Competency of extension agents on climate smart agricultural initiatives in South Western Nigeria

TO Olorunfemi

orcid.org/0000-0001-9749-0904

Thesis submitted in fulfilment of the requirements for the degree Doctor of Philosophy in Agriculture with Agriculture Extension at the North-West University

Promoter: Prof OI Oladele
Co-promoter: Dr MS Modirwa
Co-promoter: Dr LK Mabe

Graduation ceremony: October 2019
Student number: 29984998

DECLARATION

I, the undersigned, Temitope Oluwaseun Olorunfemi declare that this thesis titled, Competency of Extension Agents on Climate Smart Agricultural Initiatives in South Western Nigeria, submitted to the North-West University for the degree of Doctor of Philosophy in Agricultural Extension, in the Faculty of Natural and Agricultural Sciences, School of Agricultural Sciences, with the work contained herein, is my original work with the exception of citations and that this work has not been submitted to any other University in part or its entirely for the award of any degree.

Name: **Olorunfemi Temitope Oluwaseun**

Signature: ____________________

Date: 07/10/ 2019.

ACKNOWLEDGEMENT

All glory, honour, majesty and reference belong to the Most High God, for the opportunity given to the author to study at this level. The author can never thank Him enough for all he has done for her.

The author sincere appreciation goes to her ever dynamic Supervisor, Professor. O. I. Oladele for his steadfast and consistent mentoring, fatherly motivation and support all through the period of this research. Thank you very much, Sir. The author also appreciate the efforts of Professor S.S Lestoalo, Dr. S. Mordiwa, Dr. L. K. Mabe for their academic support made for the success of this research.

The author's profound gratitude also goes to Prof. Useh, Dr Fashola, Dr Omotayo, Dr Ajilogba, Dr Adegboye, Ms. Musanchi Sichembe, the Aremu's, Mr Simon Isaac, Dr Jerry, Dr Nike Amoo and Mrs Mary Oche and other Senior colleagues and staff of the North-West University for their administrative, moral and scholarly contributions to the success of this research.

The author is sincerely grateful for the prayers, spiritual contributions and counsel of the pastorate, workers and members of RCCG Mafikeng, most especially her Zonal Pastor (Pst & Pst Mrs Oduaran and her Parish Pastor (Chief Justice & Mrs Mogoeng Mogoeng). May all your labour of love in God's vineyard never be in vain in Jesus name.

To all author's wonderful friends and colleagues who have steadfastly remained supportive all through this journey, she is forever grateful to you. The Lord bless you all.

Lastly, to everyone that has contributed to the success of this programme but whose names do not appear here, you are sincerely remembered and the author says a very big THANK YOU to you all. The Lord bless you all.

DEDICATION

The author humbly dedicate this thesis to God Almighty, her parents, family and a list of close friends:

- To God Almighty, the sustainer of my life and the one who remains always faithful. All wisdom and inspirations come from him alone. May His name be praised forever.
- To author's amazing parents, Elder and Mrs J. O Oladele and parent-in-law Pastor and Evangelist (Mrs) D. D. Olorunfemi for their continual prayers and support towards the success of my academic pursuit. She is really grateful and her prayer is that you shall eat the fruit of your labour in Jesus name.
- To author's siblings and in-laws; Mr & Mrs Emmanuel Ugo-akaeze, Mr & Mrs Tosin Oyegbemi, Pastor & Mrs Femi Oladele and Mr & Mrs Gbenga Oladele. Ever since she was little, you have always been there for her and also her in-laws; Engineer & Mrs Muyiwa Olorunfemi and Dr & Dr Mrs Godwin Adunmo for their contributions, prayers and counsel all through this journey. The Lord perfect all that concerns you and make your ways prosperous. The author's love bubbles for you all.
- To her husband and children, Dr Oluwasogo David Olorunfemi, and our son Divine Oluwadarasimi Olorunfemi and daughter Dominion Iyinmide Olorunfemi for their love, encouragement, prayers, understanding and, most of all, contribution towards who she is today and towards the successful completion of this programme. You are the greatest asset one can ever have and she will always cherish you all her life with the help of God. May the Almighty keep us together in his love and we will always have reasons to celebrate all the days of our lives in Jesus name.

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LIST OF ACRONYMS

ADP	Agricultural Development Programme
AGRA	Alliance for a Green Revolution in Africa
ASTD	American Society of Training and Development
BEA	Block Extension Agents
CFA	Confirmatory Factor Analysis
CSAI	Climate Smart Agricultural Initiatives
FAO	Food and Agricultural Organization
FGN	Federal Government of Nigeria
FNTs	Forth-night Training Sessions
GFRAS	Global Forum for Rural Advisory Services
GHG	Green House Gases
ICT	Information Communication Technology
IFPRI	International Food Policy and Research Institute
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
LGA	Local Government Area
MOEFRN	Ministry of Environment of the Federal Republic of Nigeria
MWDS	Mean Weighted Discrepancy score
NIMET	Nigerian Meteorological Agency
NPC	National Population Commission
OLS	Ordinary Least Square Regression

SDG	Sustainable Development Goals
SEM	Structural Equation Modelling
UNIDO	United Nations Industrial Development Organization
VEA	Village Extension Agents
ZEO	Zonal Extension Office

ABSTRACT

The effect of climate change has posed a great challenge to the survival of the human race and agriculture and the competence of extension agents in the effective dissemination of climate smart agricultural initiatives (CSAI) is urgently needed in the study area for an effective climate change service delivery, which led to this study. The study examines the competency of extension agents on CSAI in South Western Nigeria. The study also specifically describes the socio-economic characteristics of the extension agents, identifies the sources of information used by the extension agents, examines their knowledge level on CSAI, determines their involvement in the dissemination of these initiatives, examines the competency level of extension agents, determines the competency need of the extension agents and also identifies constraints to the acquisition of needed competencies on CSAI.

A two (2) stage sampling procedure was employed in the selection of the extension agents in the study. Firstly, a random selection of three (3) states in the zone where extension activities were prominent based on the information obtained from the various states ADPs was utilized. The selected states were Oyo, Ekiti and Ondo. The second stage was a random selection of extension agents in the three states through the utilization of the Raosoft sample size calculator and the total number of respondents sampled for the study was two hundred and seventy seven (277) extension agents. A structured questionnaire consisting of eight sections was used to elicit information from the extension agents. Descriptive statistics (frequency counts, percentages, means and ranks) and inferential statistics (Tobit regression and Confirmatory Factor Analysis were used to analyse the data.

The findings revealed that extension agents in the study area exhibited low level of knowledge on several of the initiatives and their low level of knowledge also translated to their low level of competency on majority of the CSAI. The results on the competency needs of extension agents on CSAI after the use of Borich Needs assessment model revealed that extension agents across the study area needed training in their competency level. The most prominent areas of competency/ training needs are on water management initiatives, Tillage smart practices, Fossil reduction practices and Soil management practices and they indicated severe constraints militating against their effective acquisition of needed competencies on CSAI. Tobit regression model revealed that educational qualification, participation in climate smart agricultural *training, years of experience, job level, community covered, living in job location, knowledge, importance and involvement in climate smart initiatives dissemination significantly influence extension agents' competency level on CSAI. Confirmatory factor analysis of the result of the correlated exogenous constructs of competency revealed a significant and positive correlation between the construct of extension agents' competence and the component of their knowledge, involvement and importance.*

The study concluded that the competency level of the extension agents was found to be very low in several of the CSAI and competency was needed in twelve (12) major areas. It was recommended that extension organizations should develop the capacity of the extension agents in the areas of priority needs on climate smart agricultural initiatives identified through trainings that are majorly focused on climate change adaptation and mitigation practices.

Keywords: Climate change, Competency, Competency need, Climate smart agriculture, Extension agents.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Globally, the effect of climate change is posing a great challenge to the survival of the human race and agriculture which plays a very important role in the existence of man (Sala, 2016). It has been observed, based on the impact of climate change over the past 40 years that the West African Sub region is the most vulnerable area to climate change problem (Intergovernmental Panel on Climate Change (IPCC), 2014). According to Field et al., (2012), agriculture is evidently the most important sector in the economies of most African countries including Nigeria where it constitutes approximately 40% of the country's GDP with about 70% of the populace relying on this sector for their livelihood (FAO, 2012). Agriculture in Nigeria is faced with varying impact of climate change year in and year out adversely and directly affecting agriculture most especially the food production sector as well as the economy (Ministry of Environment of the Federal Republic of Nigeria (MOEFRN), 2003).

The occurrence of climate change has been evidently suggested to be the result of human activities such as change in land uses and emission of Green House Gases (GHG) which cause global warming at an unprecedented rate (Singh & Grover, 2013). There is no doubt therefore that the earth is getting warmer and human activities are mainly to be blamed (Nicholas & Nnaji, 2011; Mustapha et al., 2012). These human activities eventually have long term effects and cause changes in rainfall pattern, increased variability in temperature, pests and diseases outbreak, drought, changes in water variability and poor yield (Stocker et al., 2013) making agriculture the major sector of the economy being affected by the variations in climate change (Nicholas & Nnaji, 2011).

Agriculture is extremely vulnerable to climate change and the overall negative impact it has on the sector is said to be enormous (Harvey et al., 2014). In Nigeria, the evidence of the effects of climate change in some zones include increased rainfall resulting in flooding which has led to loss of arable farmlands, valuable economic trees and increased pest infestation while other pronounced effects of climate change include wind erosion, desertification and drought in other zones in Nigeria (Bello et al., 2012; Farauta et al., 2011; Dimelu et al., 2014). According to *Jalloh* et al., (2013), a lot of farmers in the West African sub-region are exposed to the threat posed by the cumulative effects of climate change such as drought, storage loss in root and tuber, flooding, decrease in soil fertility and crop yield, loss of vegetation and air pollution, soil erosion, increase in the incidence of pests and diseases, hardening of seed bed, premature ripening of crops as well as shortening of crop cycle. These effects result in poor and unpredictable yields and these make farmers environmentally and socio-economically vulnerable to poverty and food insecurity (Ogunlade et al., 2014; Zoellick, 2009; Ozor et al., 2010; Wojcik et al., 2014). In line with the adopted Sustainable Development Goals (SDGs) Pillar 2, these aimed at ending all forms of hunger, malnutrition and food insecurity by 2030 (Le Blanc, 2015). The agricultural sector in Nigeria has therefore been a centre of focus for intervention at all levels through the promotion of sustainable climatic agricultural knowledge and practices to achieve food and nutrition security.

1.2 Climate Smart Agricultural Initiatives and Agricultural Extension

Agriculture in Nigeria has been flagged a victim of the adverse impact of climate change (Jalloh et al., 2013), and there is a need for farmers to use adaptation and mitigation strategies that are sustainable and will enhance their capacity to cope with its effects. The understanding of the contribution of agriculture to observed climate change is important for designing mitigation measures, and most often, many adaptation practices also mitigate climate change (Speranza, 2010). The impacts of climate change can be addressed through adaptation, although mitigation and adaptation cannot be substituted for each other but one complements the other, the need for adaptation in the long run can be reduced by constant and current mitigation practices (Elum et al., 2016). "Adaptation is a continuum of natural and human responses to climate change that range from pure development activities on one hand to a very explicit adaptation measure on the other hand while Climate change mitigation on the other hand is the action or steps taken by man to reduce greenhouse effects or enhance the sinks of greenhouse gases" (Locatelli, 2011 and McCarthy et al, 2011).

Creating solution to the problems caused by climate change involves a lot of environmental, technological and social interventions and control needs to be applied in all areas of agriculture which are referred to as Climate Smart Agricultural Initiatives. FAO (2013) defined Climate Smart Agricultural Initiatives as a 3-pillar approach to agriculture that is created to reduce or remove greenhouse gases emission where possible, to adapt and build resilience to climate change and to sustainably increase agriculture productivity and income. Climate smart Initiative is a concept considered to be potentially effective to develop the technical, policy and investment conditions which lead to the achievement of sustainable agriculture development for food security under climate change (FAO, 2010).

Climate Smart Agricultural initiatives involve the use of initiatives which increase resilient and stability in agriculture thereby helping farmers adapt to climate change risks (Oladele, 2015). These initiatives can be grouped under different categories such as the use of water management initiatives which entails the construction of drainage system in the case of floods, adoption of irrigation techniques and water conservation practices in the case of drought which will greatly help to overcome water stress problem imposed by climate change (Bisht et al., 2016). There are also tillage-smart initiatives which involves the adoption of zero/minimum tillage practices, direct seeding, adoption of farm fallowing practices and manure fertilizer application. These initiatives help the soil in retaining its moisture and also increase crop yield (Wojcik et al., 2014).

Climate smart agricultural initiatives provide solution to fossil burning through the adoption of afforestation practices, setting law against deforestation and carbon sequestration which reduces the production of greenhouse gases and injection of organic carbon into the soil (Lal et al., 2011). Climate smart agriculture also underpins soil management practices which involve soil conservation practices such as the use of cover crop, farm fragmentation, agro-forestry practices and the use of resource conservation technology which support the retention of different crop residue on the soil surface to control erosion, improve water use efficiency and increase organic matter in the soil to enhance productivity (FAO, 2013).

Furthermore, climate smart agriculture promotes crop mix practices which involve the development and the use of drought and pest resistant crop varieties, crop diversification and changes in planting depth of seeds which will greatly help in farmers' productivity (Ifeanyi-obi et al., 2012, Ajieh & Okoh, 2012). Lastly, the utilization of agro-weather tools have also proven to be a very useful technique in controlling climate risks due to the fact that vagaries of weather cause fluctuations in agricultural production (Oladele & Braimoh, 2015). The use of weather advisories from weather forecast, seasonal forecast and climate information updates disseminated through information and communication technology help farmers to be properly informed on climate change thereby improving farmers' capacity in the adoption of adaptive techniques for sustainable agricultural practices.

Agricultural Extension

The techniques that have been discussed in previous paragraphs are meant to be disseminated by the extension agents to farmers for proper utilization in order to improve their adaptive capacity and enhance their productivity. Agricultural development in Nigeria is hinged on extension services whose purpose is to help farmers identify and link research on production problems and also provide awareness on innovations targeted towards the improvement of farm yields, living standards and facilitation of economic growth (Oladele, 2011). Agricultural extension services assist farmers through educational procedures aimed at improving farming methods and techniques, increasing production efficiency and farm income (Suvedi & Kaplowitz, 2016). According to Sala et al., (2016), "Agricultural extension services is a process that requires interactions and capacity building of rural farmers in order to improve food and nutrition security, economic stability and market knowledge thereby promoting farmer to farmer change in knowledge, attitude and skills. " Nicholas & Nnaji (2011) also stated that agricultural extension is a process of rendering advisory services to farmers in order to develop and also induce innovations which help in solving various farm problems. This is achieved through the organization of campaigns and programmes with the use of appropriate delivery method to bring about a change in the attitude, knowledge and skills of the farmers. The role and involvement of extension system therefore is very crucial in providing information and educational programmes on new technologies to farmers in order to enable them combat and mitigate the effect of climate change. This involvement is supposed to include improving farmers' access to climate resilient technologies and practices and also adequate provision of information and knowledge to enhance farmers' productivity (FAO, 2016).

To cope with the severity and urgency to mitigate the prevailing effects of climate change, there is the need for agricultural extension agents to have the right knowledge, skills and competence on climate change adaptation and mitigation strategies so that they can step up their technology transfer efforts to meet the changing needs of the farmers. Oladele (2015) pointed out the existence of a strong relationship between the competence of extension agents and their effective performance in the agricultural technology transfer model. Tarekegne et al., (2017) also highlighted the crucial role competence plays in ensuring effective performance of extension personnel. Extension agents therefore are expected to be knowledgeable and competent on climate smart agricultural best practices and initiatives for them to be able to effectively provide information, support and advisory services on these initiatives and practices to farmers. This will improve their capacity in adopting these productivity-enhancing initiatives.

Globally, the demand for competent extension agents in disseminating climate smart agricultural related initiatives, information and advisory services to farmers has been increasing. With the unfolding environmental and economic challenges posed by climate change, a critical analysis of the competence of extension personnel on climate smart adaptation and mitigation strategies is becoming more necessary. Competency is described as having a sufficient level of knowledge and skills in accomplishing an assigned task and competency is enhanced in extension agents when adequate training opportunity is made available on areas where competency is needed (Okwoche et al., 2011). The success of extension programme is therefore determined mainly by the proficiency of extension agents in transferring new knowledge, skills and technology to farmers (Laki et al., 2014). According to Bahua et al., (2016), competency of extension agents influences their level of service delivery and ensuring an implementation of constant revised pre-service and in-service training programmes is essential to facilitate better job performance from extension agents.

1.3 Statement of the Problem

In Nigeria and other developing countries of Africa, farmers have limited or no access to advanced technology and climate change related information on reducing their vulnerability and increasing their capacity for resilience and productivity (Aker, 2011) and this results in farmers experiencing low agricultural productivity and also food insecurity (Suvedi & Kaplowitz, 2016).

Agricultural development relies on an effective and vibrant extension services which provide information to farmers' in order to build their capacity on various technologies and practices. Agricultural extension agents bridge the gap between research and farmers (Oladele, 2011; Ogunlade et al., 2014). Extension services remain the most prominent trusted source of information for farmers thus extension agents need to be adequately equipped to deliver timely information related to climate smart agricultural initiatives (Prokopy et al., 2015).

Despite the fact that the work of extension agents is to facilitate learning and also provide adequate information and knowledge to farmers, there has been increasing concern on the provision of efficient and sustainable climate change risk management information and mitigation advisory services to rural farmers who produce bulk of the food supply in Nigeria (Ayansina, 2011). Similarly, the competence of extension agents to relate and disseminate information on climate change and coping strategies has been under scrutiny to ensure an effective rural advisory service delivery to farmers on climate change adaptation and mitigation strategies.

According to Sheik et al., (2011), most of the extension agents in developing countries such as Nigeria are not well informed of the effects of climate change, its related risks and the initiatives needed to adapt and mitigate its effects. Furthermore, Okwoche, Ejembi & Obinne (2011), reported that "most extension agents in Nigeria lack the knowledge and skills required to work in the complex and rapidly changing agricultural environment." Several other researches has revealed that the awareness about climate change related issues in Nigeria is still very low (Nzeh & Eboh, 2010; Egbule et al., 2010; Ifeanyi-obi et al., 2012). Similarly, extension agents have limited involvement in climate change adaptation and mitigation efforts as only few programmes related to climate change have been initiated (Simpson & Burpee, 2004) and adaptation to climate change impacts requires change in knowledge, attitudes, resilience capacities, and skills of the people.

Ali & Erenstein, (2017); Tripathi & Mishra, (2017); Akinnagbe & Irohibe (2014) have reported low level of adoption and utilization of climate change techniques among farmers and these have been attributed to the low level of knowledge and human capacity to adapt to the unfavourable effect of climate change. Otitoju & Enete (2016) reported that, one of the constraints identified by the farmers in South West Nigeria in combating the effect of climate change is the unavailability of adequate climate change related extension and advisory services in terms of inadequate programmes directed to meet climate change adaptation strategies and poor extension delivery on climate smart initiatives. There is still a wide gap in accomplishing the aim of extension services in areas such as managing climate change risks through the efficient dissemination of information on climate smart initiatives covering Soil management, Water management, Tillage smart, Fossil smart, Crop-mix and Agro-weather/ ICT practices.

The inadequacy of advisory services on climate smart agricultural initiatives by extension agents who are supposed to be a vital information source on innovations to the farmers is thus evident. This might be an indication that extension agents seem not to have the necessary expertise to play their advisory role on climate smart agriculture related issues. Singh & Grover (2013) stated that success of the extension services largely depends on the professional skills and competencies of extension agents. In order to meet the requirement of disseminating climate smart agricultural initiatives, some professional competencies should be possessed by the agricultural extension agents.

According to Laki et al., (2014), competency is the application of knowledge, technical skills and personal characteristics designed around individual abilities for an effective job performance. It is also an attribute of skills in the delivery of desired results (Fox et al, 2013). Competency in the concept of an excellent extension service delivery is dependent on the capability of an extension agent to display knowledge and skills in communication, human relation, leadership, monitoring, evaluation, extension programme planning and implementation and service delivery effectively (Wasihun et al., 2013; Laki et al., 2014). The competency level of extension agents both in professional and technical aspects influences proper communication and interaction with the farmers which increases farmer's performance (Wasihun et al., 2013). Effective service delivery is dependent on the competency level of extension agents on the agricultural innovation to be disseminated to the farmers and the steps taken in acquiring these competencies put them in the position to be more efficient and effective in the execution of their tasks and responsibilities thereby possessing good service delivery skills (Adams, 2014).

In the light of all these, the inadequacy of advisory services on climate smart agricultural initiatives rendered by extension agents in the study area might be attributed to competency shortfalls by the extension agents in combating the inimical effects of climate change and the risk posed by it. More importantly studies focusing on analyzing the competency of extension agents on the crucial issues such as climate smart agricultural initiatives in the study area are scanty or non-existent.

This study therefore examines the competency of extension agents on climate smart agricultural initiatives in South Western Nigeria. The study seeks to provide answers to the following questions;

1. What are the socio-economic characteristics of the extension agents in the study area?
2. What are the sources of information used by the extension agents on climate smart agricultural initiatives?
3. What are the climate smart initiatives in South West Nigeria?
4. How knowledgeable are the extension agents on climate smart agricultural initiatives?
5. Are extension agents involved in the dissemination of climate smart agricultural initiatives?
6. What is the competency level of the extension agents on climate smart agricultural initiatives?
7. What are the competency needs of the extension agents on climate smart agricultural initiatives?
8. What are the various constraints to the acquisition of the needed competencies on climate smart agricultural initiatives in the study area?

1.4 Objectives of the Study

The general objective of this study is to examine the competency of extension agents on climate smart agricultural initiatives in South Western Nigeria.

The specific objectives of the study were to:-

1. describe the socio-economic characteristics of the extension agents in the study area;
2. identify the sources of information used by the extension agents on climate smart agricultural initiatives;
3. examine knowledge level of the extension agents on climate smart initiatives
4. determine the involvement of extension agents in the dissemination of climate smart initiatives
5. examine the competency level of the extension agents on climate smart agricultural initiatives
6. determine the competency needs of the extension agents on climate smart agricultural initiatives and
7. identify the constraints to the acquisition of needed competencies on climate smart agricultural initiatives in the study area.

1.5 Hypotheses of the Study

The following hypotheses were tested in the study

Ho_1: There is no significant relationship between the socio-economic characteristics of the extension agents and their competency level on climate smart agricultural initiatives.

Ho_2: There is no significant relationship between the constructs of the extension agents' knowledge, importance and involvement in climate smart agricultural initiatives and their competency level.

1.6 Justification of the study

The need to embark on a comprehensive approach to solving the problem of inadequate extension and rural advisory services on climate change adaptation and mitigation strategies in South West Nigeria is very important in ensuring an informed and sustainable intervention in ameliorating the effect of climate change on agricultural production. Over the years, several solutions have been introduced into the agricultural knowledge and information system to curb the unfavourable effects caused by climate change. These solutions are referred to as Climate Smart Agricultural Initiatives and they involve a lot of technological, environmental and social interventions and controls all aimed at reducing greenhouse gases emission, building resilience to climate change and increasing agricultural productivity (FAO, 2013). However, a lot of these solutions have not yielded the desired impact.

A prominent factor identified as being responsible for this unacceptable situation is the unavailability of timely and appropriate information to farmers. A lacuna gap still exists between the advances made in terms of climate change adaptation and mitigation control technologies and the transfer of such technologies to the farmers. This is evident by the incessant complains by farmers on their limited access to information and advanced technologies on climate change coping strategies leading to their continued experience of low productivity, income and vulnerability to food insecurity as a result of the uncurbed cumulative inimical effect of climate change (Aker, 2011; Suvedi & Kaplowitz, 2016).

The unavailability of adequate information and advisory services on climate smart agricultural initiatives has been attributed to an inefficient extension service delivery system and competency shortfalls especially from extension agents who are one of the most valuable resources of the extension system and remain the most prominent trusted source of information to farmers (Prokopy et al., 2015; Otitoju & Enete, 2016; Oladele, 2015; Singh & Grover, 2013). This has resulted in low level of awareness and knowledge among farmers and consequently low level of adoption and utilization of climate change adaptation techniques (Akinnagbe & Irohibe, 2014). Research studies documenting the advances made in terms of climate change adaptation and mitigation strategies and ensuring the information gap that currently exists in terms of transfer of such technology to farmers by focusing on analysing the issues relating to competency of extension agents who are responsible for transferring this climate smart agricultural information to farmers is very few.

This lacuna thus motivated this study to access the knowledge level of the extension agents as well as their involvement in the dissemination of climate smart agricultural initiatives and also give an understanding of the competency level of extension agents on climate smart agricultural initiatives so as to inform governments, administrators of extension organization and extension policy stakeholders on developing and packaging the needed in-service training for extension agents that will help upgrade their skills and build their capacity for a more efficient extension and advisory services delivery on climate change adaptation and mitigation techniques in the study area.

Another gap filled by this research is identifying the information sources that were frequently utilized by extension agents so that relevant climate smart agricultural related information can be channelled through such medium for better and more effective delivery and capacity building of extension agents. Furthermore, the study identified the constraints that might be facing the extension agents as regards disseminating climate smart agricultural initiatives as this will assist governments and other stakeholders in the sector to plan for the gaps that need to be filled in tackling the issues militating against the agents' skill upgrade and effective dissemination of climate smart initiatives in the study area.

1.7 Scope and limitation of the Study

This study considered the competency of extension agents on climate smart agricultural initiatives in South Western Nigeria. The study was however limited to South Western Nigeria. To cater for the problem of generalizability in this research, large proportionate sample size which was randomly selected from the States with the highest population were used. This made the data sufficient and representative enough to reach general conclusion about the whole population of the study. Also, like other social researches that make use of questionnaire, this study is limited by the assumption that responses from extension agents are correct and true.

1.8 Definition of Terms

The terms below are defined operationally and conceptually as used within the scope of this study. Generalization of the meanings outside this study may not be applicable.

Adaptation: Adaptation to climate change refers to adjustments or actions taken to manage the negative and unavoidable impacts of climate change.

Adoption: It is the process of a farmer becoming aware of an innovation/initiative, evaluating it and taking the decision to finally utilize and adapt the innovation to solve a peculiar farm problem.

Agricultural Initiatives: This is the process whereby existing techniques and innovation are adjusted or new techniques and strategies created to solve specific agricultural/farm problems.

Clients: This refers to the farmers who are the end users of agricultural innovations and initiatives.

Climate change: This refers to changes in average weather condition that persist over multiple decades or longer.

Climate Smart Agricultural Initiatives: This refers to techniques, innovation and strategies that will help farmers adapt and mitigate the effect of climate change in their farming enterprise for increased productivity, income and food security while supporting environmental health.

Competency: Competency, as used in this study, is defined as the knowledge, skills and/or abilities possessed by an extension agent to allow him/her to carry out his/her responsibilities successfully.

Competency Needs: This is the training gap between the actual level of skills exhibited on the job and the desired level of skills expected by the organization and farmers from an extension agent.

Dissemination of Initiatives: This involves the process of transferring or delivering specific recommendation in a simplified mode to farmers about technologies and innovations they should adapt and adopt.

Extension Agents: These are technically trained personnel with skills in providing timely and helpful information to farmers in all agricultural aspects thereby improving their livelihood.

Knowledge: This refers to the ability of an extension agent to understand and be familiar with the application and utilization of techniques and skills that are suitable for adapting and mitigating the effect of climate change.

Mitigation: Climate change mitigation refers to actions taken to limit the magnitude of the impacts of long term climate change

1.9 Structure of the Thesis

The thesis is structured into five chapters. Chapter one presents the introduction, comprising background information on climate change with its effects on agriculture as well as climate smart agricultural initiatives and agricultural extension services in Nigeria. Others include statement of problem, research questions and objectives, justification, scope and limitation and study plan.

Chapter two is a general review of literature on climate smart agricultural initiatives and concept of competency in relation to extension services. It consists of empirical studies and theoretical framework relating to competency of extension agents alongside with the conceptual framework that was used for the study.

Chapter three describes the methodology used in the study. It includes the description of the study area, research design, population and sampling procedure used. It also contains the method of data collection and analysis that was adopted for the study.

Chapter four presents the results of the analyses. The findings of the study alongside with their implications are also discussed in the chapter.

Chapter five highlights the summary of the major findings. The conclusion and policy recommendations drawn from the study are presented in this chapter.

1.10 Chapter Summary

This chapter introduces the study of competency of extension agents on climate smart agricultural initiatives in South Western Nigeria with a broad and comprehensive background of climate change and its impact globally in the study area and the intervention of climate smart agricultural initiatives needed in ameliorating it. The problem statement was presented to highlight the need for competency upgrade of the extension agents most especially on climate smart agricultural initiatives which becomes a global concern for adequate control on climate change. This statement of the problem resulted in outlining eight research questions which the study attempted to proffer answers to alongside with seven significant objectives and three hypotheses. The relevance and justification of the study was well expatiated in this chapter and the expected outcome of this research is to provide the necessary information for the policy makers as well as all agricultural stakeholders of the need to improve the competency of the extension agents on climate smart agricultural initiatives in the study area.

CHAPTER TWO

LITERATURE REVIEW, THEORETICAL AND CONCEPTUAL FRAMEWORK

2.1 Introduction

This chapter focuses on the reviews of existing knowledge and contributions from past researches. The items reviewed include climate change and its effects on Nigerian Agriculture, concept of competency and competency in extension services, factors determining competency of extension agents, Climate Smart Agricultural Initiatives, competency of extension agents in Climate Smart Agricultural Initiatives, Borich Need Assessment Model and the Conceptual framework for the study.

2.2 Climate change and its effects on Nigerian Agriculture

Weather is simply defined as the atmospheric condition at a particular time or place in which temperature, wind, precipitation and others are the parameters being measured with and climate change is referred to as the changes in average weather condition which persist over several decades at least 30 years or more (Dielh *et al.,* 2017). It is a constant deviation from the monitored values of these parameters and the consequences of these changes include global warming, frequent hurricanes, droughts, varying intensities of temperature and floods (Uguru, *et al.*, 2011). Globally, climate in the extreme is predicted to be common and its effect is on all sectors, that is, agricultural, social, economic, energy and health sectors. Its impact on agriculture and land use has an adverse implication for food security and livelihood in Nigeria (Mustapha *et al*, 2012). Nigerian agriculture, like in other parts of the sub-Saharan region, are vulnerable to climate change impacts and this is due to the fact that agricultural production in Nigeria is dependent on weather and climate (Ifeanyi-obi *et al.,* 2012) The changes in climate are as a result of human activities and also the composition of global atmosphere over a period of time (Mustapha *et al* 2012) and the poor and rural dwellers who have limited access to resources that can combat the effect of climate change are the ones who mostly feel the impact.

In Nigeria, the effect of climate change is not only seen on crops planted but also on the lives of people and the overall development of the country. Effects such as changes in food security, decrease in crop yield and decrease in income and economic growth push the country towards poverty (Ifeanyi-Obi, 2012). Over the years, fluctuations in the condition of climate change such as temperature precipitation can either be beneficial or detrimental to agriculture depending on the location, soil condition, type of crop grown and other factors (Dielh et al., 2017; Asseng et al., 2013). Variation of climate change has led to some devastating state in various sectors especially agriculture such as flooding, drought, desertification, soil and wind erosion, heat stress and rise in sea level, incidence of pest and diseases, decrease in the yield of crops and many others. Increase in temperature reduces soil moisture availability which ultimately affects the length of the growing season and the yield of crops thereby adversely influencing farming output right from cultivation to harvest time and posing a great threat to food security in Nigeria (Ozor & Nnaji, 2011; Ifeanyi-obi et al., 2012). The impact of climate change is reality in all countries and its distribution varies among various regions, class, income group and occupation (Iwuchukwu & Onyeme, 2012). The relationships between climate change and agriculture are interrelated in that contribution from agricultural sector like land cover, emission of greenhouse gases and farming system and general agricultural practices which reduce the sustainability of an ecosystem causes climate change and also climate change affects agricultural productivity and the factors aiding production such as water availability and soil fertility (Porter, 2014; Tripathi & Mishra, 2016).

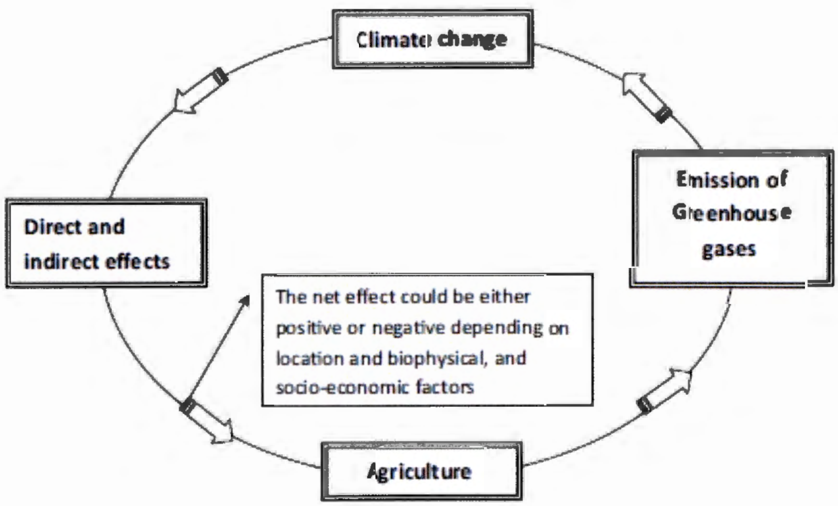


Figure 1: Interrelationship existing between climate change and agriculture

Source: Tripathi and Mishra, 2016

2.3 Climate Smart Agricultural Initiatives

Climate change affects agriculture negatively most especially food production which leads to a decrease in food availability (FAO, 2014) and this poses a significant threat to the country's food security agenda and due to this, Climate Smart Agricultural Initiatives towards agricultural practices have to come in play, in mitigating and adapting to the unfavourable effects of climate change.

According to Mc Carthy et al., (2012), the word SMART in climate smart agriculture is an acronym derived where S- specific, M-measures, A- achievable, R- reliable and T- Timely which makes it an approach in agricultural development ensuring it as the appropriate key to sustaining agricultural productivity, building resilience (adaptation) and carbon sequestration and reducing greenhouse gases (mitigation) as well as enhancing national food security goals. (Wollenberg et al., 2011; Terdoo & Adekola, 2014; FAO, 2010; World Bank, 2012; AGRA, 2014).

According to IPCC (2007), "adaptation is an adjustment in human or natural system in response to expected climate effects which help in moderating harm or even exploit beneficial opportunities. Adaptation is further classified into anticipatory, autonomous and planned. Anticipatory adaptation is a proactive type of adaptation which takes place even before the impacts of climate change are noticed; autonomous adaptation is the ecological changes which occur naturally while planned adaptation is the deliberate decision based on the awareness of a change in climatic condition." Adaptation can be described as the adjustments in practices or structures as a way of responding to the changes caused by climate either projected or actual (Ifeanyi-Obi, et al, 2012). IPCC (2007), stated that "adaptation is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects which moderates harm or exploits beneficial opportunities". On the other hand, climate change mitigation refers to actions taken by man to reduce climate change or green house effects.

Adaptation at the farming level is in two (2) stages, the first stage is to perceive the change in climate and the other is to decide the adaptation strategy to use in preventing the farmland from being affected (Tessema, 2013). Adaptation is seen as a development of management practices and viable method of reducing vulnerability associated with the negative impacts of climate change and this method enables farmers or affected community to cope or adjust to it.

Some of these methods include change in tillage practices, selection of varieties with greater drought and heat tolerance, implementation of improved Integrated Pest Management (IPM) among others (Jones, 2010; Fraisse et al., 2009). Research on adaptive strategies becomes a necessary tool to combat climate change as it threatens food security. It is therefore important for agriculture to consciously reduce its contribution to greenhouse gases production which is estimated at about 31% of the world's greenhouse gases emission (Elum et al., 2016; FAO, 2015)

The impacts of climate change is often felt by the rural dwellers and in dealing with this, extension agents need to target both the famers and the rural dwellers and the adaptive initiatives to be employed have to be at the low cost and the knowledge has to be easily accessed for quick acceptance of these initiatives by these rural dwellers (Timmerman et al., 2011). These adaptive initiatives increase resilience and reduce vulnerability of the effect of climate change which positively helps farmers in achieving their aim in terms of income, productivity and food security in the face of climatic condition (Otitoju & Enete, 2016) and this initiative process has to be facilitated by the extension agents in order to enhance adaptation and to sustainably increase agricultural productivity (Sala et al., 2016).

Climate Smart Agricultural Initiatives provide basics for scaling up technologies and practices that are proven for crop, livestock, fisheries, forestry and aquaculture production along sustainable agricultural value chain (AGRA, 2014). In order for Africa to be transformed significantly in addressing the challenges of climate change on food security, agricultural production systems must be well equipped and be more resilient in tackling the effect of climate change. This transformation includes the effective management of natural resources and initiatives as well as efficient use of these initiatives for production. The purpose of these initiatives is to promote sustainable agriculture through series of mitigation and adaptation initiatives. These initiatives include:

2.3.1 Water Management Initiatives

A major consequence of climate change is variations in precipitation distribution and as the effect of climate change increases, the initiatives on water management also need to be more properly planned out. Extreme weather such as high rainfall intensity leads to flooding and also water runoff on farmlands leading to the destruction of crops and the incidence of pests and diseases. These problems have to be curbed through the application of initiatives such as construction of drainage system and culvert and putting sand bags by the river banks to avoid water from flowing into the farm. Initiatives such as construction of artificial lakes, storage of water in ponds and construction of irrigation dams will be efficient in the case of drought (Fosu-Mensah, Vlek & MacCarthy, 2012). Agricultural productivity is driven by the availability of water as rain-fed agriculture remains the predominant agricultural practice in Sub Sahara Africa and the impact of climate change on its supply, quantity, and distribution requires efficient water management (AGRA, 2014).

2.3.2 Soil management Initiatives

Proper soil management is very important when finding solution to risks of climate change on farm lands. Agricultural productivity level has been declining over the years due to several unsustainable farming methods and activities like repeated ploughing and practice of mono-cropping and also burning of residues thereby depleting the soil (AGRA, 2014). Initiatives such as contour cropping across hills, planting of trees (afforestation), lengthened fallow, mulching practices, planting of cover crops and farm fragmentation should be effectively adopted and practised so as to conserve the soil and thereby mitigating the effect of climate change on farmlands. Agro- forestry initiative which is the integration of compatible trees and non-tree crops or animal on the same farmland for maximum beneficial interaction (AGRA, 2014) helps in soil nutrient improvement as it serves as a nutrient pump that brings nutrients that are deep in the ground for the crops and it reduces water run-off as it serves as mulch which subdues weed growth (Zougmore et al., 2016). Agroforestry initiative greatly contributes to the prevention of soil erosion, helps in water infiltration and also increases soil fertility and yields when planted with Nitrogen-fixing leguminous trees like Faidherbia albida. Adoption of agroforestry initiative prevents forest degradation and reduces greenhouse gases emission thereby increasing biomass above the ground and in the soil and they also help create carbon sinks (Garrity, 2010; FAO, 2013).

Afforestation Initiative improves the soil, helps prevent soil erosion and also increases biodiversity (Wojcik et al., 2014; Hobbs & Govaerts, 2010). The practice of mulching on farmlands also helps protect the soil from excess temperature and evaporation losses (Singh & Grover, 2013). Crop rotation and cover crops planting initiatives help in increasing soil organic matter.

2.3.3 Tillage Smart Initiatives

The major farm operation practised by most farmers include extensive land clearing and ploughing which has greatly led to severe degradation of farm lands and low yields of crops. Tillage smart initiatives to be adopted in the case of tillage practices include the practice of zero/minimum tillage, farm fallowing practice, the use of organic manure and changes in the tilling of land preparation activities as these initiatives help in increasing productivity, effectively manage resource base as well as help in greenhouse gases (GHG) reduction. These initiatives also help in organic matter build up in the soil as well as giving room for a healthy ecosystem. Zero/minimum tillage practices improve soil moisture capacity, manage agro-ecosystems for improved productivity, reduce disruption of soil aggregate structure and also conserve soil structure for related macrospores like earthworms (Singh & Grover, 2013). Tillage smart initiatives help in building up soil organic matter and its moisture capacity thereby increasing the effective use of water resources in the soil and farm fallowing also helps the soil regain its nutrient thereby improving the yield of crops (Nyong et al., 2007).

2.3.4 Fossil smart Initiatives

Initiatives such as processing of crop in order to reduce post-harvest losses, use of crop residue retention practices and the practice of forage conservation should be employed in order to curb the risk caused by fossil burning (AGRA, 2014) as fossil burning or residue burning exposes the soil and thereby makes it prone to erosion. These initiatives will help in carbon sequestration thereby reducing greenhouse gases emission which poses a great threat in climate change. Climate-smart agricultural initiatives on land management practices such as conservation agriculture, mulching and crop residue management , mixed crop-livestock farming and integrated soil fertility management sustainably increase productivity, strengthen resilience, and also contribute to the mitigation of climate change thereby reducing greenhouse gas emissions and sequestering carbon on farmlands (FAO, 2010; World Bank, 2012; Beddington, 2013: Hobbs & Govaerts, 2010; Braimoh et al., 2013). Furthermore, proper management of trees and crops as in the practices of agro-forestry, ensures full integration between the two components thereby ensuring improved soil fertility and also reduces soil erosion.

2.3.5 Crop-mix Initiatives

Initiatives on crop-mix are very important in order to improve productivity in agriculture even when affected by climate change. Initiatives of the use of crops that are drought, heat, pest and disease resistant should be adopted as this will help farmers in adapting to crop issues that have exposed them to climate risk due to climate change. As part of coping with the variability in climate, changes in planting depth of seeds and seedlings is an important initiatives to be adopted in subduing the effect of climate change on farm lands as it ensures increased availability of soil moisture for proper growth of the seedlings. Other initiatives such as mixed farming, use of crop rotation and the initiative of crop diversification should be practised as these will help farmers to be profitable even in climate risk condition (Mustapha et al., 2012; Braimoh et al., 2013). Mixed farming initiative is an improved integration system whereby crops and livestock systems are practised on the same farmland. This integrated crop and livestock system helps in the environmental sustainability and also increases production efficiency of both practices. Both practices benefit from each other as the waste of one serves as a resource for the other system, which means the manure from the livestock nourishes the soil thereby increasing crop production and on the other hand, the crop residue and by-products from the crops feed the animals (FAO, 2013).

Furthermore, increase in agricultural productivity requires technologically improved initiatives in crop yields. Agricultural biotechnology stands out as a promising tool in the development of crop varieties and traits that help in the mitigation and adaptation to climate change which has improved crop yields and has also reduced the intensity of input such as fertilizers and pesticides on farm lands. Adoption of new varieties and traits such as tolerance to drought, heat, pest and early maturation to shorten the growing season help reduce farmers' exposure to extreme risk of climate change (Lybbert & Summer, 2010; Mustapha et al., 2012).

2.3.6 Agro-weather/ ICT Initiatives

Variability in weather due to climate change perpetually affects farmers and their productivity and therefore, initiatives such as the availability of a reliable weather forecast which is an improved form of informing farmers as regards climate change must be made available.

Climate improved information through global monitoring and forecasting is an important initiative for agricultural adaptation to climate change which will help farmers respond timely to slow onset weather events such as drought and other climate variability by planting appropriate crop varieties and engaging in other climate resistant farm practices (Mude et al., 2009; Lybbert & Summer 2010; Mustapha et al., 2012). The Nigerian Meteorological Agency (NIMET) need to constantly relate with the extension services in helping them disseminate proper and timely information to farmers thereby improving their adaptation strategy as risk prone farmers find it difficult to invest in new agricultural practices because of the unexpected change in climate that can ruin their investment and therefore, assurance of weather forecast from the extension agents whom they rely on will enable them invest more in agricultural practices. Furthermore, introduction of specific and affordable insurance system can help safeguard farmers' products and can also improve farmers' capacity in adapting to climate change. Therefore, building adaptive and mitigation capacity involves developing skills, knowledge, attitude, resources and measures that reduce vulnerability and increase the resilience of farmers, farming communities and the ecosystem (Mustapha et al., 2012; Dimelu et al., 2014).

To effectively transfer information on these climate change adaptation and mitigation initiatives and meeting the increasing demand of climate change, there is need for high level of skills and requisite competence by extension agents. This will help them to effectively be able to provide the much needed climate change advisory services to farmers as successful extension service delivery has been pointed out to be highly dependent on the competence of extension agents on various agricultural initiatives and practices (Umar et al., 2018; Oladele & Tekena, 2010).

2.4 Competency in Extension services

According to Laki et al., (2014), Competency is the application of knowledge, technical skills and personal characteristics designed around individual abilities for an effective job performance. It is also an attribute of skills in the delivery of desired results (Fox et al., 2013; Bartram, 2002). Competency in the concept of an excellent extension service delivery is dependent on the capability of an extension agent to display knowledge and skills in communication, human relation, leadership, monitoring, evaluation, extension programme planning and implementation and service delivery effectively (Wasihun et al., 2013; Cochran, 2009; Laki et al., 2014). Agricultural system and practices change across the globe and so also the information in sustaining these practices becomes more needed by the farmers and this put pressure on extension agents in becoming more skilful and knowledgeable in the general discharge of their duties (Suvedi & Kaplowitz, 2016). Extension agents need to demonstrate competencies in their organizational skills and individual skills or capabilities beneficial to the organization, themselves and their clients in response to these changes.

Competency in extension is the skills and traits in which the extension agents possess and demonstrated in human relation, leadership, programme development, delivery, monitoring and programme evaluation (Wasihun et al., 2013; Khali et al., 2008). Success of extension services lies in the ability of the extension agents in being proficient in the needed competencies and this is measured by the ability of these agents to transfer knowledge, skills and information to their clients who are mostly farmers (Laki et al., 2014). Extension competencies should be based on need that is prioritized and developed into the training plan to prevent time and resource wastage (Okwoche et al., 2011). All the above listed responsibilities require extension agents in acquiring and developing competencies in different areas most especially on climate smart initiatives so as to perform optimally.

An effective extension service delivery requires highly competent extension officers in producing excellent result and an excellent result entails extension agents' ability in combining local experience and science based knowledge in providing solutions both in formal and informal ways to farmers (Oladele, 2015; Timmerman, 2011). It is essential for extension agents to be competent in the discharge of their duties so as to maintain their relevancy and this competency depends solely on their quality of skills and attitude towards their duties (Gombe et al., 2015).

Competency in technical subject matter, management, leadership, programming, human relations and communication areas are greatly needed as an attribute to be successful extension agents (Laki et al., 2014) to enable them adapt to the changing environment and meeting the immediate need of the populace. Capacity building of extension agents entails helping farmers recognize and use local and scientific knowledge to sharpen their experimental skills to improve their thinking and problem solving abilities (Sala et al., 2016). The development and the implementation of an extensive and structured programme need to be provided in changing the low qualification and competence of extension agents as competency involves extension officials possessing personal capabilities and building technical expertise in their specialty in meeting the needs of farmers (Ghimire & Martins, 2011; Oladele, 2015).

The basic requirement of extension agents being competent is in the proper and effective execution of their job and responsibilities which include; effective dissemination of agricultural innovations and technologies, design and implementation of programmes and training beneficial to the farmers and the whole community, having good understanding about the people and their culture, ability to maintain a peaceful relationship with the farmers, ability to implement programmes and activities with little or no supervision, possess the ability to use appropriate educational design to respond to farmers' needs, ability to apply adult learning principles to extension education and training and having the ability to convey messages clearly and effectively to farmers (Suvedi & Ramjee, 2015; Laki et al., 2014; Ghimire & Martin, 2011; Oladele, 2015; Okwoche et al., 2011).

2.5 Basic Core Competencies in Extension systems

Several authors have developed and explained competencies in all job functions and itemised various core competencies applicable to different job groups most especially to extension agents and specialists for effective service delivery to their clients. Competency of a professional is an act of performing duties in a standard and effective way. Professional competence is seen as an integrated and internal capability of delivering an effective performance in problem identification and solving in a particular task situation. Competencies in extension systems can be described as the basic knowledge, skills, behaviour and attitudes that contribute to excellence in the discharge of duties in extension education programmes (Mulder, 2011; Batram, 2005; Boyatzis, 1982; Mulder, 2014; Aimzhan et al., 2015 and Spencer & Spencer, 1993).

The core competencies as itemized by Mulder, (2011); Batram, (2005); Boyatzis, (1982); Mulder, (2014); Richard & David, (2004); Aimzhan et al., (2015) and Spencer, (1993) are;

Educational Programming: this is the ability to plan, design, implement, monitor and evaluate extension education programmes that will improve the livelihood of extension learners. Richard & David, (2004); Ghimire,2016

• *Engagement: this is the ability to recognize, understand, and facilitate opportunities and resources that best respond to the needs of individuals and the communities at large.* Aimzhan et al., 2015

• *Organizational Management: this is the ability to plan structure, organize processes, develop and monitor resources for a positive and effective programme output.* Spencer & Spencer, 1993; Mulder, 2014

• *Professionalism: this is the demonstration of attitudes that reflect high levels of performance, a strong work ethic, and commitment to the mission, vision, and goals of Extension systems.* Mulder, 2014; Richard & David, 2004; Ghimire, 2016

• *Technical subject matter expertise and Information Delivery: this is to take mastery of various communication skills (such as written, verbal and non-verbal), application of technology, and delivery methods for supporting extension educational programmes and monitoring behavioural change among extension learners.* Boyatzis, (1982) Richard & David, (2004); Aimzhan *et al.*, (2015); Ghimire 2016

• *Community and Social Action Processes: These refers to the ability to identify and monitor issues and values that are of great importance to the community such as socio-economic characteristics, human services and the economy of the community and still be able to plan and prioritize programmes around these values in ensuring excellent extension service delivery.* Boyatzis, (1982) Richard & David, (2004); Ghimire 2016

• *Diversity/Multiculturalism: it is the awareness, commitment, and ability to include self-perception as well as others' different perceptions, assumptions, norms, beliefs, and values.* Boyatzis, (1982) Mulder, 2011

• *Interpersonal Relations: this is the ability to successfully interact with diverse kinds of individuals and groups in order to create partnerships, networks, and dynamic and stable human systems.* Boyatzis, (1982) Mulder, 2011 ; Richard & David, (2004

•*Organizational Knowledge: this entails a perfect understanding of the history, philosophy, and contemporary structure of extension system.* Richard and David, 2004

• *Leadership: this is the ability to positively influence the decisions and actions of a wide range of individuals and groups.* Richard & David, (2004); Ghimire, 2016

• *Subject Matter: this is the mastery of a scientific discipline, a research body of knowledge, and other technical proficiency that enhance individual and organizational effectiveness.* Boyatzis, (1982) Mulder, 2014;

2.6 Factors determining competency of Extension agents

Determinants of the competency of extension agents on climate change, its adaptation strategies and other agricultural practices have been well documented by researchers in literature. It is evident from these researches that the competencies of extension agents are affected by many variables. Some of the socio-economic factors influencing the competency of extension agents on climate issues in relation to studies carried out in different places were reviewed in this section.

According to Dimelu (2016), in a study carried out in Anambra State, Nigeria, it was found that the position of extension agents in the organization as well as their years of experience in extension service are important determining factors of their knowledge and competency on climate change adaptation strategies. The reason being that the position of extension agents determines their job description and their degree of interaction with farmers who are their clients and the study therefore recommended that extension agents should be properly trained and involved in extension activities and workshops so as to sustain their knowledge throughout their service year.

Also, Umar et al., (2018) in their study revealed the interrelationships that exist between extension agents' competency on climate change issues and job performance. The research results revealed that the age of the agents had a negative significant influence on their competence and job performance while their years of experience significantly and positively influenced their competence and job performance. The study therefore recommended that extension agents should be trained on climate change adaptation initiatives in order to improve their performance and also, younger extension personnel should be recruited.

A study in South Africa also explored the factors influencing the knowledge of extension officers on climate smart organic agricultural practices (Oladele & Tekena, 2010). Climate smart initiatives include a lot of organic agricultural practices such as minimum tillage, crop rotation, cover cropping, mulching, composting and so on. They described the importance of organic agriculture in mitigating the effect of climate change by giving a long-term ecological health to soil, water, air and landscape for a sustainable agricultural development.

Their research results revealed that gender, age, educational level, job location, sources of information and working experience were significant determining factors of extension agents' knowledge on climate smart organic agricultural practices. The study recommended the implementation of sustainable educational and training policy for extension agents on climate smart related organic agricultural practices so as to enhance their knowledge and competence.

Furthermore, Zikhali (2016), in his study revealed that the educational level and years of experience of extension agents are key significant determinants of their competency in the dissemination of climate change adaptation information. He further explained that the educational level of extension agents reflects in their knowledge on programmes and agricultural related issues thereby positively affecting their service delivery and that extension agents with longer years of experience were more likely to have received climate change training, which would have a direct increase on their competency level. He therefore recommended re-training of extension agents on the changing nature and dynamics of climate change in order to avoid any shortfall in their knowledge and competency.

Oladele (2011), in his research paper examined the "*Knowledge levels and perceived effect of climate change on extension delivery in North West Province, South Africa*". He pointed out that knowledge is a major predictor of the competence and involvement of extension agents in climate change issues and programmes. Result of his findings shows that the socio-economic characteristics of extension agents such as educational level, studying for higher degree and living in job location are important factors determining the knowledge level and ultimately their competence on climate change issues. He recommended an upgrade in new skill sets, services and delivery methods by the extension agents in order to tackle the problems caused by climate change effectively.

Laki et al., (2014) also indicated in their study that age and years of experience were significant determinants of the overall competency level of extension agents in North Carolina. An implementation of in-service educational programmes with special attention to new extension agents was recommended in the study. In addition, knowledge of extension agents is a basic characteristic that influences extension agents' competence and service delivery and, according to the research contribution of Bahua et al., (2016), skills and knowledge were identified as factors influencing the competency of extension agents in Province Gorontalo, Indonesia.

More so, *Dimelu* et al. (2014) in their research revealed the constraint factors influencing the dissemination capacity of extension professionals on climate change adaptation and mitigation strategies. He pointed out that training, capacity building and adequate funding are key influencers to acquiring relevant competencies by the extension agents in terms of knowledge, proper management and dissemination of information on climate change adaptation and mitigation strategies. They therefore recommended training and swift responsiveness of extension agents to climate change issues and the implementation of policies to ensure the availability of fund in extension organization. In the same vein, Catherine et al., (2015) and Agbamu (2011) also alluded to the fact that sustainable funding is necessary to aid successful extension service delivery most especially on climate change and its adaptation strategies.

Dimelu et al., (2014) pointed out that access to climate change adaptation and mitigation technologies and information is also a very crucial factor in the building of the competency of extension agents. According to them, an immediate action from both government and private sector for valuable information on climate change related issues was recommended to be made available to extension agents as this will help them have first-hand technical knowledge on climate change, its risk and how it is being mitigated. Similarly, Meera et al., (2012) revealed that access to adequate and timely information by extension agents is a major factor that will influence their competency in handling climate change related vulnerability issues.

Also, Catherine et al., (2015) in their research stated that the quality of training given to extension agents highly determines their competency and performance in the discharge of their advisory service duties on climate change issues. More so, Okwoche et al., (2011), Gombe et al., (2015) and Ifeanyi-Obi et al., (2012) added that adequate and timely training on climate change, the effect and initiatives to combat it is a key determinant of the functional competency of extension agents in effectively teaching farmers to leverage on the right initiative to solve their climate change related problems.

2.7 Theoretical Models for the study

In this study, the following theories and models were reviewed in relation to the synthesis of literature to explain the competency and competency needs of extension agents on climate smart agricultural initiatives. The theories/models reviewed are the model of effective job performance, theory of reasoned action, ASTD competency model and Borich need assessment model.

2.7.1 Model of Effective Job Performance

Model of effective job performance was postulated by Boyatzis (1982) and this model stated that competency encompasses the knowledge, skills, abilities and behaviours of an individual which allows the individual to perform assigned task within a specific function or job. The demand for effective and competent employees constantly increases in organizations due to increase in foreign and local competition which has compelled organizations to become more effective and flexible in response to the rapidly changing environment just like the case of climate change and its effect on agriculture (Boyatzis, 1982; Vichita & Jintawee, 2007). Therefore, human resources and other managerial board encourage competency development by forming opportunities within the organization for employees to develop their competencies for both their own benefit and the benefit of others (Rao, 2000a; Rodrigues & Chincholkar, 2005). Competency models help organizations to take a more unified and coordinated approach in improving organizational sectors such as job redesign, recruitment, organizational learning, career management, performance improvements and compensation systems (United Nations Industrial Development Organization, 2002). Model of Effective Job Performance specifies that effective action and performance will occur when all three of the critical components which are organizational environment, job demands and the individual's competencies are constant. This in the same way means that the inconsistence of any of these components with each other automatically results in ineffective behaviour and incompetency. Therefore, the intent of ensuring effective job performance by extension agents on climate smart agricultural initiatives is dependent on their knowledge and competency in the dissemination of these initiatives to farmers.

2.7.2 Theory of Reasoned Action

The theory of reasoned action was postulated by Ajzen & Fishbein (1980) with the aim of identifying behavioural intensions of persons. They posited that behavioural intentions which are precursors to real behaviour are dependent on the significance of information and beliefs that acting or performing a particular behaviour leads to a certain or expected result. These behavioural precursors are in two sets, which are behavioural beliefs and normative beliefs. The behavioural beliefs influence an individual's attitude towards performing a task and normative beliefs influence the directive or subjective norm of an individual in performing a particular task (Madden et al., 1992). Therefore, information or the individual's significant beliefs affect their attitude and subjective norm which make their intention to be greatly influenced (Otieno et al., 2016). Hence, the intent of the extension agents building their capacity and getting involved in the dissemination of climate smart agricultural initiatives to the rural dwellers for adoption is greatly influenced by their attitudes, beliefs and knowledge.

2.7.3 ASTD Competency Model

The American Society of Training and Development developed a competency model for the training and development profession in which extension services profession is included. The model is called 'The ASTD Competency Model redefined to capture changes driven by digital, global and economic forces in the skills and knowledge of the professionals' (Rothwell et al., 2013). The model is segmented into 3 tiers, the lowest tier is the foundational competencies, the second tier is the training and development areas of expertise and the top tier is the role or execution level. The foundational competencies such as interpersonal skills, effective communication skills, personal development, global mindset, analysing and proposing solutions, strategic thinking, business management skills, adaptability demonstration skills and technology literacy are basic competencies relevant for successful performance of extension professionals. Foundational competencies serve as the bedrock upon which training and development areas of expertise and role competencies are built. Training and development area of expertise is a higher level of competency above foundational competencies and give detailed and specified duties of what extension professionals are expected to do. These areas of expertise are coaching, organizational knowledge and change management, career planning and talent management, performance improvement, learning impact evaluation and training delivery. The topmost tier known as the successful execution stage is the broad area of responsibility which requires effective involvement of the attributes of foundational competencies and Area of expertise for successful execution of duties (Rothwell et al., 2011; Mulder, 2014).

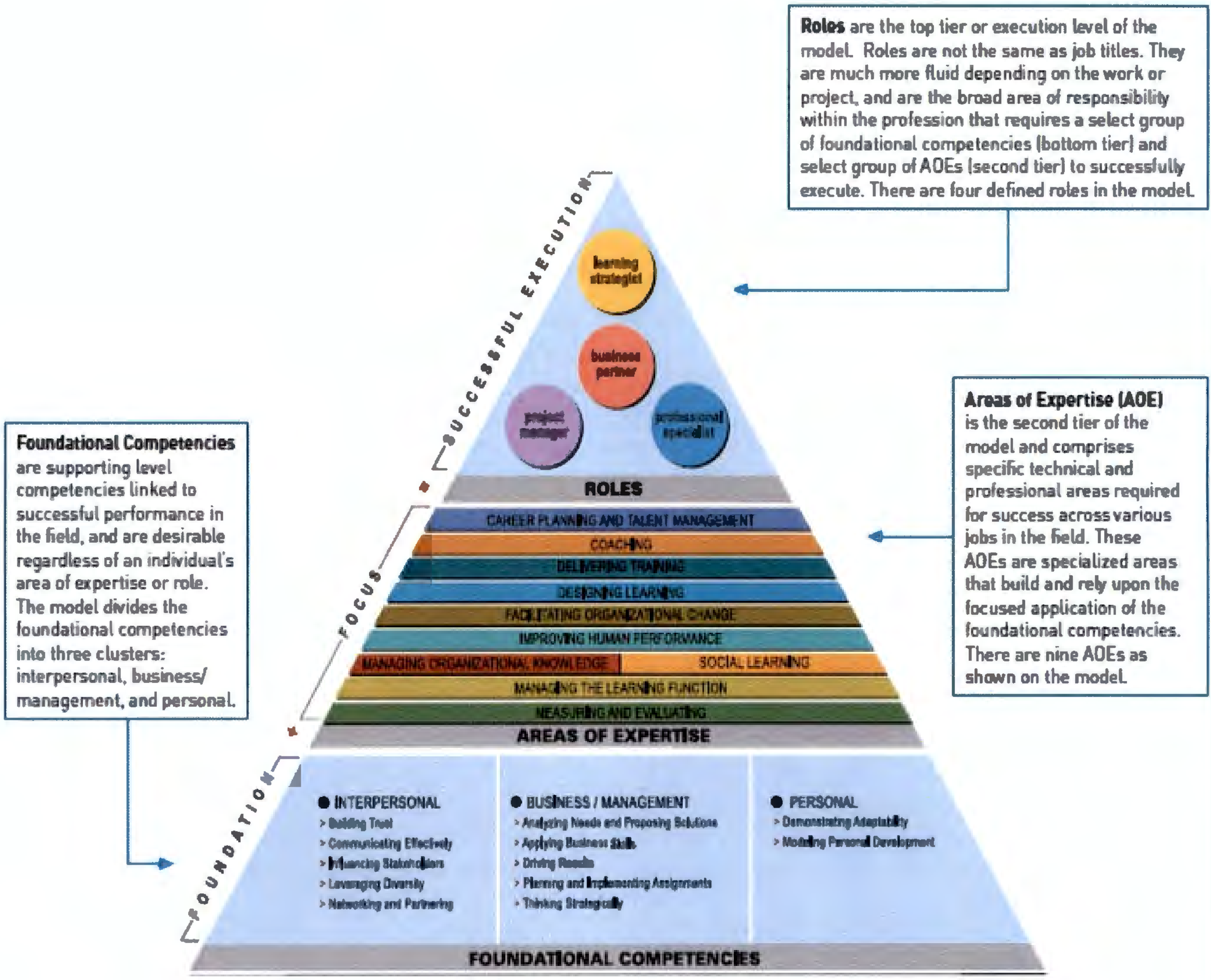


Figure 2: ASTD Competency Model

Source: Rothwell et al., 2013.

2.7.4 Borich Needs Assessment Model

The model of need assessment to be utilized in this study to assess the competency needs of the extension agents is the Borich Needs Assessment Model. Borich needs model is a comprehensive model that is used to assess the training needs of agricultural educators (Conklin et al., 2003). Needs assessment as stated by Borich is the gap between the required performance of agricultural educators and what presently exists. It gives insight to the current situation of extension agents' competence and the ideal situation (Borich, 1980). These gaps are described by Borich as discrepancies. The model utilizes the self-assessment and professional judgment of extension agents to evaluate their ability by relying on their aspects of importance. The model has a higher accuracy of assessing the competency needs of extension agents as it allows the respondents to express their educational and training needs indirectly and the areas where they need training are then determined through mathematical calculations by carrying out a discrepancy analysis using the mean weighted discrepancy scores (Goli et al., 2013; Borich, 1980). This computation involves a comparison between the level of importance rating of the extension agents (relevance of each competency item to the job function) and the ability to perform (level of attainment of each competency).

Several researchers have successfully conducted the needs assessment of school educators and agricultural extension agents in order to determine their in-service competency/training needs using the Borich needs assessment model.

Roberts et al., (2015) adapted the Borich model to determine the training needs for food security among Trinidad Food Producers and its implication for extension. The model helped in identifying the top five food security issues among the producers and this provided a research-based guide for extension programming and policy makers in the area.

Harder et al., (2013) utilized the Borich model to assess the extension officers' self-perceived programming competencies in selected Caribbean countries. Borich model was used to identify the areas of priority training needs and this was predominantly in the areas of programme planning and evaluation. The formulation of cost-effective and accessible professional development resources was recommended. Also, Harder et al., (2009) utilized the Borich model to assess the teaching competency of agricultural and life sciences lecturers at the University of Florida. The areas of needs identified by the study provided insight for more focused professional development of lecturers.

In addition, other researchers such as Lu & Miller (2002) have leveraged on the Borich model to determine the top instructional technology educational needs among vocational teachers and Mudukuti & Miller (2002) used the Borich model to determine the factors related to Zimbabwe Women's educational needs in Agriculture. The model was used to identify the top 16 educational needs for priority intervention among the respondents.

In the same vein, Lopokoiyit et al., (2013) made use of the Borich model to assess the extension management competency needs of agents in Kenya. He recommended the design of relevant in-service courses in agricultural programmes based on the management competencies with the highest training needs.

Furthermore, Alibaygi & Zarafshan (2008) used the Borich model to evaluate the in-service training needs of extension agents on sustainability in Iran. Barrick (2011) assessed the Egyptian agricultural educator's ability to implement experiential learning activities also with the use of the Borich needs assessment model. Black (2014) utilized the Borich model of needs assessment to determine the specific in-service training needs of extension agents in Moldova. The use of professional networks to enhance programmes was identified as the greatest need for training. Finally, Oladele (2015) was able to prioritize the most prominent competencies to which there is need for training among extension officers in South Africa using the Borich needs assessment model.

The Borich Need Assessment model (Borich, 1980) relies on identifying areas where employers needed training by carrying out a discrepancy analysis using the mean weighted discrepancy scores. This involves comparing the difference between the two extreme positions of what is (measuring the behaviours, skills and competencies of the extension agents) and what should be (the goals of the programme).

The use of a mean weighted discrepancy score (MWDS) is computed for each of the competencies by the application of the following statistical procedures:

i. The difference between the importance rating and the ability rating (competency) of each competency is to be calculated to generate the discrepancy score (DS)

ii. The discrepancy score is then multiplied by the mean importance rating to generate the weighted discrepancy score (WDS) of each competency given.

iii. The sum of the weighted discrepancy scores divided by the number of observation is then used to compute the MWDS for each of the competencies.

The higher the Mean Weighted Discrepancy score MWDS, the greater the competency need. (Oladele, 2015; Elhamoly, Koledoye & Kamel, 2014; Borich, 1980).

The model is shown thus:

$$\text{MWDS} = [(Iith - Cith) \times X_i / \text{N}] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (1)$$

Where, I = importance rating for each item

C = competency rating for each item,

X_i = mean of the importance rating

N = number of observations

2.8 Synthesis of the models and theories

The model of effective job performance is related to competency of extension agents on climate smart agricultural initiatives in the sense that due to the rapidly changing environment and the environmental competition imposed on farmers and their agricultural produce, there is the constant increased demand for extension organizations and administrators to constantly assess the knowledge, skills and abilities of extension agents on climate smart agricultural initiatives so as to ensure they are well-positioned and competent enough to effectively perform their task of ensuring that farmers are well informed on climate resilient practices to adopt to effectively compete and combat the pressures imposed on them by climate change and that is what this study is set to achieve.

The theory of reasoned action points out that individual behavioural intention is determined by attitude and subjective norms. The theory applies to the study in the sense that the behavioural intention of extension agents in getting involved in building their competence and in disseminating climate smart agricultural initiatives to farmers is greatly determined by their perception of its usefulness, attitude, beliefs and knowledge of those initiatives.

The American Society of Training and Development competency model emphasizes that the competency of extension professionals is in stages. The model, in line with this study, points out the need to continuously examine and upgrade the competency of extension professionals in the face of economic and global changes such as that instigated by climate change. It highlights extension professionals having the right foundational skills and knowledge about climate change and its adaptation strategies. It further emphasizes that this needs to be followed by more in-depth training and development to ensure their capability in effectively executing and performing their role of rendering rural advisory services to farmers on climate smart agricultural initiatives.

The Borich needs assessment model is a comprehensive model that seems to best suit the holistic framework of this study. It does not just focuses on assessing the competency of extension agents but it also goes further to identify the topmost areas of competency needs of the agents. The model utilizes self-assessment and professional judgement to point out the areas of discrepancies that need to be filled. The model adopts some mathematical calculations to more accurately determine the competency and areas of competency needs of extension agents by carrying out a discrepancy analysis to generate a mean weighted discrepancy score from comparison between the level of importance rating and competency of the extension agents.

An analysis of reviewed literatures indicates that the Borich needs assessment model has been utilized several times to determine the competency/training needs of extension agents and the comprehensiveness and robustness of the model from all the reviewed theories and model is very evident. This gives the needed assurance for this study to leverage upon using the Borich needs assessment model to determine the competency of extension agents on climate smart agricultural initiatives in South Western Nigeria.

2.9 Conceptual framework for the study

To place the reviewed literature in the context of this study in terms of the variables, interrelationships and analysis as well as juxtaposing the different theories and models related to this study, a conceptual framework was developed. The framework of this study is divided into three basic segments which are described as independent, dependent and intervening variables.

According to the synthesized diagram, the independent variables are the extension agents' socio-economic characteristics such as age, gender, marital status, educational level, household size and years of experience in the extension profession. These socio-economic characteristics are capable of influencing the competency of extension agents on climate smart agricultural initiatives. The knowledge level of extension agents and their involvement in disseminating climate smart agricultural initiatives is as a result of their sources of information and are all functions of the socio-economic characteristics of the extension agents. Also, the constraints the extension agents encounter affect their competency level on climate smart agricultural initiatives. All these variables are analyzed in this study and the ways they relate with each other are all based on the socio-economic characteristics of extension agents.

The dependent variable in this study is the competency of extension agents on climate smart agricultural initiatives. These competencies are categorized under Water initiatives, Tillage-smart initiatives, Fossil burning reduction initiatives, Crop-mix initiatives, Soil initiatives and ICT/ Agro-weather initiatives. The competency scale was rated on three-point Likert type scale of high (3), moderate (2) and low (1) and also with the use of the rating scale, the actual mean was 2 and a mean greater than two shows high competency level and a mean lesser than 2 shows low competency in climate smart agricultural Initiatives. This then led to the analysis of the competency need of the extension agents on climate smart agricultural initiatives using the Borich needs model in order to identify the areas of improvement to be made for an effective and efficient climate smart extension and advisory service delivery.

There are intervening variables that have indirect effects on the competency of extension agents on climate smart agricultural initiatives. These include the pre-service training needed by the extension agents before the proper extension work starts; in-service training which helps the extension agents to evaluate themselves and also to improve on their competency level; organizational factors and other extension stakeholders have their role to play in the competency needs of extension agents and the government who are in charge of facilitating policies and programmes that have impact on the sector and the extension agents. All these intervening variables relate with each other and are present in the interface of the direct relationship that exists between the dependent and independent variables.

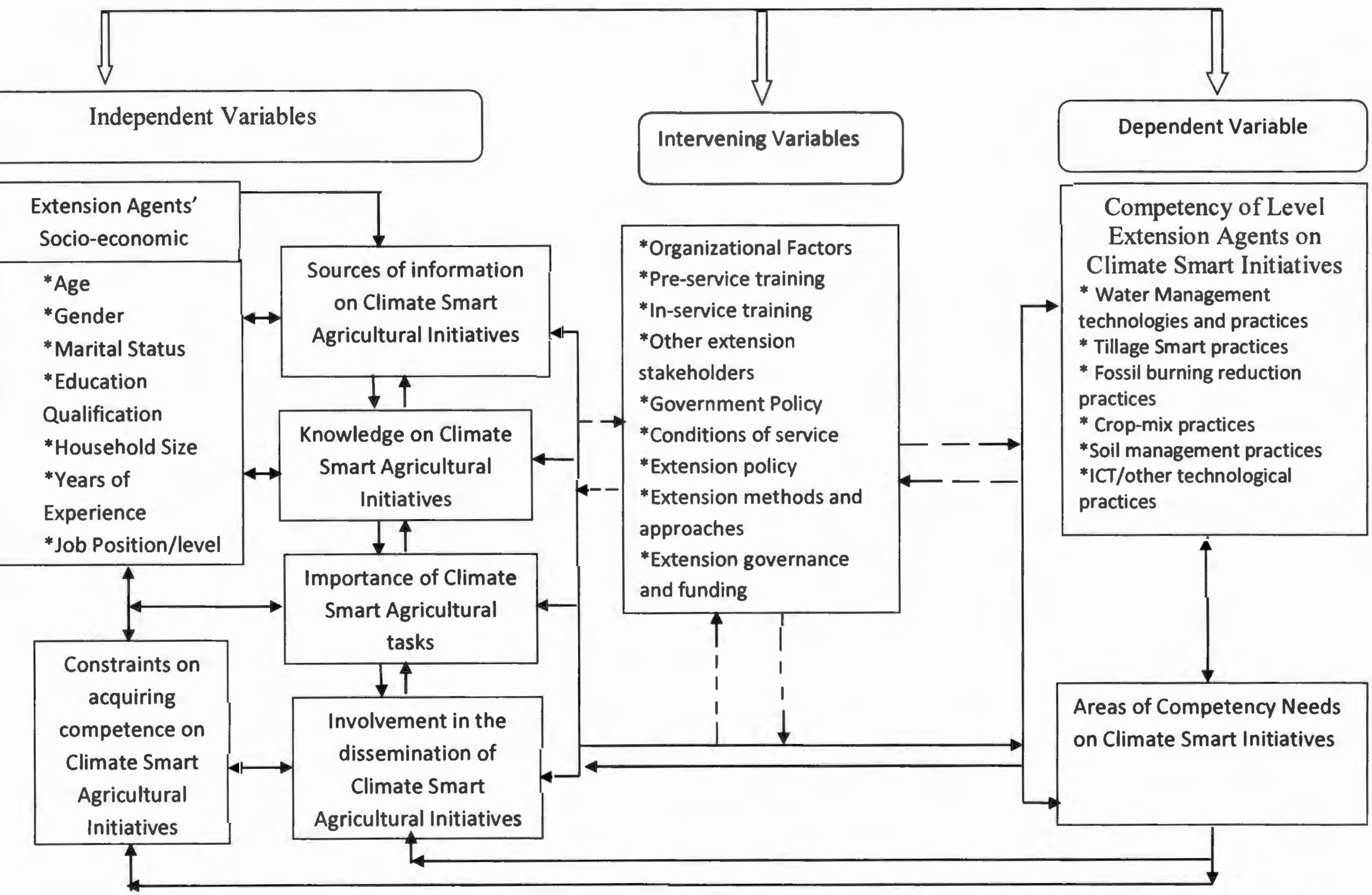


Figure 3: Conceptual Framework on Competency level of extension agents on Climate Smart Agricultural Initiatives in South Western Nigeria

Source: Author's Concept, 2017.

2.10 Chapter Summary

This chapter focuses on the reviews of literatures on the concepts of climate change, its effects on global and specifically Nigerian Agriculture. The study also explained in detail the concept of climate smart agricultural initiatives as an approach in dealing with climate change which further explained the competency of extension agents in extension services. Furthermore, theories related to the study were fully discussed in this chapter including Theory of reasoned action, Model of effective job performance, the ASTD competency model and Borich needs assessment model. This chapter was concluded with a detailed conceptual framework for the study which was considered from the reviewed theories and models.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study Area

This study was carried out in south west geo-political zone of Nigeria located in West Africa. This geo-political zone consists of six (6) states which are Ondo, Ogun, Oyo, Lagos, Ekiti and Osun States. These six (6) states comprise 85 ethnic groups speaking 250 dialects across 300 communities (NPC, 2006). This zone has a high concentration of agricultural activities and agricultural institutions (Adebayo & Oladele, 2014). It comprises five (5) agro-research institutes, five federal Universities involved in agro-research and State ADPs. This area has two (2) distinct seasons, these are rainy season (April-October) and dry season (November – March) and temperature ranges between 21 degree and 28 degree centigrade with high humidity. The agricultural sector forms the base of the overall development thrust of the zone. The area lies between 5 degrees and 9 degrees North and longitude 2 degrees and 8 degrees East. It is bounded by the Atlantic Ocean in the South, Kwara and Kogi states in the North, Eastern Nigeria in the East and Republic of Benin in the west. The land area of this zone is about 114,271km square representing 12% of the country's total land areas. Agricultural activities, salary and wage earning jobs and other off-farm income generating activities are the major means of livelihood in the area. The farmers in the area are known for the cultivation of staple crops, fruits, vegetable and tree crops. They are also involved in livestock activities such as extensive goat and sheep production, fish farming and backyard poultry production.

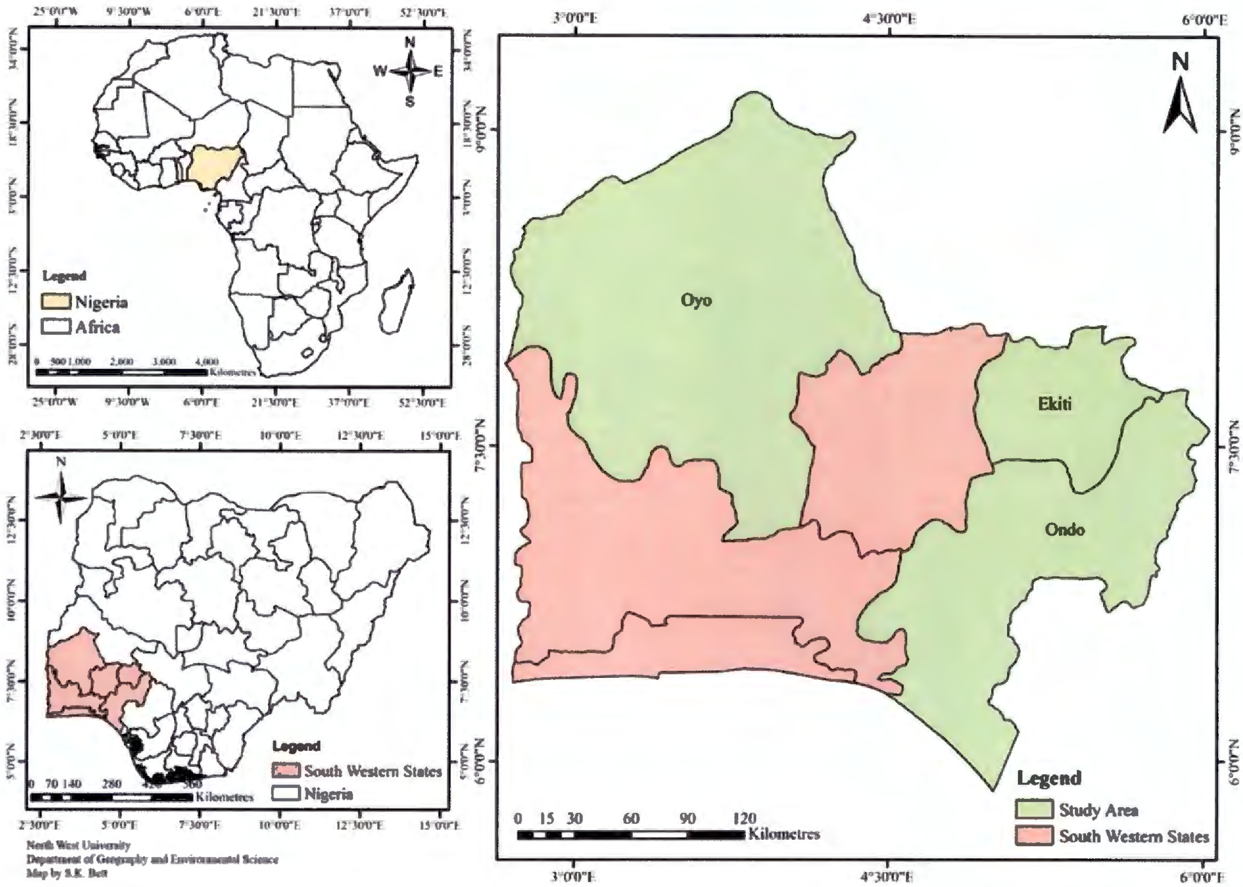


Figure 4: Map of Africa, showing Nigeria, the Southwestern region and the Study area (inset: Map of Africa; Map of Nigeria)

Source: Author, 2017

3.2 Population of the Study

The population of the study comprise the frontline extension agents in the South Western part of Nigeria in public extension agencies. The main public extension organizations in South Western Nigeria are referred to as Agricultural Development Programme (ADP), semi-autonomous from the Ministry of Agriculture. The administrative structure of the ADP is led by the director of extension services who supervises the frontline extension personnel of different cadre all saddled with the responsibility of reaching out directly to the farmers at different levels. The total number of frontline extension agents in the South Western part of Nigeria as obtained from the various State ADPs extension departments is Six hundred and sixty two (662).

3.3 Sampling Procedure and Sample Size

A two (2) stage sampling procedure was employed in the selection of the extension agents in the study. Firstly, a random selection of three (3) states in the zone where extension activities were prominent based on the information obtained from the various states ADPs was utilized. The selected states were Oyo, Ekiti and Ondo. The second stage was a random selection of extension agents in Oyo, Ondo and Ekiti states i.e 104 extension agents were selected in Oyo state, 102 extension agents from Ondo state and 71 extension agents from Ekiti state gotten through the utilization of the Raosoft sample size calculator. The Raosoft sample size calculator is used in determining the total number of respondents to sample from a known population and it calculates based on the utilization of a 5% margin of error and a 95% confidence interval level. Based on the summation of the respondents from the three states, the total number of respondents sampled for the study was two hundred and seventy seven (277) extension agents (EKSADP, 2017; LSADA, 2016; ODSADEP, 2017; OGADEP, 2016; OSADEP, 2016; OYSADEP, 2017).

Table 1: Respondents distribution and sample selection in the study area

	1st stage Random Sampling		2nd Stage Random sampling using Raosoft Calculator
States in South Western Zone	**Selected States**	**Number of Extension Agents**	**Number of Extension Agents Selected (Sample Size)**
Ogun		106	
Ekiti	**Ekiti**	**86***	**71**
Lagos		90	
Ondo	**Ondo**	**137***	**102**
Osun		102	
Oyo	**Oyo**	**141***	**104**
Total			**277**

*Selected State ADPs

Source: Authors Computation, 2016.

3.4 Data Collection

3.4.1 Instrument for Data Collection

Data were obtained with the use of structured questionnaire and the survey instrument was made up of seven (7) sections with each focusing on the objectives of the study.

Section A - Socio-economic characteristics: Questions based on the socio-economic characteristics of the respondents were asked in this section.

The variables were measured as follows:

Age: The actual age of the respondents in years as at the last birthday was obtained.

Gender: Respondents were asked to indicate whether they were male which was coded 1 or female which was coded 2.

Marital Status: Respondents were asked to indicate their status out of the following scales; married (1) and (0) if otherwise

Number of Children: Respondents were asked to state the number of their children.

Household size: respondents were asked to indicate the number of persons they reside with in the same house and with whom they share foods and other basic household utilities.

Educational qualification: Respondents' literacy level was measured on the scale of Secondary School Certificate (1), Certificate of College of Agriculture (2), OND (3), HND (4), Bachelor Degree (5), Masters Degree (6), Ph.D.(7).

Participation in Climate Smart Training: Respondents were asked whether they have participated in any climate smart agricultural related training coded as 1 if Participated and 0 if otherwise.

Years of working experience in extension service: Respondents were asked to indicate how long in years they have been in the extension service.

Average Annual Income: Respondents were asked to state their average annual income in naira.

Living in job location: Respondents were asked whether they live in their job location and this was measured as 1 if Yes and 0 if otherwise.

Number of communities: Respondents were asked to state the number of communities they cover.

Average distance to farmers: respondents were asked to state the average distance they travel in kilometres from their office to their farmer's location.

Background: respondents were asked to indicate their background and this was coded as 1 if rural and 0 if otherwise.

Section B - Sources of Information Used: In this section, the utilization of information sources on climate smart agricultural initiatives was asked from the respondents on a Yes (1) and No (0) basis and then their frequency of usefulness was rated on a 3-point Likert-type scale of frequently used (3), Sometimes used (2), not used (1). A mean score of 2 was used to identify the most frequent information sources used by the respondents.

Information Sources	Yes	No	Frequently Used	Sometimes Used	Not Used
Agricultural research Institutes					
Extension Publications and Bulletins					
Forth-night Training Sessions					
Immediate Supervisor					
Internet					
Journals					
Local Business Organization					
Local news Agencies					
On-the Job specialized trainings					
Other Extension agents/colleagues					
Personal Quest for Knowledge					
Radio					
Seminars/Conferences/Workshops					
Television					
Local meteorological station					

Section C - Knowledge Level of Extension Agents on climate Smart Agricultural Initiatives: In this section, extension agents' knowledge level on Climate Smart Agricultural Initiatives was measured on various categories of initiatives namely: Water Management Initiatives, Tillage Smart Initiatives, Fossil Burning reduction Initiatives, Soil Initiatives, Crop-Mix Initiatives and ICT/ Other technological Initiatives. A total of 45 items relating to climate change adaptation and mitigation initiative items that extension agents were supposed to be knowledgeable about was presented to the respondents. They were asked to indicate whether these statements were true or false using a 2 point scale of true (2) and false (1) and their knowledge score was determined.

The following techniques can be adopted to adapt & mitigate the effect of climate change

Climate Smart Agricultural Initiatives	True	False
Water Management Initiatives		
Construction of water storage in ponds		
Utilization of drainage systems on farm lands		
Use of Flood irrigation		
Use of Drip irrigation		
Use of Canal irrigation		
Construction of artificial lakes		
Construction of water channels on farmland		
Water Harvesting		
Use of sandbag by river bank		
Tillage-Smart Initiatives		
Zero/minimum tillage practices		
Farm Fallowing		
Changes in planting dates/harvesting dates		
Mechanical weeding		
Use of herbicides		
Land use change		
Use of soil amendments		
Use of organic manuring		
Fossil Burning reduction Initiatives		
Use of Crop residue		
Forage conservation		
Practice of soil blanketing		
Conversion of waste to compost		
Soil Initiatives		
Contour cropping across hill slopes		
Afforestation/ reforestation		
Lengthened fallow		
Use of mulching		
Planting of cover crops		
Farm fragmentation		
Agro-forestry such as Alley cropping		
Land reclamation		
Zero grazing		
Tree planting		
Crop-Mix Initiatives		
Mixed farming		

Changes in planting depth of seeds and seedlings.		
Use of crop rotation		
Use of inter cropping		
Crop diversification		
Drought resistant varieties		
Early maturing varieties		
Pest resistant varieties		
ICT/ Other technological Initiatives		
Use of weather forecasts		
Timely dissemination of weather information to farmers through ICT		
Online internet access of climate related information		
Agro meteorology information		
Use of Resources conservation technologies		
Farm insurance		

Section D - Involvement in the dissemination of Climate Smart Agricultural Initiatives: The involvement of extension agents in the dissemination of Climate Smart Agricultural Initiatives was measured on the various categories of initiatives itemized in the study namely; Water Management Initiatives, Tillage Smart Initiatives, Fossil Burning reduction Initiatives, Soil Initiatives, Crop-Mix Initiatives and ICT/ Other technological Initiatives. A total of 45 items relating to climate change adaptation and mitigation strategies was presented to the extension agents to know if they are involved in the dissemination of these agricultural initiatives and their responses were graded as Yes (1) and No (0).

Are you involved in the dissemination of any of the following techniques as adaptation and mitigation strategies for climate change? Kindly tick the appropriate column below.

Climate Smart Agricultural Initiatives	**Involved: Yes**	**No**
Water Management Initiatives		
Construction of water storage in ponds		
Utilization of drainage systems on farm lands		
Use of flood irrigation		
Use of Drip irrigation		
Use of Canal irrigation		
Construction of artificial lakes		
Construction of water channels on farmland		
Water harvesting		
Use of sandbag by river bank		

Tillage-Smart Initiatives		
Zero/minimum tillage practices		
Farm Fallowing		
Changes in planting dates/harvesting dates		
Mechanical weeding		
Use of herbicides		
Land use change		
Use of soil amendments		
Use of organic manuring		
Fossil Burning reduction Initiatives		
Use of crop residue		
Forage conservation		
Practice of soil blanketing		
Conversion of waste to compost		
Soil Initiatives		
Contour cropping across hill slopes		
Afforestation/ reforestation		
Lengthened fallow		
Use of mulching		
Planting of cover crops		
Farm fragmentation		
Agro-forestry such as Alley cropping		
Land reclamation		
Zero grazing		
Tree planting		
Crop-Mix Initiatives		
Mixed farming		
Changes in planting depth of seeds and seedlings.		
Use of crop rotation		
Use of inter cropping		
Crop diversification		
Drought resistant varieties		
Early maturing varieties		
Pest resistant varieties		
ICT/ Other technological Initiatives		
Use of weather forecasts		
Timely dissemination of weather information to farmers through ICT		
Online internet access of climate related information		
Agro meteorology information		
Use of Resources conservation technologies		

Farm insurance		

Section E - Competency Level on Climate smart agricultural initiatives: The dependent variable for the study examined the competency level of the extension agents on climate smart agricultural initiatives. Analysis of the competency level of the extension agents on climate smart agricultural initiatives were determined by using their responses to different climate change adaptation and mitigation initiative items. A total of 45 items relating to climate change adaptation and mitigation initiative items that extension agents were supposed to know and possess ability to disseminate was presented to the respondents. The climate smart initiatives addressed ranged from water management initiatives which include: drainage construction initiatives, irrigation initiatives, water conservation initiatives; tillage-smart initiatives: zero/minimum tillage initiatives, fallowing initiatives, organic soil amendments initiatives, direct seeding initiatives; soil initiatives: cover crop initiatives, contour cropping initiatives, farm fragmentation initiatives, agro-forestry initiatives, resource conservation initiatives; Crop-mix initiatives: drought and pest resistant initiatives, crop diversification initiatives, seed planting depth initiatives, crop rotation initiatives; ICT weather forecast and advisories initiatives, Fossil smart initiatives; afforestation initiatives, forage conservation initiatives and carbon sequestration initiatives. Respondents were asked to rate these climate smart initiatives on a three-point Likert type self-rating competency scale of High (3), Moderate (2) and low (1). The overall Competency Score of the respondents was determined from a range of 45 being the lowest competency score level to 135 being the highest competency score possible. From their responses, the extension agents were then classified using the mean score as a benchmark into whether they have a low competency for those below the mean and a high competency for those above the mean climate smart agricultural initiatives.

Section F – Competency needs on Climate Smart Agricultural Initiatives: The areas of competency/training need of the respondents were determined by adopting the Borich Needs assessment model. The Borich Need Assessment model (Borich, 1980) relies on identifying areas where the extension agents needed training by carrying out a discrepancy analysis using the mean weighted discrepancy scores. This involved comparing the difference between the two extreme positions of what is (measuring the behaviours, skills and competencies of the extension agents) and what should be (the goals of the programme). A comparison was made between the perceived level of importance attached to the climate smart initiatives by the extension agents and their perceived level of competence on these initiatives. The importance scale was rated as follows: High (3) Moderate (2) and Low (1). With the use of rating scale, the actual mean was 2 and thus a mean greater than 2 shows high importance and a mean less than 2 shows low importance of climate smart agricultural initiatives. The competency scale was also rated as stated earlier on three-point likert scale of high (3), Moderate (2) and low (1) and also with the use of the rating scale, the actual mean was 2 and a mean greater than two shows high competency level and a mean lesser than 2 shows low competency in climate smart agricultural Initiatives.

The use of a mean weighted discrepancy score (MWDS) was computed for each of the competencies by applying the following statistical procedures:

i. The difference between the importance rating and the ability rating (competency) of each competency was calculated for each respondent to generate the discrepancy score (DS)

ii. The discrepancy score was then multiplied by the mean importance rating to generate the weighted discrepancy score (WDS) of each competency for the respondents.

iii. The sum of the weighted discrepancy scores divided by the number of observation was then used to compute the MWDS for each of the competencies.

The model is shown thus:

$$\text{MWDS} = [(Iith - Cith) \times X_i / \text{N}] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

where I = importance rating for each item; C = competency rating for each item, X_i = mean of the importance rating; N = number of observations. The 45 competencies were then ranked using the computed MWDS (Oladele, 2015; Elhamoly, Koledoye & Kamel, 2014; Borich, 1980).

The higher the Mean Weighted Discrepancy score MWDS, the greater the competency need of extension agents on Climate Smart Agricultural initiatives.

Kindly rate the importance of skills required and your competency level in the dissemination of climate smart Initiatives on a 3-point scale of High (3), Moderate (2) and Low (1).

Skill required in Climate Smart Agricultural Initiatives	**Importance**			**Competence**			**Competency needs MWDS = (summation of importance – competence)**
	High	**Moderate**	**Low**	**High**	**Moderate**	**Low**	
Water Management Initiatives							
Construction of water storage in ponds							
Utilization of drainage system on farm lands							
Use of Flood irrigation							
Use of Drip irrigation							
Use of canal irrigation							
Construction of artificial lakes							
Construction of water channels on farmland							
Water harvesting							
Use of sandbag by river bank							
Tillage-Smart Initiatives							
Zero/minimum tillage practices							
Farm Fallowing							
Changes in planting dates/harvesting dates							
Mechanical weeding							
Use of herbicides							
Land use change							
Use of soil amendments							
Use of organic manuring							
Fossil Burning reduction Initiatives							
Use of Crop residue							
Forage conservation							
Practice of soil blanketing							
Conversion of waste to compost							
Soil Initiatives							
Contour cropping across hill slopes							
Afforestation/ reforestation							
Lengthened fallow							
Use of mulching							
Planting of cover crops							

Farm fragmentation							
Agro-forestry such as Alley cropping							
Land reclamation							
Zero grazing							
Tree planting							
Crop-Mix Initiatives							
Mixed farming							
Changes in planting depth of seeds and seedlings.							
Use of crop rotation							
Use of inter cropping							
Crop diversification							
Drought resistant varieties							
Early maturing varieties							
Pest resistant varieties							
ICT/ Other technological Initiatives							
Use of weather forecasts							
Timely dissemination of weather information to farmers through ICT							
Online internet access of climate related information							
Agro meteorology information							
Use of Resources conservation technologies							
Farm insurance							
Use of irrigation							

Section G - Constraints faced in the acquisition of needed competencies on climate smart agricultural initiatives: Respondents were asked to indicate from a list of items the severe constraints militating against their acquisition of needed competencies on climate smart agricultural initiatives rated first as Yes (2) or No (1) and then further rated on a 3-point Likert-type scale of Very severe (3), Severe (2) and Not severe (1).

Indicate the constraints faced in the acquisition of needed competencies on Climate smart agricultural initiatives in your area.

Constraints	**Yes**	**No**	**Very Severe**	**Severe**	**Not Severe**
Poor access to knowledge and information on new technologies about climate change					
Inadequate information on climate change initiatives					
Inadequate training on equipment for monitoring weather variations					
Poor working environment					
Weak/poor linkages between extension and meteorology institutions					
Inadequate mobility of staff					
Lack of climate change subject matter specialist					
Insufficient time					
High personal cost in acquiring competencies on climate smart agricultural techniques					
Lack of training resources on climate smart agriculture					
Inadequate organizational support in acquiring knowledge on climate smart agricultural initiatives					
Inadequate inclusion of climate smart agricultural strategies into training curriculum					
Lack of training incentives such as funding for acquiring competencies on climate smart agriculture					

3.5 Validity and Reliability of Instrument

3.5.1 Validity of the Instrument

Validity is the extent to which a concept is measured accurately in any quantitative study (Heale & Twycross, 2015). The items constituting the instrument were first given to test by the experts in the Department of Agricultural Economics and Extension of the North West University South Africa for proper scrutiny, appropriateness and applicability as well as checking both the content and face validity. The modified draft was then given to the supervisor who finally modified and approved for use after certifying its suitability and applicability.

3.5.2 Reliability of the Instrument

Reliability is to test the consistency of the instrument. A pre-test of the instrument was carried out in Osun State using the Split-half method of reliability. A high reliability coefficient of 0.85 was obtained which indicated proper consistency of the instrument which is according to Kuder & Richardson (1937), who stated that an instrument with a reliability co-efficient of 0.85 and above is highly consistent and reliable (Heale & Twycross, 2015).

3.6 Data Analysis

The data obtained were analysed using descriptive statistics such as frequency counts, percentages, means and ranks. Inferential statistics such as Tobit regression model and Structural Equation Modelling using Confirmatory Factor Analysis were used in the study. Tobit regression was used in analysing hypothesis one while Structural Equation Modelling (Confirmatory Factor Analysis) was used to analyse hypothesis two.

3.6.1 Model Specification

The various models used in the analysis of the objectives and hypothesis were Tobit regression, and Structural Equation Modelling using Confirmatory Factor Analysis and are specified below.

3.6.1.1 Tobit Regression Model

Tobit regression model was used to assess the factors influencing the competency level of extension agents on climate smart agricultural initiatives in hypothesis one. The model was chosen because of its ability to model variables that have either a left or right censoring in the dependent variable (Tobin, 1958) such as we have in the generated competency scores for the respondents which was used directly without categorization as the dependent variable in the model.

The Tobit model is presented as:

$$Y^{*} = X_i\beta + \varepsilon \quad \text{...} \quad (2)$$

Where:

Y^* is the dependent variable, which is the competency level of the extension agents (Using their Competency scores directly),

β is a vector of unknown coefficients,

X_i is a vector of independent variables,

ε is an error term that is assumed to be independently and normally distributed with mean zero and a constant variance of S^2.

Y^* is a latent variable that is unobservable and it is only observed as a continuous variable when the data of the dependent variable is above the limiting factor, zero in this case. If Y is at the limiting factor, it is held at zero. This relationship is presented mathematically in the following equations:

$$Y = Y^* \text{ if } Y^* > Y_0 \quad \text{..} \quad (3)$$

$$Y = 0 \text{ if } Y^* \leq Y_0 \quad \text{..} \quad (4)$$

where Y_0 is the limiting factor. These two equations represent a censored distribution of the data. The expected value E_y of the extent of competency level of extension agents on climate smart agricultural initiatives is given as

$$E_y = X_i\beta\, F(z) + \sigma\, f(z) \quad \text{..} \quad (5)$$

where

X_i is the vector of explanatory variables

$F(z)$ is the cumulative normal distribution of z f(z) is the value of the derivative of the normal curve at a given point (the unit normal distribution)

z is given as $X\beta / \sigma$

B is the vector of Tobit maximum likelihood estimates whose coefficient sign will indicate the direction of influence or effect

σ is the standard error of the model

Table 2: Description of the Independent Variables used in Tobit Analysis

Variables	Description
Y	Competency level of extension agents measured as a continuous variable using their Competency score directly
Gender	Measured as a dummy variable 1 for male, 0 if otherwise
Marital Status	Measured as a dummy variable 1 for married, 0 if otherwise
Religion	Measured as a dummy variable 1 for Christianity, 0 if otherwise
Household Size	Measured as number of persons (continuous)
Participation in Climate Smart Training	Measured as 1 if yes and 0 if otherwise
Educational Qualification	Measured as 1 for qualification of high formal education ranging from Ordinary National Diploma and above and 0 if otherwise
Years of Experience	Measured in years (continuous)
Job level	Measured as 1 for Extension agent and 0 if otherwise
Living in Job location	Measured as a dummy variable 1 for Yes, 0 if otherwise
No. of Community Covered	Measured as number of community (continuous)
Distance Covered	In Kilometers (continuous)
Rural-Urban Background	Is measured as a dummy variable 1 for rural, 0 if otherwise
Knowledge	Measured as 1 for High Knowledge, 0 if otherwise
Involvement	Measured as 1 for Involved, 0 if otherwise
Importance	Measured as 1 for important, 0 if otherwise
Sources of Information	Measured as 1 for Utilized , 0 if otherwise
Constraints	Measured as 1 for severe, 0 if otherwise

Source: Author Computation

3.6.1.2 Structural Equation Modelling (Confirmatory Factor Analysis)

Structural Equation Modelling with the use of Confirmatory Factor Analysis approach of IBM AMOS version 24 was used to determine the hypothesized model of the inter-relationship that exists between the extension agents' constructs of knowledge, involvement and importance of climate smart agricultural initiatives and their competency level on climate smart agricultural initiatives. This tool is used specifically to evaluate the effects among measured variables and latent variables. Measured variables represent and serve as indicators of each latent variable (Tutkun, Lehmann & Schmidt, 2006). Three items of knowledge, involvement, importance and competency with the highest frequencies were measured/observed variables used as indicators of the constructs of knowledge, involvement and importance in the analysis.

The general CFA model in SEM notation is:

$$Xi = \Lambda X\ \xi k + \theta\delta \qquad \text{.. (6)}$$

where:

Xi = a column vector of observed variables; (i.e. 3 observed variables of knowledge, 3 observed variables of involvement, 3 observed variables of importance and 3 observed variables of competence)

ξk = ksi, a column vector of latent variables; (i.e. the four latent variables in the model which are knowledge, involvement, importance and competence)

ΛX = lambda, an i X k matrix of coefficients defining the relations between the manifest (X) and latent (ξ) variables; (i.e. the factor loadings revealing the relationship between the observed and latent variables)

$\theta\delta$ = theta-delta, an i X i variance/covariance matrix of relations among the residual terms of X (i.e. the error term loadings revealing the relationship between the residual terms of the observed variables)

For the model used in this study, the following set of structural equations defines the model:

$$X_1 = \Lambda X_1\ \xi_1 + \theta\delta_1 \qquad \text{.. (7)}$$

$X_2 = \Lambda X_2\ \xi_1 + \theta\delta_2$ .... (8)

$X_3 = \Lambda X_3\ \xi_1 + \theta\delta_3$ .... (9)

$X_4 = \Lambda X_4\ \xi_2 + \theta\delta_4$ .... (10)

$X_5 = \Lambda X_5\ \xi_2 + \theta\delta_5$ .... (11)

$X_6 = \Lambda X_6\ \xi_2 + \theta\delta_6$ .... (12)

$X_7 = \Lambda X_7\ \xi_3 + \theta\delta_7$ .... (13)

$X_8 = \Lambda X_8\ \xi_3 + \theta\delta_8$ .... (14)

$X_9 = \Lambda X_9\ \xi_3 + \theta\delta_9$ .... (15)

$X_{10} = \Lambda X_{10}\ \xi_4 + \theta\delta_{10}$ .... (16)

$X_{11} = \Lambda X_{11}\ \xi_4 + \theta\delta_{11}$ .... (17)

$X_{12} = \Lambda X_{12}\ \xi_4 + \theta\delta_{12}$ .... (18)

where:

X_1 = knowledge observed variable 1, X_2 = knowledge observed variable 2, X_3 = knowledge observed variable 3, X_4 = involvement observed variable 1, X_5 = involvement observed variable 2, X_6 = involvement observed variable 3, X_7 = importance observed variable 1, X_8 = importance observed variable 2, X_9 = importance observed variable 3, X_{10} = competence observed variable 1, X_{11} = competence observed variable 2, X_{12} = competence observed variable 3.

$\xi 1$ = Knowledge latent variable

$\xi 2$ = Involvement latent variable

$\xi 3$ = Importance latent variable

$\xi 4$ = Competence latent variable

$\Lambda X_{1\text{-}12}$ = factor loadings for each observed variable i.e. X_1.........X_{12}

$\theta\delta_{1\text{-}12}$ = error terms for each observed variable i.e. X_1.........X_{12}

3.6.1.3 Borich Needs Assessment

The areas of competency/training need of the respondents were determined by adopting the Borich Needs assessment model. The Borich Need Assessment model (Borich, 1980) relies on identifying areas where the extension agents needed training by carrying out a discrepancy analysis using the mean weighted discrepancy scores. This involved comparing the difference between the level of importance rating and the competency of the extension agents.

The use of a mean weighted discrepancy score (MWDS) was computed for each of the competencies by applying the following statistical procedures:

i. The difference between the importance rating and the ability rating (competency) of each competency was calculated for each respondent to generate the discrepancy score (DS)

ii. The discrepancy score was then multiplied by the mean importance rating to generate the weighted discrepancy score (WDS) of each competency for the respondents.

iii. The sum of the weighted discrepancy scores divided by the number of observation was then used to compute the MWDS for each of the competencies.

The model is shown thus:

$$\text{MWDS} = [(Iith - Cith) \times X_i / \text{N}] \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(1)}$$

where I = importance rating for each item;

C = competency rating for each item

X_i = mean of the importance rating

N = number of observations.

The higher the Mean Weighted Discrepancy score MWDS, the greater the competency need of extension agents on Climate Smart Agricultural initiatives.

3.7 Ethical Consideration

Ethical considerations were diligently observed by the researcher throughout the course of the research without any form of bias or discrimination. Confidentiality and anonymous status of the respondents was maintained throughout the research. There was no use of personal identifiers. Equal respect and treatment was given to every respondent and was adhered to. Verbal permission and consent were also obtained at every level of the research. The researcher ensured that the welfare of the respondents is paramount and that the research did not endanger the health or the interest of the respondents in any way.

3.8 Chapter Summary

The description of the study area and the research methodology adopted for this study was fully discussed in this chapter. Both descriptive and quantitative research designs were used to determine the competency of the extension agents on climate smart agricultural initiatives in the study area. Sampling technique, instrument for data collection used, data collection procedure as well as validity and reliability of the instrument were explained in details. A two-staged sampling procedure was used in the selection of 277 Extension agents in South Western Agricultural Development Programme (ADPs) offices and a well-structured questionnaire was used to elicit information from the respondents. Furthermore, the use of descriptive and inferential statistics was employed in analysing the data. The models used for inferential statistics include Tobit regression and Structural Equation Modelling (Confirmatory Factor Analysis) and were all fully explained in the chapter.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Introduction

In this chapter, results of the data analyses, research findings and their implications are discussed. The chapter is divided into eight sections which are based on the objectives of the study and the hypotheses of the study. Results in each section are discussed and the eight sections include the socio-economic characteristics of the extension agents in south western Nigeria, the sources of information used in acquiring knowledge on Climate Smart Agricultural Initiatives, their knowledge on Climate Smart Agricultural Initiatives, their involvement in the dissemination of Climate Smart Agricultural Initiatives, their competency level on Climate Smart Agricultural Initiatives, their competency needs on Climate Smart Agricultural Initiatives, the constraints faced in the acquisition of needed competencies on Climate Smart Agricultural Initiatives in the study area and the factors influencing the competency level of the extension agents in Climate Smart Agricultural Initiatives in the study area.

4.2 Socio-economic Characteristics of the Extension Agents

Findings relating to the socio-economic characteristics of extension agents are discussed in this section.

The findings from Table 3 show that a little above average (57%) of the respondents were within the age range of 40 years and below, 28.5% of them were within the age range of 41-50 years, while only a few (14.5%) of the respondents were 51 years and above. The mean age of the respondents was 40.22 years with a standard deviation of 8.58. This implies that extension agents in the South West region were young and economically active and this will have a positive influence on their performance. This supports Ale, Okogbue & Alfred (2016) who reported that extension agents in South West Nigeria were young and active. Also, Thomas & Laseinde (2015) agreed to the active capability of the extension agents in this zone. This is supposed to positively enhance their innovativeness and ensure the sustainability of extension processes on climate smart agriculture for increased productivity.

The results from Table 3 also show that majority (80.5%) of the respondents were males while the remaining (19.5%) were females. This shows an uneven distribution in the workforce across the study area as the field extension officers are predominantly men. This agrees with Edeogbon & Idele (2012) who also pointed out the paucity of female extension agents in Nigeria. This might be a problem in situations whereby culture or religion does not permit male extension agents to reach out and disseminate climate smart agricultural initiatives and other services to female farmers.

Furthermore, findings from Table 3 show that a greater portion (79.4%) of the respondents were Christians while 20.6% of the respondents were Muslims. This agrees with Thomas & Laseinde (2015) who reported a higher percentage of Christians' extension agents than that of the Muslims in Oyo State. This may be as a result of the fact that Christianity as a religion is more prominent in South West Nigeria as opposed to Islam which is much more prevalent in the Northern part of the country.

Results from Table 3 show that a greater percentage (80.9%) of the respondents were married while only a few of them (19.1%) were single. This implies that a greater portion of the respondents are expected to be responsible due to the fact that they have a family to look after and cater for. This result is in consonance with Kolawole & Oladele (2013) who stated that majority of the extension agents in the South West region of Nigeria were married and this ascertain that extension agents would be more committed in the discharge of duties and can be given positions of responsibility.

The findings from Table 3 reveal that majority (71.8%) of the respondents had between 1-4 children, 10.1% had between 5-8 children and the remaining respondents (18.1%) had no children. The mean number of children was 2 with a standard deviation of 1.72. This result agrees with Oladele & Mabe (2010), who reported the same for extension agents in South Africa. This attribute also portends the possibility of enhancing the teaching skills of extension agents who one way or the other would have been exposed to teaching and training of children and family members at the home front.

The results from Table 3 show that a little above average of the respondents (59.5%) had a household size of 5-8 persons, about one-third (37.9%) had a household size of 1-4 persons while only a few of the respondents (2.6%) had a household size of more than 8 persons. The mean household size is 5 persons with a standard deviation of 2.02. This is similar to the report of Oladele (2011) among extension agents in South Africa. This implies that extension agents in the study area have dependents and family responsibility ties, thus they need to be able to plan out their time to balance between their family and work responsibilities for effective and efficient service delivery.

The findings from Table 3 show that majority (92.5%) of the respondents had Higher National Diploma (HND) and above in level of education while very little (7.5%) had Ordinary National Diploma and College of agriculture qualification. The result is in support of Thomas and Laseinde (2015) and Tijani (2011) who ascertain that education is a basic prerequisite needed by the extension agents to improve their skills for better performance and an effective service delivery in Nigeria. This shows that extension agents in the south west were educated and are knowledgeable in the basics of Agriculture and climate change and this is in contrast to Anka (2016) who concurred to the perception of Nigerians that extension profession is for people of low qualification as many graduates with higher degrees chose extension as their profession.

Furthermore, the results from Table 3 show that a little above average (59.6%) of the respondents had no training in climate smart agricultural initiatives while the remaining (40.4%) have been privileged to participate in seminars (22.7%) and workshops (17.7%) on climate smart agricultural initiatives. This implies that majority of the extension agents have not been properly exposed to the requisite training needed for effective dissemination of climate smart adaptation and mitigation strategies to farmers which is urgently needed to tackle the threat of climate change in Nigeria. This is in consonance with Edeogbon & Idele (2012) who stated that extension agents in the southern region of Nigeria have not been exposed to adequate training on climate and environmental conservation. Okwoche et al., (2011) also ascertained that most of the extension agents in the North Central States had inadequate in-service training on climate change and other contemporary issues which is a major avenue for their capacity to be enhanced. Training as described by Chikaire et al., (2015), is used mostly for capacity building of agricultural extension agents in most developing countries in which training on climate smart agricultural initiatives should not be left out.

Also, findings from Table 3 reveal that majority (70.4%) of the respondents had 10 years and below extension experience while the remaining few (29.6%) had 11 years and above experience in rendering rural advisory services to farmers. The mean years of extension experience is 9.35 years with a standard deviation of 7.86. This conforms to Thomas and Laseinde (2015) who stated that majority of the extension agents in one of the States in the South Western region had worked for an average of 7 years. Adisa (2012) also reported that extension agents in Ekiti State had high years of experience in the extension service and Oladele (2011) stated that averagely high years of experience of extension agents in Africa are supposed to enhance their exposure and build their capacity for effective service delivery. This implies that extension agents in the study area have spent commendable years in service which is likely to have given them the privilege to be knowledgeable and practically exposed to several agricultural and climate related issues.

The results from Table 3 show that majority (83.8%) of the extension agents earn between N300,000-N899,000 while very few (16.2%) of them earn above N900,000 per annum. The average income per annum across the study area was N592,137.18. This is in consonance with the findings of Ale et al., (2016) who stated that majority of the extension agents in the South Western Nigeria earn between N500,000-N700,000. Due to the moderate level of income earned by the extension agents coupled with the fact that most have family responsibility ties, this may influence or tend to limit the level of finances they might be willing to invest in their personal quest for knowledge on CSAI.

The findings in Table 3 again shows that about one-third (30.7%) of the respondents were newly employed by the government in an ad-hoc programme called N-power, a little below average (44%) of the respondents were on job level 8-10 while 25.3% of the respondents were on job level 11 and above. The employment of young graduates into the extension sector in the current government youth empowerment scheme is an improvement in the sector that provides the opportunity to train more manpower for the effective dissemination of climate smart agricultural initiatives in the study area.

The results from Table 3 also reveal that majority (75.1%) of the respondents covered about 10 communities. This suggests the wide ratio gap that exists between the numbers of communities to be covered by few extension agents available. This might hinder the effectiveness of disseminating climate smart agricultural initiatives and rendering other rural advisory services to farmers in the area. This supports Ajayi (2013) who also pointed out the existence of a high extension-farmer ratio in Osun State, South West Nigeria.

Further results from Table 3 also reveal that majority (80.5%) of the extension agents lived in their job location while very few (19.5%) of the respondents lived outside of their job location. This implies that they reside in one of the communities among those covered. This is an impressive attribute that allows a higher number of extension agents to get acclimatized to the environment and familiar with their clients which in turn is supposed to effectively enhance their service delivery. This result is in agreement with Oladele (2011) who stated that majority of the extension agents in South Africa live in their job location and he concluded that extension agents' interaction with the farmers would be greatly influenced by the proximity of their location of residence to the farmers.

The findings from Table 3 show that more than half (57.0%) of the extension agents travelled about 10km across the communities they cover and are assigned to work while a little below average (43.0%) of the respondents travel for distances more than 10km. This suggests that extension agents in the study area have to travel for an averagely long distance across all the communities they cover before they can reach out to all their clients and they will need proper mobility for them to be able to render effective rural advisory services in the area they cover.

The results from Table 3 also reveal that majority (71.1%) of the extension agents had a rural background while only a few of them (28.9%) had an urban background. This implies that the rural background history of the extension agents enables them to have a first-hand information on the impacts of climate change to agricultural development in the rural areas making them better positioned to render appropriate and effective advice on the adaptation and mitigation strategies to employ in ameliorating the effect of climate change in the areas they are located. This supports the report of Oladele (2015) that about half of extension officers in North West, South Africa, have a rural background.

Table 3: Distribution of respondents according to their Socio-economic Characteristics

Characteristics	Frequency(%)	Mean(SD)
Age(Years)		
≤ 30	41(14.8)	40.22(8.58)
31-40	117(42.2)	
41-50	79(28.5)	
51-60	39(14.1)	
>60	1(0.4)	
Gender		
Male	223(80.5)	
Female	54(19.5)	
Religion		
Christian	220(79.4)	
Muslim	57(20.6)	
Marital Status		
Single	53(19.1)	
Married	224(80.9)	
No of Children		
0	50(18.1)	2(1.72)
1-4	199(71.8)	
5-8	28(10.1)	
Household Size		
1-4	105(37.9)	5(2.02)
5-8	165(59.5)	
>8	7(2.6)	
Educational Qualification		
College of Agriculture	2(1.4)	
OND	17(6.1)	
HND	135(48.7)	
B.Sc	106(38.3)	
M.Sc	14(5.1)	
Ph.D	1(0.4)	
Participation in CSA		
No CSA Training	165(59.6)	
Workshop	49(17.7)	
Seminar	63(22.7)	
Years of Experience		
≤10	195(70.4)	9.35(7.86)
11-20	51(18.4)	
21-30	31(11.2)	
Average Income		
300,000-599,000	162(58.5)	592137.18(284841.01)
600,000-899,000	70(25.3)	
900,000-1,199,000	27(9.7)	
≥1,200,000	18(6.5)	

Job Level		
N-Power	85(30.7)	
8-10	122(44)	
11-13	41(14.8)	
>13	29(10.5)	
Community Covered		
<10	208(75.1)	9.96(13.07)
11-20	43(15.5)	
21-30	16(5.8)	
31-40	2(0.7)	
>40	8(2.9)	
Living in Job Location		
No	54(19.5)	
Yes	223(80.5)	
Distance Travelled		
≤10	158(57.0)	15.34(15.87)
11-20	68(24.6)	
21-30	20(7.2)	
>30	31(11.2)	
Background		
Rural	197(71.1)	
Urban	80(28.9)	

Source: Field Survey, 2017.

4.3 Sources of Information used on Climate Smart Agricultural Initiatives.

This section shows the sources of information used by the extension agents on Climate Smart Agricultural Initiatives in the study area. The utilization of information sources on climate smart agricultural initiatives was asked from the respondents on a Yes (1) and No (0) basis and then their frequency of usefulness was rated on a 3-point Likert-type scale of frequently used (3), Sometimes used (2), not used (1). A mean score of 2 was used to identify the most frequent information sources used by the respondents.

The results from Table 4 reveal the mean scores of the frequently used information sources on climate smart agricultural initiatives by the Extension agents. Out of the 15 sources of information listed and presented to the respondents, majority (95.3%) of the extension agents prominently used Forth-night Training Sessions (FNTs) as their information source on climate smart agricultural initiatives as it was ranked 1st among the sources of information utilized with a mean score of $\bar{X}$ = 2.70, SD = 0.55. Other sources that were also prominently used by most of the extension agents on accessing climate smart agricultural initiatives related information were Immediate supervisor (80.2%) with a mean score $\bar{X}$ = 2.27, SD = 0.77, Extension publication and Bulletins (75.1%) with a mean score of $\bar{X}$ = 2.07, SD = 0.75, Radio (82.7%) with a mean score of $\bar{X}$ = 2.06, SD = 0.64, Seminar, Conferences and Workshop (83.0%) with a mean score of $\bar{X}$ = 2.03, SD = 0.60, Television (78.7%) with a mean score of $\bar{X}$ = 2.01, SD = 0.67 ranked 2nd, 3rd, 4th, 5th and 6th respectively while Personal quest for knowledge (74.3%) with a mean score of $\bar{X}$ = 2.00, SD = 0.72 and other extension agents(74.0%) also with a mean score of $\bar{X}$ = 2.00, SD = 0.72 both ranked 7th. This agrees with Ale *et al.* (2016) who reported that Trainings, Conferences and Seminar, Supervisor and Research stations were the most used sources of information by extension agents in South West Nigeria. Iwuchukwu & Onyeme (2012) also reported a similar trend in Anambra State located in the Eastern part of Nigeria. This implies that the utilization of information on Climate Smart Agricultural Initiatives from the sources listed will be of a great advantage to the extension agents as it will broaden their knowledge and skills on Climate Smart Agriculture thereby aiding their effective dissemination of these Initiatives to the farmers. Agricultural Extension Services need adequate information on climate change and climate Smart Initiatives to plan their activities well as better informed decision made by them can provide information that are need- based to the farmers (Ekpo & Ekpo, 2011).

Table 4: Respondents' distribution according to their Sources of Information used on Climate Smart Agricultural Initiatives.

Information Sources	Frequently used Freq(%)	Sometimes Used Freq(%)	Not Used Freq(%)	Mean(SD)	Rank
Agricultural Research Institutes	67(24.2)	121(43.7)	89(32.1)	1.92(0.75)	9th
Extension Publications and Bulletins	89(32.1)	119(43.0)	69(24.9)	2.07(0.75)	3rd
Forth-night Training Sessions	206(74.4)	58(20.9)	13(4.7)	2.70(0.55)	1st
Immediate Supervisor	129(46.6)	93(33.6)	55(19.9)	2.27(0.77)	2nd
Internet	58(20.9)	128(46.2)	91(32.9)	1.88(0.73)	10th
Journals	25(9.0)	116(41.9)	136(49.1)	1.60(0.65)	14th
Local Business Organization	27(9.7)	95(34.3)	155(56.0)	1.54(0.67)	15th
Local News Agencies	40(14.4)	130(46.9)	107(38.6)	1.76(0.69)	12th
On-the Job specialized trainings	59(21.3)	116(41.9)	102(36.8)	1.84(0.75)	11th
Other Extension agents/colleagues	71(25.6)	134(48.4)	72(26.0)	2.00(0.72)	7th
Personal Quest for Knowledge	71(25.6)	135(48.7)	71(25.6)	2.00(0.72)	7th
Radio	65(23.5)	164(59.2)	48(17.3)	2.06(0.64)	4th
Seminars/Conferences/Workshops	54((19.5)	176(63.5)	47(17.0)	2.03(0.60)	5th
Television	63(22.7)	155(56.0)	59(21.3)	2.01(0.67)	6th
Local meteorological station	33(11.9)	117(42.2)	127(45.8)	1.66(0.68)	13th

Mean Score derived from frequently used=3, sometimes used=2, not used=1

Source: Field Survey, 2017

4.4 Knowledge and Involvement of Extension agents in the dissemination of Climate Smart Agricultural Initiatives

The extension agents' knowledge level on Climate Smart Agricultural Initiatives as well as their involvement in the dissemination of the same was measured on various categories of initiatives in the study namely: Water Management Initiatives, Tillage Smart Initiatives, Fossil Burning reduction Initiatives, Soil Initiatives, Crop-Mix Initiatives and ICT/ Other technological Initiatives. A total of 45 items relating to climate change adaptation and mitigation initiative items that extension agents were supposed to be knowledgeable about were presented to the respondents. They were asked to indicate whether these statements were true or false using a 2 point scale of true (2) and false (1) and also the same items were presented to the extension agents to know if they are involved in the dissemination of these agricultural initiatives and their responses were graded as Yes (1) and No (0).

The result from Table 5 shows that the extension agents in the study area had a high level of knowledge on some of the items under water management initiatives such as "Construction of water storage in ponds" (84.1%), "Construction of water channels on farmland" (80.1%) and "Utilization of drainage systems on farm lands" (69%). These initiatives are related to water distribution and if effectively disseminated to the farmers, they are supposed to positively enhance water availability, curb the problem of erosion which occurs in the area during heavy rains and facilitate optimum soil moisture distribution in the area. However, low knowledge was recorded for "Use of flood irrigation" (16.2%), "Use of Drip irrigation" (13.4%) and "Use of Canal Irrigation" (14.4%). This implies that the extension agents still require a lot of education and training on major irrigation techniques. Ogunjimi & Adekalu (2007) reported that one of the major problems and constraints of small-scale farmers in the use of irrigation in South West Nigeria is their lack of basic knowledge transfer from extension agents on irrigation scheduling and skills in maintaining and operating irrigation pumps. Ale et al., (2016) also stated that extension agents in South West Nigeria need more training on Water conservation practices for farm purposes. Furthermore, Stevens & Ntai (2011) reported that extension agents in Lesotho were not competent enough to render the necessary irrigation management support and advisory services to farmers due to their lack of in-service training regarding irrigation initiatives. Therefore extension agents in the study area need an upgrade of their knowledge on water management initiatives especially as regards various irrigation techniques so as to equip them to be able to effectively provide advisory services to farmers for their use especially during the period of fluctuations in rains and prolonged dryness experienced in the area due to the effect of climate change.

The findings from Table 5 show that extension agents in the study area are involved in the dissemination of some of the water management initiatives such as "Construction of water channels on farmland" (74.4%), "Use of sandbag by river bank" (66.8%) and "Utilization of drainage systems on farm lands" (53.4%) while they were not involved in the dissemination of most of the irrigation related Water management Initiatives such as "Use of Canal irrigation" (8.3%), "Water harvesting" (11.6%) and "Use of Drip irrigation" (13.4%). This is most likely due to the low level of knowledge exhibited by the extension agents in these areas. This agrees with Edeogbon & Idele (2012) who stated that extension agents in the South West zone of Nigeria were not involved in the dissemination of various Irrigation methods to farmers. Arimi (2014) and Ozor & Nnaji (2011) attested to it that farmers in the South West and Eastern part of Nigeria respectively are not effectively utilizing irrigation schemes as they do not see it as a significant adaptive measure. This is most likely due to the lack of adequate education and enlightenment from extension agents on the importance and usage of irrigation and water harvesting. This implies that agriculture in these areas is still predominantly dependent on the unstable and unpredictable rainfall regime associated with climate change thus the potential for all-year round farming which is achievable by water harvesting and irrigation is not being maximized. Mati et al., (2006) and Tuinhof et al., 2011 stated that the potential for water harvesting in Sub Sahara Africa is enormous and if only 15% of the rainwater were harvested, it would be sufficient to meet all the water needs of the continent which can be conveyed even through irrigation.

On Tillage Smart Initiatives, the extension agents prominently demonstrated a high level of knowledge by their correct responses to statements such as "Use of organic manuring" (85.9%), "Zero/minimum tillage practices" (77.6%) and "Use of herbicides" (84.8%), while on the other hand, the extension agents had low knowledge on just few of the tillage smart initiatives which were, "Land use change" (4.7%) and "Use of Soil amendment" (15.2%). This is supported by Adebayo & Oladele (2014), who stated that the adoption of minimum tillage and other organic agricultural practices to improve and conserve soil structure was predominant among farmers in the South West Nigeria. This can be attributed to the technology transfer by extension agents in the study area which is a major source of trusted information dissemination to farmers. Minimum/zero tillage is a farm practice whereby the soil is disturbed to the nearest minimum in order to improve the soil structure. The high level of knowledge exhibited by the extension agents on tillage smart initiatives gives an indication of adequate dissemination of these initiatives to the farmers as Oladele (2012) stated that knowledge and awareness of innovations by extension agents are globally considered a prerequisite that aids the technology dissemination and adoption of such initiatives.

Further results from Table 5 also indicate that the prominent Tillage Smart Initiatives the extension agents were involved in disseminating include "Use of organic manuring" (80.9%), "Use of herbicides" (70.4%) and "Zero/minimum tillage practices" (76.2%) while on the other hand they were less involved in the dissemination of initiatives such as "Land use change" (5.8%), "Changes in planting dates/harvesting dates" (8.7%) and "Use of soil amendments" (12.3%). The involvement of extension agents in the dissemination of some of the prominent tillage-smart initiatives highlighted supports the findings of Afful (2016) who stated that extension agents in South Africa were also actively involved in promoting and disseminating zero/minimum tillage and manure usage to farmers. This thus reveals the potential wide-spread rate of adoption of these initiatives among farmers across the continent. AGRA (2014) pointed out that the utilization of zero or minimum tillage makes water use efficiency method on farm more achievable in that it contributes to improved soil structure, topsoil organic matter content and increased soil moisture.

The results from Table 5 show that the extension agents had a wide range of knowledge in Fossil Burning Reduction Initiatives. Prominent knowledge statements with correct responses were

"Use of Crop residue" (75.5%) and "Forage conservation" (57.0%). This is a good omen as it portends that in line with the recent advocacy by many development agencies of no-burning, all things being equal, extension agents in the area are well-positioned to disseminate these fossil burning reduction initiatives to the farmers which reveals the great potential to reduce the usual practice of the use of fire (flame cultivation) which was reported by Adebayo (2012) to be very predominant in the area. However, extension agents indicated low knowledge on initiatives such as "Practice of soil blanketing" (10.1%) and "Conversion of waste to compost" (13.4%). Adebayo (2012) reported the low utilization of compost by farmers in South West Nigeria despite the potential benefits derivable from its use. Singh (2003) reported that the use of composting helps to adequately fulfil the nutrient demands of crops and promote the activity of beneficial micro- and macro-flora in the soil. This reveals the need to upgrade the knowledge of extension agents on composting especially because of the technicalities involved so that they can effectively transfer this initiative to farmers in the area as a mitigation strategy against the vagaries of climate change and thus facilitating improved soil fertility and productivity.

The results from Table 5 reveal that "Use of crop residue" (72.2%) was the major Initiative under Fossil burning reduction Initiative disseminated to the farmers by the extension agents. This implies that majority of the farmers in this area are expected to be enlightened and knowledgeable about the benefits and socio-economic potentials they can derive from the utilization of crop waste generated from their farms. On the other hand, majority of the extension agents were not involved in the dissemination of "Practice of soil blanketing" (6.1%) and "Conversion of waste to compost" (9.7%). Their low level of dissemination is most likely due to their low knowledge on these initiatives revealing the need for more training for extension agents in these areas.

Table 5: Distribution of respondents based on their Knowledge and Involvement level on Water Management, Tillage Smart and Fossil Reduction practices

Climate Smart Agricultural Initiatives	**Knowledge**		**Involvement**	
	True	**False**	**Yes**	**No**
Water Management Initiatives				
Construction of water storage in ponds	233(84.1)	44(15.9)	137(49.5)	140(50.5)
Utilization of drainage systems on farm lands	191(69.0)	86(31.0)	148(53.4)	129(46.6)
Use of Flood irrigation	45(16.2)	232(83.8)	24(8.7)	253(91.3)
Use of Drip irrigation	37(13.4)	240(86.6)	37(13.4)	240(86.6)
Use of Canal irrigation	40(14.4)	237(85.6)	23(8.3)	254(91.7)
Construction of artificial lakes	156(56.3)	121(43.7)	51(18.4)	226(81.6)
Construction of water channels on farmland	222(80.1)	55(19.9)	206(74.4)	71(25.6)
Water harvesting	41(14.8)	236(85.2)	32(11.6)	245(88.4)
Use of sandbag by river bank	193(69.7)	84(30.3)	185(66.8)	92(33.2)
Tillage-Smart Initiatives				
Zero/minimum tillage practices	215(77.6)	62(22.4)	211(76.2)	66(23.8)
Farm Fallowing initiatives	199(71.8)	78(28.2)	189(68.2)	88(31.8)
Changes in planting dates/harvesting dates	180(65.0)	97(35.0)	24(8.7)	253(91.3)
Mechanical weeding	210(75.8)	67(24.2)	165(59.6)	112(40.4)
Use of herbicides	235(84.8)	42(15.2)	195(70.4)	82(29.6)
Land use change	16(5.8)	261(94.2)	13(4.7)	264(95.3)
Use of soil amendments	42(15.2)	235(84.8)	34(12.3)	243(87.7)
Use of organic manuring	238(85.9)	39(14.1)	224(80.9)	53(19.1)
Fossil Burning reduction Initiatives				
Use of Crop residue	209(75.5)	68(24.5)	200(72.2)	77(27.8)
Forage conservation	158(57.0)	119(43.0)	111(40.1)	166(59.9)
Practice of soil blanketing	28(10.1)	249(89.9)	17(6.1)	260(93.9)
Conversion of waste to compost	37(13.4)	240(86.6)	27(9.7)	250(90.3)

Note: Figures in parentheses are percentages.

Furthermore, the findings from Table 6 reveal the knowledge of extension agents on Soil Initiatives. The prominent initiatives with correct responses were "Planting of cover crops" (79.4%), "Use of mulching" (75.5%) and "Afforestation/ reforestation" (70.8%). Conversely, extension agents had a low performance on Soil Initiatives statements such as "Farm fragmentation" (4.0%), "Agro-forestry such as Alley cropping" (8.7%) and "Land reclamation" (11.6%). This implies that extension agents are knowledgeable in some of the soil and Fossil burning reduction initiatives and this is positive indication that the respondents have the required capacity to educate farmers on these initiatives. However, low performance was expressed by the extension agents on some of the important Soil and Fossil burning reduction Initiatives and this reveals the need to acquire the appropriate training in order to be knowledgeable on those initiatives as farmers can only be adept in managing climate change risk provided the extension agents are knowledgeable on the new and existing Climate Smart Agricultural Initiatives that are being proffered and effectively disseminate them to the farmers. Singh & Grover (2013) confirmed that extension agents are to share their knowledge on crop and soil management initiatives that are resilient to climate change variability with the farmers as the adoption of the knowledge shared will improve their crop yield as well as their income thereby ensuring household food security.

The results from Table 6 further show that extension agents were involved in disseminating some of the Soil Initiatives to the farmers. The prominent initiatives being disseminated were the "Use of mulching" (84.5%), "Planting of cover crops" (79.4%) and "Afforestation/ reforestation" (71.1%). But it is worthy of note that there was a low level of dissemination of majority of the soil initiatives to farmers. Some of these were "Farm fragmentation" (4.3%), "Agro-forestry such as Alley cropping" (15.9%) and "Land reclamation" (17.0%). This is most likely due to the shortfall of extension agents' knowledge in these areas. This is in agreement with Adisa (2012), who stated that extension agents in Ekiti State, South West Nigeria need training on various soil conservation initiatives which have hindered them from disseminating these initiatives to farmers. Also, Ajieh & Okoh (2012) stated that farmers in Delta State, Nigeria had low level of awareness and knowledge of land reclamation strategies and other important climate smart Initiatives such as Agro-forestry. Agro-forestry contributes to adaptation in a way that improves the resilience of agricultural production by using trees to moderate local microclimate which also intensifies and diversifies production in farming systems (AGRA, 2014).

The results from Table 6 show that the extension agents by their positive responses demonstrated high knowledge on majority of the Crop-mix initiatives. The prominent initiatives among these were "Use of crop rotation" (86.3%), "Mixed farming" (88.8%) and "Pest resistant varieties" (77.3%). This portends that extension agents are expected to be in the forefront of disseminating this initiative and several others that they are knowledgeable about to farmers. On the other hand, the extension agents indicated low knowledge on only few Crop-mix Initiatives which were "Changes in planting depth of seeds and seedlings" (16.2%) and "Crop diversification initiatives" (11.6%). This simply means that the extension agents are well grounded in majority of the Crop-Mix initiatives and this is expected to enhance their dissemination of these initiatives to the farmers. However, the low knowledge exhibited on some of the identified initiatives needs urgent upgrade via training for them to be able to make the expected impact on farmers. This agrees with Ale et al., (2016) who stated that extension agents in the South West zone of Nigeria needed to be more knowledgeable on diversification practices in crop enterprise for adequate dissemination to the farmers.

Findings from Table 6 show that extension agents in the study area prominently disseminate the following Crop-Mix Initiatives to the farmers. These are "Early maturing varieties" (73.7%), "Use of crop rotation" (76.9%) and "Pest resistant varieties" (72.9%). This is consistent with Zikhali (2016) who reported that extension agents in Limpopo, South Africa, are involved in the dissemination of crop management initiatives. On the other hand, there was low level of dissemination of initiatives such as "Crop diversification initiatives" (10.5%) and "Changes in planting depth of seeds and seedlings" (6.9%).

The results from Table 6 also revealed that extension agents had high knowledge level on only one of the six ICT/ other technological initiatives presented to them which is "Use of Weather Forecast" (74.7%). Weather influences all agricultural activities from pre-sowing to postharvest. Thus the high level of knowledge exhibited by the extension agents is expected to help them to adequately provide weather-based advisories to the farmers. This will help them in planning their day-to-day agricultural operations well in advance. Weather forecast-based advisory service can have a significant influence in minimizing climate change related risks and increase productivity (Oladele et al., 2018).

The extension agents however showed low knowledge on other ICT Initiatives such as "Timely dissemination of weather information to farmers through ICT" (14.4%), "Use of Resources conservation technologies" (11.2%) and "Farm insurance" (13.7%). This implies that the potential of ICT and other technological initiatives in helping to adapt and mitigate the effects of climate change is still far from been fully utilized in the study area as the extension agents who are key players in transferring these technologies to the rural farmers are also not knowledgeable about them. This corroborates Edeogbon & Idele (2012) who stated that efforts made by the extension agents in Nigeria in the transfer of improved climate change adaptation initiatives to farmers have not yielded the desired results and he attributed this to the inadequate knowledge of these initiatives by the extension agents as well as the lack of effective communication skills which will help in the dissemination of these initiatives. Meera et al., (2012) also reported that most of the extension agents in developing countries are not aware of the impacts of climate change on agriculture despite the urgent need for timely and useful information on climate risks.

The results from Table 6 further reveal that a little above average of the extension agents in the study area were involved in the dissemination of "Use of weather forecasts" (58.8%) while on the other hand, majority of the extension agents were not involved in disseminating other ICT/ and technological Initiatives to the farmers. These initiatives include; "Use of Resources conservation technologies" (10.1%), "Farm insurance initiatives" (12.3%) and "Timely dissemination of weather information to farmers through ICT" (6.1%). The low involvement in the dissemination of ICT and other initiatives such as farm insurance is most likely due to the fact that the extension agents have low knowledge about some of these initiatives. This is in consonance with Ajayi (2013) who reported that extension agents in Osun State, South West Nigeria had low knowledge about agricultural insurance. The implication of this is that the potential of ICT and other technological initiatives in helping to adapt and mitigate the effects of climate change is still far from been fully utilized in the study area. Apata & Adekunmi (2013) reported that farmers in the South West Nigeria identified lack of weather and other climatic information as a major constraint to their ability to adapt to climate change and this can be attributed to the inability of the extension agents to effectively educate and inform farmers on the various available Climate smart initiatives. As pointed out by Arimi (2014), farmers in the South

West Nigeria did not see farm insurance as a way of coping with climate change. Elum et al., (2016) also affirmed in his report that Agricultural Insurance Programme is limited in developing countries most especially in Africa as farmers in South Africa indicated that they do not engage in farm insurance and the major reason being that they are not aware of insurance policies. There is also a need for extension agents to source for the most common ICT to be used by farmers to help them in disseminating information to farmers. Advanced and useful information about the upcoming growing season and weather variability through ICT or any other means enables farmers to adopt improved technological initiatives and also be able to diversify and invest in more profitable enterprises when conditions are favourable (AGRA, 2014). As reported by Oladele et al., (2018), this has been seen to be effective in Kenya and Ethiopia where farmers were reported to have been able to adopt and make use of Agro-weather tools because of its dissemination through commonly used ICT information sources.

Table 6: Respondents distribution according to their Knowledge and Involvement level on Soil management, Crop-mix and ICT/ Other technological practices.

Climate Smart Agricultural Initiatives	Knowledge		Involvement	
	True	**False**	**Yes**	**No**
Soil Initiatives				
Contour cropping across hill slopes	151(54.5)	126(45.5)	137(49.5)	140(50.5)
Afforestation/ reforestation	197(71.1)	80(28.9)	196(70.8)	81(29.2)
Lengthened fallow	138(49.8)	139(50.2)	114(41.2)	163(58.8)
Use of mulching	234(84.5)	43(15.5)	209(75.5)	68(24.5)
Planting of cover crops	220(79.4)	57(20.6)	219(79.1)	58(20.9)
Farm fragmentation	12(4.3)	265(95.7)	11(4.0)	266(96.0)
Agro-forestry such as Alley cropping	44(15.9)	233(84.1)	24(8.7)	253(91.3)
Land reclamation	47(17.0)	230(83.0)	32(11.6)	245(88.4)
Zero grazing	64(23.1)	213(76.9)	38(13.7)	239(86.3)
Tree planting	205(74.0)	72(26.0)	47(17.0)	230(83.0)
Crop-Mix Initiatives				
Mixed farming	246(88.8)	31(11.2)	185(66.8)	92(33.2)
Changes in planting depth of seeds and seedlings.	45(16.2)	232(83.8)	19(6.9)	258(93.1)
Use of crop rotation	239(86.3)	38(13.7)	213(76.9)	64(23.1)
Use of inter cropping initiatives	195(70.4)	82(29.6)	186(67.1)	91(32.9)
Crop diversification initiatives	32(11.6)	245(88.4)	29(10.5)	248(89.5)
Drought resistant varieties	197(71.1)	80(28.9)	192(69.3)	85(30.7)
Early maturing varieties	209(75.5)	68(24.5)	203(73.3)	74(26.7)
Pest resistant varieties	214(77.3)	63(22.7)	202(72.9)	75(27.1)
ICT/ Other technological Initiatives				
Use of weather forecasts	207(74.7)	70(25.3)	163(58.8)	114(41.2)
Timely dissemination of weather information to farmers through ICT	40(14.4)	237(85.6)	17(6.1)	260(93.9)
Online internet access of climate related information	43(15.5)	234(84.5)	43(15.5)	234(84.5)
Agro meteorology information	115(41.5)	162(58.5)	74(26.7)	203(73.3)
Use of Resources conservation technologies	31(11.2)	246(88.8)	28(10.1)	249(89.9)
Farm insurance	38(13.7)	239(86.3)	34(12.3)	243(87.7)

Note: Figures in parentheses are percentages.

4.5 Perceived level of importance and Competency Level of Extension agents on Water Management, Tillage, Fossil Burning and Soil Initiatives.

Perceived level of importance attached to the climate smart initiatives by the extension agents and their perceived level of competence on these initiatives were carried out in the study area. The importance scale was rated as follows: High (3) Moderate (2) and Low (1). With the use of this rating scale, the actual mean is 2 and thus a mean greater than 2 shows high importance and a mean less than 2 shows low importance of climate smart agricultural initiatives. The competency scale was also rated as stated on a 3-point likert scale of high (3), Moderate (2) and low (1) and also with the use of the rating scale, the actual mean is 2 and a mean greater than 2 shows high competency level while a mean less than 2 shows low competency in climate smart agricultural Initiatives.

The results from Table 7 reveal that of the 9 water management initiatives, two of them had a mean score of less than 2. These were "water harvesting" ($\bar{X}$ =1.81, SD = 0.71) and "construction of artificial lake" ($\bar{X}$ =1.88, SD = 0.74). The low level of importance attached to these initiatives by the extension agents reveal why they were not adequately involved in their dissemination to farmers thus limiting their maximization of the enormous potential for water harvesting in the area. The prominent water management initiatives in which the extension agents attached high importance to were "Construction of water storage in ponds" ($\bar{X}$ =2.70, SD = 0.46), "Use of Canal irrigation" ($\bar{X}$ = 2.65, SD = 0.54), "Use of flood irrigation ($\bar{X}$ = 2.64, SD= 0.59) and "Use of drip irrigation ($\bar{X}$ = 2.56, SD= 0.64). Though the extension agents perceived majority of the irrigation based initiative to be important, they were not highly involved in disseminating these initiatives to farmers because of their low level of knowledge on these initiatives. This is consonance with Ale et al., (2016) who stated that extension agents in South West Nigeria needed more knowledge on irrigation practices.

Also, the findings from Table 7 overwhelmingly reveal that the extension agents attached a high level of importance to all the tillage smart initiatives as all the means for the level of importance of these initiatives were above the cut-off point of 2. The most important initiatives as ranked by the extension agents were "Land use change" ($\bar{X}$ =2.77, SD = 0.46) and "Use of soil amendments" ($\bar{X}$ =2.68, SD = 0.53). This implies that among all the other initiatives, the extension agents attached a very high importance to land use change most likely because they are well informed on how land use change affects climate change. Land use change is said to be responsible for 15-20% of carbon dioxide emission (IPCC, 2007; Onwuatudo, 2014; www.gcrio.org). This finding is in contrast to Onwuatudo (2014) who stated that extension agents in the Eastern part of Nigeria expressed low perception towards land use as having an effect on climate change.

Furthermore, the results from Table 7 show the competency level of extension agents on Water Management Initiatives. Using 2 as the cut-off point, out of the 9 initiatives, only 2 had a mean score of more than 2. These were "construction of water channel" ($\bar{X}$ =2.02, SD = 0.69) and "use of sandbag by river banks" ($\bar{X}$ =2.07, SD = 0.79). This implies that the extension agents exhibited high competence only on water distribution related initiatives but were not so competent on water harvesting and irrigation related initiatives. This confirms why they were not as involved in the dissemination of these initiatives to farmers despite their attachment of high importance to those initiatives as very relevant in the adaptation and mitigation of climate change. Saleh & Man (2017) also reported that extension officers in Iraq exhibited low competence in irrigation and water drainage techniques.

On Tillage Smart Initiatives, the results revealed that of the 7 initiatives, 2 had a mean score of less than 2. These initiatives wherein the extension agents had low competence were "land use change" ($\bar{X}$ =1.86, SD = 0.75) and "use of soil amendments" ($\bar{X}$ =1.81, SD = 0.76) while the prominent initiatives in which the extension agents exhibited high competence were "Use of herbicides" ($\bar{X}$= 2.20, SD = 0.65), "Use of organic manuring" ($\bar{X}$= 2.17, SD = 0.69), "Mechanical weeding" ($\bar{X}$= 2.14, SD = 0.70) and "Zero/minimum tillage practices" ($\bar{X}$= 2.12, SD = 0.72). Zwane et al., (2015) reported that farmers in South Africa also expected extension officers to be competent in zero tillage and other soil-related climate change coping strategies. The high level of competence of the extension agents on majority of the tillage smart initiatives tends to indicate that the agents will be at the fore-front of ensuring the transfer of these technologies to farmers in the area. This might explain the high level of adoption of tillage and other organic agriculturally related initiatives among farmers in South West Nigeria reported by Adebayo & Oladele (2014). However, it is worthy of note that the low level of dissemination of land use change and soil amendment initiatives earlier reported by the agents in the area can be directly linked to the low level of knowledge and competence exhibited by the extension agents on the duo. This reveals the need for more training in these areas for the extension agents to better position them for effective rural advisory services.

The findings from Table 7 show the perceived level of importance on Fossil burning reduction Initiatives as indicated by the extension agents. The results overwhelmingly revealed that high importance is attached to all the initiatives as the means for all the 4 initiatives were above the cut-off of 2. Conversion of waste to compost ($\bar{X}$= 2.74, SD = 0.47), and Practice of soil blanketing ($\bar{X}$= 2.66, SD = 0.50) were the most important initiatives indicated by the extension agents. Also, the extension agents perceived all the soil initiatives to be highly important. The most important initiatives as ranked by the extension agents were "zero grazing" ($\bar{X}$= 2.69, SD = 0.48), "agro-forestry" ($\bar{X}$= 2.68, SD = 0.51) and "land reclamation" ($\bar{X}$= 2.62, SD = 0.53). However, even though the extension agents perceived the highlighted fossil burning reduction and soil initiatives to be highly important as an adaptation and mitigation strategy for climate change, they were not highly involved in disseminating these to farmers as a result of their low knowledge level on these initiatives. This is likely to translate into the low level of adoption and utilization of some of these importantly perceived initiatives among farmers in the area.

Furthermore, Table 7 reveals the competency level of the extension agents on Fossil burning reduction Initiatives in the study area. The extension agents exhibited high competence in only one initiative which had a mean score of above 2. This is the "use of crop residue" ($\bar{X}$ = 2.05, SD = 0.70). This high level of competence is expected to translate into wide spread awareness and adoption of this initiative in the study area. However, the extension agents were not so competent in majority of those fossil burning reduction initiatives they rated as important revealing the lacuna that need to be filled in terms of training of agents in order to ensure the scaling-up of these climate smart initiatives in the area.

The findings further show the competence of the extension agents on soil initiatives. It was revealed that of the 10 initiatives, 4 had a mean score of more than 2. The soil initiatives with the highest competence mean score were "tree Planting" ($\bar{X}$ = 2.30, SD = 0.67), "planting of cover crops" ($\bar{X}$ = 2.23, SD = 0.76), "use of mulching" ($\bar{X}$ = 2.23, SD = 0.73) and "afforestation/reforestation ($\bar{X}$ = 2.23, SD = 0.73). This finding is in agreement with Onwuatudo (2014) who stated that extension agents in Anambra State, Nigeria were competent in afforestation and other soil related initiatives. This implies that the competence of extension agents on these initiatives is expected to enhance the performance of their education and advisory services roles to farmers for better adaptation to climate change. On the other hand prominent soil initiatives in which the extension agents indicated low competence were "agro-forestry such as Alley cropping" ($\bar{X}$ = 1.70, SD = 0.75) and "land reclamation" ($\bar{X}$ = 1.63, SD = 0.65). It is worthy of note that the high perceived importance of the extension agents earlier exhibited on these initiatives does not translate into them being highly competent in them. The low competence exhibited on these initiatives further confirms the reason why the extension agents were not highly involved in the dissemination of these initiatives to farmers even though they pointed them out as very important for adaptation to climate change. This points out the need for more training in these areas to empower extension agents to be able to build the adaptive capabilities of farmers.

4.5.1 Competency needs of Extension agents on Water Management, Tillage, Fossil Burning and Soil Initiatives.

The areas of competency need of the extension agents on Climate Smart Agricultural Initiatives were determined by using the Borich Needs assessment model. A comparison was made between the perceived level of importance attached to the climate smart initiatives by the extension agents and their perceived level of competence on these initiatives. The initiatives were then ranked using the computed MWDS. The higher the Mean Weighted Discrepancy score MWDS, the greater the competency need of extension agents on Climate Smart Agricultural initiatives.

The findings from Table 7 shows the competency needs of the extension agents on water management initiatives. Based on the mean weighted discrepancy scores' ranking, it was revealed that the prominent areas where extension agents needed more competency on water management initiatives were "Use of Canal irrigation" (MWDS= 3.19), as it is ranked first, "Use of flood irrigation" (MWDS = 2.57), "Construction of water storage in ponds" (MWDS = 2.38) and "use of drip irrigation" (MWDS = 2.23). Initiatives such as "Use of sandbag by river bank", "Water harvesting" and "Construction of water channels on farmland" had MWDS of 0.15, 0.52 and 0.69 respectively indicating less competency needs in these areas. This implies that the extension agents needed major training in techniques related to irrigation and water storage. This finding is in agreement with Ale *et al.* (2016) who reported that extension officers in South West Nigeria also exhibited low competence in irrigation techniques and needed training in these areas. This findings also agree with Wasihum (2013) and Alibaygi & Zarafshani (2008) who stated that training is highly needed on irrigation and water conservation techniques by the extension personnel in Ethiopia and Iran respectively.

Furthermore, the extension agents' highest ranking competency needs for tillage smart initiatives were "Land use change" (MWDS = 2.51) and "Use of soil amendments" (MWDS = 2.31) while they indicated less competency need on "Use of herbicides" (MWDS = 0.15), "Mechanical Weeding" (MWDS = 0.15) and "Use of organic manuring" (MWDS = 0.49). This implies that priority should be given to training extension agents in the areas of land use and soil amendments to better equip them for better performance in building the adaptive capabilities of farmers in these areas. Apel & Glenn (2009) pointed out that there is the need to build the competency of extension agents on land use planning for them to be able to effectively play their role of providing information to farmers on new and emerging innovations in this area for them to be able to offset and mitigate the effect of climate change.

The results from Table 7 reveal the competency needs of the extension agents on fossil burning reduction initiatives. The areas where competency was highly needed were "Practice of soil blanketing" (MWDS= 3.02) and "Conversion of waste to compost" (MWDS = 2.14) while on the other hand less competency was needed on initiatives such as "Use of crop residue" (MWDS= 0.56) and "Forage conservation" (MWDS = 1.40). Oladipo et al., (2017) pointed out that the paucity of information from extension agents on the efficient and environmental friendly utilization of farm waste initiatives was a major reason why the farmers in Kwara State, Nigeria have not been able to leverage on the potentials derivable from its utilization. This literature report and earlier findings from this study of the low level of involvement of extension agents in the dissemination of waste conversion and utilization initiatives which is further confirmed by their high need for competency in this area points out the urgent need to package training and educational programmes on waste management and utilization to enhance their capacity for better performance of their extension and advisory services roles to farmers. Kwaw-Mensah (2008) also stated the need to expose county extension educators to more in-service training on best waste management practices in order to enhance their job performance.

Also, further findings from Table 7 pointed out that the extension agents' highest ranking area of competency need on Soil Initiatives include "Agro-forestry such as Alley cropping" (MWDS = 2.64), "Land Reclamation" (MWDS = 2.62) and "Zero grazing " (MWDS= 2.19). On the other initiatives, "Tree planting" (MWDS= 0.03), "Afforestation/ reforestation" (MWDS = 0.58) and Use of mulching (0.89) were areas where less competency need was indicated. This points out the need to design relevant in-service training for the agents in the areas of high competency need indicated on soil initiatives. Terdoo & Adekola, (2014) stated that enhancing the competence of extension agents on agro-forestry practices will ultimately help in building resilience of rural farmers and also help to improve their production. The utilization of agro-forestry techniques helps to improve the quality and quantity of available agricultural land as it protects the soil from all kinds of erosion and at the same time acts as a sink for greenhouse gases emission (FAO, 2010).

Table 7: Respondents' distribution according to their Level of importance, Competence and Competency need on Water Management, Tillage, Fossil burning and Soil initiatives.

Climate Smart Agricultural Initiatives	Mean (SD) Importance	Mean (SD) Competence	MWDS	Ranks
Water Management Initiatives				
Construction of water storage in ponds	2.70(0.46)	1.82(0.73)	2.38	3rd
Utilization of drainage systems on farm lands	2.26(0.65)	1.87(0.68)	0.88	5th
Use of flood irrigation	2.64(0.59)	1.66(0.68)	2.57	2nd
Use of Drip irrigation	2.56(0.64)	1.68(0.67)	2.23	4th
Use of Canal irrigation	2.65(0.54)	1.46(0.59)	3.19	1st
Construction of artificial lakes	1.88(0.74)	1.46(0.62)	0.78	6th
Construction of water channels on farmland	2.34(0.68)	2.04(0.69)	0.69	7th
Water harvesting	1.81(0.71)	1.53(0.67)	0.52	8th
Use of sandbag by river bank	2.14(0.66)	2.07(0.79)	0.15	9th
Tillage-Smart Initiatives				
Zero/minimum tillage practices	2.37(0.64)	2.12(0.72)	0.59	4th
Farm Fallowing initiatives	2.36(0.63)	2.04(0.73)	0.76	3rd
Changes in planting dates/harvesting dates	2.27(0.67)	2.01(0.68)	0.58	5th
Mechanical weeding	2.21(0.73)	2.14(0.70)	0.15	7th
Use of herbicides	2.26(0.70)	2.20(0.65)	0.15	7th
Land use change	2.77(0.46)	1.86(0.75)	2.51	1st
Use of soil amendments	2.68(0.53)	1.81(0.76)	2.31	2nd
Use of organic manuring	2.37(0.65)	2.17(0.69)	0.49	6th
Fossil Burning reduction Initiatives				
Use of crop residue	2.30(0.68)	2.05(0.70)	0.56	4th
Forage conservation	2.27(0.59)	1.66(0.73)	1.40	3rd
Practice of soil blanketing	2.66(0.50)	1.53(0.67)	3.02	1st
Conversion of waste to compost	2.74(0.47)	1.96(0.71)	2.14	2nd
Soil Initiatives				
Contour cropping across hill slopes	2.14(0.72)	1.68(0.71)	0.97	6th
Afforestation/ reforestation	2.28(0.70)	2.03(0.68)	0.58	8th
Lengthened fallow	2.24(0.66)	1.78(0.75)	1.03	5th
Use of mulching	2.57(0.61)	2.23(0.73)	0.89	7th
Planting of cover crops	2.57(0.58)	2.23(0.76)	0.88	7th
Farm fragmentation	2.59(0.53)	1.75(0.72)	2.18	4th
Agro-forestry such as Alley cropping	2.68(0.51)	1.70(0.75)	2.64	1st
Land reclamation	2.62(0.53)	1.63(0.68)	2.62	2nd
Zero grazing	2.69(0.48)	1.87(0.71)	2.19	3rd
Tree planting	2.32(0.69)	2.30(0.67)	0.03	9th

Source: Field Survey, 2017

4.6 Perceived level of importance and Competency Level of Extension agents on Crop-Mix Initiatives and ICT/ other technological Initiatives.

The results from Table 8 reveal the perceived level of importance attached to the Crop-Mix Initiatives by the extension agents. The findings overwhelmingly showed that the extension agents attached a very high level of importance to all the crop-mix initiatives as all the means were above the cut-off point of 2. The most important initiatives as ranked by the extension agents were "changes in planting depth of seeds and seedlings" ($\bar{X}$ = 2.75, SD = 0.43) and "Crop diversification initiatives" ($\bar{X}$ = 2.75, SD = 0.45) and "use of crop rotation" ($\bar{X}$ = 2.75, SD = 0.45). Also, it was further revealed from the results that the extension agents attached high importance to all the ICT/ other technological Initiatives as they were above the mean score of 2. Prominent among these initiatives were "timely dissemination of weather information to farmers through ICT" ($\bar{X}$ = 2.82, SD = 0.42), "agro meteorology information "($\bar{X}$ = 2.77, SD = 0.44) and "use of resources conservation technologies" ($\bar{X}$ = 2.76, SD = 0.48). Afful (2016) stated that conservation agriculture was pointed out by extension officers in Limpopo, South Africa as one of the most important climate change coping strategy to be promoted. Also, Ghimire (2016) and Umar et al. (2017) reported that extension agents in Nepal and Malaysia respectively identified communication through the use of ICT as important required competencies.

Table 8 further shows the competency level of the extension agents on Crop-Mix Initiatives. It was revealed that the extension agents exhibited high competency in 3 out of the 8 crop-mix initiatives as their mean score was above the cut-off point of 2. These initiatives were "mixed farming" ($\bar{X}$ = 2.26, SD = 0.70), "use of crop rotation" ($\bar{X}$ = 2.23, SD = 0.69) and "changes in planting depth of seeds and seedlings" ($\bar{X}$ = 2.00, SD = 0.70). On the other hand, the crop-mix initiatives with the lowest competence mean score were "crop diversification" ($\bar{X}$ = 1.88, SD = 0.70), "drought resistant varieties" ($\bar{X}$ = 1.88, SD = 0.65) and early maturing varieties ($\bar{X}$ = 1.94, SD = 0.66). This implies that the extension agents were not competent in majority of the crop-mix initiatives that they pointed out as important coping strategies for climate change. Zwane et al., (2015) reported that farmers in South Africa stated that extension officers needed to be competent on drought resistant and early maturing varieties so as enable them build their adaptive capabilities against climate change.

The results in Table 8 also revealed the competency of the extension agents on ICT/ other technological Initiatives in the study area. It is evident from the findings that although the extension agents had earlier attached high importance to all the ICT/ other technological Initiatives, they however exhibited low competency in all the 6 initiatives as they were all below the mean score of 2. The initiatives with the lowest competence mean score were "Use of Resources conservation technologies "($\bar{X}$ = 1.37, SD = 0.59), "Agro meteorology information" ($\bar{X}$ = 1.43, SD = 0.60) and "Farm insurance initiatives" ($\bar{X}$ = 1.75, SD = 0.67). This is in contrast with Afful (2016) who reported that resource conservation agriculture was a major initiative being promoted by extension agents in South Africa which indicates they were competent in it. Umar et al., (2017) also reported that using ICTs in climate change adaptation is an area where in-service training is highly needed in Malaysia.

4.6.1 Competency needs of Extension agents on Crop-Mix Initiatives and ICT/ other technological Initiatives.

The results from Table 8 pointed out the areas under Crop-Mix Initiatives where extension agents need competency upgrade. The mean weighted discrepancy scores ranking of the initiatives revealed that the prominent areas where extension agents needed more competency were "Crop diversification initiatives" (MWDS= 2.40) and "Changes in planting depth of seeds and seedlings" (MWDS = 2.08) while they indicated less competency need on "Mixed farming" (MWDS= 0.21), "Use of crop rotation" (MWDS = 0.61) and "Use of inter cropping initiatives" (MWDS = 0.64). Competence of extension agents is fundamental for the performance of their extension and advisory services roles in enhancing the capacity of farmers' adaptation to climate change. Hence training is highly needed in the areas of competency short fall identified on crop-mix initiatives.

Furthermore, the mean weighted discrepancy score in Table 8 revealed that the extension agents needed competency on majority of the ICT and other technological initiatives. Prominent among these initiatives were "Use of Resources conservation technologies" (MWDS= 3.85), "Agro meteorology information" (MWDS= 3.70) and "Farm insurance initiatives" (MWDS = 2.59) while it was only on the "Use of weather forecasts" (MWDS= 0.96) where they indicated less competency need. Ajayi (2013) also reported that extension agents in South West Nigeria needed more training on agricultural insurance. Umar et al., (2017) also reported that priority training is highly required for extension agents in Malaysia on the use of ICTs in climate change adaptation, promoting agricultural insurance and understanding basic agro-meteorological parameters. Afful (2016) pointed out that agents in South Africa need new competencies regarding correct application of conservation agriculture and Ghimire (2016) stated that communication via the utilization of ICT was one of the competencies with the highest training need among extension officers in Nepal.

Table 8: Respondents' distribution according to their Level of importance, Competence and Competency need on Crop-Mix and ICT/other technological practices.

Climate Smart Agricultural Initiatives	Mean(SD) Importance	Mean(C) Competence	MWDS	Ranks
Crop-Mix Initiatives				
Mixed farming	2.35(0.68)	2.26(0.70)	0.21	8th
Changes in planting depth of seeds and seedlings.	2.75(0.43)	2.00(0.70)	2.08	2nd
Use of crop rotation	2.48(0.64)	2.23(0.69)	0.61	7th
Use of inter cropping initiatives	2.24(0.68)	1.96(0.74)	0.64	6th
Crop diversification initiatives	2.75(0.45)	1.88(0.70)	2.40	1st
Drought resistant varieties	2.18(0.69)	1.88(0.65)	0.66	5th
Early maturing varieties	2.27(0.64)	1.94(0.66)	0.75	3rd
Pest resistant varieties	2.29(0.67)	1.96(0.66)	0.74	4th
ICT/ Other technological Initiatives				
Use of weather forecasts	2.36(0.67)	1.96(0.65)	0.96	6th
Timely dissemination of weather information to farmers through ICT	2.82(0.42)	1.98(0.63)	2.36	4th
Online internet access of climate related information	2.65(0.49)	1.77(0.65)	2.34	5th
Agro meteorology information	2.77(0.44)	1.43(0.60)	3.70	2nd
Use of Resources conservation technologies	2.76(0.48)	1.37(0.59)	3.85	1st
Farm insurance initiatives	2.71(0.47)	1.75(0.67)	2.59	3rd

Source: Field Survey, 2017.

4.7 Constraints faced in the acquisition of needed competencies on Climate Smart Agricultural Initiatives

This section presents the results of the constraints faced by the extension agents in the dissemination of Climate Smart Agricultural Initiatives. Respondents were asked to indicate from a list of items the severe constraints militating against their effective delivery of climate smart agricultural initiatives rated on a 3-point likert-type scale of Very severe (3), Severe (2) and Not severe (1). Using the rating scale, a mean of 2 was used to identify the most severe constraints militating against their effective dissemination of Climate Smart Agricultural Initiatives in the study area.

Using the mean score to rank the constraints according to their order of severity as indicated by the respondents, the most severe constraints from Table 9 pointed out by the extension agents were " Inadequate training on equipment for monitoring weather variations" (83.4%) which was ranked 1st with mean score of 2.49 and a standard deviation of 0.69. Others were "Inadequate mobility of staff" (88.1%) ranked 2nd with a mean score of $\bar{X}$= 2.43, SD= 0.70, "Lack of climate change subject matter specialist" (84.4%) ranked 3rd with a mean score of $\bar{X}$ = 2.37, SD = 0.74, "Poor access to knowledge and information on new technologies about climate change" (83.4%) ranked 4th with a mean score of $\bar{X}$ = 2.36, SD = 0.75 and "Inadequate information on climate change initiatives" (83.4%) ranked 5th with a mean score of $\bar{X}$ = 2.34, SD = 0.75. This implies that extension agents are not well exposed in terms of training specifically tailored to enhance their knowledge on climate change adaptation needed for an excellent service delivery in the dissemination of Climate Smart Agricultural Initiatives to the farmers. This is in line with FAO, (2016) which stated that inadequate training of extension agent in Nigeria is one of the challenges faced in the dissemination of Climate Smart Agricultural Initiatives to farmers and rural dwellers. Inadequate mobility of staff to effectively disseminate Climate Smart Agricultural Initiatives to farmers might be due to shortage of staff in the extension services thereby making the workload of extension services rest on few extension agents and this is in consonance to Saliu et al., (2009), who reported inadequate staffing with poor support at all state level in Nigeria as a major constraints faced by the extension agents in Nigeria. Asiedu-Darko (2013) also attested to it that poor training of extension agents and inadequate fund to support extension services are parts of the challenges faced in the dissemination Climate Smart Agricultural

Initiatives in Ghana. Tessema et al., (2013) also stated that farmers in Ethiopia identified lack of information about climate change and its adaptation strategies as a barrier to their adoption due to the failure of the extension agents in disseminating such information to them. The lack of information on climate smart agricultural initiatives particularly to the extension agents can adversely affect the dissemination of these initiatives to farmers. Sperenza (2010) and Maddison (2007) identified lack of information as a major constraint to agricultural development and adaptation to climate change in Africa. Also the availability of Climate Smart Subject Matter Specialists should be greatly considered in helping the extension agents as these specialists play an important role in training field extension agents on important issues.

Table 9: Distribution of the respondents' based on constraints faced in the acquisition of needed competencies on Climate Smart Agricultural Initiatives

Constraints	Very Severe Freq(%)	Severe Freq(%)	Not Severe Freq(%)	Mean(SD)	Rank
Poor access to knowledge and information on new technologies about climate change	146(52.7)	85(30.7)	46(16.6)	2.36(0.75)	4th
Inadequate information on climate change initiatives	140(50.5)	91(32.9)	46(16.6)	2.34(0.75)	5th
Inadequate training on equipment for monitoring weather variations	166(59.9)	80(28.9)	31(11.2)	2.49(0.69)	1st
Poor working environment	121(43.7)	112(43.7)	44(15.9)	2.28(0.72)	7th
Weak/poor linkages between extension and meteorology institutions	145(52.3)	78(28.2)	54(19.5)	2.33(0.78)	6th
Inadequate mobility of staff	152(54.9)	92(33.2)	33(11.9)	2.43(0.70)	2nd
Lack of climate change subject matter specialist	145(52.3)	89(32.1)	43(15.5)	2.37(0.74)	3rd
Insufficient time	67(24.2)	112(40.4)	98(35.4)	1.89(0.77)	13th
High personal cost in acquiring competencies on climate smart agricultural techniques	99(35.7)	128(46.2)	50(18.1)	2.18(0.71)	11th
Lack of training resources on climate smart agriculture	90(32.5)	152(54.9)	35(12.6)	2.20(0.64)	9th
Inadequate organizational support in acquiring knowledge on climate smart agricultural initiatives	90(32.5)	149(53.8)	38(13.7)	2.19(0.66)	10th
Inadequate inclusion of climate smart agricultural strategies into training curriculum	76(27.4)	161(58.1)	40(14.4)	2.13(0.64)	12th
Lack of training incentives such as funding for acquiring competencies on climate smart agriculture	92(33.2)	161(58.1)	24(8.7)	2.25(0.60)	8th

Mean Score derived from Very Severe=3, Severe=2, Not Severe=1

Source: Field Survey, 2017

4.8 Factors influencing the competency level of the extension agents on Climate Smart Agricultural Initiatives using Tobit Regression

Table 10 below shows a number of variables tested for significance of socio-economic characteristics of extension agents on their competency level in the study area. Nine (9) variables out of the variables presented were significant at different levels of probability. The statistic results show likelihood ratio to be -949.30993 and Pseudo R^2 of 0.1018 at a significant level of ($p < 0.01$) which indicate that the model has a strong explanatory power. The test for multicollinearity among the variables used in the model was carried out using Variance Inflation Factor (VIF) and multicollinearity was not a problem as the computed mean VIF value was 1.57. The F-test statistics value for the model was 14.78 with a statistical significance at $p < 0.01$.

The variables with positive parameters simply mean there is a positive and direct relationship with the dependent variable while the variables with negative parameters indicate a negative relationship with the dependent variable. The result from the table shows that educational qualification, participation in climate smart agricultural training, years of experience, job level, community covered, living in job location, distance to job location, knowledge, importance, and involvement in climate smart initiatives dissemination significantly influence extension agents' competency level on climate smart agricultural initiatives, therefore the null hypothesis of the study (H_{01}) was rejected.

The coefficient of educational qualification (0.9561947; $p < 0.10$) of the extension agents had a positive and significant influence on their competency level on climate smart agricultural initiatives. This indicates that extension agents' educational attainment contributes significantly to their competency level and this means that the more they acquire more level in their educational qualification, the more they are competent in the dissemination of climate smart agricultural initiatives to farmers as each stage of educational pursuits shed more light on climate change as well as climate smart agricultural initiatives. This is in consonance with Demenongu et al., (2015) who agreed that an increase in educational level of extension agents increases the probability of their communication competence as well as overall competence in the discharge of their duties. This, however, disagrees with Ayansina & Adeogun (2017) who stated that educational level of extension agents in Ogun, Nigeria is not significantly related to their competency need.

The coefficient of the participation of extension agents in climate smart agricultural related trainings (0.7547653) was statistically significant at $p<0.05$ and positively influenced the competency level of the agents on climate smart agricultural initiatives. This indicates that an increase in climate smart agricultural training participation among the extension agents will increase the likelihood of the extension agents being more competent. This is expected because training is supposed to enhance knowledge which in turn is expected to positively impact on competency and performance. This is in consonance with Dimelu et al., (2014) who stated that access to training on climate change adaptation and mitigation technologies is very crucial in enhancing the competence and capacity of extension agents to effectively carry out their role in reaching out to farmers.

The extension agents' years of experience were seen to have a positive contribution to their competency level on climate smart agricultural initiatives. The coefficient of years of experience (0.1575214) was positive and statistically significant ($p < 0.10$) in the model. The result indicates that the probability that extension agents with high or low competency on climate smart agricultural initiatives is as a result of the number of years spent in extension service. The longer the years spent by the extension agents in extension service as a result of their commitment in improving adaptation strategies on climate change, the more experienced, knowledgeable and competent they are likely to become in the discharge of their duties on climate smart agricultural initiatives. This is in consonance with Dimelu (2016) who revealed that there was a positive and significant relationship between the years of experience of extension agents in Anambra State and their knowledge on climate change as the number of years spent by these extension agents affords them opportunity to participate in various workshops and training thus having access to information on climate change and climate smart agricultural initiatives.

The coefficient of job level (0.4499483; $p < 0.05$) had a significant and positive influence on the competency level of extension agents on climate smart agricultural initiatives. This reveals that there is a significant relationship between the extension agents' job level and their competency level on climate smart agricultural initiatives. This implies that as extension agents move higher in their job level, the more competent they are likely to be in the dissemination of climate smart agricultural initiatives as they are more privileged to be exposed to specialized training that is expected to avail them the required skills and knowledge for better job performance.. This agrees with Demenongu et al., (2015), who stated that higher job level of extension agents leads to higher competency level as higher job level signifies higher educational attainment as well higher income to finance professional programmes which automatically improves their competency.

Also, the coefficient of number of community covered was negative (-0.0698953) and significant at ($p<0.01$) level of significance. This indicates an indirect relationship between the extension agents and their competency on climate smart agricultural initiatives. This means that the probability of becoming more competent on climate smart agricultural initiatives decreases with increase in the number of communities to be covered by the extension agents. This therefore implies that as the community to be covered becomes more in number, the less competent the extension agents is likely to be in dissemination of climate smart agricultural initiatives to the farmers due to job fatigue as these communities might exceed their capacities. Ajayi (2013) had earlier reported a very high extension to farmer ratio in his study in Osun State, South West Nigeria. On the other hand, the smaller the number of the community to be covered, the more efficient and competent they are likely to be in the discharge of their duties.

Furthermore, the coefficient of living in job location (1.840568; $p < 0.10$) of the extension agents in the study area had a significant and positive influence on their competency level on climate smart agricultural initiatives. The result indicates a direct relationship between the job location of the extension agents and their competency level on climate smart agricultural initiatives in that if the community the extension agents are assigned to perform their duties is in the same location they reside, it makes it easier for the extension agents to identify the problem of the community and proffer immediate solution which enhances their competency and efficiency level when compared to extension agents sent to a location that are far away and terrain they are not familiar with. The proximity of the extension agents to his job location contributes positively to enhancing their competency level as they have the privilege to get involved in the dissemination of these initiatives more and are able to interact with the farmers more frequently. This agrees with Dimelu (2016) who stated that extension agents receive and process feedback from farmers which enable them to be well informed about challenges experienced by rural communities on climate change and its effects and perform better as a result of their residence and contact with the farmers

More so, the coefficient of the extension agents' knowledge (0.4047614) was found to be positive and statistically significant ($p < 0.01$) in relation to their competency level. This implies that an increase in the knowledge of the extension agents on climate smart agricultural initiatives tends to enhance their likelihood of being more competent in the effective dissemination of these initiatives to the farmers. This agrees with the report of Sperenza (2010) that the knowledge of extension agents on agricultural innovations such as climate smart agricultural initiatives enhances their competence and thus their efficiency and effectiveness in extension service delivery. Also, Oladele (2011) and Dimelu (2016) also stated that adequate knowledge of climate change is a fundamental predictor of extension agents' competence in the development and dissemination of adaptation and mitigation strategies to farmers. Hence the need for extension agents to be regularly exposed to trainings, conferences and workshops on climate smart agricultural initiatives so as to beef up their knowledge and keep them well informed on emerging issues of climate change.

Furthermore, the parameter of the importance (0.331535) the extension agents place on climate smart agricultural initiatives was positive and statistically significant at ($p<0.01$). This indicates that the importance placed by the extension agents on the climate smart agricultural initiatives positively influences their probability of being more competent on those initiatives. This conforms with apriori expectation as the more the extent of importance placed on these initiatives by the extension agents the more they will want to know about them thus positively triggering their information seeking behaviour and quest for knowledge on these initiatives which are expected to ultimately enhance their competence. This is in agreement with Ghimire & Martin (2011) who stated that extension educators' perception of the importance of a task tends to enhance their competence and professional development on those tasks.

Finally, the coefficient (0.4544476) of the involvement of extension agents in the dissemination of climate smart agricultural initiatives was found to be statistically significant at ($p<0.01$) and also positively related to their competence. This indicates that the more involved the respondents are in the dissemination of climate smart agricultural initiatives the higher the probability of their being more competent on those initiatives. This is in consonance with Adebayo & Oladele (2012), who stated that personal experience on the practice of an innovation enhances one's competence on the utilization of such an innovation.

Table 10: Tobit Regression Analysis Result of the Effects of Socio-Economic Characteristics of Extension Agents on their Competency Level in Southwest Nigeria.

Competency score	Coefficients	Robust Std. Error	t	p> | t |	VIF
Gender	0.6152224	1.176133	0.52	0.601	1.10
Religion	-0.5940068	1.055745	-0.56	0.574	1.15
Marital status	-0.2439609	1.552235	-0.16	0.875	1.52
Household size	0.1633526	.311993	0.52	0.601	1.62
Educational level	0.9561947	.5701377	1.68	0.095*	1.15
Participation in Climate change training	0.7547653	.6003395	1.26	0.029**	1.12
Years of experience	0.1575214	.1193088	1.32	0.088*	3.72
Job level	0.4499483	.1886521	2.39	0.018**	3.79
Job location	0.1078362	.0490614	2.20	0.210	1.12
Community covered	-0.0698953	.0293291	-2.38	0.018**	1.36
Living in job location	1.840568	1.00764	1.83	0.069*	1.19
Distance to job location	-0.0183136	.0259683	-0.71	0.481	1.23
Background	-0.0728369	.9510483	-0.08	0.939	1.14
Knowledge	0.4047614	.1549544	2.61	0.010*	1.58
Importance	0.331535	.0462792	7.16	0.000***	1.38
Involvement	0.4544476	.1562911	2.91	0.004***	1.69
Sources of Information	0.1612327	.1476235	1.09	0.276	1.27
Constraints	0.0933879	.2122568	0.44	0.660	1.13
Constant	-22.52757	12.38436	-1.82	0.070	
/sigma	7.572305	.3484491			
Number of obs	277				
F(18, 259)	14.78				
Prob > F	0.0000				
Pseudo R2	0.1018				
Log likelihood	-949.30993				

Source: Authors Computation from Computer Tobit Analysis (2018)

Note: *, ** means 10%, 5% and 1% levels of significant respectively

4.9 Confirmatory Factor Analysis (Structural Equation Modelling) of factors influencing Competency level of Extension Agents

The findings from Table 11 show the Confirmatory Factor Analysis (CFA) results of the relationship between the constructs of the variable that influences the competency level of extension agents in the study area. Confirmatory Factor Analysis was performed was conducted on four major variables in order to see the interrelationship that exists between these variables. The variables involved in the analysis were Knowledge, Involvement, Importance and Competence. The evaluation of the model fitness reveals the chi-square statistic to be 52.847 and the degree of freedom X^2/df is 1.101 which is less than 3 the recommended measure and this shows a good model fit (Markland, 2006; Zaremohzzabieh et al., 2015). The model further reveals the Root Mean Square of Approximation (RMSEA) value to be 0.019 indicating a good fit as it is below the expected threshold. The RMSEA assists in correcting the tendency of X^2 index rejecting the model (Hair et al., 2003; Abdullah & Zhou, 2017). The Comparative Fit Index (CFI) is a fit index which compares the value of a proposed covariance matrix model to the observed covariance model and the value is 0.944 indicating an acceptable fit. Furthermore, Goodness of Fit Index (GFI) value is 0.969 and it serves as an alternative to Chi-Square test as it calculate the variance proportion accounted for population covariance which ranges from 0 – 1. Therefore, large values of GFI close to 1 indicate good fit (Tabachnick & Fidell, 2007; Nursalihah et al., 2010). Other model fit indicators such as the Adjusted Goodness Fit Index (AGFI), Tucker Lewis Index (TLI) and Incremental Fit Index (IFI) are with the value of 0.950, 0.924, and 0.954 respectively and these values go beyond the cut-off value of 0.90 hence indicating an excellent model fit for the data in the study (Hair et al., 2010; Seyed Mehdi et al., 2015; Tabachnick & Fidell, 2007 and Zaremohzzabieh et al., 2015). The display of good fit in all the indicators used in the model results in the consideration of hypothesis testing for the study.

Table 11: Summary of Model Fit for the Confirmatory Factor Analysis

Model	Recommended Index	Default result	Independence result
Chi-square X^2		52.847	153.119
Chi-square/degree of freedom (X^2/df)	≤ 3	1.101	2.320
Adjust goodness-of-fit (AGFI)	≥ 0.90	0.950	0.894
Goodness-of-Fit (GFI)	≥ 0.90	0.969	0.911
Comparative fit index (CFI)	≥ 0.90	0.944	0.000
Root mean square error of approximation (RMSEA)	≤ 0.1	0.019	0.690
Tucker Lewis Index (TLI)	≥ 0.90	0.924	0.000
Incremental Fit Index (IFI)	≥ 0.90	0.954	0.000
AIC		112.847	177.119

Source: Analysis of field survey, 2017

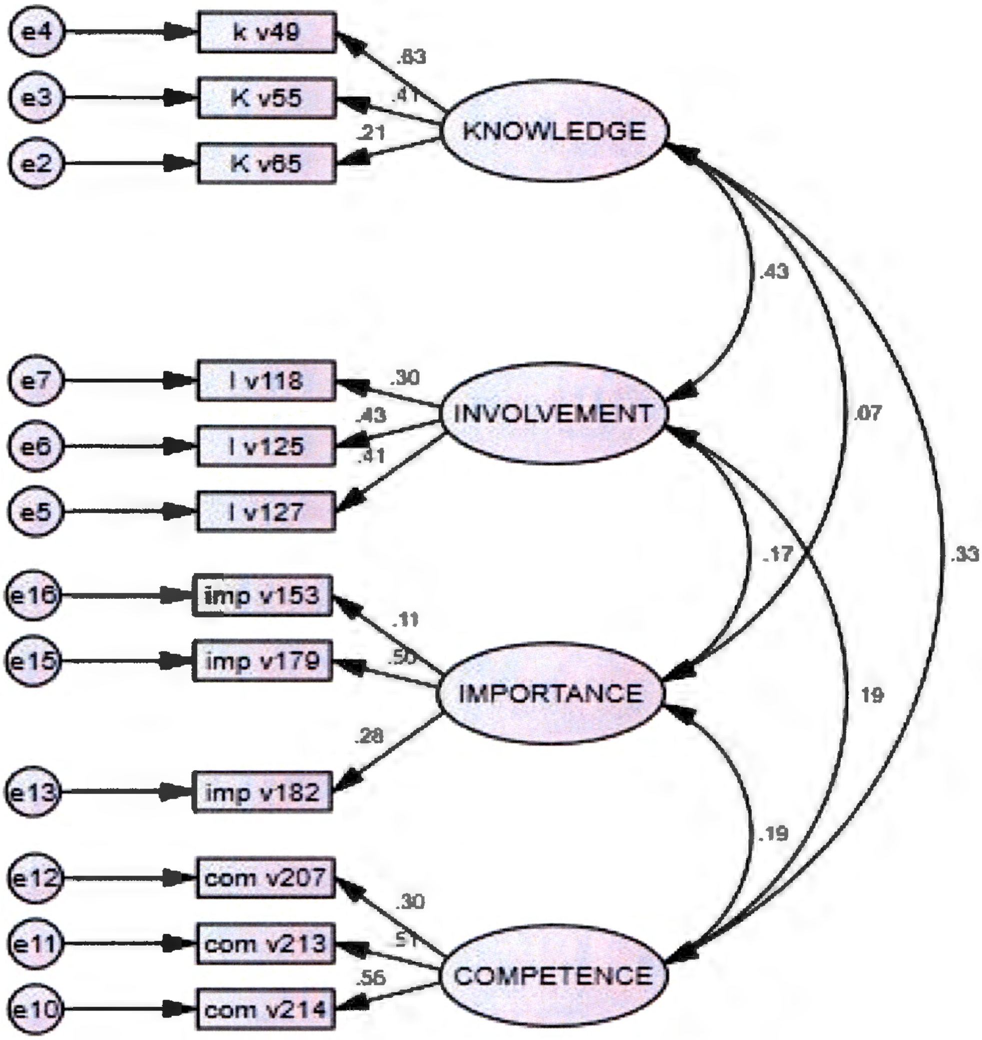
The results of the hypothesis testing of the four-model construct using confirmatory factor analysis in Table 12 and Figure 5 reveal the existence of correlation between the construct of knowledge, involvement, importance and competence. There is a significant and positive correlation between the construct of extension agents' competence and the component of their knowledge, involvement and importance with the coefficient value of 0.33, 0.19 and 0.19 respectively hence the hypothesis 2 was rejected. This implies that the competence of the extension agents increases as their knowledge increases and they realise the importance of climate smart agricultural initiatives thus helping them to build the necessary capacity needed to be involved in its dissemination to the famers who are the end users of these initiatives. The significance of the variables of knowledge, importance and involvement as they relate to the extension agents competency in both models (i.e. the Tobit regression model and the confirmatory factor analysis model) is a clear indication that these variables are very relevant and key influencers of the extension agents' competency on climate smart agricultural initiatives and will therefore have strong policy implications for continuous upgrade of their competency and scaling-up the dissemination and adoption of climate smart agricultural initiatives in the area.

Table 12: Correlation Coefficient matrices between latent variables of the Confirmatory Factor Analysis

Variables	Knowledge	Involvement	Competence	Importance
Knowledge	1			
Involvement	0.435***	1		
Competence	0.328***	0.189***	1	
Importance	0.074***	-0.170***	0.192***	1

***** p<0.01**

Source: Analysis of Field Survey, 2017



Source: Analysis of Field Survey, 2017

Figure 5: Path Diagram of Confirmatory Factor Analysis among the Constructs of Knowledge, involvement, importance and Competence

4.10 Chapter Summary

This chapter gave an overview of the results of data collected and analysed in the study. The findings of the research carried out as well as their implications to the study were fully discussed in this chapter. The first detailed discussion made was on the first objective of the study which is the socio-economic characteristics of the extension agents using of descriptive statistics. Findings from this section revealed that majority of the extension agents were in their active age, were mostly males, were married and also experienced. Furthermore, most of the extension agents possessed higher educational qualification with the average household size of approximately 5 persons.

The chapter further identified the prominent sources of information on climate smart agricultural initiatives by the extension agents in the study area and also the extension agents displayed high knowledge level on some of the climate smart agricultural initiatives as well as their involvement in the dissemination of these initiatives to the farmers. Competency level of the extension agents was also assessed in this chapter which revealed the areas of competency shortfall the extension agents have and highlighted those areas of competency needed on climate smart agricultural initiatives by the extension agents in the study area. Lastly, extension agents identified a number of constraints faced in the dissemination of climate smart agricultural initiatives to the farmers.

This chapter further presented the inferential statistics used in determining factors influencing the competency of extension agents on climate smart agricultural initiatives in the study area. Tobit regression model showed that educational qualification, participation in climate smart agricultural related trainings, years of experience, job level, number of communities covered, living in job location, knowledge, importance and involvement were variables that significantly influence extension agents' competency level on climate smart agricultural initiatives. The level of importance and involvement of the extension agents were significant at 1 per cent, participation in CSAI related training, job level, number of communities covered were significant at 5 per cent while educational qualification, years of experience, living in job location and knowledge level were significant at 10 per cent. Furthermore, Confirmatory Factor analysis model revealed a good and accurate model fit and shows a significant correlation between the constructs of extension agents' competency and other component of knowledge, involvement and importance confirming the influence of these variables on the extension agents' competency on climate smart agricultural initiatives. The significance of these variables in the models is an indication of their relevance in the capacity building of extension agents on climate smart agricultural initiatives thereby increasing their competency for better climate related extension and advisory services delivery to farmers in the study area.

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Introduction

The unfavourable effect of climate change on sustainable agricultural productivity and the livelihoods of a lot of farming communities and households is becoming more intense and creating solutions to the problem it is causing involving the application of a lot of environmental, technological and social interventions and control in all areas of agriculture which are referred to as Climate Smart Agricultural Initiatives. Climate Smart Agricultural initiatives involve the use of initiatives which increase resilient and stability in agriculture thereby helping farmers adapt to climate change risk and these initiatives as operationalized in this research includes water management initiatives, Soil initiatives, Tillage smart initiatives, Fossil burning reduction initiatives, Crop-mix initiatives and Agro-weather/ other technological initiatives. Extension agents who remain the most trusted source of information for rural farmers are therefore expected to be competent in these initiatives and should be able to offer adequate information, support and advisory services to famers. Hence the need to examine their level of competency in these initiatives in order to identify the areas of capacity building needed to ensure the efficient dissemination of these productivity-enhancing initiatives to farmers for adoption.

The main objective of the study was to assess the competency of extension agents on climate smart agricultural initiatives in South Western Nigeria. Specifically, the study made a detailed description of the socio-economic characteristics of the extension agents in the study area and also identified the sources of information used by the extension agents on climate smart agricultural initiatives. The study also examined the knowledge level of extension agents on climate smart agricultural initiatives, determined the involvement of extension agents in the dissemination of climate smart agricultural initiatives, examined the competency level of the extension agents on climate smart agricultural initiatives, determined the competency needs of the extension agents on climate smart agricultural initiatives in the study area and identified the constraints to the acquisition of needed competencies on climate smart agricultural initiatives in the study area.

This study was carried out in the South Western region of Nigeria which is made up of six states namely; Ondo, Ogun, Oyo, Osun, Ekiti and Lagos. The zone has an intensive operation on agricultural and extension activities which led to the choice of the study area. A two-staged sampling procedure was used in the selection of 277 extension agents and the use of structured questionnaire was employed to elicit information from the extension agents. Furthermore, descriptive and inferential statistics were used to analyse data. Models well fitted for the inferential statistics were Tobit regression and Structural Equation modelling using Confirmatory Factor Analysis.

5.2 Summary of major findings

The results of the descriptive analysis of the extension agents' socio-economic characteristics reveal that the mean age of the respondents was 40.22 years. Majority were males and married, having Higher National Diploma (HND) certificate and a mean household size of 5persons. More than half of the extension agents had no training on climate smart agricultural initiatives while their mean years of experience in extension service was 9.35 years. Majority of the respondents lived in their job location, travelled about 10km to the communities to provide extension services and had rural background.

The study identified five prominently utilized sources of information on climate smart agricultural initiatives among the extension agents. These information sources include Forth-night Training Sessions (FNTs), immediate supervisor, Extension publication and Bulletins, Radio and Seminar, Conferences and Workshop.

The respondents' knowledge level on Climate Smart Agricultural Initiatives revealed that extension agents in the study area exhibited low level of knowledge on several of the initiatives among which were all irrigation related water initiatives, and use change, use of soil amendments, conversion of waste to compost, agro-forestry, land reclamation, crop diversification initiatives, use of resource conservation and dissemination of weather related information to farmers through ICT. Their low level of knowledge also translated into their low level of involvement in the dissemination of several of these climate smart agricultural initiatives to farmers. The respondents were knowledgeable in some of the various categories of initiatives which include: Construction of water storage and channels, Utilization of drainage systems on farm lands, Use of organic manuring, Zero/minimum tillage practices, Use of Crop residue, Planting of cover crops, Use of mulching, Use of crop rotation and "Use of Weather Forecast.

Furthermore, although the extension agents rated a lot of the climate smart agricultural initiatives as important, the results of the competency level of extension agents on climate smart agricultural initiatives showed that extension agents were only competent in just a few of these initiatives some of which were water distribution related initiatives, use of crop residue, tree planting, use of mulching, mixed farming and use of crop rotation. On the other hand however, the extension agents had low level of competency on majority of the initiatives among which were: water harvesting and all irrigation related initiatives, land use change, use of soil amendments, Forage conservation, Contour cropping across hill slopes, Agro-forestry, land reclamation, use of resources conservation technologies, agro meteorology information, dissemination of weather related information to farmers through ICT, farm insurance initiatives and crop diversification initiatives.

The results of the competency needs of extension agents on climate smart agricultural initiatives in the study area revealed that the extension agents across the study area needed training in various areas of climate smart agricultural initiatives after the use of the Borich Needs assessment model. The prominent areas of initiatives where competency/ training is needed are: On Water management initiatives – training is required on all irrigation-related techniques; On Tillage-smart practices – training is required on land use change and use of soil amendments; On Fossil-burning reduction initiatives – training is required on practice of soil blanketing and conversion of waste to compost; On Soil management initiatives – training is required on agro-forestry such as Alley cropping and land reclamation; On Crop-mix initiatives – training is required on crop diversification and changes in planting depth of seeds and seedlings; and on ICT/Other initiatives – training is required on the use of resources conservation technologies, farm insurance practices and dissemination of weather related information to farmers through ICT.

The extension agents indicated the most severe constraints militating against their effective acquisition of needed competencies on climate smart agricultural initiatives to the farmers in the study area as Inadequate training on equipment for monitoring weather variations, Inadequate mobility of staff, Lack of climate change subject matter specialist, Poor access to knowledge and information on new technologies about climate change, and Inadequate information on climate change initiatives.

The study applied Tobit regression model to identify the socio-economic factors influencing the competency level of the extension agents on Climate Smart Agricultural Initiatives in the study area. The Tobit Regression model revealed that educational qualification, participation in climate smart agricultural training, years of experience, job level, community covered, living in job location, knowledge, importance and involvement in climate smart initiatives dissemination significantly influence the extension agents' competency level on climate smart agricultural initiatives.

Furthermore, the relationship between extension agents' competency level and the constructs, of their knowledge, importance and involvement were determined with the use of confirmatory factor analysis. The result of the analysis revealed that all the indicators used in the model displayed a good fit and adequately represented the hypothesized relationship used for the study. Finally, the result of the correlated construct of competency revealed a significant and positive correlation between the construct of extension agents' competence and the component of their knowledge, involvement and importance. The significance of the variables of knowledge, importance and involvement as they relate to the extension agents' competency in both models (i.e. the Tobit regression model and the confirmatory factor analysis model) constitute a clear indication that these variables are very relevant and key influencers of the extension agents' competency on climate smart agricultural initiatives and will therefore have strong policy implications for continuous upgrade of their competency and scaling-up the dissemination and adoption of climate smart agricultural initiatives in the area.

5.3 Conclusion

This study therefore concluded that the extension agents had low knowledge on several of the climate smart agricultural initiatives which also translated in their low level of involvement in the dissemination of these initiatives to farmers. Furthermore, the competency level of the extension agents was found to be very low in several of the climate smart agricultural initiatives including a lot of those they rated as important and the Borich needs model was adopted to identify the priority areas where training and more competency is needed on climate smart agricultural initiatives among the extension agents. These areas include training on all irrigation-related techniques, land use change, use of soil amendments, practice of soil blanketing, conversion of waste to compost, agro-forestry such as Alley cropping, land reclamation, crop diversification, changes in planting depth of seeds and seedlings, use of resources conservation technologies, farm insurance practices and dissemination of weather related information to farmers through ICT. In addition, the extension agents indicated severe constraints militating against their acquisition of needed competencies on climate smart agricultural initiatives effective delivery of climate smart agricultural initiatives to the farmers in the study area. The educational qualification, participation in climate smart agricultural training, years of experience, job level, number of community covered, living in job location, the knowledge of the extension agents, the importance they place on CSAI initiatives and their involvement in the dissemination of these initiatives were significant variables that were seen to influence the extension agents' competency level on climate smart agricultural initiatives.

5.4 Recommendation

The results of this study serve as an input to the development of agricultural extension service delivery and provide insight to the government, agricultural extension administrators and other policy makers on the development of the necessary adaptation strategy to adopt in setting policies that will develop the capacity and efficiency of the extension agents on climate agricultural extension in the study area. The following recommendations were made based on the findings of the study;

The proximity of extension agents to farmers was seen to enhance their competency on climate smart agricultural initiatives; the study therefore recommended that there is need to ensure that the distance travelled by the extension agents in reaching the farmers is reduced to allow for more frequent and effective dissemination of CSAI in the study area.

The various information channels on climate smart initiatives should be greatly improved upon and extension agencies should focus more attention on channelling climate smart related information through the frequently utilized sources of information highlighted by the agents.

There is the need to eliminate the severe constraints to acquisition of needed competencies on CSAI by ensuring the availability and accessibility of extension agents to climate change subject matter specialists in order to increase their knowledge and competence on new technologies and use of weather-related equipment so that they will be able to disseminate more effectively climate smart advisories to farmers.

Extension organizations should set up strategies that will encourage continuous professional education among the extension agents and create more opportunities for them to participate in climate smart agriculturally related trainings as these were significant variables that the study found to be influential in enhancing their competence on CSAI.

Extension organizations should develop the capacity of the extension agents in the areas of priority needs on climate smart agricultural initiatives identified though training that are focused on:

the dissemination of climate smart agricultural initiatives through the internet and other ICT initiatives,

irrigation and water storage related initiatives

land use and soil amendments

agricultural insurance initiatives

farm waste conversion and utilization and

resource conservation.

5.5 Contribution to Knowledge

The novelty and contribution of this research to knowledge is its ability to point out empirically the low level of competency of extension agents with specific focus on climate smart agricultural initiatives. More importantly, the study was able to point out twelve (12) major areas of core competency needs on Climate Smart Agricultural Initiatives cutting across the six categories of CSAI operationalized in the study. These is expected to serve as a major input in guiding governments, agricultural extension administrators and policy makers on the key areas to focus on in building and developing the capacity of field extension officers in being able to provide sustainable extension and rural advisory services on climate change adaptation and mitigation stategies to farmers in the study area.

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APPENDIX A

NWU®

NORTH-WEST UNIVERSITY
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UNIBESITI YA BOKONE-BOPHIRIMA

QUESTIONNAIRE

Questionnaire on Competency of Extension Agents on Climate Smart Agricultural Initiatives in South Western Nigeria

Questionnaire number: ....

State: ....

Dear Respondent,

This questionnaire is designed for the study of **Competency of Extension Agents on Climate Smart Agricultural Initiatives in South Western Nigeria.** All information obtained will be treated with **GREAT CONFIDENTIALITY**. The potential benefits to you as extension agents for taking part in this study is that it will generate knowledge about what types of training interventions are needed for effective dissemination of climate smart initiatives in the area. The potential risks from participating in this study are that you will be asked questions about your socio-economic status, knowledge and competency on some climate change adaptation and mitigation initiatives. **The questions are strictly for the purpose of this research**. Participation in this survey is voluntary and your provisions of responses to the questions indicate your willingness to participate in this research survey. You can refuse to answer specific questions or any question(s). All your responses will be summed together as a group with other respondents with no reference to individuals nor demeaning or impinging on the dignity of individuals that make up the group. Please, answer each question you respond to honestly and accurately as your participation in this exercise is crucial to the success of this study.

Thank you for your anticipated cooperation.

OLORUNFEMI, TEMITOPE OLUWASEUN
North West University
Department of Agricultural Economics and Extension
Mafikeng Campus, South Africa

Please Fill and Tick (✓) in the appropriate place where necessary.

Section A: Socio-economic Characteristics

1. Zone: ______________________
2. Local Government Area Covered: ______________________
3. Age of the Respondent: __________ years
4. Gender: Male ( ) Female ( )
5. Religion: Christianity ( ) Islam ( ) Traditional ( )
6. Marital Status: Single ( ) Married ( )
7. Number of children: ___________
8. Household Size: _________ persons
9. Educational Qualification: Sec. School Cert. ( ) College of Agriculture ( ) OND ( ) HND ( ) B.Sc ( ) M.Sc ( ) Ph.D ( )
10. Participation in Climate smart agricultural training: Workshop ( ) Seminar ( ) Conference ( ) Lecture ( ) Others (pls specify) ....
11. Years of Working Experience: __________ years
12. Average annual income: ____________________ naira
13. Current Job Level/Position: ______________________
14. Job location: ______________________

15. Number of community covered: ________________

16. Do you live in your job location area? Yes ( ) No ( )

17. State the average distance travelled to farmers from your office: __________ km

18. Background: a) Brought up in rural areas ( ) b) Brought up in urban areas ( )

Section B: Sources of Information Used on Climate Smart Initiatives

18. Indicate your sources of information on Climate Smart Agricultural Initiatives.

Information Sources	**Yes**	**No**	**Frequently Used**	**Sometimes Used**	**Not Used**
Agricultural research Institutes					
Extension Publications and Bulletins					
Forth-night Training Sessions					
Immediate Supervisor					
Internet					
Journals					
Local Business Organization					
Local news Agencies					
On-the Job specialized trainings					
Other Extension agents/colleagues					
Personal Quest for Knowledge					
Radio					
Seminars/Conferences/Workshops					
Television					
Local meteorological station					

Section C: Knowledge of Extension Agents on Climate Smart Agriculture

19. Kindly indicate your knowledge on the following techniques/initiatives by ticking the appropriate column below.

The following techniques can be adopted to adapt & mitigate the effect of climate change

Climate Smart Agricultural Initiatives	**True**	**False**
Water Management Initiatives		
Construction of water storage in ponds		
Utilization of drainage systems on farm lands		

Use of Flood irrigation		
Use of Drip irrigation		
Use of Canal irrigation		
Construction of artificial lakes		
Construction of water channels on farmland		
Water Harvesting		
Use of sandbag by river bank		
Tillage-Smart Initiatives		
Zero/minimum tillage practices		
Farm Fallowing		
Changes in planting dates/harvesting dates		
Mechanical weeding		
Use of herbicides		
Land use change		
Use of soil amendments		
Use of organic manuring		
Fossil Burning reduction Initiatives		
Use of Crop residue		
Forage conservation		
Practice of soil blanketing		
Conversion of waste to compost		
Soil Initiatives		
Contour cropping across hill slopes		
Afforestation/ reforestation		
Lengthened fallow		
Use of mulching		
Planting of cover crops		
Farm fragmentation		
Agro-forestry such as Alley cropping		
Land reclamation		
Zero grazing		
Tree planting		
Crop-Mix Initiatives		
Mixed farming		
Changes in planting depth of seeds and seedlings.		
Use of crop rotation		
Use of inter cropping		
Crop diversification		
Drought resistant varieties		
Early maturing varieties		
Pest resistant varieties		
ICT/ Other technological Initiatives		
Use of weather forecasts		
Timely dissemination of weather information to farmers through ICT		
Online internet access of climate related information		

Agro meteorology information		
Use of Resources conservation technologies		
Farm insurance		

Section D: Involvement of Extension Agents in the dissemination of Climate Smart Agricultural Initiatives

20. Are you involved in the dissemination of any of the following techniques as adaptation and mitigation strategies for climate change? Kindly tick the appropriate column below.

Climate Smart Agricultural Initiatives	**Involved: Yes**	**No**
Water Management Initiatives		
Construction of water storage in ponds		
Utilization of drainage systems on farm lands		
Use of flood irrigation		
Use of Drip irrigation		
Use of Canal irrigation		
Construction of artificial lakes		
Construction of water channels on farmland		
Water harvesting		
Use of sandbag by river bank		
Tillage-Smart Initiatives		
Zero/minimum tillage practices		
Farm Fallowing		
Changes in planting dates/harvesting dates		
Mechanical weeding		
Use of herbicides		
Land use change		
Use of soil amendments		
Use of organic manuring		
Fossil Burning reduction Initiatives		
Use of crop residue		
Forage conservation		
Practice of soil blanketing		
Conversion of waste to compost		
Soil Initiatives		
Contour cropping across hill slopes		
Afforestation/ reforestation		

Lengthened fallow		
Use of mulching		
Planting of cover crops		
Farm fragmentation		
Agro-forestry such as Alley cropping		
Land reclamation		
Zero grazing		
Tree planting		
Crop-Mix Initiatives		
Mixed farming		
Changes in planting depth of seeds and seedlings.		
Use of crop rotation		
Use of inter cropping		
Crop diversification		
Drought resistant varieties		
Early maturing varieties		
Pest resistant varieties		
ICT/ Other technological Initiatives		
Use of weather forecasts		
Timely dissemination of weather information to farmers through ICT		
Online internet access of climate related information		
Agro meteorology information		
Use of Resources conservation technologies		
Farm insurance		

SECTION E: Competency Level of Extension Agents on Climate Smart Agricultural Initiatives.

21. Kindly rate the importance of skills required and your competency level in the dissemination of climate smart Initiatives on a 3-point scale of **High (3), Moderate (2) and Low (1).**

Skill required in Climate Smart Agricultural Initiatives	Importance			Competence			Competency Needs (Summation of importance – competence)
	High	Moderate	Low	High	Moderate	Low	
Water Management Initiatives							
Construction of water storage in ponds							
Utilization of drainage system on farm lands							

Use of Flood irrigation							
Use of Drip irrigation							
Use of canal irrigation							
Construction of artificial lakes							
Construction of water channels on farmland							
Water harvesting							
Use of sandbag by river bank							
Tillage-Smart Initiatives							
Zero/minimum tillage practises							
Farm Fallowing							
Changes in planting dates/harvesting dates							
Mechanical weeding							
Use of herbicides							
Land use change							
Use of soil amendments							
Use of organic manuring							
Fossil Burning reduction Initiatives							
Use of Crop residue							
Forage conservation							
Practice of soil blanketing							
Conversion of waste to compost							
Soil Initiatives							
Contour cropping across hill slopes							
Afforestation/ reforestation							
Lengthened fallow							
Use of mulching							
Planting of cover crops							
Farm fragmentation							
Agro-forestry such as Alley cropping							
Land reclamation							
Zero grazing							
Tree planting							
Crop-Mix Initiatives							
Mixed farming							
Changes in planting depth of seeds and seedlings.							
Use of crop rotation							
Use of inter cropping							
Crop diversification							
Drought resistant varieties							

Early maturing varieties							
Pest resistant varieties							
ICT/ Other technological Initiatives							
Use of weather forecasts							
Timely dissemination of weather information to farmers through ICT							
Online internet access of climate related information							
Agro meteorology information							
Use of Resources conservation technologies							
Farm insurance							

Section F: Constraints faced in the acquisition of needed competencies on Climate Smart Agricultural Initiatives

22. Indicate the constraints faced in the acquisition of needed competencies on Climate smart agricultural initiatives in your area.

Constraints	**Yes**	**No**	**Very Severe**	**Severe**	**Not Severe**
Poor access to knowledge and information on new technologies about climate change					
Inadequate information on climate change initiatives					
Inadequate training on equipment for monitoring weather variations					
Poor working environment					
Weak/poor linkages between extension and meteorology institutions					
Inadequate mobility of staff					
Lack of climate change subject matter specialist					
Insufficient time					
High personal cost in acquiring					

competencies on climate smart agricultural techniques					
Lack of training resources on climate smart agriculture					
Inadequate organizational support in acquiring knowledge on climate smart agricultural initiatives					
Inadequate inclusion of climate smart agricultural strategies into training curriculum					
Lack of training incentives such as funding for acquiring competencies on climate smart agriculture					

APPENDIX B
LETTER OF INTRODUCTION

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

MAFIKENG CAMPUS

Tel: +27 18 389 2745 Fax: +27 18 389 2748 *Internet: http://www.nwu.ac.za*

20th July, 2017.

TO WHOM IT MAY CONCERN

Dear Sir/Ma

LETTER OF INTRODUCTION: TEMITOPE OLUWASEUN OLORUNFEMI

Mrs. Olorunfemi is a Postgraduate Student (Doctoral) of the above named institution with Student number 2·084998 and her research in on Competency of Climate Smart Initiatives in Nigeria. The title of his research is "**Competency of Extension Agents on Climate Smart Agricultural Initiatives in South Western Nigeria**"

Mrs. Olorunfemi will need your support and assistance on getting relevant information and data for her research work. All information obtained will be treated with great confidentiality and used strictly for research purpose.

Kindly give her the needed assistance in this regard.

Thank you for your anticipated cooperation.

Kind regards,

Prof. OLADELE O. I.
Research Supervisor

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YUNIBESITI YA BOKONE BOPHIRIMA
NOORDWES UNIVERSITEIT
MAFIKENG CAMPUS
DIRECTOR: SCHOOL OF AGRICULTURAL SCIENCES
2017 -07- 20
TEL. No: (018) 389 2··· / 2749
FAX No: (018) 389 ··48
WEBSITE: www.nwu.ac.za

APPENDIX C
PICTURES OF DATA COLLECTION

Cross section of Ekiti State ADP Extension agents filling the questionnaire administered to them

Cross section of Ondo State ADP Extension agents filling the questionnaire administered to them

Cross section of Ondo State ADP Extension agents filling the questionnaire administered to them

The researcher at the Oyo State ADP office after questionnaire administration

APPENDIX D
LIST OF PUBLICATIONS

The following manuscripts were extracted from the research carried out in this thesis and are undergoing review process

1. **Publication 1- Chapter Four of the Thesis**

   Determinants of the Involvement of Extension Agents in disseminating Climate Smart Agricultural Initiatives: Implication for Scaling Up. *Journal of the Saudi Society of Agricultural sciences* (Published) Available online at https://doi.org/10.1016/j.jssas.2019.03.003.

   Authors: T. O Olorunfemi, O. D Olorunfemi and O. I Oladele

2. **Publication 2 – Chapter Four of the Thesis**

   Borich Model Analysis of Extension Agents' Competence on Climate Smart Agricultural Initiatives in South West Nigeria. *Journal of International Agricultural and Extension Education* (Undergoing review)

   Authors: T. O Olorunfemi and O. I Oladele

3. **Work in Progress on Publication 3 – Chapter Four of the Thesis**

   Factors influencing extension agents' competence on climate smart practices and methods in South West Nigeria: A structural Equation modelling approach. *Journal of Developing Areas* (Tentative Publisher)

   Authors: T. O Olorunfemi and O. I Oladele

4. **Work in Progress on Publication 4 – Chapter Two of the Thesis**

Promoting Climate Smart Agricultural Initiatives in Sustaining Food Security in Africa. *Journal of Agricultural Education and Extension* (Tentative Publisher)

Authors: T. O Olorunfemi and O. I Oladele

5. **Work in Progress on Publication 5 – Chapter Four of the Thesis**

Knowledge level and constraints faced by the Extension agents in the dissemination of Climate Smart Agricultural Initiatives in South Western Nigeria. *Journal of International Agricultural and Extension Education* (Tentative Publisher)

Author: T. O Olorunfemi