni and Anim, 2011 and Ozor and Nnaji, (2011). Farmers can be conservative in making decisions to change their farming practices, this is because decision making is embedded in uncertainty (Akibu, 2002). Each adaptation practice has its unique advantages that are derived from careful combination of farm resources resulting in a special lifestyle of the farm family.

(d) Economic Capacity/Condition: A control factor affecting investment and production, decisions is the farmersô level of control over his land and other farm resources. Carlos, *et al,* (2006) declared that private land owners posses the decision making authority for most of their lands. A farmer with secure tenure is much more likely to think of long term production activities than share croppers or migrant labourers (Koppelman and French, 2005).

The amount and type of land under a farm household determine their access to loan, the need for mechanisation, extent of market oriented production and saving (FAO, 2005).

Therefore, household income or wealth status is likely to influences its farm decision making. In affirmation, Ministry of Agriculture and Forestry New Zealand (2000) reported that farm business characteristics such as farm size and financial capacity are influential on farmersô behaviours and actions on the farm. The schematic representation of the conceptual framework of the on-farm factors (socio-economic and biophysical factors) influencing household farming decision is presented in figure 2.2 below.

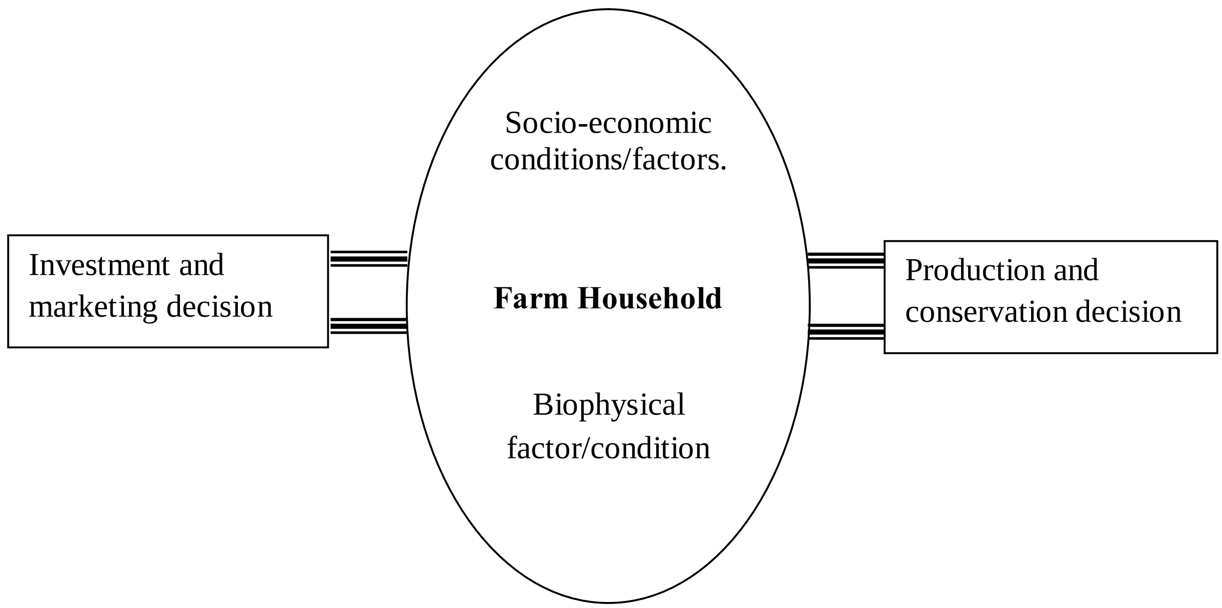

Fig. 2.2: On-farm Factors Influencing Household Farming Decision
***Source*: FAO, 2005**

Adaptation to temperature rise and reduced precipitation or drought is a response to climate change. Farmers do this inform of strategies such as crop diversification, varying the planting dates, varying harvesting dates, irrigation, mulching, construction of drainages, tree planting and so on in order to reduce the vulnerability of natural and human systems to climate change effects (Farber, 2007). Nigerian agriculture being rain dependent is sensitive to climate change. Therefore, farmers make farming decision on daily, seasonal and annual basis and always have good reasons for their decisions (Koppelman and French, 2005).

(ii) Biophysical Factors

The biophysical factors are on-farm factors that are most of the time beyond the direct control of the farm households. These factors are more or less environmental factors. In the context of this study, biophysical factors are environmental factors relating to climate change which have direct influence on farming decision for selection of adaptation practices to cope with the negative impact of climate change. The major biophysical factors of interest in this study are temperature rise and declining pattern of precipitation (rainfall).

The temperature trend in Nigeria since 1901 shows increasing pattern. The increase was gradual until between late 1960s and early 1970s when a sharp rise in air temperature was recorded (see figure 2.3) Since this period, the increasing trend in the air temperature has been continuous and technically beyond the control of the farmers. On the other hand, the rainfall pattern in Nigeria between 1901 and 2005 reveals the general declining trend over the periods (see figure 2.4). The period of declining rainfall was sharp around 1970 which corresponds with the periods of sharp temperature rise in the country. This gives a clearer picture of the general changing climatic condition in the country there by making adaptation in food production inevitable.

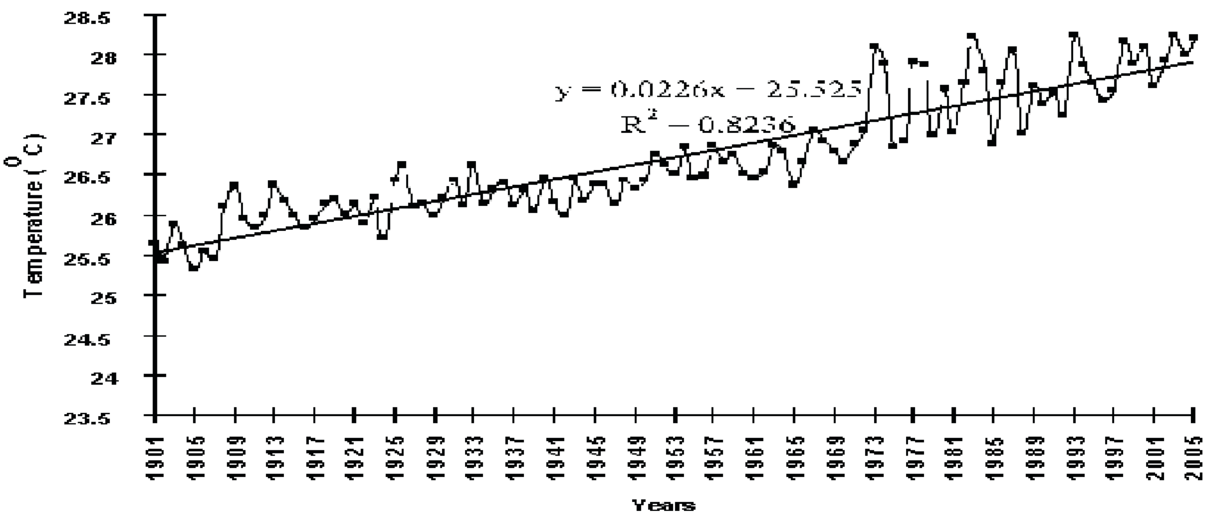

Figure 2.3: Air temperature distribution in Nigeria between 1901 and 2005.
Source: **Odjugo (2010).**

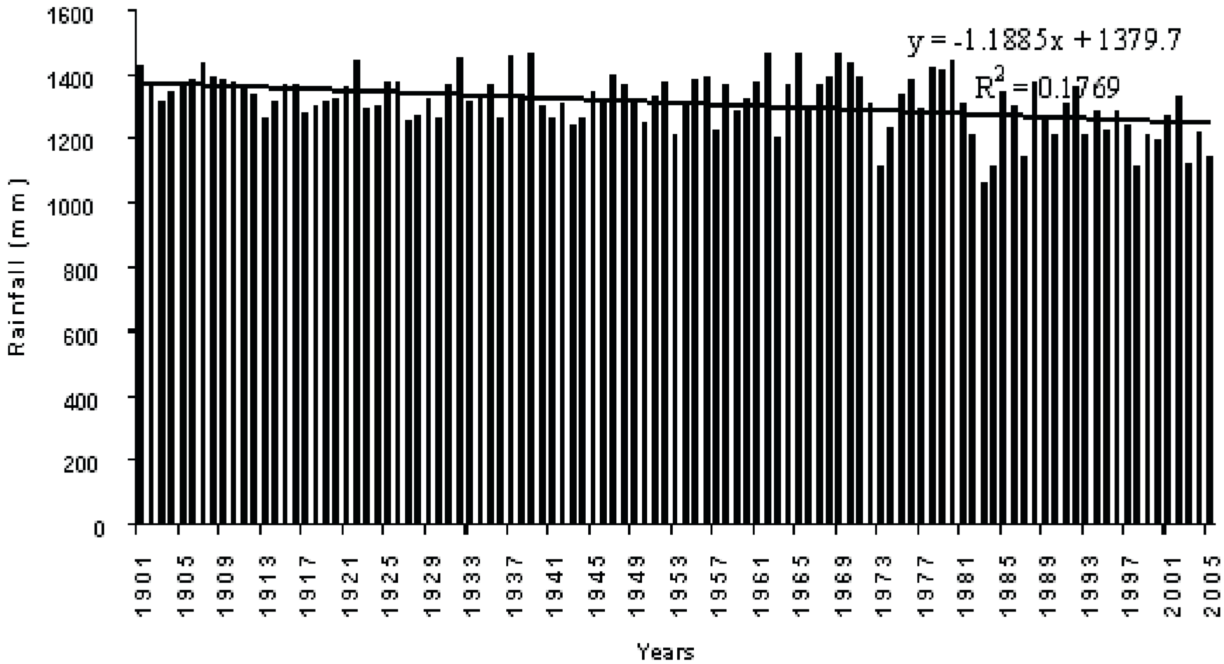

Figure 2.4: Rainfall distribution in Nigeria between 1901 to 2005.
Source: **Odjugo (2010).**

2.10.2 Off-farm Factors Influencing Household Farming Decision

Decision making at farm household level for climate change adaptation strategies is influenced by some conditions that are off the farm. These factors exist within the government favourable supporting services and policies. Smit and Skinner (2002) stated that to ensure progress in implementing adaptations to climate change in agriculture, there is need to better understand the relationship between the potential adaptation options, existing at farm-level decision-making processes and government policies. Climate change adaptation policies operate outside the farm households and will be more efficient if they encourage private individuals and farmers in their on-farm adaptation decision-making.

Explicitly, Koppelman and French (2005) shared that, agricultural investment and production decisions are made by farmers, landowners, and agricultural entrepreneurs based on key external factors which include; availability and access to market; availability and access to support services; availability and access to scientific and indigenous knowledge; presence of policies, rules and regulations.

(i) Markets and Marketing Channels

Arene (2003) described agricultural marketing to involve all those legal, physical and economic services that make it possible for products from producers to get to consumers in a form desired by consumers and at the price agreeable to both producers and consumers for effecting a change of ownership of possessions. These activities or services occur through marketing channels and help to supply market related information to farm households. Farm households need such information for making rational farming decision. Even though not all farmers do detailed cost-benefit analysis, they usually make budget on paper before making decision. Farmers seek information from middlemen, producers associations, retailers, wholesalers, processors, manufacturers and other farmers who all play active roles in marketing channel. FAO (2005) declared that such marketing channels as local, provincial/national and international channels are considered by farmers for sales of farm produce and obtaining necessary market information for decision making.

(ii) Policies, Rules and Regulations

Household farming decisions are greatly influenced by policies, rules and regulations that are made and enforced by the state or community. These are agricultural laws which concern farmers and their agricultural activities (Olaitan and Austin, 2006). As regards climate change adaptation, agricultural adaptation options are categorized into: (i) technological development, (ii) government programmes and insurance; (iii) farm production practices, and (iv) farm financial management. The authors noted further that the first two categories (technological development and government programmes) are principally the responsibility of public agencies by formulating and enforcing government policies to moderate the activities of the major actors in the informal sectors such as farmers.

(iii) Support Services

External support services are often needed by farmers to take the advantage of available adaptation technologies and options. Farm householdôs access to support services such as credit institutions, supplies, subsidies, farm associations, services rendered by middlemen and brokers, market information and extension services influence their farming decision (FAO, 2005). Agricultural extension for instance is a farmer support-oriented service. Farinde (1995) described agricultural extension as non-formal system of education through which farmers are taught how to use agricultural innovations disseminated to them to improve their social and economic conditions with their own farming efforts and resources.

Extension service increases the level of awareness of farmers about climate change. Hence, literature on climate change adaptation makes it clear that awareness is a necessary prerequisite for adaptation (Madddison, 2007). In addition, Gbetibouo (2009) argued that farmers with access to extension services are likely to be aware of changes in the climate because extension services provide information about climate and weather.

Other support services such as subsidies are efforts to support farmers through which government finances agricultural production by reducing prices of farm inputs such as irrigation facilities to the level affordable by the low income farmers. This is necessary for sustainable adaptation by the farmers. For instance, Deressa (2008) reported that most of the problems or constraints encountered by farmers in adaptation to climate change are associated with poverty. Also, the results of studies conducted by Mendelsohn (2000) listed financial constraint in the use of recommended adaptation methods as one of the major barriers to climate change adaptation in Africa.

(iv) Technical Information

Technical information can be provided to farm households from different sources such as successful farmers, researchers, extension workers, and private industries. Information on farm resources and support services is important in decision-making. Obtaining information is described by Okoye (2002) as one of the major farming decision making steps. Akibu (2002) shared the same opinion that the quality of a decision made is a function of the quality of information made available for it. There is need for technical information to combat climate change, this is because, climate change is technically complex. Recognising this fact, Ibe (2010) suggested that it will be appropriate for the nation education and research institutes to design and support a capacity building of major actors to combat climate change. Capacity building in this sense refers to building technical competence of farmers and other major actors in climate change adaptation. The schematic representation of the conceptual framework of the off-farm factors (market, support services, policies and technical information) influencing household farming decision is depicted in figure 2.5 below.

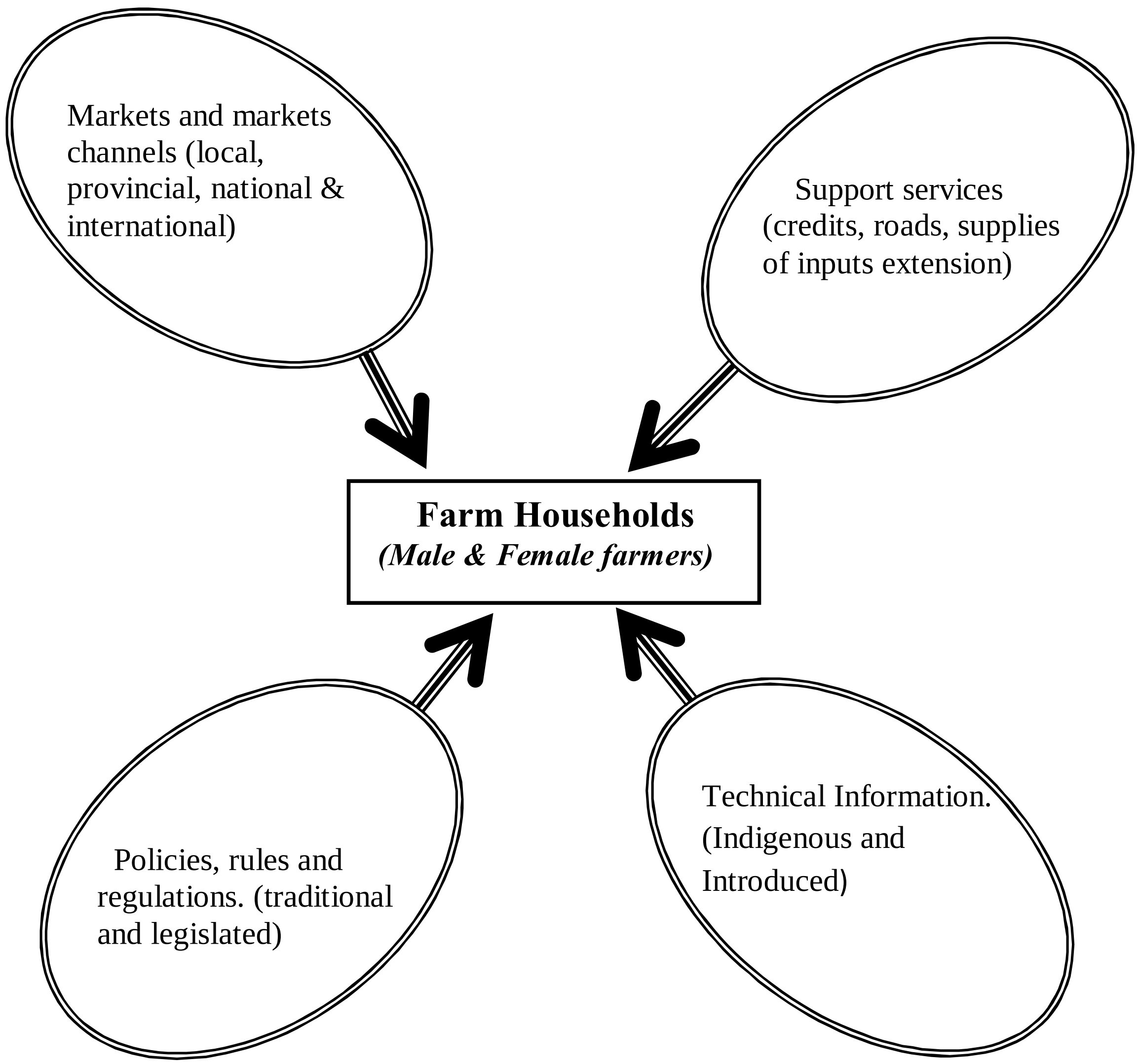

Fig. 2.5: Off-farm Factors Influencing Household Farming Decision
***Source*: FAO, 2005**

The farm household is at the centre of the struggle for climate change resilience. Therefore, for climate change resilience to be sustainable on national scale, effort must be made by the government to make adaptation farm household-driven. This is because, agriculture is climate dependent and it also contributes significantly to the release of greenhouse gases (GHGs) (IPCC, 2001). To prepare for and respond effectively to the impacts of climate change BNRCC

(2011) gender factor within farm households is also important. Effective gender-based participation and responsibilities in natural resources management ensure balanced, equitable and sustainable development in developing countries. There are convincing arguments, substantial proofs and broad agreement that adaptive responses will be more equitable, balanced and sustainable when gender is effectively mainstreamed to climate change adaptation.

2.11 Theoretical Framework

A theory is a set of related statements that are arranged so as to give a functional meaning to a set of events. Theoretically, this study is anchored on theory of rational choice, utility theory and bargaining theory of household decision making.

2.11.1 Rational Choice Theory

Rational choice theory, also known as rational action theory, is a framework for understanding social and economic behaviour (Abella, 2008). Rational choice theory uses a specific and narrower definition of rationality simply to mean that an individual acts to balance costs against benefits to arrive at action that maximizes personal advantage (Arrow, 1989). Rationality is widely used as an assumption of the behaviour of individuals in microeconomic models of human decision-making. According to Green (2002), rational choice theory generally begins with consideration of the choice behaviour of one or more individual decision-making units which in basic economics are most often consumers and/or firms.

The idea of rational choice, where people compare the costs and benefits of certain actions, is easy to see in economic theories. The rational choice approach to the problem of climate change adaptation decision making is based on the fundamental premise that the adaptation choices made by farmers are the choices that best help them achieve their farm objectives, given all relevant factors that are beyond their control. The basic idea behind rational choice theory is that people do their best under prevailing circumstances to get the best satisfaction. Farmers always want to get the best results at the lowest cost of adaptation practice, and they will want to judge the benefits of the adaption practices taken. In general, farmers will prefer adaptive actions that provide the greatest benefit at the lowest possible cost. Actions are often expressed as a set of j exhaustive and exclusive actions:

$$A = \{a_1, \ldots, a_i, \ldots, a_j\}$$

For example, if a farmer is to adapt using either planting of drought resistant crop or practicing irrigation farming or change completely to livestock rearing, their set of possible adaptive actions is:

A = {plant drought resistant crop; irrigation; change to livestock}.

Rational choice theory makes two assumptions about individuals' preferences for actions (Allingham, 2002), these include:

- Completeness ï all actions can be ranked in an order of preference (indifference between two or more is possible).
- Transitivity ï if action a_1 is preferred to a_2, and action a_2 is preferred to a_3, then a_1 is preferred to a_3.

Together, these assumptions form the result that, given a set of exhaustive and exclusive actions to choose from, an individual can rank them in terms of his preferences, and that his preferences are consistent. An important element of the choice process is the presence of constraints (Green, 2002). It is believed that a typical farmer could be faced with the constraint of how much of his resources or his farm budget goes for adaptation to severe drought as opposed to some other production activities. The presence of constraints makes choice necessary, and one virtue of rational choice theory is that it makes the trade-offs between alternative choices very explicit (Yuengert, 2001). A typical constraint in a simple one-period farmerøs choice of adaptation practices is the farm budget constraint, which implies that the farmer cannot spend beyond his income limit. The solution to the constrained optimization problem in the view of Green (2002) generally leads to a decision rule.

2.11.2 Utility Theory

Utility theory is concerned with peopleøs choice and decisions. It is concerned also with preferences and with judgements of preferability, worth, value, goodness or any of a number of similar concepts. This theory provides a methodological framework for the evaluation of alternative choices made by individual, firms and organisations. Utility refers the satisfactions that each choice provides to the decision makers. Thus, this theory assumes that any decision is made on the basis of the utility maximization principles according to which the best choice is the one that provides the highest utility (satisfaction) to the decision makers.

Utility theory is often used to explain the behaviour of individual consumers. In this case, the crop and livestock farmer plays the role of the decision maker that must decide how much each of the many available climate change adaptation strategies to use so as to secure the highest possible level of total utility subject to his or her available income, resources and other factors.

The traditional framework of the utility theory has been extended over the past three decades to multi-attribute case, in which decisions are taken by multiple criteria. In all cases the utility that the decision makers that is, farmers get from selecting a specific choice of climate change adaptation strategy is measure by a utility function U, which is a mathematical representation of the decision makers (farmers) system of preferences such that: $U(x_1) > U(x_2)$, where choice of the climate change adaptation x_1 is preferred over choice x_2 or $Ux_1 = Ux_2$, where choice x_1 is indifferent from choice x_2, that is both choices are equally preferred. Also, preferences are described by their utility function or payoff function. This is an ordinal number an individual assigns over the available actions, such as:

$$\mathcal{U}(a_i) > \mathcal{U}(a_j)$$

The individual's preferences are then expressed as the relation between these ordinal assignments (Allingham, 2002). For example, if a farmer prefers adaptive option of planting drought resistant crop over irrigation farming and irrigation farming over changing to livestock farming, his preferences would have the relation:

$$\mathcal{U}(\textit{plant drought resistant crop}) > \mathcal{U}(\textit{irrigation}) > \mathcal{U}(\textit{change to livestock rearing}).$$

In this case, it could be infer that planting drought resistant crop as an adaptive strategy is prefer over changing to livestock farming. The climate change adaptation strategies adopted by the farmers will be modelled into MNL function to determine the socioeconomic factors of the farmers (male and female) that influence the level of contribution to climate change adaptation decisions among farming households in south-western Nigeria.

2.11.3 Bargaining Theory

Household bargaining refers to negotiations that occur among members of a household in order to arrive at decisions regarding the household unit (Agarwal, 1997). Bargaining plays a role in the functioning and decision making of households, where agreements and decisions do not often have direct monetary values and affect various members of the household (Haviland, 2003). The household is not always synonymous with family, but in the case of intra-household bargaining, in which members of the household are considered to be a unit dependent upon the functioning of each individual, the household is most commonly synonymous with a family (Agarwal, 1997).

At farm household level, members work together to carry out farm activities and combine available farm resources for maximum farm output. These activities require decision making, and the farming household members providing the labour for these activities should be involved in bargaining process on how best these farm activities decision could be made and farm resources effectively combined. Bargaining theory supports interdependence among the farm household members in which farm decision making is viewed as a share commitment of the members. According to Abhinary (2000), bargaining is ubiquitous and married couples are almost constantly negotiating over a variety of matters such as who will do which household chores.

Personalities involved in decision making determine the bargaining process and the outcome. The desire of the household head as dictated by his or her bargaining power, the economic and social power versus the economic and social power of the spouse determines who makes decision in the farming households. Bargaining power is the relative capacity of each of the parties to a negotiation or dispute to compel or secure agreements on its own terms (Merriam-Webster, 2011). For instance, if farm spouse are on equal footing in a bargain for adaptation decision making, then they will have equal bargaining power, and conversely, if one party has an advantageous position in the bargaining process, the spouse have unequal bargaining power in adaptation decision making. What determines the equality or inequality of bargaining power is the relative positions of each party in the bargaining process; this is express in their economic or socially standing relative to other. More specifically, the socio-economic attributes (gender, income, farming experience, education, age, access to land etc) of an individual in a farming household may possibly influence his/her bargaining power in adaptation decision making process.

Social scientists have long asserted that differences between economic positions of household members based on gender and age exist within patriarchal societies (Blumberg and Coleman, 1989). The household head usually the male represents the owner of the farm while other household members are similar to the workers employed by the farm. Recent developments in game theory and increased inter-disciplinary studies focusing on gender issues have resulted in the development of a school of thought that assumes that preferences vary among household members and views bargaining among the members as a process that reconciles these differences in preferences (CCOFE, 2004). Bargaining captures the changing in preferences of the household with changing opportunity costs that accompany technological change and economic opportunities. As farming households move away from subsistence economic with the introduction of new economic opportunities, new income streams are generated and demands upon household members change creating a need for institutional reorganization within the household behaviour (Buvinic and Mehra, 1989).

Bargaining theory has consistently explained the evolution of household decision making. Lidja (1996) stated that available evidence from both developed and developing countries indicate bargaining as the predominant type of household behaviour in decision making.

2.12 Analytical Framework

The nature and purpose of a study determine the type of analysis that can be employed (Chukwuone, 2009). While calculation of rates, means, frequency distribution and percentages may be adequate for some exploratory studies, Eboh (2009) declared that more detailed and higher level analysis will be required for case studies and sample surveys especially those that deal with quantitative data. For the case of this study, Heckmanφs double stage selection model, multinomial logit model and exploratory factor analysis will be employed.

2.12.1 *Heckman's two-step selection model.*

The Heckman two-step estimation is a way of estimating treatment effects when the treated sample is self-selected (Mandleni and Anim, 2011). Heckman two-step selection model (heckprob) provides consistent, asymptotically efficient estimates for all parameters in the model (StataCorp, 2003). This model is appropriate when the explanatory variables of interest are to be estimated in two stages as outcome and selection variables.

Empirical studies in which the advantage of Heckmanôs two-step procedure has been employed in estimating the determinants of outcome and selection steps in adaptation studies are documented in this literature. Moreover, when decision process by farmers to adopt a new technology requires more than one step, models with two- step regressions are employed to correct for the selection bias generated during the decision making processes.

Similarly Mandleni and Anim (2011) employed the Heckmanôs selection model to analyze the two-step processes of climate change awareness and decision on adaptation measures by livestock farmers in the Eastern Cape Province of South Africa. In addition, Maddision (2007) investigated the perception and adaptation to climate change in Africa where the author employed Heckmanôs two-step selection model to identify the determinants of climate change perception and adaptation among the farmers. Similarly Yirga (2007) employed the Heckmanôs selection model to analyze the two-step processes of agricultural technology adoption and the intensity of agricultural input use. Thus, this study will adopt the Heckmanôs two-step procedure to estimate the determinants of farmersô adaptation to climate change and extent of adaptation to climate change among farming households in south-western Nigeria.

The adaptation to climate change and the extent of the adaptation as informed by farming decision was considered to be a two-stage process. As it is used in this study, the first stage is whether a farmer adapt to climate change or not. The second stage involves the extent of the adaptation to climate change by adopting some series of adaptation strategies. The second stage, called the ñextent of adaptationò is considered a sub-sample of the first stage, the ñselectionò stage. Since the outcome stage is a sub-sample of the selection stage, it is likely that the outcome stage sub-sample will be non-random and different from those farmers who did not adapt to climate change in the full sample. A sample selection bias will then be created which will be corrected by the maximum likelihood Heckmanôs two-step or *Heckit* selection procedure (Heckman, 1979).

The application of this model in this study is to estimate the determinants of an individual farmers adaptation and the extent of the adaptation to climate change by using some selected number of coping strategies. The first step is to create a model of farmers who adapt (selection) of climate change, and then from that model, we obtain the model for extent of the adaptation (outcomes).

Let *Πij* be a vector of observations of the size of issue for the *ith* group of farmers with a *jth* form of adaptation and extent of adaption to climate change, and let *Xij* be a vector of observations on measurable socioeconomic characteristics and other associated variables associated with the *jth* state of adaptation. Thus we can specify the latent equation as:

$$\Pi ij^* = \beta'_3 X_3 + \varepsilon ij \text{ -- } (1)$$

Where: X_3 = is a vector of coefficients and β'_3 is the disturbance term in the size of the issue equation. The sample selection problem will arise in the size of issue equation because the sample contains farmers that adapt to climate change and the extent to which they adapt by exploring different adaptation strategies.

2.12.2 *Multinomial Logit Model*

The analytical approaches that are commonly used in an adaptation decision study involving multiple choices are the multinomial logit (MNL) and multinomial probit (MNP) models. Both are important for analysing farmers adaptation decision making. One of the major tools for this study therefore, is multinomial logit model. Multinomial logit model is polytomous and recognizes the index nature of various response categories. According to Ying and Warren (2003), multinomial logit model is used to model relationships between a polytomous response variable and a set of regressor variables. It handles explanatory variables that are continuous or take different values for different categories of responses.

In multinomial logit model, the response *Y* of an individual unit is restricted to one of *m* ordered values. Ying and Warren (2003) exemplified such model using the severity of a medical condition which may be none, mild or severe. The cumulative logit model assumes that the continuous nature of the observed response is due to methodological limitation in collecting the data that results in lumping together values of an otherwise continuous response variable.

Generalized logit models like ordinary regression model can contain continuous or discrete dependent variable. Let $\pi_1\ (x_1)$ denote the probability of response $j,\ j = 1, \ldots\ldots j,$ at the ith setting of values of k explanatory variables $xi = (1,\ x_{i1},\ \ldots\ldots\ldots x_{ik})$. In terms of response probabilities, the generalized logit model is stated as;

$$\pi_j\ (xi) \quad = \quad \frac{\ell xp\ (\beta_j^{1}\ x_i)}{\sum\limits_{h=1}^{j} \exp\ (\beta_h^{1}\ x_i)} \text{ -- } \quad (1)$$

β_j *assumes* O *i.e* $\beta_j = O$

$$Log\ [\pi_j\ (x_i) \ /\ \pi_j\ (x_i)]\ \beta_j^{1}\ x_i,\ j\ = 1 - 1. \text{ -- } \quad (2)$$

Multinomial logit model is one of the most widely used models for ordinal response data. Several empirical studies in which the dependent variable has to be measured in an ordinal categorical manner and in which multinomial logit model has been employed include study conducted by Pablo and Miguel (2005) on the factors influencing the adoption of environmental technologies in the pulp and paper sector in Spain. In the study, three sets of interrelated factors influencing the widespread adoption of these technologies are considered; factors of external to the farm, characteristics of the environmental technologies, and internal characteristics / conditions of the potential adopters. Chukwuone (2009) carried out a study on analysis of conservation and utilization of Non-wood forest products in Southern Nigeria. The author used multinomial logistic regression to determine the socio-economic characteristics of respondent that determine the odds of a household being in one of the categories of production of non ï wood forest product species; production of non-wood forest product was categories into four.

Stratton, Oötoole and Wetzel (2003) also employed multinomial logit model to estimate the attrition that distinguishes between stop out and dropout behaviour. The respondents in the study were made to face three choices; continuous enrolment =1, short term enrolment =2 and longï term dropout=3. This category is modelled as a function of individual specific characteristics x that affect the category associated with each choice differently; Hence, $U_{ji} = X_i \alpha j + \ell ji$

where; j = denotes the category,

i = denotes the individual.

Therefore, for the case of this study in which the contributions of men and women to climate change adaptation decision in a farming households are to be estimated, the dependent variable ñcontribution to adaptation farming decisionò is defined to have three (3) possible values; value 1, if the contribution adaptation farming decision is Low; value 2, if Moderate and value 3, if the contribution is High. The socio-economic characteristics of the both the men and women farmers constitute the explanatory variables for this study. These variables are clearly defined under item 3.5.2 of the methodology. By implication, after estimating the parameters, one can predict the probability that a sampled farmer either with a specified set of socio-economic characteristics may have a particular level of contribution to climate change adaptation decision as either low, medium or high.

2.12.3 *Exploratory Factor Analysis*

The ultimate goal of factor analysis is to explain the covariance relationships among the variables in terms of some unobservable and non ï measurable random factors. A wide range of dimension or multivariate variables may exist; therefore factor analysis aims at reducing the dimensionality or multi-variate data set to an orderly structure (Ashley, Amber and Anthony, 2006; Ledyard and Robert, 1997). Factor analysis is a means of describing groups of highly correlated variables by a single underlying construct or factor that is responsible for the observed correlations (Ashley *et al*, 2006), and once the groups of correlated variables are identified, they are interpreted and labelled.

There are methods of factor analysis which include common and principal component analysis. Exploratory factor analysis procedure using the principal component model with iteration and varimax rotation will be employed in grouping the constraints to women contribution to household farming decision into major components. In this analysis, the factor loading under each constraint (beta weight) represent a correlation of the variables (constraint areas) to the identified constraint factor and has the same interpretation as any correlation coefficient. However, only variables with factor loading of 0.30 and above will be used in naming the factor (Ashley, *et al,* 2006 and Madukwe, 2004). Also, variable that loaded in more than one factor will not be used.

High reliability of factor analysis models in social science studies has widely been explored by several authors. Ashley *et al,* (2006) employed factors analysis to analyse education systems of 64 countries around the world; Okorji and Chukwuone (2000) applied factor analysis to determine constraining factors to community seed project in Enugu State, Nigeria; Agwu (2000) analysed his data on extracting cowpea technology diffusion in Northeast Savanna Zone of Nigeria using Factor analysis; Kessler (2006) applied factor analysis in determining the decisive key factors influencing farm households soil and water conservation investments in Netherlands. Also Aleke (2007) employed Factor analysis to study the impact of the Phase ï 1 National Special Programme on food security on poverty reduction in Enugu State, Nigeria.

Set of variables $X^{ôs}$ (X_1, X_2, ----------------------------X_n) are measured to derive Carleton coefficient or factor loading ñaò between the K explanatory Variables. Thus the correlation coefficient may be arranged preparing a correlation matrix as shown below.

	X_1	X_2	* *	X_k	$\sum_j^K r\, x_i\, x\, j$
X_1	Rxixi	Rx_1x_2	* *	rx_1x_k	$\sum_j^K r\, x_i\, x\, j$
X_2	Rx_1x_2	rx_2x_2	* *	rx_2x_k	*
*	*	*			*
*	*	*			*
X_K	Rxjxk	rk_2xk	* *	rx_kx_k	*
$\sum_j^K r\, xi\, x\, j$	$\sum_J^K r\, xi\, x\, j$	$\sum_J^K r\, x_2\, x\, j$	* *	Σx_{KX} j	$\sum_j^k \sum_j^k$ rxixj

Koutsoyiannis (1977) described that, the correlation matrix is symmetrical as the elements of each row are identical to the elements of the corresponding columns thus *rxixj* =

rxjxi. The correlation coefficient or factor loading ñaò for the principal component P_1 is determined thus;

$$a1j = \frac{\sum^{k} r\, xi\, x\, j}{\sqrt{\sum_{j}^{k} \sum_{j}^{k} rxixj}}$$

The sum of square of the loadings of each principal component is called the latent root, characteristics root or eigenvalue denoted λ with the subscript of the principal component to which it refers and is given as;

$$\lambda = \sum_{i\,1}^{k} a^2 = a1^2 + a_2^2 + \text{-----------------------------------} a_k^2$$

The eigenvalue measure the variance in the entire variable which is accounted for by that factor. Only components with eigenvalue greater than 1.0 should be retained when interpreting the principal analysis result. The latent roots can be expressed as a percentage of the total variation in the set of $X^1{}_s$. The percentage variance accounted by P_m;

$$P_m = \frac{\text{Latent root}}{\text{Number of } X^1{}_s} \text{ X } \frac{100}{1}$$

$$P_m = \frac{\lambda_m}{K} \text{ X } \frac{100}{1}$$

2.13 Related Empirical Studies

Some empirical studies related to this work are reviewed. For instance, a survey research carried out by Agricultural Resource Management Study (ARMS) (1996) on contributions by spouse of farm operators covered over 90% of the farmers whose spouses are female. Both male and female farmers were selected from the farm households to answer questions on their participation in both on and off farm work activities as well as the degree of their involvement in day to day and long term farm decision making. The findings of the study revealed that women farmers spent less time working on the farm than the male farmers themselves. On a gender basis, the study identified that about 70% of farm activities decision are made by men. This result clearly shows relatively low recognition of women in farming and possibly gender disparity against women in farming decision making.

Gbetibouo (2009) investigated farmers' perceptions and adaptations to climate change and variability using the case of farm households in Limpopo Basin, South Africa. The research used a ñbottom-upò approach, which seeks to gain insights from the farmers themselves based on a farm household survey. Farm-level data were collected from 794 households in the Limpopo River Basin of South Africa for the farming season 2004ï 2005. The study examines how farmer perceptions correspond with climate data recorded at meteorological stations in the Limpopo River Basin and analyzes farmersô adaptation responses to climate change and variability. A Heckman probit model and a multinomial logit (MNL) model are used to examine the determinants of adaptation to climate change and variability. The statistical analysis of the climate data shows that temperature has increased over the years. Rainfall is characterized by large interannual variability, with the previous three years being very dry. Indeed, the analysis shows that farmersô perceptions of climate change are in line with the climatic data records. However, only approximately half of the farmers have adjusted their farming practices to account for the impacts of climate change. Lack of access to credit was cited by respondents as the main factor inhibiting adaptation. The results of the multinomial logit and Heckman probit models highlighted that household size, farming experience, wealth, access to credit, access to water, tenure rights, off-farm activities, and access to extension are the main factors that enhance adaptive capacity. Thus, the government should design policies aimed at improving these factors.

Oluwatayo (2009) conducted a study to examined how gender participation in decision-making influences householdsô food security status in Rural Nigeria. Ekiti State was particularly chosen for this study because of its prime position among the poorest States (top five) in the country and that it depicts the nationô s true agrarian nature. This study used the data collected from a random sample of 254 households. The data were collected though the aid of well-structured questionnaire and interview schedule. Analytical techniques used include descriptive statistics (tables, frequencies, mean used to analyse householdsô socioeconomic characteristics) and probit model (used to examine the determinants of food security among households surveyed). On the food security status of the households, it was found out that households experience increased food insecurity especially during the planting season (lean period). Meanwhile, the results of the probit analysis showed that age, gender, household size, educational level, belonging to social group and income were the determinants of food security in the study area. Meanwhile, the most startling observation from this study was that less than 30 percent of the female respondents actively participated in all the decision-making roles considered except the decision-making on the types of food to buy (where only about 40 percent females took the decision). The findings therefore underpins the need to implement the recommendation made at the Beijing Conference that at least 30 percent of decision-making on any issue should be left to women. Based on the study findings, the study recommended that women should be empowered educationally and financially if the clamour to achieve the Millennium Development Goals (MDGs) 1 and 3- i.e. reduce poverty by half and ensure gender equity by 2015) are to be realised.

Amusa (2010) examined the contributions of women to household farming decisions among cocoa-based agroforestry households in Ekiti state, Nigeria using cross-sectional data. The study used purposive, multistage and random sampling techniques for the selection of 120 cocoa-based agroforestry farm units that constituted respondents for the study. The analytical techniques involved descriptive statistics, exploratory factor analysis and multinomial logistic regression model. With regards to food crop production activities, the contributions of women to decision making were very high with mean values of between 2.48 ï 3.19 on a 4-point scale, while that of the men were comparatively low with mean values ranging from 1.85 ï 2.66. However, in the cocoa production activities, the contributions of women to decision making were relatively low with mean ranging between 1.42 ï 3.23 compare to high contributions of men with mean values ranging from 2.82 ï 3.94 on a 4-point scale. The multinomial logistic regression result comparing high contribution (3) as base outcome, revealed that years of formal education of the women, financial contribution status of the women to farming activities, average number of hours spent on cocoa farm per day were negatively related while years of farming experience of the women and number of adult male farmers in a household were positively and significantly related with the probability of women making low (1) or medium (2) contributions to household farming decisions. The t-test of no significant difference between the contributions of women and men to farming decisions in the production of the integrated food crops and the cocoa revealed that, on the average, women had significantly higher contributions to decision making in food crop production activities while in cocoa production, men had significantly higher contributions. The identified constraints militating against women farmers were classified into three major factors using principal component factor analysis with varimax ï rotated and factor loading of 0.30. These constraints range from techno-institutional factor (lack of extension programmes directed to women, lack of access to NGOs programmes and low technical-know-how); socio-personal factor (the belief that women are subordinate, low self confidence of women, multiple domestic responsibilities of women farmers) and economic / financial factor which include low/lack of financial contributions by women farmers to farming activities, involvement of the women in off farm jobs, lack of collateral security to secure loans to support farming and so on.

Advancing Capacity to Support Climate Change Adaptation (ACCCA) (2010) on improving decision-making capacity of small holder farmers in response to climate risk adaptation in three drought-prone districts of Tigray, Northern Ethiopia: Farm-level climate change perception and adaptation in drought prone areas of Tigray, Northern Ethiopia. The study was carried out to have a better understanding of farmersô perceptions of climate change, ongoing adaptation measures, and the decision ï making process is important to inform policies aimed at promoting successful adaptation strategies for the agricultural sector. Using data from a survey of 160 farm households in four tabias of Tigray, Northern Ethiopia, this study presents the adaptation strategies used by farmers and analyze the factors influencing the decision to adapt. We find that the most common adaptation strategies include: use of different crop varieties, soil and water conservation, changing planting dates, use of external fertilizer, borrowing lost local crops from community, using short growing crops etc. Using a Multivariate

Probit model, econometric investigation reveals a number of findings that is similar with the earlier literature in climate change adaptation at farm level. Extension service, livestock ownership gender of the household head being female, access to climate change information and perceived change in temperature have positive and significant impact on adaptation to climate change. This study also indicates that the perception of climate change is already high.

Adepoju, Yusuf, Omonona and Okunmadewa (2011) estimated vulnerability profile of rural households in Southwest Nigeria using primary data from a two-wave panel survey (lean versus harvesting periods). The primary data used in this study were collected from a two-wave panel survey undertaken at 5-months interval to allow measurement of seasonal variation in behaviour and outcome and to balance both the cross-sectional and time series requirements of panel data. The two periods corresponds to the lean and harvesting seasons of 2009. Data were collected (from the same households in the two rounds) on demographic characteristics, education, employment, housing and housing conditions, social capital, income, consumption expenditure as well as shocks and the economic infrastructure available to the community. This was supplemented with information from secondary sources such as Central Bank of Nigeria (CBN) and National Bureau of Statistics (NBS). The frame for the study was the demarcated Enumeration Area (EA) maps produced by National Population Commission for the 2006 Housing and Population Census. However, the EAs selected were updated before the commencement of the study. Furthermore, the EAs used are part of the ones usually used by National Bureau of Statistics (NBS) for her regular household-based surveys. A multi-stage sampling technique was adopted for this study. The first stage was a random selection of two states of Oyo and Osun from the six states that make-up the South-West geo-political zone of the country. The second stage involved the random selection of three local government areas (LGAs) from each of the selected state. The third stage was the random selection of ten rural enumeration areas (EAs) from each of the selected LGA. The final stage of the sampling was the systematic selection of ten households from the households listed in each selected EA. Hence, in each state 300 households were interviewed giving a total of 600 households in the two selected states canvassed for the study in the first period but only 582 households could be re-interviewed in the second round. Data from these 582 households were used for analysis in this study. These samples are representative and robust enough to give estimates at the LGA, State and Zonal levels. Results showed that on the average there is a 0.56 probability of entering poverty a period ahead in the region and relatively high poverty rates were associated with much higher vulnerability while low poverty rates were associated with considerably low vulnerability. Vulnerable households are mostly large sized with high number of dependants and characterized by under aged or old, female headed, widowed household heads. They are mostly engaged in farming as their primary occupation, have no or low educational attainment and are landless. The findings underscore the centrality of social protection policy mechanisms as potent poverty reduction tools and necessary policy interventions to reduce consumption variability through reducing exposure to risk or improving the *ex post* coping mechanisms of the vulnerable.

Mandleni and Anim (2011) estimated climate change awareness and decision on adaptation measures by livestock farmers in the Eastern Cape province of South Africa. This study was based on a cross-sectional household survey data collected from 250 household heads during the 2005-2009 farming season in three district municipalities in the Eastern Cape of South Africa namely: Amathole, Chris Hani and OR Tambo. The 250 households surveyed were from the three selected district municipalities based on representative agro-ecological zones and livestock farming systems in each municipality. The sampled districts were selected purposefully to cover uniform or homogeneous characteristics of the three areas, namely: agro ecological zones, intensity of livestock (cattle and sheep) farming activities, average annual rainfall and household characteristics. The 250 household were proportionally selected according to the information on household sizes given by the Department of Agriculture and Rural Development office. The awareness of livestock farmers about climate change and the decision to select adaption measures was considered to be a two-stage process. The first stage was whether livestock farmers were aware of climate change or not. The second stage involved whether livestock farmers adapted to climate change after being aware and selecting some adaptation measures. The Heckman two-step estimation is a way of estimating treatment effects when the treated sample is self-selected. The application of this model in this study was to estimate the determinants of an individual livestock farmerôs decision to select adaptation. The first step was to create a model of farmers who were aware of climate change, and then given that model, the outcomes (adaptation) was modeled. Based on data collected and analysed and the study found that livestock farmersô awareness of climate change. Of importance to the study were the groups of variables with highest percentages. The results indicated that 57% of a total of 250 livestock farmers were more aware of climate change and 43% were not aware during the study period. With reference to household size group (6-10), the percentages were, aware (60.10%), not aware (53.30%). With gender 93.70% represented males who were aware of climate change and 83.20% were males who were not aware of climate change. The results of the Heckman probit model were presented in Table 4. The results indicated that the model had good overall predictive power, as indicated by the overall 76.0% prediction for the selection model and 71.4% for the outcome model. The likelihood ratio - test was 237.107 for selection model and 182.905 for the outcome model. The likelihood ratio - tests were used to test the null hypothesis for each of the model that all coefficients were zero. Given the *p*-value of 0.01for both the -tests, the null hypothesis for each model was rejected. The results from the selection model, which predicted factors that affected awareness to climate change, indicated that marital status, level of education, formal extension, temperatures and the way in which land used for farming was acquired, significantly affected awareness of climate change. Variables that significantly affected adaptation were: gender, formal extension, information received about climate change to improve livestock production, temperatures and the way in which land was acquired.

Okuli, Jonathan and Flavianus (2012) investigated gender and adaptation practices to the effects of climate Change in Bahi and Kondoa Districts Dodoma Region, Tanzania. The study also analyzed perception of climate change and identified elements influencing adaptation practices. A sample of 360 respondents, 12 focus groups of discussants and 78 key informants were consulted. Analysis involved descriptive statistics for quantitative data and content analysis for qualitative data. Results showed that women were more devoted to adaptation practices that enabled them to adapt to or reduce hunger/food, water and firewood shortages while men were more devoted to adaptation practices that enabled them to adapt to or reduce effects of climate change on crops, livestock and environment. The corrected Rao-Scott chi-square (GC 2) test showed significant association between adaptation practices implemented by respondents and sex, revealing that undertaken adaptation practices varied by sex. Respondents perceived climate change and managed to identify adaptation practices undertaken to manage climate change effects. The findings can be used to improve/formulate appropriate adaptation practices to manage climate change problems in agriculture sector. The study recommends systematic collection of in-depth information of this kind at the community level in other areas of Dodoma Region, Tanzania and the LDCs in order for the policy makers to design and implement appropriate interventions to manage climate change problems.

CHAPTER THREE

METHODOLOGY

3.1 Area of Study

The study was carried out in southwest Nigeria. It is made up of six states which include: Ekiti, Lagos, Ogun, Ondo, Osun and Oyo states. Southwest Nigeria falls on latitudes 6^0 N, 4^0 S and longitudes 4^0 W, 6^0 E; covering about 114, 271 kilometre square (Adepoju, Yusuf, Omonona and Okunmadewa, 2011). It is bounded in the North by Kogi and Kwara States, in the East by Edo and Delta States, in the South by Atlantic Ocean and in the West by Republic of Benin.

The national population census conducted in 2006 gave the total population of Southwestern Nigeria to be 27,581,992 people (National Population Commission, 2006). The average annual rainfall of southwest Nigeria ranges between 1,200 to 1,500mm (Adebayo, *et al,* 2011) with a mean monthly temperature range of 18^0 - 24^0C during the rainy season and 30^0 - 35^0C during the dry season (Adepoju, *et al,* 2011). Southwest Nigeria is predominantly agrarian due to the rich alluvial soil in the area. Notable food crops cultivated in the area include: cassava, maize, yam, cocoyam, cowpea, vegetables and cash crops such as cocoa, kola nut, rubber, citrus, coffee, cashew, mango and oil palm. Livestock such as goat, pig, sheep and poultry are predominantly reared in the area (Adene and Oguntade, 2006).

3.2 Sampling Techniques

Purposive, multi-stage and random sampling techniques were employed in selecting the 348 farm units that were used for the study. Firstly, three (3) states were purposively selected. Ekiti was selected from Derived savanna zone, Oyo State was selected from Guinea savanna while Ogun State was selected from the Rainforest zone. Secondly, two (2) agricultural zones were randomly sampled from each of the three (3) selected states making six (6) agricultural zones for the study. Thirdly, from each of the six (6) agricultural zones, two (2) Local Government Areas (LGAs) were randomly selected making twelve (12) LGAs for the study. The fourth stage involved random selection of two (2) farming communities from each of the twelve (12) LGAs making a total of twenty four (24) farming communities. Lastly, fifteen (15) farm units engaging in both crop and livestock production were purposively and randomly selected from each of the twenty four (24) farming communities totalling 360 farm units for the study. The purposive selection of the farm units taking into cognisance the farm enterprise combination (crop and livestock) was ensured with the assistance of key informants (fadama community facilitators/extension agents) in each of the selected farming communities.

Out of the 360 copies of questionnaire administered, 348 copies were retrieved from the respondents (farmers) representing 96.7% return rate. Data generated from the retrieved copies were used for the study.

3.3 Method of Data Collection

Data for this study were obtained from primary source with the use of structured questionnaire. Based on the wide geographical spread of the sample of the study across south-western Nigeria, the data were gathered by the researcher with the help of five trained research assistants making six enumerators for data collection. Each of the six enumerators handled one agricultural zone for administration, interview and retrieving of the 60 copies of the research instrument (questionnaire) meant for each of the six agricultural zones. The instrument for data collection focused on such information as socio-economic characteristics of farm units, level of awareness, sources of information about climate change, the intensity of climate change adaptation practices among the farm units and the vulnerability of farmers to the effects of climate change. The contributions of the male and female farmers in their farm units to climate change adaptation decision making; and data on constraints facing women farmers in making adequate contribution to farming decision as regards climate change adaptation practices were collected.

3.4 Data Analysis

The data for the study were analysed using both descriptive and inferential statistics. Objectives (i), (ii) and (vi) were actualised with descriptive statistics such as frequency, percentage, chart, line graphs, mean and standard deviation using 4-point Likert rating scale. Objective (iii) was achieved with binary probit model, Objective (iv) was achieved with the use of Heckmanôs double-stage selection model; Objective (v) was realised using vulnerability analysis; Objective (vii) was realised with the use of multinomial logit (MNL) model while

Objective (viii) was achieved using exploratory (principal component) factor analysis procedure. Hypotheses (i), (v) and (vi) were tested with t-test statistics, hypothesis (ii) was tested using Analysis of Variance (ANOVA) while hypotheses (iii), (iv) and (vii) were tested using chi-square.

3.4.1 Rating Scale Technique

To assess the level of awareness of climate change among farmers in southwest Nigeria, extent of intensity of the effects of climate change on agricultural production and compare the contributions of men and women to climate change adaption decision in crop and livestock production activities, mean and standard deviation were employed using 4-point rating scale technique.

For the assessment of level of awareness of climate change among the farmers, the 4-point rating scale was graded as High Awareness (HA) = 4, Moderate Awareness (MA) =3, Low Awareness (LA) =2 and No Awareness (NA) = 1. The mean ratings of the respondents based on the 4-point rating scale were graded using real limit of number as stated below:

Response Categories	***ordinal values***	***real limit values***
High Awareness (HA)	= 4	3.50 ï 4.00
Moderate Awareness (MA)	= 3	2.50 ï 3.49
Low Awareness (LA)	= 2	1.50 ï 2.49
No Awareness (NA)	= 1	1.00 ï 1.49

To assessment the extent of intensity of the effects of climate change on agricultural production as perceived by farmers in southwest Nigeria, the 4-point rating scale was categorized as Very Serious (VS) = 4, Serious (S) =3, Less Serious (LS) =2 and Not Serious (NS) = 1. The mean ratings of the respondents based on the 4-point rating scale were graded using real limit of number as stated below:

Response Categories	***ordinal values***	***real limit values***
Very Serious (VS)	= 4	3.50 ï 4.00
Serious (S)	= 3	2.50 ï 3.49
Less Serious (LS)	= 2	1.50 ï 2.49
Not Serious (NS)	= 1	1.00 ï 1.49

In assessing gender (male and female farmersô) contributions to climate change adaptation decision making among farming households in southwest Nigeria, the 4-point rating scale was also used and graded as Very High (VH) = 4, High (H) =3, Low (L) =2 and Very Low (VL) = 1. The mean ratings of the respondents based on the 4-point rating scale were named using real limit of number as stated below:

Response Categories	***ordinal values***	***real limit values***
Very High (VH)	= 4	3.50 ï 4.00
High (H)	= 3	2.50 ï 3.49
Low (L)	= 2	1.50 ï 2.49
Very Low (VL)	= 1	1.00 ï 1.49

3.4.2 Household Vulnerability Analysis

Vulnerability Index (VI) Analysis

To achieve objective (v) which aimed at assessing gender-based vulnerability to climate change, vulnerability analysis was employed. Using household adaptive capacity approach, the collected data were arranged in the form of a rectangular matrix with rows representing gender of household head and columns representing indicators. Thus, vulnerability is potential impact (*I)* minus adaptive capacity (*AC).* This leads to the following mathematical equations for vulnerability.

$$V = f\,(I - AC) \qquad (1)$$

Gender of HHold Head	Indicators of Vulnerability				
	1	*2*	.	.	*K*
MHHD	*Xij1*	*Xij2*	.	.	*Xijk*
FHHD	*Xij1*	*Xij2*	.	.	*Xijk*

The obtained data from the estimated vulnerability indicators (adaptive features) as used in the study were normalized to be free from their respective units so that they all lie between 0 and 1. The gender with the higher value corresponds to high vulnerability and *vise versa.* Hence, the normalisation is achieved with this formula following UNDP (2006) in assessing Human Development Index:

$$yij = \frac{Max\{Xij\} - Xij}{Max\ \{Xij\} - Min\ \{Xij\}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where: *Xij* represents the value of the vulnerability indicator for the farm household for *x* indicator.

Max & *Min* represent maximum and minimum values of indicators respectively for the variables of interest.

When equal weights are obtained for the vulnerability indicators, simple average of all the normalized scores is computed to construct the vulnerability index using:

$$VI = \frac{\times x_{m1} + \times x_{mk}}{K} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

VI = represent the vulnerability indicator

K = represents the number of indicators used

After normalization, the average index (AI) for each source of vulnerability is worked out and then the overall vulnerability index is computed by employing the following formula:

$$VI = \left\{ \mathop{\times}_{i-1}^{n} x_{ij}\ (AI_i)^{\alpha} \right\}^{1/\alpha} \Big/ n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Where: *n* is the number of sources of vulnerability and $\alpha = n$. The vulnerability indicators that were used to measure adaptive capacity of farm households in southwest Nigeria include:

X1 = Farming Income

X2 = Years of Formal Education

X3 = Farm Size

X4 = Number of livestock

X5 = Land Ownership Status

X6 = Number of Farm labourers

X7 = Number of Extension contacts

X8 = Access to farm credits or loan

X9 = Household working members

X10 = Access to remittances

X11 = Membership of Cooperative

3.4.3 Heckman's double stage model

The Heckman (1976) double stage selection model was adopted in this study because the subject being investigated in objective (iv) involved a two stage adaptation decision process for the farm households. The first stage is a discrete decision of whether or not to adapt to climate change, while the second stage is continuous (Enete, 2003; Okorie, 2013; United Nations and World Trade Organization, 2012; and Vance and Buchheim, 2005) which is the extent of adaptation considering the number of coping strategies used by the household is estimated with the inverse Millôs ratio obtained from the first estimation included as independent variable. The second stage is conditional on the positive first decision, that is, decision to adapt to climate change. The second stage was estimated by the percentage of adaptation strategies employed by the farmers out of the total thirty three (33) adaptation strategies specified in the study.

The procedure for the first stage of Heckman double-stage model of positive decision to adapt to climate change is modelled as:

$$Z = \alpha X + e \quad \text{.......} \quad (1)$$

Where:

Z = 1 if a household decide to adapt to climate change or Z = 0 if otherwise.

The decision on the extent of adaptation by number of coping strategies used will be modelled as:

$$Y = \beta X + \mu \quad \text{.......} \quad (2)$$

Where:

X = is a vector of exogenous variables, Y > 0 if Z = 1, and Y = 0 if Z = 0,

e, ε ~ N(0, ů$_i$) with correlation ɟ . equation (2) can be estimated as:

$$E\ [Y/Z = 1] = \beta X + \rho\sigma_u\lambda_e + \omega \text{...} \quad (3)$$

Where:

$\lambda_e = \phi\ (\alpha X)/\Phi(\alpha X)$, and ϕ and Φ standard normal pdf and cdf of the first equation. Equation (2) is thus estimated including ɚ as an explanatory variable. The explanatory variables hypothesised as affecting the two-stage adaptation decision process; that is, adaptation (discrete) and extent of adaptation to climate change (continuous) are indicated below:

X1=	Gender of HHold Head	Dummy, takes the value 1 if male, 0 if female
X2=	Years of Farming Experience	Continuous (years)
X3=	Years of Formal Education	Continuous (number)
X4=	Household Size	Continuous (number)
X5=	Extension Visits per Cropping Season	Continuous (number)
X6=	Farm Size	Continuous (hectare)
X7=	Number of livestock	Continuous (number)
X8=	Farming Income	Continuous (ك)
X9=	Access to Credit	Dummy, takes the value 1 if having access, 0 otherwise
X10=	Land ownership status	Dummy, takes the value 1 if owned, 0 otherwise
X11=	Number of farm labourers	Continuous (number)
X12=	Number of dependent hhold members	Continuous (number)

3.4.4 Multinomial Logit Model (MNL)

Considering the categorical nature of the dependent variable (level of contributions) in objective (vii), Multinomial logit model (MNL) was used to estimate the influence of socio-economic characteristics of the farmers on their contributions to climate change adaptation decisions in their farm households in the study area. Adaptation decisions which determine the odds of a farmerȇs contributions in a farming household being in one of the four categories of contributions as very high (VH), high (H), low (L) and very low (VL).

The multinomial logit model can be estimated with set of coefficients ɓ$^{(1)}$, ɓ$^{(2)}$, ɓ$^{(3)}$ and ɓ$^{(4)}$ as follows:

$$Pr \quad (Z = 1) \quad = \quad \frac{ă^{xɓ(1)}}{ă^{xɓ(1)} + ă^{xɓ(2)} + ă^{xɓ(3)} + ă^{xɓ(3)}} \quad \ldots\ldots (1)$$

$$Pr \quad (Z = 2) \quad = \quad \frac{ă^{xɓ(2)}}{ă^{xɓ(1)} + ă^{xɓ(2)} + ă^{xɓ(3)} + ă^{xɓ(3)}} \quad \ldots\ldots (2)$$

$$Pr \quad (Z = 3) \quad = \quad \frac{ă^{xɓ(3)}}{ă^{xɓ(1)} + ă^{xɓ(2)} + ă^{xɓ(3)} + ă^{xɓ(3)}} \quad \ldots\ldots (3)$$

$$Pr \quad (Z = 4) \quad = \quad \frac{ă^{xɓ(4)}}{ă^{xɓ(1)} + ă^{xɓ(2)} + ă^{xɓ(3)} + ă^{xɓ(3)}} \quad \ldots\ldots (4)$$

Multinomial logit model is a choice between three or more alternative response (Kartels, Boztug and Muller, 1999). The model however is unidentified in the sense that there is more than one solution to ɓ$^{(1)}$, ɓ$^{(2)}$, ɓ $^{(3)}$ and ɓ$^{(4)}$ that lead to the same probabilities for Z = 1, Z = 2, Z = 3 and Z = 4. To identify the model, one of the ɓ$^{(1)}$, ɓ$^{(2)}$, ɓ $^{(3)}$ and ɓ$^{(4)}$ was arbitrarily set to O. That if ɓ $^{(2)}$ is arbitrarily set = 0, the remaining coefficients ɓ$^{(1)}$, ɓ$^{(3)}$ and ɓ$^{(4)}$ will measure the change relative to the Z = 4. In other words, this study compared the case of low contribution (2) of the farmers to climate change adaptation decision in their farming household with other possible levels of contribution (1, 3 and 4). Therefore, using four category response as used in the model for this study and setting ɓ$^{(2)}$ = 0, the equation became.

$$Pr \quad (Z = 1) \quad = \quad \frac{ă^{xɓ(1)}}{ă^{xɓ(1)} + ă^{xɓ(2)} + ă^{xɓ(3)} + ă^{xɓ(4}} \quad \ldots\ldots (5)$$

$$Pr \quad (Z = 2) \quad = \quad \frac{1}{ă^{xɓ(1)} + ă^{xɓ(2)} + ă^{xɓ(3)} + ă^{xɓ(4}} \quad \ldots\ldots (6)$$

$$Pr \quad (Z = 3) \quad = \quad \frac{ă^{xɓ(3)}}{ă^{xɓ(1)} + ă^{xɓ(2)} + ă^{xɓ(3)} + ă^{xɓ(4}} \quad \ldots\ldots (7)$$

$$Pr \quad (Z = 4) \quad = \quad \frac{ă^{x\,ɓ(4)}}{ă^{xɓ(1)} + ă^{xɓ(2)} + ă^{xɓ(3)} + ă^{xɓ(4)}} \quad \ldots\ldots (8)$$

The relative probability of Z = 1 to the base category is

$$\frac{\Pr(Z = 1)}{\Pr(Z = 4)} = \text{ǎ}^{x\text{ɓ}(1)} \text{ .... (9)}$$

If this is called the relative likelihood and assume that X and $\text{ɓ}_k^{(1)}$ are vectors equal to (X_1, X_2..., Xn) and ($\text{ɓ}_1^{(1)}$, $\text{ɓ}_2^{(1)}$,é .ɓ$k^{(1)}$) respectively, the ratio of relative likelihood for one unit change in X_i relative to the base category is then stated as;

$$\frac{\text{ǎ}^{\text{ɓ}_1^{(1)}}\ x_1+\text{é é ..}+\text{ɓ}_1^{(1)}(x_1+1)+\text{é é }+\text{ɓ}_k^{(1)}{}_{xk}}{\text{ǎ}^{\text{ɓ}_1^{(1)}}\ x_1+\text{é é é }+\text{ɓ}_1^{(1)}x_1+\text{é é é é .}+\text{ɓ}_k^{(1)}{}_{xk.}} \text{ .... (10)}$$

Enete (2003) citing StataCorp (1999) reported that, the exponential value of a coefficient is the relative likelihood ratio for one unit change in the corresponding variable. As pointed out, the dependent variable ñcontribution to adaptation decisionò have four (4) possible values; value 1 if the contribution is very low (VL), value 2 if low (L), value 3 if it is high (H) and value 4 if the contribution is very high (VH). An individual farmerôs contributions to climate change adaptation decisions as either very low, low, high or very high was hypothesized to be function of some socio-economic characteristics of the farmers as explanatory variables for the Mlogit model. These hypothesized variables are:

X1=	Gender of HHold Head	Gender of Household Head (1 = male, 0 female)
X2=	Years of Formal Education	Years of formal education of the farmer (in years)
X3=	Years of Farming Experience	Years of faming experience (in years)
X4=	Financial Contributions	Financial contributions of farmer (value 1 if rendering financial contribution, 0 otherwise).
X5=	Number Hours Spent in Farm	Number of hours spend on farm per day (in number)
X6=	Off-farm Job Status	Off-farm job status (having off farm job, 1 and 0 otherwise).

3.4.5 Factor Analysis

To address objective (viii), exploratory factor analysis was employed to identify constraints facing the women farmers in making contributions to climate change adaptation decision in the study area. To group the identified constraints, principal component analysis with varimax rotation was adopted with factor loading of 0.40. Therefore, factor loading of less than 0.40 or variables that load in more than one factor were discarded.

Factor analysis model specification

Principal component factor analysis model for achieving objective (viii) was given as:

$Y_1 = a_{11}X_1 + a_{12}X_2 + * \; * * + a_{1n}X_n$

$Y_2 = a_{21}X_1 + a_{22}X_2 + * \; * * + a_{2n}X_n$

$Y_3 = a_{31}X_1 + a_{32}X_2 + * * * + a_{3n}X_n$

$* \; = \qquad\qquad\qquad\qquad *$

$* \; = \qquad\qquad\qquad\qquad *$

$Y_n = a_{n1}X_1 + a_{n2}X_2 + * \; * + a_{nn}X_n$

***Where*:**

Y_1, Y_2 …Y_n = observed variables/constraints to women farmers in climate change adaptation decision making.

$a_1 - a_n$ = factor loadings or correlation coefficients.

X_1, X_2, … X_n = unobserved underlying factors constraints facing the women farmers in climate change adaptation decision making.

3.4.6 t-test statistics

The t-test was adopted in this study to test hypotheses (i), (v) and (vi) to ascertain whether there is significant difference in the mean awareness of climate change, contribution to adaptive decision making and vulnerability of male and female farmers to climate change respectively.

The formula for the t- test statistics for hypothesis testing is presented as follows:

$$t = \frac{\overline{X}_m - \overline{X}_w}{\sqrt{\dfrac{S_m^2}{n_m} + \dfrac{S_w^2}{n_w}}}$$

Where:

$\overline{X}_m$ = mean of menô awareness/contributions to climate change adaptation decision making.

$\overline{X}_w$ = mean of womenô awareness/contributions to climate change adaptation decision making.

S_m^2 = variance of menô awareness/contributions to climate change adaptation decision making.

S_w^2 = variance of womenô awareness/contributions to climate change adaptation decision.

n_m = number of men respondents.

n_w = number of women respondents.

3.4.7 Analysis of Variance (ANOVA)

Analysis of Variance (ANOVA) is an extremely important method in exploratory and confirmatory data analysis (Gelman, 2004). It was employed in this study to compare the mean ratings of the intensity of effects of climate change across the three agro-ecological zones in southwestern Nigeria. When using ANOVA, the observed differences between group means depends on the spread (variance) of the responses within groups. Widely different averages can more likely arise if individual farmers response to the extent of climate change adaptation within groups vary greatly. It is therefore necessary to take into account the variance within group when assessing difference between groups. Thus, if the variance between groups exceeds what is expected in terms of variance within groups, the null hypothesis will b rejected.

Variance Between Groups:

Let S^2_B represent the sample variance between groups:

$$S^2_B = \frac{SS_B}{df_B} \quad \text{--} \quad (1)$$

This represent the Mean Square between (MSB) which is the variability of the group means around the grand mean.

The SS_B (sum of square between) is:

$$SS_B = \sum_{i=1}^{k} n_i \, (X_i - X)^2 \quad \text{---} \, (2)$$

Where: n represents the size of the group i, the X_i represents the mean of the group i, and X represents group mean.

The degree of freedom (df) is represented as:

$$df_B = k - 1 \quad \text{--} \, (3)$$

Where k represent the number of groups of farmers, that is across the agro-ecological zones. Therefore, $df_B = 3 - 1 = 2$. -- (4)

Variance Within Groups:

Variance within (SW^2) quantifies the spread of values within groups. In ANOVA, the variance within is also called the Mean Square Within (MSW) and is calculated:

$$SW^2 = \frac{SS_w}{df_w} \quad \text{-- (5)}$$

Where the Sum of Squares within (SS_w) is:

$$SS_w = \sum_{i=1}^{k} (n_i - 1)s_i^2 \quad \text{-- (6)}$$

and the degree of freedom within is:

$$df_W = N - k \quad \text{-- (7)}$$

An alternative formula for the variance within is:

$$s_w^2 = \frac{(df_1)(s_1^2) + (df_2)(s_2^2) + \cdots + (df_k)(s_k^2)}{df_1 + df_2 + \cdots + df_k} \quad \text{------------------------ (8)}$$

Where: S^2_i represent the variance in group i and df_i represent the degrees in the group ($df_i = n_i - 1$). This alternative formula shows the variance within as a weighted average of group variances with weights determined by group degrees of freedom.

The statistics describe so far are arranged to form an ANOVA table as follows:

Source	**Sum of Squares**	**Degrees of freedom**	**Mean Squares**
Between	SS_B	$df_B = k - 1$	$S^2_B = SS_B / df_B$
Within	SS_W	$df_w = N - k$	$S^2_w = SS_W / df_W$
Total	$SS_T = SS_B + SS_W$	$df = df_B + df_w$	

The ratio of the variance between (S_B) and the variance within (S_w) is the ANOVA *F*-statistic:

$$F_{\text{stat}} = \frac{s_B^2}{s_W^2} \quad \text{-- (9)}$$

Under the null hypothesis, this test statistic has an F sampling distribution with df_1 and df_2 degrees of freedom. The p-value for the test is represented as the area under Fdf_1, df_2 to the right tail of the F_{stat}. Therefore, the null hypothesis was upheld when the F-calculated (*F-cal*) value was less than the F-critical (*F-tab*) value of 3.00 at PÒ0.05 level of significance. On the other hand, when the F-calculated (*F-cal*) value was greater than the F-critical (*F-tab*) value of 3.00 at PÒ0.05 level of significance, the null hypothesis of no significant different on the intensity of effects of climate change across the three local agro-ecological zones was rejected.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of the Farmers

4.1.1 Gender of Household Heads.

As presented in table 4.1, the majority (76%) of the farmers were males while the remaining 24% were females. This indicated that farm households in Southwestern Nigeria are mainly headed by male farmers. The finding of this study on gender of farm households head agreed with that of Raufu, Adepoju, Salau and Adebiyi (2009) while estimating the determinants of yield performance in small scale fish farming in Alimosho Local Government Area of Lagos state where the authors found that the majority (73.8%) of the farmers were males while 26.3% were females. Also, the finding disagreed with the findings of Okon, Enete and Amusa (2012) on enterprise combination among farmers in Akwa Ibom State which showed that majority (82.5%) of the farmers sampled for the study were females while the remaining 17.5% were male farmers.

4.1.2 Age of the Farmers

The majority (47%) of farmers in southwest Nigeria were between 41-60 years age bracket. This was followed by 31% representing farmers between 61-80 years age brackets. 20% of the farmers were between 21-40 years age bracket. Only 1% and 0% of the farmers were above 80 years and below 20 years of age respectively. The average age of the farmers was computed as 51 years. The trend of age distribution of farmers in southwest Nigeria as found out in this study is in conformity with the findings of Ogunniyi (2009) while estimating the economic analysis of snail production in Ibadan, Oyo state. Also, the result of this study conformed with the findings of Oyekale (2008) who found that the average age of farmers in southwestern Nigeria is 53 years. In addition, the findings of this study of age of the farmers corroborated the result of Adetunji, *et. al* (2007) which showed that farmers in Oyo state have an average age of 50 years.

4.1.3 Marital Status of the Household Heads

The result presented in table 4.1 showed that none of the sampled household heads was single while majority (67%) of the farmers were married. About 8% and 26% of the farmers were divorced and widowed respectively. The trend of marital status of the farmers agreed with the findings of Oluwatayo (2009) with about 63% of the sampled farmers married while 7.5% and 10.3% were widowed and divorced respectively. In addition, the finding of this study is in agreement with the result of a study conducted by Okon, Enete and Amusa (2012) where the authors found out that 56.3% of the farmers in Akwa Ibom State were married, 6.3% were single, 28.1% were widowed while 9.4% of the farmers were divorced.

4.1.4 Level of Education of the Farmers

As presented in Table 4.1, about 19% of the sampled farmers never attended school, that is, they had no formal education, while the remaining 80% had formal education at varying degrees. Out of this 80% that had formal education, 44% of them only attended primary school, 26% attended secondary school while 10% had higher education. The average years of education by the farmers is 7.1 (7) years. This finding conformed with that of Oluwatayo (2009) who investigated the influence of cooperatives on farm householdsô food security in the Southwest Nigeria and found that about 19.2% of the farmers had no formal education, 17.5% had primary school education, 26.7% and 36.6% of the farmers had secondary and tertiary education respectively. Also, the finding of this study on the average year of education of the farmers is technically close to that of Chukwuone (2009) who found the average years of education of farmers on a study in southern Nigeria to be 9 years.

4.1.5 Farm Household Size

The majority of the farmers (53%) were within the household size of 6 to 10 persons, followed by 27% of the farmers who were within the household size of 11 to 15 persons. About 16% of the farmers were within the household size of 1 to 5 persons while only 3% of the farmers have above 15 persons in their farm households (Table 4.1). The average farm household size as found out in the study is 7.7 (8) persons. The findings of this study on farm household size agreed with the findings of Abdulai and Huffman (2000) that the rice farmers in Northern

Ghana had the average household size of about 8 (8.4). In addition, the finding is also in line with that of Obamiro, Doppler and Kormawa (2003) who reported on their study that the average number of persons per farm household in Nigeria was 7 persons. Although, the trend of the result of this study disagreed with that of Abah (2011) who found out that majority of tomato farmers in FCT Abuja fell within household size of 1ï 5 persons.

4.1.6 Years of Farming Experience

As presented in Table 4.1, majority (36%) of the farmers in Southwest Nigeria had between 21-30 years of experience. This was closely followed by 29% of the farmers who had between 31-40 years of farming experience. Moreover, 16% of the farmers had years of farming experience of between 11 to 20 years while 15% and 4% of the farmers had above 40 years of experience and between 0 to 10 years of farming experience respectively. The average year of farming experience of the farmers was 36.4 (36) years; which is relatively high. This conformed with the finding of Aigbekaen, Dongo, Sanusi, Adeogun and Agbongiathuoyi (2006) who found that the average years of experience of agroforestry farmers and marketers was about 35 years in Nigeria. The finding of this study seemed to a little bit far from that of Oyekale (2008) while who found that the average years of farming experience of farmers in Southwestern Nigeria was about 29 years.

4.1.7 Land Ownership Status of the Farmers

The result on land ownership status in the study area showed that the majority (71%) of the farmers owned their farm lands for agricultural production while 29% of them acquired their farm lands through rents and lease. This finding supported the findings of Idowu, et al (2007) who reported that the systems of gaining access to farmlands in Nigeria tend to follow three main patterns: (i) inheritance (ii) operator cultivated and (iii) Leasing.

4.1.8 Off Farm Occupations of the Farmers

The result on multiple responses of the farmers on off-farm (secondary) occupations indicated that, majority of the farmers were involved in one or more off-farm jobs to support their major source of livelihood which is farming. For instance, majority (57%) of the farmers were involved in petty trading, 27% in artisanship, 17% in civil service jobs, 7% in apprenticeship, 7% in other off-farm vocations which include (driving, hunting and politicking) while 9% of the farmers indicated none involvement in any off-farm job. This showed that farmers in southwest Nigeria diversified their farming activities to off-farm occupations to increase household income and possibly cope with risks that are associated with farming business. The findings of this study on off-farm occupations of the farmers agreed with the findings of Abah (2011) who found out that tomato farmers around FCT Abuja were involved in business/trading, artisanship and civil service as secondary occupations to farming.

Table 4.1: Distribution of Respondents (Farmers) by Socioeconomic Characteristics in Southwest Nigeria.

Socio-economic Characteristics of Farmers	Frequency	Percentage (%)	Mean
Gender of Household Heads			
Male	263	75.6	
Female	85	24.4	
Total	**348**	**100**	
Age (years)			
Ò20	0	0	
21-40	71	20.40	
41-60	165	47.41	**51.4**
61 ï 80	107	30.75	
> 80	5	1.44	
Total	**348**	**100**	
Marital Status of Household Head			
Single	0	0	
Married	232	66.67	
Divorced	27	7.76	
Widowed	89	25.57	
Total	**348**	**100**	
Level of education			
No formal education	69	19.83	
Primary school education	154	44.25	
Secondary school education	90	25.86	**7.1**
Tertiary institutions	35	10.06	
Total	**348**	**100**	
Farm Household Size			
1 ï 5	57	16.38	
6 ï 10	184	52.87	
11 ï 15	95	27.30	**7**
16 and above	12	3.45	
Total	**348**	**100**	
Years of farming experience			
0-10	15	4.31	
11-20	54	15.52	
21-30	126	36.21	**36.4**
31-40	101	29.02	
Above 40	52	14.94	
Total	**348**	**100**	
Land Ownership Status			
Owned	246	70.69	
Otherwise	102	29.31	
Total	**348**	**100**	
Off-Farm (Secondary) Occupations			
None	33*	9.48	
Trading	197*	56.61	
Civil service	58*	16.67	
Artisanship	93*	26.72	
Apprenticeship	23*	6.61	
Others	25*	7.18	

* Multiple responses

Source: **Field Survey, 2012.**

4.2 Awareness of Climate Change Phenomenon among Farmers in the Study Area.

Awareness of climate change, most especially, among farmers in many studies has been of great concern. This is because, the decision to adapt to climate change is subject to awareness or the perception of the threats of the global phenomenon. Hence, Nzeadibe, *et al,* (2011) stated that the perception of climate change by stakeholders, such as farmers, is important as perception (awareness) can shape the preparedness of these actors to adapt and change or modify their farm practices. Table 4.2 presented some indices of levels of awareness of climate change among farmers in southwest Nigeria. According to the table, six out of the twenty identified indicators of climate change as presented in the table had mean values that range between 3.50 to 3.67 which were within the real limit of number 3.50-4.00 indicating high awareness of the six (6) climate change indicators among farmers in the area. These indicators with their corresponding mean values on a 4-point rating scale include: unpredictable rainfall patterns (3.52), increase in temperature or heat intensity (3.67), prolonged drought than before (3.50), delay in arrival of annual rainfall (3.53), gradual disappearing of the usual harmattan periods (3.64) and decrease in ice fall during rainfall unlike before (3.55).

The result in Table 4.2 showed further that, ten out of the twenty identified climate change indicators had mean values that ranged between 2.66 to 3.39 which fell within the real limit of number 2.50-3.49 indicating moderate awareness of the ten (10) climate change indicators among the farmers. These indicators with their corresponding mean values on a 4-point rating scale include: decreased rainfall amount in the continental interiors (2.93), increased rainfall in the coastal areas (2.66), high winds and heat waves (3.39), fast water evaporation from the ground (2.90), unusual heavy rainfall (2.89), reduced length of growing season (3.03), increased flooding/erosion menace (3.20), increased desertification (2.92), drying up of rivers, lakes and streams (3.12) and increased post harvest deterioration of crops (3.24). The findings of this study on level of awareness of climate change is related to the findings of the study of Ozor & Nnaji (2011) who found out that effects of climates change as perceived by farmers in Enugu State, Nigeria include: heat from high temperature (3.53) drying of rivers, lakes and surface water bodies (3.48), drought (3.35) and change in storage quality of fruits and vegetable (3.16).

Findings of this study on awareness also conformed with the report of the study of Sofoluwe, Tijani and Baruwa (2011) who confirmed that most Nigerian farmers are already aware of the changes in climate; through variation in the indicators. Maddison (2007) reported that preliminary evidences from a number of studies across African countries showed that large number of farmers already perceive that the climate has become hotter and the rain has become less predictable and shorter in duration. The finding of this study also supported that of Mandleni and Anim (2011) whose findings indicated that 55.90% of farmers in Eastern Cape Province of South Africa perceived an increase in temperatures while 74.10% of the farmers perceived a decrease in rainfall indicating high awareness of climate change in the area.

The remaining four climate change indicators with their respective mean values include: river surface temperature rise (2.45), variation in bloom date (fruiting of crops) (2.35), rising sea level (2.41) and crop and animal species extinctions (2.17) which all fell within the real limit of number 1.50 ï 2.49 indicating low awareness of the indicators among the farmers. Hence, the report of Maddison (2006) affirmed that one of the major constraints encountered by farmers in adaptation is still inadequate information and consequently low awareness of climate change. In affirmation, Enete, *et al,* (2011) emphasized the need for increased education and awareness creation among farmers as potent tools for climate change adaptation in Nigeria.

Table 4.2: Mean Ratings of the Responses of Farmers in Southwest Nigeria on their Level of Awareness of Climate Change Phenomenon. (N= 348).

S/N	Climate change indicators	$\overline{X}$	SD
1	Decreased rainfall amount in the continental interiors	2.93**	1.050
2	Increased rainfall in the coastal areas	2.66**	1.098
3	Unpredictable rainfall patterns	3.52***	0.801
4	Increase in temperature (heat)	3.67***	0.623
5	Prolonged drought than before	3.50***	0.738
6	Delay in arrival of annual rainfall	3.53***	0.707
7	Gradual disappearing of the usual harmattan periods	3.64***	0.635
8	High winds and heat waves	3.39**	0.877
9	Fast water evaporation from the ground	2.90**	1.155
10	Unusual heavy rainfall	2.89**	1.153
11	Reduced length of growing season	3.03**	0.806
12	Decrease in ice fall during rainfall unlike before	3.55***	0.820
13	River surface temperature rise	2.45*	0.947
14	Variations in bloom date (fruiting of crops)	2.35*	1.133
15	Rising sea level	2.41*	1.139
16	Increased flooding/erosion menace	3.20**	0.880
17	Crop and animal species extinctions	2.17*	1.125
18	Increased desertification	2.92**	0.802
19	Drying up of rivers, lakes and streams	3.12**	0.931
20	Increased post harvest deterioration of crops	3.24**	0.982

Note: *** High Awareness (HA)
** Moderate Awareness (MA)
* Low Awareness (LA)

Source: **Field Survey, 2012.**

Farmersô awareness of climate change phenomenon is shaped by a number of socio-economic and institutional factors. Figure 4.1 presents the percentage distribution of major sources of information on climate change among farmers in southwest Nigeria. From the figure, it was shows that about 79% of the farmers were aware of climate change through personal observation of variations in the indicators. This was closely followed by 63% of the farmers who indicated extension agents as their source of information on the phenomenon. About 28% of the farmers indicated researchers as their sources of information, 22.41% got their information through friends, 20.11% through radio/television, 19.25% through farmers' cooperatives, 17.81% from newspapers, 5.46% through the internet while only 3.74% of the farmers got their information about climate change through politicians.

As found out in this study, the majority of the farmers were aware of climate change through personal observation. This finding is in line with that of Adebayo, *et al* (2011) who found that there is a high level of climate awareness among farmers (90%) in southwest Nigeria; that their main sources of information about climate change are personal observation, personal contacts, family and friends as well as radio and television. The findings of this study is in agreement with the report of National Metrological Services Agency (NMSA) (2001) which showed that farmers through personal observation are aware of increasing trend in temperature and decreasing trend in precipitation. The findings of this study also agreed with that of Maddison (2006) who in a study reported that the awareness of climate change appears to hinge on farmerǿs experience and the availability of extension services specifically related to climate change. In addition, Gbetibouo (2009) reported that farmers with access to extension services were likely to be aware of changes in the climate because extension services provide information about improved farm practices under the prevailing biophysical conditions such as climate and weather. This corroborates the fact that effective extension service delivery is a good avenue for farmersô increased awareness of climate change.

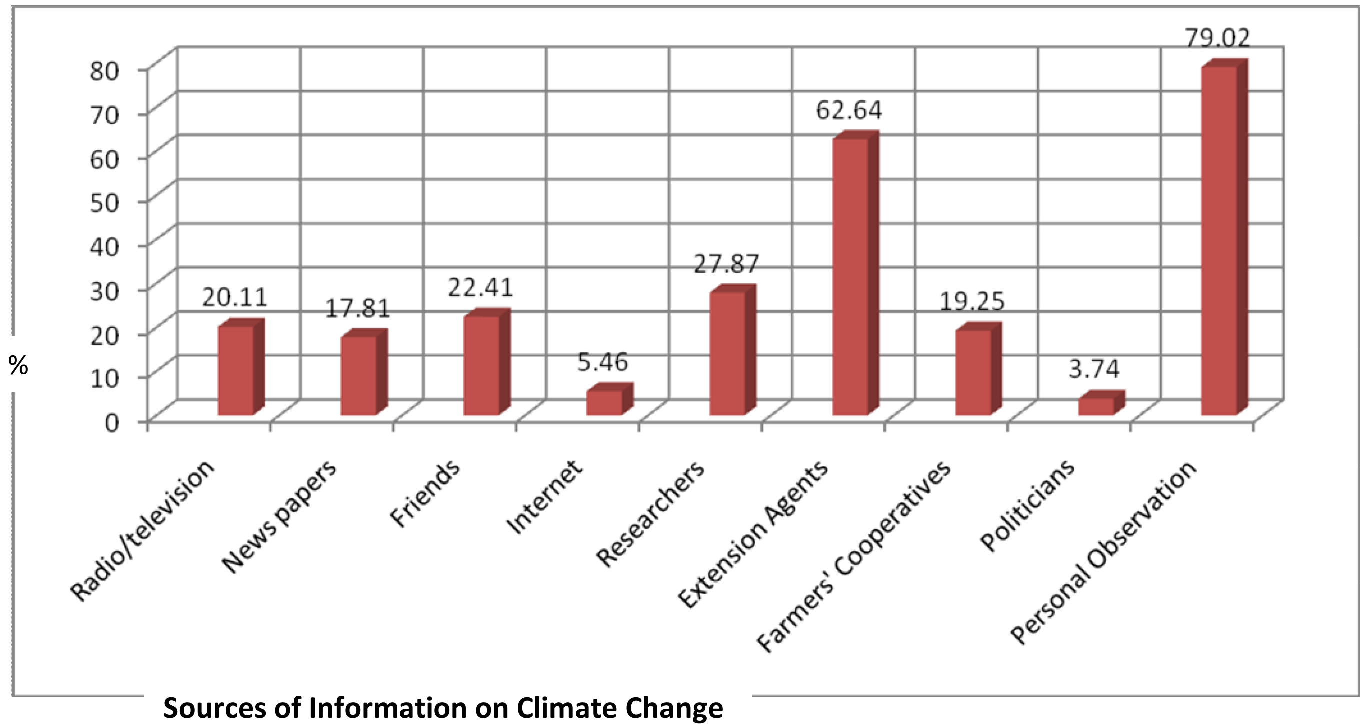

Figure 4.1: Bar Chart Showing Percentage Distribution of Sources of Information on Climate Change among Farmers in Southwest Nigeria.
***Source:* Field Survey, 2012.**

4.3 Intensity of Climate Change Effects on Agricultural Production in Southwest Nigeria.

Literature suggests that climate change is already having significant negative impacts in Nigeria, and these impacts are expected to increase in the future. For instance, the report of Building Nigeria Response to Climate Change ñBNRCCò (2011) showed that the adverse impacts of climate change are expected to lead to production losses in the Nigerian agricultural sector, compromising the attainment of the Millennium Development Goals, especially Goal 1 ñEradicate Extreme Poverty and Hungerò and Goal 7 ñEnsuring Environmental Stability. Table 4.3 presented some indices of intensity of the effects of climate change on agricultural production from the perception of farmers in southwest Nigeria. Two out of the twenty three identified effects of climate change on food production as presented in the Table had mean values that fell within 3.50 - 4.00. These two effects with their respective mean values include: higher temperature and heat (3.58) and prolonged drought (3.51) on a 4-point rating scale. This implied that these two effects of climate change are perceived as having very serious impact on agricultural production in southwest Nigeria.

The result in Table 4.3 showed further that, eleven out of the twenty three identified effects of climate change on food production had mean values that ranged between 2.51 to 3.14 which fell within the real limit of number 2.50-3.49 indicating that the 11 effects are already having serious impact on agricultural production in the area. These variables with their corresponding mean values on a 4-point rating scale include: decreased rainfall amount (2.71), unusual heavy rainfall (2.55), increased cases of flooding (2.83), deceased soil moisture (2.51), reduction in crop yield (2.53), poor quality of storage farm produce as a result of heat (3.10), drying up of rivers, lakes and streams (2.88), increased drying up of seedlings after germination (3.14), heat stress on crop and livestock (2.62), increased soil erosion resulting from unusual heavy rains (2.73) and increased post harvest spoilage of harvested crops (2.87). The findings of this study conformed with part of Ozor and Nnaji (2011) who found that significant effects of climate change on agricultural production as perceived by farmers in Enugu state include: soil erosion, post harvest losses due to climate variability, decrease in yields of crops and animals, flooding, heat from high temperature, drought and decrease in soil moistures. The findings of this study also corroborated the report of Tarhule and Woo (1997) which showed that drought is responsible for about 90% of famine events in northern Nigeria through effects on agricultural production. Findings of Ishaya and Abaje (2008) showed that the threat of climate change is more on health, food supply, biodiversity lost and fuelwood availability than on businesses and instigating of disaster; and it is the poor, who depend heavily on the natural resources that are mostly affected by incidence of climate change. This findings of this study also agreed with the findings of Adebayo, *et al* (2011) who found that in terms of climate change effects on farming enterprises, reduction in crop yield were reported by 60% of the farmers interviewed in southwest Nigeria while about 46.7% of the farmers also noted a general low level of farm productivity as a consequence of climate change.

The result in Table 4.3 also showed that, the remaining ten identified effects of climate change on food production had mean values that ranged between 1.61 to 2.48 which fell within the real limit of number 1.50-2.49 indicating less serious effects of the climate change items on agricultural production in the area. These variables with their corresponding mean values on a 4-point rating scale include: heavy winds (2.22), increased desertification (2.37), increase in pest and disease problems (2.09), extinction of some crop species (1.79), premature ripening of fruits (1.61), stunted growth of crops (2.48), intense weed growth (2.39), storage losses in roots and tubers (2.47), increased salinity/water pollution due to climate variability (1.79) and decrease in fish population due to salinity, water level, ocean currents or speed (2.10). The finding of this study indicating less serious effects of heavy winds, increased desertification, increase in pest and disease, stunted growth of crops and intense weed growth among others on food production in southwest Nigeria disagreed with part of the findings of Ozor and Nnaji (2011) who found out that intense weed growth, incidence of pests and diseases and premature ripening had significant effects on agricultural production in Enugu State. The findings of the study on less serious effects of storm on agriculture in southwest Nigeria disagreed with the findings of Adebayo, et al (2011) whose findings showed that farmers in swamp zone of southwestern Nigeria report concern about increased incidence of storms damaging boats, nets and increased incidence of boats capsizing during storms; resulting from the effects of climate change.

Table 4.3: Mean Ratings of the Responses of Farmers in Southwest Nigeria on Intensity of the Effect of Climate Change on Agricultural Production. (N= 348).

S/N	Effects of climate change on agriculture	$\overline{X}$	SD
1	Decreased rainfall amount	2.71**	0.993
2	Unusual heavy rainfall	2.55**	0.831
3	Higher temperature and heat	3.58***	0.650
4	Heavy winds	2.22*	0.819
5	Increased cases of flooding	2.83**	0.952
6	Prolonged drought	3.51***	0.679
7	Increased desertification	2.37*	0.837
8	Increase in pest and disease problems	2.09*	1.084
9	Extinction of some crop species	1.79*	1.169
10	Deceased soil moisture	2.51**	0.859
11	Premature ripening of fruits	1.61*	1.144
12	Reduction in crop yield	2.53**	0.890
13	Poor quality of storage farm produce as a result of heat	3.10**	0.608
14	Stunted growth of crops	2.48*	0.938
15	Drying up of rivers, lakes and streams	2.88**	0.942
16	Increased drying up of seedlings after germination	3.14**	0.599
17	Heat stress on crop and livestock	2.62**	0.859
18	Intense weed growth	2.39*	0.995
19	Increased soil erosion resulting from unusual heavy rains	2.73**	0.831
20	Storage losses in roots and tubers	2.47*	0.913
21	Increased salinity/water pollution due to climate variability	1.79*	1.168
22	Decrease in fish population due to salinity, water level, ocean currents or speed	2.10*	0.952
23	Increased post harvest spoilage of harvested crops	2.87**	0.792

Note: *** Very Serious (VS)
** Serious (S)
* Less Serious (LS)

Source: **Field Survey, 2012.**

4.4 Gender-based Vulnerability to Climate Change among Farm Households in South West Nigeria.

The result presented in Table 4.4 showed gender-based vulnerability analysis of farm households in southwest Nigeria to impact of climate change using adaptive capacity approach. The adaptive indicators assessed in this study include: years of education, farm size, farmland ownership status of the farmer, farm income, extension visits, access to credit, membership of cooperative, farm labourers, number of livestock, working members of household and access to remittance to support farming. It was hypothesized that increase in adaptive indicators result to increased adaptability and coping capacity of households which consequently reduce their vulnerability. Therefore, the adaptive indicators assessed in this study have negative or inverse functional relationship with vulnerability. As presented in the table, the actual values of the adaptive indicators are in different units and scales. To obtain the vulnerability indices on each of the indicators on gender basis across the selected three states in southwestern Nigeria, the methodology used by United Nations Development Programme (UNDP) (2006) for assessing Human Development Index was followed to normalize and standardize the values to remove the variation in units and scales to lie between 0 and 1.

Using education of the household head as indicator, male headed households in southwest Nigeria having vulnerability index of 0.42 was less vulnerable and have more educative capacity to cope with climate change relative to female headed households that had high education vulnerability index of 0.80 indicating less educative capacity to cope with climatic shock. Considering farm size, male headed households have low vulnerability index of 0.26 compared to female headed households that have high vulnerability index of 0.86. This indicates that male headed households operate more farm size in the area than their female counterpart. On ownership of land for agricultural production, the vulnerability index of male headed households was 0.23 while that of female headed households was 0.75. This indicated that male headed households have more access to land which could possibly enhance their adoption of varieties of adaptation strategies to cope with climate change than females. Fabiyi *et. al* (2007) reported that women in Nigeria rarely own land despite their heavy involvement in agriculture. The finding of this study agreed with the study of Ogada, *et al*. (2010) that secure land tenure had a positive influence on the probability of adopting terrace as a farm technology in the rain-fed semi-arid lands of Kenya; it was also found out by Birungi and Hassan (2010) that land tenure security increases the probability of investment in land management as coping strategy.

On farming income of the farmers, the vulnerability index of male headed households was 0.36 while that of female headed households was 0.83. This implied that male headed households have more farming income and possibly increased adaptive capacity to employ more adaptation strategies to cope with the challenges of climate change than their female counterparts. This finding corroborated that of Agabi (2012) that, increase in farmersô income in north central Nigeria increase coping capacity and access to more adaptive technologies among the farmers. Using number of extension visits/contacts as adaptive indicator, male headed households in southwest Nigeria having vulnerability index of 0.42 was less vulnerable and have more training to cope with climate change relative to female headed households that had high vulnerability index of 0.93 indicating less access to extension training for improved adaptive knowledge by the female headed households. Rafferty (1988) reported that agricultural extension programmes and other supporting services have traditionally concentrated more on educating male farmers and hence farm women still largely depend on their husbands for information on farm inputs and other resources necessary for farm decision making. The vulnerability index of male headed households under access to credit was 0.41 while that of the female headed households was 0.89 which was relatively higher than the male. The low vulnerability index of male headed households indicated more access to farm credit for increased financial base which in turn enhance their climate change adaptive capacity. The findings of the study carried out by Fosu-Mensah, *et al* (2010) in Ghana showed that farmersô access to farm credit and loan facilitates adaptation to new technology and climate change as access to cash allows farmers to purchase inputs like seeds of improved varieties and fertilizer.

Table 4.4 Gender-based Vulnerability Analysis (Vulnerability Index) to Climate Change among Farm Households in South West Nigeria. (N = 348)

			Ekiti		Ogun		Oyo		Average	
SN	**Adaptive Indicators**	**Gender**	**Actual Value**	**Vul. Index**	**Actual Value**	**Vul. Index**	**Actual Value**	**Vul. Index**	**Actual Value**	**Vul. Index**
X1	EDUCATION	**MHHD**	7.032	**0.68**	7.483	**0.00**	7.101	**0.57**	7.205	**0.42**
		FHHD	6.818	**1.00**	7.043	**0.66**	6.988	**0.74**	6.950	**0.80**
X2	FARM SIZE	**MHHD**	3.365	**0.00**	2.247	**0.53**	2.849	**0.25**	2.820	**0.26**
		FHHD	1.346	**0.96**	1.256	**1.00**	2.071	**0.61**	1.558	**0.86**
X3	LAND OWNERSHIP	**MHHD**	0.776	**0.00**	0.613	**0.40**	0.657	**0.29**	0.682	**0.23**
		FHHD	0.582	**0.47**	0.458	**0.77**	0.365	**1.00**	0.468	**0.75**
X4	INCOME	**MHHD**	100364.4	**0.60**	160068.6	**0.00**	113321.7	**0.47**	124584.9	**0.36**
		FHHD	60598.5	**1.00**	98534.1	**0.62**	73098.1	**0.87**	77410.2	**0.83**
X5	EXTENSION VISITS	**MHHD**	4.732	**0.00**	2.464	**0.96**	4.002	**0.31**	3.733	**0.42**
		FHHD	2.809	**0.82**	2.375	**1.00**	2.429	**0.98**	2.538	**0.93**
X6	CREDIT ACCESS	**MHHD**	0.363	**0.71**	0.535	**0.00**	0.408	**0.53**	0.435	**0.41**
		FHHD	0.294	**1.00**	0.339	**0.81**	0.327	**0.86**	0.320	**0.89**
X7	COOP MEMBER	**MHHD**	0.420	**0.25**	0.457	**0.00**	0.335	**0.83**	0.404	**0.36**
		FHHD	0.396	**0.41**	0.312	**0.99**	0.310	**1.00**	0.339	**0.80**
X8	FARM LABOURERS	**MHHD**	5.526	**0.00**	3.526	**0.85**	4.335	**0.50**	4.462	**0.45**
		FHHD	4.076	**0.61**	3.162	**1.00**	3.659	**0.79**	3.632	**0.80**
X9	NO OF LIVESTOCK	**MHHD**	23.943	**0.93**	22.387	**1.00**	26.152	**0.83**	24.161	**0.92**
		FHHD	25.451	**0.27**	39.354	**0.23**	44.282	**0.00**	36.362	**0.17**
X10	WORKING MEMBERS	**MHHD**	3.145	**0.92**	5.257	**0.00**	5.043	**0.09**	4.482	**0.34**
		FHHD	3.347	**1.00**	4.400	**0.56**	4.564	**0.47**	4.104	**0.68**
X11	REMITTANCE	**MHHD**	0.634	**1.00**	0.821	**0.26**	0.766	**0.47**	0.740	**0.58**
		FHHD	0.685	**0.79**	0.887	**0.00**	0.697	**0.75**	0.756	**0.51**

OVERALL VULNERABILITY INDEX (V.I)

Gender-based Vul. to Climate Change	**Vul. Index**
MHHD	**0.43**
FHHD	**0.73**
Zonal-based Vul. to Climate Change	**Vul. Index**
Derived Savanna Zone (Ekiti State)	**0.61**
Rainforest Zone (Ogun State)	**0.53**
Guinea Savanna Zone (Oyo State)	**0.60**

Note: **MHHD** = Male Headed Household
FHHD = Female Headed Household

Source: Computed from Field Survey, 2012.

Considering membership in farmers cooperative as opportunity to build up adaptive capacity, male headed households have vulnerability index of 0.36 compared to female headed households that have high vulnerability index of 0.80. This indicated that male headed households are more organized into farmersô cooperative societies in the area than their female counterparts. Through cooperatives, farmer members can have more access to agricultural inputs, technologies and training from extension agents. The findings of Enete and Amusa (2010) showed that lack of access to supporting programmes such as cooperatives and adult education are part of the challenges facing women farmers in making adequate contribution to farm decision making. Using availability of farm labour as indicator of climate change adaptive capacity, male headed households have vulnerability index of 0.45 while female headed households have vulnerability index of 0.80. The low vulnerability index of male farmers indicated that male headed households in southwest Nigeria are more endowed with farm labour which suggested their higher adaptive capacity to effects of climate change than the female headed households. Hence, the result of the study conducted by Onyeneke and Madukwe (2010) in southeastern Nigeria confirmed that shortage of labour constitutes a major barrier to adaptation to climate change.

Using number of livestock owned by the farmers as indicator of adaptive capacity, the vulnerability index of male headed households was 0.92 which was high compared to that of the female headed households was 0.17. This finding showed that the diversification of farming operation into rearing of livestock for economic benefits of households as adaptation option is more supported by female headed households. The size or number of livestock reared by a farmer suggests the farm resource base of the farmer. For instance, Yisehak (2008) reported that livestock are significant in maintaining the livelihoods of their keepers by providing food, draught power, manure, skin, hide, cash, security, social and cultural identity, medium of exchange and means of savings. Farmersô resources are important factor influencing their ability to cope with climate change. This finding of this study is in line with the report of a study conducted by FAO (1995) on women, agriculture and rural development in the near East where the report showed that compared to womenôs critical roles in food crop production and rearing of livestock, their contributions to agroforestry is less substantial.

Considering the number of working household members as indicator of climate change adaptive capacity, male headed households has vulnerability index of 0.34 while female headed households has vulnerability index of 0.68. The number of active household members involve in economic activities suggests the human capital endowment of the household and consequently high adaptive capacity in times of shock. Using household access to remittance as a measure of adaptive capacity, the vulnerability index of male headed household was 0.58 while that of female households in southwest Nigeria was 0.51. Buttressing the significance of remittances on household livelihood sustainability and poverty reduction, Taylor, Mora and Adams (2005) in a study in rural Mexico found that international remittances account for a sizeable proportion of the total per capita household income in rural Mexico and that international remittances reduce both the level and depth of poverty. Also, Yang and Martinez (2005) in a study in Philippines found that remittance has significant positive effects on poverty reduction among benefited households.

Therefore, using household adaptive capacity approach which is a function of the available institutions, human and material resources to cope with effects of climate change, the result of the overall gender-based vulnerability analysis showed male headed farming households in southwest Nigeria has vulnerability index of 0.43 while the female headed farming households on the other hand has vulnerability index of 0.73. This finding therefore showed that, employing adaptive capacity approach, female headed farming households in southwest Nigeria are more vulnerable to the effects of climate change than their male counterpart. This finding is in line with that of Babatunde, Omotesho, Olorunsanya and Owotoki (2008) who assessed gender-based determinants of vulnerability to food insecurity among farming households in Nigeria and found that male headed households possessed more resources than female headed households. The authors reported further that crop output, off-farm income, total household income, and available labour were significantly higher in male headed farm households than in female headed households. The report of USAID (2010) showed that women who constitute the major food producers in developing countries generally have lower incomes, less access to credit and limited control over resources resulting in their increased vulnerability to many climate change impacts. In addition, Olorunsanya and Omotesho (2011) found that female headed households are more poverty prone than male headed farming households in North-central Nigeria. For further clarification, figure 4.2 compared gender-based vulnerability index using different adaptive indicators.

On zonal basis, the result presented in Table 4.4 further showed that, farming households in derived savanna ecological zone (Ekiti) has climate change vulnerability index of 0.61, while farming households in rainforest (Ogun) and guinea savanna (Oyo) ecological zones have climate vulnerability index of 0.53 and 0.60 respectively. Therefore, using vulnerability threshold probability of 0.5 (Deressa, et al, 2009), the findings showed that farmers from the three local agro ecological zones in southwest are vulnerable to effects of climate change.

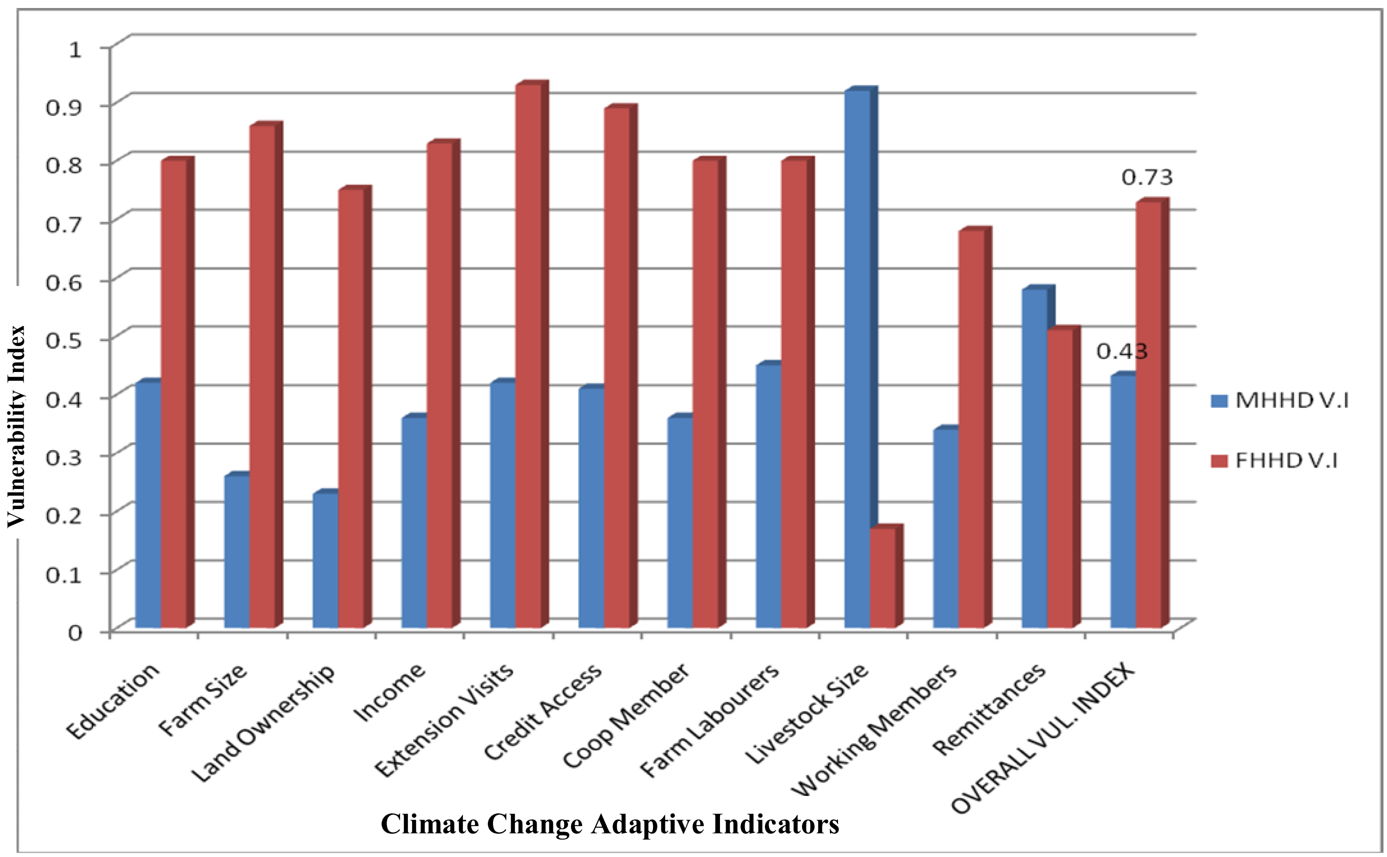

Figure 4.2: A Bar Chart Showing Gender-based Vulnerability Index (V.I) to Climate Change Using Adaptive Capacity Approach among Farm Households in Southwest Nigeria.

Source: Field Survey, 2012.

4.5 Socio-economic Determinants of Farmers Adaptation and Extent of Adaptation to Climate Change in Southwestern Nigeria.

The Heckman double stage model was used for estimating the influence of socio-economic characteristics of the farmers on the discrete decision of whether or not to adapt and the continuous decision of the extent of adaptation to climate change. Perceived change in climate variables is an important pre-condition to take up adaptation measures (Maddison, 2006). Therefore, farmers that reported in affirmative to awareness of climate change constituted the sample for this model. The first stage being the selection model was the discrete decision of whether (1) or not (0) to adapt to climate change while the second stage being the outcome model was continuous (Enete, 2003; United Nations and World Trade Organization, 2012; and Vance and Buchheim, 2005) and a percentage of the total number of adaptation strategies utilized by a farm unit out of the 33 strategies specified in the study. The results justified the use of Heckman double stage selection model with rho value (0.61561) which was significantly different from zero (0). Moreover, the likelihood function of the Heckman double stage model was significant (Wald^{2}G= 743.72, with pÒ0.0000) showing strong explanatory power of the model.

As presented in Table 4.5, the results from the regression showed that most of the explanatory variables affected the probability of adaptation decision and extent of adaptation as expected. Variables that positively and significantly influenced the first decision of whether or not to adapt include: gender, farming experience, extension visits, farm size, income, credit access and number of farm labourers. However, dependency ratio was significant and negatively related with the first discrete decision. On the other hand, variables that positively and significantly influenced extent of adaptation to climate change include: gender, farming experience, education, extension visits, farm size, income, credit access and number of farm labourers. Dependency was also found to significant and negatively affected extent of adaptation to climate change.

The parameter estimates of the Heckmanøs double stage selection model only provided the direction of the effect of the explanatory variables on adaptation decision and extent of adaptation to climate change and did not present the actual magnitude of change or probabilities in the coefficients. Thus, the marginal effects (dy/dx) from the Heckmanô s double stage selection, which measure the expected change in probability of adaptation and extent of adaptation to climate change with respect to a unit change in an independent variable was also presented in Table 4.4 for both selection and outcome models respectively.

Gender of household head (GENDERHHHD) was positively and significantly ($p<0.05$) related with the discrete decision of adaptation and also positively and significantly ($p<0.01$) related with extent of adaptation by number of adaptation strategies utilized. A unit increase in households headed by male will have a marginal effect of raising the probability of adaptation to climate change by 0.01668 (1.6%). Similarly, a unit increase in households headed by male will have a marginal effect of raising the probability of using addition adaptation strategies by 0.01976 (1.9%). This result is in line with the findings of Deressa, *et al* (2008) that male headed households have more probability of adapting to climate change as showedby the fact that a unit change from being headed by a female household to male increases the probability of adapting to climate change by 18%. Asfaw and Admassie (2004) reported that male-headed households are often considered to be more likely to get information about new technologies for adoption and take risky businesses than female-headed households. Although, the findings of this study disagreed with that of Kakooza, Kabasimba, Ssemakula and Musisi (2005) while assessing gender variation in agricultural technology in Uganda and found out that women have greater preference and use of indigenous agricultural technologies than men.

Years of farming experience (YRSFMEXPR) of the farmers was found to be significant ($p<0.10$) and positively affected discrete decision of adaptation. The extent of adaptation was also positively and significantly ($p<0.01$) correlated with experience. The result of the marginal impact showed that a unit increase in years of farming experience of the farmers will result in increase of the probability for deciding to adapt to climate change by 0.00122 (0.1%) and probability for taking additional adaptation strategies by 0.04378 (4.3%). This findings supported the result of the study of Yohannes, John and Garth (2007) on strategic decision-making on adoption of agricultural technologies and risk in a peasant economy in the Ada and Selale districts of Ethiopia where the authors established positive and significant relationship between years of farming experience and adoption of coping farm technologies such as fertilizer, pesticides, the use of improved livestock and seeds.

The coefficient of years of formal education (YRSOFEDU) was positive and significantly ($p<0.05$) correlated with the discrete decision to adapt climate change and also significantly ($p<0.05$) related with extent of adaptation to climate change by number of strategies utilized. A unit increase in years of formal education of the farmers will have a marginal effect of raising the probability of taking additional adaptation strategies by 0.15988 (15.9%). This agreed with the findings of Enete, *et al* (2011) that farmer's number of years of formal education was also positive and highly significantly related with the level of investment in indigenous climate change adaptation practices. Knight, Weir and Woldehanna (2003) found that education encourages farmers to adopt innovations. Hence, it is expected that educated farmers may better understand and process information provided by different sources regarding adoption of new farm technologies. For instance, the findings of the study of Onyeneke and Madukwe (2010) showed that lack of information on appropriate adaptation options could constitute barrier to climate change adaptation.

Number of extension visits (EXTVISITS) to the farmers was highly significant and positively influenced discrete decision of adaptation at $p<0.01$ and extent of adaptation at $p<0.01$. This conforms with *apriori* expectation as extension contact expose farmers to various coping techniques and farm technologies. The result of the marginal impact showed that a unit increase in number of extension visits to the farmers will yield 0.01288 (1.3%) increase in probability of taking discrete decision to adapt and 0.08181 (8.2%) probability of taking additional adaptation strategies. This finding is in agreement with that of Bekele and Drake (2003) whose findings showed that extension education was an important factor motivating increased intensity of use of specific soil and water conservation practices. In addition, the result of this study is in consonance with the report of a study conducted by Advancing Capacity to Support Climate Change Adaptation (ACCCA) (2010) on improving decision-making capacity of small holder farmers in responses to climate change which showed that number of extension contacts positively and significantly related to increased fertilizer use and increase soil and water conservation practices in Ethiopia. Other studies that established positive influence of extension contact/services with adoption of agricultural and adaptation technologies include: Birungi and Hassan (2010) that found positive relationship between agricultural extension and adoption of inorganic fertilizer as land management technology in Uganda; also Hassan and Nhemachena (2008) found out that extension contact had positive influence on adoption of multiple crops under irrigation, mono crop-livestock under dry land, mono crop-livestock under irrigation, multiple crop-livestock under irrigation and multiple crop-livestock under dryland as adaptation strategies employed by African farmers.

The coefficient of farm size (FMSIZE) of the farmers had positive and significant ($p<0.01$) relationship with discrete decision of adaptation. Farm size was also positive and significantly ($p<0.01$) related with the extent of adaptation to climate change. The result of marginal effects on farm size indicated that a one-unit increase in farm holdings of the farmers would lead to 0.02910 (2.9%) increase in the probability of adapting to climate change and 0.02792 (2.7%) increase in probability for taking additional adaptation strategies by the farmers. This finding agreed with the results of the study of Ayanwuyi, *et al* (2010) who found out that farm size had positive and significant relationship with the perception and climate change adaptation strategies adopted by farmers in Ogbomosho Agricultural zone of Oyo State.

Table 4.5: Parameter Estimates and Marginal Effects of the Heckman Double Stage Selection Model of Socio-Economic Determinants of Farmers' Adaptation and Extent of Adaptation to Climate Change in Southwestern Nigeria.

	Selection Result (Adaptation model)		**Outcome Result (Extent of Adapt model**	
Variables	**Regression Coefficients (ß)**	**Marginal effects (dy/dx)**	**Regression Coefficients (ß)**	**Marginal effects (dy/dx)**
GENDERHHHD** (male 1, female 0)	0.37211 (3.80)**	0.01668 (3.80)**	3.19976 (4.13)***	0.09976 (4.13)***
YRSFMEXPR (number of years)	0.03279 (2.46)*	0.00122 (2.46)*	0.24378 (10.86)***	0.04378 (10.86)***
YRSOFEDU (number of years)	0.36636 (3.36)**	0.01363 (3.36)**	0.15988 (2.55)**	0.15988 (2.55)**
HHSIZE (number of persons)	-0.29726 (-1.42)	-0.01106 (-1.42)	-0.00614 (-0.07)	-0.00614 (-0.07)
EXTVISITS (number of visits per season)	0.34625 (3.07)***	0.01288 (3.07)***	0.28118 (3.23)***	0.08181 (3.23)***
FMSIZE (in hectare (ha))	0.78225 (4.31)***	0.02910 (4.31)***	0.46793 (4.62)***	0.02792 (4.62)***
NOOFLIVESTOCK (number of flock)	-0.00238 (-0.64)	0.00088 (-0.64)	0.00260 (1.07)	0.01269 (1.07)
INCOME (in naira ڭ)	2.18900 (3.22)***	0.08144 (3.22)***	5.49446 (3.47)***	0.01944 (3.47)***
CREDITACCESS** (having access 1, otherwise 0)	4.82041 (5.15)**	0.05615 (5.15)**	2.63932 (2.62)***	0.03933 (2.62)***
LNDOWNERSHIP** (Owned land 1, otherwise 0)	1.08854 (1.54)	0.07567 (1.54)	0.94283 (1.26)	0.00268 (1.26)
FARMLABORERS (number of persons)	0.50047 (3.49)***	0.01862 (3.49)***	0.74709 (6.73)***	0.04783 (6.73)***
DEPENDENCY (number of persons)	-0.23735 (-2.11)*	-0.00883 (-2.11)*	-0.54824 (-3.87)***	-0.04823 (-3.87)***
CONSTANT	4.56480 (4.86)***		2.81866 (3.61)***	

(*) dy/dx is for discrete change of dummy variable from 0 to 1.

Note: *** denotes P Ò0.01, ** denotes 0.01>PÒ0.05, *denotes>0.05Ò0.10

Figures in parenthesis () are z-ratios

Number of obs = 296
Censored obs = 61
Uncensored obs = 235
rho = 0.61561
Wald chi2(12) = 743.72
Prob > chi2 = 0.0000

Source: Field Survey, 2012.

Farmers income (INCOME) was found to be highly significant ($p<0.01$) and positively related to the discrete decision to adapt to climate change. The extent of adaptation was also positive and significantly ($p<0.01$) correlated with farmers income. The result of the marginal effects showed that a unit increase in the farmers income will result in increase of the probability for taking positive decision to adapt to climate change by 0.08144 (8.1%) and probability for taking additional adaptation strategies by 0.01944 (1.9%). Increase in farmersô income increases their adaptive capacity to cope with changes in climatic conditions by adopting various adaptation strategies. This finding is in line with that of Agabi (2012) who found out that increase in farmersô income in north central Nigeria increased farmers access to adaptive technologies and coping capacity. Poverty is a major barrier for low income earners to adapt to climate change, therefore high income farmers are at advantage. In addition, the findings of this study also agreed with that of Yohannes, John and Garth (2007) who found out that adoption of fertilizer and pesticides is positively influenced by factors such as farmersô income and wealth among others.

Farmersô access to credit (CREDITACCESS) was found to be significant ($p<0.05$) and positively related to discrete decision to adapt to climate change. The extent of adaptation was also positive and highly significant ($p<0.01$) with access to credit. This conforms with *apriori* expectation as access to credit increase financial capacity of farmers to employ various adaptation options that are climate and profit driven. The result of the marginal effect showed that a unit increase in farmersô access to credit will yield 0.05615 (5.6%) increase in probability for taking positive decision to adapt and 0.03933 (3.9%) probability for taking additional adaptation strategies. Access to farm credit as found out by Nhemachena and Hassan (2008) increases financial resources of farmers and their ability to meet transaction costs associated with various adaptation options they might want to take. Hence, access to credit was hypothesized to have positive and significant effect on climate change adaptation measures. Fosu-Mensah, Vlek and Manschadi (2010) while investigating farmersô perception and adaptation to climate change in Sekyedumase District of Ghana found out that access to farm credit and loan facilitates adaptation to new technology and climate change as access to cash allows farmers to purchase inputs like seeds of improved varieties and fertilizer. In addition, the finding of this study supported that of Ayanwuyi, *et al* (2010) who found out that farmers access to credit positively and significantly influence the perception of climate change and adaptation strategies by farmers. Sofoluwe, Tijani and Baruwa (2011) further buttressed that farmers access to loan positively and significantly influence plating of trees, planting of various crop varieties and variation of planting date as adaptation strategies.

Number of farm labourers (FARMLABORERS) was highly significant ($p<0.01$) and positively correlated with discrete decision of adaptation. Also, the coefficient of farm labourers was positive and significantly ($p<0.01$) related to the extent of adaptation. A unit increase in number of farm labourers will have a marginal effect of increasing the probability of taking positive decision to adapt to climate change by 0.01862 (1.8%) and increase probability of taking additional adaptation strategies by 0.04783 (4.7%). Literature suggests that climate adaptation is costly and labour intensive. Therefore, a farming household with more number of farm labourers is at advantage of using more adaptation strategies to cope in the face of climate change. The finding of this study on influence of farm labourers technically agreed with the report of Teklewold, Dadi, Yami and Dana (2006) who reported that household size as a proxy to labour availability influence the adoption of a new technology positively as its availability reduces the labour constraints. In affirmation, Gbetibouo (2009) found out that household size is part of the main factors that enhance adaptive capacity of farm households. Hence, the result of the study conducted by Onyeneke and Madukwe (2010) in southeastern Nigeria confirmed that shortage of labour constitute a major barrier to adaptation to climate change.

The coefficient of number of dependent group (DEPENDENCY) in farming households in southwest Nigeria was significant and negatively influenced discrete decision of adaptation to climate change at $p<0.10$ and extent of adaptation at $p<0.01$. The negative relationship between dependency and climate change adaptation is expected. This is because, an increase in number of dependent household members may indicate decrease in the number of economically active household members and consequently low adaptive capacity through utilization of various adaptation strategies to cope with the effects of climate change, all things being equal. The result of the marginal effect showed that a unit increase in number of dependent population of farm household, will result to 0.00883 (0.9%) decrease in probability for taking positive decision to adapt and 0.04823 (4.8%) decrease in probability for taking additional adaptation strategies. It is hypothesized that farm households with large economically active members would expectedly be endowed with the required farm labour for use considering the labour intensive nature of climate change adaptation practices. The finding of this study is in line with findings of Magheed (2011) who found out that number of dependent persons in farm households significantly and negatively related to adoption of soil and water conservation technologies in Pakistan.

4.6 Gender-based Contributions to Climate Change Adaptation Decision Making in Crop Production Activities among Farm Households in Southwest Nigeria.

Members of farm households irrespective of gender are involved in building adaptive response to climate change in their daily food production activities. Table 4.6 presented the indices of variations in gender-based contributions to decision making in climate change adaptation activities in crop production among farming households in southwest Nigeria. From the Table, the result showed that the contributions of men to decision making in the twenty three identified adaptation activities in crop production were exceedingly very high. This was showed in the mean values of eighteen out of the twenty three identified climate change adaptation activities as presented in the Table. The 18 activities having mean values that ranged from 3.50-3.71 which fell within the real limit of number 3.50-4.00 confirming very high contributions by men to decision making process in the 18 climate change-related activities. The contributions of men to decision making were only low in two adaptive activities. These and their corresponding mean values include: processing of crops to minimize post-harvest losses (2.48) and consulting rain maker during prolonged drought (1.98) which fell between within real limit of number 1.50-2.49 indicating low contributions of men to these two adaptive measures. This finding agreed with the reports of ARMS (1996) that even though women are involved in farming activities such as farm planning, working on the farm and farm management, men still play dominant roles when it comes to allocation of farm resources and decision making. The report of a study conducted by Centre for Integrated Agricultural Systems ñCIASò (2004) showed that womenôs low level of income and economic resources in the society limit their contributions to household farm decision making.

On the other hand, the contributions of women to decision making in the climate change adaptation activities in crop production were relatively low compare to that of their men counterpart. The contributions of women to decision making were only very high in seven out of the twenty three identified adaptation activities. These with their corresponding mean values include: diversification of farm enterprise to nonfarm business (3.56), planting pest and disease resistant crops (3.53), planting of drought tolerant crop varieties (3.60), planting of fast maturing crop varieties (3.68), adopting recommended planting distance (3.70), changing crop harvesting dates (3.60) and processing of crops to minimize post-harvest losses (3.81). This is technically expected because, farm activities such as planting, harvesting and processing are carried out by the women. In affirmation, Eilor and Giovarelli (2002) in their studies found that women provide most of the labour in agriculture in planting, weeding, harvesting, processing and storage of food and cash crops, hence, their high contribution to adaptation decision making on these activities. Arene and Omoregie (1990) confirmed that Nigerian women are frequently in charge of processing, preservation and distributive trade of farm produce. Sabo (2006) reported that women contribute between 46 and 65% of all hours spent on traditional agricultural production and processing; hence the likelihood for their higher contributions to decision making in these activities.

The generally very high contribution of men over women in climate change adaptation decision making in crop production was further showed in figure 4.3. The figure presented the graphical representation of the steadily very high contributions of men over women in decision making except in crop processing to reduce food spoilage where women have higher contribution than their male counterparts.

Table 4.6: Comparative Analysis of Gender-based Contributions to Climate Change Adaptation Decision Making in Crop Production Activities among Farm Households in Southwest Nigeria. (N = 348)

SN	Climate change adaptation activities involving decision making	Men Mean ($\overline{X}$)	Women Mean ($\overline{X}$)
1	Use of irrigation system/water storage	2.52** (0.75)	2.17* (0.86)
2	Early or late planting of crops as adaption strategies	3.55*** (0.52)	3.15** (0.73)
3	Planting different varieties of crop (multiple cropping)	3.70*** (0.50)	2.24* (0.98)
4	Planting of trees (afforestation/reforestation or agroforstry practices)	3.84*** (0.64)	2.20* (1.01)
5	Planting cover crops to help conserve soil moisture	3.63*** (0.66)	2.75** (0.87)
6	Minimum/zero tillage so as not to expose the soil to loss of nutrients	3.57*** (0.60)	2.35* (1.11)
7	Increased mulching of crops to conserve moisture and reduce heat effect	3.59*** (0.54)	2.46* (0.90)
8	Staking of crawling crops such as yam to avoid heat burns	3.67*** (0.56)	2.31* (1.06)
9	The use of organic manure	3.03** (0.89)	2.34* (1.04)
10	Mixed farming (diversification of farm enterprise to nonfarm business)	3.61*** (0.70)	3.53*** (0.69)
11	The use of inorganic manure (fertilizers)	2.96** (0.90)	2.04* (1.12)
12	Making ridges across farms to reduce effects of erosion	3.63*** (0.65)	2.43* (0.97)
13	Planting pest and disease resistant crops	3.60*** (0.80)	3.00** (0.82)
14	Planting of drought tolerant crop varieties	3.64*** (0.85)	2.97** (0.91)
15	Making of contour bunds around farmland	3.68*** (0.63)	2.22* (0.98)
16	Planting of fast maturing crop varieties	3.71*** (0.68)	3.68*** (0.77)
17	Avoiding eroded/erosion prone area for farming	3.50*** (0.88)	2.34* (0.99)
18	Adopting recommended planting distance	3.63*** (0.75)	3.70*** (0.78)
19	Changing crop harvesting dates	3.67*** (0.60)	3.60*** (0.62)
20	Processing of crops to minimize post-harvest losses	2.48* (1.04)	3.81*** (0.42)
21	Construction of drainages across the farmland	3.70*** (0.59)	2.30* (1.09)
22	The use of wetlands/river valleys for production (Fadama system or *akuro*)	3.66*** (0.58)	2.24* (1.25)
23	Consult the rain maker during prolonged drought	1.98* (1.18)	1.53* (1.26)

Note: Figures in parentheses represent the standard deviation.
*** indicates Very High (VH) contributions to farming decision making.
** indicates High (H) contributions to farming decision making.
* indicates Low (L) contributions to farming decision making

Source: Computed from Field Survey, 2012.

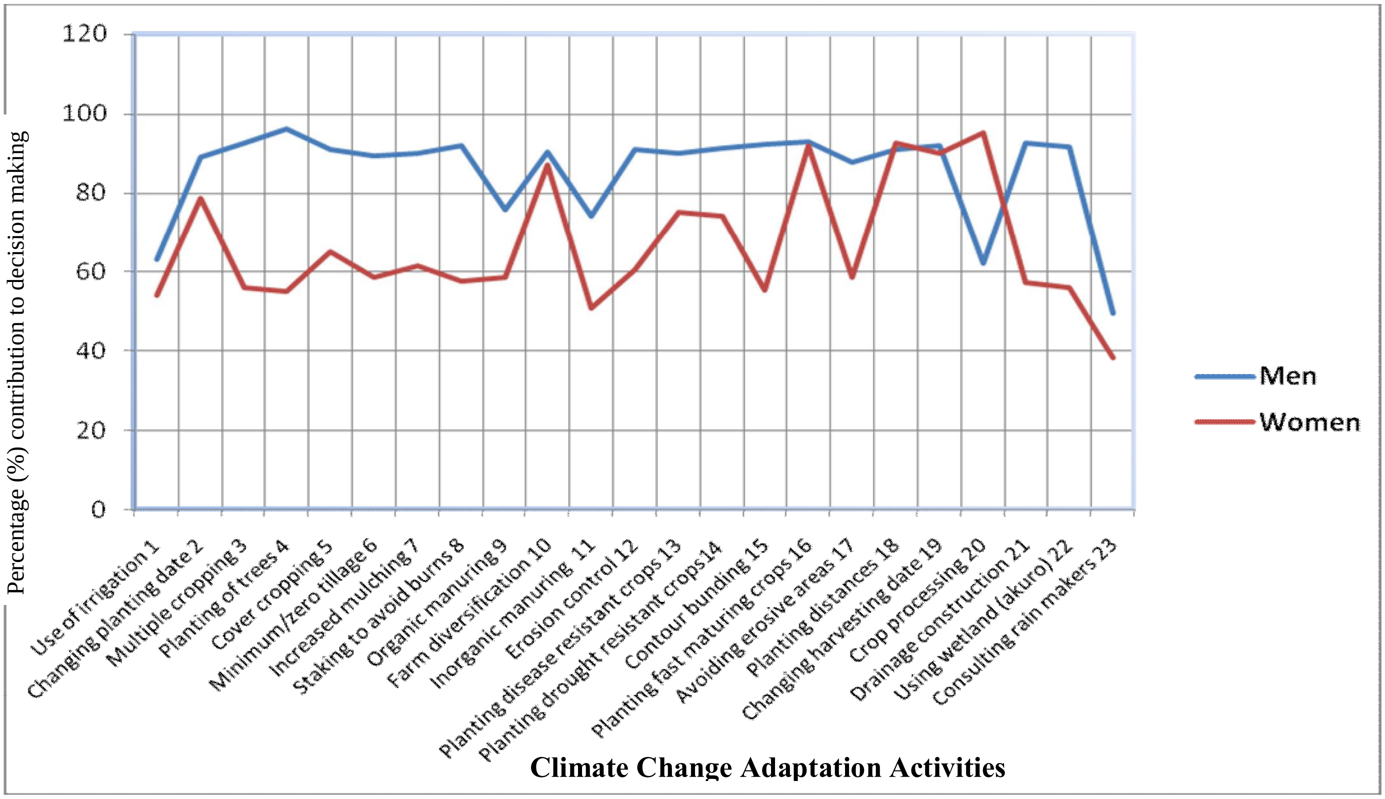

Figure 4.3: Graphical representation of steadily high and relatively low contributions of men and women respectively to climate change adaptation decision making in crop production.
Source: Field Survey, 2012.

4.7 Gender-based Contributions to Climate Change Adaptation Decision Making in Livestock Rearing Activities Among Farm Households in Southwest Nigeria.

Both men and women do a large number of tasks related to animal production, with some degree of variation in level of involvement (Yisehak, 2008). From the result presented in Table 4.7, it was showed that the contributions of men to climate change adaptation decision making were very high on five out of the ten identified livestock rearing activities. This is because, the mean values for the five activities were within the real limit of 3.50-4.00. These adaptation activities with their respective mean values include: improved fence camps for livestock (3.51), construction of shelter for animals using non-conductors of heat (3.57), decrease in stocking rate of animals (3.52), distributing livestock herds in different places to reduce disease spread (3.50) and intensify shading of livestock pens (3.52). The contributions of the men to decision making were high in decision making on intensify supplementary feeding system (2.43), on dip and dose system in livestock rearing (2.73), rearing of disease and pest resistant livestock varieties (3.45) and culling of infected animals (3.35) and low in rainwater harvesting for livestock rearing (2.02).

The contributions of the women on the other hand to decision making in climate change adaptation in livestock production were exceedingly very high across all the identified activities. For instance, womenõs contributions to decision making in nine out of the ten identified adaptation activities in livestock production had mean values that ranged between 3.55 to 3.75 which fell within the real limit of 3.50 - 4.00. This indicates very high contribution of the women to decision making in those livestock adaptation activities. The mean contribution of women to decision making in dip and dose system in livestock rearing was 2.89 which were within 2.50ï 3.49 real limit of number indicating high contribution to decision making on that activity. The result presented in Table 4.7 showed that women have relatively higher contributions to decision making as regards adaptation activities in livestock rearing than male farmers.

The generally very high contribution of women over men in climate change adaptation decision making in livestock production was further showed in figure 4.4. The figure presented the graphical representation of the steadily very high contributions of women over their male counterparts in adaptive decision in livestock production activities among farm households in southwest Nigeria. In affirmation, Hoque and Itohara (2008) in their study found out that among the agricultural activities assessed, womenõs participations were relatively higher in various post harvest activities and livestock management activities than other agricultural activities. The report of FAO (1995) showed that women play significant roles in food crop production and rearing of livestock; hence, their high contributions to decision making in adaptive activities in livestock production. This findings of this study disagreed with that of Yisehak (2008) while assessing gender responsibility in smallholder mixed crop-livestock production systems of Jimma zone, South West Ethiopia where the author found that men are largely the decision makers for livestock production and are in charge of general herd management.

Table 4.7: Comparative Analysis of Gender-based Contributions to Climate Change Adaptation Decision Making in Livestock Rearing Activities among Farm Households in Southwest Nigeria. (N = 348)

SN	Climate change adaptation activities involving decision making	Men Mean ($\overline{X}$)	Women Mean ($\overline{X}$)
1	Intensify supplementary feeding system	3.43** (0.74)	3.55*** (0.81)
2	Dip and Dose system in livestock rearing	2.73** (0.99)	2.89** (0.92)
3	Improved fence camps for livestock	3.51*** (0.89)	3.57*** (0.83)
4	Rearing of disease and pest resistant livestock varieties	3.45** (0.76)	3.63*** (0.84)
5	Construction of shelter for animals using non-conductors of heat	3.57*** (0.71)	3.66*** (0.91)
6	Culling of infected animals	3.35** (0.92)	3.65*** (0.62)
7	Decrease in stocking rate of animals	3.52*** (0.87)	3.60*** (0.84)
8	Distributing livestock herds in different places to reduce disease spread	3.50*** (0.63)	3.64*** (0.79)
9	Rainwater harvesting for livestock rearing	2.02* (1.05)	3.75*** (0.55)
10	Intensify shading of livestock pens	3.63*** (0.70)	3.56*** (0.73)

Note: Figures in parentheses represent the standard deviation.
*** indicates Very High (VH) contributions to farming decision making.
** indicates High (H) contributions to farming decision making.
* indicates Low (L) contributions to farming decision making

Source: Computed from Field Data, 2012.

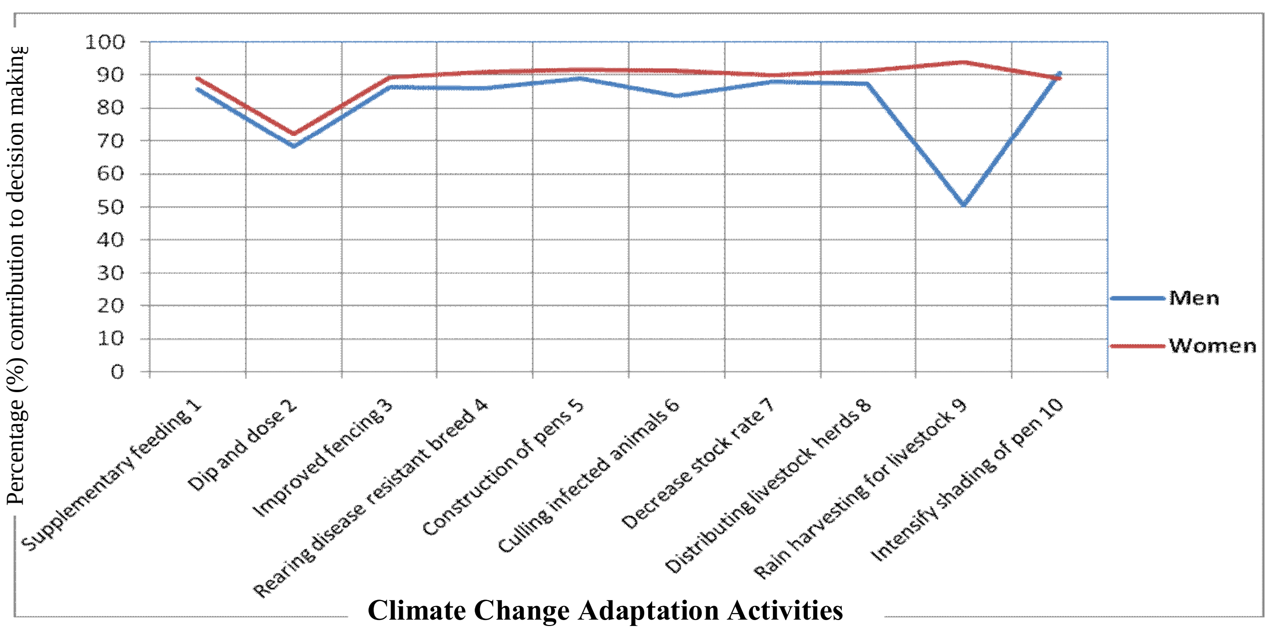

Figure 4.4: Graphical representation of steadily high and relatively low contributions of women and men respectively to climate change adaptation decision making in livestock rearing.

Source: Field Survey, 2012.

4.8 Socio-Economic Factors Influencing Farmers' Level of Contribution to Climate Change Adaptation Decision Making in Southwestern Nigeria.

The level of farmersô contributions to climate change adaptation decision making in this study was hypothesized to depend on a number of socio-economic factors. Multinomial logit (MNL) model was used to estimate socio-economic factors that influenced farmers level of contributions (Very Low, Low, High and Very High) to climate change adaptation decision among farming households in southwestern Nigeria. This was estimated by normalizing one category, which is referred to as the ñreference state,ò or the ñbase category.ò In this analysis, the base category is Low contribution (2) against which comparisons are made in each case. The result of the multinomial logit (MNL) model indicated that socio-economic factors that influenced farmersô level of contribution to climate change adaptation decision include: gender, education, farming experience, financial contribution, average hours spend on the farm per day and off-farm job. The result of the parameter estimates from the multinomial logit (MNL) model is presented in Table 4.8a.

The likelihood ratio statistics as indicated by G^2 statistics are highly significant ($p<0.0000$). The explanatory power of the factors as reflected by Pseudo R^2 was high (0.6862), indicating that the hypothesized variables are actually responsible for about 69% of the variations in extent of farmers contribution to adaptive decisions in their farming households. In terms of consistency with *a priori* expectations on the relationship between the dependent and the explanatory variables, the model seems to have behaved well. The parameter estimates of the MNL model only provided the direction of the effect of the explanatory variables on the dependent variable (levels of contribution) and did not present the actual magnitude of change or probabilities in the coefficients. Thus, the marginal effects from the MNL, which measure the expected change in probability of a particular level of contribution to decision making with respect to a unit change in an independent variable was presented in Table 4.8(b) reported and discussed.

The gender of household head (GENDERHHD) (male 1 and female 0) was significant (pÒ0.01) and negatively related with the probability of making very low contributions to adaptation decision but was positive and significantly (pÒ0.01) related to making high and very high contributions to adaptation decision in comparison with low contribution (Table 4.8a). The negative and significant implication of gender to very low contributions to decision making showed that, male farmers are less likely to make very low contribution to climate change adaptation decisions in their farming households. On the other hand, the positive and significant effect of gender on high and very high contributions to decision making as against low contribution implied that male farmers are more likely to make high and very high contributions to climate change adaptation decisions in their farming households in Southwest Nigeria. The result of the marginal effects in Table 4.8b indicated that a one-unit increase in number of male-headed households means a decrease in the probability of making very low contribution to adaptation decision by -0.13284 (-13.3%) and an increase in the probability of making high contribution to adaptation decision by 0.06125 (6.1%) and making very high contribution by 0.01746 (1.7%). In other words, gender is a significant factor determining farmersô level of contribution to climate change adaptation decision making.

The findings of this study on influence of gender on adaptation decision seems to correspond with the findings of Ogada *et al.*, (2010) who found that male household heads have a positive relationship in adoption of manure and intensity of its use and fertilizer adoption and intensity of its use in farm technology adoption in Kenya; and the study of Hassan and Nhemachena (2008) who also established that climate change adaptation strategies of multiple crops under irrigation and multiple crop-livestock under irrigation are significant and positively related with male gender. Lizárraga, Baquedano1y and Cardelle-Elawar (2007) investigated factors that affect decision making with specific interest on gender and age and found out that gender in favour of male positively and significantly influence household decision making. In addition, Babugura, Mtshali and Mtshali (2010) reported that women tend to have limited access to decision-making, a situation that hinder and restrict them from public and contribution to disaster prevention and emergency response and management such as climate change phenomenon.

Years of formal education (YROFFEDU) of the farmers was positively and significantly (pÒ0.01) related to the probability of making very high contribution to climate change adaptation decision among farming households in southwest Nigeria (Table 4.8a). The coefficient of education was negatively and positively related with very low and high contributions respectively but not significant in each case. The result of the marginal impact (Table 4.8b) indicated that a unit increase in years of formal education of the farmers will likely lead to 0.007103 (0.7%) increase in the probability of making very high contribution to adaptation decision making. Recognizing the significance of education in farm decision making, Nuthall (1997) on farm decision information cost and returns reported that the lifeblood of decision making is useful and accurate information, which is often acquire through education of the farmers. The findings of Bekele and Drake (2003) also found that education of farmers through extension was found to be an important factor motivating increased decision for intensified use of specific soil and water conservation practices. Nzeadibe, Chukwuone, Egbule and Agu, (2011) investigated farmers' perception of climate change governance and adaptation constraints in Niger Delta region of Nigeria and found that part of the major constraints to climate change adaptation by farmers in the Niger Delta are lack of information, inability to access available information and limited knowledge on adaptation measures, which are subject to their level of education and affect their decision making in relation to climate change adaptation.

The coefficient of years of farming experience (YOFFMEXPR) was positive and significantly (pÒ0.01) related to the probability of making very high contribution to climate change adaptation decision among farming households in southwest Nigeria; although no significantly related with very low and high contribution (Table 4.8a). The result of the marginal effects (Table 4.8b) showed that a unit increase in years of farming experience of the farmer would result to 0.02272 (2.3%) increase in the probability of making very high contribution to adaptation decision making process. This indicated that experienced farmers in farming households make the bulk of adaptation decisions; and that as experience increases the likelihood of making high contribution to decision making process also increases. This finding agreed with that of Yohannes, John and Garth (2007) who investigated strategic decision-making for adoption of agricultural technologies and risk in a peasant economy and found that the impact of indigenous production knowledge and farming experience on adoption decisions was found to be positive and significantly greater than most economic and social variables. Hence, the report of the study conducted by ACCCA (2010) on improving decision-making capacity of small holder farmers in response to climate risk adaptation in three drought-prone districts of Tigray, northern Ethiopia found that household characteristics considered to have differential impacts on adoption or adaptation decisions are farmers age (which often reflects experience), education level among others.

Table 4.8(a): Parameter Estimates of the Multinomial Logit (MNL) Analysis of Socio-Economic Factors Influencing Farmers' Level of Contributions to Climate Change Adaptation Decision Making in Southwestern Nigeria.

Explanatory Variables	Coefficients		
	Very Low Contr (1)	**High Contr (3)**	**Very High Contr (4)**
GENDER	-0.24927	3.94364	3.71227
(male 1, female 0)	(-0.45)***	(6.84)***	(3.21)***
YROFFEDU	-0.09256	0.05381	0.47621
(in years)	(-1.35)	(0.62)	(4.18)***
YOFFMEXPR	-0.02798	0.01731	0.14625
(in years)	(-1.05)	(0.64)	(4.02)***
FINCONTR	0.04794	1.31007	3.09765
(offering fin. contr 1, No 0)	(0.06)	(2.04)**	(3.92)***
NHOURS/DAY	-0.72548	0.41558	0.82863
(in hours)	(-3.11)***	(1.74)**	(2.95)***
OFFFARMJOB	1.10712	-0.24159	-0.39278
(having off-farm job 1, No 0)	(1.71)*	(-0.39)	(-0.50)
CONSTANTS	3.23475	-5.42296	14.16894
	(2.38)**	(-3.32)***	(6.13)***

Note: **Low Contr (2)** is the Base Outcome
*** denotes P Ò0.01, ** denotes 0.01>PÒ0.05, *denotes>0.05Ò0.10
Figures in parenthesis () are z-ratios
Number of obs = 348
Wald chi-square (ɢ^2) (18) = 450.36
Prob > ɢ^2 = 0.0000
Pseudo R^2 = 0.6862
Log pseudo likelihood = -237.9859
Contr = Contribution

Source: Field Survey, 2012

The marginal effect for the parameter estimate of the multinomial logit model (MNL) in table 8(a) above is presented in table 8(b) below to show the expected change in probability of the dependent variable as a result of a unit change in the independent variables.

Table 4.8(b): Marginal Effects from the Multinomial Logit (MNL) Analysis of Socio-Economic Factors Influencing Farmers' Level of Contributions to Climate Change Adaptation Decision Making in Southwestern Nigeria.

Explanatory Variables	Marginal Effects		
	Very Low Contr (1) (dy/dx)	**High Contr (3)** (dy/dx)	**Very High Contr (4)** (dy/dx)
GENDERHHD*	-0.13284	0.06125	0.01746
(male 1, female 0)	(-2.26)**	(7.52)***	(2.33)**
YOFFEDU	-0.00775	-0.03889	0.00710
(in years)	(-1.82)*	(-1.97)**	(3.84)***
YOFFMEXPR	-0.00238	-0.01176	0.02272
(in years)	(-1.84)*	(-2.00)**	(3.62)***
FINCONTR*	-0.04794	-0.00382	0.03439
(offering fin. contr 1, No 0)	(-1.63)	(-0.34)	(3.55)***
NHOURS/DAY	-0.00396	0.00229	0.00911
(in hours)	(-2.21)**	(0.54)	(2.59)***
OFFFARMJOB*	0.00511	-0.00254	-0.01209
(having off-farm job 1, No 0)	(1.60)	(-0.23)	(-0.41)

*dy/dx is for discreet change of dummy variable from 0 to 1

Note: **Low Contr (2)** is the Base Outcome

*** denotes P Ò0.01, ** denotes 0.01>PÒ0.05, *denotes>0.05Ò0.10

Figures in parenthesis () are z-ratios

Number of obs = 348

Contr = Contribution

Source: Field Survey, 2012

Financial contributions (FINCONTR) was significantly and positively related to the probabilities of making high and very high contributions to climate change adaptation decision at pÒ0.05 and pÒ0.01 respectively in comparison with low contributions (Table 4.8a). The positive and significant effect indicated that the more the financial involvement of a farmer to climate change adaptation activities, the more the likelihood of the farmer making high and very high contributions to adaptation decision making in their farm households. A unit increase in financial involvement as shown in the marginal effects (Table 4.8b) would yield -0.00382 (-0.3) decrease in probability of making high contribution and 0.03439 (3.4%) increase in the probability of making very high contribution to adaptation decision making process. The finding of this study is in support of the result of Ngome (2003) while studying gender division of labour and women's decision-making power in rural households in Mbalangi, Ediki and Mabonji Villages of Meme Division Uganda found that decision-making is based on economic power, income earnings which are likely to confer a certain degree of decision-making power on women. In addition, this finding seems to agree with findings of Pitt, Khandker and Cartwright (2003) who investigated the influence of micro-credit women empowerment in Bangladesh and found that woman farmers who participate in micro-credit have access to financial, economic and social resources and therefore take greater role in household decision making. Also in affirmation, Nhemachena and Hassan (2008) reported that access to affordable credit increases financial resources of farmers and their ability to meet transaction costs associated with various adaptation options they might want to take, which are subject to decision making.

The average number of hours spend on the farm per day (NHOURS/DAY) was significant ($p \leq 0.01$) and negatively related to the probability of making very low contributions to adaptation decision but was positive and significantly related to making high and very high contributions to adaptation decision at $p \leq 0.05$ and $p \leq 0.01$ respectively (table 4.8a). The negative and significant connotation of number of hours spent on the farm to very low contributions to decision making implied that, farmers who spend more hours on the farm are less likely to make very low contribution to climate change adaptation decision making. On the other hand, the positive and significant effect of the variable on high and very high contribution to decision making in comparison with low contribution implied that farmers who spend more number of hours on the farm are more likely to have high and very high contributions to adaptation decisions in their farming households. The result of the marginal effects in Table 4.8b suggested that a unit increase in average number of hours spend on the farm decrease the probability of making very low contribution to adaptation decision by -0.00396 (-0.3%) and an increase in the probability of making high contribution to adaptation decision by 0.00295 (0.2%) and making very high contribution by 0.00911 (0.9%). The finding of this study is in line with that of Enete and Amusa (2010) who investigated the determinants of women contribution to farming decision making among cocoa-based farm households in Ekiti State, Nigeria and found that the average number of hours spent in the farm by women farmers positively and significantly influenced their level of contribution to farming decisions.

The coefficient of having Off-farm job (OFFFARMJOB) was positive and significantly (pÒ0.10) related to the probability of making very low contribution to adaptation decisions in comparison with low contribution (table 4.8a). The significant and positive relationship of off-farm job with very low contribution to adaptation decision making implied that farmers with off-farm jobs are likely to be absent from the farm most of the time therefore having very low contributions to adaptation decision making in their farming households. A unit increase in number of farmers with off-farm occupation as shown in the marginal effects (Table 4.8b) would result to 0.00511 (0.5%) further increase in the probability of making very low contribution to adaptation decision making process among farming households in southwestern Nigeria. It is expected that in farming households where most of the farmersô responsibilities are in favour of on-farm activities than off-farm ones, contributions to farm decision making is also expected to be increased. Contrary to this finding, Yohannes, *et al* (2007) found that the decision for adoption of fertilizer is positively influenced by economic factors by off-farm income from off-farm jobs.

4.9 Constraints Militating Against Women in Making Contributions to Climate Change Adaptation Decision.

Table 4.9 presented the varimax-rotated principal component factor analysis of major factors constraining women from making adequate contribution to climate change adaptation decisions among farming households in southwest Nigeria. From the result presented in the table, four factors were extracted based on the responses of the respondents (farm units). Only variables with factor loadings of 0.40 and above at 10% overlapping variance (Ashley, *et.al* 2006) were used in naming the factors. Variables that loaded in more than one factors as in the case of variables 10, 17 and 25 were discarded while variables that have factor loading of less than 0.40 were not used. The naming of each factor is based on the set of variables or characteristics the factor is composed of (Kessler, 2006). This was equally adopted in this study to group the variables into four major factors as; Factor 1 (Socio-infrastructural factor); Factor 2 (Financial/cultural factor); Factor 3 (Technological factor) and Factor 4 (Institutional factor).

Under factor 1 (Socio-infrastructural factor), the specific constraining variables against women contribution to climate change adaptation decision among farming households in southwestern Nigeria include: poor access to sources of information (0.585), inadequate knowledge of how to cope or build resilience (0.783), lack of access to weather forecast technologies (0.751), non-availability of storage facilities (0.765), the belief that farm women are less informed (0.750), illiteracy of the farm women (0.483) and far distance of household farms to their residential areas (0.766). Based on this finding, it is therefore hypothesized that weak infrastructural supports to farm households such as lack of weather forecast technologies, storage facilities and far distances to farms may reduce capacity to adapt to climate change. For instance, Maddison (2007) while studying the perception and adaptation to climate change in Africa found out that lack of market access or transport problems and lack of information about weather constitute major problems in climate change adaptation among farmers. Farmersô access to weather forecast information, climatic conditions and other factors vary across different zones and influence farmersô perceptions of climate change and their decisions to adapt. Deressa, *et al* (2008) showed lack of information is one of the greatest challenges facing farmers in climate change adaptation. The authors reported further that information on climate represents access to the information required to make decision on adaptation to climate change. Yirga (2007) noted that various studies in developing countries reported a strong positive relationship between access to information and the adoption behaviours of farmers. This is because, Nhemachena and Hassan (2007) showed that access to information through extension increase the chance of adapting to climate change.

Table 4.9: Varimax Rotated Factors/Variables Constraining Women Farmers in Contributing to Climate Change Adaptation Decision Making. (N = 348)

SN	Observed Constraining Variables	Factor 1: Socio-infrastructural factor	Factor 2: Financial/cultural factor	Factor 3: Technological factor	Factor 4: Institutional factor
1	Poor access to sources of information	**0.585**	0.268	0.228	0.381
2	Non-availability of credit facilities for women farmers	0.227	0.120	0.107	**0.785**
3	Illiteracy of the farm women	**0.441**	0.355	0.283	-0.330
4	Inadequate knowledge of how to cope or build resilience	**0.783**	-0.075	0.253	0.136
5	Lack of access to weather forecast technologies	**-0.451**	0.269	0.230	0.015
6	Non-availability of storage facilities	**0.765**	0.215	0.050	0.139
7	Low income of women farmers in the households	-0.068	**0.625**	0.135	0.345
8	Lack of extension programmes directed to meet woman farmers need	0.376	0.215	0.250	**0.537**
9	Far distance of household farms to their residential areas.	**0.757**	-0.051	0.166	0.203
10	Misconception that women farmers donøt have farming ideas.	**0.524****	**0.406****	0.041	**0.415****
11	Low/lack of financial contribution to farm operation by women.	0.053	0.252	0.104	**0.454**
12	Lack of access to supporting facilities e.g, credit, cooperative, adult education programme.	0.175	**0.566**	0.289	0.165
13	The believe of tedious nature of climate change adaptation activities.	0.183	0.284	**-0.699**	0.050
14	The belief that farm women are less informed.	**0.750**	0.290	0.206	0.254
15	Unwillingness of farm women to take farming risks to adapt.	0.398	0.330	**0.591**	0.023
16	The general belief by the society that women are always subordinate to their husbands or male counterparts.	0.367	**0.692**	0.267	0.194
17	Domestic violence between the farm women and their male counterparts.	**0.522****	**0.434****	0.302	0.041
18	Low self-confidence by the farm women in taking certain farming decision.	0.370	0.373	**0.483**	0.156
19	Poor access to and control of farm resources e.g. land, farm capital.	0.205	**0.729**	0.186	0.151
20	Lack of awareness and access about NGOs programme for women self-development.	0.228	-0.361	0.103	**0.612**
21	Multiple domestic responsibilities of women e.g. cooking, taking care of homes, caring for household members etc.	0.140	0.197	**0.653**	0.083
22	Low technical know-how of farm women in handling mechanized and technical duties in the farm.	0.118	0.232	**0.423**	-0.005
23	High number of male farmers in the farming household	0.204	**0.681**	0.230	-0. 301
24	Involvement of the farm women in some off farm jobs, e.g. trading, artisans etc.	0.272	0.399	**-0.519**	-0.143
25	Religious belief of the farming household	**0.422****	**0.637****	**0.476****	-0.092
26	Lack of collateral security required to secure loan to support climate related farm operations.	0.335	0.311	0.260	**0.515**

Note: Factor loading of **0.40** was used at 10% overlapping variance.
Variables with factor loadings of less than **0.40** were not used.
**Variables 10, 17, & 25 were discarded for loading in more than one factor.

Constraining variables that loaded under Factor 2 (financial/cultural factor) include: low income of women farmers in the households (0.625), lack of access to supporting facilities e.g, credit, loans, cooperative, adult education programme (0.566), poor access to and control of farm resources e.g land, farm capital (0.729), high number of male farmers in the farming household (0.681) and the general belief by the society that women are always subordinate to their husbands or male counterparts (0.692). The findings of this study agreed with the report of CIAS (2004) that women are faced with many constraints which range from lack of access to farm credit, loans, low level of income, to shortages of input supply and other economic resources, thereby limiting their contributions to household farming decisions. Therefore, for women contribution to farming to be improved, efforts should be made to economically empower the women to acquire the necessary farm resources which could help make them more relevant in their farming households in allocation of farm resources which involves decision making. CIAS (2004) reported further that women financial contributions to farm activities increase their involvement in decision making on allocation of farm resources. The findings of the study carried out by Fabiyi *et al,* (2007) in Gombe state showed that low economic status of farm women limits their opportunities for broader participation in agricultural production. The authors further found out that about 88% of the sampled farm women for the study lack financial assistance to support farm production. Mngodo *et al,* (1996) found out that despite womenôs important roles as producers and household managers, they are often marginalized when it comes to allocation of farm resources which include decision making. They lack access to economic resources such as land, capital, credit and information which in the end reduce their contribution and productivity. On the cultural challenges facing women in decision making, Kakooza, *et al* (2005) reported that the decision-making process in the farm household is influenced by the culture of the community to which the household belongs. In addition, the report of a study conducted by FAO (1995) showed that major socio-cultural barriers against farm women include lack of access and mobility to employment opportunities, constraints on access to continuing education and underrepresentation of women in key farming activities. African culture generally discriminates a lot against women especially in area of inheritance (land).

The main constraints limiting womenǿs contribution to farming decision as regards climate change adaptation activities under factor 3 (technological factor) include: tedious nature of climate change adaptation activities (0.699), unwillingness of farm women to take farming risks to adapt (0.591), low self-confidence by the farm women in taking certain farming decision (0.483), multiple domestic responsibilities of women e.g. cooking, taking care of homes, caring for members etc (0.653), involvement of the farm women in some off farm jobs, e.g. trading, artisans etc (0.519) and low technical know-how of farm women in handling mechanized and technical duties in the farm (0.418). These constraints reveal attitudinal and technological barriers against women in farming decision making.

Attitudinal barriers against women as noted by Amaechina (2002) are deeply rooted in patriarchal-based socialization where men are considered superior to women in socio-economic activities, resulting in low women presence in decision making bodies. The report of the study conducted by Program on Agricultural Technology Studies (PATS) (2001) showed that the instrumental roles played by women in Wisconsin dairy farm are challenged by low recognition, self-confidence, social isolation and social security inequalities against farm women. The findings of Enete and Amusa (2010) showed among others that part of the challenges facing women in farm decision making is their low technical know-how in handling mechanized equipment on the farm. The result of technical report by FAO (1996) on food grain marketing improvement in Tanzania showed that low level of skills, technical training and high level of illiteracy among women farmers are some of the barriers militating against their contributions to agriculture. Peter (1996) on a study of constraints to farm resources acquisition by women farmers in semi-arid zone of Borno State reported that non-involvement of women in training programmes on modern farm production techniques has pushed them further backward as requisite skills and knowledge to make relevant contributions to technological related farming activities are lacked by the women.

Under Factor 4 (institutional factor) the specific constraining variables against women contribution to climate change adaptation decision among farming households in southwestern Nigeria include: non-availability of credit facilities for women farmers (0.785), lack of extension programmes directed to meet woman farmers need (0.537), low/lack of financial contribution to farm operation by women (0.454), lack of awareness and access about NGOs programme for women self-development (0.612) and lack of collateral security required to secure loan to support climate related farm operations by women (0.515). These suggest that institutional benefits such extension services, credit sources and awareness creation have put women farmers at disadvantage both at the design and implementation stage. The findings of this study is similar to that of Enete and Amusa (2010) where the authors found out that lack of adequate information and awareness of modern farming methods, lack of extension programmes for womenös development and lack of awareness and access to NGO programmes for womenös development are the major challenges facing women in making contribution to farm decision among coca-based agroforestry households in Ekiti State. Nayenga (2008) reported that women farmers interviewed in many sites in Uganda complained that extension workers are biased against them. Some of the women interviewed by Nayenga during field assessment had this to say: ñ*We never received and never benefitted from improved seeds from agricultural extension workers. We are told we have no knowledge in agriculture and women do not own land".* In affirmation, Rafferty (1988) also reported that agricultural extension programmes and other supporting services have traditionally concentrated more on educating male farmers and hence farm women still largely depend on their husbands for information on farm inputs and other resources necessary for farm decision making. On institutional barrier, Nzeadibe, Chukwuone, Egbule and Agu (2011) found out among others that major barriers to climate change adaptation in the Niger Delta region of the country include low institutional capacity and absence of government policy on climate change. For the women to be more relevant and productive in agriculture, effective institutional framework should be developed through programmes to address their training needs in farm technology for improved skills and productivity.

4.10 Testing of Hypotheses

Hypothesis One

$H0_1$: There is no significant difference in the mean ratings of farmers from the three local ecological zones on the intensity of climate change effects in the study area.

The data for testing hypothesis one are presented in Table 4.10.

Table 4.10: Analysis of variance (ANOVA) of the mean ratings of farmers from three local ecological zones on the intensity of climate change effects in the study area. (N = 348)

S/N	Effects of climate change	Source of variance	Sum of Square	DF	Mean Square	F-ratio	F-critical	p-value (Sig.)	Decision	Post Hoc Test
1	Decreased rainfall amount	B/W Groups W/N Groups	1.854 164.997	2 245	0.927 0.478	1.938	3.00	0.146	**NS**	-
2	Unusual heavy rainfall	B/W Groups W/N Groups	10.296 321.804	2 245	5.148 0.933	5.519	3.00	0.004	**S****	Ogun (RF)/ Ekiti (DS)
3	Higher temperature and heat	B/W Groups W/N Groups	6.383 322.246	2 245	3.192 0.930	3.417	3.00	0.034	**S****	Ogun (RF)/ Ekiti (DS)
4	Heavy winds	B/W Groups W/N Groups	2.433 230.498	2 245	1.216 0.008	1.821	3.00	0.163	**NS**	-
5	Increased cases of flooding	B/W Groups W/N Groups	11.946 343.330	2 245	5.973 0.995	6.179	3.00	0.003	**S****	Ogun (RF)/ Ekiti (DS)
6	Prolonged drought	B/W Groups W/N Groups	0.577 159.481	2 245	0.288 0.462	0.624	3.00	0.537	**NS**	-
7	Increased desertification	B/W Groups W/N Groups	2.005 186.604	2 245	1.003 0.541	1.854	3.00	0.158	**NS**	-
8	Increase in pest and disease problems	B/W Groups W/N Groups	1.535 211.568	2 245	0.768 0.613	1.252	3.00	0.287	**NS**	-
9	Extinction of some crop species	B/W Groups W/N Groups	0.855 204.202	2 245	0.428 0.592	0.723	3.00	0.486	**NS**	-
10	Deceased soil moisture	B/W Groups W/N Groups	1.247 198.707	2 245	0.123 0.579	1.213	3.00	0.268	**NS**	-
11	Premature ripening of fruits	B/W Groups W/N Groups	0.860 191.094	2 245	0.430 0.554	0.777	3.00	0.461	**NS**	-
12	Reduction in crop yield	B/W Groups W/N Groups	0.077 165.257	2 245	0.038 0.479	0.080	3.00	0.923	**NS**	-
13	Poor quality of storage farm produce as a result of heat	B/W Groups W/N Groups	9.083 321.434	2 245	4.541 0.932	4.874	3.00	0.008	**S****	Ogun (RF)/ Ekiti (DS)
14	Stunted growth of crops	B/W Groups W/N Groups	0.158 243.658	2 245	0.079 0.706	0.112	3.00	0.294	**NS**	-
15	Drying up of rivers, lakes and streams	B/W Groups W/N Groups	7.249 307.671	2 245	3.124 1.892	3.139	3.00	0.015	**S****	Ekiti (DS)/ Oyo (GS)
16	Increased drying up of seedlings after germination	B/W Groups W/N Groups	0.621 220.759	2 245	0.310 0.640	0.485	3.00	0.616	**NS**	-
17	Heat stress on crop and livestock	B/W Groups W/N Groups	4.558 251.258	2 245	1.779 0.737	2.057	3.00	0.149	**NS**	-
18	Intense weed growth	B/W Groups W/N Groups	11.203 277.786	2 245	4.101 0.805	4.026	3.00	0.012	**S****	Oyo (GS)/ Ogun (RF)
19	Increased soil erosion resulting from unusual heavy rains	B/W Groups W/N Groups	3.655 235.931	2 245	2.328 0.693	2.473	3.00	0124	**NS**	-
20	Storage losses in roots and tubers	B/W Groups W/N Groups	9.640 289.073	2 245	2.320 0.838	3.282	3.00	0.030	**S****	Ogun (RF)/ Ekiti (DS)
21	Increased salinity and pollution due to climate variability	B/W Groups W/N Groups	0.249 324.855	2 245	0.124 0.942	0.132	3.00	0.132	**NS**	-
22	Decrease in fish population due to water level, currents or speed.	B/W Groups W/N Groups	0.704 314.008	2 245	0.352 0.910	0.387	3.00	0.387	**NS**	-
23	Increased post harvest spoilage of harvested crops	B/W Groups W/N Groups	8.539 275.380	2 245	3.270 0.798	3.338	3.00	0.027	**S****	Ogun (RF)/ Ekiti (DS)

Note: *Level of Sig =* $p \leq 0.05$ *RF = Rainforest*

NS = Not Significant *GS = Guinea Savanna*

S** *= Significant at* $p \leq 0.05$ *DS = Derived Savanna*

Post Hoc (Scheffe) Test = Showing the direction of significance among the three local agro ecological zones.

The result of analysis of variance (ANOVA) presented in Table 4.10 showed that the F-ratios of 15 out of 23 items on effects of climate change were between 0.080 to 2.473 which in each case less than the F-critical value of 3.00 at pÒ0.05 level of significance. This implied that, there are no significant differences in the mean ratings of the responses of the farmers from Ekiti (derived savanna), Ogun (rainforest) and Oyo (guinea savanna) on the intensity of the effects of climate change on the 15 identified items. Therefore, the null hypothesis of no significant difference is accepted on the 15 effects of climate change.

On the other hand, the F-ratios on the remaining eight items ranged between 3.139 to 6.179. Specifically, the eight items with their corresponding F-ratios include item 2 (5.519), 3 (3.417), 5 (6.179), 13 (4.874), 15 (3.139), 18 (4.026), 20 (3.282) and 23 (3.338) which in each case greater than the F-critical value of 3.00 at pÒ 0.05 level of significance. This finding indicated that there are significant differences in the mean ratings of the responses of farmers from Ekiti (derived savanna), Ogun (rainforest) and Oyo (guinea savanna agro ecological zone) on the intensity of the 8 identified items of effects of climate change. Therefore, the null hypothesis of no significant difference on the 8 effects of climate change are rejected.

The result of the Post Hoc (Scheffe) test for the 8 items where there are significant differences showed that climate change effects of unusual heavy rainfall, higher temperature and heat, increased cases of flooding, poor quality of storage farm produce as a result of heat, storage losses in roots and tubers and increased post harvest spoilage of harvested crops are significantly different between Ekiti (derived savanna) and Ogun (rainforest zone agro ecological zone). The significance in the effect of climate change of drying up of rivers, lakes and streams was between Ekiti (derived savanna) and Oyo (guinea savanna) while significance difference in the intense weed growth as effects of climate change was between Oyo (guinea savanna) and Ogun (rainforest agro ecological zone).

Hypothesis Two (a)

$H0_1$: There is no significant difference in the mean ratings of male and female farmersô level of awareness of climate change indicators in the study area.

The data for testing the hypothesis are presented in Table 4.11.

Table 4.11: t–test Statistics of the Mean Ratings of Male and Female Farmers' Level of Awareness of Climate Change Indicators in the Study Area.

		Male farmers		Female farmers				
SN	**Climate Change Indicators**	$\bar{X}_1$	S_1^1	$\bar{X}_2$	S_2^2	**t-cal**	**t-tab**	**Decision**
1	Decreased rainfall amount in the continental interiors	2.99	1.044	2.86	1.071	0.568	1.96	**NS**
2	Increased rainfall in the coastal areas	2.84	1.087	2.58	1.093	2.394	1.96	**S****
3	Unpredictable rainfall patterns	3.58	0.837	3.49	0.679	-0.783	1.96	**NS**
4	Increase in temperature (heat)	3.69	0.701	3.65	0.576	0.859	1.96	**NS**
5	Prolonged drought than before	3.58	0.704	3.28	0.628	2.147	1.96	**S****
6	Delay in arrival of annual rainfall	3.54	0.675	3.50	0.647	0.454	1.96	**NS**
7	Gradual disappearing of the usual harmattan periods	3.66	0.756	3.60	0.870	0.607	1.96	**NS**
8	High winds and heat waves	3.38	0.869	3.42	0.904	-0.395	1.96	**NS**
9	Fast water evaporation from the ground	2.97	0.842	2.84	0.897	0.130	1.96	**NS**
10	Unusual heavy rainfall	2.89	0.775	2.88	0.682	-0.191	1.96	**NS**
11	Reduced length of growing season	3.21	0.798	2.93	0.931	2.043	1.96	**S****
12	Decrease in ice fall during rainfall unlike before	3.58	0.839	3.54	0.967	0.312	1.96	**NS**
13	River surface temperature rise	2.48	0.964	2.40	0.897	0.590	1.96	**NS**
14	Variations in bloom date (fruiting of crops)	2.38	0.838	2.35	0.822	0.209	1.96	**NS**
15	Rising sea level	2.41	1.044	2.42	1.023	0.992	1.96	**NS**
16	Increased flooding/erosion menace	3.23	0.908	3.18	0.794	0.224	1.96	**NS**
17	Crop and animal species extinctions	2.24	1.117	2.13	1.150	-0.730	1.96	**NS**
18	Increased desertification	2.95	1.024	2.88	1.093	1.333	1.96	**NS**
19	Drying up of rivers, lakes and streams	3.20	0.939	3.18	0.906	0.769	1.96	**NS**
20	Increased post harvest deterioration of crops	3.05	0.971	3.41	1.001	3.321	1.96	**S****

Note: **S**** = Significant at 0.05
NS = Not Significant.

Table 4.11 presented 20 items comparing level of awareness of climate change indicators between male and female farmers in southwest Nigeria. From the data presented in the Table, the t-calculated (t-cal) values of 16 out of the 20 identified indicators had values that ranged from -0.783 to 1.333 which were less than t-tabulated (t-tab) value of 1.96 (two tailed test) at pÒ0.05 level of significance. This showed that there were no significant differences in the mean awareness of male and female farmers on the 16 identified climate change indicators in southwest Nigeria. Therefore, the null hypothesis of no significant difference in the mean ratings of male and female farmersô level of awareness on the 16 climate change indicators in the study area is therefore accepted.

The result in the Table showed further that, the remaining four items of climate change indicators, specifically items 2, 5, 11 and 20 had t-calculated (t-cal) values of 2.394, 2.147, 2.043 and 3.321 respectively which are all greater than t-table (t-tab) value of 1.96 (two tailed test) at pÒ0.05 level of significance. This indicated that there were significant differences in the mean awareness of male and female farmers on the 4 climate change indicators in southwest Nigeria. Therefore, the null hypothesis of no significant difference in the mean ratings of male and female farmersô level of awareness on the 4 climate change indicators in the study area is rejected.

Hypothesis Two (b)

The vulnerability of male and female headed households to climate change in southwest Nigeria is not significantly different.

Table 4.12: Test of significance difference in vulnerability of male and female headed households to climate change in Southwest Nigeria. (N = 348)

SN	Groups	$\overline{X}$	SD	Std. Error	t- Cal	t-Tab	p-value Sig.	Decision
1.	MHHD	0.43	0.187	0.086	3.438	1.96	0.003	**S**** Reject H_0
2.	FHHD	0.73	0.217					

Note: **MHHD** = Male Headed Household
FHHD = Female Headed Household
S** = Significant at $p \leq 0.05$.

Using household's adaptive capacity approach which is a function of the available institutions, human and material resources to cope with effects of climate change, the result of the t-test statistics showed that the t-calculated (t-cal) value of 3.348 was significantly greater than the t-table (t-tab) value of 1.96 at $p \leq 0.05$ level of significance and 346 degree of freedom (df). In addition, the obtained p-value of 0.003 was less than the level of sig. 0.05. This implied that there is significant difference in vulnerabilities of male and female headed farming households to effects of climate change in Southwest Nigeria. Therefore, the null hypothesis of no significant difference in vulnerabilities of the two groups of farming households is rejected.

Hypothesis Four

H0$_4$: There is no significant difference in the mean ratings of men and women contributions to climate change adaptation decisions in food crop and livestock production activities in the study area.

The data for testing hypothesis four are presented in Tables 4.13 and 4.14.

Table 4.13: t–test statistics of the mean ratings of men and women's level of contributions to climate change adaptation decision making in crop production activities in southwest Nigeria. (N = 348)

		Men		Women				
SN	Adaptation activities involving decision	$\bar{X}_1$	S_1^1	$\bar{X}_2$	S_2^2	t-cal	t-tab	Decision
1	Use of irrigation system/water storage	2.52	0.75	2.17	0.86	5.727	1.96	S**
2	Early or late planting of crops as adaption strategies	3.55	0.52	3.15	0.73	2.128	1.96	S**
3	Planting different varieties of crop (multiple cropping)	3.70	0.50	2.24	0.98	13.543	1.96	S**
4	Planting of trees (afforestation/reforestation or agroforstry practices)	3.84	0.64	2.20	1.01	8.935	1.96	S**
5	Planting cover crops to help conserve soil moisture	3.63	0.66	2.75	0.87	5.776	1.96	S**
6	Minimum/zero tillage so as not to expose the soil to loss of nutrients	3.57	0.60	2.35	1.11	7.814	1.96	S**
7	Increased mulching of crops to conserve moisture and reduce heat effect	3.59	0.54	2.46	0.90	6.727	1.96	S**
8	Staking of crawling crops such as yam to avoid heat burns	3.67	0.56	2.31	1.06	23.318	1.96	S**
9	The use of organic manure	3.03	0.89	2.34	1.04	6.705	1.96	S**
10	Mixed farming (diversification of farm enterprise to nonfarm business)	3.61	0.70	3.53	0.69	1.054	1.96	NS
11	The use of inorganic manure (fertilizers)	2.96	0.90	2.04	1.12	9.049	1.96	S**
12	Making ridges across farms to reduce effects of erosion	3.63	0.65	2.43	0.97	5.343	1.96	S**
13	Planting pest and disease resistant crops	3.60	0.80	3.00	0.82	3.464	1.96	S**
14	Planting of drought tolerant crop varieties	3.64	0.85	2.97	0.91	2.823	1.96	S**
15	Making of contour bunds around farmland	3.68	0.63	2.22	0.98	8.361	1.96	S**
16	Planting of fast maturing crop varieties	3.71	0.68	3.68	0.77	0.341	1.96	NS
17	Avoiding eroded/erosion prone area for farming	3.50	0.88	2.34	0.99	7.949	1.96	S**
18	Adopting recommended planting distance	3.63	0.75	3.70	0.78	1.589	1.96	NS
19	Changing crop harvesting dates	3.67	0.60	3.60	0.62	0.619	1.96	NS
20	Processing of crops to minimize post-harvest losses	2.48	1.04	3.81	0.42	12.101	1.96	S**
21	Construction of drainages across the farmland	3.70	0.59	2.30	1.09	7.603	1.96	S**
22	The use of wetlands/river valleys for production (Fadama system or *akuro*)	3.66	0.58	2.24	1.25	3.471	1.96	S**
23	Consult the rain maker during prolonged drought	1.98	1.18	1.53	1.26	6.003	1.96	S**

Note: **S**** = Significant at 0.05
NS = Not Significant.

Table 4.13 presented the comparison of gender contributions to climate change adaptation decisions in crop production activities in southwest Nigeria. From the data presented in the Table, the t-calculated (t-cal) values of 19 out of the 23 identified activities where decisions were made had values that ranged from 2.128 to 23.318 which were greater than t-tabulated (t-tab) value of 1.96 (two tailed test) at pÒ0.05 level of significance. This showed that men have significantly higher contributions to climate change adaptation decision making as regards the 19 crop production activities than the women. Therefore, the null hypothesis of no significant difference in the mean ratings of male and female farmersô contribution to decision making in the 19 activities are rejected.

The result in the Table showed further that, the remaining four items, specifically items 10, 16, 18 and 19 had t-calculated (t-cal) values of 1.054, 0.341, 1.589 and 0.619 respectively which are all less than t-table (t-tab) value of 1.96 (two tailed test) at pÒ 0.05 level of significance. This indicated that there were no significant differences in the mean contributions of men and women to decision making in the 4 climate change adaptation activities. Therefore, the null hypothesis of no significant difference in the mean contribution of men and women in decision making on the 4 adaptive activities is accepted.

Table 4.14: t–test statistics of the mean ratings of male and female farmers' level of contributions to climate change adaptation decision making in livestock production

		Men		Women				
SN	**Adaptation activities involving decision**	$\overline{X}_1$	S_1^1	$\overline{X}_2$	S_2^2	**t-cal**	**t-tab**	**Decision**
1	Intensify supplementary feeding system	3.43	0.74	3.55	0.81	2.040	1.96	**S****
2	Dip and Dose system in livestock rearing	2.73	0.99	2.89	0.92	2.113	1.96	**S****
3	Improved fence camps for livestock	3.51	0.89	3.57	0.83	1.128	1.96	**NS**
4	Rearing of disease and pest resistant livestock	3.45	0.76	3.63	0.84	2.212	1.96	**S****
5	Construction of shelter for animals using non-conductors of heat	3.57	0.71	3.66	0.91	1.448	1.96	**NS**
6	Culling of infected animals	3.35	0.92	3.65	0.62	4.239	1.96	**S****
7	Decrease in stocking rate of animals	3.52	0.87	3.60	0.84	0.795	1.96	**NS**
8	Distributing livestock herds in different places to reduce disease spread	3.50	0.63	3.64	0.79	1.980	1.96	**S****
9	Rainwater harvesting for livestock rearing	2.02	1.05	3.75	0.55	10.638	1.96	**S****
10	Intensify shading of livestock pens	3.63	0.70	3.56	0.73	0.914	1.96	**NS**

Note: **S**** = Significant at 0.05
NS = Not Significant

Table 4.14 presented t-test statistics of no significant difference in the mean contribution of men and women to adaptive decision making in livestock production activities in southwest Nigeria. From the data presented in the Table, 6 out of the 10 identified activities had t-calculated (t-cal) values that ranged from 1.980 to 10.638 which were greater than t-table (t-tab) value of 1.96 (two tailed test) at pÒ0.05 level of significance. This indicated that there are significant differences in the mean contributions of men and women to decision making on the six (6) climate change adaptation activities in livestock production. Therefore, the null hypothesis of no significant difference in the mean contributions of male and female farmers to decision making on the 6 activities are rejected.

On the other hand, the t-calculated (t-cal) values on activities 3, 5, 7 and 10 in the table were 1.128, 1.448, 0.795 and 0.914 respectively which were all less than the t-table (t-tab) value of 1.96 (two tailed test) at pÒ0.05 level of significance. This implied that there are no significant differences in the mean contributions of men and women to decision making on the four (4) climate change adaptation activities in livestock production. Therefore, the null hypothesis of no significant difference in the mean contribution of male and female farmers to decision making on the 4 activities are accepted.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study investigated gender and climate change adaptation decisions among farming households in Southwest Nigeria. In carrying out the study, five specific objectives and five hypotheses were developed to guide the study. Purposive, multi-stage and random sampling techniques were employed in selecting the 348 farm units. Data for the study were obtained from primary source using structured questionnaire. Descriptive and relevant inferential statistics such as frequency, percentages, mean, line graph, bar charts, multinomial logit (MNL) model, vulnerability analysis, Heckmanǿs double stage selection model, factor analysis, t-test and analysis of variance (ANOVA) were used for data analysis.

Based on the data analyzed, the study found that the majority (76%) of farmers were males while 24% were females. Greater percentage of about (47%) of the farmers fell between 41-60 years age bracket while the average age of the farmers was 51 years. Majority (67%) of the sampled farmers in southwestern Nigeria were married. As found out in the study, 20% of the farmers never attended school, while the remaining 80% had varying degree of formal education with 44% of them having primary school education, 26% having secondary school education while 10% had higher education. The average year of education of the farmers was 7 years. The average size of farm households in southwest Nigeria is about 8 persons. Greater percentage of 36% of the farmers had between 21-30 years of experience while the average year of farming experience of the respondents was 36 years. On land ownership status of the farmers, the study found that majority (71%) of the farmers owned their farm lands for agricultural production with greater percentage (57%) of the farmers are involved in petty trading as major off-farm occupation.

Findings on level of awareness of climate change among the farmers showed that 16 out of 20 identified indicators of climate change had mean values that ranged between 2.66 to 3.67 on a 4-point rating scale indicating high level of awareness of climate change among the farmers in southwest Nigeria. On source of awareness, greater percentage (79%) of the farmers were aware of climate change through personal observation, followed by 63% of the farmers that that indicated awareness through extension agents. Presently, climate change as perceived by the farmers has affected agricultural production in southwest Nigeria in a number of ways. For instance, 13 out of 23 identified effects of climate change of agricultural production had mean values that ranged from 2.51 to 3.58 on a 4-point rating scale indicating serious effects of the 13 threats of climate change on food production in the area.

Using household adaptive capacity approach, the result of gender-based vulnerability analysis showed that female headed farming households in southwest Nigeria were more vulnerable to climate change with higher vulnerability index of 0.73 as against male headed households with vulnerability index of 0.43. On zonal basis, farmers in the three local agro-ecological zones in southwest Nigeria are vulnerable to the effect climate change giving vulnerability threshold probability of 0.5. For instance, farming households in derived savanna ecological zone (Ekiti) has vulnerability index of 0.61, farming households in rainforest (Ogun) has vulnerability index of 0.53 while farming households in guinea savanna (Oyo) ecological zones have vulnerability index of 0.60.

The result of Heckmanôs double stage selection model with rho 0.61561, Wald^{2}G= 743.72 and pÒ0.0000 showed strong explanatory power of the model. The results from the regression indicated that most of the explanatory variables affected the probability of adaptation decision and extent of adaptation as expected. Variables that significantly influenced discrete decisions of whether or not to adapt to climate change include: gender, farming experience, education, extension visits, farm size, income, credit access, farm labourers and dependency. On the other hand, variables that significantly influenced the extent of adaptation to climate change include: gender, farming experience, extension visits, farm size, income, credit access, farm labourers and dependency at 1, 5 and 10%. Gender-based contributions to decision making in climate change adaptation activities in crop and livestock production among farming households in southwest Nigeria was assessed. The result of the mean ratings showed that men dominated decision making as regards climate change adaptation activities in crop production in southwest Nigeria while women on the other hand dominated decision making relating to climate change adaptation activities in livestock production. The result of the parameter estimates from the multinomial logit (MNL) model was significant as indicated by G^2 statistics and highly significant ($p<0.0000$).

The explanatory power of the factors as reflected by Pseudo R^2 was high (69%). In terms of consistency with *a priori* expectations on the relationship between the dependent variable and the explanatory variables, the model behaved well. Socioeconomic factors that significantly influenced farmersô contributions to decision making include: gender, education, farming experience, financial contributions, number of hours spent on the farm per day and off-farm job status of the farmers at 1, 5 and 10%. The result of varimax-rotated principal component factor analysis with factor loading of 4.00 showed that the major factors constraining women from making adequate contribution to climate change adaptation decisions among farming households in southwest Nigeria to include: socio-infrastructural, financial/cultural, technological and institutional factors.

On the hypotheses tested, the result of the t-test statistics showed that there were no significant ($p<0.05$) differences in the mean ratings of awareness of men and women on 16 out of the 20 identified climate change indicators in southwest Nigeria while on the remaining four (4) indictors therefore were significant ($p<0.05$) difference in the mean ratings of male and female farmers. The result of analysis of variance (ANOVA) showed that there were no significant ($p<0.05$) differences in the mean ratings of farmers from Ekiti (derived savanna), Ogun (rainforest) and Oyo (guinea savanna) on 15 out of the 23 intensity of the effects of climate change in the area while on the remaining 8 items of intensity of the effects of climate change, there were significant ($p<0.05$) differences in the mean ratings from the three local ecological zones. The result of the t-test statistics showed a significant ($p<0.05$) difference in vulnerabilities of male and female headed households to climate change in southwest Nigeria. On test of significance difference in level of contribution by gender to adaptation decision, the result of the t-test statistics showed that there were significantly ($p<0.05$) higher contributions to adaptation decision in crop production by men than their women counterparts. On the other hand, there were significantly ($p<0.05$) higher contributions to adaptation decision making in livestock production activities by women than men.

5.2 Conclusion

Irrespective of gender (male and female), there is high level of awareness of climate change among farmers in southwest Nigeria. As perceived by the farmers, climate change has negatively affected agricultural production in southwest Nigeria in a number of ways. The socio-economic attributes of the farmers significantly influenced their awareness of climate change, discrete decisions of whether or not to adapt to climate change, extent of adaptation to climate change and level of contribution to adaptation decision making in crop and livestock production activities. Female headed farm households are more vulnerable to climate change than male headed farm households in southwest Nigeria. Women farmers in southwest Nigeria are facing some challenges in making contribution to farm decision making. Socio-infrastructural, financial, cultural, technological and institutional factors are the major challenges constraining women farmers from making adequate contribution to climate change adaptation decisions among farming households in the study area. Therefore, improved socio-economic status of the farmers irrespective of gender will enhance farm level adaptation to climate change for improved food production in southwest Nigeria.

5.3 Recommendations

The findings of the study have some important policy implications for enhanced climate change adaptation at farm household level in southwest and the entire country in general. Based on the findings of this study therefore, the following recommendations are made:

1. Government at all levels should ensure capacity building of the farmers in quality adaptive response to climate change for alleviating their vulnerability.
2. The results of the study confirmed gender differences in farm householdsô resource availability and allocation in southwest Nigeria. Therefore, specific policies providing increased women access to education, land and off-farm activities would be needed to alleviate the gender disparity in contribution to climate adaptation decision.
3. Agricultural production and productivity cannot increase without a substantial increased access to extension advice by all household categories. There is therefore urgent need to

step up access to agricultural services most especially to the disadvantaged groups (women farmers) on training regarding climate change adaptation options in southwestern Nigeria.

4. Ministries of agriculture should be more committed to formulating gender sensitive policies that will help to strengthen women farmers and reverse their present institutional neglect. This is because several efforts in the past to empower women have been concentrated on either women in politics or learned women but the women farmers that produce the bulk of food for both Nigerian rural and urban population has been grossly neglected.
5. Government should invest in research in areas such as: gender-specific resource-use patterns; gender-specific effects of climate change; gender aspects of mitigation and adaptation; womenǿs and menǿs capacities to cope with climate change; and gender-related patterns of vulnerability.

5.4 Major Contribution to Knowledge

Despite the proliferation of research in gender roles in farming and climate change adaptation, few studies have jointly estimated gender and climate change while no empirical study available to the researcher captured gender and decision making with regards to climate change adaptation activities. It is therefore imperative that gender roles in climate change adaptation decision be empirically investigated for the development of effective climate change policies that are gender responsive. This is because, the study made available much needed data on gender-based vulnerability to the effects of climate change, gender disaggregated contributions to climate change adaptation decisions in crop and livestock production, and factor-constraints undermining women contributions to climate change adaptation decision making in farm households.

5.5 Areas of Further Research

There is need to embark on further research in the following areas;

1. Gender and climate change adaptation decision among fish farming households in Southwestern Nigeria.
2. The contribution of male and female farmers in climate change adaptation decision in agricultural food processing of a given food crop in Southwestern Nigeria.
3. Gender differentials in climate change adaptation decision among agroforestry-based farming households in Southwestern Nigeria.
4. Capacity building needs of major actors in climate change adaptation for food production in Southwestern Nigeria; and
5. Replication of the present study in farming households in other southern zones and northern Nigeria.

REFERENCES

Abah, E. O. (2011). Economics of Organic Solid Waste Utilization in Urban Tomatoes Gardening in Abuja, Nigeria. *An Unpublished M.Sc Thesis,* Submitted to the Department of Agricultural Economics, University of Nigeria Nsukka.

Abdulai, A. and Huffman, W. (2000). Structural Adjustment and Economic Efficiency of Rice Farmers in Northern Ghana. *Economic Development and Cultural Change.* 48: 503-520.

Abella, A. (2008). *Soldiers of Reason: The RAND Corporation and the Rise of the American Empire*. New York: Harcourt.

Abhinary, M. (2000). ñA Non-technical Introduction to Bargaining Theory.ò *Journal of World Economics*. Vol.1. No.2.

Action Aid International. (2008). *The time is now; Lesson from farmers to adapting to climate change.* Retrieved from: http://.www.actionaid.org, on April 13, 2011.

Adebayo, K; Dauda, T. O; Rikko, L. S; George, F. O. A; Fashola, O. S; Atungwu, J. J; Iposu, S. O; Shobowale, A. O and Osuntade, O. B. (2011). Emerging and Indigenous Technology for Climate Change Adaptation in Southwest Nigeria. African Technology Policy Studies Network Research Paper, No. 10. Nairobi: APTS.

Adebayo, O. O and Adeola, R. G. (2008). Sources and Uses of Agricultural Credit by Small Scale Farmers in Surulere Local Government Area of Oyo State. *Anthropologist,* 10(4): 313-314.

Adedipe, N.O., P.A Okunneye, and I.A Ayinde, (2004). The Relevance of Local and Indigenous knowledge for Nigerian Agricultureò. Being a paper presented at the *International Conference on Bridging Scales and Epistemologies; Linking Local knowledge with Global Science in Multi-Scale Assessment;* March 16 ï 19 2004, Alexandra, Egypt.

Adene, D. F and Oguntade, A. E. (2006). The Structure and Importance of the Commercial and Village Based Poultry Industry in Nigeria. Rome: Food and Agriculture Organisation.

Adepoju, A. O., Yusuf, S. A., Omonona, B. T and Okunmadewa, F. Y. (2011). Vulnerability Profile of Rural Households in South West Nigeria. *Journal of Agricultural Science*. 3, (1)

Adesina, F. A and Odekunle, T. O. (2011). Climate Change and Adaptation in Nigeria: Some Background to Nigeriaôs Response ï III. 2011 International Conference on Environmental and Agriculture Engineering IPCBEE (15), Singapore: IACSIT Press.

Adesina, F.A; Odekunle, T. O; Ajayi, O; Eludoyin, O; Babatimehin, O; Dami, A; Moruf, S; Aloba, O; Bmbo, M and Adetiloye, O. T. (2008). Adaptation Strategies of Action for Nigeria. *A Working Document Prepared for the Special Climate Change Unit of the Federal Ministry of Environment Housing and Urban Development.* Lagos: Heinrich Boell Foundation.

Adetunji, M.O., Olaniyi, O. A and Raufu, M. O. (2007). Assessment of Benefits Derived by Cocoa Farmers from Cocoa Development Unit Activities of Oyo State. *Journal of Human Ecology* 22 (3): 211 ï 214.

Advancing Capacity to Support Climate Change Adaptation (ACCCA). (2010). Improving decision-making capacity of small holder farmers in response to climate risk adaptation in three drought-prone districts of Tigray, Northern Ethiopia: Farm ï Level Climate change Perception and Adaptation in Drought Prone Areas of Tigray, Northern Ethiopia (Vol. 3). Makelle, Ethiopia: ACCCA.

Agabi, B. M. (2012). The Perception and Adaptation to Climate Change among Rural Farmers in North-Central Nigeria. *Middle East Journal of Environmental Research.* 5 (2). 338 ï 352.

Agarwal, B. (1997). ñBargainingô and Gender Relations: Within and Beyond the Household.ò Feminist Economics. Vol. 3, No. 1, pp. 1-51.

Aguilar, L. (2009). Training Manual on Gender and Climate Change. Costa Rica Marzo: Masterlitho S.A.

Agwu, A.E. (2000). ñDiffusion of Improved Cocoa Technology Among Farmers in the North East Savanna Zone of Nigeria.ò *An Unpublished Ph.D Thesis* Submitted to the Department of Agricultural Extension University of Nigeria, Nsukka.

Agwu, J. (2009). Climate Change, Its Impacts and Adaptation: Gendered Perspective from South-Eastern Nigeria Lagos: Heinrich Böll Stiftung (HBS).

Aigbekaen, E. O., Dongo, L. N., Sanusi, R. A., Adeogun, S. O and Agbongiarhuoyi, E. A. (2006). Study on the Risk Associated with the Farming, Production, and Marketing of Cocoa in Nigeria. Proceedings in 15th International Cocoa Conference 9th -14th October 2006 San Jose - Costa Rica. Organised by the Cocoa Producersô Alliance (COPAL) in collaboration with the Tropical Agricultural Research and Higher Education Center (CATIE).

Akibu, I.A. (2002). *Foundations of Business Policy.* Ede: TAYBIS Computer Service.

Aleke, M.O (2007). ñImpact of the Phase ï 1 National Special Programme on Food Security on Poverty Reduction in Enugu State, Nigeriaò. *An Unpublished M.Sc Thesis* Submitted to the Department of Agricultural Extension, University of Nigeria, Nsukka.

Allen Consulting Group (2005) Climate Change Risk and Vulnerability. Report to the Australian Greenhouse Office, Department of the Environment and Heritage. AGO, Canberra. 159.

Allingham, M. (2002). *Choice Theory: A Very Short Introduction*, Oxford: Oxford University Press.

Amaechina, E.C. (2002). ñGender Relationsò. *Being an Unpublished Paper Presented at Gender and Good Governance Training Workshop for Communities Leaders from 2 Communities in Abia state* (WorldWide Network / Erbert Stiftung foundation) June 2002.

Amusa, T. A. (2010). Contributions of Women to Household Farming Decisions among Cocoa-based Agroforestry Households in Ekiti State, Nigeria. An Unpublished Masters Dissertation submitted to the Department of Agricultural Economics, University of Nigeria, Nsukka.

Anim, F. D. K. (1999). A note on the adoption of soil conservation measures in the Northern Province of South Africa. *Journal of Agricultural Economics*, vol. 50, 336-345.

Anley, Y., A. Bogale and A. Haile-Gabriel. (2007). Adoption Decision and intensity of soil and water conservation measures by smallholder subsistence farmers in Dedo District, Western Ethiopia. Land Degradation and Development, Vol. 18: 289-302

Annecke, W. (2010). Gender and Climate Change adaptation. Lessons from the Community Based Adaptation in Africa (CBAA). Nieuwoudtville: Indigo development and change.

Anyanwu, A.C and V.C, Agu (1995). Gender Issues and Priorities in Agricultural Extension Delivery Systemò. In Adedoyin, S.F and Aihonsu, J.O.Y (Eds) Sustainable Development in Rural Nigeria. *Proceedings of the Eight Annual Conference of the Nigerian Rural Sociological Association.* pp. 108 ï 118

Apata T.G. (2008). The Effect of Climate Change and Adaptability on Arable Food Crop Farmers in South western, Nigeria. *Session 6, Cropping System*, 28th October, 2008.

Apata, T.G., Samuel, K.D and Adeola, A.O. (2009). Analysis of climate change perception and adaptation among arable food crop farmers in South West Nigeria. Contributed paper prepared for presentation at International Association of Agricultural Economistsô 2009 conference, Beijing, China.

Aphunu, A and Okoedo and Okojie, D.U (2011). Small ruminant production constraints among farmers in ika north-east local government area of Delta State, Nigeria. Archives of Applied Science Research, 3 (2):370-376.

Araya, B. and Adjaye, J. A. (2001). Adoption for farm level soil conservation practices in Eritrea. *Indian Journal of Agricultural Economics*, vol. 56, 239-252.

Arene, C. J and Omoregie, E. M., (1990). The Place of Women in the Agricultural Labour Force in Nigeria. *Beitritro. Landwirtsch.Vet.Med*. 29 (3): 277-282.

Arene, C. J. (2003). *Introduction to Agricultural Marketing Analysis and Policy*. Enugu: Fulladu Publishing Company.

ARMS (1996) ñContributions by Spouses of Farm Operators.ò *Agricultural Resource Management Study*, version 1.

Arnold, J.E.M. (1987). ñEconomic considerations in agroforestryò in steppler, H.A. and Nair, P.K. (1998). Agroforesty: A Decade of Development. ICRAF, Nairobi, pp. 174-190.

Arrow, K. J. (1989). "Economic Theory and the Hypothesis of Rationality," in *The New Palgrave: Utility and Probability*, pp. 25-39.

Asfaw, A and Admassie, A. (2004). The role of education on the adoption of chemical fertilizer under different socioeconomic environments in Ethiopia. *Agricultural Economics,* 30 (3): 215-228.

Ashley, B., S. Amber and Anthony, F. (2006). ñEducation by Nation: Multivariate analysisò. Retrieved April 22, 2008, from http://www.users.muohio.edu/porterbm/

Asoegwu, S and Asoegwu, A. (2007). An overview of Agricultural Mechanization and its Environmental Management in Nigeria; Agricultural Engineering International: *CIGR E-Journal* No.6.Vol.IX.

Ayanwuyi, Kuponiyi, E; Ogunlade, F. A and Oyetoro, J.O (2010). Farmers Perception of Impact of Climate Changes on Food Crop Production in Ogbomosho Agricultural Zone of Oyo State, Nigeria. *Global Journal of Human Social Science.* 10 (7): 33 ï 39.

Ayinde, O. E; Ajewole, O. O; Ogunlade, I and Adewumi, M.O. (2010). Empirical Analysis of Agricultural Production and Climate Change: A Case Study of Nigeria. *Journal of Sustainable Development in Africa.* 12 (6): 275 ï 283.

Babatunde, R. O; Omotesho, O. A; Olorunsanya, E. O and Owotoki, G. M. (2008). Determinants of Vulnerability to food insecurity: A gender-based analysis of farming households in Nigeria. *Indian Journal of Agricultural Economics*. 63 (1): 116 ï 125.

Babugura, A; Mtshali, N. C and Mtshali, M. (2010).Gender and Climate Change: South Africa Case Study. South Africa: Published by the Heinrich Böll Foundation.

Barker, S. (2002). Gender and Household Chores. Retrieved February 5, 2011 from http://www.genderrelation.ulmt/html

Bekele, W and Drake, L, (2003). Soil and water conservation decision behavior of subsistence farmers in the Eastern Highlands of Ethiopia: a case study of the Hunde-Lafto area. *Ecological Economics* 46, 437ï451.

Birungi, P. and Hassan, R. (2010). Poverty, property rights and land management in Uganda. *African Journal of Agricultural and Resource Economics*, 4(1), 48-69.

Blumberg, R.L and M.T, Coleman (1989). ñA Theoretical look at the Gender Balance of Power in the American Couple.ò *Journal of family Issues* 10: 225 ï 255.

BNRCC. (2011). National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN). Nigeria: Building Nigeriaøs Response to Climate Change.

Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Lasha, B., Tabo, R and Yada, P. (2007). Africa Climate Change ï Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of Intergovernmental Panel on Climate Change. Parry, *et al,* (Eds). Cambridge: Cambridge University Press.

Brain, J., Seveir and S.L. Won (2005). Precision Farming Adoption by Florida citrus producers: University of Florida; IFAS Extension: First published February 2005. Retrieved from www.http:/edis.ifas.ufl.edu. on 7th November, 2009.

BRIDGE. (2008). *Gender and Climate Change: Mapping the Linkages,* BRIDGE Institute of Development Studies (IDS), UK. Retrieved March 10, 2011 from *http://www.bridge.ids.ac.uk*

Brody, A. (2008) Gender and climate change: mapping the linkages A scoping study on knowledge and gaps. United Kingdom: Department for International Development.

Brody, J., Demetriades, J and Esplen, E., (2008). Gender and Climate Change: Mapping the Linkages. A Scoping Study on Knowledge and Gaps, prepared for the UK Department for International Development by BRIDGE. United Kindom: Institute of Development Studies (IDS).

Brussel, S.E.C. (2009). Adapting to climate changes: the challenge for European agriculture and rural areas. Commission of the European communities. Commission working staff working document accompanying the white paper No. 147.

Bryan, E., Deressa, T.T., Gbetibouo, G.A and Ringler, C. (2009). Adaptation to climate change in Ethiopia and South Africa: options and constraints. *Environmental Science and Policy*, l (12): 413-426.

Bryant, R.C., Smit, B., Brklacich, M., Johnston, R. T., Smithers, J., Chiotti, Q and Singh, B. (2000). Adaptation in Canadian Agriculture to Climatic Variability and Change. *Climatic Change* 45:181ï 201.

Buvinic, M and Mehra, R. (1989). *Women in Agricultural Development; Agricultural Development in the Third World.* In: Eicher, C.K and Staatz, J.M (Eds) 300ï 308. Baltimore, Maryland: John Hopkins University press.

Canadian Grain Commission (2009). Spoilage and Heating of Stored Agricultural Products. Retrieved 10th April, 2010 from http://www.grainscanada.gc.ca.

Carlos, F.M., Stephen, J. W and Richard, E. B. (2006). ñDemographic, Socio-economic and Biophysical Factors Affecting Land Use and Land Cover Change in the Northern Ecuadorian Amazon: Factors, Statistical Models and Spatial Explicit Simulationsò. Retrieved February 7, 2010, from http://www.fao.org/demo.

Carvajal, Y., Quintero, M and Garcia, M. (2008). ôWomenõs Role in Adapting to Climate Change and Variabilityõ, *Advances in Geosciences* 14, 277 ï 280.

Castle, E.N and Becker, H. M. (1971). *Farm Business Management: The Decision – Making Process*. London: The Macmillan Company.

CEEPA (2006). Climate Change and African Agriculture Policy Note No. 10,, Centre for Environmental Economics and Policy in Africa (CEEPA), University of Pretoria, South Africa.

CCOFE, (2004). ñEvolution of Household Decision Makingò. *Creating Career Opportunities for Female Economists*. Retrieved September 10, 2007, from www.cda.maris.umn-edu/~lawrenpg/Cv.htm

Chaudhuri, S., J. Jalan and Suryahadi, A. (2002). *Assessing household vulnerability to poverty: A methodology and estimates for Indonesia*. Department of Economics Discussion Paper No. 0102-52. New York: Columbia University.

Christiaensen, J and Subbarao, K. (2004). *Toward an understanding of household vulnerability in rural Kenya*. World Bank Policy Research Working Paper 3326. Washington D.C: World Bank.

Chukwuone, N. A; Agwu, A. E and Ozor, N. (2006). Constraints and Strategies towards Effective Cost-Sharing of Agricultural Technology Delivery in Nigeria: Perception of Farmers and Agricultural Extension Personnel. *Journal of International Agricultural and Extension Education*. Vol. 13 Number 1: (29-41).

Chukwuone, N.A. (2009). ñAnalysis of Conservation and Utilization of Non-Wood Forest Products in Southern Nigeria: Implications for Forest Management and Poverty Alleviationò. *A Ph.D Thesis* Submitted to the Department of Agricultural Economies, University of Nigeria, Nsukka.

CIAS, (2004). ñWomen on Dairy Farms; Juggling Roles and Responsibilitiesò. *Centre for Integrated Agricultural Systems* (CIAS). Retrieved November 14, 2007, from http://www.cias.wisc.edu/archives/

Commission on the Status of Women. (2008). Gender Perspectives on Climate Change. Retrieved March 10, 2011 from http://www.un.org/ womenwatch/daw/csw/csw52/issuespapers/

Damisa, M.A and Yohanna, M. (2007). ñRole of Rural Women in Farm Management Decision Making process: Ordered Probit Analysisò *World Journal of Agricultural Sciences* 3 (4): 543 ï 546.

Dankelman, I. (2002). Climate Change: Learning from Gender Analysis and Womenôs Experience of Organising for Sustainable Developmentô. *Gender and Development*. 10 (2): 21 ï 29.

Dennison, C. E. (2003). *From Beijing to Kyoto: Gendering the international climate change negotiation process*ö 53rd Pugwash Conference on Science and World Affairs. Advancing Human Security: The Role of Technology and Politics. 17 ï 21 July 2003. Halifax and Pugwash, Nova Scotia, Canada. http:// pugwash.org/reports/pac/53/dennison.htm

Deressa, T. (2008). Analysis of perception and adaptation to climate change in the Nile Basin of Ethiopia. An unpublished Ph.D thesis, Centre for Environmental Economics and Policy for Africa (CEEPA), University of Pretoria, South Africa.

Deressa, T. T; Hassan, R. M and Ringler, C. (2009). Assessing Household Vulnerability to Climate Change: The Case of Farmers in the Nile Basin of Ethiopia. Washington DC: International Food Policy Research Institute (IFPRI).

Deressa, T. T; Hassan, R. M; Ringler, C; Alemu, T and Yesuf, M. (2008). Analysis of the Determinants of Farmersô Choice of Adaptation Methods and Perceptions of Climate Change in the Nile Basin of Ethiopia. *International Food Policy Research Institute Research Brief 15 – 9.* Washington, DC: International Food Policy Research Institute.

Dessai, S and Sluijs, J. (2007). Uncertainty and Climate Change Adaptation- a Scoping Study. A report is prepared for the Netherlands Environmental Assessment Agency, in a joint project between Copernicus Institute of Utrecht University, Tyndall Centre for Climate Change Research, UK and School of Environmental Sciences, University of East Anglia, Norwich, UK.

Doss C and Morris M, (2001). How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. *Agricultural Economics* 25: 27ï 39.

Doss C, (2001). Designing agricultural technology for African women farmers: Lessons from 25 years of experience. *World Development* 29: 2075ï 2092.

Doss, C.R. (2002). ñMenös crops? Womenös Crops? The Gender patterns of Cropping in Ghanaò. *Journal of World Development* Vol. 30 No 11 pp 1987 ï 2000. Great Britain: Elsevier Science ltd.

Downing, T and Watt, R. (2008). Using Science To Improve Adaptation in Africa. Policy Brief. Oxford, United Kingdom: Stockholm Environment Institute (SEI).

Duddy, J. (2005). óIs Climate Change a Gender Issue?ô Retrieved March 10, 2011 from http://www.awid.org/go.php?stid=862

Eboh, E. C. (2009). Developing Conceptual Framework for Empirical Research. In Anyakoha, E. U. (Ed) Developing Research Skills: Concepts and Conceptual Frameworks. Nsukka: Great AP Express Publishers Ltd.

Eboh, E.C. (2009). Social and Economic Research: Principles and Methods. Enugu: African Institute for Applied Economics.

Eilor, E and Giovarelli, R, (2002). Land Sector Analysis. Gender/Family Issues and Land Rights component. Rural Development Institute.

Enete, A. A and Amusa, T. A (2010). Determinants of Womenös Contribution to Farming Decisions in Cocoa-Based Agroforestry Households of Ekiti State, Nigeria. *Field Actions Science Reports* (FACTS), Vol. (4) 1, pp 1-6.

Enete, A. A and Onyekuru, A. N. (2011). Challenges of Agricultural Adaptation to Climate Change: Empirical Evidence from Southeast Nigeria. TROPICULTURA 29 (4): 243-249.

Enete, A. A. and Amusa, T. A. (2011). Challenges of Agricultural Adaptation to Climate Change: A Synthesis from the Literature. *Field Actions Science Reports* (FACTS) Reports. Vol. 4, pp: 1 ï 11.

Enete, A. A; Madu, I. I; Mojekwu, J. C; Onyekuru, A. N; Onwubuya, E. A and Eze, F. (2011). Indigenous Agricultural Adaptation to Climate Change: Study of Imo and Enugu States in Southeast Nigeria. African Technology Policy Studies Network Working Paper Series | No. 53. Nairobi: APTS.

Enete, A.A. (2003). ñResource Use, Marketing and Diversification Decisions in Cassava Producing Household of Sub-Saharan Africaò. *A Ph.D Dissertation* Presented to the Department of Agricultural Economics, Catholic University of Louvain, Belgium.

Fabiyi, E. F., Danladi, B. B., Akande, K. E and Mahmood, Y. (2007). Role of Women in Agricultural Development and their Constraints: A Case Study of Biliri Local Government Area of Gombe State, Nigeria. *Pakistan Journal of Nutrition*, 6 (6): 676-680.

Fakoya, E.O., S.O Apantaku and F.O, Adereti. (2006). ñGender Involvement in Arable Crop Cultivation and its Contributions to Household Food Security in Ogun State, Nigeriaò. *Research Journal of Social Sciences* 1 (1): pp 1 ï 4.

FAO, (1995). ñWomen, Agriculture and Rural Development in the Near East: Findings of an FAO Studyò, Rome: Food and Agriculture Organization.

FAO, (1996). ñFood Grains Marketing Improvement in Tanzaniaò. *Report of Technical Corporation among Developing Countries* (TCDC) *Exports on Grain Marketing Visit in Tanzania*, 20th September to 16th October 1996.

FAO. (1997). Irrigation potential in Africa: a basin approach. Retrieved October 12, 2011 from http://www.fao.org/docrip

FAO, (1998). ñImproving Information on Women Contribution to Agricultural Production for Gender Sensitive Planning,ò Rome: Food and Agriculture Organization.

FAO, (2005) ñFramework for Farm Household Decision Makingò, Retrieved November 10, 2007, from http://www.fao.org/docrep/

FAO. (2007). Climate Change and Food Security. FAO, Rome, Italy.

FAO (2008). Hunger on the Rise. *Food and Agriculture Organisation.* Retrieved April 7, 2011 from http://www.fao.org/newsroom/ EN/news/

Farber, D. A. (2007). *Adapting to Climate Change: Who Should Pay"], 23 Fla. St. U. Journal of Land Use and Envtl.* 1, 8.

Farinde, A.J. (1995). ñEffective Agricultural Technology Transfer: Need for a Nodal Extension Delivery Body for Sustainable Rural Development in Nigeria.ò In Adedoyin, S.F and Aihonsu, J.O.Y (Eds), Sustainable Development in Rural Nigeria. *Proceedings of the Eighth Annual Conference of the Nigerian Rural Sociological Association.* 119 ï 132.

Fasola, T. R. (2007). Controlling the Advancement of Savanna into Southwestern Nigeria. *Zonas Aridas*, 11 (1): 251 ï 259.

Federal Ministry of Environment of Nigeria (2010). Climate Change. Available at http://environment.gov.ng/issues/.

Fishburn, P. C. (1968). Utility Theory. *Management Sciences.* 14 (5): 335 ï 378.

FMENV. (2003). Nigeriaôs First national Communication Under the United National Framework Convention on Climate Change. Abuja: Federal Ministry of Environment.

Fosu-Mensah, B. Y; Vlek, P. L. G and Manschadi, A. M. (2010). Farmersô Perception and Adaptation to Climate Change; A Case Study of Sekyedumase District in Ghana. Tropentag, September 14 - 16, Zurich, World Food System.

Francis, P.A (1987) Sociological and ecological factors in technology adoption: fodder trees in southeast Nigeria. Experimental Agriculture (25): 1-10.

Füssel, H.M. and Klein, R.J.T. (2006) Climate change vulnerability assessments: An evolution of conceptual thinking. Climatic Change, 75 (3): 301ï329.

Gbetibouo, G. A. (2009) Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability: The Case of the Limpopo Basin, South Africa. International Food Policy Research Institute (IFPRI) Discussion Paper 00849. Washington, DC: IFPRI.

Gelman, A. (2004). Analysis of Variance - Why it is more important than ever. *Annals of Statistics.* New York: Columbia University.

Green, S. L. (2002). Rational Choice Theory: An Overview. Being a paper Prepared for the Baylor University Faculty Development Seminar on Rational Choice Theory. Waco, Texas: Baylor University.

Haigh, C and Vallely, B. (2010). Gender and the Climate Change Agenda**:** The Impacts of Climate Change on Women and Public Policy. London: Womenôs Environmental Network.

Hammond, K and Raiffa, O. (1998). What is Structured Decision Making. Retrieved 10 February, 2011 from http://.www.unfactdecision/html/

Hassan, R and Nhemachena, C. (2008). Determinants of African farmersô strategies for adaptation to climate change: Multinomial choice analysis. *African Journal of Agricultural and Resource Economics.* 2 (1): 83-104.

Haviland, W.A. (2003). Cultural Anthropology: The Human Challenge. Wadsworth: Belmont, CA, 219.

Heckman, J. (1976). ñThe common structure of statistical models of truncation, sample selection and limited dependent variable and a simple estimator for such modelsò. *The Annals of Economics and Social Measurements* 5, 475-492.

Heckman, J. (1979). Sample Selection Bias as a Specification Error. *Econometrica,* Vol 47; 153-161.

Hoddinott, J and Quisumbing, A. (2003). *Methods for microeconometric risk and vulnerability assessments*. Social Protection Discussion Paper Series No. 0324. Social Protection Unit, Human Development Network. Washington D.C: World Bank.

Hoque, M and Itohara, Y. (2008). Participation and Decision Making Role of Rural Women in Economic Activities: A Comparative Study for Members and Non-Members of the Micro-Credit Organizations in Bangladesh. Journal of Social Sciences 4 (3): 229-236.

Ibe, A. C. (2009). Institutional Challenges to Combating Climate Change in Nigeria. Being a Paper Presented at the third Lagos State Climate Change Summit Victoria Island, Lagos Nigeria.

Idowu, E. O., Osuntogun, D. A and Oluwasola, O. (2007). Effects of Market Deregulation on Cocoa (*Theobroma cacao*) Production in Southwest Nigeria. *African Journal of Agricultural Research.* 2 (9): 429-434.

IFAD (2007) Rural Poverty in Nigeria: Agriculture in the Federal Republic of Nigeria. International Fund for Agricultural Development. Retrieved August 7, 2010 from http://www.ruralpovertyportal.org/web/guest.

IITA, (2005). *Pre-emptive management of the virulent cassava mosaic Nigeria.* Annual report July 2003 to June 2004. International Institute of Tropical Agriculture, Ibadan, Nigeria.

Ilbery, B.W. (1985). *Agricultural Geography – A Social and Economic Analysis*, Oxford, Oxford University Press.

Indiana State University, (2005). Analyzing Data in SPSS 13.0 Using Regression Analysis. Indiana: Office of Information Technology.

IPCC. (2001). Working Group 2, Third Assessment Report. Intergovernmental Panel on Climate Change. Annex B: Glossary of Terms.

IPCC. (2007). Climate Change Impacts, adaptation and vulnerabilityö. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. UK: Cambridge University Press.

Ishaya, S and Abaje, I. B. (2008). Indigenous Peopleös Perception of Climate Change and Adaptation Strategies in Jemaös Local Government Area of Kaduna State, Nigeria. *Journal of Geography and Regional Planning* 1 (18): 138-143.

Ishengoma, C.G. (2005). õAccessibility of Resources by Gender: The Case of Morogoro Region inTanzaniaö.Retrieved November 22, 2007, from http://www.codesria.org/

Jagtap, S (2007) Managing vulnerability to extreme weather and climate events: Implications for agriculture and food security in Africa. *Proceedings of the International Conference on Climate Change and Economic Sustainability held* at Nnamdi Azikiwe University, Awka, Nigeria. 12-14 June 2007.

Jill, F., Hema, S and Anuja, J. (2001) õFarm Womenös Involvement in Decision- Making, Ownership and Farm Organisationö. Retrieved April 4, 2008, from http://www.agwomen.aers.psy.edu.

Kakooza, J; Kabasimba, E; Ssemakula, B and Musisi, A. (2005). Gender Variation in Agricultural Technology: A Comparative Analysis of Two Ecological Zones of Uganda. Entebbe, Uganda: Eastern and Central Africa Programme for Agricultural Policy Analysis/Association for Strengthening Agricultural Research in East and Central Africa (ECAPAPA/ASERECA).

Kandlinkar, M and Risbey, J., (2000). Agricultural impacts of climate change: If adaptation is the answer, what is the question? *Climatic Change,* Vol 45:529ó39.

Kang, B.T. and G.F Wilson, (2009). The Development of Alley cropping as a promising Agroforestry Technology. In: Steppler, H.A. and Nair, P.K. eds. Agroforestry: A decade of development. ICRAF, Nairobi. Pp. 174 ó 190.

Kartels, K, Y. Boztug and M, Muller. (1999). õTesting the Multinomial Logit Model.ö Retrieved June 14, 2008, from http://www.mkartels.org/htm/

Katz, E. (1996). õIntra-Household Economics: Neo-Classical Synthesis or Feminist-Institutional Challenge?ö Mimeo, Dept. of Economics, Barnard College, USA.

Kessler, C.A. (2006). õDivisive Keyó Factors Influencing Farm Households Soil and Water Conservation Investmentö. *Journal of Applied Geography* 26: 40 ó 60.

Khanal, R.C. (2009). Climate change and organic agriculture. The journal of agriculture and environment, vol. 10, pp 100-110.

Kim, V. (2000). Probit Analysis: A Quick Overview. Retrieved 12, March 2012 from http://home.gwu.edu/~soyer/mv1h.pdf.

Kishor. R, B. Gupta, S.R, Yaday and Singh, T. R. (1999). ñRole of Rural Women in Decisionï Making Process in Agricultural in District Sitapur (Utter Pradesh)ò *Ind. Journal of Agricultural Economics;* 54: 282 ï 286.

Knight J, Weir, S and Woldehanna T, (2003). The role of education in facilitating risk-taking and innovation in agriculture. *Journal of Development Studies* 39: 1ï 22.

Koppelman, R and French, J. A. (2005). ñA Framework for Understanding Agroforestry Decision Making at the Farm Household Levelò. Retrieved 10/11/2007 from http://www.fao.org/docrep/x0267e/x0267e00htm-4k

Koutsoyiannis, A. (1977). *Theory of Econometrics*. (2nd Edition) London: The Macmillan press ltd.

Kurukulasuriya, P and Rosenthal, S. (2003). Climate Change and Agriculture: A Review of Impacts and Adaptations, World Bank Climate Change Series (World Bank Environment Department, Washington, DC), 91, p 96.

Lally, M. (1998). ñRural Womenôs Participation in Decision Making in Irelandò. *Ninth Session of the Working Party on Women and the Family in Rural Development*. Yerevan, Armenia, 30 September ï 3 October 1998.

Lambrou, Y and Piana, G. (2006). Gender: the Missing Component of the Response to Climate Change. Rome: Food and Agriculture Organization (FAO).

Lamming, G.N. (1983). ñWomen in Agricultural Cooperatives: Constraints and Limitations to Full Participationò. *Human Resources, Institution and Agrarian Reform Division.* Rome: Food and Agriculture Organisation of the United Nations.

Ledyard, R.T and Robert, C. M. (1997). *Exploratory Factor Analysis.* Ohio: Ohio State University Press.

Lidja, N. (1996). Technological Change on Agriculture and the Welfare of Women in Southern Mali. *Unpublished Ph.D Dissertation, Department of Agricultural Economics,* Purdue University, Indiana USA.

Ligon, E and Schechter, L. (2003). *Measuring vulnerability*. Manuscript. California: University of California, Berkeley.

Lizárraga, M. L, Baquedano1y, S. A and Cardelle-Elawar, M. T. S. A. (2007). Factors that affect decision making: gender and age differences. *International Journal of Psychology and Psychological Therapy*. 7 (3): 381-391.

Maddison, D. (2006). The Perception of and Adaptation to Climate Change in Africa. *CEEPA Discussion Paper No. 10.* Centre for Environmental Economics and Policy in Africa, University of Pretoria, South Africa.

Maddison, D. (2007). The Perception of and Adaptation to Climate Change in Africa. *Policy Research Working Paper 4308*. New York: World Bank.

Madu, D.B; Gundiri, M.N; Musa, I.K; Nwa, E.U; Adamu, M.S; Bala, M.S; Jada, A; Musa, I.K and Ogunniyi, E.O (2010). Country Profile ï Nigeria. Abuja: Ministry of Water Resources.

Madukwe, M. C. (2004)."Multivariate Analysis for Agricultural Extension Researchò. In Olowu, T. A. (Ed) *Research Methods in Agricultural Extension*. pp 206 ï 236.

Magheed, S. A. (2011) Determinants of household adoption of soil and water conservation technologies in Pakistan. *Journal of Environmental Science and Technology*. 3 (6): 145 ï 159.

Mandleni, B and Anim, F. D. K. (2011). Climate Change Awareness and Decision on Adaptation Measures by Livestock Farmers. *A paper presented at 85rd Annual Conference of the Agricultural Economics Society Warwick University,* 18 - 20 April 2011.

Medugu, N. I (2008) Nigeria: Climate Change ï A Threat to the Countryôs Development. http://www.allafrica.com/nigeria/

Mehra, R. (1993). *Gender in Community Development and Resource Management: An Overview*. Washington DC: ICRW.

Meinzen-Dick, R., A. Knox, F. Place and B. Swallow (eds) (2002). Innovation in Natural Resource Management: The Role of Property Rights and Collective Action in Developing Countries. Johns Hopkins University Press, Baltimore, USA.

Mendelsohn, R., Dinar, A and Dalfelt, A. (2000) Climate change impacts on African agriculture. Preliminary analysis prepared for the World Bank, Washington, District of Columbia, pp 25.

Mendelsohn, R. (2000). óEfficient Adaptation to Climate Change.ô *Climatic Change,* 45: 583-600.

Merriam-Webster, Incorporated. (2011). ñBargaining Power.ò http://www.merriam-webster.com/dictionary/bargaining

Migindadi, N.B. (1992). ñAgricultural Extension for Women: Experience from Nigeriaò. Ibadan: Federal Agricultural Cooperating Unit (FACU).

Ministry of Agriculture and Forestry New Zealand, (2000). ñInfluence of Farm and Farm Household Values, Attitudes and Behaviourò *Ministry of Agriculture and Forestry, New Zealand*. Retrieved April 15, 2008, from http://www.maf.govt.nz/mafnet/profile/.

Mngodo, J.T.J., P.M, Hinge, A.R.I, Kwaya, O.O.N, Lemweli, G.K, Magai. F, Nkinya, T, Banda and A.M, Thomson. (1996). ñFood Security in Tanzania; Transport, Markets and Poverty Alleviationò. Tanzania: Ministry of Agriculture and Co-operation.

Mosha, A.C. (1992). ñDecision Making on Resource Allocation in Rural Households for Food Security in Shinyanga Rural District.ò Tanzania: Food and Nutrition Centre (FNC).

National Meteorological Services Agency (NMSA). (2001). *Initial National Communication of Ethiopia to the United Nations Framework Convention on Climate Change (UNFCCC),* Addis Ababa, Ethiopia.

National Population Commission (2006). Provisional Figures for 2006 Nigeriaös Census. *National Population Commission.* Retrieved December 10, 2011, from http://www.nigerianmuse.com.

Nayenga, R. N. (2008). Gender Dynamics in Agriculture in Uganda: What are the Key Policy Considerations.

Ngome, A. N., (2003) óGender Division of Labour and Womenös Decision- Making Power in Rural Households: The Case of Mbalangi, Ediki and Mabonji Villages of Meme Divisionö, *Unpublished Masters Thesis*, University of Buea, Department of Women and Gender Studies.

Nhemachena.C and Hassan.R, 2008. Determinants of African farmersô strategies for adapting to climate change: Multinomial choice analysis, *AfJARE* Vol 2 No 1.

Nigeria House Committee on Agriculture (2005). Sustainable Funding of Agricultural Sector in Nigeria. Policy Brief No. 2, August 2005.

Nigerian Environmental Study/Action Team (NEST). (2004). Gender and Climate Change Adaptation: Tools for Community level Action in Nigeria. Ibadan: Nigerian Environmental Study/Action Team (NEST).

Njoku, J.E., (1991). Determinants of Adoption of improved Oil palm production technologies in Imo State, Nigeria. In: Doss, C.R., and Olson, C. (eds). Issues in African rural development. Winrock International Institute for Agricultural Development. Arlington, USA.

Nkemachena, C and Hassan, R. (2007). Micro-Level Analysis of Farmersô Adaptation to Climate Change in Southern Africa. *IFPRI Discussion Paper 00714 August,* Washington DC: International Food Policy Research Institute.

Nuthall, P. L. (1997). Farm Decision Information Costs and Returns Revisited. *A paper presented at First European Conference for Information Technology in Agriculture,* Copenhagen, 15th 18 June, 1997.

Nwafor, J. C. (2007) Global climate change: The driver of multiple causes of flood intensity in Sub-Saharan Africa. *Paper presented at the International Conference on Climate Change and Economic Sustainability held at Nnamdi Azikiwe University, Enugu,* Nigeria, 12-14 June 2007.

Nwaipopo, R. (1994). ñThe Impact of Community Relations on the Status and Positions of Women in Peasant Households.ò A Case Study of Syukula Village, Rungue District, Mbeya Region of Tanzania. Tanzania: University of Dar-es-Salaam.

Nweke, F.I and Enete, A. A. (1999). Gender surprises in food production, processing and marketing with emphasis on cassava in Africa. COSCA working paper No. 19, COSCA, Ibadan: International Institute of Tropical Agriculture.

Nyong, A; Adesina, F and Osman-Elasha, B. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitig Adapt Strat Glob Change*. 12: 787ï 797.

Nzeadibe, T. C; Chukwuone, N. A; Egbule, C. L and Agu, V. C. (2011). Farmers' Perception of Climate Change Governance and Adaptation Constraints in Niger Delta Region of Nigeria. *African Technology Policy Studies Network RESEARCH PAPER | No. 7*. Nairobi Kenya: African Technology Policy Studies Network (ATPS).

Oba, G (1997) Pastoralistsô traditional drought coping strategies in Northern Kenya. A Report for the Government of the Netherlands and the Government of Kenya, Euroconsult BV, Arnheim and Acacia Consultants Ltd, Nairobi.

Obamiro, E., Doppler, W and Kormawa, P. (2003). Pillars of Food Security in Rural Areas of Nigeria. Food Africa Internet Forum. 31st March - 11th April. Internet Paper Accepted for the Food Security Theme. Retrieved 15 March, 2011 from http://www.foodafrica.nri.org/security/internetpapers/

Obiora, E. (2008). Climate Change, Population Drift and Violent Conflict over land resources in North Eastern Nigeria. Journal of Human Ecology, 23(4), 311-324.

Obiora, U. (2009). Gender and Climate Change in Nigeria: A Study of Four Communities in North-Central and South-Eastern Nigeria (*Preface*). Lagos: Heinrich Böll Foundation

O'Brien, K; Sygna, L and Haugen, J.E. (2004). ñVulnerable or resilient? A multi-scale assessment of climate impacts and vulnerability in Norway.ò Climatic Change, 64: 193ï 225.

Odekunle, T.O. (2004). Rainfall and the Length of the Growing Season in Nigeriaò International Journal of Climatology, UK, 24: 467- 479.

Odjugo, P. A. O (2010). General Overview of Climate Change Impacts in Nigeria. *Journal Hum Ecol,* 29(1): 47-55.

Ogada, M. J., Nyangena, W and Yesuf, M. (2010). Production Risk and Farm Technology Adoption in the Rain-fed Semi-arid Lands of Kenya. AfJARE, 4 (2): 159 ï 174.

Ogato, B, and Subramani, A. (2009). Gender Roles in Crop Production and Management Practices: A Case Study of Three Rural Communities in Ambo District, Ethiopia. *Journal Human Ecology,* 27(1): 1-20.

Ogunniyi, L. T. (2009). Economic analysis of snail production in Ibadan, Oyo state. *International Journal of Agricultural Economics and Rural Development.* 2 (1): 26 ï 34.

Oji, K.O. (2002). *Basic Principles of Economics for Agricultural Projects and Policy Analyses.* Nsukka: Prize Publishers.

Okhimamhe, A. A. (2009). Climate Change, Its Impacts and Adaptation: Gendered Perspective from Northern Nigeria. Lagos: Heinrich Böll Stiftung (HBS).

Okon, U.E; Enete, A.A and Amusa, T.A (2012). Enterprise Choice Decision in Urban Crop Production in Akwa Ibom State, Nigeria: A Multinomial Logit Approach. *Journal of Outlook on Agriculture.* Vol 41, (1): 51ï 56.

Okorie, O. J. (2013). Adoption of Improved Cassava Varieties and Profitability of Cassava in Enugu State. *An M.Sc Dissertation* Submitted to the Department of Agricultural Economics, University of Nigeria, Nsukka.

Okorji, E.C and Chukwuone, N. A. (2002). ñAssessment of Farmers Under the Community Seed Project: Implications for Agricultural Development and Poverty Eradication in Nigeriaò, In Iloeje, M.U and Osuji, G.E (Eds), Agriculture: A Basis for Poverty Eradication and Conflict Management; *Proceedings of the 36th Annual Conference of Agricultural Society of Nigeria.* Held at the Federal University of Technology Owerri, Nigeria. pp 138 ï 142.

Okoye, C.U. (2002). ñFarm Managementò. *Unpublished Monograph for AGEC 421, (Farm Management and Accounting Practice)* Department of Agricultural Economics, University of Nigeria, Nsukka.

Okuli, W. S., Jonathan, S. M and Flavianus, T. M. (2012). Gender and Adaptation Practices to the Effects of Climate Change in Bahi and Kondoa Districts Dodoma Region, Tanzania. *Journal of Sustainable Development*, 5 (12): 65 ï 77.

Olaitan, S.O and Austin, O. O. (2006). *Round-up Agricultural Science; A Complete Guide*. Lagos: Longman Nigerian PLC.

Olomola, A. S. (2006) Competition Issues in the Agricultural Sector in Nigeria. *Invited Paper Presented at the Regional Conference of the 7Ups Project – Capacity Building on Competition Policy in Selected Countries of Eastern and Southern African.* Organised by the Aha Ethiopian Consumer Protection Association and Consumer Unity and Trust Society (CUTS), Held in Hilton Hotel, Addis Ababa, Ethiopia. March 27 ï 28, 2006.

Olorunfemi, F (2009). Risk communication in climate change and adaptation: policy issues and challenges for Nigeria. Earth and Environmental Science 6, (10). 1755-1307/6/1/412036. Retrieved from http: // iopscience.iop.org /

Olorunsanya, E. O and Omotesho, O. A. (2011). A gender analysis of poverty profile of rural farming households in North Central, Nigeria.

Oluwatayo, I. B. (2009). Towards assuring householdsô food security in rural Nigeria: Have cooperatives got any place? *International Journal of Agricultural Economics and Rural Development*. 2 (1): 52 ï 61.

Oluwatayo, I. B. (2011). Gender Considerations in Decision Making in Rural Nigeria: Implications on HouseholdsôFood Security in Ekiti State.

Oni, K. C (2009). Adoption of Appropriate Agricultural Technologies for Commercial Arable Crops Farming in Nigeria. *An Invited Paper Presented at the Workshop on Commercial Farming of Arable Crops in Nigeria Organised by the Nigerian Agricultural, Co-operative and Rural Development Bank Ltd*, held at Kwara Hotel, Ilorin, 16th ï 18th June, 2009.

Oni, O.A., Oladele, O. I and Oyewole, I. K. (2005). ñAnalysis of Factors Influencing Loan Defualt Among Poultry Farmers in Ogun State Nigeriaò. *Journal of Central European Agriculture*; vol 6 (2005) No. 4 (619-624).

Onyeneke, R. U and Madukwe, D. K (2010). Adaptation measures by crop Farmers in the southeast rainforest Zone of Nigeria to climate change. *Science World Journal. 5 (1): 32 – 34.*

Oruonye, E. D. (2011). An assessment of the level of awareness of the effects of climate change among students of tertiary institutions in Jalingo Metropolis, Taraba State Nigeria. *Journal of Geography and Regional Planning,* 4 (9): 513-517.

Oyebanji, O.O. (1996). The Development of Agricultural Extension in Nigeria. Agricultural Extension in Africa vol. 1 pp235. Technical Center for Agricultural Co-operation. The Netherlands.

Oyakale, A. S (2008). Land Degradation, Soil Conservation Practices and Poverty Incidence in Southwestern Nigeria. *Agricultural Journal* 3 (6): 482 ï 487.

Oyekale, A.S. (2008) Determinants of Agricultural Land Expansion in Nigeria: An Application of Error Correction Modeling (ECM) *Central European Journal of Agriculture,* Volume 8. No. 3 (301-310).

Ozor, N and Nnaji, C. (2011). The role of extension in agricultural adaptation to climate change in Enugu State, Nigeria. *Journal of Agricultural Extension and Rural Development.* 3 (3), pp. 42-50.

Pablo, D.R.G and Miguel, A.T.M. (2005). ñA Multinomial Logit Model of the Factor Influencing the Adoption of Environmental Technologies in the Pulp and Paper Sector in Spain.ò *International Journal of Environmental Technology and Management.* Vol.5 No.4, pp 319-346.

Parikh, J. (2007) Gender and Climate change: Framework for Analysis, Policy and Action. Retrieved February 2, 2011 from http://www.data.undp.org.in/Gender_CC.pdf

PATS, (2001). ñThe Role of Women on Wisconsin Dairy Farms at the Turn of the 21st Century[1]ò *The Program an Agricultural Technology Studies*. Retrieved September 29, 2007, from http://www.wisc.edc/parts.

Paul, D.C and M, Saadulah. (1991). ñRole of Women in Homestead of Small Farm Category in an Area of Jessore, Bangladeshò. *Journal of Livestock Research for Rural Development.* Vol. 3, 1991.

Peter, M.B. (1996). ñConstraints to Farm Resources Acquisition by Women Farmers in Semi-Arid Zone: The Case of Konduga Local Government Area, Borno Stateò. In Adedoyin, S.F and Aihonsu, J.O.Y (Eds) Sustainable Development in Rural Nigeria. *Proceedings of the Eight Annual Conference of the Nigerian Rural Sociological Association.* pp. 279 ï 287.

Phillip, D; Nkonya, E; Pender, J and Oni, O. A. (2009). Constraints to Increasing Agricultural Productivity in Nigeria: A Review. International Food Policy Research Institute (IFPRI). Washington D C: IFPRI.

Pitt, M., Khandker, S and Cartwright, J. (2003). ñDoes Micro-Credit Empower Women? Evidence from Bangladesh.ò Policy Research Working Paper 2998, World Bank, Washington, DC, and In: Bangladesh Development Series, Paper No. 11 ñEconomics and Governance of Nongovernmental Organizations in Bangladesh, available at, http://siteresources.worldbank.org/bangladeshext

Raffety, M. (1988). ñThe Roles of the Women in Economic Development in Tanzaniaò. In Nyerere, H.M (Ed). *Women Development and Adult Education in Tanzania*. pp 122 ï 129. London: Printer Publishers Ltd

Raufu, M. O., Adepoju, A. A., Salau, A. S and Adebiyi, O. A. (2009). Determinants of yield performance in small scale fish farming in Alimosho local government area of Lagos state. *International Journal of Agricultural Economics and Rural Developmen*t. 2 (1): 9 ï 14.

Riley, N. (1997). ñGender, Power and Population Changeò. In Kent, M.M (Ed) *Population Bulletin.* 52 (1). pp 48 ï 53.

Risbey, J., Kandlikar, M and Dowlatabadi, H. (1999), óScale, context, and decision making in agricultural adaptation to climate variability and changeô, *Miti. and Adapt. Strat. for Glob. Change*, 4 (2), 137ï167.

Roehr, U; Alber, G; Skutsch, M; Rose, J and Heul, R. (2004). Mainstreaming Gender into the Climate Change Regime. A paper presented during COP10 discussion at Buenos Aires 14 December 2004.

Rosenzweig, C and Hillel, D. (1998). *Climate Change and the Global Harvest: Potential Impacts of the Greenhouse Effect on Agriculture*. Oxford: Oxford University Press.

Rota, A. Sperandini, S and Hartl, M. (2010). Gender and Livestock: tools for design. IFAD Thematic Paper. Rome. http://www.ifad.org/lrkm/events/cops/papers/gender.pdf

Sabo E., (2006). Participatory Assessment of the Impact of Women in Agriculture Programme of Borno, Nigeria. *Journal of Tropical Agriculture*, 44 (2): 52-56.

Seiz, J.A. (1995). ñBargaining Models, Feminism and Institutionalismò *Journal of Economic Issues* 29: 609 ï 618.

Shan, A. A. (2009) Farmers access to credit in North-central Nigeria. *International Journal of Agricultural Development*. 3 (2): 58 ï 72.

Sikod, F. (2007). Gender Division of Labour and Womenôs Decision-Making Power in Rural Households in Cameroon. *Africa Development,* 32 (3): 58ï 71.

Skoufias, E. (2003). Consumption smoothing in Russia. *Economics of Transition* 11(1): 67ï 91.

Smit, B and Skinner, M.W. (2002). Adaptation options in agriculture to climate change: A typology. 7 (1): 85-114.

Sofoluwe, N. A; Tijani, A. A and Baruwa, O. I. (2011). Farmersô Perception and Adaptation to Climate Change in Osun State, Nigeria. *African Journal of Agricultural Research,* 6 (20): 4789-4794.

StataCorp. (2003). Stata base reference manual. Volume 4, G-M, release 8. Collage Station, TX: Stata Corporation.

Stratton, L.S., Oôtoole, D. M and Wetzel, J. M. (2003). ñA Multinomial Logit Model of Attrition That Distinguishes Between Stopout and Dropout Behaviour.ò Retrieved June 14, 2008, from http:// www.eric.ed.gov/

Tarhule, A. and Woo, W. (1997): Towards an Interpretation of Historical Droughts in Northern Nigeria: Journal ï Climate Change, 37 (4) December 1997 publishers-Springer Netherlands

Taylor, J. E; Mora, J and Adams, R. (2005). Remittances, Inequality and Poverty: Evidence from Rural Mexico. *Unpublished manuscript.* University of Califonia, Davis, CA, USA.

Teklewold, H., Dadi, L., Yami, A., and Dana, N. (2006). Determinants of adoption of poultry technology: A double hurdle approach. *Livestock Research for Rural Development* 18 (3). http://www.lrrd.org/lrrd18/3/tekl18040.htm

Thomas-Slayter, B and G. Sodikoff. (2001). ñSustainable Investment; Womenôs Contributions to Natural Resource Management Project in Africa.ò *Development in Practice,* Vol. 11, 2001.

Tubiello, F. N and C. Rosenzweig. (2008). Developing climate change impact metrics for agriculture. *Integrated Assessment Journal.* 8 (1): 165ï 184.

Tubiello, F. N., Rosenzweig, C., Goldberg, R. A., Jagtap, S and Jones, J. W (2002). Effects of climate change on US crop production: simulation results using two different GCM scenarios. Part I: wheat, potato, maize, and citrus,ò *Climate Research*, 20, (3): 259ï 270.

UNDP (2006) Human Development Report. United Nations Development Programme. Available at: http://hdr.undp.org/hdr2006/statistics/

UNDP (2008) Empowered and Equal. Gender Equality Strategy 2008-2011. New York: United Nations Development Programme.

UNDP (2010). Gender, Climate Change and Community-Based Adaptation: A Guidebook for Designing and Implementing Gender-Sensitive Community-Based Adaptation Programmes and Projects. New York: United Nations Development Programme.

UNDP, IUCN and GGCA, (2009). Training Manual on Gender and Climate Change, Masterlitho, San Antonio, Costa Rica.

UNFCCC. (1992). The United Nations Framework Convention on Climate Change, A/AC.237/18, 9 May.

United Nations Framework Convention on Climate Change (UNFCCC) (2007). Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries. Bonn Germany: United Nations Framework Convention on Climate Change.

United Nations and World Trade Organisation (2012). Recent Advances in the Field of Trade Theory and Policy Analysis Using Micro-Level Data. Bangkok, Thailand: Economic and Social Commission for Asia and the Pacific.

Upton, M. (1996). *The Economics of Tropical Farming Systems.* Cambridge: Cambridge University Press.

URT/UNICEF, (1990). ñWomen and Children in Tanzamia; A Situation Analysis. Tanzania: University of Dar-es-Salaam, Tanzania.

Usman A.T. (2003). Vegetation Modification and Man-induced Environmental Change in Rural Southwestern Nigeria. Agriculture, Ecosystem and Environment, 70: 159-167.

USAID. (2010). Fact Sheet: Climate Change and Gender. United State: United State Agency for International Development (USAID).

Valtorta, S. E. (2009). Animal Production in a changing Climate: Impacts and Mitigation. Rafaela, Argentina: National Institute of Agricultural Technology.

Vance, C and Buchheim, S. (2005). On the Application of Heckmanÿs Sample Selection Model to Travel Survey Data: Some Practical Guidelines. Berlin, Germany: Association for European Transport and Contributors.

Vincent, K; Wanjiru, L, Aubry, A; Mershon, A; Nyandiga, C; Cull, T and Banda, K. (2010). Gender, Climate Change and Community-based Adaptation: A Guidebook for Designing and Implementing Gender-Sensitive Community-based Adaptation Programmes and Projects. New York: United Nations Development Programme (UNDP).

Watson, D. (2010). Climate change, cropping systems and coping strategies. Impacts of climate change on food security in sub-Saharan Africa. Proceedings of the 14th Annual Symposium of the International Association of Research Scholars and Fellows, IITA,

Wilkinson, L.G and Gruber, C. (1996). ñDesktop Data Analysis with SYSTAT.ò Upper Saddle River, NJ: Prentice Hall.

Womenÿs Environment and Development Organisation (WEDO). (2007). ó*Changing the climate: Why women's perspectives matter*ô. Whirled Bank Group 2008. Agriculture and the World Bank.

Womenÿs Environment and Development Organisation (WEDO). (2008). Gender, Climate Change and Human Security. WEDO website: http://www.wedo.org/wp-content/uploads/hsn-study-final-may-20-2008.pdf

World Bank. (2008). Updates of Poverty Estimates for the Developing World. Washington D.C.: World Bank.

Wozniak, G.D., (1984). The adoption of interrelated innovations: A human capital approach. *Review of Economics and Statistics* 66 (LXVI): 70ï79.

Yang, D and Martinez, C. A. (2005). Remittances and Poverty in Migrant Home Areas: Evidence from Philippines. World Bankÿs International; Migration and Development Research Group.

Ying So and F.K, Warren. (2003). ñMultinomial Logit Models.ò Retrieved June 14, 2008, from http://www.support.sas.com/techsup/tnote-start.

Yirga, C., T. (2007). The dynamics of soil degradation and incentives for optimal management in Central Highlands of Ethiopia. *PhD Thesis.* Department of Agricultural Economics, Extension and Rural Development. University of Pretoria, South Africa

Yisehak, K. (2008). Gender responsibility in smallholder mixed crop-livestock production systems of Jimma zone, South West Ethiopia. *Livestock Research for Rural Development* 20 (1).

Yohannes, M; John, G and Garth, C. (2007) Strategic Decision-Making: Adoption of Agricultural Technologies and Risk in a Peasant Economy. Online at http://mpra.ub.uni muenchen.de/387/ MPRA Paper No. 387.

Yuengert, A. M. (2001). ñRational Choice with Passion: Virtue in a Model of Rational Addiction.ò *Review of Social Economy* 59(1), 1-21.

Zayeda,S and Mohammad, S. I. (2013) Consequences of Climate Change and Gender Vulnerability: Bangladesh Perspective. http://dx.doi.org/10.2139/ssrn.2200116

Zoellick, R. B. (2009) A Climate Smart Future. The Nation Newspapers. Vintage Press Limited, Lagos, Nigeria. Page 18.

APPENDIX I

Department of Agric Economics,
University of Nigeria, Nsukka
Date ---------------------------

Dear Respondent,

Request for Response to Questionnaire

I am a postgraduate student of the above named Department and University currently undertaking a research work titled: *"Gender and Climate Change Adaptation Decisions among Farming Households in South-western Nigeria"*

Your farm unit has been selected as one of the farm units to supply the required information towards addressing the specific objectives of the study. I therefore solicit for your cooperation to respond as objective as possible to the questions/items in the questionnaire. It is purely academic work and all information supplied by you will be strictly treated in confidence and for the purpose of the research work.

Thank you for your patient and cooperation.

Yours faithfully,

Amusa, T. Ade.
(Researcher)

QUESTIONNAIRE/INTERVIEW SCHEDULE

A. State: Ekiti ☐ Ogun ☐ Oyo ☐

1. Agric Zoneé .
2. Local Government Areaé é é é é é é é é é é é é é é é é é .

B. Socio-economic Characteristics of the Farmers

1. Gender of Household Head: **Male** ☐ **Female** ☐

2. Age in yearsé .

3. Marital Status: **Single** ☐ **Married** ☐ **Widow** ☐ **Divorced** ☐

4. How many of your children are below 10 years of ageé é é é ....é é é

5. Level of Education:

i. Never attended school ☐

ii. Attended primary school ☐

iii. Attended secondary school ☐

iv. Attended any higher institution ☐

6. How many years did you totally spend in schoolé é é é é é é é ....é é

7. Number of people in your farming householdé é é é é é é é é é ....é .

8. Number of male farmers in your farming householdé é é é é é é .....é é

9. Years of farming experience ....é é é é é ......é é

10. Your farm distance from home? **Far** ☐ **Close** ☐

11. Location of your settlement **Rural** ☐ **Urban** ☐

12. Do you render financial contribution to support farm activities?

Yes ☐ **No** ☐

13. How many hours on the average do you spend on the farm per day?.................

14. Average size of your farm under cultivation...

15. Your land ownership status: **Owned** ☐ **Other wise** ☐

16. Do you have any other occupation outside farming: **Yes** ☐ **No** ☐

17. If yes, specify ....

18. How many of your household members are educated?...

19. What is your estimated annual farm income? (ك..)

20. How many extension visits do you have last cropping season? ....

21. Do you have free access to farm credits or loans? **Yes** ☐ **No** ☐

22. Is your house connected to electricity/generator? **Yes** ☐ **No** ☐

23. Do you have radio/television to listen to news? **Yes** ☐ **No** ☐

24. Membership of farmersô cooperatives **Yes** ☐ **No** ☐

25. Number of farm labourers in your household...

26. Number of livestock in your farm...

27. Types of crops grown...

28. Types of livestock reared..

29. Number of household working members..

30. Do you receive remittance? **Yes** ☐ **No** ☐

31. Number of dependent household members..

32. Are you aware of climate change phenomenon? **Yes** ☐ **No** ☐

33. If yes, what is the source of your information? Indicate your sources of information on climate change with a check (√)

1	Radio/television	
2	Newspapers	
3	Friends	
4	Internet	
5	Researchers	
6	Extension workers	
7	Farmers' co-operative	
8	Politicians	
9	Personal observation	

34. Have you adapted to climate change using some coping strategies? **Yes** ☐ **No** ☐

35. If yes, indicate with a check (ã) on the adaptation practices you adopt in your farm land?

1	Use of irrigation system/water storage	
2	Early or late planting of crops as adaption strategies	
3	Planting different varieties of crop (multiple cropping)	
4	Planting cover crops to help conserve soil moisture	
5	Minimum/zero tillage so as not to expose the soil to loss of nutrients	
6	Increased mulching to conserve moisture and reduce heat effect	
7	Staking of crops such as yam to avoid heat burns	
8	The use of organic manure	

9	The use of inorganic manure (fertilizers)	
10	Agroforesty as adaptation strategy	
11	Diversification of farm enterprise to non-farm business to reduce shock	
12	Mixed farming (producing crops and rearing livestock at the same time)	
13	Making ridges across farms to reduce effects of erosion	
14	Planting pest and disease resistant crops	
15	Planting of drought tolerant crop varieties	
16	Making of contour bunds around farmland	
17	Planting of fast maturing crop varieties	
18	Avoiding eroded and erosion prone area for farming	
19	Adopting recommended planting distance	
20	Changing crop harvesting dates	
21	Processing of crops to minimize post-harvest losses	
22	Construction of drainages across the farmland	
23	The use of wetlands/river valleys for farming (Fadama system/*akuro*)	
24	Consult the rain maker during prolonged drought	
25	Lengthened fallow of cropland	
26	Intensify supplementary feeding system for livestock	
27	Dip and Dose system in livestock rearing	
28	Improved fence camps for livestock	
29	Rearing of disease and pest resistant livestock varieties	
30	Construction of shelter for animals using non-conductors of heat	
31	Culling of infected animals	
32	Rainwater harvesting for livestock rearing	
33	Intensify shading of livestock pens	

36. What is the extent of your contributions to decision making in climate change adaptation practices in your farm household?

Very High	
High	
Low	
Very Low	

C. Level of awareness of the following climate change indicators?

The response options are**: Highly Aware (HA) = 4; Moderately Aware (MA) = 3**

Less Aware (LA) = 2 and Not Aware (NA) = 1

SN	Climate Change Indicators	HA	MA	LA	NA
1	Decreased rainfall amount in the continental interiors				
2	Increased rainfall in the coastal areas				
3	Unpredictable rainfall patterns				
4	Increase in temperature (heat)				
5	Prolonged drought than before				
6	Delay in arrival of annual rainfall				
7	Gradual disappearing of the usual harmattan periods				
8	High winds and heat waves				
9	Fast water evaporation from the ground				
10	Unusual heavy rainfall				
11	Reduced length of growing season				
12	Decrease in ice fall during precipitation				
13	River surface temperature rise				
14	Variations in bloom date (fruiting of crops)				
15	Rising sea level				
16	Increased flooding/erosion menace				
17	Crop and animal species extinctions				
18	Increased desertification				
19	Drying up of rivers, lakes and streams				
20	Increased post harvest deterioration of crops				

D. What is the intensity of these effects of climate change on farming activities in your area?

The response options and the values attached are as follows:

Very Serious	**(VS) = 4**
Moderately Serious	**(MS) = 3**
Less Serious	**(LS) = 2**
Not Serious	**(NS) = 1**

S/N	**Effects of Climate Change**	**VS**	**MS**	**LS**	**NS**
1	Decreased rainfall amount				
2	Unusual heavy rainfall				
3	Higher temperature and heat				
4	Heavy winds				
5	Increased cases of flooding				
6	Prolonged drought				
7	Increased desertification				
8	Increase in pest and disease problems				
9	Extinction of some crop species				
10	Deceased soil moisture				
11	Premature ripening of fruits				
12	Reduction in crop yield				
13	Poor quality of storage farm produce as a result of heat				
14	Stunted growth of crops				
15	Drying up of rivers, lakes and streams				
16	Increased drying up of seedlings after germination				
17	Heat stress on crop and livestock				
18	Intense weed growth				
19	Increased soil erosion				
20	Storage losses in roots and tubers				
21	Increased salinity/water pollution due to climate variability				

22	Decrease in fish population due to salinity, water level, ocean currents or speed				
23	Increased post harvest spoilage of harvested crops				

F. What is the extent of your contributions to decision making in the following climate change adaptation practices in crop production activities in your farmland?

The response options and the values attached are as follows:

Very High **(VH) = 4**

High **(H) = 3**

Low **(L) = 2**

Very Low **(VL) = 1**

		Male farmers				Female farmers			
S/N	**Level of contributions to decision making in climate change adaptation practices**	**VH**	**H**	**L**	**VL**	**VH**	**H**	**L**	**VL**
1	Use of irrigation system/water storage								
2	Early or late planting of crops as adaption strategies								
3	Planting different varieties of crop (multiple cropping)								
4	Planting of trees (aforestation/reforestation or agroforstry practices)								
5	Planting cover crops to help conserve soil moisture								
6	Minimum/zero tillage so as not to expose the soil to loss of nutrients								
7	Increased mulching of crops to conserve moisture and reduce heat effect								
8	Staking of crawling crops such as yam to avoid heat burns								
9	The use of organic manure								
10	Mixed farming (diversification of farm enterprise to nonfarm business)								
11	The use of inorganic manure (fertilizers)								
12	Making ridges across farms to reduce effects of erosion								
13	Planting pest and disease resistant crops								

14	Planting of drought tolerant crop varieties								
15	Making of contour bunds around farmland								
16	Planting of fast maturing crop varieties								
17	Avoiding eroded/erosion prone area for farming								
18	Adopting recommended planting distance								
19	Changing crop harvesting dates								
20	Processing of crops to minimize post-harvest losses								
21	Construction of drainages across the farmland								
22	The use of wetlands/river valleys for production (Fadama system or *akuro*)								
23	Consult the rain maker during prolonged drought								

G. What is the extent of your contributions to decision making in the following climate change adaptation practices in livestock rearing activities in your households?

The response options and the values attached are as follows:

		Male farmers				**Female farmers**			
SN	**Level of contributions to climate change adaptation practices for livestock production**	**VH**	**H**	**L**	**VL**	**VH**	**H**	**L**	**VL**
1	Intensify supplementary feeding system								
2	Dip and Dose system in livestock rearing								
3	Improved fence camps for livestock								
4	Rearing of disease and pest resistant livestock varieties								
5	Construction of shelter for animals using non-conductors of heat								
6	Culling of infected animals								
7	Decrease in stocking rate of animals								
8	Distributing livestock herds in different places to reduce disease spread								
9	Rainwater harvesting for livestock rearing								
10	Intensify shading of livestock pens								

H. Constraints militating against farm women in making contributions to climate change adaptation decisions.

The response options and the values attached are as follows:

Very Serious **(VS) = 4**

Serious **(S) = 3**

Less Serious **(LS) = 2**

Not Serious **(NS) = 1**

S/N	Challenges of women in making contributions to climate change adaptation decisions in their farm households	VS	S	LS	NS
1	Poor access to sources of information				
2	Non-availability of credit facilities for women farmers				
3	Illiteracy of the farm women				
4	Inadequate knowledge of how to cope or build resilience				
5	Lack of access to weather forecast technologies				
6	Non-availability of storage facilities				
7	Low income of women farmers in the households				
8	Lack of extension programmes directed to meet woman farmers need				
9	Far distance of household farms to their residential areas.				
10	Misconception that women farmers donõt have farming ideas.				
11	Low/lack of financial contribution to farm operation by women.				
12	Lack of access to supporting facilities e.g, cooperative, adult education programme.				
13	Tedious nature of climate change adaptation activities.				
14	The belief that farm women are less informed.				
15	Unwillingness of farm women to take farming risks to adapt.				
16	The general belief by the society that women are always subordinate to their husbands or male counterparts.				
17	Domestic violence between the farm women and their male counterparts.				
18	Low self-confidence by the farm women in taking certain farming decision.				

19	Poor access to and control of farm resources e.g. land, farm capital.				
20	Lack of awareness and access about NGOs programme for women self-development.				
21	Multiple domestic responsibilities of women e.g. cooking, taking care of homes, caring for household members etc.				
22	Low technical know-how of farm women in handling mechanized and technical duties in the farm.				
23	High number of male farmers in the farming household				
24	Involvement of the farm women in some off farm jobs, e.g. trading, artisans etc.				
25	Religious belief of the farming household				
26	Lack of collateral security required to secure loan to support climate related farm operations.				

APPENDIX II

Summary of the Study Locations and Sampling

(First Stage) States	(Second Stage) Agric Zones	(Third Stage) Local Govts Areas	(Fourth Stage) Farm Communities	(Fifth Stage) Sampled Farm Units	Number of Questionnaire Retrieved
Ekiti (Derived Savanna)	Zone I	Ekiti West (Aramoko)	Erio	10	10
			Aramoko	10	10
		Moba	Osun	10	10
			Otun	10	10
		Ekiti South West (Ilawe Ekiti)	Ilawe	10	10
			Ogotun	10	10
	Zone II	Ikole	Odo-Oro	10	10
			Ipao	10	10
		Emure	Eporo	10	10
			Gbooge	10	10
		Ekiti East	Omuooke	10	10
			Ilasa	10	10
Ogun (Rainforest)	Ijebu Ode	Ijebu North	Awa	10	10
			Ilaporu	10	10
		Odogbolu	Ayepe	10	9
			Omu Ijebu	10	8
		Ijebu Northeast	Atan	10	10
			Erunwon	10	8
	Abeokuta	Abeokuta North	Akomoje	10	9
				10	10
		Ado-Odo/Ota		10	10
				10	10
		Ifo	Agbado	10	7
			Akute	10	10
Oyo (Guinea Savanna)	Ibadan/Ibarapa	Akinyele	Moniya	10	10
			Arulogun	10	10
		Lagelu	Egbeda	10	10
			Lalupon	10	9
		Ibarapa North	Igbo Ora	10	10
			Tapa	10	10
	Ogbomosho	Ogo Oluwa	Ajawa	10	10
			Ogo Oluwa	10	10
		Surulere	Araromi	10	10
			Sadiwin	10	10
		Ogbomosho South	Arowomole	10	8
			Isale Ora	10	10
Total 3	**6**	**12**	**24**	**360**	**348**