EFFECTIVENESS OF EXTENSION AGENTS IN DISSEMINATING CLIMATE SMART AGRICULTURAL PRACTICES AMONG RICE FARMERS IN NORTH CENTRAL NIGERIA

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DECLARATION

I, IBUKUN, Elizabeth Olayiwola, a Ph.D student in the Department of Agricultural Economics & Extension, Landmark University, Omu-Aran, hereby declare that this thesis entitled "Effectiveness of Extension Agents in Disseminating Climate Smart Agricultural Practice Among Rice Farmers in North central Nigeria" submitted by me is based on my original work. Any material(s) obtained from other sources or work done by any other persons or institutions have been duly acknowledged.

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CERTIFICATION

This is to certify that this thesis has been read and approved as meeting the requirements of the Department of Agricultural Economics & Extension, Landmark University, Omu-Aran, Nigeria, for the Award of Ph.D

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ABSTRACT

The significance of extension agents (E.As) in mitigating the negative effects of climate change on rice farming cannot be overstated, as they aid in the dissemination of Climate Smart Agricultural (CSA) techniques. Studies on extension agents' engagement in CSA have rarely focused on how effective extension agents are at disseminating CSA practices, mostly to rice farmers. Therefore, effectiveness of extension agents in disseminating Climate Smart Agricultural practices (CSAPs) to rice farmers in North central Nigeria was investigated.

Multistage sampling procedure was used to select rice farmers. Purposive selection of Kwara, Kogi and Niger States, purposive selection of zone B in Kwara, zone A in Niger, and zone D in Kogi States respectively based on their involvement in rice farming. Proportionate sampling of 40% of blocks from each selected Agricultural Development Programme (ADP) stratum to give a total of 7 blocks. Random selection of 2 communities from each block giving a total of 14 cells and snowballing technique was used in selecting 350 contact farmers. All the eighty-eight extension personnel in each State's ADP strata were interviewed. Focus group discussion (FGDs) was held in each of the three ADPs zones. Data were analyzed with descriptive statistics, Borich need model analysis, and inferential statistics.

Majority of the E.As were males (93.2%), married (95.5%), village extension officers (64.8%), had tertiary education (85.2%) with average of 21years of experience. Majority of the E.As (77.3%) were indifferent towards CSA, a little above half (53.4%) fell within low level of participation in disseminating CSAPs among rice farmers. Generally, more than half (53.4%) of the E.As had high level of knowledge on CSAPs and a little above average (51.1%) had low competence on CSA practices. The dissemination method mostly used by the E.As in order of ranking are farm & home visits ($\bar{x} = 1.73$), result demonstration ($\bar{x} = 1.66$) and methods demonstration ($\bar{x} = 1.58$). The major challenges of the E.As in disseminating CSAPs include Insufficient number of extension workers to provide services for large number of farmers (E.A: farm families) ($\bar{x} = 1.87$), lack of incentives for staff motivation ($\bar{x} = 1.83$), inadequate training programs for extension agents in CSA ($\bar{x} = 1.76$). The mean age of the rice farmers was 49 years with most of them being males (88.9%), had attained secondary education (37.1%), full time farmers (77.1%), practice low land farming (97.7%). Generally, more than half of the rice farmers (54%) were aware of CSAPs, 56% had low knowledge, 52.6% had low uptake and 54.6% had low knowledge sharing. More than half of the E.As (52.9%) had low level of effectiveness in disseminating CSAPs to rice farmers. Results on test of hypotheses revealed that age (p=.000), educational level (p=.07) income (p=.000), years of experience (p=.000) and extension contact (p=.000) of farmers were significantly related to effectiveness of extension agents in disseminating CSAPs. Competence and external constraints of E.As had significant impact on the effectiveness of extension agents.

The study concluded that E.As had low level of effectiveness in disseminating CSAPs. The study recommends that while designing trainings, the competency needs of extension agents be taken into account to ensure that all important areas are covered.

Keywords: Extension agents, Climate smart agricultural practice, Effectiveness, Competence, Rice farmers.

DEDICATION

I dedicate this project to The Lord God Almighty, The Alpha and the Omega, The Glory and The Lifter of my head, who in His infinite mercies and loving kindness has been my very present helper in times of need all through the period of this research and will be afterwards. Thank you Lord!

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Finally I want to give three hearty hugs to my lovely angels, I mean Tanfoluwa and Emmanuel, you are all simply amazing, loving and wonderful children. Thanks for your great understanding always. May God's favour and mercies never depart from your life in Jesus name. I want you to know you're real blessings to my world and you're deeply loved and celebrated, may God bless and keep us forever in His unending love. May this height I achieved through your understanding and love be a stepping stone to your greater heights in life.

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ACRONYMS

ADP-Agricultural Development Programme

CSA-Climate Smart Agriculture

FAO-Food and Agricultural Organization

FMARD-Federal Ministry of Agriculture and Rural Development

USAID-United State Agency for International Development

SG- Sasakawa Global

IITA-International Institute of Tropical Agriculture

ARMTI- Agricultural and Rural Management Training Institute

IRRI- International Rice Research Institute

CIAT- Interenational Center for Tropical Agriculture

SSNM- Site Specific Nutrient Management

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Rice has become a daily staple food consumed globally throughout different religion, cultural and geographical boundaries. It is considered to be one of the most promising cereal crops to achieve the African Green Revolution as it is recognized as part of the basic diet of the population and is a significant source of revenue for many small producers (Tsusaka & Otsuka, 2013). Most individuals in Sub-Saharans, specifically those in West Africa, consider rice to be a necessary diet, as the consumption of cereals like millet and sorghum has declined and that of rice has risen due to population growth, changes in consumer priorities, and urbanization (Zalkuwi, 2019).

Likewise in Africa, due to the ever-increasing population, increase in demands from urban areas, and the ease of cooking, rice has evolved into one of the most essential staple cereals, as well as the second most consumed cereal after maize (Oladele, Chimewah & Olorunfemi, 2019). It is also one of the cereal crops in Nigeria that has substantially contributed to the agricultural sector, gain cash crop status, resulting in up to 80% jobs for residents of the producing area (Bello, Baiyegunhi, & Danso-abbeam, 2020)

Globally, rice is farmed in more than 100 nations throughout six continents and under different conditions (Rao, Wani, Ramesha, & Ladha, 2019). In 2009, it covered roughly 158 million hectares (M ha) of land and produced 470 million tons (Mts) of milled rice. (IRRI, Africa Rice & CIAT, 2010). The three largest rice producing countries are China (204, 285, 000 metric/tons), India (152, 600, 000 metric/tons) and Indonesia (69, 045, 141 metric/tons), however, Vietnam (43, 061, 569 metric/tons), and Thailand (37, 000, 000 metric/tons) were also recognized as the 4th & 5th main rice producing countries FAOSTAT, (2014). Nigeria is the greatest rice producer in the West African sub-region and ranks third in Africa, after Egypt and Madagascar (Oyinbo, Omolehin, & Abdulsalam, 2013).

In West Africa rice has been the continent's primary source of calories since the early 1970s, and it is the third largest source of calories (after maize and cassava) (Haggblade, Longabaugh, Boughton, Dembele, Diallo, Staatz & Tschirley, 2012). In Nigeria, rice is grown nearly on an area of 3,700,000 hectares, which makes up 10.6% of the overall land area of 35 million hectares as well as 70 million hectares total arable land area (Cadoni & Angelucci, 2013). As at 2016, rice produced locally in Nigeria was estimated at 4.8 million tons (FAO, 2016) and in 2017 there was an increase in production by 1 million tons. This increase was accredited to the Anchor Borrowers Program that made loans available and provides farmers with the necessary tools to increase productivity (RIFAN, 2017).

According to (Udemezue, 2018), over 8 million tons of rice are consumed annually, with consumption increasing by roughly 6% per year, while a typical Nigerian consumes 24.8 kg of rice per year, according to (Anyaoha, Uba, Onotugoma, Mande, Gracen, & Ikenna, 2019). This implies that the consumption rate is far greater than the production rate. Despite the increase in rice production, Nigeria can only meet 49 percent of its own internal demand (Udemezue, 2018). Therefore, there is need for increase in the local rice production by ensuring the incorporation of adaptation measures that are climate smart. As a result, there is a need to increase local rice production by incorporating climate-smart adaptation measures.

Nigeria is recognized as the world's top rice importer, with a 3.4 million tonnes expected import (Bello et al., 2020). However, studies have revealed that most Nigerians prefer imported rice brands to native rice kinds. This could be as a result of the poor processing technology used by the rice processors (Ajala & Gana, 2015). For example, FAO estimates that by 2030, the world's rice consumption will rise from 586 million metric tons in 2001 to 756 million metric tons (Udemezue, 2014). In view of the foregoing, local rice output can be boosted if rice farmers implement appropriate Climate Smart Agricultural practices (CSAPs), such as the adoption of improved rice varieties and the application of soil amendments, among others.

Different rice production methods practiced in Nigeria include rainfed lowland, rainfed upland, mangrove swamp and deep inland water, irrigated lowland, (Anyaoha et al., 2019; Van Oort & Zwart, 2018). However, the most common method used in Nigeria is rainfed upland rice farming, which is prominent in areas such as Ado-Ekiti, Abakiliki, Abeokuta, Gombe, Zamfara, and Yola in the north, and Ogoja in the south. (Nwaobiala & Adesope, 2013; Olanrewaju, Tilakasiri, & Oso, 2017). The rainfed upland rice production method are mostly practiced by small scale farmers and it is mostly attributed with low yield as of result of some climate change factors such as drought, stress related to irregular rainfall as the primary water supply Kumar, Dixit, Ram, Yadaw, Mishra, & Mandal, 2014). Also as reported by (Ajetomobi, Abiodun & Hassan, 2011; Ali, Liu, Ishaq, Shah, Ilyas, & Din, 2017; Anyaoha et al., 2019) rice-growing communities in Nigeria are mostly challenged with drought stress caused by increased variation in rainfall pattern within rice growing seasons. An increase in drought stress hence have an adverse effect on the rice crop physiology, morphology and molecular trait, which might result in reduced grain production and quality (Bernier, Atlin, Serraj, Kumar, & Spaner, 2008; Kumar et al., 2014). This means that climate change will have an ongoing impact on rice output in Nigeria, and CSAP adoption would be hampered if it is not effectively disseminated to the farmers by the extension agents.

1.2 Challenges of rice production in Nigeria & the way forward

Rice production faces numerous obstacles, the most significant of which is climate change, as most production activities are carried out in open fields. One of the research conducted by (Anyaoha et al., 2019) pointed out that most rice farmers are faced with the challenges of change in rainfall pattern, pest & weed infestation, flooding which are all attribute of climate change. More so, most farmers lack the information & capacity resources needed to reduce the impact of climate change on rice production. Furthermore, as stated in a study conducted in Niger state, Nigeria, factors such as high labor costs, inadequacy of capital, unavailability of improved rice seeds, and diseases and pests have a substantial impact on rice productivity. Likewise, providing farmers with greater agricultural loans may result in increased rice harvest (Nwankwo & Chigbo 2019).

According to (Rahman, 2012), one of the issues that rice farmers experienced was a lack of awareness about IPM (integrated pest management) and sufficient training in IPM practice, which may result in reduced yield. However, the country's rice production statistics reveal that the country need 7 million metric tons more than the 5.8 million metric tons it currently produces (Udemezue, 2018). This implies that rice production need to increase in order to reduce food insecurity and hunger in the future.

Ajetomobi et al., (2011) stressed that salt stress, drought (Water shortages), flooding, and extreme temperatures, are among some of the key concerns related with rice production and climate change is expected to worsen all of these issues. However, Babatunde, Salami, & Muhammed, (2017) reported that rice production is more profitable and efficient under the irrigated production system than the rainfed production system. However, associated with irrigated lowland rice farming is Green House Gas (GHG) emissions, that produces almost four times the amount of greenhouse gases (GHG) for every ton of crop as wheat or maize, with methane and nitrous oxide as their most common forms. Major constraints to rice production as noted by Fahad et al., (2019) include salt stress, climatic factors, soil nutrients imbalance, pest, diseases such as rice blast and economic and social factor

As a result of the aforementioned issues, a solution to this problem is required. The term CSA was then coined by FAO in a preliminary report from the Conference on Agriculture, Food Security and Climate Change held at Hague in 2010. The Climate Smart Agriculture (CSA) definition was created with a strong emphasis on food security and climate change adaptation both for now and in the future. According to (FAO, 2010), CSA is a holistic strategy to landscape management (livestock, fisheries, cropland, and forests) that explores the intertwined issues of rapid climate change and food security. More so, Tiamiyu, Ugalahi, Fabunmi, Sanusi, Fapojuwo, & Shittu, (2017) reported that food adequacy can be guaranteed despite inadequate weather through Climate-Smart Agricultural (CSA) practices. This is realized through a variety of soil management practices that store carbon in the soil, minimize greenhouse gas emissions, and contribute in the intensification of production (FAO, 2013).

Olorunfemi, Olorunfemi, & Oladele, (2019) also asserted that increase in agricultural production can only occur by incorporating a good deal of technological, social and environmental intervention known as Climate smart agriculture interventions (CSA) used by farmers in mitigating and adapting to the devastating impact caused by climate change. Climate Smart Agriculture (CSA) stands for “Agriculture that aspires to sustainably raise production, improve resilience (adaptation), wherever possible, reduce/eliminate GHGs (mitigation), and encourage the attainment of development goals and national food security (FAO, 2013). However, CSA is not an all-encompassing set of practices that each farmer should adopt. Its form has to be defined in each location by context (i.e level of climate change vulnerability, varying population risk profiles, resource availability, and livelihood options). Some examples of CSA practices include diversification of farm enterprise, proper timing and application of farm operations, soil and water conservation measures (such as minimum or zero tillage, construction of water-retention structures, planting crops that enhance ground cover quickly and use minimal water), crop rotation and intercropping by incorporating legumes to promote soil fertility, farmyard composting and adopting farmyard manure management through biogas production, and minimize release of methane amongst others (FAO, 2018). CSA operations may also necessitate farmers having access proximity to particular inputs such as seeds and tree seedlings (Lipper et al., 2014).

An innovation platform is one type of institutional innovation that can aid in climate change adaptation and mitigation (Leeuwis, Hall, Weperen & Preissing, 2013), and this platform is an area where ADPs (Agricultural development projects) can serve as a facilitator and a broker for a variety of tasks, such as bringing farmers together to discuss adaption techniques with researchers and building climate service tools.. Although, extension agents are widely saddled with the responsibility of assisting farmers in identifying their problems and exploring appropriate answers by combining indigenous knowledge with improved knowledge, provide new information to farmers, encouraging utilization of new technology or new methods of crops and farms managements, connecting farmers with researchers and other actors in the innovation system and act as brokers, facilitators, and implement policies and programmes Akinnagbe, (2018), There isn't a lot of research on significance of extension agents in fostering resilience Rupan, Saravanan, & Suchiradipta, (2018); Davis, Babu & Blom, (2014).

Therefore, there is need to probe or investigate the effectiveness of extension agents in disseminating climate smart agricultural practices. This study is an attempt in this direction.

1.3 Statement of problem

Rice is globally recognized as a basic diet for over half of the world's population with over 3.5 billion people relying on rice for 20% of their daily calorie intake (IRRI, Africa Rice & CIAT, 2010). It is a staple food in various African countries and accounts for a significant amount of the diet on a regular basis Merem et al., (2017). More so, Fahad et al., (2019) revealed that about 75% of rice produced globally is gotten from 85 to 90 M ha of paddy lowland areas, where rice is cultivated up to three times on the same field yearly. This insinuates that majority of the rice produced globally solely depend on some climate indicators such as temperature, rainfall and so on which invariably means any change in climate will affect their production.

Generally, crop production in Nigeria and Sub-Saharan Africa at large is rain-fed Enete & Amusa, (2010) and therefore any change in climate will have an inauspicious impact on their output. Climate change is a natural result of human activity, and it is believed that it has already reduced global maize and wheat yields by 3.8 percent and 5.5 percent, respectively (Lobell, Schlenker, & Costa-Roberts, 2011) and also global rice yield is reduced by 0.3% on average every year Ray, West, Clark, Gerber, Prishchepov, & Chatterjee, (2019). Upland rice farming strategies that rely on rainwater are generally depicted by low yields caused by stress from sporadic drought as a result of sole reliance on unreliable rainfall as the primary source of water Kumar et al., (2014)

Ronald, Dulle & Honesta, (2014) in a study in Tanzania, showed that some of the information needs of rice farmers include agricultural credit/loan, weather condition, new seeds, storage method, diseases and pest control, planting methods, , pesticide availability and its application and marketing information. While Tondo, CLN, CLN, & Akaaimo, (2019) noted that rice farmers in Benue require information on better varieties, agricultural loan and credit facilities, contemporary farm technology, and market location, all of which are characteristics of climate smart agricultural practices.

Several studies have been carried out on climate and agriculture in Nigeria. Some of them focused on impact of climate change on rice (Chandio, Magsi & Ozturk, 2020; van Oort & Zwart, 2018; Ladan, 2014; Nwalieji & Uzuegbunam, 2013; Ayinde, Ojehomon, Daramola & Falaki 2013) some on adaptation strategies to climate change (Akinnagbe & Irohibe, 2015; Limantol, Keith, Azabre & Lennartz 2016; Mbah & Ezeano, 2016; Ojo & Baiyegunhi, 2018; Ifeanyi-obi, Etuk, & Jike-wai, 2012) while some on adoption and dissemination pathways for CSA practices (Kughur, 2015; Nyasimi, Kimeli, Sayula, Radeny, Kinyangi, & Mungai, 2017; Tiamiyu, Ugalahi, Eze, & Shittu, 2018; Tiamiyu, Ugalahi, Fabunmi, Sanusi, Fapojuwo, & Shittu, 2017) This is an indicator that climate change is real and has significant impact on agricultural production in Nigeria.

However, research has revealed that farmers are responding to shifting climate situations, but the uptake of possibly advantageous measures is frequently low Arslan, McCarthy, Lipper, Asfaw, & Cattaneo, (2014) and McCarthy, Lipper, Branca, & Security, (2011). This was also ascertained by a number of researchers who have observed limited climate adaptation practices uptake and utilization (Akinnagbe & Irohibe, 2014; Ali & Erenstein, 2017; Tripathi & Mishra, 2017). More so, Tiamiyu et al., (2018) pointed out that adoption rate of CSA practices in guinea savannah region is generally very low. The low adoption rate can be ascribed to the knowledge of human as well as their flexibility to respond to the negative consequences of climate change Olorunfemi et al., (2019). The low level of adoption can also be attributed to inadequate information communicated to the farmers through the extension agents. This was ascertained by Zarmai, Okwu, & Dawang, (2014) and Tologbonse, Fashola, & Obadiah, (2008) who states that in certain cases, farmers' low yield is due to their adoption attitude/actions and perception of information sources of information which are the extension agents.

Another major constraint to accessing information by rice farmers as identified by Tiamiyu (2001) and Zarmai et al., (2014) is inadequate accessibility and availability of contemporary information technology components in Nigerian government entities. In Malawi, Kakota, Maonga, Synnevag, Chonde, & Mainje, (2017) asserted that there is a lack of coordination of messages, tactics, and methodologies in field extension delivery for promoting CSA practices. Likewise, River Basin Development Authorities (RBDAs) and ADPS, which have been at the cutting edge of supplying rice producing facilities and infrastructure has become inefficient due to inadequate funding, mismanagement, and poor administration. As a result, reduction in yield will continue to be the experience of the farmers, unless agronomic restrictions are solved & handled correctly (Udemezue, 2018).

Thus, in order to sustain and increase rice production level in line with the food sufficiency aim of the country coupled with the sustainable development goals (SDG) of zero hunger and climate action, farmers need to be informed and knowledgeable on certain agricultural practices that help to boost their production amongst the climate change menace, which is the responsibility of agricultural extension agents. This is mostly because rice farmers have acknowledged using and preferring information disseminated by extension agents (Adisa, Ahmed, Ebenehi, & Oyibo, 2019). Likewise, Tologbonse, Fashola, & Obadiah, (2008) revealed that most farmers want information from extension agents and choose personal contact as a preferred communication mode. Daudu, Chado, & Igbashal, (2009) was of the opinion that most farmers selected extension agents as their source of knowledge.

In alliance with the projection of increase in population by 2.4 billion inhabitant in developing countries (Lipper et al., 2014), and expectation of increase in global rice production by 116 million (26%) by 2035, rice production should be increased as it is a staple food in the country. More so, contemporary research anticipated that world rice output needs to rise by 7-13 percent over the next decade to come, and double by 2050 to meet the estimated need at current market prices (Ray, Mueller, West, & Foley, 2013; OECD/FAO,2019; USDA/FAO, 2019). As we expect a significant increase in rice output in the near future, this might put great pressure on limited natural resources and exacerbate environmental degradation. This therefore calls for sustainable practice or production system among rice farmers.

However, there are varieties of literatures as regard extension agents and climate change issues across countries (Oladele, 2011; Dimelu 2016; Mainje, 2017 and Olorunfemi et al., 2019). These studies are useful because they assisted in informing us that extension agents have been involved in disseminating CSA practices to farmers, but there are still questions as to whether they were effective in performing their roles. Olorunfemi et al., (2019) explored determinant of extension agents' involvement in promoting CSA activities in Nigeria's south western region. Okwuokenye & Okoedo-Okojie, (2014) also evaluated extension agents' commitment to the Agricultural Loans and Inputs Supply Program for Special Rice Production in Delta State, Nigeria. Climate change knowledge and perceived effects on extension delivery were explored by (Oladele et al., 2011) in the province of North West, South Africa.

Ahmed & Adisa, (2017) examined perceived effectiveness of agricultural extension methods used to transfer improved rice technology to rice farmers in Kogi state, Nigeria. Also, Dimelu, (2016) analyzed the factors that influence extension professionals' knowledge and attitudes on climate change in Anambra State, Nigeria. From the foregoing, it is evident that there are large numbers of literature on extension agents' knowledge, involvement, in climate change issue. Many studies have investigated issues relating to impact and effect of climate change on agriculture as earlier stated. However, literature is still scanty in the country on how effective the extension agents are in disseminating CSA practices. More so, Onyeneke et al., (2019) stated that climate change adaptation studies in North central is just 14 percent. This is the research gap this study has attempted to fill. It is only when the effectiveness of extension agents and its determinants are known that CSA policy can be properly implemented.

1.4 Research Questions

This research work therefore will attempt to provide answers to the following research questions.

i. What are the socio economic characteristics of both the farmers and extension agents?
ii. What is the knowledge level of the extension agents?
iii. What attitude do the extension agents have towards climate smart agriculture?
iv. How has the extension agent participated in disseminating CSA practices?
v. What are the teaching/ information dissemination methods used by the extension agents in disseminating CSA practices ?
vi. What is the competence and competency need of extension agents

vii. Are the extension agents effective in disseminating CSA practices to the rice farmers?

viii. What are the constraints to the dissemination of CSA practices to the

1.5 Research objectives

The broad objective of the study is to evaluate the effectiveness of extension agents in disseminating climate smart agricultural practices in north central Nigeria. The specific objectives of the study are to:

1. ascertain the socio economic characteristics of the respondents(extension agents & farmers) in the study area
2. determine the knowledge level of extension agents
3. ascertain the attitude of extension agents to CSA practices
4. examine the level of participation of extension agents in disseminating CSA practices
5. determine the information dissemination methods used by extension agents
6. determine the competence and competency need of the extension agents
7. examine the effectiveness of extension agents in disseminating CSA practices, and
8. identify perceived challenges/ constraints associated in disseminating CSA practices

1.6 Hypotheses of the study

The hypotheses of the study, stated in null form, are as follows;

H_{01}: There is no significant relationship between the socio-economic characteristics of farmers and effectiveness of extension agents in disseminating CSA practices

H_{02}: There is no significant relationship between knowledge and competence of extension agents

H_{03}: There is no significant relationship between attitude and competence of extension agents’

H_{04}: There is no significant relationship between personal & professional characteristics of extension agents and competence of extension agent in disseminating CSA practices

H_{05}: There is no significant relationship between the socio-economic characteristics' of extension agents and constraints/challenges in dissemination in disseminating CSA practices

H_{06}: There is no significant difference in effectiveness of the extension agents' among the three states

1.7 Justification of the study

This research is basically undertaken to elicit and analyze data for understanding and enhancing effectiveness of extension workers in disseminating CSA practice in North central and may have an implication in rice producing region in Nigeria at large.

There is a paucity of scientific information about extension effectiveness in disseminating CSA practices. Particularly, on their competency and competency need, knowledge, extension teaching method used and factors affecting their effectiveness. Also, there is no indication of their interrelationships and varied significance. Information from this research will provide proper assessment of extension workers' needs based on their knowledge and competence. CSA practices readily available to the rice farmers and the best practices needed by them. It could as well form the premise for enhancing extension workers job performance and subsequently farmers' adoption of CSA practices. Thus, the findings of the study may have policy implications.

Through these findings, policy makers could make informed decisions in relation to the areas of competency need by extension agents. Consequently, accruable benefits from these policies would reflect on the rice farming communities being served by the extension service providers.

This report would be useful to the global communities, government and non-government agencies that provide financial assistance as well as executive planners in charge of extension services in the country to determine the extent of effectiveness of extension agents in performing their roles. Furthermore, through major findings and recommendations of this study, intervention programmes on CSA for extension service providers will be properly planned in relation to how, where and when such programmes should be introduced so as to increase rice output and reduce unavailability, inaccessibility and unaffordability of rice in the long run.

Finally, this research will add to the present system of agricultural structural knowledge as well as provide relevant data to other researchers in related fields of study, as a result of the report obtained.

1.8 Operational Definition of terms

Agricultural extension: Agricultural extension is a continuous process of delivering helpful information to farmers and assisting them in gaining the knowledge, skills, and attitudes necessary to increase their productivity and use the information they receive.

Extension Agents: Extension agents can be conceptualized in this study as persons that are trained regularly with the expectation of disseminating information adequately to farmers in order to improve their knowledge and their standard of living.

Climate smart agriculture (CSA): is an "agricultural practices that increases output in a sustainable manner, builds resilience (adaptation), lessens GHGs (mitigation) whenever possible, as well as contributes to the achievement of national food security and development goals.

Soil smart mechanism: can be defined as are practices related to soil so as to improve the soil nutrients and capacity.

Crop smart mechanism: are practices associated with crops, that is increasing the crop capacity.

Water smart mechanism: are techniques/ methods used to improve water efficiency, so as to increase rice production without necessarily releasing GHG's (green house gas emission).

Weather smart mechanism: can be defined as practices related to weather information beneficial to farmers and helps in reducing the consequences of climate change.

Attitude: Attitude of extension agents can therefore be conceptualized as an individual's reaction/perception towards an innovation, and it is a determinant of the success of such innovation.

Competency: Competency of extension agents can be defined as the ability and capacity of the extension agents to carry out the climate smart agricultural practices efficiently &effectively as expected.

Competency need: can be described as the training needs required by the extension agents to improve their knowledge, skills and performance in a particular technology (CSAP)

Effectiveness of extension personnel:

Extension organizations' efficacy/effectiveness is defined by the capacity of extension agents to develop, implement, and assess effective educational programs, as they are directly servicing the people's needs. Hence effectiveness of an extension worker can be defined and conceptualized as the degree or extent to which an extension worker successfully has perform his role.

CHAPTER TWO

2.0 LITERATURE REVIEW & CONCEPTUAL FRAMEWORK

2.1 Conceptual Issues

2.1.1 The Concept of Climate change

The term climate change is used interchangeably with global warming and this is mostly among academicians and in the in media. However, the term though scientifically similar describe two different processes that are intertwined Zikhali, (2016). Global warming can be defined as an increase in the average global temperature caused by excess greenhouse gases such as carbon dioxides, methane, and chlorofluorocarbons Gaan, (2008), whereas change in climate is defined as a prolonged increase or reduction in the global average temperature (Hussen, 2004).

According to Intergovernmental panel on climate change (IPCC, 2007) climate change can be define as a major change in the state of a place's climate that can be characterized by changes in the average and/or variability of its attributes that persist over a long period of time.. Thus it can be said that climate change connotes any form of climatic inconsistency which occurs for a long-term. FAO, (2015) describe climate change as an alteration in average climatic conditions throughout time or indefinitely. Ayoade, (2003) further explained changing climate during the course of 100 to 150 years cannot be referred to as a climate change because the conditions will quickly be rectified, but rather changes in climate that occur over the course of 150 years or more and have major and long-term repercussions on the ecosystem.

Two factors that basically cause climate change include natural processes (biogeographical) and human activities (anthropogenic). Extraterrestrial and astronomical factors are examples of the natural processes. The astronomical factors include the variations in the ambiguity of the plane of ecliptic, variations in the oddity of the earth’s orbit, and variation in orbital procession whereas extraterrestrial influences include solar radiation quantity and quality, among others.

On the other hand, the anthropogenic factors are the human actions that either emit huge amounts of greenhouse gases into the atmosphere, depleting the ozone layer, or diminish the amount of carbon absorbed from the environment.For instance, gas flaring, Fossil fuel combustion, industrialization, urbanization, and agriculture are examples of activities that release significant volumes of greenhouse gases. While, Agricultural practices, changes in land use, deforestation, and water pollution are examples of human activities that reduce the number of carbon sinks.

Human factors have apparently been proven to be the cause of the unstoppable global warming and climate change IPCC, (2007). Carbon dioxide, methane, nitrous oxide and chlorofluorocarbons are among the greenhouse gases emitted. Carbon dioxide now contributes the most to greenhouse gas emissions, followed by methane, chlorofluorocarbons, nitrous oxide and others (such as tropospheric ozone, sulfuric hexafluoride and halons) Akpodiogaga-a & Odjugo, (2010)**.** It is surprising that Agricultural practices have long been recognized as having a significant impact on climate change, coming in third after industry and transportation in terms of carbon dioxide emissions. Land use changes contribute another 8 percent or so to total anthropogenic greenhouse gas emissions, with emissions from agricultural sources accounting for about 15% of that (Ozor & Nnaji, 2011). The following are agricultural activities that reinforce effects of climate change:

- Land clearing and plant biomass burning for farming or wood also releases carbon stored in the soil
- Inadequate tillage procedures uncover the soil, allowing the earth's carbon to be released.
- Wrong timing and haphazardly use of agrochemicals harm the ecosystem.

2.1.2 Climate change & Agriculture

Climatic change could have a variety of impact on agriculture: agricultural operations, via alteration in irrigation and agricultural inputs such as insecticides, herbicides and fertilizers; productivity, in terms of crop quality and quantity; soil erosion; environmental effects, particularly in terms of soil drainage frequency and intensity (leading to nitrogen leaching), and crop yield reduction.

Climate change has caused fluctuations in temperature, which have a direct impact on food production. Most African nations are susceptible to the effects of climate change and unpredictability since agricultural production in these countries is essentially relies on rainfall for water and subsistence-based (Akinnagbe & Irohibe, 2015). Climate change affects production systems, disrupt the functioning of ecosystems and then increase the pressure on ecosystem services. According to Fakava, (2012), climate hazard on agricultural production include heat stress on plants, loss of soil fertility through erosion of top soil, changes in soil moisture and temperature, less water available for crop production, changes in height of water table, salinization of freshwater aquifer and loss of land through sea level rise.

Nigeria is highly vulnerable to the impacts of climate change. Stated below are visible changes as a result of its impact:

- Variations in duration, amounts and intensity of rainfall
- Increase in average temperature;
- Changes in the onset and end of the rainy seasons
- The emergence of new and different pests and diseases
- Changing strength and direction of winds
- Increased droughts and floods
- Increased temperatures and stronger solar radiation; (FAO 2015, Worldbank 2015).

Higher temperatures, ocean acidification, water scarcity, land devastation, more frequent extreme weather events, rising sea levels, habitat disruption, and biodiversity loss are among the predicted consequences of climate change. All of this could imperil agriculture's ability to feed the world's poorest people, impeding progress toward reducing hunger, malnutrition, and poverty (FAO, 2016). Agriculture is also a big contributor to climate change. Currently, it accounts for 19-29 percent of total greenhouse gas emissions (GHG).

Climate change has a lot of impact on Agriculture, among which (Ozor & Nnaji, 2011) reported that intense weed growth, pests and diseases outbreak, soil erosion, disruption and destruction of wildlife ecosystems, loss of vegetation/pastures, decrease in soil fertility, seasonal climate uncertainties such as fluctuations in rainfall pattern, temperature, decrease in crop and animal yields, as well as a lack of portable water supply for human and cattle consumption, storage losses in roots and tubers, post harvest losses due to climate variability, flooding, premature ripening, high rainfall intensity, heat from high temperature, shortening of crop cycle, drought, decrease in soil moistures, loss of farm land/households due to floods and erosion, drying of rivers, lakes, and surface water bodies, crop destruction in the field due to rain and wind.

According to Ray et al., (2019) climate change generally results in lower yields across Sub-Saharan Africa, Europe and Australia. Although yields in Latin America have increased, outcomes in North, Central, and Asia have been variable. The percentage change in recent yield for all croplands harvested globally ranged from -13.4 percent (oil palm) to +3.5 percent (soybean). Recently, compared to the previous year, yields for rice and wheat fell by 0.3% and 0.9%, respectively, while for maize, yields increased by 0.2%, respectively. This results in a reduction of the amount of calories consumed by rice, wheat and maize by 0.4, 0.5, and 0.7 percent respectively. Western and Southern Europe experienced reduction in their dominant crop such as wheat (-2.1%), maize (-24.5%), and barley (-9.1%), and this is attributable to climate change.

France's agricultural production of edible food calories was reduced due to significant yield / production losses across crops, such as barley, cassava, maize, rice, sorghum, sugar cane, soybean, wheat, oil palm, and rapeseed by 24% or -7% of total dietary calories consumed. Climate change has resulted in significant declines in consumable food calories in these 10 crops in Italy (-7%), Germany (-11%), Spain (-4%), and other important Western European agricultural countries.

Crop yields in Sub-Saharan Africa fell by 5.8 percent for maize and 3.9 percent for sugarcane, respectively. Meanwhile, maize yields on this continent have fallen overall, but cassava yields have grown in response to climate change, albeit this varies by location. Cassava yields, for example, dropped in the central and southern parts of Madagascar but climbed in northeastern Madagascar and Eastern Africa in general.

2.1.3 Climate change and Rice production

Changes in climate have been recorded to affect agricultural produce including rice. Anyaoha et al., (2019) assessed the awareness and perceptions of farmers to changing rainfall patterns across two rice growing states in south western Nigeria. A participatory rural appraisal (PRA) which include comparative approach, probing and semi structured interviews was used in eliciting information. Data was collected from 119 rice farmers and the farmers identified pests, weed infestations and drought stress as the major constraint and flooding as a minor constraint limiting upland rice production in the study area. A change in rainfall pattern was also recognized with a decrease in amount of rainfall during crop growing season. It is noteworthy that less than 10% of the farmers use improved rice varieties and use information from weather observation to ensure stability of rainfall before planting. This is because they do not have access to irrigation, therefore they rely solely on rainwater to irrigate their rice fields. During drought stress, however, majority of farmers' pray God the Creator for rain or make sacrifices to please the gods.

This means that the vast majority of farmers are ill-equipped to deal with the threat of drought stress in their fields.

2.1.4 Climate Smart Agriculture

CSA is a strategy for achieving sustainable agricultural development for food security in the face of climate change by establishing technological, policy, and investment conditions. As a platform for educating and reorienting policy in response to climate change, CSA identifies synergies and trade-offs among, adaptation, mitigation and food security.

It ushers in a transition to agricultural production systems that are more resilient to risks and shocks, more productive and efficient, and less susceptible to long-term unpredictability, while also lowering GHG emissions and sequestering carbon.

CSA has its foundation on three pillars which are productivity, adaptation and mitigation. CSA is also an approach for developing the technical, policy, and investment conditions to achieve sustainable agricultural development for food security under climate change

(World Bank, 2016). However, their technical feasibility can be highly productive and profitable (Lipper et al., 2014). CSA also aims at transforming and reorienting agricultural systems cut across crops, livestock and fisheries sector so as to support food security and poverty reduction up against the changing climate (FAO, 2018). Climate smart agriculture is neither a new agricultural system nor a new set of practices, but it is a new way to steer the necessary adjustments in agricultural systems in light of the need to address food security and climate change simultaneously.

Criteria for CSA Implementation

In order to implement CSA, certain climate-smartness indicators are required which include:

• CSA-**Technology**: helps to determine how well technology will contribute to the CSA's goals

• CSA-**Policy:** On the other hand, help determine the extent to which an enabling environment (e.g. policies) supports CSA.

• CSA-**Result:** track the short-term outcomes of CSA programs (Rawlins, 2015).

However, an integrated approach that is responsive to specific local situations is essential for CSA to become a reality.

2.1.5 Need for Climate Smart Agriculture

Agriculture, despite its contribution to climate change can also help in reducing the emission of GHG. A number of adaptation strategies to mitigate the climate change effect are summed up under a term called CSA (climate smart agriculture) so as to reduce adverse effects or even reduce or absorb GHG emissions.

According to the World Bank, (2015) and FAO, (2016) CSA is a basket of agricultural practices and techniques that not only aims at increasing profits and resilience for farmers but does so without harming, often even bettering, environmental parameters. It improves input efficiency, soil quality and benefit-cost returns for farmers while limiting the expected negative effects of climate change on Kenyan agriculture for producers and consumers.

Main features of climate smart agriculture

1. Addresses adaptation and increases shock resilience
2. Looks at climate change mitigation as a potential co-benefit.
4. Identifies and integrates choices that produce synergy while minimizing trade-offs
5. Identifies adoption barriers and develops appropriate solutions
6. Improves livelihoods by enhancing access to resources, services, and knowledge
7. Synchronizes climate finance with traditional investment sources

Therefore, adoption of CSA practices by farmers needs to be promoted so as to ensure sustainable farming and enhance increase in production by supporting the farmers in terms of finance and also provision of agricultural inputs. Farmers can further be motivated to use CSA practices if they are trained on pulling of resources together via cooperative societies.

2.1.6 Success Attributed to Climate Smart Agricultural Practices:

Globally, agricultural practices and technologies are categorized to be climate-smart if they have potential to generate benefits that is integrated (CGIAR, 2018). For instance, minimized tillage methods can boost productivity by improving soil quality, aid in mitigation by increasing carbon sequestration, and strengthen farmers' resilience to climate shocks like drought and flooding. (Branca, McCarthy, Lipper, Jolejole, 2011: Thierfelder, Chivenge, Mupangwa, Rosenstock, Lamanna, & Eyre, 2017).

The Urea Deep Placement (UDP) technique is a climate smart technology developed by the International Rice Research Institute (IRRI) and International Fertilizer Development Center (IFDC). As part of the UDP approach, the urea is converted into "briquettes" of 1 to 3 grams, which are subsequently deposited in the soil at a depth of 7 to 10 cm after the paddy is transplanted. This method reduces nitrogen losses by 40% and increases urea efficiency by 50%. A 25 percent reduction in urea usage results in 25 percent more yield.

UDP was employed by a million farmers on half a million hectares in 2009. The broad adoption of this UDP technique in Bangladesh led in increased farmer income, yield, and lower fertilizer costs. Locally, women have been empowered by their participation in the production of briquettes, which provided as additional source of income. There are now 2500 briquette making machines in Bangladesh. As the briquettes are set by hand, which needs 6 to 8 days of labor per hectare, on-farm jobs were also created. Increased yields and fertilizer savings more than compensate for the higher field labor expenses.

At the national level, urea imports have been reduced, with IFDC estimating savings in import costs at USD 22 million and government subsidies at USD 14 million (IFDC, 2008), resulting in an increase in production of 268 000 metric tons.

Globally, UDP has reduced GHG emissions caused by fertilizer production and management. (FAO, 2014). This implies that training women in Nigeria on how to produce this briquettes can help in increasing their farm yield and increase their income.

Another researcher in Bangladesh (Rahman & Bulbul, 2015)assessed adoption of water saving irrigation techniques by rice farmers in Bangladesh and reported that farmers who adopted the AWD (alternate-wetting-and-drying technique) have higher income compare to known adopters. Likewise, (Lampayan, Rejesus, Singleton, & Bouman, 2015) also reviewed a study in Bangladesh, between the Phiippines and Vietnam and compare their yield and economic returns by "before and after" analysis among the AWD adopters and "with and without" analysis between AWD users and non-users. The result revealed higher net returns for the use of AWD without yield penalties.

Rejesus, Palis, Rodriguez, Lampayan, & Bouman, (2011) used the PSM (propensity score matching) approach in examining the impact of Safe AWD adoption at a site in Tarlac Province in the Philippines. The information was gathered from 146 farms (30 AWD adopters and 116 non adopters). The results showed that safe AWD reduced the number of hours of irrigation required by roughly 38% without affecting yield or profit significantly.. This arguably implies that AWD helps in reducing farmers marginal cost on water usage.

Abdulai & Abdulai, (2016) reported that farmers who use conservative agriculture (CA) which is also a climate smart practice are more efficient technically and environmentally than those who use conventional means. In another study (Mwanza, 2016) reported that as at 2015 in Zambia almost 350,000 small scale farmers adopted conservative agriculture from 30,000 farmers in years 2000. This implies that this climate smart agricultural practice is yielding good result for the farmers. Based on adult learning theory, farmers will only adopt technology that is useful and relevant to their present challenges. It was also reported by the same author that, there are actors that play a key significant role in fostering the adoption of this technology. They include Zambia Agricultural Research Institute (ZARI) in partners with extension service of the Ministry of Agriculture and Cooperative, and NGO's. Some of the practices used include reduced tillage, weed control, cover crops, and crop rotation.

In Vietnam, System of Rice Intensification (SRI) is a SRI is a CSA methodology for enhancing rice productivity. This approach is founded on four guiding principles: (i) reduced plant density (ii); early, rapid, and healthy plant establishment (iii) enhanced soil conditions through organic matter enrichment; and (iv) reduced and controlled water application (SRI Rice, 2015). According to reports, rice production in the country has steadily increased, from 25 million tons in 1995 to nearly 40 million tons in 2010 (Ricepedia, 2012). Howbeit, higher yields were made possible in part by the use of improved seeds, but they also reflect increasing usage of fertilizer, herbicides, and pesticides, all of which are harmful to the environment and community health (Belfort, 2016).

System of Rice Intensification has enhanced crop yield while cutting down on inputs including seed, water, fertilizer, and herbicides. This change is achieved through help of Vietnamese Government who is a key provider of agricultural services and regulates access to inputs and financing, and agricultural technicians and extension agents who organize and train farmers. More so, according to their PPD, the SRI methodology is being applied on 6% of all rice-growing areas in the country. During the 2011 spring crop season, SRI farmers boosted their combined income by USD 18.35 million (VND 370 billion). SRI was used by almost 1.8 million farmers in 2015, significantly more than the 440, 833 farmers that used it in 2009 (Sulaiman, Chuluunbaata, & Vishnu, 2018).

In India, (Malabayabas, Kajisa, Mazid, Palis, & Johnson, 2012) examined 40 farmers using DSR (Direct seeding of rice) method only. In eastern Uttar Pradesh and Bihar, India, 40 farmers use DSR and 20 farmers use both. Direct seeing rice (DSR) is a process of sowing seeds directly in the field rather than transplanting seedlings from a nursery. Direct seeding rice (DSR) is a process that involves sowing seeds directly in the field rather than transplanting seedlings from a nursery (Farooq, Siddique, Rehman, Aziz, Lee, & Wahid,2011). Based on simple mean comparisons, the average net income for DSR was larger than for transplanting, owing to the lower labor expenses for DSR.

Also, In Bangladesh, Malabayabas, Kajisa, Mazid, Palis, & Johnson, (2014) surveyed 179 farmers in northern Bangladesh. Their study included three dummy factors: a DSR dummy, an early-maturing rice variety dummy (EMV), and an interaction term between the two dummy variables. DSR and EMV together enhanced Bangladeshi farmer's annual crop income by USD 625 per hectare. As a result of the improved rice output, and the lower labor expenses associated with crop installation, income increased.

The propensity sore matching (PSM) method was also used by Ali et al., (2014) when 238 farmers in Pakistan's rice-wheat region were examined by the use of DSR technology stratified the sampling. The results showed that DSR increased average rice yield by 0.9t per hectare over the old approach. This can be attributed to the cheap production cost.

In South Asia, stress-tolerant rice varieties were introduced in 2008 under the project Stress-Tolerant Rice for Africa and South Asia (STRASA). This project organizes seed multiplication with local counterparts and distributes stress-tolerant rice variety seeds through government agencies and non-governmental organizations (NGOs) via mini-kits and demonstrations. After the National Food Security Mission (NFSM) of India began distributing stress-tolerant rice variety seeds (Swarna-Sub1) in 2010, seed distribution in India increased rapidly. A large-scale household survey of about 9000 households was conducted in 2014 to track the distribution of Swarna-Sub1 in South Asia, and the total area under stress-tolerant rice varieties was estimated to be 0.6 million ha (or 3 percent of total rice area) with 1.4 million farmers in 2013 in Bangladesh and four states in eastern India (Yamano et al., 2015; Malabayabas et al., 2015).

Dar, De, Emerick, Raitzer, & Sadhoulet, (2013) conducted a randomized control trial to assess the farm-level impact of adopting stress-tolerant rice varieties, and the results showed that the average yield of Swarna-Sub1 was 45 percent higher than that of Swarna (one of the parental varieties) after 10 days of submergence. Although there was no difference in yields between the two varieties under normal conditions, the new variety has shown to be advantageous to underprivileged people.

Pampolino, Manguiat, Ramanathan, Gines, Tan, Chi, Rejendran, & Buresh, (2007) investigated the economic benefits of site specific nutrient management (SSNM) irrigated systems in Asia, particularly those in southern India, southern Vietnam, and the Philippines, and discovered that the use of SSNM resulted in greater efficiency in nitrogen utilization.

As a result, fertilizer use using SSNM was reduced by 10% in the Philippines and 14% in Vietnam. Ellul, (2013) also reported the use of drought tolerant maize variety in sub-Sahara Africa. The project in its totality benefitted approximately 30-40 million people in 13 or more countries in Africa by raising yields by at least one ton per hectare, even in periods of moderate drought.

In East Africa, ACRE (Agriculture and Climate Risk Enterprise) is a type of insurance that solves the issue of farmer vulnerability to weather unpredictability. The ACRE approach is built on three pillars (ACRE 2014), which include a diverse range of insurance products based on various data sources, such as automatic weather stations and remote sensing technologies, followed by ACRE's role as an intermediary between insurance companies, reinsurers, and distribution channels/aggregators, such as microfinance institutions, agribusiness, agricultural input supplier and index insurance, which is a relatively new technique to providing insurance. Compensation is provided based on a predetermined index (for example, rainfall level) for the loss of assets and investments caused by weather or catastrophic occurrences, and does not necessitate the usual services of insurance-claim assessors. The typical cost of insurance was 5 to 25% of the harvest value (IFC, 2014). Syngenta assessed 455 farmers with coverage and 181 without after two years of offering index-based agriculture programs in Kenya.

According to the findings, insured farmers invested 16 percent more in their fields than uninsured farmers (Syngenta Foundation for Sustainable Agriculture, 2017). Furthermore, in 2013, 97 percent of farmers covered by ACRE got loans tied to their insurance coverage. As a result, even in the face of approaching hazards, having insurance boosted the possibility that growers would invest more in agriculture.

In 2012, the World Bank and its partners launched the Agroweather Tools for Adapting to Climate Change pilot project in Ethiopia and Kenya to investigate how climate information services (CIS) may be used to improve farmers' adaptation response (Braimoh et al., 2015). CIS enabled farmers in making informed judgments about which types to plant. It was quite helpful in developing and supplementing recommendations on which farm supplies to utilize. Extension agencies and farmer organizations took use of it, resulting in increased rates of new varieties and improved techniques.

Another significant advantage of the CIS is its amazing impact on farm income. Farmers with access to agroweather information in Kenya earned 9,402 shillings (Kes) from maize, compared to 3,918 Kes for non-beneficiaries. In Ethiopia, beneficiaries received an average income of 19,760 Birr, compared to 17,878 Birr for non-beneficiaries.

Success story was also recorded in usage of digital agriculture in Kenya. The Kenya Climate-Smart Agriculture Project (KCSAP) aims to improve agro-weather forecasting and marketing information systems, as well as their dissemination tools, by mapping existing publicly and privately operated automated weather stations (AWSs) and establishing agro-meteorological centers in participating counties to improve drought and famine forecasting (NDMA).

In Nigeria, Bello, Baiyegunhi, & Danso-abbeam, (2020) examined the productivity impacts of improved rice varieties' (IRV) adoption on smallholder rice farmers in Nigeria and reported that adopters of IRV had an additional yield of about 452kg rice grains per hectare. The findings also indicated that extension contact, access to credit, access to IRV seeds, experience in rice farming and educational attainment had a significant influence on the adoption of IRV. This implies that IRV has proved to be productive and can help farmers in this season to increase their livelihood. All these success stories are evidences of how various climate smart agricultural practices have helped farmers in increasing their output and thereby increasing their income and mitigating the adverse effect of climate change.

2.2 Knowledge of Extension Practitioners on Climate Change and Climate Smart Practices (Adaptation)

The effects of climate change is equally evident in agriculture and if not addressed, will continuously result in food insecurities particularly in Africa with a projection of 50% crop yield loss in 2050 (Ziervogel, Nyong, Osman, Conde, Cortés, & Downing, 2006; Agwu et al., 2012).

Nevertheless, the use of extension agents will with no doubt go a long way in assisting farmers to adopt new knowledge, technology, including climate smart practices necessary in curbing the effects of climate change on agriculture (Van den Ban & Hawkins, 1998). One of the major duties of the extension agents is to ensure the availability and dissemination of research based information, and training programs to give the farmers access to the information they require based on their economic, social and cultural needs (Long & Sworzel, 2007).

After researchers must have discovered new methods and innovations to adapt and build resilience for the effects of climate change, it is then the responsibility of extension agents to bridge the gap between the rural farmers and researchers by tabling these technological advances and new practices in agriculture to the farmers in a timely manner (Anaeto et al., 2012; Singh & Grover, 2013).

However, the success of this information dissemination to farmers could be affected by certain factors, one of which is the level of knowledge that the extension agents possess. And this is also inclusive of the Climate Smart Agriculture practices. Adequate knowledge and skills of climate smart agriculture initiatives will therefore be evident in how effective these initiatives are disseminated to farmers in a bid to promote food security and agricultural development (Oladele &Tekena, 2010).

It is therefore necessary and important that extension agents get exposed to proper trainings and extension activities useful in increasing their knowledge levels at each point.

In their study to determine the involvement of extension agents in disseminating climate smart agricultural initiatives, Olorunfemi et al., (2019) concluded that among the factors influencing extension agents in disseminating climate smart agricultural initiatives include their years of experience, educational qualifications, participation in climate smart agriculture trainings, etc. Their years of experience can be equivalent to knowledge, because the longer their years of service, the more knowledge they gain. According to this study, more qualified extension agents should be employed, while establishing in-service trainings for extension agents on major climate smart agriculture initiatives, as this will in the long run have great impact on the farmers' access to timely information needed to reduce climate change, and increase agricultural productivity.

This was equally confirmed by a study carried out by Dimelu, (2016) which supports the fact that the number of years of experience of extension agents, years spent in school and their positions in the organization will affect their competency and knowledge on climate smart agriculture initiatives. He also recommended that extension agents should be granted access to seminars, conferences, workshops, and necessary trainings in recent discoveries relating to climate change in order to upscale their knowledge levels. In addition, it was suggested that policies should be put in place to ensure that educational curriculums in higher institutions should include issues of climate change to allow potential extension agents to be conversant with them beforehand.

2.3 Competency of Extension Agents

Without controversies promoting sustainable agriculture and food security is one of the major global goals to be achieved, and sustainability of agricultural practices can only be effective through understanding the effects of climate change.

In a bid to adopt and implement CSA practices, certain hindrances such as financial hindrances have been observed. However, this is not the only limiting factor as the absence of adequate knowledge, skills and potentials has been noted to be among the reasons hindering the adaption to climate change among farmers (Antwi-Agyei, Dougill, & Stringer, 2015; Yiran & Stringer, 2017; Nnadi et al., 2013).

With time, it has been observed that the role of extension agents is a non-negotiable one in agricultural development and promoting food security. This is because they are the major forces in charge of making contacts with small-scale farmers with the aim and responsibilities of impacting new skills, knowledge, propagating new technological advances and how to implement them in agriculture (Rickards, Alexandra, Jolley, & Frewer, 2018; Khan et al., 2012)

This is evident in the study carried out by Emmanuel, Owusu-Sekyere, Owusu, & Jordaan, (2016) as farmers were able to embrace the use of chemical fertilizers got soil improvement based on the availability of agricultural extension agents.

By providing information and guiding management of new methods of farming, through developing capacity and by facilitating and implementation of policies, extension agents can actively contribute to the adaptation of farmers to climate change (Mustapha, Undiandeye, & Gwary, 2012).

All these, therefore reinstate the fact that the need to employ agricultural extension in the adoption of Climate Smart Agriculture practices among farmers is paramount.

However for these to be effective the extension agents must also be trained in order to better assist farmers. In their study of the training needs for extension agents in preparation for extension work, (Salman, Ridha, & Ahlam, 2012)) showed that there were results of more motivation amongst extension agents who were trained.

The study conducted by Man, Saleh, Hassan, Zidane, Nawi, & Umar, (2016) emphasizes the need to engage in the training of extension agents in the various divisions of the agricultural sector. The study further stated that assessment should be done on extension agents regularly in order to know the specific areas of deficiencies, thereby effectively maximizing and planning the trainings for the extension agents. That is, to build the competency of extension personnels, their specific training needs must be identified.

Conclusions made by Antwi-agyei & Stringer, (2021) in their study revealed that there is the need for extension agents to build capacity in areas such as, but not limited to effective interpretation of weather forecast, training on the use of climate smart interventions, development of effective extension delivery skills, and the use of ICT to pass across climate change advices; in order to ensure successful delivery of their extension services. Radios and televisions were further established to be effective tools in ensuring extension officers are exposed to climate change information. Yet, it was also noted that apart from access to trainings and capacity building opportunities, certain factors like inadequate funds for implementation of new practices, transportation hindrances, farmers' resistance to doing away with old farming practices equally reduce the competencies of extension agents. Also, farmers should be trained and educated on the need to embrace these new innovations to curb the effects of climate change.

2.4 Constraints that limits extension agents in Disseminating CSA Practices

There are certain factors that can affect the dissemination of climate smart agriculture practices by extension agents among rural farmers. These barriers will invariably affect agricultural productivity and sustainability.

One major hindrance among others affecting extension practices is unavailability of adequate funds. As discovered by Sennuga &Fadiji, (2016), most extension agents could be discouraged from effectively delivering their duties to farmers. This is because, lack of funding will result in inconsistencies in meeting with farmers and in providing the necessary trainings required.

Also, the fact that there are not enough supports from the government has also been noted to be a barrier to the dissemination of information to farmers including climate smart agriculture initiatives (Okeke, Nwalieji, & Uzuegbunam, 2015, Matthew, & Olatunji, 2016).

In their study of the effectiveness of traditional extension models among rural dwellers in sub Saharan Africa communities, Sennuga & Fadiji, (2016) also noted that low wages and salaries equally contribute to the ineffectiveness of the extension agents. Their study showed that due to backlog of unpaid salaries, most extension agents had to look for other means of getting income. This definitely can prevent extension agents from effectively carrying out their duties.

Furthermore, the lack of interest on the rural farmers' part could be a hindrance to the adoption of innovations and other new technologies. When farmers are not actively involved, adoption of a technology would be made impossible (Ragasa, Ulimwengu, Randriamamonjy, & Badibanga, 2016).

Issues relating to effective communication have also been identified to be constraints in the dissemination of useful information to farmers. As reported by Sennuga & Fadiji (2016), language barriers, excessive distance from the village, farmers' knowledge of ICT, poor road networks are factors that hinder effective communication, in turn hindering information dissemination to farmers by extension agents.

2.5 Constraints to adoption of climate smart practices by farmers.

Despite the benefit attached to the utilization of CSA by farmers, there are certain constraints that limit the utilization of some CSA practices. For instance, in Uganda NERICA rice variety was introduced to the farmers, but in the long run there was discontinuity in its usage. This was because the upland NERICA as reported by (Kijima, Otsuka, & Sserunkuuma, 2010) is highly affected by rainfall vagaries, even though it is drought-tolerant, more so, according to Kijima, Otsuka, & Sserunkuuma, (2008) the variety requires intensive labor use for planting, weeding, harvesting, and bird scaring, compared with other subsistence crops such as maize. However, the farmers may not be aware of this information before adopting the technology and this can be attributable to lack of effective extension and seed delivery systems (Dalton, 2004; Spencer et al., 2006). Therefore, out of 374 households adopters in Uganda between 2004 and 2006, more than 50% of the NERICA adopter had abandoned it in 2006 (Africa Rice Centre (WARDA), 2006.

More so, a study carried out in Niger state Nigeria concluded that one of the most significant issues confronting women rice farmers is a lack of financial resources. Other problems include financial availability and accessibility, a lack of mechanized/technological equipment, and a high level of degradation, to name a few (Omiunu, 2014).

Major barriers to the implementation of climate change adaptation strategies as identified by Mbah & Ezeano, (2016) include a lack of modern processing facilities, lack of contemporary farm inputs, a lack of access to weather forecasts, a lack of knowledge relevant to climate change adaptation, poor extension service delivery, the government's incapacity to respond to/come to the help of individuals affected by climate change, such as floods high storage facility costs, , and the high cost of agriculture inputs such as fertilizer, herbicides, and so on, are just a few examples.

However, it is important to emphasize that CSA practice adoption will continue to decline if these constraints are not properly addressed

2.6 Role of extension agents in information dissemination & climate change issue

Agricultural extension play an important role in improving the welfare of farmers and other people living in rural areas and through the provision of knowledge and information, they also help farmers innovate. Currently, the role of extension has now shifted from technological transmission to facilitation. (i.e helping group of farmers to work together and perform effectively); Further than training and education, this includes assisting farmers with marketing issues, forming groups, and tackling public issues in rural areas such as resource management, food safety, health, conservation, food security and agricultural production, monitoring, nutrition, family education, and youth development, as well as collaborating with a diverse range of service providers and other agencies (USAID, 2002).

According to FAO, (2003) agricultural extension has been identified to be involved in public information and education programs that could assist farmers in adapting and mitigating the effects of climate change. This involvements include creating awareness and knowledge mediator on the issues of climate change; encouraging wide participation of all stakeholders in addressing climate change issues; building resilience capacities among vulnerable individuals, communities and regions and developing appropriate framework for coping/adapting to climate change effects/impacts. Uncertainties associated with climate change insinuate that extension services need to be informed regularly with new knowledge and extend the information timely and adequately to the farmers.

Extension agents also serve as innovation intermediaries and can provide a range of support services which include network brokerage, demand articulation and knowledge brokerage, Visioning, Process facilitation, Interactive design and experimentation, exploration of opportunities and constraints, lobby and advocacy communication, conflict management, and so on (Klerkx & Gildemacher, 2012)

In a study by Maponya & Mpandeli, (2013) on the role of extension services in climate change adaption in Limpopo province South Africa. The result found that farmers who got information through extension services had a 2.46-times greater chance of being impacted by climate change than those who did not. One reason for this is that many farmers believe some extension officers are unqualified for their positions. Another complaint was made by several extension officers, who claimed that the government failed to organize relevant training courses on climate variability and change and agricultural production. Although, farmers benefit greatly from extension services because they not only supply valuable information but also help them develop management and technical skills that they may apply to other endeavors outside of farming. Farmers who have benefited from extension programs can pass on their knowledge to their neighbors about agricultural production and climate change.

The study further discovered that the likelihood of food scarcity for farmers who received information from extension agent is 0.95 less than those who do not receive information and extension services is also very important to adapt against high food prices. This implies that through extension services, farmers can receive skills and knowledge in increasing food production. As a result, extension agents' responsibility is confined to sharing information that can help in mitigating against climate variability, train farmers for off farm season, encourage farmers to adopt new technologies, improved methods of farming so as to increase food production and using a variety of methods to reach farmers by, organizing study groups for farmers, farmer days, demonstrations, lectures and literature, as well as informing the media about farmers challenges.

2.7 Role of extension officers in dissemination of Climate Smart Agriculture

Generally, all definitions of extension education imply a shift in rural people's behavior, supposedly leading to increased agricultural production, a higher standard of living, and a stronger national economy. Agricultural extension can also be defined as a discipline that deals with the people's behaviour, educational in content and purposive in approach. The role of extension services is indispensable and not limited to teaching farmers how to improve their productivity, but also help in creating awareness of new technology or innovation to farmers. Agricultural Extension also engaged in transporting the problems and needs of farmers to agricultural research centers in order to find solutions to them. As well as persuading the farmers to adopt the new technology brought to them by explaining its usefulness or importance. It is when the farmers get are aware of the new innovation and understands it then the innovators or adventurers among them adopt the technology first, follow by the early adopters, early majority, late majority and then the laggards. Other roles played by extension worker in transferring technology are as follows:

- Identify the farmer's problem.
- Act as an intermediary between the researchers and farmers, by creating awareness to the farmers, and also taking of farmer's problem to the researchers
- Provide solution that is he or she has an idea about effective solution to farmers problems
- Act as catalyst to speed up the rate at which the farmers accept changes or innovation.
- Ensure reinforcement of continued use of technology that is created
- Help in stabilizing changes made by the farmers and attempts to prevent discontinuance, individuals tend to seek confirming information for the decision they may make Altalb, Filipek, & Skowron, (2015). Extension workers can also assist in effectively stabilizing new behaviour by controlling, and reinforcing messages to those clients who have adopted innovation.

Some other roles or activities performed by extension workers include distributing farm materials, writing reports, supervising government programmes, holding meetings with the farmers such as farm and home visits, organizing community projects, conducting demonstrations such as method demonstration, results demonstration and so on, teaching home economics due to off farm season, planning programmes and work calendar, and also evaluate programmes (Atala, 1986). This implies that extension workers are penultimately altruistic towards the farmers and therefore plays a critical role in agricultural and rural development in general.

In a bid for extension workers to disseminate information on climate smart agriculture (CSA) effectively, they need be well groomed in issues of climate change and also knowledgeable about the various CSA practices required by each farmer at the right time. However, there are certain factors that affect their performance such as lack of satisfaction with job due to irregular salary payments, lack of motivation such as giving of fringe benefits, promotion, non-availability of inputs amongst others.

Ozor & Nnaji, (2011) also examined the role of extension in agricultural adaptation to climate change in Enugu State, Nigeria. Primary data collected was analyzed using descriptive and inferential statistics. The result revealed the following as the role of extension agents;

They help in disseminating innovations on best practices and build resilience capacities of vulnerable people in climate risk management; Re-training of extension staff to acquire the new knowledge and skills (capacity) in climate risk management; Setting up of emergency management unit by extension agencies that will attend to victims of climate risks; Providing feedbacks to governments and interested agencies with situation reports on various causes of climate change, its effects, and the local knowledge and practices of the rural people; Use of demonstration methods in teaching farmers the measures used to mitigate or adapt to the effects of climate change; Organizing seminars, workshops, and field days to sensitize farmers and the public on climate risk management; Use of farmer-to-farmer extension strategy to promote awareness and adoption of best practices in climate risk management; Use of information communication technologies (ICTs) such as the internet, radio, television, media vans, leaflet, and posters etc, to create awareness on the climate change issues; Formation of Young Farmers Club (YFC) in schools to educate and encourage young farmers in learning about climate change issues with a view to reducing human causes and improving adaptation options; Use of farmer field schools (FFS) to promote faster learning by farmers on the measures used to mitigate and adapt to the effects of climate change.

2.8 Empirical review

2.8.1 Studies on factors affecting extension agent knowledge, competence and participation in climate change issues

In analyzing factors that affect extension agents Olorunfemi et al., (2019) examined engagement in the dissemination of climate-smart agriculture activities in the southwest of Nigeria. The results of the linear regression analysis showed that participation at CSA training, academic level, number of regions covered as well as years of work experience as factors determining involvement in climate smart agriculture initiatives. Thus, the study recommend that agricultural extension administrators and agencies should focus on institutionalizing polices that will encourage continuous education and pursuit of higher degree by extension agents and also facilitate the organization of in-service training these agents especially on the wide range of CSAI (Climate smart Agriculture initiatives).

In another study, Oladele & Tekena, (2010) examined factors influencing agricultural extension officers' knowledge on practice and marketing of organic agriculture in North West Province, South Africa. Organic farming which also is recognized as an approach to overcoming the negative impacts of the Green Revolution on soil, air, water, produce, landscape, and humans worldwide. The study discovered that age, gender, educational level, working experience, job location and sources of information were significant factors influencing their knowledge on practice and marketing of organic agriculture. Hence, the study recommends training and educating extension officers in organic agriculture issues.

Dimelu, (2016) studied the determinants of knowledge and attitude of extension professionals to climate change in Anambra state, Nigeria. The result of the analysis revealed that position of extension personnel in extension organization and year spent in extension organization determine extension knowledge on climate change. This is so because, greater number of years could affords extension workers opportunity for training, attendance to workshops, conference, interaction and access to information on climate change. While, level of education and years of experience were factors that determining their attitude. This can be as a result of the fact level of education, exposure, knowledge and information about emerging issues like climate change will probably brings about a change in attitude and commitment.

The study recommends that extension organizations should provide more opportunities to develop extension personnel by training them through conferences and workshops among other so as to sustain positive attitude and improve knowledge on emerging issues in climate change. More so, institutions of higher learning should increase climate change content of curriculum for training prospective extension personnel to encourage early exposure and commitment to climate change issues.

In a study by Ragasa, Ulimwengu, Randriamamonjy, & Badibanga, (2016) factors affecting the performance of Agricultural extension, from Democratic republic of Congo (DRC) was assessed. The study was analyzed using descriptive statistics and logit regression model. The study showed that despite the fact that DRC have one of the greatest extension agent-to-farmer ratios and a pluralistic extension system, they fail to convey information and technologies to rural areas. This is attributed to absence of coordination, aging and low competencies of extension agents, no clear and unified policy and mandate, lack of funding, interactions of agents with key actors, and lack of mobility. The study also revealed that number of extension agent does not compliment their performance but instead factors determining the extension agents' performance is an enabling environment which include enforcement of performance targets, external funding, systems of sanctions and rewards for duties performed, mobility to create links between NGOs and other agents and satisfied with fair and equal salary.

2.8.2 Studies on level of adoption/acceptance of climate smart agricultural practices

In a study, Emmanuel & Oba, (2019) explored the utilization of climate smart agriculture among farmers in Ogun state, Nigeria. According to diffusion theory, utilization of an innovation can only take place after the user has adopted the innovation. Data were collected using a multistage sampling procedure, which include random selection of one zone (Abeokuta) out of the four zones in the state, random selection of two blocks (Ilewo and Ilugun) from the zone, three cells were randomly selected from each of the blocks to give a total of 149 respondents from the six cells. This was analyzed using mean, PPMC

(Pearson Product Momentum Correlation) and one way Analysis of variance (ANOVA). This study revealed that application of organic manure minimum or zero tillage practice, crop rotation practices, and use of mulching, were the most frequently used CSA practices by the respondents while rain water harvesting was the least used climate-smart agricultural practice which is expected, as a result of the fact that respondents do not receive information or training on this practice, thus the level of respondents' utilization of climate-smart agricultural practices in the study is high Also, source of information is the factor that determine farmer's utilization of CSA (Climate smart agricultural) practices and also the use of CSA practices varies from one study location to another. Based on this findings, the study therefore recommend that benefits of using CSA practices should be more publicized to farmers, especially on radio and also extension agents should ensure they pay farmers regular visit to ascertain their utilization of CSA practices, assess the challenges facing its use, and proffer useful solutions.

In another study, Enujeke & Ofuoku, (2012) examined determinants of adaptation to climate change among arable crop farmers in Edo state, Nigeria. The result of the analysis showed that educational level, age, household size of the farmers, extension visit, visit to other famers, and meeting attendance were factors determining adaption to climate change. Thus, the study infers that extension service should organize information network between the farmers and other stakeholders. This will enhance the flow of information among farmers and between farmers and other stakeholders within and outside the extension service. Farmers should also be given access to credit through micro-credit or state empowerment scheme so as to help them access irrigation facilities. Public and private sectors, non-governmental organizations (NGOs) and the media should be more involved in promoting farmers adaptation to climate change.

Several factors influenced the adoption of climate smart agriculture technology among which are limited availability and accessibility of resources needed to use the practices such as financial capital ,land and labor; skills and information needed to use the technology; ability to cope with challenges that might arise during or after using the practices; and compatibility with local social and cultural practices (Waithaka, Thornton, Shepherd & Ndiwa, 2007; Sanga, Kalungwizi & Msuya 2014). These findings were in consonance with the findings of Nyasimi, Kimeli, Sayula, Radeny, Kinyangi, & Mungai, (2017) in Tanzania that most farmers are willing to use CSA practices, but are constrained by some factors such as cultural practices, in terms of tenure and ownership rights, labor requirements, high investment costs, and lack of skills and knowledge on how to use the practices. Their findings also indicate that improved crop varieties, composting, cut and carry feeding, use of inorganic fertilizers, agroforestry, and early crop planting were the most commonly used by the farmers, while biogas(from animal waste), matengo pits for water conservation, and SACCOs(saving and credits cooperatives) were the least CSA used by farmers.

In consonance with the awareness to adherence model, a farmer or learner must first be aware of an innovation before he adheres and adopt it. Teerdoo & Adekola, (2014) examined the awareness of CSA practices in northern region of Nigeria and discovered that none of the respondents were aware of the term ‘climate-smart agriculture’ but the younger farmers in the 20 to 35 age group were most interested in knowing more about this approach, while the older farmers are not interested. However, after explaining the concept CSA the majority of the respondents realized they are currently practicing some element of CSA while the remaining have done that in the past, this reflect that majority of the farmers were not knowledgeable on CSA practices. The study further stated that factors responsible for adoption of CSA practices include human and financial investment, incentives and information availability, and also political commitment (so as to provide backing and integration into current agricultural and environmental policies in Nigeria),

Weniga Anuga et al., (2019) studied determinants of climate smart agriculture (CSA) adoption among smallholder food crop farmers in the techiman municipality, Ghana using a regression model. The study revealed that economic, socio-cultural, environmental and institutional support are factors that influenced adoption of CSA practices.

Kughur, (2015) studied the adoption of sustainable agricultural practices by farmers in Otukpo LGA of Benue state. The result revealed that majority of the farmers got information from friends, while few of them got information from extension agents.

Likewise the factors determining the adoption of CSA were lack of extension agent to create awareness, lack of biomass, political constraints and inadequate land. Therefore, the study recommends more agricultural extension workers should be recruited and trained on sustainable agriculture in order to increase food production in the study area.

Mbah & Ezeano, (2016) examined climate change adaptation measures practiced by rice farmers in Benue state, Nigeria. The study used a multi-stage sampling technique in selecting 90 rice farmers and the study revealed that climate change adaptation measures practiced by rice farmers in the study area to were mixed cropping, zero tillage, adjustment of planting dates, value addition of produce, afforestation i.e planting of trees, crop rotation, improved land management techniques, early planting of rice, early harvesting of rice, diversification in crop and livestock production among others. There were also certain constraints in using climate change adaptation measures such as non-availability of modern farm inputs, lack of access to weather forecasts poor access to information relevant in adapting to climate change, lack of modern processing, facilities poor extension service delivery high cost of storage facilities, and so on.

2.8.3 Studies on Teaching/Dissemination methods `used by extension agents

Adoption of agricultural innovation is a necessary step in achievement of sustainable agricultural development such as climate smart agriculture. However, inadequate information dissemination methods may leave farmers unaware of new technologies and innovations necessary to develop their production capacity. More so, new technologies and agricultural practices might be a total unfamiliar terrain for farmers and would need to be taught how to make use of them. Information disseminated to farmers usually assists in farmers' decision making process (Vidanapathirana, 2012). This makes the main function of extension agents to be teaching. This shows that climate smart decisions can be made with proper teaching dissemination methods by extension agents. This had necessitated extension agents to develop various teaching dissemination methods to effectively disseminate improved technologies to farmers.

Okoedo-Okojie, (2015) stated that extension teaching methods are "methods of extending new knowledge and skills to the rural people by drawing their attention towards them, arousing their interest and helping them to have a successful experience of the new practice". The importance of effective extension teaching methods cannot be overemphasized. Okoedo-Okojie, (2015) asserted that teaching-learning process will only be effective when extension agents' choice of teaching methods or combination of methods is most fitting to the economic and social peculiarities of the agents' audience and environment. Studies have shown the teaching dissemination methods used by extension agents as well as the effectiveness of those teaching dissemination methods.

Okoedo-Okojie, (2015) study on assessment of group teaching methods effectiveness in dissemination of swine technologies among farmers in Delta state, Nigeria, it was revealed that on-farm demonstration was the most used group method among extension agents in Delta state as 92.5% of the agents make use of the method. The study also revealed that other group method used by the extension agents were workshops, farmers field school, group discussion and seminars. This result implies that extension agents in the area make use of combination of extension teaching methods in disseminating information about swine technologies and this means that extension agents will be able to reach different age and social groups. This is because the choice and preference of teaching methods to be used in learning could differ across diverse age groups and social groups. However, as revealed in the study, despite the increased awareness of some swine technologies such as breeding/mating techniques, artificial insemination and formulation of ration which has 94.2%, 85.8% and 72.5% awareness respectively had a very low level of adoption.

The adoption of breeding/mating techniques, artificial insemination and formulation of ration had adoption of 37.5%, 33.3%, and 22.5% respectively. The low level of adoption despite the high rate of awareness may be due to the type of extension teaching method (group methods) used. However Okoedo-Okojie, (2015) stated that the low level of adoption might not be as a result of the extension teaching methods used but because most of the respondents were older farmers. The result of the study further revealed that most effective group method used was on-farm demonstration compared to other group methods such as workshop, Discussions, field day, and seminars. This same author stated that the reason for the effectiveness of on-farm demonstration could be because of the ability of the method to appeal to the eye as well as its ability to answer the questions of inquisitive individuals, reach large number of people at the same time and its interesting nature. The study also showed a positive correlation between respondents' age, sex and effectiveness of group teaching methods. The positive correlation between age and effectiveness of teaching methods implies that group teaching methods is perceived effective by older farmers than younger farmers. This he attributes to the independent nature of the younger generation. However, the result revealed a negative correlation between respondents' education and effectiveness of group teaching methods. This according to Okoedo-Okojie, (2015) implies that people with higher level of education such as secondary and tertiary education perceive group teaching methods to be ineffective and he attributed this to the craving for individuality that comes with education.

In another study, Khan & Akra, (2012) researched on "farmers' perception of extension methods used by extension personnel for dissemination of new agricultural technologies in Khyber Pakhtunkhwa, Pakistan". In the study, farmers rated various extension methods used by extension agents on a five point Likert scale namely "very poor", "poor", "average", "good" and "very good". The ranking which was done on the basis of weighted mean score revealed that farm/home visit with mean of 0.73 ranked highest on farmers' perception of the most effective extension teaching methods. This was followed by group discussion, then demonstration plots which ranked third. Office calls ranked fourth workshop/discussion ranked fifth, farmers' training ranked sixth followed by local agriculture fair which ranked seventh.

Khatam, Muhammad, & Ashraf, (2013) studied the "role of individual contact methods in dissemination of agricultural technologies". In their study, respondents indicated the extension teaching methods they were aware of. As revealed in the study, most of the respondents were aware of farm visits (66.43%), demonstrations (62.50%) and home visits (60.71%) as extension teaching methods used by extension agents for disseminating agricultural technologies. However, the study revealed that few of the respondents' were aware of office call and telephone calls as teaching methods used by extension agents in disseminating agricultural technologies. On the awareness of farmers on teaching methods, personal letters was the least. Farmers were also asked to indicate the extension teaching methods they make use of. The result from the study revealed that majority of the farmer respondents obtained from farm visits of extension staffs. More than half of them obtained information from demonstration and home visits of extension agents respectively. The result of the study further revealed that 47.86% and 41.78% of the farmers respectively were obtaining information from office calls and telephone calls respectively. The mean score and the weighted mean score was used to rank the extent of use of extension teaching methods among the farmers in the study area. The result revealed that individual contact methods such as farm visits, demonstrations, home visits and office calls had mean values of 2.85, 2.81, 2.79 and 2.68 with weighted scores of 798,791,780 and 743 respectively. This made the individual contact methods (farm visits, demonstrations, home visits and office calls) to be ranked 1st, 2nd, 3rd, and 4th respectively. Most farmers could have preferred the individual methods because of the advantages attributed to it.

Khatam, Muhammad, & Ashraf, (2013) citing Anandajayasekeram, Puskur, Workneh, & Hoekstra, (2008) stated that through individual methods, unclear messages can be understood and clarified and that individual method facilitates immediate feedback on the effectiveness of the measures measured. Though disadvantages of the individual contact methods were also stated such as expensiveness in terms of time and transport and that it facilitates immediate feedback on the effectiveness of the measures discussed.

Muhammad, Latif, & Ashraf, (2005) studied the “role of demonstrations in the dissemination of rice production technology”. The result of the study revealed that above half (56.67%) of the respondents were aware of the availability of rice demonstration plots in their area/village. This shows that extension agents make use of demonstration plots as a means of teaching methods in the study area where the study was conducted. Muhammad, Latif, & Ashraf, (2005) stated that demonstration was one of the most effective teaching methods for dissemination of agricultural information. The result of their study revealed that among the criteria used to measure the effectiveness of demonstration as a teaching methods (provision of information about recommendations”, “motivating farmers for adoption” and “helping farmers in the adoption of recommendations), providing information about recommendation to farmers ranked first.

This according to their study was followed by “motivating farmers for adoption” which ranked second. Helping farmers with the adoption of recommendation ranked least of the criteria. The study therefore concluded that contribution of demonstration method towards helping farmers for adoption of technology was perceived to be high.

In the study of Natarajan, (2016) three treatments (extension teaching methods) that increased the skill level of farmers was assessed. The result of the study revealed that the three methods increased the skill level of respondents, however, combination of video teaching and method demonstration was found to have increased the skill of most of the respondent to the extent of 90.16% which was followed by method demonstration. The study concluded that combination of extension teaching methods is more effective than using a single method in dissemination of agricultural information.

Some aspect of extension teaching methods was assessed by Abubakar, Ango, & Buhari, (2009) while studying on “the roles of mass media in disseminating agricultural information to farmers in Birnin Kebbi Local Government Area of Kebbi state: A case study of state Fadama II development project.” In the study, farmers’ sources of agricultural information were assessed. It was revealed that, among the mass media teaching methods, most (85%) of the respondents assess agricultural information from radio and television while 8.75% and 6.25% of the respondents gets agricultural information via extension bulletins and posters respectively. These mass media were perceived by most (76.25%) of the respondents to be highly accessible while 13.75% and 10% of the respondents identified their media sources as moderately accessible and not accessible to them. Since most of the respondents’ access radio and television, the authors attributed this to local dialects and languages that is mostly used in the channel especially Radio. It was further stated that radio is the most the most effect mass media extension teaching method for communicating agricultural information.

The preferred time for listening to radio as a mass media for assessing extension education was also identified, and majority of the respondents stated preference for listening to radio during night time while only few identified afternoon as preferred time for listening to radio. The study of Abubakar et al., (2009) proved that the agricultural information received from these mass media proved relevant. From the study, 65% of the respondents claimed the information to be highly relevant while 27.5% and 7.5% of the farmers claimed that the information from the mass media sources they access were moderately and not relevant respectively.

Furthermore, the hypotheses in this study revealed that sources of agricultural information significantly correlate to relevance of information received. This implies that effectiveness of knowledge dissemination is dependent on the type of teaching methods used.

Igene, Sedibe, Van der Westhuizen, & Solomon, (2018) assessed processors preference and effectiveness of extension teaching methods used by raw material research development council for dissemination (RMRDC) of shear butter processing technologies in Moro Local Government of Kwara State, Nigeria". The result of the study showed that demonstration was the most used extension teaching methods used by RMRDC in dissemination of improved technologies. Lecture and group discussion were also well used extension teaching methods used by RMRDC in dissemination of improved processing technologies. However, the result of the study revealed that the individual methods (Telephone calls and personal letters) and mass contact (radio, television, cinema, literature, internet and newspaper) were not used in the study area. The study further assessed the perceived effectiveness of the categories of the extension teaching method and the result revealed that group discussion ranked first followed by demonstration and lecture ranked second and third respectively. The order of preference for extension teaching methods among processors in the study area were further revealed. The result revealed that the group discussion ranked first while demonstration, workshop and farmers' day ranked 2nd, 3rd, 4th and 5th respectively.

Bajwa, Ahmad, & Ali (2010) elicited information about the use of extension teaching methods among farmers' field school staff. The result revealed that majority of the respondents perceived group discussion to be used on an average extent followed by lectures, literature, and demonstration. However, few of the respondents claim signboards/slogans were used on an average extent. The use of extension teaching methods among respondents was ranked in order of the one mostly used by farmers' field school staff. The result revealed that group discussion ($\bar{x} = 3.24$), lecture ($\bar{x} = 2.94$), and literature ($\bar{x} = 2.86$), with weighted sores of 1107, 1003 and 935 were ranked first, second and third respectively. Extension methods less used were signboards/slogans ($\bar{x} = 2.50$) and exhibitions ($\bar{x} = 2.10$) which ranked 6^{th} and 7^{th} respectively.

Okunade, (2007) study on “effectiveness of extension teaching methods in acquiring knowledge, skill and attitude by women farmers in Osun state” revealed that information was disseminated to all (100%) of the respondents via farm and home visit, office call, result demonstration, agricultural show, SPAT, Method demonstration and field day. About 96.25% of the respondents identified posters as extension teaching method used while 93.75% of the respondents identified exhibitions as extension teaching method used by extension agents. Leaflets (87.50%), radio programme (83.75%), video tapes (68.75%), slides (63.5%), audio cassettes (62.5%), television telephone call (12.5%) were other extension teaching methods used by extension agents. The result of the study further revealed that home visit with weighted mean score of 2.35 ranked the most effective extension teaching methods used in acquisition of knowledge. Office calls with weighted mean score of 2.10 and radio programme with weighted mean score of 2.00 ranked second and third respectively for the effective extension teaching methods for knowledge acquisition. In terms of effectiveness in acquiring knowledge, other extension teaching methods includes leaflets, video type, audio-cassette, slides, posters, result demonstration, method demonstration, SPAT, agricultural show, field day, Exhibit, television and telephone calls with weighted mean scores of 1.98, 1.89, 1.83, 1.80, 1.77, 1.76, 1.70, 1.67, 1.60, 1.55 and 1.42 respectively.

It was further revealed that method demonstration with weighted mean score of 2.43 ranked the most effective extension teaching methods used in acquisition of skills. SPAT with weighted mean score of 2.10 and video tape with weighted mean score of 2.01 ranked second and third respectively for the effective extension teaching methods for knowledge acquisition. Other extension teaching methods includes farm and home visits, field day, agricultural show, television programme, audio-cassette, office calls, leaflets, posters, telephone call, exhibit and radio programme with weighted mean scores of 1.99, 1.90, 1.86, 1.70, 1.64, 1.60, 1.56, 1.41, 1.38, 1.33 and 1.28 respectively. The study further revealed the order of other teaching methods in acquiring attitudes include; farm and home visit, office call, video tapes, slides, television programme, radio, audio cassette, posters and leaflets with weighted mean scores of 1.88, 1.85, 1.83, 1.80, 1.75, 1.72, 1.69, 1.63 and 1.60 respectively.

Ahmed & Adisa, (2017) studied "perceived effectiveness of agricultural extension methods used to disseminate improved technologies to rice farmers in Kogi state, Nigeria". The study revealed the following as an effective extension teaching method among extension teaching methods, result demonstration ranked first with a mean score of 3.86. Radio ($\bar{x} = 3.47$) and method demonstration ($\bar{x} = 3.36$) ranked second and third respectively. In terms of effectiveness training($\bar{x} = 3.06$), farm and home visit($\bar{x} = 2.91$), audio-visual aids, group discussion($\bar{x} = 2.26$), farm organization($\bar{x} = 2.03$), television($\bar{x} = 1.91$), general meeting($\bar{x} = 1.79$) ranked 4th, 5th, 6th, 7th, 8th, 9th and 10th respectively. However, telephone calls($\bar{x} = 1.56$), office calls($\bar{x} = 1.47$), contact farmers($\bar{x} = 1.43$) and publications($\bar{x} = 1.33$) ranked 11th, 12th, 13th and 14th position respectively.

2.9 Review of Methodological/analytical approach

2.9.1 Measurement of Effectiveness

Sher, Athar and Ijaz (2005) in their study on the "role of demonstrations in the dissemination of rice production technology" measured the effectiveness of extension teaching methods by calculating the weighted scores by multiplying the score value allotted to each category of the scale with frequency count. The scale that was used for measuring the effectiveness was "very low", "low", "medium", "high", "very high" and "no response". No response was included in the scale because of the respondents who were not familiar with the existence of demonstrations in their area. The criteria for measuring effectiveness of demonstration as a teaching method includes; "provision of information about recommendations", "motivating farmers for adoption" and "helping farmers in the adoption of recommendations".

Igene et al., (2018) measured the extent of use of extension teaching methods in their study of "processors preference and effectiveness of extension teaching methods used by raw material research development council for dissemination (RMRDC) of shear butter processing technologies in Moro Local Government of Kwara State, Nigeria". In this study, extension teaching methods was classified into three which were individual methods, mass method and group contacts. Examples of extension teaching method in each category was highlighted and respondents were to select from the response option; “very low”, “low”, “average”, “high” and “very high” which was assigned scores of 1, 2, 3, 4 and 5 respectively. The mean score was then used to rank the teaching methods in terms of use. The effectiveness of the extension teaching methods was further assessed on the scale of Not effective, poorly effective, effective, very effective which was assigned score of 1, 2, 3 and 4 respectively.

Kansiime, Alawy, Allen, Subharwal, Jadhav, & Parr (2019) examined effectiveness of mobile agri-advisory service extension model: evidence from Direct2Farm program in India. Effectiveness was measured using four and knowledge sharing. Awareness was measured with I received information (1) and I do not receive information (0). Knowledge acquisition was measured using I do not understand at all (0), only some part of the message (1), almost the whole message (2), I understood clearly the entire message (3). Uptake of new technologies was measured by asking respondents to indicate whether they have taken action on any of the CSA practices disseminated to them and measured using yes (1) and no (0). Knowledge sharing was measured by asking whether they have shared the knowledge with any one with response of yes (1) and (0).

In another study, (Agbarevo, 2013) examined farmers’ perception of effectiveness of agricultural extension service delivery in Cross river state, Nigeria. The study found that farmers were of the opinion that extension delivery process was not very effective as the study revealed no significant difference between the population and sample means at 95% confidence level.

2.9.2 Determinants of effectiveness

Various approaches have been designed in modelling the determinants of effectiveness. Some of the model used include Heckman’s sample selection model (Heckman, 1976). The model has been used by some other researchers (Kaliba, Verkuijl, & Mwangi, 2000; William & Stan, 2003; Kansiime et al., 2019) The model assumes that observations are classified into two regimes.

The first stage is referred to as the selection model (if a farmer comprehended the information received), and the second stage is referred to as the outcome model (whether the farmer took action).

The first stage is derived using the probit maximum likelihood approach, and the second stage is derived using OLS regression.

The probit model for sample selection is based on the assumption that there is a relationship between the selection and outcome models stated in equations (1) and (2)

The outcome variable was defined as farmers adopting any of the methods suggested by extension agents. Uptake was also classified into two, if a farmer reported to taking action 1 or 0 otherwise.

Selection variable (Knowledge acquisition) was assessed in farmers' comprehension of messages received and coded as 1 and 0 otherwise. This was regressed against factors such as age, household size, sex, marital status, academic field of specialty, educational level, , position in extension organization, years of experience in extension work, mobile information e.t.c. The first stage was computed using the probit maximum likelihood approach, and the second stage was computed using OLS regression.

In Okunade, (2007) study on “extension teaching method’s effectiveness of in obtaining knowledge, skill and attitude among women farmers in Osun state”, the use of extension teaching methods and its effectiveness was measured. Okunade (2007) measured extension teaching methods used by extension agents by asking the women farmers to state the extension teaching methods used by extension agents in disseminating information to them. The frequency and percentages were used to note those that various listed teaching methods were used for. The teaching methods from which the respondents selected from include; farm & home visits, office calls, telephone calls, result demonstration, radio programme, slides, posters, leaflets, video tapes, exhibition, method demonstration, SPAT, audio cassettes, agricultural show and field day. The effectiveness of the different extension teaching approaches employed was assessed on a four point Likert scale of “very effective”, “effective”, “fairly effective” and “not effective” which were assigned scale of 3, 2, 1 and 0 respectively. The mean score was used to rank the extension teaching methods on the basis of their effectiveness.

Sezgin, Kaya, Atsan, & Kumbasaro (2010) assessed factor affecting extension agents' effectiveness in Turkey. The data collected was analyzed utilizing OLS (ordinary least squares) model in GRETL software. The average number of farmers interviewed for training reasons as well as the number of days an extension employee spends on the land on a monthly basis represented the dependent variables which was used to demonstrate the effectiveness of extension personnel. The result of the analysis showed regional variations in; the age, the extension member's graduation year, the marital status, , perception of extension personnel if the job is appropriate for his/her specialty; extension education received; number of training received during service; number of the villages served. The study finally recommended that extension staff employed in public institutions receive in-service training on a regular basis, that studies be conducted to reduce the proportion of farmers to extension personnel, and that extension personnel be employed in disciplines suitable for their specialty.

2.10 THEORETICAL AND CONCEPTUAL FRAMEWORK

2.11 Theoretical framework

Theories are analytical tools for understanding, explaining, and making predictions about a given subject matter. For the purpose of this study the following theories are considered important;

2.11.1 Learning theory

One of the theories this study relies on is learning theory. The origin of learning theories may be traced backed to 1898. According to E.L. Thorndike learning theory can be classified into three (Cognitivism, Behaviorism, and constructivism learning theories). However, this study will rely on Cognitivism theory because cognitive theory has risen to prominence among modern learning theories (Bednar, Cunningham, Duffy, & Perry 1991). This theory shows the connection between learning and cognitive functions like thinking, concept development, information processing, language, and problem solving (Snelbecker, 1983). Cognitive psychology affirmed that learning entails use of memory, thinking, motivation and reflection (Alzaghoul, 2012). They regard learning as an internal process and contend that the amount learned is determined by the learner's processing capacity, the amount of energy expended during the learning process, the depth of the processing (Craik & Lockhart 1972; Craik & Tulving 1975), and the learner's existing knowledge structure (Ausubel, 1974).

Individual variations are important to the cognitive school. For the purpose of this study, it is opined that the effectiveness of extension agents which is justified by the adoption of CSA practices by farmers depends on the processing capacity of the farmers (which is related to their age, as age could affect individual thinking and processing capacities), the amount of time invested in teaching (this is related to the method of dissemination, as this means of dissemination could determine the volume of time invested in teaching the farmers), the farmers’ existing knowledge structure (which can be attributed to their years of experience, as farmers gain knowledge over the years) and motivating the farmers by sourcing for funds, this will motivate them to adopt the CSA disseminated to them. In addition, due to the fact that majority of farmers are adults, successful learning will take place if the innovation is relevant to the current problem they are facing as well as if the extension agents understand and recognize individual farmer differences.

2.11.2 Diffusion of Innovations theory

According to Rogers' (1972) theory, an innovation gains momentum over time and diffuses (or spreads) through a specific population or social system. An innovation is conveyed through various channels throughout time to members of the social system using this notion, which has its origins in communication. Awareness about the need for an innovation, decision to adopt (or reject) the innovation, first use of the innovation to verify it, and continuous use of the innovation and ongoing use of the innovation are the phases that lead to diffusion/adoption of innovations. This stages are explicitly stated below and it is parallel to the stages of change described by Prochaska and Di Clemente (1986).

There are **five recognized adopter categories** (innovators (2.5%), early adopter (12.5%), early majority(34%), late majority(34%) and laggards(16%) meanwhile the vast majority of the population falls into one of the intermediate categories. According to Roger, (1995) and Orr, (2003), determinations about innovation are highly dependent on decisions made by others in a system. More so, if 10-25% of system members adopt an innovation, there is relatively rapid adoption by the remaining members and then a period in which the holdouts finally adopt.

The significance of this theory to the contention of this study is on the basis that before utilization of CSA practices can occur, farmers need to first of all be aware of the innovation which is the duty of the agricultural extension. As Oladele & Tekena, (2010) cited Agbamu, (2002) that farmers in most African countries rely on agricultural extension agents as their primary source of knowledge, and extension agents play a significant role in influencing farmers' acceptance of innovation.. Also, for effectiveness in dissemination of CSA practices, the extension agents need to grasp the target population's characteristics, and be able to differentiate the farmers into various adopters' categories. Thus climate smart agricultural practices can be adopted, if extension agents can explicitly inform the farmers that CSA practices is a better approach to improve their produce. Juxtapose the consistent use of climate smart agricultural practices with their experiences, and needs, and also provide examples of the innovation's ability to produce practical results.

2.11.3 Model of Effective Job Performance: Boyatzis (1982) proposed this concept, which argued that competency covers an individual's knowledge, skills, talents (abilities), and behaviors that enable the individual to accomplish assigned duties within a certain role or profession. According to the concept, three important components (organizational environment, work needs, and person competencies) must be constant for an individual to display effective action and performance. Therefore, any change in these components in relation to one another will result in ineffective behavior and incompetence. Subjected to this study, extension workers can be productive and effective in disseminating CSA practice if they operate in a consistent and ideal environment, if their job demands are identified, and if their competences (knowledge, skills, abilities, and attitude) on the CSAP are ideal / flawless. Likewise, Olorunfemi, Olorunfemi, & Oladele, (2020) infer that extension agents' ability to effectively disseminate climate-smart agriculture techniques to farmers is contingent on their knowledge and skill in this area. There is an ever-increasing need for extension organizations to ensure the effectiveness of extension agents by enhancing their knowledge, skills, and abilities (competency) in CSAP, so that they can perform their role efficiently by ensuring that farmers are appropriately informed on climate resilient/adaptation strategies in order to cope with the inimical effect of climate change.

2.11.4 Kirkpatrick's model: Donald Kirkpatrick developed the concept in 1959, with updates in 1975 and 1993. The Kirkpatrick Four-Level Training Evaluation Model is intended to objectively measure the success of training, identify how effectively team members have learned, and improve their future learning. Reaction, Learning, Behavior, and Results are the four levels.

1. Reaction: it entails measuring how the learners were engaged, how they reacted to the training program, and how actively they contributed. It enables to makes improvement of future programs.

2. Learning: This describes how their abilities, attitudes, and knowledge, as well as their confidence and commitment, have all improved as a result of their training with the CSA techniques.
3. Behaviour: This level helps one to comprehend how well people have used their training.
4. Results: This level comprises determining outputs, advantages, or ultimate results that are directly tied to the training and devising an appropriate method to quantify these outcomes. Consider the following outcomes: higher output, less waste, and increased sales e.t.c.

The significance of this theory to this study is based on the fact that extension personnel level of effectiveness in disseminating an innovation (climate smart agriculture) to farmers can be measured based on the farmer's reaction to what they've learnt (which is determined by the method of dissemination), learning (this is related to the skills and abilities they have gained via the CSA practices disseminated to them, which can be determined by the competence of the extension agents in those practices), behaviour (which describes the utilization of the CSA practice by the farmers), and result (which comprises of the farmers output as a result of uptaking the CSA practices disseminated to them i.e if the farmers can specifically point out benefits derived or things they have achieved from using CSA practices).

2.12 Conceptual Framework

2.12.1 Explaining the conceptual framework

Effectiveness of extension agents is the dependent variable of this study while the independent variables are personal and professional characteristics of farmers and extension personnel, knowledge of extension agents on CSA practice, attitude towards CSA practice, method of disseminating CSA practice, competency and competency need of extension agents, participation in extension delivery strategies, and constraints to disseminating CSA practice.

In analyzing the effectiveness of extension agents in disseminating CSA practices in North central, Nigeria, the roles played by the independent and intervening variables in explaining the dependent variable were conceptualized and captured. Figure 1 reveals that personal characteristics of extension agents will influence their effectiveness. For instance, as years of professional experience of extension agents increase, their knowledge on CSA practice increases. This will also have influence on their ability to perform their job which is their competence. It will enable them to optimally use extension methods that can make their extension work much more effective. Also their level of education will influence their effectiveness in disseminating CSA practice. This is basically due to the fact that level of education determines the level of exposure, which will in turn have effect on their knowledge on CSA practices. The level of knowledge will determine the mode of disseminating, which will determine whether the farmers will uptake the CSA practice or not. Numbers of training received on CSA will influence their competence and ultimately determine their effectiveness. Consequently, the level of education also affects the extension agents' disposition i.e attitude towards CSA practice. This is because education determines exposure and creates an open to receive new information.

Finally constraints faced in disseminating CSA practice have influence on the effectiveness of extension agents. For example, lack of fund will have the adequate delivery of the CSA practice. Then, lack of motivation such as incentives will also demoralize the extension agents from performing their roles.

The farmers' socio-economic characteristics have influence on the effectiveness of extension agents. This is because illiteracy is a disease and could make one to be adamant in receiving innovation that could change their output and status. More so, years of experience of the farmers is attributed to age and this will have influence on farmers, as aged farmers find it difficult to adapt to changes and thus makes the extension agents less effective. However, there are forces that exist between these independent variables and the dependent variable that are not studied in this study, despite the fact that they are expected to have an impact on the relationship between the study's independent and dependent variables. These forces are referred to as intervening variables in the framework. Some of the intervening variables include government policy on extension services, the operational mandates of each extension organization, and public sector changes. Agriculture policy can either aid or impede farmers' access to extension services. These intervening variables will not be investigated in this study, however their influences are recognized on the effectiveness of extension agents.

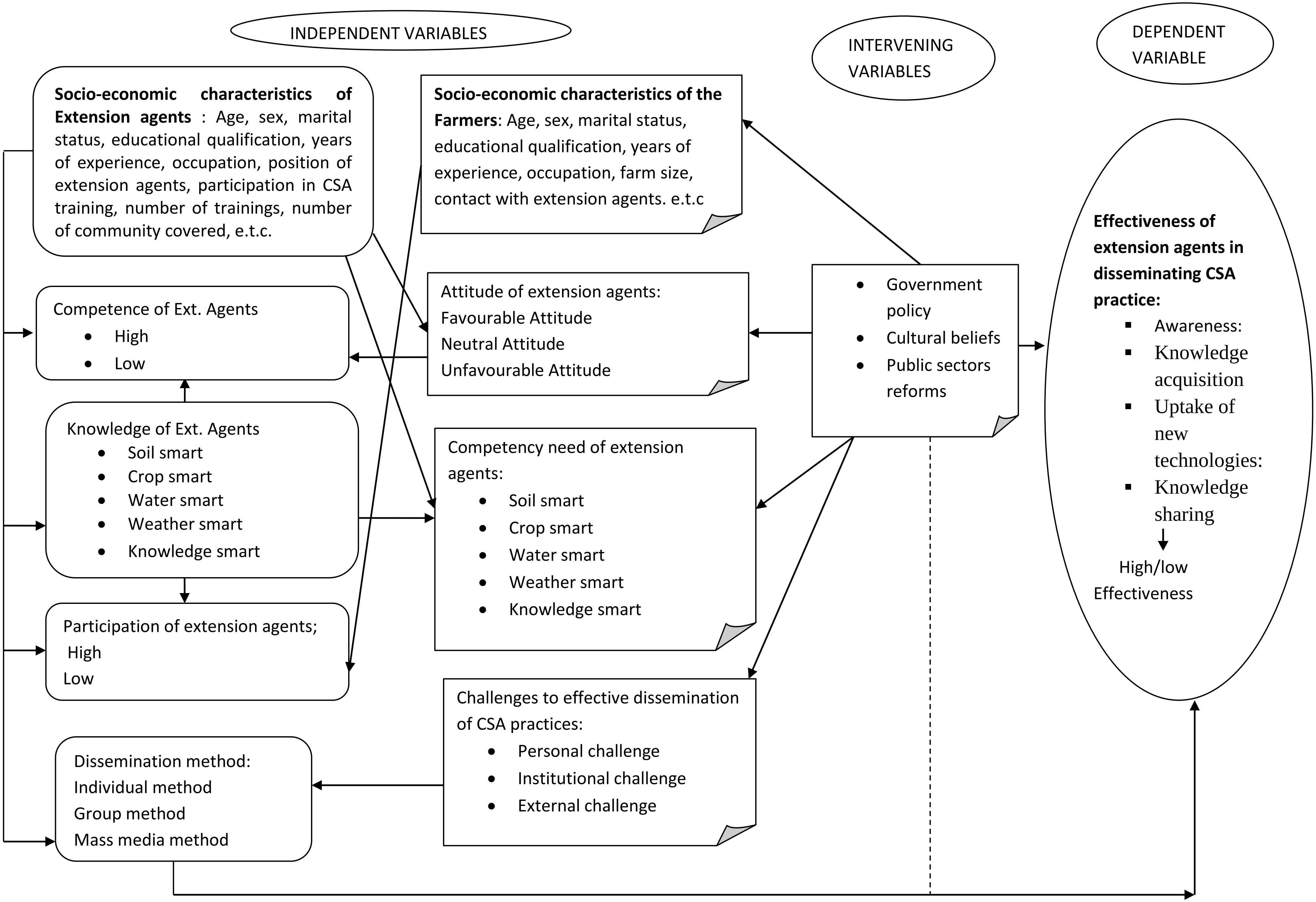


FIG 1: CONCEPTUAL FRAMENWORK ON EFFECTIVENESS OF EXTENSION AGENTS IN DISSEMINATING CSA PRACTICE

CHAPTER THREE

3.0 METHODOLOGY

This chapter describes the study area, sampling procedure and size, methods of data collection and the analytical techniques employed in analyzing the data collected from the respondents.

3.1 Study area

The study was carried out in the North Central zone of Nigeria. It is one of the six geopolitical zones in Nigeria. Areas of Nigeria which are generally referred to as belonging to the North Central are: Benue, Plateau, Niger, Kogi, Kwara, Nasarawa and the Federal Capital Territory (Abuja) Federal Capital Territory (Abuja). It covers latitude 7^0 00'-11^0 30' North of the equator and longitude $4^0$00'-$11^0$00' East of the Greenwich meridian. The economy is mostly agrarian suitable for: growing of crops such as maize, beans, and tomatoes; livestock such as sheep goat and cattle; and fisheries activities. Average annual rainfall ranges between 1,200mm and 1500mm while temperature is high almost throughout the year except during hamattan period which begins in November and ends in February. The weather is cold and dry during the period coupled with hazy atmosphere and dust particles flowing around. The rainfall pattern is predicted with increase of 0.58mm of rainfall per annum from 2013 to 2042. Presently, it has 20 ADPs out of 37 with few extension agents to cover millions of farm families in the agricultural value chain. Ecologically, North Central zone is situated in the Guinea savanna region of the country (National Bureau of Statistics, NBS, 2005), however its vegetation cut across the three savannah belts (Guinea, Sudan and Sahel) and this is one of the reasons why both cereals and roots crops are prominent in this ecological zones.

According to Federal Government of Nigeria (FGN) (2006); the zone has a population of about 20,266,257 inhabitants. The presiding occupation of the inhabitants of this zone is farming and the farming systems include mono cropping, mixed cropping, crop rotation, nomadic herding by migrant herdsmen, shifting cultivation, as well as traditional raising of livestock.

Finally, the north central zone was chosen for this study, because Central zone was identified to be the largest producer of rice in Nigeria, accounting for 44% of total rice output (PCU, FMARD, 2001).

(http://www.ombudsman.state.ny.us/Documents/Manual/Oct04-Revised5-5-05/Module5.pdf)

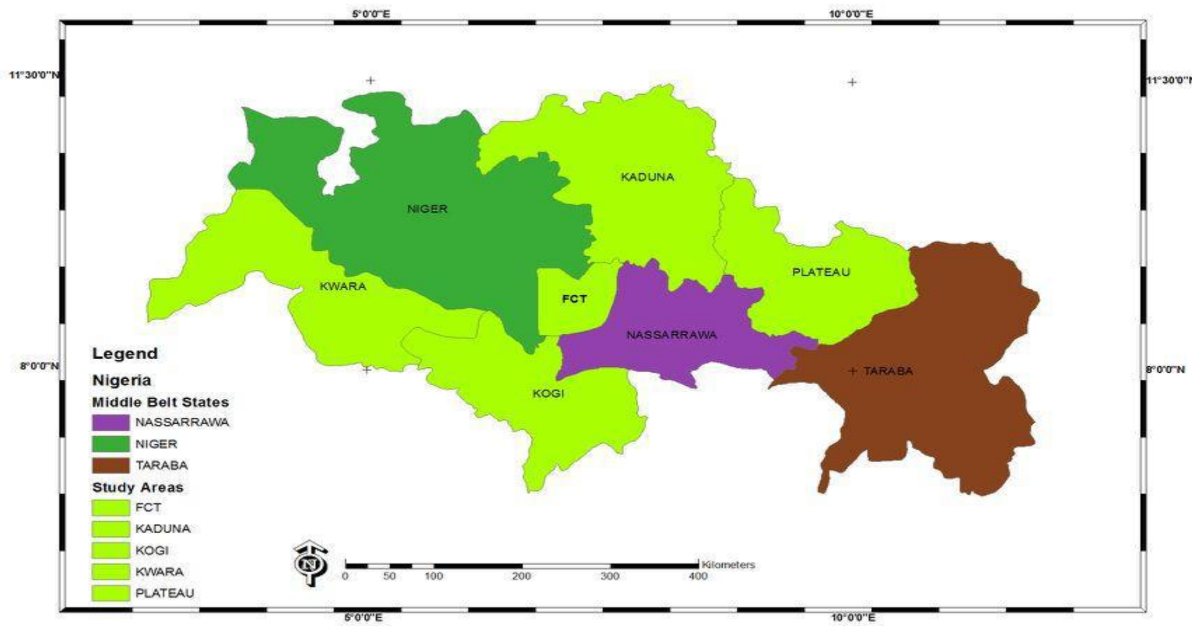


Figure 2: Map of North-Central Nigeria showing the study area.

Source: National Space Research Development, (NASRDA, 2013)

3.2 Population of the study

The population of the study constitutes both Agricultural extension agents (i.e from ADPs) and registered rice farmers in North Central, Nigeria.

3.3 Sampling procedure and Sample size

3.3.1 Sampling procedure for Rice farmers

The respondents (farmers) were drawn using a Multi-stage sampling procedure. Farmers were selected through the following steps:

Stage 1: Purposive selection of Kwara, Kogi and Niger states out of the seven states in North central, Nigeria. This is because the states are known for rice farming.

Stage 2: Purposive selection of zone B out of four ADP strata in Kwara state, zone A out of three ADP strata in Niger state, and zone D out of four ADP strata in Kogi state, based on their involvement in rice production

Stage 3: Proportionate sampling of 40% of blocks from each selected ADP stratum to give a total of 7 blocks.

Stage 4: Random selection of 2(two) cells/ rural communities from each block to give a total of 14 cells.

Stage 5: Snow balling technique was used in selecting 130, 120 and 100 contact farmers from each cell making a total of 350 farmers.

Table 1: **Sampling procedure for Rice farmers**

States	Zones/LGA	Blocks	Cells
Kwara	**4/16 LGAs**	**Zone B**	Lafiagi 1
		Edu	Shonga
		Patigi	Patigi 1
			Lalagi
Kogi	**4/ 21 LGAs**	**Zone D**	Onyedega
		Ibaji	Unale
		Idah	Ogegele
			Ichala
Niger	**3/25 LGAs**	**Zone A**	Majin-gari,
		Lavun	Goggata
		Edati	Gboduti
		Mokwa	Fada
			Muregi
			Lafiagi

3.3.2 Sampling procedure for extension agents

The extension agents were also selected from the same study area as the farmers. A two-stage sampling procedure was employed in selecting the extension agents;

Stage 1: Purposive Random selection of Kwara, Kogi and Niger states out of the seven states in North central, Nigeria. This is because the states are known for rice farming.

Stage 2: All the village extension agents, subject matter specialists (SMSs), Zonal Extension Officers (ZEOs) and Block Extension Officers (BEOs) were interviewed totaling 88. This is because all the extension workers mentioned irrespective of their status were involved in disseminating CSA practice to the farmers and the total population selected was due to their small size.

3.4 Method of data collection

Structured questionnaire and focus group discussion were used to elicit information from both the extension agents and the farmers.

3.5 Validation of research instrument

The content validity of the instrument used for data collection was done to ascertain that the required information within the framework of the objectives of the study was measured. The supervisor of the researcher and other professionals in the Department of Agricultural Extension and Rural Development did face validity of the instrument to ensure suitability of the instrument for the study.

3.6 Reliability of the research instrument

Cronbach's Alpha method was employed in testing the reliability of the instrument. Research instrument was administered to thirty rice farmers & twenty extension personnel from Irepodun LGA in Kwara state. Each construct that define each concept were analyzed automatically using Cronbach's Alpha method to determine if the strength of questions tally, and how each of them relate with each other. A reliability coefficient of 0.87 was obtained for this study. This means that the internal consistency of the research instrument was excellent at 87 percent because it is close to 0.9.

3.7 Measurement of variables

Two sets of variables, namely the independent and dependent variables were measured in the study**.**

3.7.1 Independent variables

The independent variables in the study consist of socio economic characteristics of the respondents, farmers perception on extension agents in disseminating CSA practices, level of knowledge and attitude of respondents to CSA practices, competency of extension agents on CSA practices needed by rice farmers in the study area, participation level of extension agents, teaching/ dissemination methods used by extension agents, adoption/ acceptance level of CSA practices by the farmers, effectiveness of extension agents in disseminating CSA practices, factors that influence effectiveness of extension agents and challenges/ constraints faced by extension agents in dissemination of CSA practices.

3.7.2 **Socio economic characteristics of the respondents:** This was analyzed using descriptive statistics such as percentage, mean and standard deviation

1. Age: This was measured in years.
2. Sex: respondents were asked to indicate their sex group and was measured at norminal level as male(1) and female (2)
3. Marital status: e.g. single {1} married {2} divorced {3}separated.
4. Educational qualification: respondents were asked to indicate their level of education as primary (1), secondary (2) and Tertiary (3)
5. Household size: Respondents were asked to state actual number of people in their household.
6. Farm size: Respondents were asked to state actual sizes of their farm.
7. Occupation: Respondents were asked of their primary and secondary occupation.
8. Position of extension agent in the organization: Respondents were asked to state their position in the family. Such as: VEA, ZEO, BEO, SMS, WIA
9. Years of experience: respondents were asked to state their farming experience in years
10. Participation in CSA training: Yes (), No ( )
11. Numbers of training received on CSA practices:

12. Numbers of Contact with research agency on CSA practices
13. Numbers of community covered: in years
14. Monthly income
15. Job location
16. Area of specialization

3.7.3 Attitude of respondents (extension agents) towards CSA practices:

According to Kerlinger, (1973) cited by Afzal, Al-Subaiee, & Mirza, (2016), attitude is a structured tendency to think, perceive, feel, and respond to a psychological object or idea.

The attitude of respondents was ascertained using attitudinal statements (both positive and negative statements so as to confirm the statement). The respondents were provided with 38 statement (both positive and negative) and indicate their agreement to the altitudinal statement on a five point Likert-type scale of strongly agree (5), agree (4), undecided (3) disagree (2) and strongly disagree (1). Possible total score was 190 as most favourabe attitude and minimum of 38 scores the most unfavourable attitude for the 38 items. Total scores for each extension agents was calculated and the respondents were grouped into 3 categories as: favourable, neutral and unfavourable attitudes. The neutral attitude was placed within the range attitude mean score ± standard deviation. Unfavourable attitude was below mean score ± standard deviation; while favourable attitude was above mean score ± standard deviation.

3.7.4 Knowledge of extension agents on CSA practices:

Respondents were exposed to a list of perceived knowledge of extension agents on CSA practices and this was measured using five point Likert-type scale of strongly agree (5), agree (4), undecided (3) disagree (2) and strongly disagree (1). These values was summed up to 15 and divided by 5 to give a mean score of 3.0 which was used for decision rule. Knowledge statement was categorized as high and low knowledge level.

3.7.5 Competency and Competency need of extension agents on CSA practices:

Respondents were provided with a list of perceived competencies. Respondents were rated on a three point likert's scale thus; high (3 points), moderate (2 points) and low (1 point). The possible maximum score for each respondent was 153, while the minimum was 51.

Competency need of the extension agents was measured using Borich Needs Assessment model (Olorunfemi et al., 2020; Roberts et al., 2015; Harder et al., 2013) which was analyzed by mean weighted discrepancy scores (MWDS). In order to determine mean weighted discrepancy score the following steps are followed:

1. A discrepancy score (DS) was calculated for each individual for each competency by subtracting the ability (competency) rating from the Importance rating minus.
2. A weighted discrepancy score (WDS) was then calculated for each individual for each of the professional competencies by multiplying the discrepancy score by the mean importance rating.
3. A MWDS for each of the competencies was calculated by taking the sum of the weighted discrepancy scores and dividing by the number of observations.
   MWDS= $\sum[(I_{ith} - C_{ith}) \times \bar{X}i/N]$

Where, I = importance rating for each task,

C = competency rating for each task,

$\bar{X}i$ = mean of importance rating,

N = number of observations.

Using the MWDS, the 63 competencies were ranked (Borich, 1980; Alibaygi & Zarafshani, 2008; Christensen, Warnick, Spielmaker, Tarpley, & Straquadine, 2009; Elhamoly, Koledoye, & Kamel, 2014, Oladele, 2015). Respondents were requested to assess the importance and knowledge (competency) of CSA competency statements using a 3-point Likert scale: 3= High Importance/competence; 2=moderate

Importance/competence; and 1 = Low Importance/competence. The actual mean was 2, due to the rating scale; thus, a mean greater than 2 denoted high importance, while a mean less than 2 denoted low importance of the professional task. The higher the Mean Weighted Discrepancy score MWDS, the greater the competency need of extension agents on Climate Smart Agricultural initiatives.

3.7.6 Participation of extension agents in disseminating CSA practices:

Respondents were provided with a list of CSA practices with response of 'active' (2), passive (1) or 'never' (0), to identify the CSA they have been involved in disseminating. This follows from previous research on participation in extension activities (Asfaw, Shiferaw, Simtowe, & Lipper, 2012; Suvedi, Ghimire, & Kaplowitz 2017). The actual mean was 1, due to the rating scale; thus a mean greater than 1 denoted high level of participation, while mean lower than 1 denoted low level of participation.

3.7.7Dissemination methods used:

Respondents were exposed to a list of methods in which information were disseminated such as individual methods (farm and home visit, telephone call, office call), group methods (group discussions, meetings, method demonstration, field days e.t.c) and mass media methods (radio, television, newspapers, social medias, SMS, Participatory videos, printed materials and so on). This was measured using often used (2), rarely used (1), and not used (0). Then the extension teaching methods were ranked based on their weighted mean score, which was calculated by adding all the assigned scores together and divided by 3 to give a weighted mean score of 1.

3.7.8 Constraints faced in dissemination of CSA practices by extension agents

Respondents were exposed to a list of perceived constraints to dissemination of CSA practices and this will be measured using 3- point Likert scale Major Constraints (2), Minor constraints(1) and Not a constraints(0). Examples include: lack of finance to support CSA practices, lack of input and infrastructures, inadequate logistics support for field staff, lack of information, lack of policy and institutional framework to support CSA practices. e.t.c.

3.8 Dependent Variable

The dependent variable is effectiveness of extension agent in disseminating CSA practices in the study area. This was measured using four proxy measures which include awareness, knowledge acquisition, uptake of new technologies and knowledge sharing. This framework was adapted from Cai & Abbott, (2013; Karubanga, Kibwika, Okry, & Sseguya, (2016); Kansiime et al., 2019). Each of these domains has different ways of measurement;

- Awareness: respondents were provided with a list of CSA practices and responses were elicited using I received information (1) and I do not receive information (0).
- Knowledge acquisition: respondents were asked question based on their level of understanding on certain CSA practices. This was measured using I do not understand at all (0), only some part of the message (1), almost the whole message (2), I understood clearly the entire message (3).
- Uptake of new technologies: this was measured by asking respondents to indicate whether they have taken action on any of the CSA practices disseminated to them. This will be measure using yes (1) and no (0), and
- Knowledge sharing: this was measured by asking respondents to indicate whether they have shared the knowledge with any one with response of yes (1) and (0). Also data was elicited on reasons for sharing.

3.9 Method of data analysis

Data were analyzed with descriptive and inferential statistics using the Statistical Package for Social Sciences (SPSS). The descriptive statistical tools are frequency distributions, mean and percentage while the inferential statistics was tested as follows;

- Hypothesis 1 was tested using Chi-square, PPMC (Pearson Product-Moment Correlation) and linear regression
- Hypotheses 2, was tested using PPMC & probit regression
- Hypothesis 3 was tested using Chi square
- Hypothesis 4 was tested using probit regression

- Hypothesis 5 was tested using PPMC
- Hypothesis 6 was tested using One-way ANOVA

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS OF FINDINGS

This chapter presents the results of data analysis and discusses their implication with respect to the specific objectives and hypotheses of the study.

4.1 Socio-Economic Characteristics of the Extension workers

4.1.1 Personal & Professional Characteristics of the Extension workers

Table 2, 3 and 4 presents the summary of findings on socio-economic characteristics of the respondents in the study area.

4.1.2 Age

Result in Table 2 shows that mean age of the respondents was 48 ± 6.914. In Niger state, the mean age of the respondents was 47.4 ± 6.5 and greater percentage of the respondents' (75.5%) were within 38 – 53 years, while only 5.7% were within 30 – 37 years of age. In Kwara state, the mean age of the respondents was 46.4 ± 6.9 and the age range 38 – 45 years make up 55.0%, while only 5.0% were within the age range of 30-37 years. In Kogi state, the mean age of the respondents was 52.8 ± 6.6 with more than half of the respondents (53.3%) above 53 years of age, while 13.3% were within the age 38 – 45 years.

This implies that majority of the extension workers in North central are young, active, economically productive and have a high proclivity and degree of innovativeness, thus making to effectively dissemination CSA practices useful to the farmers.

This agrees with the report of Olorunfemi et al., (2018) who pointed out that majority of the extension agents in Kwara state, are generally in their prime earning years, indicating their ability t carry out their responsibility and roles effectively as well as disseminating climate smart agricultural practices to farmers.

4.1.3: Sex

Results in Table 2 revealed that majority of the extension workers were males (95.5%). However, in Niger state male respondents make up 92.5% and only 7.5% were female. However, in Kogi and Kwara state all the respondents (100.0%) were found to be male respectively. This implies that there is gender imbalance among staffs in North central ADPs as it is male dominated, which may be due to unequal distribution during recruitments. The implication for an extension organization is that extension agents will be unable to effectively disseminate CSA practices to female farmers because North Central is characterized by Islamic religion, with the majority of men marrying multiple wives and their wives not being allowed to interact with people of opposite sex. As a result, more female extension workers are needed by extension organizations.

This agrees with the report of Adisa, (2015), who also mentioned that extension personnel in North-central, Nigeria are male dominated and few women in extension work will reduce the female farmers access to extension education due to inability of female farmers to relate with male extension workers. This is also in line with the assertion made by Bidoli, Kezi, & Shehu, (2013) certain socio-cultural factors restrict contacts between male EAs and female farmers in most communities of Northern Nigeria.

4.1.4: Marital status

Results as shown in Table 2 revealed that larger percentage of the respondents were married (95.5%). Precisely, in Niger state 96.2% were married while 3.8 were single. In Kogi, state 93.3% were married, while just 6.7% were single. In Kwara state, majority of the respondents (95%) were married, while 5% were single.

This implies that almost all the extension worker have more family-related experience and are emotionally attached to someone hence, helps them value rural family and effectively perform their roles by disseminating CSA practice that will help in increasing their income and standard of living.

More so, due to their marital status, majority of them could have the tendency to fulfill the responsibilities of not only disseminating enhanced agricultural technologies to farmers, but also providing a comprehensive and all-encompassing advisory service to farm households such as off-farm activities.

Their marital status is in consonance with Olorunfemi et al., (2020) who identified that majority of the extension agents in North central are married.

4.1.5 Level of Education

The result on educational status of the respondents in Table 2 revealed that majority of the respondents had tertiary education (85.2%), 12.5% had secondary school education, while 2.2% had primary education. However, specifically (84.9%) had tertiary level of education, 11.3% had secondary school certificate and only 3.8% had primary level of education in Niger state. In Kwara state, 75.5% had tertiary education, and 25% had secondary school certificate. While in Kogi state, all the respondents (100.0%) had a tertiary level of education.

This implies that majority of the extension agents are learned and exposed. This could enhance their thinking ability and knowledge on CSA practice and therefore will be able to adequately marshal their assignment efficiently by educating the farmers and providing them with information to ameliorate their production, hence increasing their standard of living. This is in consonance with Oladele, (2011) who stated that educational qualification influence the skills and knowledge of extension agents as regard climate change and agricultural issues.

4.1.6 Position of Extension Agents

Result in Table 2 revealed that majority of the respondents' were village extension agents (64.8%). In Niger state, most of the respondents (58.5%) were village extension officers, 32.1% were block extension agents, 5.7% were zonal extension officer while 3.8% were SMS. In Kwara state, almost all the respondents (95.0%) were village extension officers, while 5.0% were subject matter specialist (SMS). However, in Kogi state village extension officers make up 46.7%, block extension officers make up 26.7%, while 13.3% were zonal extension agents and subject matter specialist (SMS) respectively. This implies that majority of the extension workers are in lower cadre in the extension organization, hence will have a good rapport with farmers, know their felt needs and also recognize which climate smart agricultural practices suitable for the farmers to mitigate/ adapt climate change since CSA is not an all encompassing strategy but locally specific, thus enhance effective dissemination. This agrees with the findings of Oladele, (2011) who stated that almost half of the respondents(43%) were extension officers, while the reaming percent of the respondents were in higher cadre.

4.1.7 Years of Experience

As indicated in Table 2, the mean years of experience was 20.50 ± 9.38. In Niger state, the mean years of experience was 22.09 ± 8.70 with almost half of the respondents (47.2%) had between 5- 26 years of experience, while 9.4% had above 38 years of experience. In Kogi state, the average years of experience of the respondents was 28.1 ± 5.90 and larger part of the respondents (53.3%) had 16-26 years of experience while only 6.7% had above 38 years of experience. In Kwara state, the mean years of experience was 10.55 ± 3.57 and nearly all the respondents (95%) had between 5-15 years of experience and only 5% had 16-26 years of experience. The implication of this is that majority of the extension agents have spent a reasonable number of years in extension services, well experienced in relating with farmers and so will possess sound knowledge in certain climate change adaptation practices, hence will be able to successfully disseminate appropriate technology/ innovations to farmers. This is in agreement with Dimelu, (2016) who reported that years of experience in extension work are positively associated to the likelihood that extension employees will have low or high understanding about climate change. This is in consonance with the findings of Bidoli, Kezi, & Shehu, (2013)who stated that majority of extension agents (81.49%) in northern Nigeria had within 11-30 years of extension service. Also, it conforms to the findings of Kolawole, Isitor, & Owolabi, (2017) who reported that all extension staff are capable and well experienced and this depth of experience will have an impact on their performance on the job.

Table 2: Distribution of Respondents (E.A) by Age, Sex, Marital status, Level of Education, Position of Extension agents, and Years of experience

Characteristics N=88	Niger Freq.	Per. (%)	Kwara Freq.	Per. (%)	Kogi Freq.	Per. (%)	Pooled Freq.	Per. (%)
Age (Years)								
30 – 37	3	5.7	1	5.0	0	0.0	4	4.5
38 – 45	17	32.1	11	55.0	2	13.3	30	34.1
46 – 53	23	43.4	5	25.0	5	33.3	33	37.5
>53	10	18.9	3	15.0	8	55.3	21	23.9
Total	53	100.0	20	100.0	15	100.0	88	100.0
Mean	47.4		46.4		52.8		48	
S.D	6.5		6.9		6.6		6.91	
Sex								
Male	49	92.5	20	100.0	15	100.0	84	95.5
Female	4	7.5	0	0.0	0	0.0	4	4.5
Total	53	100.0	20	100.0	15	100.0	88	100.0
Marital status								
Single	2	3.8	1	5.0	1	6.7	4	4.5
Married	51	96.2	19	95.0	14	93.3	84	95.5
Total	53	100.0	20	100.0	15	100.0	88	100.0
Level of Education								
Primary	2	3.8	0	0.0	0	0.0	2	2.2
Secondary	6	11.3	5	25.0	0	0.0	11	12.5
Tertiary	45	84.9	15	75.5	15	100.0	75	85.2
Total	53	100.0	20	100.0	15	100.0	88	100.0
Position of extension agents (E.As)								
Village E.As	31	58.5	19	95.0	7	46.7	57	64.8
Block E.As	17	32.1	0	0.0	4	26.7	21	23.9
Zonal E.As	3	5.7	0	0.0	2	13.3	5	5.7
SMS	2	3.8	1	5.0	2	13.3	5	5.7
Total	53	100.0	20	100.0	15	100.0	88	100.0
Years of experience								
5 – 15	16	30.2	19	95.0	0	0.0	35	35.2
16 – 26	9	17.0	1	5.0	8	53.3	18	17
27 – 37	23	43.4	0	0.0	6	40.0	29	46.6
>37	5	9.4	0	0.0	1	6.7	6	1.1
Total	53	100.0	20	100.0	15	100.0	88	100.0
Mean	22.09		10.55		28.1		20.50	
S.D	8.70		3.57		5.90		9.38	

Source: *Field Survey*, 2020

4.1.8 Household Size

Results in Table 3 shows that the mean household size of the respondents' was 9.5 ± 4.3. However, the table revealed that in Niger state the mean household size was 11.2 ± 4.4 and Less than half of the respondents (41.5%) had between 8 and 12 household members while 5.6% had 18 and above household members.

In Kwara state, the mean household size was 7.35 ± 2.66 and more than half of the respondents (55.0%) had between 3 and 7 household members, while 45% had between 8 and 12 household members. In Kogi state, average household size was 6.33 ± 1.45 and majority of the respondents (80%) had between 3 and 7 household members, while 20% had between 8 and 12 household members. This implies that the majority of extension agents will be ineffective in disseminating CSA practices to farmers due to their large number of dependents and inability to earn enough money to support their large household size.

This negates the findings of Okwuokenye & Okoedo-Okojie, (2014) who reported that the household size of extension agents was 4.15 persons, thus motivate them to do their job.

4.1.9 Monthly Income

Results in Table 3 shows that the average monthly income of the respondents was ₦74,370 ± ₦ 51,868.8. In Niger state, the average income was ₦77,068 ± ₦32,096.3 with more than half of the respondents (69.8%) earn within ₦30,000 – ₦82000 monthly, 3.8% earn above ₦134,000. In Kwara state, the average monthly income was ₦44,530 and all the respondents (100%) earn within ₦30,000 – ₦82,000 monthly. In Kogi state, the average income was ₦104,627 ± ₦1.025 and majority of the respondents (80%) earn within ₦30,000 – ₦82000 monthly, while only 3% earn above ₦186,000. This implies that majority of the extension workers had a moderate remuneration. More so, in comparing their income to their household size, majority of the extension agents' income is not sufficient to feed their household, thus there is no motivation in performing their roles. Therefore, making them ineffective in disseminating CSA practices to the farmers. This is in line with the implication drawn by Obabire, Atere, &

Adedapo, (2019) that with the current economic reality of the country, the level of income of extension workers with an average family size of five people may be deemed insufficient, this therefore results into to job dissatisfaction.

4.1.10 Participation in Climate Smart Agricultural Practices (CSA) training

Results as shown in Table 3 revealed that majority of the respondents (84.9%) in Niger state had participated in CSA training while 15.1 % didn't participate in any CSA training during their years of service. In Kwara state, all the respondents (100%) had participated in CSA training in the course of their service year. Also, in Kogi state all the respondents (100%) had participated in CSA training in the course of their service year. This implies that majority of the extension agents are aware and very knowledgeable about CSA practices, thus enabling them to effectively disseminate information to farmers. This can also be attributed to the fact that the respondents had large number of years in extension service which could afford them opportunities to have participated on training, conferences, and workshops on mitigations against climate change, since climate change has been a challenge for agricultural for a very long time. This is in consonance with Dimelu, (2016) who found out that extension agents in Nigeria had a good knowledge on climate change and adaptation to climate change

4.1.11 Numbers of in-service training attended on CSA practices

As revealed in Table 3, the mean number of in-service training attended was 4.81 ± 4.74. However, in Niger state the mean number of in-service training on CSA practice was 2.5 ± 2.89 where majority of the respondents (90.6%) had between 1 and 6 in-service trainings, 9.4% had between 7 and 12 in-service trainings on CSA practice in the last three years. In Kwara state, the mean in service training was 10.6 ± 5.6, where 65% had between 1 and 12 training sessions, while 10% had above 18 in-service trainings in the last three years. However, in Kogi state, the mean in service training was 5.4 ± 0.91, and all the respondents (100%) had between 1 and 6 in-service trainings on CSA practice in the last three years.

This result revealed that although nearly all the respondents had participated in CSA training, majority of the extension agents in the study area had between 1 and 6 in-service training on CSA practice. The number of in-service trainings attended was significantly low which could negatively affect their knowledge and competence on CSA practices, thus making them ineffective to train the farmers on the CSA practice suitable to mitigate the effect of climate change. This could be because the issue of climate change and its effect on agriculture which necessitated the need for CSA practices are new, and are just receiving adequate attention from Government and research institutions. This corroborates with the findings of Kshash, (2018) and Oladele & Tekena, (2010) who reported that Extension agents' knowledge of the various agricultural technologies they disseminate to farmers is vital to effectiveness of their service delivery (i.e the knowledge of the EA’s determines how effective they are in their services).

Table 3: Distribution of Respondents (E.A) By Household Size, Monthly Income, Participation in Training, Number of in-service Training, Contact with Agency and Number of farm family served per Extension agents.

Characteristics	Niger		Kwara		Kogi		Pooled	
N=88	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**
Household size								
3 – 7	15	28.6	11	55.0	12	80.0	38	39.8
8 – 12	22	41.5	9	45.0	3	20.0	34	38.6
13 – 17	13	24.5	0	0.0	0	0.0	13	14.8
>17	3	5.6	0	0.0	0	0.0	3	6.8
Total	53	100.0	20	100.0	15	100.0	88	100.0
Mean	11.2		7.35		6.33		9.5	
S.D	4.4		2.66		1.45		4.3	
Monthly Income (₦)								
30,000 – 82,000	37	69.8	20	100.0	12	80.0	69	78.4
82,000 – 134,000	14	26.4	0	0.0	0	0.0	14	15.9
134,001 – 186,000	1	1.9	0	0.0	0	0.0	1	1.1
>186,000	1	1.9	0	0.0	3	20.0	4	4.5
Total	53	100.0	20	100.0	15	100.0	88	100.0
Mean	77,068		44,530		104,627		74,370	
S.D	32096.3		8635.3		1.025		51,868.8	
Participation in CSA training								
Yes	45	84.9	20	100.0	15	100.0	80	90.9
No	8	15.1	0	0.0	0	0.0	8	9.0
Total	53	100.0	20	100.0	15	100.0	88	100.0
Number of in-service training on CSA practice								
1 – 6	48	90.6	6	30.0	15	100.0	69	78.4
7 – 12	5	9.4	7	35.0	0	0.0	12	13.6
13 – 18	0	0.0	5	25.0	0	0.0	5	5.7
19 – 25	0	0.0	2	10.0	0	0.0	2	2.3
Total	53	100.0	20	100.0	15	100.0	88	100.0
Mean	2.5		10.6		5.4		4.81	
S.D	2.89		5.6		0.91		4..74	

Source: ***Field Survey, 2020***

4.1.12 Number of Contact with Research Agency

The number of contact with agency is a reflection of support system given to extension agents and which will have impact on the farmers' knowledge and income. Result in Table 4 show that the mean number of contact with agency in the study area was 2.3 ± 1.3. however, in Niger state the average number of contact with agency was 1.98 ± 1.63, in which majority (67.9%) of the respondents had between 1 and 2 contacts with agency in the last three years, 26.4% had between 3 and 4 contacts, 1.9% had between 5 and 6 contacts with agency,3.8% had above 6 contacts . In Kwara state, the average number of contact with agency was 2.60 ± 0.59 and more than half of the respondents (55%) had between 3 and 4 contacts with agency, 45% of the respondents had between 1 and 2 contacts with agency. While in Kogi state, the average number of contact with agency was 3.06 ± 0.25 and all the respondents had between 3 and 4 contacts with agency. This implies that majority of the extension agents had low contact with agency, and so limit them from getting adequate training on CSA practices needed by the rice farmers and also financial support to implement the practices.

Result from the focus group discussion: one of the discussant at Kwara state ADP indicated that they had contacts with agency like USAID and ABC(Agricultural Business Concepts)

Another discussant in Kogi state ADP mentioned that they receive training from FMARD, International Institute of Tropical Agriculture (IITA), ARMTI and SASAKAWA Global (SG), which is the one that is going on currently. We receive training periodically (2 years interval).

4.1.13 Number of Farmers/Farm Family Served Per Extension Agents

Results in Table 4 revealed that the mean number of farmers/ farm families per extension workers was 1935.6 ± 6690.1. However, in Niger state, the mean number of farm families served per extension agents was 2862.5 ± 8517.4. Majority (88.9%) of the respondents served between 1 and 6700 farm families, 9.4% served between 6701 and 13400 farm families, while 1.9% served above 13,400 farm families. In Kwara state, the mean number of farmers/farm families served per extension agents was 787.65 ± 397.0

where all the respondents (100%) served between 1 and 6700 farm families. Likewise in Kogi state, the mean number of farmer/farm families served per extension agents was 207 ± 276.68 and whole respondents (100%) served between 1 and 6700 farm families. The number of farmers/farm families served per extension agents in the study area was relatively high compare to the 1:1000 number of extension agent to farm families ratio recommended by FAO. This result is high enough to de-motivate and impede the extension agent from disseminating climate smart agricultural practices to the farmers across the study. This is in line with the findings of Haruna, (2013) who reported that extension to farm families ratio in Kwara and Kogi and Niger state was relatively higher than the FAO standard.

Table 4: Distribution of Respondents (E.A) by Number of Contact with Agency. Number of farm families per Extension Agents

Characteristics N=88	Niger Freq.	Per. (%)	Kwara Freq.	Per. (%)	Kogi Freq.	Per. (%)	Pooled Freq.	Per. (%)
Number of contact with agency								
1 – 2	36	67.9	9	45.0	0	0.0	45	51.13
3 – 4	14	26.4	11	55.0	15	100.0	40	45.45
5 – 6	1	1.9	0	0.0	0	0.0	1	1.13
>6	2	3.8	0	0.0	0	0.0	2	2.27
Total	53	100.0	20	100.0	15	100.0	88	100.0
Mean	1.98		2.60		3.06		2.3	
S.D	1.63		0.59		0.25		1.3	
Number of Farm Families Per Extension Agents								
1 – 6700	47	88.7	20	100.0	15	100.0	82	93.18
6701 – 13401	5	9.4	0	0.0	0	0.0	5	5.68
>13401	1	1.9	0	0.0	0	0.0	1	1.14
Total	53	100.0	20	100.0	15	100.0	88	100.0
Mean	2862.5		788.65		207		1935.6	
S.D	8517.4		397.0		276.68		6690.1	

Source: ***Field Survey, 2020***

4.2 Socio-Economic Characteristics of Rice Farmers

4.2.1 Age

Age most times helps in cognitive abilities of an individual such as reasoning, thinking and learning new skills among others. The data analysis on Table 5 revealed that the mean age of the respondents was 48.8 ± 12.75. Meanwhile, in Niger state the mean age of the rice farmers was 41.49 years ± 10.22, and majority of the rice farmers (63%) were between the age of 31 and 50 years while 3.85 were 60 years and above. In Kwara state, the mean age of the rice farmers was 50.06 years ± 12.19, with majority of the respondents (54.2%) between the age of 31 and 50 while only 5.0% were between the age of 20 and 30 years. In Kogi state, the average age was 56.7 years ± 11.02, with majority of the respondents (47%) between the age of 41 and 60 years while 12% were between the age of 31 and 40 years. This implies that the farmers are active, vibrant, and still in their middle age, able to perform tedious farm activities and eager to learn new innovations. More so, according to FAO, (2014) Young farmers may be more likely to see farming as a business opportunity in order to financially help their families, while older farmers see farming as a way of life passed down from their forefathers.

This will also enhance the effectiveness of extension agents in disseminating CSA practices so as to ensure food sufficiency and mitigate the adverse climatic conditions. This agrees with the findings of Omotesho et al., (2017) who reported that majority of the rice farmers in North central, Kwara state were above 40 years of age. Similarly, Ahmed & Adisa, (2017) reported that majority of sampled respondents were more of youths and in their productive age. The age of the farmers also indicate experience in farming as indicated by Ishaya & Abaje, (2008). The implication of this is that majority of the farmers have been involved in the profession for a long time.

There was a significant relationship between the age of the farmers and effectiveness of extension agents in disseminating CSA using Pearson Product Moment Correlation (PPMC).

4.2.2 Sex

Analysis in Table 5 revealed that large proportion of the respondents (88.9%) were males, while 11.1 % were females. Also as reflected in Niger state, majority of the respondents (87.7%) were male while only 12.3% were female. Likewise in Kwara state, majority of the respondents (98.3%) were males while only 1.7% were females. In Kogi state, large percentage (79%) of the respondents were males, while 21% were females. This implies that majority of the rice farmers were predominantly male, this is due to the fact that women are mostly occupied with non-farm activities such as trading and do not have access to productive resources such as land, market opportunities, new practices and infrastructure (Khan, Sajjad, Hameed, Khan, & Jan, 2012; Rasheed, Mwalupaso, Abbas, Tian, & Waseem, 2020). This corroborates with findings of Opaluwa, (2014) who stated that 89.5%of farmers in Kogi were males, Adisa et al., (2019) and (Ahmed & Adisa, (2017) who reported that rice farmers in North central (Kogi state) are dominated by males. However, Khan, Sajjad, Hameed, Khan, & Jan (2012) opined that women are more involved in post harvest activities such as rice processing than pre harvest activities. This is further buttressed by Kolawole, Oladele, Alarima, & Wakatsuki, (2017) who stated that women do not only complement men’s roles in rice production but are major players in the production of rice.

4.2.3 Marital Status

The data on Table 5 revealed that majority of the respondents (94.0%) were married while 0.6% were divorced. Furthermore, in Niger state majority of the respondents were married (94.6%) while 0.8% were divorced. In Kwara state, majority of the respondents (90.8%) were married while 9.2% were single. In Kogi state, majority of the respondents were married (97%) while 1% were divorced. The implication of this is that majority of the rice farmers are well experienced in relating with farming household, and will be able to adopt necessary CSA practice that will help in improving their status and income, thus enhance effectiveness of extension agents in performing their role of disseminating information. This conform to the findings of Adisa et al., (2019) and Ebenehi, Ahmed, & Barnabas, (2018) who reported that majority of the respondents are married. Suggesting the need to take on obligations and find ways to provide food and income to their dependants in order to avoid food insecurity and poverty.

4.2.4 Educational status

The level of education is expected to have influence on the knowledge of individual. Results in Table 5 revealed that 37.1% of the respondents had secondary school education while 5.4 had no formal level of education. Furthermore, the result revealed that almost half of the respondents (43.8%) in Niger state had secondary school education, while 2.3 % had no formal education. In Kwara state, 40% of the respondents had tertiary level of education while 10% had no formal level of education. In Kogi state, 34% had secondary school education, while 6.0% had no formal level of education. This implies that larger proportion of the rice farmers had one level of education or the other, thus influence their ability to adopt CSA practices to mitigate against climate change thereby enhancing effectiveness of extension agents. This is because level of education is expected to have influence on knowledge of individual. This is in line with the finding of Adisa et al., (2019) who reported that 53.3% of the rice farmers had secondary school education in Kogi state. Also, Sheshi & Usman, (2018) confirmed that majority of the respondents in Niger state had one form of education or the other. As well as (Umeh et al., 2017) who stated that 50.9% of the respondents had secondary school as their highest level of education. This is also similar to the result of (Ahmed & Adisa, 2017) who reported that 53.3% of the rice farmers in Kogi state had up secondary school education as highest level of education.

Table 5: Distribution of Respondents (rice farmers) by Age, Sex, Marital Status, Educational Status

Characteristics	Niger		Kwara		Kogi		Pooled	
N=350	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**
Age								
20 – 30	20	15.4	6	5.0	0	0	26	7.4
31 – 40	51	39.4	23	19.2	12	12.0	86	24.6
41 – 50	31	23.8	42	35.0	23	23.0	96	27.4
51 – 60	23	17.7	21	17.5	24	24.0	68	19.4
>60	5	3.8	28	23.3	41	41.0	74	21.1
Total	**130**	**100.0**	**120**	**100.0**	**100**	**100.0**	**350**	**100.0**
Mean	41.49		50.06		56.7		48.8	
S.D	10.22		12.19		11.02		12.75	
Sex								
Male	114	87.7	118	98.2	79	79.0	311	88.9
Female	16	12.3	2	1.7	21	21.0	39	11.1
Total	130	100.0	120	100.0	100	100.0	350	100.0
Marital Status								
Single	6	4.6	11	9.2	2	2.0	19	5.4
Married	123	94.6	109	90.8	97	97.0	329	94.0
Divorced	1	0.8	0	0.0	1	1.0	2	0.6
Total	**130**	**100.0**	**120**	**100.0**	**100**	**100.0**	**350**	**100.0**
Educational Status								
Non formal education	3	2.3	12	10.0	6	6.0	21	5.4
Primary education	23	17.7	26	21.7	27	27.0	76	21.7
Secondary education	57	43.8	34	28.3	34	34.0	125	37.1
Tertiary education	47	36.2	48	40.0	33	33.0	128	35.7
Total	**130**	**100.0**	**120**	**100.0**	**100**	**100.0**	**350**	**100.0**

Source: ***Field Survey, 2020***

4.2.5 Years of Experience

The data in Table 6 revealed that less than half of the respondents (42.9%) had between 17 and 30 years of experience, while 2.0% of the respondents had more than 56 years of experience in farming and the mean years of experience was 26.77 ± 13.29. However, in Niger state, the mean years of experience was 21.7 ± 12.8, meanwhile 45.4% of the respondents had between 17 and 30 years of experience while 3.1% of the respondents had more than 56 years of experience. In Kwara state, majority of the respondents (46.7%) had between 17 and 30 years of experience, while 1.7% had above 56 years of experience in farming, and the mean years of experience was 30.61 ± 13.49. Lastly in Kogi state, the mean years of experience was 28.77 ± 11.6, and 35.0%) had between 17 and 30 years of experience, while 10% had between 44 and 56 years of experience. This insinuates that large percentage of the respondents are well experienced on the field in rice production, thus provide a good platform for them to adopt CSA practices that will help to increase their output, thereby making the extension agents to be effective. This is corroborated with the findings of Oladele & Kolawole, (2013) who reported that the farmers are not amateur on the field but have better understanding of crop management which is a favourable platform for adoption of technology. This is also supported by Gbengeh & Akuibilo, (2013) who stated that farming experience expands the take-up of all technologies.

4.2.6 Farming/ Production system

Results in Table 6 showed that majority of the respondents (97.7%) practice low land production system, while 2.3% practice upland production system. Likewise in Niger state, greater percentage of the respondents (96.9%) practice low land production system, while 3.1% practice upland production system. In Kwara state, huge proportion of the respondents (96.7%) practice low land production system, while 3.3% practice upland production system. Finally, in Kogi state, all the respondents practice low land production system. This implies that majority of the farmers in the study area are into rainfed low land production system, thereby depending on the climate for rainfall in order for them to experience increase in rice production. This will therefore motivate them to be willing to adopt CSA practice that will assist in mitigating the effect of climate change on their output, and thus making extension agent to be effective. This is in conformity with FMARD, (2011) and Longtau, (2003) who reported that rainfed low land and irrigated low production system is predominant in North central, Nigeria.

4.2.7 Household Size

Results in Table 6 revealed that the mean household size of the respondents was 8.11 ± 4.25 and majority of the respondents (53.9%) had between 6 and 10 household size while 0.6% had above 20 household size. In Niger state, the average household size was 9.5 ± 5.38 and majority of the respondents (43.8%) had between 6 and 10 household size, while 1.5% had above 20 household size. In Kwara state, the mean household size was 7.65 ± 3.18 and majority of the respondents (60.8%) had household size of 6 to 10 persons, while 4.2% had household size of 16 to 20 persons. In Kogi state, the mean household size was 6.84 ± 3.05 and majority of the respondents (56%) had household size of 6 to 10 persons while 10% had between 11 and 15 persons. This implies that majority of the respondents had a large household size. Usually most rural household are characterized by large household size which is used mainly for farm labour. This is in consonance with the findings of Ahmed & Yisa, (2020) who reported that large household often leads to high family labour supply in a farming community. This results also corroborates with the findings of Falola, Animashaun, & Olorunfemi, (2014) who reported that 96% of the respondents had a household size above five members.

4.2.8 Occupation

The data analysis in Table 6 revealed that majority of the respondents (77.1%) were full-time farmers, while 22.9% were part-time farmers. In Niger state, majority of the respondents (83.1%) were full-time farmers, 16.9% were part-time farmers. In Kwara state, more than half of the respondents (64.2%) were full time farmers while 35.8% were part-time farmers or use farming as secondary occupation. Likewise, in Kogi state, most of the respondents (85.0%) were also full time farmers while 15.0% were part-time farmers. This implies that majority of the respondents had rice farming as their main source of income that is their primary occupation, hence will be motivated to listen and adopt the CSA practices introduced by the extension agents so as to increase their income and ensure food security. This is in line with the findings of Umeh et al., (2017) who reported that 61% of the respondents in Akwa- ibom were full time farmers. Also according to Umeh et al., (2015) who reported that full time farming enhances quick use of research innovations from agricultural extension than part time farming

4.2.9 Farm Size

Results in Table 6 revealed that the mean farm size of the respondents was 3.64 ha ± 3.20. However, in Niger state the mean farm size was 3.39 ha ± 4.45 and majority of the respondents (89.2%) had farm size of 1 to 4 hectares, while 3.1% had above 12 hectares of land. In Kwara state, the mean farm size was 4.20 ± 2.72 and larger percentage of the respondents (56.7%) had between 1 to 4 hectares of land, while 0.8% had farm size of more than 12 hectares. In Kogi state, the mean farm size was 3.29 ha ± 0.89 and majority of the respondents (81.0%) had between 1 to 4 hectares of farm land, while 19.0% had between 5 to 8 hectares. This suggests that a large percentage of the respondents cultivate their farms on a medium scale, thus may discourage them from adopting CSA practices particularly when it is capital intensive. This is corroborated by the findings of Sheshi & Usman, (2018) who stated that majority of the farmers in Niger state were cultivated on medium-scale level, as a result technological adoption and output level may be limited. This findings also agrees with Falola et al., (2014) who reported that 73% of the farmers cultivated 0.1- 6ha and had a mean farm size of 4.3ha. Likewise Jim, Villano, & Fleming, (2012) stated Farmers who cultivated more land adopted & embraced more integrated crop management practices (ICMPs) due to the fact that they are less vulnerable to failure from trying new technologies than farmers with small land areas

Table 6: Distribution of Respondents (rice farmers) by Years of Experience, Farming/Production System, Household size, Occupation, and Farm size

Characteristics	Niger		Kwara		Kogi		Pooled	
N=350	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**
Years of Experience								
3 – 16	49	37.7	15	12.5	21	21.0	85	24.3
17 – 30	59	45.4	56	46.7	35	35.0	150	42.9
31 – 43	15	11.5	18	15.0	34	34.0	67	19.1
44 – 56	3	2.3	29	24.2	10	10.0	41	11.7
>56	4	3.1	2	1.7	0	0.0	7	2.0
Total	130	100.0	120	100.0	100	100.0	350	100.0
Mean	21.7		30.61		28.7		26.77	
S.D	12.8		13.49		11.6		13.29	
Production System								
Low land Farming	126	96.9	116	96.7	100	100.0	342	97.7
Upload farming	4	3.1	4	3.3	0	0.0	8	2.3
Total	130	100.0	120	100.0	100	100.0	350	100.0
Household size								
1 – 5	29	22.3	23	19.2	34	34.0	86	24.6
6 – 10	57	43.8	73	60.8	56	56.0	186	53.1
11 – 15	28	21.5	19	15.8	10	10.0	57	16.3
16 – 20	14	10.8	5	4.2	0	0.0	19	5.42
>20	2	1.5	0	0.0	0	0.0	2	0.57
Total	130	100.0	120	100.0	100	100.0	350	100.0
Occupation								
Full Time	108	83.1	77	64.2	85	85.0	270	77.1
Part Time	22	16.9	43	35.8	15	15.0	81	22.9
Total	130	100.0	120	100.0	100	100.0	350	100.0
Farm size (ha)								
1 – 4	116	89.2	68	56.7	81	81.0	265	75.71
5 – 8	5	3.8	50	41.7	19	19.0	74	21.14
9 –12	5	3.8	1	0.8	0	0.0	6	1.71
>12	4	3.1	1	0.8	0	0.0	5	1.42
Total	130	100.0	120	100.0	100	100.0	350	100.0
Mean	3.39		4.20		3.29		3.64	
S.D	4.45		2.72		0.89		3.20	

Source: Field Survey, 2020

4.2.10 Extension Contact

Results in Table 7 shows that mean extension contact was 24 ± 6.5 and almost half (48.4%) of respondents had between 10 and 17 extension contacts while, 7.1% had more than 33 extension contacts in the last three years. However in Niger state, the mean extension contact was 26 ± 6.3 in which 40.0% of the respondents had between 18 and 25 extension contacts, while 6.2% had between 10 and 17 extension contacts in the last three years.

In Kwara states, the mean extension contact was 24.15 ± 5.39, where more than half of the respondents (54.2%) had between 18 and 25 extension contacts and 4.2% had above 33 extension contacts in the last three years. Lastly, in Kwara state, the mean extension contact was 20 ± 5.88, where majority of the respondents (53.3%) had between 18 and 25 extension contacts while 16% had between 26 and 33 extension contacts in the last three years. This implies that the farmers had a moderate contact with extension agents, therefore will develop interest in climate smart agricultural (CSA) and will be willing to adopt more of the practices, thereby making the extension worker moderately effective in disseminating CSA practices.

This is corroborated by the findings of Falola et al., (2014) that a good number of farmers in Kwara state had access to extension services. The findings is also similar to Umeh et al., (2017) who reported that 85.9% of the farmers had contact with extension agents once in a week, which infer they have frequent contact and access to extension services. Similarly, Ahmed & Adisa, (2017) reported that majority of the rice farmers in Kogi state were visited fortnightly.

4.2.11 Annual Income

Results in Table 7 show that the mean income was ₦619,111.78 ± 672,958.86 and majority of the respondents (72.3%) earn between ₦37,000 and ₦710,000, while 2.0% earn between ₦1,383,001 and ₦2,056,000, and between ₦2,056,00 and ₦2,729,000 respectively.

However, in Niger state, the average annual income was ₦725,877.63 ± 1.03 where more than half of the respondents (77.7%) earn between ₦37,000 and ₦710,000, while 4.6% earn between ₦1,383,001 and ₦2,056,000, and between ₦2,056,00 and ₦2,729,000 respectively. In Kwara state, the mean annual income was ₦683,500 ± 2.5, while half of the respondents (50.0%) earn between ₦37,000 and ₦710,000, while 0.8% earn between ₦1,383,001 and ₦2,056,000, and between ₦2,056,00 and ₦2,729,000 respectively. Finally in Kogi state, the average annual income was ₦404,250 ± 1.65, where majority of the respondents (92%) earn between ₦37,000 and ₦710,000 while 8.0% earn between ₦710,001 and ₦1,383,000. This implies that majority of the farmers earn a reasonably moderate income from their faming activities, which may be a source of motivation for them to adopt CSA practice in order increase their standard of living. Thus, extension agent would be said to be effective in disseminating information to farmers. This is because the human needs are unlimited and insatiable.

This negates the findings Adisa, Ahmed, Ebenehi, & Oyibo, (2019) who reported low income among the rice farmers. Similarly Adejo, Adejo, Ahmed, & Bello, (2016) reported that the respondents by and large were of low income; which can influence adoption of capital intensive modern farm technologies.

4.2.12 Religion

As shown in Table 6 majority (60.3%) of the respondents practice Islam, 38.6% were Christians, while 1.1% were traditional religion worshipper. In Niger state, 93.1% practice Islam, while 6.9% were Christians. In Kwara state, 71.7% practice Islam, while 28.3% were Christians. However, in Kogi state majority of the respondents (92.0%) were Christians, 4.0% practice Islam and 4.0% were traditional religion worshipper. The analysis thus revealed that majority of the rice farmers either belongs to Christian or Muslim faith. This implies that majority of the farmers due to their belongingness to these organized religions are more likely to be exposed to certain CSA practices and be motivated to adopt the technology. This is because the place of worship is a place where people's faith is built to become a better person and also currently being used for disseminating information to the populace (mosque). This agrees with the findings of Mubofu & Elia, (2017) who recommended that there is a need to use religious leaders, as key dissemination pathways to disseminate information, this is because farmers recognized to receive information from both extension officers and religious leaders more often in an oral form.

Table 7: Distribution of Respondents (rice farmers) by Extension Contact, Annual Income and Religion

Characteristics	Niger		Kwara		Kogi		Pooled	
N=350	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**	**Freq.**	**Per. (%)**
Extension Contact								
10 – 17	8	6.2	14	11.7	31	31.0	53	15.1
18 – 25	52	40.0	65	54.2	53	53.0	170	48.6
26 – 33	50	38.5	36	30.0	16	16.0	102	29.1
>33	20	15.4	5	4.2	0	0.0	25	7.1
Total	130	100.0	120	100.0	100	100.0	350	100.0
Mean	26		30.61		28.7		24	
S.D	6.3		13.49		11.6		6.5	
Annual Income (₦)								
≤ 710,000	101	77.7	60	50.0	92	92.0	253	72.3
710,001-1,383,000	7	5.4	58	48.3	8	8.0	73	20.9
1,383,001-2,056,000	6	4.6	1	0.8	10	10.0	7	2.0
2,056,001-2,729,000	6	4.6	1	08	0	0.0	7	2.0
>2,729,000	10	7.7	0	0.0	0	0.0	10	2.9
Total	130	100.0	120	100.0	100	100.0	350	100.0
Mean	725,877		683,500		404,250		619,111	
S.D	1.03		2.5		1.65		672,958	
Religion								
Christian	9	6.9	34	28.3	92	92.0	135	38.6
Muslim /Islam	121	93.1	86	71.7	4	4.0	211	60.3
Traditionalist	0	0.0	0	0.0	4	4.0	4	1.11
Total	130	100.0	120	100.0	100	100.0	350	100.0

Source: *Field Survey, 2020*

4.3 Attitude of extension agents towards Climate Smart Agricultural Practices

This section presents the result of the extension agents' attitude towards climate smart agricultural practices in the study area (Objectives 2). Attitude is defined as a "psychological tendency expressed by favoring or disfavoring a specific entity" Eagly & Chaiken, (1993).

Results in Table 8 revealed that majority (77.3%) of the respondents had neutral attitude, while 12.5% had favourable attitude towards their message and only 9 extension agents representing 10.2% had unfavourable attitude towards their message. The mean score for extension agents' attitude towards subject matter was 157.68 ± 17.23. The implication of this is that extension agents in the study are moderately satisfied with their job, this tend to enable them disseminate CSA practices to farmers. As Oladele & Mabe, (2010) stated that theoretically, job satisfaction is equal to positive attitudes toward one's job, whereas job dissatisfaction is equal to negative attitudes toward one's job.

Their moderate favourable attribute may also be due to extension personnel's years of service, and level of education which could afford them opportunities to understand the effect of climate change on agricultural production, thus makes them embrace CSA practices so as to help the farmers. This is corroborated with the findings of (Ilevbaoje, (2004) and Ogunremi & Olatunji, (2017), who reported that the relative effectiveness of an extension system can be measured in part by measuring extension workers' attitudes toward their jobs. This finding is in line with Dimelu, (2016) who reported that probability that extension professionals will have positive altitude to climate change adaptation challenges is a function of the number of years spent in school. This finding is also in line with (Oladele & Mabe, 2010) stated that theoretically, job satisfaction is equal to positive attitudes toward one's job, whereas job dissatisfaction is equal to negative attitudes toward one's job.

Table 8: Attitude of extension agents towards CSA practices

Categories	**Frequencies**	**Percentage**	**Mean**	**Std. Deviation**
Unfavourable attitude	9	10.2		
Neutral attitude	68	77.3	157.68	17.23
Favourable attitude	11	12.5		
Total	88	100.0		

Source: ***Field Survey, 2020***

4.4 Knowledge Level of the Extension Agents on Climate Smart Agriculture

Table 9 presents the knowledge level of extension agents across all the climate smart agricultural mechanisms. The Table revealed that generally, more than half (53.4%) of the extension agents had high level of knowledge on CSA practice, while less than half (46.6%) had a low level of knowledge. This indicates that a large number of extension agents are familiar with the concept of CSA practice. This could be due to the numbers of years of experience they had in service, which could afford them opportunities to have been trained on different adaptation practice to climate change. Thus, could afford them to be effective in disseminating CSA practices. This is corroborated by (Dimelu, 2016) who reported that knowledge of climate change increases with the number of years in extension organization.

The Table further revealed that larger percentage of the respondents (53.4%) had high knowledge in soil smart mechanism, while 46.6% had low level knowledge on soil smart mechanism. Majority of the extension agents (56.8%) had high knowledge on crop smart mechanism and less than half (43.2%) had low knowledge level. More than half (52.3%) of the respondents had low level of knowledge on water smart mechanism, while almost half of the respondents (47.7%) had low level of knowledge. Above half (54.5%) of the extension workers had low level of knowledge on weather smart mechanism or practices, while less than half (45.5%) of the extension workers had a high knowledge level. The table finally showed that the level of knowledge of extension agents was high with a percentage of 62.5% on ‘‘knowledge smart mechanism” while 32.5% had low level of knowledge. This implies that there were disparities in the level of knowledge in the various CSA components, which could be attributed to lack of adequate training in this CSA practice.

Table 10 presents the items for which the extension agents had low or high knowledge based their mean score. In soil smart mechanism, the items for which the extension agents had highest mean score was on planting of cover crops which helps in retaining soil nutrient, increase soil organic matter and controls crop erosion ($\bar{x}$=4.44), Application of manure and compost helps to increases the soil nutrients ($\bar{x}$=4.42), use of urea deep placements helps to reduce nitrogen loss ($\bar{x}$=4.39), Mulching is a CSA management practice that buffers the soil against extreme temperature and therefore maintaining soil nutrients ($\bar{x}$=4.09), minimum tillage practice is a CSA practice used in breaking soil compacts and hardpans, increase water infiltration ($\bar{x}$=3.73). This implies that majority of the rice farmers are aware of the use of compost, minimum tillage among others in adapting to climate change. This conforms to the apriori expectations as (Yakubu, Akpoko, Akinola, & Abdulsalam, 2020) reported that minimum tillage and use of organic manure are the major practices used by rice farmers while planting of tress (agro-forestry) were rarely used in North-west, Nigeria

While the lowest mean score was on agro-forestry as a CSA practice that helps in water purification and water regulation ($\bar{x}$=2.47) and agro-forestry as a CSA practice that helps in fixing nitrogen ($\bar{x}$=2.66). This implies that extension agents had low knowledge in that area. This corroborates with the findings of Olorunfemi et al., (2020) who reported that extension agents in south west Nigeria had low competence in Agro-forestry such as Alley Cropping. Similarly, Yakubu et al., (2020) stated that planting of tress (agro-forestry) were rarely used in North-west, Nigeria.

In crop smart mechanism, the item for which the respondents had the highest mean score was planting of early maturing rice varieties ($\bar{x}$=4.31), Use of healthy young rice seedlings is a CSA approach that aids rice germination and increase rice yield ($\bar{x}$=4.24), Planting of pest and disease-resistant rice varieties ($\bar{x}$=4.07), Primed crops emerge fasters, more completely, produce more vigorous seedlings, flower and mature earlier and yield better than non primed ($\bar{x}$=4.06), Using DSR (direct-seeded rice) method help in reducing labour, energy, preparing field, emission of green house-gasses and transplanting cost ($\bar{x}$=3.99)**,** Crop rotation with legumes serve as a CSA solution for weed management ($\bar{x}$=3.83), and mixed cropping practice help in fixing nutrients ($\bar{x}$=3.76). This implies that farmers in the study area have a good knowledge and practice the use of planting of early maturing rice varieties, pest and disease resistant varieties, mixed cropping among others. This implication of this is that majority of the farmers in the study area are naïve about the use of improved rice variety in adapting to the inimical effect of climate change. This is corroborated by the findings of Mbah & Ezeano, (2016) who stated that rice farmers in North central, Nigeria majorly adopt planting of improved rice variety as a adaptation mechanism to climate change. In another study, Onyegbula & Oladeji, (2017) reported high knowledge on use of mulching, appropriate use of fertilizer, mixed cropping, improved tillage practice and planting of early maturing variety among rice farmers in Ekiti, Ebonyi and Niger state, Nigeria.

For water smart mechanism, the item for which the respondents had the lowest mean score was on use of Alternate-Wet-and-Dry (AWD) technique aid farmers in monitoring the water level of the crop ($\bar{x}$=1.92), In AWD technique, a field is flooded and allowed to dry alternately instead of remaining flooded continuously throughout season ($\bar{x}$=2.19).

While, highest mean score was on construction of water channels in farm as it helps in reducing effect of flood ($\bar{x}$=4.08), furrow irrigation ($\bar{x}$=3.92), multiple inlet irrigation which reduce water waste due to runoff ($\bar{x}$=3.67) and planting of basins method use for capturing rain water $\bar{x}$=3.40. The implication of this is that majority of the rice farmers use construction of water channels, basins in collecting water as resilience to climate change, but low level of awareness of use of AWD technique in adapting to climate change. This conforms to the findings of Abaje et al., (2014) who identified the most significant climate change adaptation strategies used by rice farmers were water harvesting.

For weather smart mechanism, the items for which they had the highest mean score was on ‘‘Early warning system is a climate information service (CIS) that helps in reducing the effect on climate change on farmers’’($\bar{x}$=4.13), and ‘‘CIS such as seasonal forecast is a CSA practice aimed to improve farmers’ access to relevant information on weather and climate’’ ($\bar{x}$=4.13)

While, the items for which they have the lowest score was on decision support system (DSS) tools which analyzed, interprets information and finally uses the analysis to recommend the most appropriate action for sustaining maximum yields ($\bar{x}$=2.32), DSS tools are used to copy crop management practices on specific crop yields and subsequently generates climate-smart agro-advisory ($\bar{x}$=2.44) and digital agriculture technology such as yield prediction ($\bar{x}$=2.64). This implies that the extension agents in the study area are not totally abreast with climate/ weather information, digital agriculture and insurance policies that can help farmers to make informed decision. This conforms to the findings of Olorunfemi et al., (2019) who reported that extension agents in southwest, Nigeria had low involvement in timely dissemination of weather information, farm insurance initiative. This could be attributed to their low level of knowledge in such initiatives.

In knowledge smart mechanism, the items for which they had the highest mean score was on ‘‘farmer to farmer learning is one of the CSA practices” ($\bar{x}$=3.91), Off-farm risk management kitchen garden is a CSA practice that helps farmers to diversify their resources $\bar{x}$=3.50. This implies that the extension agents had a low to moderate awareness on all the CSA practices. Therefore, this makes them moderately effective in disseminating CSA practices to the farmers. This is in agreement with Ebenehi, Ahmed, & Barnabas, (2018) who reported low to moderate level of awareness on climate change adaptation among farmers, and that 79.25% of farmers had extension worker as their source of information. Oladele & Tekena, (2010) stated that lack of knowledge among extension agents can deterred farmers to adopting OA (organic agriculture) practices. That is, when extension professionals have more information on an expertise and this expertise is shared with organic farmers, the adoption of OA is more likely to increase. Thus, this makes them effective in dissemination of the technology.

Table 9: Distribution of extension agents by Knowledge Level

Categories /	Frequency	Percentage
General knowledge		
Low (<65.39)	41	46.6
High(>65.39	47	53.4
Total	88	100.0
Soil smart mechanism		
Low(<40.55)	41	46.6
High(>40.55)	47	53.4
Total	88	100.0
Crop smart mechanism		
Low (<68)	38	43.2
High (>68)	50	56.8
Total	88	100.0
Water smart mechanism		
Low (<31.45)	46	52.3
High (>31.45)	42	47.7
Total	88	100.0
Weather smart mechanism		
Low (<29.43)	48	54.5
High (>29.43)	40	45.5
Total	88	100.0
Knowledge smart mechanism		
Low(<7.4)	33	37.5
High(>7.4)	55	62.5
Total	88	100.0

Source: Field Survey, 2020

Table 10: Knowledge of extension agents on CSA PRACTICE

	General knowledge	S.A F (%)	A F (%)	U.D F (%)	D F (%)	S.D F (%)	Mean	Std. Dev.	Rank
	General knowledge								
a.	CSA practices when adopted can sustainably increase agricultural productivity and income	45 (51.1)	43 (48.9)	0 (0)	0 (0)	0 (0)	4.51	.503	1st
b.	CSA is an approach that helps to guide actions to transform and change the direction of agricultural system.	27 (30.7)	59 (67.0)	1 (1.1)	0 (0)	1 (1.1)	4.26	.597	2nd
c.	CSA practices help famers to build resilience and withstand adverse weather conditions caused by climate change)	22 (25.0)	48 (54.5)	16 (18.2)	2 (2.3)	0 (0)	4.02	.727	3rd
d.	Planting of improved seeds variety is one of the way of mitigating climate change	21 (23.9)	52 (59.1)	11 (12.5)	3 (3.4)	1 (1.1)	4.01	.780	4th
e.	Building input supply systems and extension services that support efficient and timely use of inputs is a CSA practice	19 (21.6)	53 (60.2)	13 (14.8)	3 (3.4)	0 (0)	4.00	.711	5th
f.	Enhancing management of water resources is a CSA practice that helps in building resilience to climate change.	15 (17.0)	58 (65.9)	11 (12.5)	4 (4.5)	0 (0)	3.95	.693	6th
g.	Minimum or zero tillage practices helps in minimizing carbon dioxide losses, correct compaction and hardpans, and also increase soil organic matter.	22 (25.0)	48 (54.5)	6 (6.8)	12 (13.6)	0 (0)	3.91	.930	7th
h.	Diversification of production and income is a CSA practices that aids adaptation to climate change	12 (13.6)	61 (69.3)	9 (10.2)	6 (6.8)	0 (0)	3.90	.712	8th

Source: Field Survey, 2020

TABLE 10.1: General Knowledge of extension agents on CSA PRACTICE

	General knowledge	S.A F (%)	A F (%)	U.D F (%)	D F (%)	S.D F (%)	Mean	Std. Dev.	Rank
	General knowledge								
a.	Limiting soil erosion is one of the farm management methods of building resilience to mitigate the climate change.	18 (20.5)	44 (50.0)	16 (18.2)	9 (10.2)	1 (1.1)	3.78	.928	9th
b.	Reducing soil disturbance is one of the ways in reducing soil erosion, increases carbon sequestration (removal of CO2), and moisture increases moisture in the soil, which helps to increase rice yield.	14 (15.9)	49 (55.7)	13 (14.8)	11 (12.5)	1 (1.1)	3.73	.919	10th
c.	Strengthening market linkages throughout the rice value-chain i.e improving market connections is also CSA practices	17 (19.3)	41 (46.6)	17 (19.3)	12 (13.6)	1 (1.1)	3.69	.975	11th
d.	Direct seeding of rice (DSR) method is a CSA approach that helps to reduce the cost of production (fertilizer, fuel and rent cost on both land preparation an irrigation	13 (4.8)	46 (52.3)	15 (17.0)	9 (10.2)	5 (5.7)	3.60	1.045	12th
e.	Using of direct seeding of rice (DSR) method is a CSA approach that helps to reduce loss due to drought in a rain-fed environments	6 (6.8)	52 (59.1)	11 (12.5)	4 (4.5)	0 (0)	3.51	.959	13th
f.	Increasing tree covers in crop is one of the way in reducing green house gas emissions	6 (6.8)	48 (54.5)	17 (19.3)	16 (18.2)	1 (1.1)	3.48	.909	14th
g.	Conservative agriculture with trees helps to control pests and weeds thereby ensuring good harvests and reducing post-harvest losses.	11 (12.5)	31 (35.2)	23 (26.1)	21 (23.9)	2 (2.3)	3.32	1.045	15th

Source: Field Survey, 2020

Table 10.2: Knowledge of extension agents on CSA PRACTICE (soil smart mechanism)

	Soil smart mechanism	S.A F (%)	A F (%)	U.D F (%)	D F (%)	S.D F (%)	Mean	Std. Dev.	Rank
a	Planting of cover crops helps in retaining soil nutrient, increase soil organic matter leading to increasing soil structure, stability and controls crop erosion.	40 (45.5)	47 (53.4)	1 (1.1)	0 (0)	0 (0)	4.44	.522	1st
b	Application of manure and compost helps to increases the soil nutrients	40 (45.5)	46 (52.3)	1 (1.1)	1 (1.1)	0 (0)	4.42	.582	2nd
c	Use of urea deep placement technique, where urea is made into briquettes(solid form) helps to reduce nitrogen loss compare to broadcasting methods of urea application and thus increase rice yield.	42 (47.7)	39 (44.3)	6 (6.8)	1 (1.1)	0 (0)	4.39	.668	3rd
d	Organic fertilizers application is a CSA practice used in increasing the soil nutrients , thus increase crop yield	35 (39.8)	45 (51.1)	6 (6.8)	1 (1.1)	1 (1.1)	4.27	.739	4th
e	In SSNM, fertilizer N management is identified through the use of the leaf color chart (LCC)	11 (12.5)	48 (54.5)	26 (29.5)	3 (3.4)	0 (0)	4.20	.628	5th
f.	Mulching is a CSA management practice that buffers the soil against extreme temperature and therefore maintaining soil nutrients and boost crop production	23 (26.1)	54 (61.4)	7 (8.0)	4 (4.5)	0 (0)	4.09	.721	6th
g	Site-Specific Nutrient Management (SSNM) is a technology, plant-need-based approach for optimally applying fertilizers such as nitrogen (N), phosphorous (P), potassium (K) to rice.	26 (29.5)	56 (63.5)	4 (4.5)	2 (2.3)	0 (0)	3.99	.719	7th
h	Use of compost help in protecting against erosion	10 (11.4)	46 (52.3)	9 (10.2)	22 (25.0)	1 (1.1)	3.88	.800	8th

Source: Field Survey, 2020

Table 10.3: Knowledge of extension agents on CSA PRACTICE (soil smart mechanism)

	Soil smart mechanism	S.A F (%)	A F (%)	U.D F (%)	D F (%)	S.D F (%)	Mean	Std. Dev.	Rank
a.	Micro-dosing(efficient application of fertilizers in split - small but repeated - dosages based on assessment boost the crop yield	16 (18.2)	53 (60.2)	7 (8.0)	11 (12.5)	1 (1.1)	3.82	.917	9th
b.	Minimum tillage practice such as ripping is a CSA practice used in breaking soil compacts and hardpans	5 (5.7)	62 (70.5)	14 (15.9)	6 (6.8)	1 (1.1)	3.73	.723	10th
c.	Use of compost also add to the soil nutrients	25 (28.4)	55 (62.5)	3 (3.4)	4 (4.5)	1 (1.1)	3.48	1.028	11th
d.	Planting of cover crops such as sorghum help to increase soil organic matter, leading to improvements in soil structure, stability, and increased moisture and nutrient holding capacity for plant growth	12 (13.6)	42 (47.7)	12 (13.6)	14 (15.9)	8 (9.1)	3.41	1.181	12th
e.	Agro-forestry (i.e planting of trees) is a CSA practice that helps in controlling soil erosion	16 (18.2)	30 (34.1)	14 (15.9)	22 (25.0)	6 (6.8)	3.32	1.228	13th
f.	Agro-forestry (i.e planting of trees) is a CSA practice that helps in fixing nitrogen and increase soil fertility by improving water infiltration.	5 (5.7)	16 (18.2)	25 (28.4)	28 (31.8)	14 (15.9)	2.66	1.123	14th
g.	Agro-forestry (i.e planting of trees) is a CSA practice that helps in water purification and water regulation	4 (4.5)	7 (8.0)	28 (31.8)	36 (40.9)	13 (14.8)	2.47	.994	15th

Source: Field Survey, 2020

Table 10.4: knowledge of extension agents on CSA practice (crop smart mechanism)

	Crop smart mechanism	S.A F (%)	A F (%)	U.D F (%)	D F (%)	S.D F (%)	Mean	Std. Dev.	Rank
a.	Planting of early maturing rice varieties is a CSA practice that increase rice yield	35 (39.8)	46 (52.3)	1 (1.1)	1 (1.1)	0 (0)	4.31	.650	1st
b.	Use of healthy young rice seedlings is a CSA approach that aids rice germination and increase rice yield.	30 (34.1)	52 (59.1)	4 (4.5)	1(1.1)	1(1.1)	4.24	.695	2nd
c.	Planting of stress-tolerant rice varieties is a CSA practice that increase rice yield	18 (20.5)	60 (68.2)	9 (10.2)	1(1.1)	0(0)	4.08	.592	3rd
d.	Planting of pest and disease-resistant is a CSA practice that increase rice yield.	23 (26.1)	53 (60.2)	8 (9.1)	3(3.4)	1(1.1)	4.07	.770	4th
e.	Primed crops emerge fasters, more completely, produce more vigorous seedlings, flower and mature earlier and yield better than non primed.	14 (15.9)	67 (76.1)	5 (5.7)	2(2.3)	0(0)	4.06	.554	5th
f.	Planting of leguminous crops helps in protecting the soil against any kind of erosion	15 (17.0)	65 (73.9)	3 (3.4)	3(3.4)	2(2.3)	4.00	.743	6th
g.	Using DSR (direct-seeded rice) method help in reducing labour, energy, preparing field, emission of green house-gasses and transplanting cost.	23(26.1)	47 (53.4)	12 (13.6)	3(3.4)	3(3.4)	3.99	.869	7th

Source: Field Survey, 2020

TABLE 10.5: knowledge of extension agents on CSA practice (crop smart mechanism)

	Crop smart mechanism	S.A F (%)	A F (%)	U.D F (%)	D F (%)	S.D F (%)	Mean	Std. Dev.	Rank
a.	Retention of crop residues or other surface cover increases water content and reduce runoff by evaporation	15 (17.0)	60 (68.2)	4 (4.5)	9 (10.2)	0 (0)	3.92	.791	8th
b.	Crop rotation with legumes serve as a CSA solution for weed management	13 (14.8)	53 (63.6)	10 (11.4)	9 (10.2)	0 (0)	3.83	.805	9th
c.	Mixed cropping help in fixing nutrients like phosphorus, nitrogen and potash into the soil and thus increase yield	21 (23.9)	41 (46.6)	10 (11.4)	16 (18.2)	0 (0)	3.76	1.017	10th
d.	Construction of terraces that are reinforced with drought tolerant fodder grasses strips are used in increasing soil nutrients	7 (8.0)	51 (58.0)	24 (27.3)	6 (6.8)	0 (0)	3.67	.723	11th
	Water smart mechanism								
a.	Construction of water channels in farm helps in reducing effect of flood as a result of climate change on farm	23 (26.1)	56 (63.6)	3 (3.4)	5 (5.7)	1 (1.1)	4.08	.791	1st
b.	Furrow irrigation involves pumping water into trenches on furrows dug in between rows of crops	12 (13.6)	65 (73.9)	5 (5.7)	4 (4.5)	2 (2.3)	3.92	.761	2nd
c.	Multiple inlet irrigation reduce water waste due to runoff, and wear on levee gates due to over pumping	8 (9.1)	58 (65.9)	7 (8.0)	15 (17.0)	0 (0)	3.67	.867	3rd

Source: Field Survey, 2020

TABLE 10.6: knowledge of extension agents on CSA practice (water smart mechanism)

	Water smart mechanism	S.A F (%)	A F (%)	U.D F (%)	D F (%)	S.D F (%)	Mean	Std. Dev.	Rank
a.	Planting of basins is method use for capturing rain water and therefore reduce crop failure due to unreliable rainfall	10 (11.4)	34 (38.6)	29 (33.0)	11 (12.5)	4 (4.5)	3.40	1.000	4th
b.	In AWD technique, shallow flooding is done for the first two weeks after transplanting so as to help the plant in recovering from shock and suppresses weed.	11 (12.5)	19 (21.6)	17 (19.3)	26 (29.5)	15 (17.0)	2.83	1.297	5th
c.	AWD technique entails maintaining shallow pond from heading to the end of flowering stage time when the crop has high growth rate and when the rice crop is very sensitive to water-deficit stress.	5 (5.7)	8 (9.1)	41 (46.6)	28 (31.8)	6 (6.8)	2.75	.925	6th
d.	Alternate-Wet-and-Dry (AWD) irrigation technique is a process where rice producers prevent the field from constant flooding by ensuring that it dries intermittently throughout the rice lifecycle.	3 (3.4)	7 (8.0)	44 (50.0)	27 (30.7)	7 (8.07)	2.68	.865	7th
e.	In AWD, a field is flooded, allowed to dry alternately instead of remaining flooded continuously throughout	1 (1.1)	4 (4.5)	21 (23.9)	47 (53.4)	15 (17.0)	2.19	.814	8th
f.	Alternate-Wet-and-Dry irrigation technique helps to save water usage and reduce methane emission	0 (0)	2 (2.3)	22 (25.0)	46 (52.3)	18 (20.5)	2.09	.737	9th
g.	Alternate-Wet-and-Dry technique aid farmers in monitoring the water level of the crop	0 (0)	0 (0)	7 (8.0)	67 (76.1)	14(15.9)	1.92	.485	10th

Source: Field Survey, 2020

TABLE 10.7: Knowledge of extension agents on CSA practice (water& weather smart)

	Water smart mechanism	S.A F (%)	A F (%)	U.D F (%)	D F (%)	S.D F (%)	Mean	Std. Dev.	Rank
a.	Alternate-Wet-and-Dry technique entails keeping irrigation water applied whenever the perched water table falls to about 15cm below the soil surface during all other periods	0 (0)	0 (0)	19 (21.6)	43 (48.9)	26 (29.5)	1.92	.715	10th
	Weather smart mechanism								
b.	Climate information services (CIS) such as seasonal forecast is a CSA practice aimed to improve farmers' access to relevant information on weather and climate that help in mitigating climate change	25 (28.4)	50 (56.8)	12 (13.6)	1 (1.1)	0 (0)	4.13	.675	1st
c.	Early warning system is also climate information service that helps in reducing the effect on climate change on farmers.	6 (6.8)	26 (29.5)	28 (31.8)	14 (15.9)	14 (15.9)	4.13	.658	1st
d.	Climate information services (CIS), develop farm management capabilities in a context of climate change, raise awareness of the practical utility of agro-weather information.	4 (4.5)	16 (18.2)	24 (27.3)	36 (40.9)	8 (9.1)	4.00	.695	2nd
e.	Financial services such as credit and loans is a CSA practice used in increasing productivity and income	20 (22.7)	54 (61.4)	3 (3.4)	9 (10.2)	2 (2.3)	3.92	.937	3rd
f.	Digital agriculture technology entails providing integrated and market advisories to farmers which helps farmers to make decisions on what to grow, when to plant, harvest and where to sell their produce.	6 (6.8)	24 (27.3)	24 (27.3)	20 (22.7)	14 (15.4)	3.34	1.092	4th

Source: Field Survey, 2020

TABLE 10.8: Knowledge of extension agents on CSA PRACTICE (weather smart)

	Weather smart mechanism	S.A F (%)	A	U.D F (%)	D F (%)	S.D F (%)	Mean	Std. Dev.	Rank
a.	Despite rising climatic variability, new index-based weather insurance products may boost farmers' ability to invest in agriculture.	5 (5.7)	17 (19.3)	41 (46.6)	23 (26.1)	2 (2.3)	3.00	.884	5th
b.	Digital agriculture technology such as yield prediction involve the use of internet (remote sensing) to predict crop yields	1 (1.1)	11 (12.5)	39 (44.3)	29 (33.0)	8 (9.1)	2.64	.860	6th
c.	DSS gathers, arranges, and unifies all forms of information essential for crop production.	3 (3.4)	4 (4.5)	34 (38.6)	39 (44.3)	8 (9.1)	2.49	.858	7th
d.	Decision Support System (DSS) tools are used to copy crop management practices on specific crop yields and subsequently generates climate-smart agro-advisory	0 (0)	2 (2.3)	41 (46.6)	39 (44.3)	6 (6.8)	2.44	.658	8th
e.	DSS analyzes and interprets data and uses the results to recommend the best course of action for maintaining maximum yields.	1 (1.1)	7 (8.0)	29 (33.0)	33 (37.5)	18 (20.5)	2.32	.929	9th
f.	New index-based weather insurance products can increase the ability of farmers to invest in agriculture despite increasing climate variability	5 (5.7)	17 (19.3)	41 (46.6)	23 (26.1)	2 (2.3)	2.15	.884	10th
Knowledge smart mechanism									
a.	Farmer to farmer learning is one of the CSA practices	24 (27.3)	44 (50.0)	10 (11.4)	8 (9.1)	2 (2.3)	3.91	.978	1st
b.	Off farm risk management kitchen garden is a CSA practice that helps farmers to diversify their resources.	7(8.0)	46 (52.3)	20 (22.7)	14 (15.9)	1 (1.1)	3.50	.897	2nd

Source: Field Survey, 2020

4.5 Competency profile of Extension agents on Climate smart agricultural practices

Table 11 reveals that more than half (51.1%) of the respondents had a low competence in CSA practices. This implies that majority of the Extension agents are still in need of competency upgrade in various Climate smart agricultural practices. This tends to increase their knowledge and skills in the practices and enable them to perform their extension and advisory roles effectively in order to enhance the capacity of farmer's adaptation to climate change. This is in consonance with Olorunfemi et al., (2020) who stated that competency level of extension agents in south west was very low in several of the climate-smart agricultural initiatives.

Table 11: Competency profile of Extension agents on Climate smart agricultural practices

Competency level	Frequency	Percentage
High (>97.5)	43	48.9
Low (<97.5)	45	51 .1
Total	88	100.0

Source: Field survey, 2020

4.5.1 Competency needs of Extension agents on Climate smart agricultural practices

Table 12 provides a comparison of the extension agents' assessed importance of climate-smart adaptation practices and their perceived level of competency in these practices.. The computed MWDS was then used to rank the CSA practices. The larger the Mean Weighted Discrepancy score (MWDS), the greater the requirement for extension personnel to be knowledgeable (i.e need to be competent) about Climate Smart Agricultural practices.

The results of this study reveal that extension agents need more training in climate-smart agriculture. According to the ranking of mean weighted discrepancy scores, extension agents need to be more competent in the following areas; Ability to operate the AWD irrigation technique by monitoring the water level and recognize when water level is below 15cm beneath the soil surface prior to irrigation (MWDS = 4.21), Possess skills in relay cropping practice such as growing rice together with other crops such as maize (MWDS = 3.42) , Ability to operate the rice grain planter in sowing seed directly into the soil, (MWDS = 3.03), Ability to operate multiple inlet irrigation(MIRI), where polypipes are laid throughout the length of the field to simultaneously fill each paddy (MWDS = 2.98), In using Site-specific nutrient management (SSNM), I have ability to establish the yield target (MWDS = 2.95), ‘Use of Decision support system (DSS) to get help (MWDS = 2.77), Use ICTs such as computers to solve solutions (MWDS = 2.69), In Dry- DSR, ability to plant by drilling seeds in rows using a power tiller-operated seeder or in a raised bed after minimal tillage (MWDS = 2.60), Micro-dosing: knowledgeable and ability to apply small and affordable quantities of fertilizer (MWDS = 2.50), Ability to identify the cropping calendar and determine when to plant (MWDS = 2.42, Ability to operate the drip irrigation system on the rice field (MWDS = 2.35), Ability to operate the AWD technique by applying irrigation to about 2-5 cm above the surface(MWDS = 2.35). ‘Able to optimally use the existing(indigenous) nutrients coming from the soil, organic amendments, crop residue, manure, and irrigation water (MWDS = 2.30), ‘Use of Climate information services (CIS) to get new weather & climate information (MWDS = 2.29), ‘Use of Index-based weather insurance and apply to farmers (MWDS = 2.18), and Posses skills in IPM(integrated pest management) by calculating appropriate pesticides/herbicides mixing (MWDS = 2.13).

This result implies that the extension agents are majorly in need of training on some of the practices which include: operating Alternate wet & dry technique, water harvesting procedure during excess rainfall, operating multiple inlet irrigation, operating rice grain planter in sowing seeds directly, calculating appropriate pesticides/herbicides mixing (IPM), use of decision support system to get information on cropping calendar , use of ICT to source for solutions, getting index-based weather insurance and interpreting weather forecast, relay cropping practices, micro dosing and site specific nutrient management, and use of urea deep placement method.

This is in agreement with Olorunfemi et al., (2020) who reported ‘Use of soil amendments (MWDS = 2.31 and Use of Canal irrigation’ (MWDS = 3.19),) as areas where extension agent in southwest had low competency. Similarly, Ale, Okogbue, & Alfred, (2016) reported that extension officers in South West Nigeria also exhibited low competence in irrigation techniques and needed training in these areas. The low competence of extension agents on use of ICTs conforms to the findings of Antwi-Agyei & Stringer, (2021) who stated that extension agents in northeast, Ghana needs to build capacity on the use of ICTs. This findings is also in line with Man et al., (2016) who reported that extension agents are in training on Integrated pest managements practices.

Table 12: Competency needs of Extension agents on Climate smart agricultural practices

	Climate smart agricultural practices **Soil smart mechanism**	Mean (S.D) Importance	Mean (S.D) Competence	MWDS	Ranks
a.	Micro-dosing: knowledgeable and ability to apply small and affordable quantities of fertilizer onto the seed at planting time, or a few weeks after emergence	2.85(.545)	1.97(.718)	2.50	1st
b.	In using Site-specific nutrient management (SSNM), I have ability to establish the yield target	2.68(.740)	1.82(.736)	2.30	2nd
c.	Ability to use the urea deep placement method in applying fertilizer after transplanting.	2.64(.693)	1.86(.698)	2.05	3rd
d.	Possess skills in using leaf color chart (LCC) to assess leaf N status and the crops need for N.	2.55(.623)	2.05(.633)	1.28	4th
e.	Able to apply moderate amount of fertilizer (N, P, K) twice 50% near transplanting or sowing and 50% at early panicle initiation. So as to supplement the nutrients from indigenous sources and achieve the yield target	2.45(.501)	2.07(.675)	0.93	5th
f.	Possess skills in growing cover crops, and incorporating it into the soil so as to provide nutrient needed for production.	2.58(.673)	2.22(.734)	0.92	6th
g.	Mulching: Ability to mulch with soil with straws, plastic and paper	2.24(.695)	1.85(.704)	0.87	7th
h.	Ability to operate drilling machine in sowing seed at 80km/ha directly into the soil.	2.12(.658)	1.70(.761)	0.87	8th
i.	Ability to identify and estimate the amount of supplemental N needed, through the leaf N status.	2.43(.603)	2.11(.633)	0.78	9th
j.	Able to prepare high quality compost manure using different materials such as fruit scraps, rice husks, rice bran, straw, dry leaves, saw dust from untreated wood, egg shell e.t.c. so as to fertilize the soil.	2.30(.681)	2.00(.643)	0.69	10th
k.	Ability to plant by using broadcasting method	2.18(.810)	1.89(.780)	0.67	11th
l.	Possess skills in applying green manures in the soil so as to provide organic matter and nutrients.	2.42(.769)	2.15(.810)	0.65	12th

Source: field survey, 2020

Table 12.1: Competency needs of Extension agents on Climate smart agricultural practices

	Climate smart agricultural practices	Mean (S.D) Importance	Mean (S.D) Competence	MWDS	Ranks
	Soil smart mechanism				
a.	Agro-forestry: ability to incorporating trees into landscapes which helps reduce temperatures and improve infiltration of water into the soil.	2.52(.711)	2.30(.745)	0.55	13th
b.	Ability to: Grow trees in the midst of crops	1.99(.703)	1.76(.711)	0.46	14th
c.	Possess skills in minimum tillage: able to ensure the soil is covered by keeping residue on top surface so as to protect the soil.	2.41(.637)	2.25(.715)	0.39	15th
d.	Grow trees in rows with crops in between (alley cropping)	1.99(.809)	1.80(.775)	0.38	16th
	Crop smart mechanism				
a.	Have skills in relay cropping practice such as growing rice together with other crops such as maize	2.93(.814)	1.76(.758)	3.42	1st
b.	Ability to operate the rice grain planter in sowing seed directly into the soil	2.33(.496)	1.03(.748)	3.03	2nd
c.	In Dry- DSR, ability to plant by drilling seeds in rows using a power tiller-operated seeder or in a raised bed after minimal tillage.	2.83(.755)	1.91(.637)	2.60	3rd
d.	Ability to identify the cropping calendar and determine when to plant	2.69(.488)	1.79(.794)	2.42	4th
e.	Posses skills in IPM(integrated pest management): Able to calculate appropriate pesticides/herbicides mixing	2.84(.398)	2.09(.756)	2.13	5th
f.	Posses skills in IPM(integrated pest management): such as identifying the application time, frequency and method of applying herbicides/pesticides	2.91(.289)	2.40(.598)	1.45	6th
g.	In Wet- DSR, Ability to plant by sowing peregrinated seeds(radical 1-3 mm) on or into puddled soil	2.43(.675)	1.94(.748)	1.19	7th

Source: Field Survey, 2020

Table 12.2: Competency needs of Extension agents on Climate smart agricultural practices

	Climate smart agricultural practices Crop smart mechanism	Mean (S.D) Importance	Mean (S.D) Competence	MWDS	Ranks
a.	Possess skills in crop rotation such as effectively rotating rice with leguminous crops such as soy beans	2.30(.664)	1.93(.755)	0.85	8th
b.	Ability to identify an improved rice variety(stress-resistant variety, pest and disease-resistant rice varieties, early maturing rice varieties)	2.40(.537)	2.07(.675)	0.79	9th
c.	In Dry- DSR, ability to plant rice by dibbled method in a well prepared field.	2.38(.763)	2.07(.799)	0.74	10th
d.	Ability to sow seed directly into the soil manually i.e (direct-seeded rice) method	2.52(.643)	2.25(.762)	0.68	11th
e.	Ability to prime seeds with micronutrients such as Zinc.	1.99(.719)	1.66(.693)	0.66	12th
f.	Ability to carry out Direct seeding by sowing pre-germinated seed into a puddled soil (wet seeding) or prepared seedbed (dry seeding) or standing water (water seeding).	2.24(743)	1.98(.816)	0.58	13th
g.	In Dry- DSR, ability to plant by broadcasting of dry seeds on unpuddled soil after either zero tillage or conservative tillage	2.00(.788)	1.86(.714)	0.28	14th
h.	Ability to prime seeds with water by soaking it for 24 hours and drain for 24 hours in a shade before broadcasting the seed over the water covered surface.	2.11(.765)	2.01(.719)	0.21	15th
	Water smart mechanism				
a.	Ability to operate the AWD technique by: monitoring the water level and recognize when water level is below 15cm beneath the soil surface, prior to irrigation	2.65(.751)	1.06(.278)	4.21	1st
b.	Ability to operate multiple inlet irrigation(MIRI), where polypipes are laid throughout the length of the field to simultaneously fill each paddy	2.95(.586)	1.94(.717)	2.98	2nd
c.	Ability to operate the AWD technique by By applying irrigation to about 2-5 cm above the surface	2.35(.761)	1.35(.480)	2.35	3rd
d.	Possess skills in water harvesting during excess rainfall so as to reduce flood and fill the field when necessary during drought season	2.47(0.694)	1.58(0.0802)	2.19	4th

Source: field survey, 2020

Table 12.3: Competency needs of Extension agents on Climate smart agricultural practices

	Climate smart agricultural practices	Mean (S.D) Importance	Mean (S.D) Competence	MWDS	Ranks
a.	Have knowledge and have skills in conventional flooding, where the highest paddy rice is filled with water and water to flow to the lower paddies though levee gates	2.51(.587)	2.18(.736)	0.82	5th
b.	Ability to operate canal irrigation	2.41(.600)	2.08(.682)	0.79	6th
	Weather smart mechanism				
a.	Have knowledge and have skills in conventional flooding, where the highest paddy rice is filled with water and water to flow to the lower paddies though levee gates	2.51(.587)	2.18(.736)	0.82	5th
b.	Ability to use of Decision support system (DSS) to get help	2.41(.600)	1.26(.442)	2.77	1st
c.	Ability to use ICTs such as computers to provide solutions and phones to communicate weather informations to farmers	2.84(.711)	1.89(.749)	2.69	2nd
d.	Ability to get information from climate information services	2.39(.513)	1.43(.498)	2.29	3rd
e.	Able to get information from Index-based weather insurance and apply to farmers	2.06(.701)	1.00(.000)	2.18	4th
f.	Able to source for credits or loans for farmers from reliable institute.	2.22(.615)	1.77(.707)	0.99	5th
g.	Digital agricultural technology: ability to source information through internet in applying in solving farmers' challenge	2.27(.690)	1.95(.677)	0.73	6th
	Knowledge smart mechanism				
a.	Ability to provide necessary market information and off-takers to the farmers	2.77(.421)	2.27(.638)	1.38	1st
b.	Ability to provide farmers with information on off farm risk management kitchen garden.	2.65(.548)	2.26(.686)	1.03	2nd
c.	Ability to source for seeds from a reliable source for the farmers	2.64(.529)	2.27(.673)	0.97	3rd

Source: Field Survey, 2020

4.6 Level of Participation of Extension agents in disseminating CSA practices

Result in Table 13 shows that 53.4% of extension agents generally have low level of participation in disseminating CSA practices among rice farmers, while 46.6% had high level of participation. This could be due their low knowledge or competence in the CSA practices applicable to the rice farmers.

Table 13 further presents the level of participation of extension agents using their mean scores. Table 13.1 revealed that extension agents had high level of participation in disseminating the following soil smart mechanism; minimum tillage ($\bar{x}$ =1.42), planting of cover crops ($\bar{x}$ =1.39), Use of urea deep placement (UDP) ($\bar{x}$ =1.35), use of compost ($\bar{x}$ =1.16), and site specific nutrient managements (SSNM) ($\bar{x}$ =1.05).

This implies that the extension agents in the study area are aware and knowledgeable of those practices as an adaptation measures to climate change. This conform to the apriori expectation as farmers in Niger state were reported to be moderately aware of use of cover crops as a climate change adaptation strategies (Ebenehi, Ahmed, & Barnabas, 2018). This agree to the findings of (Olorunfemi et al., 2019) who stated that extension agents in south west, Nigeria were involved in disseminating minimum/zero tillage practices to the farmers.

However, extension agents in the study were found to have low level of participation in disseminating information on agro-forestry ($\bar{x}$ =0.66). This implies that extension agents in the study area do not have adequate knowledge on the use of agro-forestry as an adaptation to climate change menace. This is in agreement with the findings of (Ale, A. Okogbue, & Alfred, 2016) who identified knowledge on afforestation initiatives as one of the highest need of extension agents in south west, Nigeria. Similarly, (Olorunfemi *et al.*, 2019) revealed in his study that extension agents had low level of involvement in disseminating agro-forestry to farmers, which could be due to low knowledge of the personnel in the initiative. In another study by (Olorunfemi *et al.*, 2020), in south west, Nigeria, it was reported that extension agents needs training on agro-forestry such as alley cropping.

The Table further revealed that the notable crop smart mechanisms extension agents highly participated in disseminating were: Use of healthy young rice seedling ($\bar{x}$ =1.60), Planting early maturing rice varieties ($\bar{x}$ =1.49), Seed priming ($\bar{x}$ =1.41), Planting of stress-resistant variety ($\bar{x}$ =1.39), crop rotation ($\bar{x}$ =1.39) and mixed cropping ($\bar{x}$ =1.35). This implies that farmers in the study area used the above technologies in mitigating the effect of climate change in their field. This conforms to the apriori expectation as (Mbah & Ezeano, 2016) reported that rice farmers in Benue state, indicated the use of mixed cropping, crop rotation, early planting of rice, planting of improved rice varieties as an adaptation measures to climate change. Similarly, Tarfa et al., (2019) in his study in Nasarawa state Nigeria, reported crop rotation, cover cropping as part of the major adaptation strategies to climate change.

While, practices which they had low level of participation was: Precision agriculture ($\bar{x}$ =0.91) and Integrated Pest Management (IPM) ($\bar{x}$ =0.62). This implies that farmers in the study area do not perceive IPM as a CSA practice to mitigate climate change and also have adequate knowledge on appropriate use of pesticides. This conforms to the apriori expectation as Tiamiyu *et al.*, (2017) reported a very low adoption rate of IPM among farmers in Northern, Nigeria, which could be attributed to the fact that cultural and biological methods are rarely demonstrated to the farmers by the extension agents.

Furthermore, the findings from the Table 13.2 revealed that construction of water channels ($\bar{x}$ =1.35) and use of sand bags ($\bar{x}$ =1.20) were the major CSA practice under water smart mechanism the extension agents highly disseminated to farmers. However, they were less involved in disseminating alternate-wet-and-dry irrigation (AWD) technique ($\bar{x}$ =0.00), water harvesting ($\bar{x}$ =0.92), and drip irrigation ($\bar{x}$ =0.73). This implies that farmers in the study area lack knowledge on water harvesting, AWD irrigation and drip irrigation technologies therefore do not use them as adaptation strategies to climate change. This corresponds to the result of (Yakubu et al., *2020)* who reported minimal use of rainwater harvesting by rice farmers in North-west, Nigeria.

According to a study by Steenbergen, Haile, Alemehayu, Alamirew, & Geleta, (2011) in Ethiopia as cited by Olorunfemi et al., (2019), the potency for water harvesting in Sub-Saharan Africa is massive, and even if only 15% of rain water were harvested, it would be enough to meet all of the continent's water needs, which can be conveyed even through irrigation. Another study by Tiamiyu et al., (2017) reported low level of adoption of water management practices by farmers in Northern, Nigeria. However, Tiamiyu et al., (2018) and Shittu & Kehinde, (2018) stated that farmers in Northern, Nigeria are willing to accept incentives so as to shift and adopt selected CSA practices such as soil conservation, water managements.

Furthermore, Table 13.2 revealed that the extension agents had high level of participation in disseminating climate information services ($\bar{x}$ =1.23) and seasonal weather forecast ($\bar{x}$ =1.17) which were under weather smart mechanism. This implies that the farmers in the study area are aware on the choice of crop varieties and mode of production. As Onyeneke et al., (2019) stated that climate education services helps farmers to better cope with the climate change as it provide farmers with knowledge on varieties of crop, mode of production , adjustment with planting dates, which eventually has the potential to improve willingness to have access to credit facilities and enable farmers to adopt better farm technologies that improve farm productivity.

However, they were less involved in disseminating index-based weather insurance ($\bar{x}$ = 0.00), digital agricultural technology ($\bar{x} = 0.74$) and use of ICTs ($\bar{x} = 0.93$). This implies that farmers in the study area have no access to index-based weather insurance information and low access to use of digital agricultural technology and ICTs. This could be due to low knowledge of extension agents on the use of those technologies. This conforms to the apriori expectation as (Monday, Jimoh, Ojochogwu, Omojola, & Aliojo, 2020) stated that crop farmers in Kogi state, Nigeria are less aware of agricultural insurance, however they are willing to take agricultural insurance.

This results is also in agreement to the findings of Olorunfemi et al., (2019) who reported low involvement of extension agents in disseminating weather information to farmers through ICT". As Elum, Modise, & Marr, (2017) opined that Agricultural insurance programs are limited in developing countries, particularly in Africa, as farmers in South Africa stated that they do not engage in farm insurance with the primary reason being a lack of awareness of insurance policies.

Finally, the Table 13.2 revealed that extension agents in the study area had high level of participation in knowledge smart mechanism: farmers to farmers learning ($\bar{\boldsymbol{x}} = \mathbf{1.61}$), off farm risk managements ($\bar{\boldsymbol{x}} = \mathbf{1.05}$), seeds banks ($\bar{\boldsymbol{x}} = \mathbf{1.06}$) and market information ($\bar{\boldsymbol{x}} = \mathbf{1.50}$). This implies that farmers in the study area train one another as regard CSA practices being taught by the extension agents, farmers perceive and engage in off farm activities, getting market information as a measure to adapt to climate change. This is in consonance with Ajetomobi et al., (2011) who reported off farm activities as one of the climate change adaptation strategies among rice farmers in Nigeria. In another study in South Africa Abegunde, Sibanda, & Obi, (2019) reported that one the major CSA practice used by farmers was diversification of crops.

Table 13: Level of Participation in Disseminating CSA Practices

Level of participation	Frequency	Percent
Low	47	53.4
High	41	46.6
Total	88	100.0

Source: field survey, 2020

Table 13.1: Distribution of Respondents by Level of Participation in Disseminating CSA Practices

	Climate smart agricultural practices	Actively Freq (%)	Passively Freq (%)	Not at all Freq (%)	Mean	Std. Deviation	Rank	Level
	Soil smart mechanism							
a.	Minimum Tillage	44(50.0)	37(42.0)	7(8.0)	1.42	.638	1st	**High**
b.	Application of manure and compost	38(43.2)	31(35.2)	19(21.6)	1.41	.600	2nd	**High**
c.	planting of cover crops	47(53.4)	28(31.8)	13(14.8)	1.39	.734	3rd	**High**
d.	Use of urea deep placement (UDP)	40(45.5)	39(44.3)	9(10.2)	1.35	.662	4th	**High**
e.	Organic fertilizer	37(42.0)	45(51.1)	6(6.8)	1.35	.607	5th	**High**
f.	Zero tillage	38(43.2)	41(46.6)	9(10.2)	1.33	.656	6th	**High**
g.	Mulching	37(42.0)	37(42.0)	14(15.9)	1.26	.719	7th	**High**
h.	Micro-dosing	28(31.8)	49(55.7)	11(12.5)	1.19	.641	8th	**High**
i.	Use of compost	33(37.5)	36(40.9)	19(21.6)	1.16	.756	9th	**High**
j.	Site-specific nutrient management (SSNM)	24(27.3)	44(50.0)	20(22.7)	1.05	.718	10th	**High**
k.	Precision fertilizer	23(26.1)	34(38.6)	31(35.2)	.91	.783	11th	**Low**
l.	Agro-forestry	36(40.9)	37(42.0)	15(17.0)	0.66	.771	12th	**Low**
	Crop smart mechanism							
a.	Use of healthy young rice seedling	60(68.2)	21(23.9)	7(8.0)	1.60	.635	1st	**High**
b.	Planting early maturing rice varieties	54(61.4)	23(26.1)	11(12.5)	1.49	.711	2nd	**High**
c.	Crop rotation	50(56.8)	22(25.0)	16(18.2)	1.39	.780	3rd	**High**
d.	Planting of stress-resistant variety	45(51.1)	32(36.4)	11(12.5)	1.39	.702	3rd	**High**
e.	Planting of pest and disease-resistant rice varieties	47(55.7)	22(25.0)	17(19.3)	1.36	.790	4th	**High**
f.	Mixed cropping	50(56.8)	19(21.6)	19(21.6)	1.35	.817	5th	**High**
g.	Use of DSR (direct-seeded rice) method	40(45.5)	34(38.6)	14(15.9)	1.30	.730	6th	**High**
h.	Seed priming	41(46.6)	42(47.7)	5(5.7)	1.22	.780	7th	**High**
i.	Changing cropping calendars	33(37.5)	50(56.8)	5(5.7)	.91	.689	8th	**Low**

Source: Field survey, 2020

Table 13.2: Distribution of Respondents by Level of Participation in Disseminating CSA Practices

	Climate smart agricultural practices	Actively Freq (%)	Passively Freq (%)	Not at all Freq (%)	Mean	Std. Dev.	Rank	Level
	Crop smart mechanism							
a.	IPM(integrated pest management) such as identifying application times, frequency, method, and appropriate pesticides mixing calculation	16(18.2)	23(26.1)	49(55.7)	.62	.778	9th	**Low**
	Water smart mechanism							
b.	Construction of water channels	39(44.3)	41(46.6)	8(9.1)	1.35	.644	1st	**High**
c.	Sandbags	32(36.4)	42(47.7)	14(15.9)	1.20	.697	2nd	**High**
d.	Drip irrigation technology	23(26.1)	46(52.3)	19(21.6)	.73	.707	3rd	**Low**
e.	Water harvesting	22(25.0)	37(42.0)	29(33.0)	.92	.761	4th	**Low**
f.	Alternate-wet-and-dry (AWD) irrigation technique	0(0)	0(0)	0(0)	.00	.000	5th	**Low**
	Weather smart mechanism							
a.	Seasonal weather forecast	27(30.7)	49(55.7)	12(13.6)	1.17	.654	1st	**High**
b.	Use of Climate information services (CIS)	41(46.6)	26(29.5)	21(23.9)	1.23	.813	2nd	**High**
c.	Use of ICTs such as phones computers e.t.c	37(42)	39(44.3)	12(13.6)	.93	.603	3rd	**Low**
d.	Digital agricultural technology	32(36.4)	32(36.4)	24(27.3)	.74	.735	4th	**Low**
e.	Use of Decision support system (DSS)	6(6.8)	31(35.2)	51(58.0)	.49	.625		**Low**
f.	Index-based weather insurance	0(0)	0(0)	0(0)	.00	.000	5th	**Low**
	Knowledge smart mechanism							
a.	Farmer to farmer learning	60(68.2)	22(25.0)	6(6.8)	1.61	.615	1st	**High**
b.	Market info	49(55.7)	34(38.6)	5(5.7)	1.50	.606	2nd	**High**
c.	Seeds and folder banks	24(27.3)	39(44.3)	22(25.0)	1.06	.748	3rd	**High**
d.	Off farm risk management kitchen garden.	24(27.3)	44(50.0)	20(22.7)	1.05	.710	4th	**High**

Source: Field survey, 2020

4.7 Dissemination/Teaching Method used by Extension Agents

Table 14 presents the teaching method used by extension agents in the study area. The table showed that teaching methods mostly used by the respondents in disseminating climate smart agricultural practices to the rice farmers include; individual contact methods: farm and home visits ($\bar{\boldsymbol{x}} = \mathbf{1.73}$), group contact methods: (result demonstration ($\bar{\boldsymbol{x}} = \mathbf{1.66}$), methods demonstration ($\bar{\boldsymbol{x}} = \mathbf{1.58}$), meetings at results demonstrations ($\bar{\boldsymbol{x}} = \mathbf{1.57}$) and leaders training meetings ($\bar{\boldsymbol{x}} = \mathbf{1.48}$) and mass media methods: posters ($\bar{\boldsymbol{x}} = \mathbf{1.50}$).

This implies that farmers in the study mostly have physical contacts with the extension agents which may motivate them to adopt the CSA practices being disseminated to them, thereby making the extension agents effective in performing their roles. This is in consonance with the findings of Ahmed & Adisa, (2017) who reported that rice farmers in Kogi State perceived field demonstration and individual contact methods(result demonstration, farm & home visits) as the most effective teaching methods used by the extension agents.

In another study, Khatam et al., 2013) stated that individual contact methods like farm visits, demonstration and home visits are the major methods used by extension agents for the farmers. In Pakistan, Khan & Akra, (2012) reported that farm and home visits, field days and demonstration were the best methods used by extension personnel for disseminating improved technologies as perceived by the farmers. Similarly, Igene et al., (2018) in Kwara state, Nigeria identified group methods(discussion and demonstration) as the most effective teaching methods used by 'Raw Material Development Council' in disseminating information to the farmers. Likewise Abdulshakur, Yusuf, Nnaji, & Haruna, (2020) ranked group discussion and demonstration 1st and 2nd as the most effective methods used by extension agents.

The table further reveals the teaching methods rarely used by the extension agents include: films ($\bar{\boldsymbol{x}} = \mathbf{0.68}$), personal letter ($\bar{\boldsymbol{x}} = \mathbf{0.78}$), slide shows ($\bar{\boldsymbol{x}} = \mathbf{0.78}$), flip charts ($\bar{\boldsymbol{x}} = \mathbf{0.82}$), radio ($\bar{\boldsymbol{x}} = \mathbf{0.85}$), drama ($\bar{\boldsymbol{x}} = \mathbf{0.85}$) and circular letters ($\bar{\boldsymbol{x}} = \mathbf{0.86}$). This could be due to high cost of disseminating information through these media. Therefore, extension organization should seek for private sponsorship of Radio and T.V programmes by corporate organizations and NGOs (non-governmental organizations).

Table 14: Distribution of Respondents by teaching/Dissemination methods used

	Dissemination methods	Often used Freq (%)	Rarely used Freq (%)	Never used Freq (%)	Mean	Std. Deviation	Rank
a.	**Individual contact methods**						
	Farm and home visits	64(72.7)	24(27.3)	0(0)	1.73	.448	1st
	Telephone Calls	40(45.5)	41(46.6)	7(8.0)	1.38	.631	
	Office calls	38(43.2)	41(46.6)	9(10.2)	1.33	.656	
	Personal letter	14(15.9)	41(46.6)	33(37.5)	.78	.702	
b.	**Group Contact methods**						
	Result demonstrations	61(69.3)	24(27.3)	3(3.4)	1.66	.544	2nd
	Method demonstration	55(62.5)	29(33.0)	4(4.5)	1.58	.582	3rd
	Meetings at result demonstrations	54(61.4)	30(34.1)	4(4.5)	1.57	.583	4th
	Lecturer meetings	24(27.3)	57(64.8)	7(8.0)	1.19	.564	
	Conferences	12(13.6)	66(75.0)	10(11.4)	1.02	.502	
	Leader training meetings	45(51.1)	40(45.5)	3(3.4)	1.48	.567	
	Discussion meetings	41(46.6)	41(46.6)	6(6.8)	1.40	.617	
	Tours (field trips)	27(30.7)	50(56.6)	11(12.5)	1.18	.635	
	Schools	9(10.2)	44(50.0)	35(39.8)	.70	.646	
	Flip chart	11(12.5)	50(56.8)	27(30.7)	.82	.635	
c.	**Mass Contact methods**						
	Posters	51(58.0)	30(34.1)	7(8.0)	1.50	.643	5th
	New Stories	25(28.4)	41(46.6)	22(25.0)	1.03	.734	
	Circular letters	21(23.9)	34(38.6)	33(37.5)	.86	.776	
	Radio	15(17.0)	45(51.1)	28(31.8)	.85	.687	
	Television	28(31.8)	32(36.4)	28(31.8)	1.00	.802	
	Exhibits	24(27.3)	52(59.1)	12(13.6)	1.14	.628	
	Leaflets	28(31.8)	41(46.6)	19(21.6)	1.10	.728	
	Bulletin	29(33.0)	33(37.5)	26(29.5)	1.03	.794	
	Campaign	22(25.0)	39(44.3)	27(30.7)	.94	.748	
	News paper	11(12.5)	38(43.2)	39(44.3)	.68	.687	
	Extension journals	38(43.2)	37(42.0)	13(14.8)	1.28	.710	
	Newsletter	22(25.0)	40(45.5)	26(29.5)	.95	.741	
	Pamphlet	27(30.7)	43(48.9)	18(20.5)	1.10	.712	
	Folders	21(23.9)	45(51.1)	22(25.0)	.99	.703	
	Drama	16(18.2)	43(48.9)	29(33.0)	.85	.704	

Source: field Survey, 2020

4.8 Challenges/ Constraints Associated in Disseminating CSA practices

Table 15 presents the perceived challenges impeding the extension agents in disseminating CSA practices. The table shows the challenges in three categories; Personal challenges faced by the extension agents in order of ranking were: Lack of incentives for staff motivation ($\bar{x} = 1.83$), Non-payment of allowance to field staff ($\bar{x} = 1.75$) and Non availability of inputs ($\bar{x} = 1.66$). This implies that there is need for the extension agents to be motivated through incentives in order to ameliorate the extension service delivery. This is corroborated by Ndem et al., (2020) who discovered that provision of incentives to the extension agents is one of the major strategies to improve extension service delivery. Also, according to Okwoche, Eziehe, & Agabi, (2015), extension agents are motivated by increase in salary and welfare package.

The table further revealed the institutional challenges faced by the extension agents were: Insufficient number of extension workers to provide services for large number of farmers (E.A: farm families) ($\bar{x} = 1.87$) ranked 1st, followed by Inadequate means of transportation ($\bar{x} = 1.83$), Inadequate training programs for extension agents in CSA ($\bar{x} = 1.76$), Low institutional/government support for agricultural extension ($\bar{x} = 1.70$), Lack/ inadequate information from research institute ($\bar{x} = 1.49$) were ranked 2nd, 3rd, 4th and 5th respectively. This implies that more hands are needed in the extension organization so as to augment the imbalance ratio and to be able to cover large number of farmers in a short period as insight from this study revealed that an extension agent per farm families was 1: 2000.

Further implication of this result is that farmers in the study area are not exposed to adequate training on CSA practice and majorly depend on their income to source for instruments in mitigating the effect of climate change as much support is not received from the governments. Therefore extension organization should organize adequate training for extension agents so that farmers can also be trained adequately. This result is in line with the findings of Sennuga & Fadiji, (2020) who reported inadequate government support, low/inadequate number of extension personnel, insufficient agricultural technologies to farmers, as factors that influence extension agents effectiveness models in Nigeria. The same authors also identified bad roads and language barriers as factors that affect effective communication. In another study Ragasa et al., (2016) reported lack of mobility and lack of interaction of agents with key actors as one of the major factor that limits the performance of extension agents.

Finally the table reveals that the external challenges faced by farmers include: Poor funding of CSA practices ($\bar{x} = 1.59$) and certain techniques associated with sustainable land management can be incompatible with traditional practices (cultural beliefs) ($\bar{x} = 1.28$). This implies that farmers in the study area are not adequately funded, which may discourage the farmers from adopting CSA practices or even discontinuous of adoption, if the technology is capital intensive and time consuming. Therefore fund and support should be given to farmers by Governmental and NGOs so as to increase adoption of CSA practices. This is in line with the findings of (Nyasimi et al., 2017) in Tanzania who reported that most farmers are willing to use CSA practices, but are constrained by some factors such as cultural practices

Table 15: Distribution of Respondents by Challenges associated with the effective dissemination of CSA practices

	Challenges associated with the effective dissemination of CSA practices	Mean	Std. Deviation	Rank
a.	**Personal challenges**			
	Lack of incentives for staff motivation	1.83	.460	1st
	Non-payment of allowance to field staff	1.75	.572	2nd
	Non availability of some inputs/ Delay in providing working material for field demonstration	1.66	.565	3rd
	Limited capacity to implement the techniques	1.55	.623	4th
	Inability to flow with the target population	1.51	.695	5th
	lack of regular promotion	1.49	.711	6th
	Gender imbalance between farmers and extension agents	1.15	.720	7th
	Complexity of extension messages	1.08	.665	8th
	Low interest in CSA practices among extension agents	.90	.831	9th
b.	**Institutional challenges**		.	
	Insufficient number of extension workers to provide services for large number of farmers(E.A: farm families)	1.87	.366	1st
	Inadequate means of transportation	1.83	.407	2nd
	Inadequate training programs for extension agents in CSA	1.76	.455	3rd
	Low institutional/government support for agricultural extension.	1.70	.550	4th
	Lack/ inadequate information from research institute	1.49	.661	5th
	Dearth of subject matter specialist	1.41	.753	6th
c.	**External challenges**			
	Poor funding of CSA practices	1.59	.517	1st
	Certain techniques associated with sustainable land management can be incompatible with traditional practices (cultural beliefs)	1.28	.566	2nd
	Deep religion beliefs by the farmers	.83	.820	3rd

Source: Field Survey, 2020

4.9 Effectiveness of Extension agents

4.9.1 Awareness creation

Table 16 revealed the categorization of awareness of CSA practices using the mean score. The table shows a high level of awareness (54%) of Climate Smart Agricultural Practices (CSAP) among rice farmers in the study area. Specifically, the table revealed that more than half (56.3%) of the farmers rated their level of awareness on soil mechanism to be high. Similarly, 62.6% had high level of awareness on crop smart mechanism, and 54.3% had high level of awareness on weather smart mechanism. This implies that extension agents in the study area had one way or the other introduced CSAP such as planting of pest & disease resistant varieties, tillage practice, organic fertilizers and so on to the rice farmers so as to mitigate the effect of climate change on their output.

However, more than half (55.7%) of the respondents reported low level of awareness on water smart mechanism. This could be due to low level of knowledge of the E.A's on certain water management practices in mitigating the effect of climate change.

This results is in consonance with the findings of Sheshi & Usman, (2018) who reported a greater level of acceptance of improved rice varieties among rice farmers in Niger state, Nigeria. This could be attributed to increase in the level of awareness of the farmers. Similarly, Tiamiyu et al., (2017) stated that the adopted practices most used by farmers in Northern, Nigeria were agronomic practices in terms of cultivation of pest & diseases varieties, drought tolerant seeds.

Also Tiamiyu et al., (2018) revealed low level awareness and adoption of water management practices by farmers in Northern, Nigeria.

Table 16: Distribution of Respondents by Level of Awareness of Climate Smart Agricultural Practices

N=350

	Awareness Level	Frequency	Percentage
a.	**Soil smart mechanism**		
	High	197	56.3
	Low	153	43.7
	Mean	6.42	
	Standard deviation	1.84	
b.	**Crop smart mechanism**		
	High	219	62.6
	Low	131	37.4
	Mean	10.2	
	Standard deviation	3.6	
c.	**Water smart mechanism**		
	High	155	44.3
	Low	195	55.7
	Mean	3.0	
	Standard deviation	1.2	
d.	**Weather smart mechanism**		
	High	190	54.3
	Low	160	45.7
	Mean	3.37	
	Standard deviation	1.8	
	Total	**350**	**100**

Source; Field survey, 2020

4.9.2 Knowledge Acquisition

From Table 17 the categorization of farmers by knowledge acquisition on CSA practices indicated that the farmers reported low knowledge (56.0%) on CSA practices. Specifically, majority of the farmers had low knowledge (63.7%) on soil smart mechanism (like UDP (Urea Deep Placement), use of compost, zero & minimum tillage e.t.c), and water smart mechanism (61.1%) like AWD, water harvesting, drip irrigation e.t.c.) and weather smart mechanism (54.6%). This implies that although majority of the farmers were aware of the CSA practices, they do not completely comprehend the technology disseminated to them and also do not perceive those mechanism (Agro-forestry, AWD, drip irrigation, Index based weather insurance e.t.c) as an adaptation strategy to climate change. This may be attributed to low competence of the EA's as a result of inadequate training on the subject matter particularly to rice farmers in the study area. Therefore, the knowledge of the farmers needs to be enhanced by providing them with adequate trainings in the subject matter. This findings is in consonance with (Arimi, 2014) who reported that farmers in south-west Nigeria do not view farm insurance as way of coping with climate change.

However, more than half of the respondents had high knowledge on crop smart mechanism (52.3%) like (crop rotation, mixed cropping, planting of stress-tolerant and early maturing varieties, changing of cropping calendar, micro dosing, manures, e.t.c). This conforms to the apriori expectation as Tiamiyu et al., (2017) reported agronomic practices (such as cultivating of drought tolerant varieties, intercropping cover crops and mixed cropping amongst others) as the most adopted climate change adaptation practices used by farmers in Northern, Nigeria. Similarly, Ajibade, Babatunde, Ajibade, & Akinsola, (2019) analyzed adaptation strategy used by rice farmers in Kwara state, and identified planting of early maturing varieties as the most adopted practice used by rice farmers in Kwara, state. Also Falola & Achem, (2017), identify the changing planting calendar as the adaptation strategy employed by farmers in Kwara state, Nigeria. This could be attributed to high knowledge on those measures.

Table 17: Distribution of Respondents by Knowledge Acquisition on Climate Smart Agricultural Practices

N=350

	Knowledge acquisition Level	Frequency	Percentage
a.	**Soil smart mechanism**		
	High	127	36.3
	Low	223	63.7
	Mean	8.3	
	Standard deviation	4.0	
b.	**Crop smart mechanism**		
	High	183	52.3
	Low	167	47.7
	Mean	15.4	
	Standard deviation	7.8	
c.	**Water smart mechanism**		
	High	136	38.9
	Low	214	61.1
	Mean	3.9	
	Standard deviation	2.0	
d.	**Weather smart mechanism**		
	High	159	45.4
	Low	191	54.6
	Mean	4.2	
	Standard deviation	2.9	
	Total	**350**	**100**

Source: Field Survey, 2020

4.9.3 Uptake of Climate Smart Agricultural Practices

The results on uptake of CSA practices by the respondents as shown in Table 18 revealed that the uptake of CSA practices among the rice farmers in the study area was generally low (52.6%). The table further revealed high uptake level for crop smart mechanism (57.9%) such as (crop rotation, mixed cropping, planting of stress-tolerant and early maturing varieties, changing of cropping calendar, micro dosing, manures, precision fertilizers e.t.c). Then, low uptake (54.9%) for soil smart mechanism (such as Agro-forestry, Urea Deep Placement (UDP), Minimum Tillage, and so on), water smart mechanism (62.6%) such as water harvesting, drip irrigation, AWD, sandbags, construction of water channels and weather smart mechanism (55.1%) such as use of climate information services, index based weather insurance, use of ICT's and so on. This implies that rice farmers in the study area mainly practice crop smart mechanism like (crop rotation, mixed cropping, planting of improved varieties, changing cropping calendar, micro dosing e.t.c) as their adaptation/mitigation strategy to climate change.

Meanwhile, the low level of uptake of water smart mechanism could be attributed to the low knowledge on the techniques coupled with the fact that it is capital intensive for the drip irrigation and AWD. Likewise, the low uptake on soil smart mechanism could be attributed to farmers not perceiving the practice (e.g Agro forestry) as an adaptation to climate change.

This is in line with the findings of Tarfa et al., (2019) who reported utilization of improved crop varieties, crop diversification, mulching and crop rotation as one of the major adaptation strategies used by farmers in guinea savanna, Nigeria. This is also similar with the report of Ajibade et al., (2019) who stated the adoption of early maturing rice seedling varieties by rice farmers in Kwara state in mitigating the effect of flood on their farm. In another study, Onyegbula & Oladeji, (2017) reported the use of pest-disease resistant varieties, appropriate utilization of fertilizers as one of the main climate change adaptation strategies used by rice farmers in Ekiti, Ebonyi and Niger state, Nigeria.

Table 18: Distribution of Respondents by level of Uptake of Climate Smart Agricultural Practices

N=350

	Level of uptake	Frequency	Percentage
a.	**Soil smart mechanism**		
	High	158	45.1
	Low	192	54.9
	Mean	4.48	
	Standard deviation	2.48	
b.	**Crop smart mechanism**		
	High	202	57.9
	Low	167	42.4
	Mean	7.95	
	Standard deviation	4.05	
c.	**Water smart mechanism**		
	High	131	37.4
	Low	219	62.6
	Mean	2.02	
	Standard deviation	1.56	
d.	**Weather smart mechanism**		
	High	157	44.9
	Low	193	55.1
	Mean	2.24	
	Standard deviation	1.88	
e.	**Pooled scores**	**350**	**100**
	High	166	47.4
	Low	184	52.6
	Total	**350**	**100**

Source: Field survey, 2020

4.9.4 Knowledge Sharing of Climate Smart Agricultural Practices

The results on knowledge sharing of CSA practices among rice farmers as shown in Table 19 revealed that level of sharing knowledge was generally low (54.6%). This conforms to the apriori expectation due to the fact that the level of uptake of CSAP was generally low, as information that is not adopted cannot be shared with others.

Specifically, the table revealed that 72.3% of the rice farmers do not share the knowledge on soil smart mechanism (such as Agro-forestry, Urea Deep Placement (UDP), Minimum Tillage, and so on) to the farmers. This could be because the rice farmers felt they have low knowledge on those practices, and not considered as an effective mechanism to mitigate the effect of climate change.

The results further revealed that majority of the rice farmers (90%) shared crop smart mechanism (crop rotation, mixed cropping, planting of stress-tolerant and early maturing varieties, changing of cropping calendar, micro dosing, manures, precision fertilizers e.t.c)information with others. This can be due to the fact that farmers felt they have high knowledge in these areas and had benefited from adopting those practices.

The results also show that majority of the rice farmers (65.4%) do not share information on water smart mechanism (water harvesting, drip irrigation, AWD, sandbags, construction of water channels) and weather smart mechanism (61.4%) (use of climate information services, index based weather insurance, use of ICT's and so on). This could be due to the fact that the message was not adequately communicated/ conveyed to the farmers, thus could results in low interest and knowledge in the practices. Therefore, the extension agents should ensure that message is communicated to the farmers using the appropriate method without any barriers to enhance usage of CSA practices. The low sharing of weather smart mechanism could also be due to lack of timely climate information services to the farmers, thus extension agents should ensure timely dissemination g CSA practices. This is in consonance with the findings of Ajibade et al., (2019) who stated that farmers' access to climate information is a determinant to adoption of climate smart agricultural practices.

Table 19: **Distribution of Respondents by Knowledge Sharing of Climate Smart Agricultural Practices**

	Knowledge sharing Level	Frequency	Percentage
a.	**Soil smart mechanism**		
	High	97	27.7
	Low	253	72.3
	Mean	4.34	
	Standard deviation	2.55	
b.	**Crop smart mechanism**		
	High	315	90
	Low	35	10
	Mean	8.49	
	Standard deviation	3.61	
c.	**Water smart mechanism**		
	High	121	34.6
	Low	229	65.4
	Mean	2.0	
	Standard deviation	1.44	
d.	**Weather smart mechanism**		
	High	136	38.85
	Low	214	61.4
	Mean	1.93	
	Standard deviation	1.90	
e	**Pooled scores**	**350**	**100**
	High	166	47.4
	Low	184	52.6
	Total	**350**	**100**

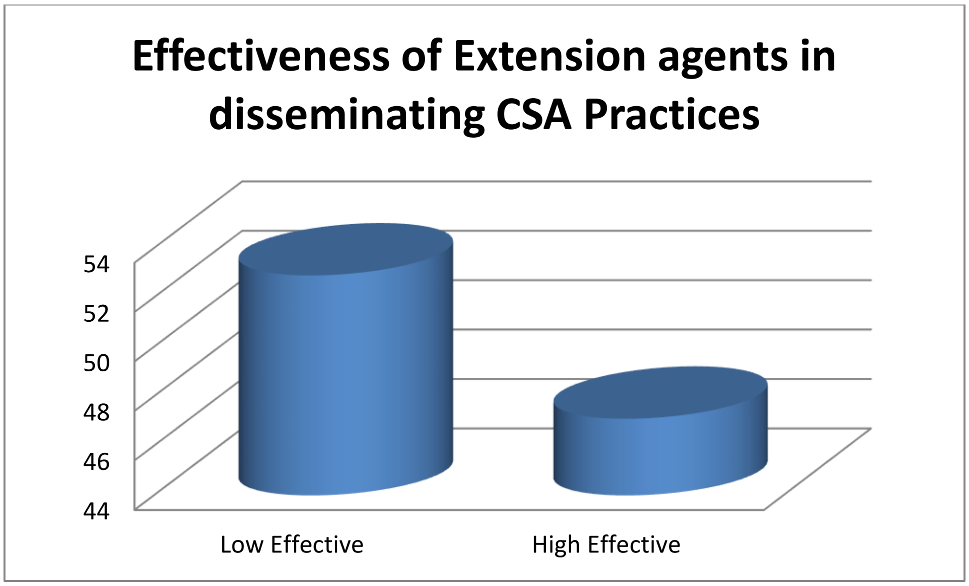
Source: Field Survey Data, 2020

4.9.5 Effectiveness of extension agents in Disseminating CSA practices

The result in figure 2 showed the effectiveness of extension agents as perceived by the farmers. The Table revealed that majority of the extension agents (52.9%) were less effective in disseminating CSA practices while 47.1% had high level of effectiveness in disseminating CSA practice to rice farmers in the study area. This implies that the extension agents were not exposed to adequate training that could enable them to be competent in disseminating CSA practices. This could be attributed to their low knowledge, skills and abilities in most of the practices and non-conducive environment to motivate the extension agents. Therefore, the study recommends that extension agents should be rigorously trained in all the CSA practices so as to enhance their effectiveness in disseminating those practices.

This is in line with Model of effective Job performance Boyatzis, (1982), job demands, organizational environment, and the individual's competencies (knowledge, skills, abilities and behaviours) are the three critical component that must be constant for an individual to display effective action and performance. Hence, dissimilarity/differences in any of these components with each other will automatically results in ineffective behaviour and incompetency.

This corroborates with the findings of Olorunfemi et al., (2020) who stated that effectiveness of extension agents is determined by their knowledge and competency in disseminating CSA initiatives. In another study, Okwoche et al., (2015) stated that extension workers satisfaction with their works increases if they receive more training that helps to increase their job competency. This suggests that increase in training which directly lead to increase in knowledge will enhance extension workers job performance. Thereby, makes them effective in disseminating information or carrying out their duties. Also, (Ragasa et al., 2016) was of the opinion that an effective system must focus on creating an enabling environment for agents to be motivated to work as assigned.



Source: Field Survey Data, 2020

Figure 3: Distribution of Respondents by their level of Effectiveness in Disseminating CSA practices to Rice Farmers

4.10 Hypotheses testing

This section discusses the result of the test of relationships and differences between the independent and dependent variables. Six hypotheses were tested and were stated in the null form.

4.10.1 Test of relationship between selected personal and professional Characteristics of Farmers and Effectiveness of Extension Agents

Result in Table 20 indicate that farming system (χ^2= 0.444; p = 0.50), and marital status (χ^2= 2.991; p = 0.224), of the farmers do not have significant relationship with effectiveness of extension agents. This inferred that irrespective of the farming system and marital status of the farmers; the respondents' socio-economic characteristics do not really affect the effectiveness of extension agents in disseminating CSA practices.

However, occupation of farmers was found to be significantly related to the effectiveness of extension agents (χ^2= 6.002; p = 0.05). The implication of this is that the more farmers are into full-time agriculture, the more they will adopt CSA practices and also share the information to their fellow farmer, thus making extension agents effective. This may be because the rice farmers are able to identify the impact of climate change on their yield or output and thus are willing to improve their output and finally their income so as to become a better person. This corroborates with the findings of Atibioke et al., (2012) who stated that occupation significantly affect the adoption of technology.

Table 20 further revealed the educational level of the rice farmers (χ^2= 7.034; p = 0.07) had a positive & significant impact on the effectiveness of extension agents. This implies that the higher the level of education of the farmers, the greater the adoption rate of CSA practices thus enhancing the effectiveness of extension agents. This is in consonance with the apriori expectation as education is expected to positively influence adoption and enhance effectiveness. This is because education have a way of influencing the thinking and reasoning capacity of an individual. This can also be attributed to the fact that the farmers who are enlightened will understand the benefit attached to adopting CSA practices on their field. It is therefore recommended that adult education should be introduced to the farmers in order to aids their understanding on CSA practices. This corroborates with the findings of Ahmed & Yisa, (2020) who reported that formal education of the farmers may encourage them to accept agricultural innovations, which in turn could increase crop production and food security.

Data obtained from Table 21 revealed that farm size of the farmers is not significantly related to effectiveness of extension agents (r = -0.07; p=0.891). This is corroborated by the findings of Kariyasa & Dewi, (2011) who also found that the size of one's land holdings had no significant effect on the likelihood of adopting the Integrated Crop Management Farmer Field School (ICM-FFS). Also Samiee, Rezvanfar, & Faham, (2009) concluded that the farm size had no significant effect on adopting Integrated Pest Management (IPM), meaning that IPM can be disseminated regardless of the size of the farm.

Table 21 shows that there was a statistical significant correlation between age of farmers and effectiveness of extension agents (r = -0.46; p=0.000). However, the correlation coefficient is negative which implies that the older the farmers, the lower the adoption rate of technology. This can be as a result of the fact that older people find it difficult to change their way of life, and take risk in adopting new technology on their field. This result is in line with previous studies by Awotide, Wiredu, Diagne, & Ojehomon, (2012), and Wachira, Ortmann, Wale, Darroch, & Low, (2012) that the intensity of adoption decreases as farmers get older which may be explained by the fact that older farmers are less open to new ideas and less willing to take chances.

The result from Table 21 also shows that income of the farmers was found to have statistical impact on effectiveness of extension agents (r = 0.167 p=0.002). The positive correlation coefficient indicates that the higher the income of farmer, the higher the adoption of CSA practices, therefore the higher the effectiveness of extension agents. This is expected because the farmers with high income have capacity to adopt new technology and more receptive to take risk as they will have the purchasing power to get products such as fertilizers, seeds especially when they are no subsidies so as to increase their income, which conforms to the apriori expectation. This result is in line with previous studies by Foster & Rosenzweig, (2010), Diiro, (2013) and Oladele et al., (2019).

Furthermore, result in Table 21 shows that the years of experience of the farmers was found to have a statistically significant effect on effectiveness of extension agents (r = -0.346; p=0.000). The negative correlation coefficient implies that the more the farming experience the lesser the adoption of CSA practices and so the lesser the effectiveness of extension agents. This can be attributed to the fact that farmers years of experience is related to their age and so the older the farmers less receptive the farmers is to take risk and adapt to change. This is in agreement with the results of (Oladele & Kolawole, (2013) who reported that farming experience is a significant factor in adoption of Sawah rice production technology. Likewise Oladele et al., (2019) stated that farming experience is a significant factor in adoption and in utilization of short message service (SMS) as agro-weather information source.

Household size of the farmers was found to have significant relationship with effectiveness of extension agent (r = 0.249; p=0.000) as revealed in Table 21. The correlation coefficient shows a strong positive relationship, which implies that the bigger the family size of the farmers, the higher the rate of adoption of CSA practices. This may be due to the fact that a large household have the capacity to embrace improved technologies that involves more labour. For instance CSA practice such as DSR requires more time, thus larger household will be able to adopt the technology due to high labour availability compare to small household size. This is supported by the result of Awotide et al., (2012), claims that farmers with large household sizes are more likely to adopt improved rice varieties.

Finally, result in Table 21 revealed that farmer's extension contact had a significant relationship with effectiveness of extension agents (r = 0.246; p=0.000). The correlation coefficient indicate a strong positive relationship, which suggest that the more the contact the extension agents have with the farmers, the greater the chances of adopting CSA practices, thus the more effective the extension agents. This is in line with the a priori expectation, because frequent contact with extension agents guarantees better understanding of CSA practices by the farmers, hence increases adoption and make extension agents effective in their dissemination role. This is in line with previous studies by Oladele & Kolawole, (2013) and Onyeneke, (2017), farmers who have extensive extension contacts are more likely to be aware of various management practices that can be used to increase production. This is also supported by the findings of Ologbon, Ikheloa, & Akerele, (2012) and Ogunya, Simeon, & Ogunleye, (2017) who reported that numbers of contact with extension agents is one of the significant determinant of adopting the improved rice variety.

Moreover, the regression analysis on Table 22 revealed the professional characteristics and other variables that influence the effectiveness of extension agents in disseminating various CSA practices. The result showed that farmers' age, sex, farm size, income, competence of extension agents, and external constraints in disseminating CSA were significant at 1%. While the farmer's household size and educational attainment was significant at 5%.

The Table 22 further revealed that some farmers' personal characteristics had a significant impact on the effectiveness of extension agents in disseminating soil smart mechanism. The age of the farmers showed a negative influence on effectiveness of extension agents in disseminating soil smart mechanism $p<0.005$ ($p = 0.000$). This implies that the younger ones have the tendency to uptake and use CSA practices on their field than the older farmers. This could be attributed to the fact that they are young and willing to take risk in order to improve their output, thus enhancing effectiveness of extension agents. The implication of this in formulating policy is that government should support more youth and make agriculture attractive to them in order to increase rice production in the midst of the climate change menace.

In Table 22, sex of farmers was found to have a negative and significant influence on the effectiveness of extension agents. This implies that females are more likely to uptake CSA practices than the male farmers. This could be attributed to the fact that women have the natural tendency of evaluating and uptaking improved technology they belief will be useful to them to increase their income and make them a better person. Thus there is need to leverage on women engagement in rice farming in order to enhance adoption of CSA practice and improve the effectiveness of extension agents.

Table 22 further revealed that farmers' house hold size showed a positive and significant influence on effectiveness of extension agents in disseminating soil smart mechanism

$p<0.005$ ($p = 0.031$). This implies that farmers with large household size have the tendency to adopt CSA practice, thus enhancing the effectiveness of extension agents. This could be due to farmers leveraging on the member of the family as a source of labour on the field where the CSA practice is efficient but time consuming such as in the use of urea deep placement rather than broadcasting. This is in tandem with the findings of Herath & Takeya, (2003) who reported that if agricultural technologies increase seasonal labor demand, it will be less appealing to a household with limited family labor.

The table further showed that farmers' farm size had a positive and significant influence on effectiveness of extension agents in disseminating soil smart mechanism ($p = 0.001$). This indicate that probability of farmers adopting soil smart mechanism (agro-forestry, minimum tillage, zero tillage, planting of cover crops, urea deep placements, site specific nutrients management, use of compost among others) increases significantly as rice farm size increases.

Also, data obtained from Table 22 revealed that secondary school level of education of the farmers had positive and significant influence on effectiveness of extension agents ($p = 0.047$) in disseminating soil smart mechanism. This implies that the higher the level of education of the farmers, the greater the adoption of soil smart mechanism. This is because the level of education of the farmers would afford them to read the instructions on some of the labels on the technology such as fertilizers, and understand the technical know-how of the technology. Thus the policy implication of the findings is that education of the farmers should be enhanced by promoting adult education among the rice farmers and formal education among children, so as to enhance effectiveness of the extension agents. This is in line with the findings of Yisa, (2013) who reported that, education enables the farmers cope with complexities associated with technology adoption.

As shown in Table 22 income of farmers had a negative and significant influence on the effectiveness of extension agents in disseminating soil smart mechanism. This implies that decrease in income of farmers, will probably increase effectiveness of extension agent, which could be attributed to the fact that poor farmers with low income would be willing to adopt soil smart mechanism, so as to increase their income than rich farmers who already have more than enough. This however negates the findings of Zakaria, Alhassan, Kuwornu, Azumah, & Derkyi, (2020).

In furtherance, result in Table 22 showed that the competence of extension agents had significant positive influence on effectiveness of extension agents in disseminating soil smart mechanism (p = 0.002). This implies that the effectiveness of extension agents increases with an increase in the competency level of extension agents. Therefore, improving the competence of extension agents is crucial in achieving greater level of effectiveness in disseminating soil smart mechanism (minimum tillage, zero tillage, planting of cover crops, use of urea deep placements, and agro-forestry among others).

However, the extent of their effectiveness is undermined by the external constraints (p = 0.000) facing the extension agents such as poor funding of CSA practice programme by the governments amongst others as revealed in Table 22. The implication of this is that external constraints needs to be relaxed so as to improve the effectiveness of the extension agents by providing them with adequate fund to support the CSA practice being disseminated to the rice farmers.

Result in Table 23 showed that the farmers' age, sex, household size, farm size, income, extension agents' competence and external constraints in disseminating crop smart mechanism were statistically significant at 1%.

The table showed that the farmers' age was statistically significant (p = 0.000) and negatively influenced the effectiveness of extension agents in disseminating crop smart mechanism (crop rotation, use of early maturing rice varieties, stress- tolerant rice varieties, mixed cropping, changing cropping calendar). This suggested that an increase in age of the farmers will reduce the effectiveness of extension agents. This is expected because older farmers have the probability of not accepting new innovation compare to young farmers. This further implies that effort should be intensify in teaching younger farmer on CSA practice (crop smart mechanism). More so agriculture should be more attractive to the youth, so that they can be involved in farming, thereby increasing the effectiveness of extension agents. This is in consonance with the findings of Zakaria et al., (2020) who argued that older farmers are less likely to adopt drought tolerance varieties compared to younger farmers because they may not be aware of drought-tolerant rice variety.

Furthermore, Table 23 showed that sex of the farmers had a significant negative influence on effectiveness of extension agents in disseminating crop smart mechanism. This implies that female farmers are more likely to adopt crop smart mechanism (early maturing varieties, stress tolerant varieties, changing cropping calendar), than the male farmers. The reason could be that female farmers may be eager to learn and perceived that the yield potential derived from adopting the crop smart mechanism may be higher than the former method used.

As shown in Table 23, farmers' household size had a significant positive effect on the effectiveness of extension agents in disseminating crop smart mechanism. This implies that farmers with large household are more likely to embrace crop smart mechanism, due to the fact that farmers with large households have more workers than those with small households. Consequently, they may be more inclined to use crop-smart mechanisms in future, thereby improving the effectiveness of extension agents. This result is in line with Abegunde, Osanyinlusi, & Sibanda, (2018) who reported that rice farmers with larger households are more likely to adopt and implement (Improved Rice Varieties) IRVs because they have larger labor than those with smaller households.

More so, the Table 23 revealed that farm size of the farmers had a significant and positive effect on effectiveness of extension agents in disseminating crop smart mechanism. This indicates that farmers with large farm size have the tendency of adopt crop smart mechanism than those with small farm land. Thus implying that land reclamation should be provided to the farmer, as fragmentation of land is a constraints to adoption of crop smart mechanism. This is in consonance with the findings Himire, Wen-chi, & Hrestha, (2015) conducted in Central Nepal, report that bigger farm size has greater tendency to adopt (Improved Rice Varieties) IRVs.

Income of farmers had a negative significant influence on effectiveness of extension agents in disseminating crop smart mechanism ($p = 0.000$) as revealed in Table 23. This indicates that decrease in farmers' income will result in increase in adoption of crop smart mechanism. This is because farmers with lower income may be willing to embrace crop smart mechanism (early maturing rice varieties, stress tolerant varieties among others) in order to increase their output, so as to increase income and standard of living. While, higher-income farmers may focus on diversification of income instead of adopting crop smart mechanism. This implies that extension agents’ effectiveness can be improved by addressing poor farmers. This negates Onyeneke, (2017) who reported that increase in income of farmers increase the likelihood of adopting improved rice varieties.

The Table 23 also shows that the competence of extension agents had significant positive influence on effectiveness of extension agents in disseminating crop smart mechanism (p = 0.000). This indicates that the effectiveness of extension agents increases with an increase in the competency level of extension agents on crop smart mechanism (crop rotation, use of early maturing rice varieties, stress- tolerant rice varieties, mixed cropping, changing cropping calendar). The implication of this is that uptake/adoption of crop smart mechanism by farmers can be achieved through improving competence of extension agents in the practices. This is in line with the findings of Antwi-Agyei & Stringer, (2021) concluded that building the capacity of extension agents enable them to successfully deliver extension services in relation to climate change.

The Table 23 finally revealed that external constraints had a negative and significant effect on effectiveness of extension agents in disseminating crop smart mechanism (CSM) (p = 0.000). This indicates that effectiveness of extension agents in disseminating CSM (improved rice varieties, stress-tolerant varieties, changing cropping calendar, crop rotation, mixed cropping) is limited by external constraints like lack of funding by government and non governmental bodies, cultural beliefs system. This means that extension agents' effectiveness can be improved by minimizing external restraints, such as giving financial support to provide improved rice varieties and early maturing rice types to farmers at a subsidized rate, as well as educating farmers to modify their beliefs. This findings is similar to Ragasa et al., (2016) who opined that externally funded agric extension officers are more likely to be active and perform effectively in providing extension services.

Result in Table 24 showed that the farmers' age, farm size, extension agents' competence and external constraints in disseminating water smart mechanism were statistically significant at 1%. However, the household size of the farmers was significant at 5%.

Table 24 also showed that age of farmers was found to have a negative and statistical significant influence on effectiveness of extension agents in disseminating water smart mechanism (planting of basins, furrow irrigation, water harvesting, construction of water channels, canal irrigation) (p= 0.001). This indicates that increase in age of farmers will result in decrease in extension agents' effectiveness in disseminating water smart mechanism. This implies that adoption of water smart mechanism can be increased by focusing on younger farmers. This is expected because younger farmers are active and have the tendency to take risk, in order to increase their output compare to older farmers. This result is in line with the findings of Kadipo Kaloi, Isaboke, Onyari, & Njeru, (2021) who stated that age had a significant negative relationship with adoption of rice intensification system.

As shown in 24, farm size of the farmers had positive and significant effect on effectiveness of extension agents in disseminating water smart mechanism (p= 0.001). This insinuate that the larger the farm size, the higher the rate of adoption of water smart mechanism. This implies that farmers with large farm size would appreciate water smart mechanism than those with small land area. This could be attributed to the fact that large farm area is difficult to maintain when it comes to water management. This therefore leads to increase in adoption of water smart mechanism, thereby improving the effectiveness of extension agents. This agrees with the findings of (Quintana-Ashwell, Gholson, Jason Krutz, Henry, & Cooke, 2020) who reported the adoption of OFWS (on farm water storage) was positively and significantly associated with the number of irrigated hectares under operation.

Result in Table 24 likewise show that the farmer's household size is statistically significant and show a positive influence on the effectiveness of extension agents in disseminating water smart mechanism (p=0.046). This indicate that the larger the household size, the greater the adoption rate of water smart mechanism. This could be due to fact that large household size is characterized with natural labour, which could serve as a motivator in adopting water smart mechanism (particularly, those that are labour intensive).

As revealed in Table 24, the coefficient of competence of extension agents is positively and statistically significant in influencing the effectiveness of extension agents in disseminating water smart mechanism (p=0.000). This indicates that higher the competence of extension agents, the greater their effectiveness in disseminating water smart mechanism. The implication of this is that extension effectiveness can be achieved by improving their competence in water smart mechanism.

Finally, Table 24 shows that the estimate for external constraints was negative and had statistical significant influence on effectiveness of extension agents in disseminating water smart mechanism. This indicates that adoption of water smart mechanism by farmers is basically restricted by external constraints such as funding, and cultural belief. The policy implication of this is that a platform should be made available for farmers to get fund and also programs should be conducted to educate farmers on the benefits accrued from using water smart mechanism to clear their unbelief. This will therefore increase their adoption rate and enhance the effectiveness of extension agents in disseminating the practice. This findings agree with (Ebenehi, Ahmed, & Barnabas, who reported that due to lack of funds farmers are unable to obtain the required resources and technologies that will help them. Similarly, this findings is in agreement with Anuga et al., (2019); Kang'ee, (2016) who reported that farmers' acceptance of CSA practices is influenced by socio-cultural elements such as community conventions, beliefs, and values.

Result in Table 25 showed that the farmers’ age, household size, farm size, competence of extension agents and external constraint faced in disseminating weather smart mechanism were significant in influencing the effectiveness of extension agents at 1%, while tertiary educational attainment was significant at 10%.

Result in Table 25 revealed that the age of the farmers had a negative and significant influence on extension agents in disseminating weather smart mechanism (p=0.000) (new index-based weather insurance, climate information services, digital agriculture technology and use of ICTs in sourcing for agro weather information). This implies that increase in the age of farmers, will reduce the adoption of weather smart mechanism, thereby reducing the effectiveness of the extension agents in disseminating weather smart mechanism. This is may be because older farmers had their way of studying the weather, thus could perceive the information on weather smart mechanism to be irrelevant to them.

Also Table 25 shows that the household size of the farmers had a statistical significant and positive influence on effectiveness of extension agents in disseminating weather smart mechanism (p=0.000). This indicates that a unit increase in the household size will result in an increase in the adoption of weather smart mechanism by 0.282, thereby increasing the effectiveness of extension agents. This may be attributed to the fact that larger household size may be endowed with persons that are ICT inclined and can use it in sourcing for information thus could motivate the uptake of weather smart mechanism in adapting to the inimical effect of climate change. This is in line with (Shannon & Motha, 2015) was of the opinion that by using weather-smart methods such as mobile phones or the internet to get weather information, radio/television for weather and information Index-Based Insurance (IBI), farmers can minimize climate change impacts

As shown in Table 25, farm size of the farmers was found to have a significant positive effect on effectiveness of extension agents in disseminating weather smart mechanism (p=0.01). This insinuates that increase in farm size will result in increase in the adoption of weather smart mechanism by the farmers, thereby improving the effectiveness of extension agents. This could be due to the fact that farmers with most farmers with large area of land are mainly known for rain-fed production sysytem thus makes them more vulnerable to climate change. As a result, farmers will be eager to adopt weather smart mechanism so as to adapt to climate change menace.

The Table 25 also revealed that variable tertiary education had a positive and significant effect on effectiveness of extension agent in disseminating weather smart mechanism (p=0.090). This implies that the higher the level of education, the greater the adoption of weather smart mechanism, thereby increasing the effectiveness of extension agents. This is expected because increase in level of education provides exposure and aids the processing capacity of individual, which could promote the adoption of weather smart mechanism.

The coefficient of competence of extension agents as shown in Table 25 had a positive significant influence on effectiveness of extension agents in disseminating weather smart mechanism (p=0.000). This indicates that an increase in the competence of extension agents will result in additional increase in the adoption of the practice, thus increasing the effectiveness of extension agents. This is in line with the apriori expectation as increase in knowledge, skills and abilities of the E.A will enhance their communication and teaching skills in the subject area. This is in agreement with the findings of Antwi-Agyei & Stringer, (2021) in northeastern Ghana, who concluded that capacity building is required for improving the effectiveness of agricultural extension services. Similarly, Jasmin, Azizan, & Azahari, (2013), Kshash, (2018) and Okoedo-Okojie & Edobor, 2013) was of the opinion that effectiveness of extension services is largely dependent on the readiness and professional competencies of extension agents.

Finally, Table 25 revealed that effectiveness of extension agent in disseminating weather smart mechanism is negatively influenced by external constraints (p=0.000) (lack of fund, cultural beliefs). This implies that increase in external constraints will reduce effectiveness of extension agents in disseminating weather smart mechanism. This is because increase in external constraints such as lack of fund will lead to low adoption of weather smart mechanism, therefore reducing the effectiveness of extension agents. This is in consonance with the findings of Ebenehi, Ahmed, & Barnabas, (2018) who reported that farmers are unable to obtain the required resources and technologies that will help them.

In conclusion, the result rejects the null hypotheses that there is no significant relationship between selected personal and socio-economic characteristics of the respondents and effectiveness of extension agents. Hence accept the alternative hypothesis is accepted. This implies that extension agents' effectiveness in disseminating each CSA practices can be generally be improved if the farmers are young, ensures consistent contact with the farmers with large farm size and low income. More so, effectiveness of extension agents can be improved by enhancing their competence via training while relaxing the external constraints by providing adequate funds.

Table 20: Chi-square Results on the relationship between selected personal characteristics of farmers and effectiveness of extension agents

Variable	X^2	**Df**	**p-value**	**Decision**
Sex	0.003	1	0.955	Not Significant
Occupation	6.002	2	0.05	Significant
Farming system	0.444	1	0.50	Not significant
Educational level	7.034	3	0.07	Significant
Marital status	2.991	1	0.224	Not significant

**, * - Variable is significant at 5% and 10% respectively

Source: Field Survey Data, 2020

Table 21: Pearson Product Moment Correlation (PPMC) Analysis of the relationship between selected socio-economic characteristics of respondents and effectiveness of extension agents

Variable	r-Value	N	p-value	Decision
Age	-0.46	350	0.000	Significant
Income	0.167	350	0.002	Significant
Years of experience	-0.346	350	0.000	Significant
Household size	0.249	350	0.000	Significant
Extension contact	0.246	350	0.000	Significant
Farm size	-0.07	350	0.891	Not Significant

***, ** - Variable is significant at 1% and 5% respectively

Source: Field Survey Data, 2020

Table 22: Linear Regression Analysis Results on the relationship between other personal and professional characteristics and effectiveness of extension agents in disseminating soil smart mechanism

Variables	Coef.	Std. Error	p>t value	Remarks
Farmers' age	-0.137	0.038	0.000***	S
Farmer's sex	-3.62	1.062	0.001***	S
Farmer's household size	0.204	0.094	0.031**	S
Farmer's farm size	0.395	0.119	0.001***	S
Farmer's income	-1.107	0.413	0.008***	S
Primary education	1.674	1.276	0.191	NS
Secondary education	2.634	1.323	0.047*	S
Tertiary education	1.952	1.284	0.130	NS
Competence of the extension agents	0.228	0.072	0.000***	S
External constraints by faced by extension agents	-4.981	0.492	0.000***	S
cons	50.512	7.312	0.000	

Field survey, 2020

Table 23: Linear Regression Analysis Results on the relationship between other personal and professional characteristics and effectiveness of extension agents in disseminating crop smart mechanism

Variables	Coef.	Std. Error	p>t value	Remarks
Farmers' age	-0.419	0.074	0.000***	S
Farmer's sex	-5.818	2.299	0.012***	S
Farmer's household size	0.779	0.212	0.000***	S
Farmer's farm size	1.209	0.232	0.000***	S
Farmer's income	-4.196	0.789	0.000***	S
Primary education	0.559	2.488	0.822	NS
Secondary education	1.662	2.390	0.487	NS
Tertiary education	0.337	2.451	0.989	NS
Competence of the extension agents	0.894	0.193	0.000***	S
External constraints by faced by extension agents	-13.514	0.907	0.000***	S
cons	130.155	13.956	0.000	

Field survey, 2020

Table 24: Linear Regression Analysis Results on the relationship between other personal and professional characteristics and effectiveness of extension agents in disseminating water smart mechanism

Variables	Coef.	Std. Error	p>t value	Remarks
Farmers' age	-0.079	0.023	0.001***	S
Farmer's sex	0.063	0.733	0.931	NS
Farmer's household size	0.112	0.056	0.046**	S
Farmer's farm size	0.155	0.056	0.006***	S
Farmer's income	-0.256	0.237	0.280	NS
Primary education	-0.553	0.961	0.565	NS
Secondary education	-1.127	0.965	0.244	NS
Tertiary education	-0.807	0.969	0.406	NS
Competence of the extension agents	0.479	0.101	0.000***	S
External constraints by faced by extension agents	-1.959	0.314	0.000***	S
cons	13.773	4.557	0.003	

Field survey, 2020

Table 25: Linear Regression Analysis Results on the relationship between other personal and professional characteristics and effectiveness of extension agents in disseminating weather smart mechanism

Variables	Coef.	Std. Error	p>t value	Remarks
Farmers' age	-0.226	0.032	0.000***	S
Farmer's sex	-0.887	0.922	0.336	NS
Farmer's household size	0.281	0.075	0.000***	S
Farmer's farm size	0.274	0.108	0.012***	S
Farmer's income	-0.217	0.487	0.656	S
Primary education	0.067	1.056	0.950	NS
Secondary education	-1.674	1.116	0.135	NS
Tertiary education	-1.791	1.052	0.090	NS
Competence of the extension agents	3.262	0.555	0.000***	S
External constraints by faced by extension agents	-5.913	0.495	0.000***	S
cons	13.760	9.493	0.148	

Field survey, 2020

4.11 Test of relationship between selected personal characteristics and competence of extension agents.

Data from Table 26 shows the probit regression analysis between selected personal characteristics and competence of extension agents. The result shows that the extension agents' years of experience significantly and positively contributed to the competence of extension agents in CSA practices. This suggests that the competence of extension agents in CSA practiced can be improved as a result of increased number of professional years of experience. This is because the E.A's could acquire more knowledge on CSA practices as their years in service increases. The policy implication of this for the extension organization is that when choosing the best applicant for a certain project, years of experience of the personnel should be considered. However, when designing trainings in the extension organization newly employed personnel should be considered first. This is line with the Nwaogu & Akinbile, (2018) who reported level of experience have positive significant effect on the competencies of extension agents in Oyo and Ogun state.

The result further showed that level of education of the extension agents had a positive and significant influence on the competencies of extension agents. This implies that increase in level of education results in increases in competencies of extension agent. This is due to the fact that increase in level of education could make an individual to be knowledge receptive, thereby building their competencies in their field. This is in line with the findings of Olorunfemi et al., (2018) who reported that extension agents with a greater degree of education are more likely to be highly competent than their less educated counterparts, because education has been shown to raise individual levels of innovativeness and expertise.

Table 26: Test of relationship between selected personal characteristics and competence of extension agents

Variables	Coef.	Std. Err.	p>z value	Decision
Age	-0.019	0.025	0.443	NS
Education qualification	0.198	0.117	0.089*	S
Years of experience	0.062	0.019	0.002***	S
No of training	-0.0008	0.034	0.816	NS
cons	-3.394	2.180	0.120	
LR chi2 (4) = 21.15				
Prob > chi2 = 0.0003				

Field survey, 2020

4.12: Test of relationship between the Socio Economic Characteristics of Extension Agents and Constraint/Challenges to Dissemination of CSA practices

Table 27 showed that there was no significant relationship between age of the extension agent and personal, institutional and external constraints in disseminating CSA practices (p=0.767, 0.211 and 0.303). In the same vein, educational attainments (p=0.914, 0.441 and 0.551), position of extension agents (p=0.247, 0.601 and 0.231), and years of experience (p=0.470, 0.143 and 0.311), was not statistically significant.

Numbers of training was found to have statistical significant influence on personal (p=0.05) and institutional constraints (p=0.017) to dissemination of CSA practices. However, the correlation coefficient r shows a negative linear relationship, thus the implication of this is that as the numbers of training increases, the lower the constrained faced in dissemination of CSA practices. This further implies that increase in numbers of training will enhance the effectiveness of the extension agents in disseminating CSA practices to the farmers. This study agrees with (Nwosu, Onyenek, Onoh, & Ekechukwu, 2015)who concluded that trainings and level of education significantly influence the job performance of the extension workers. Likewise, (Ogunremi & Olatunji, 2017) reported number of in-service training as one of the main determinant of job satisfaction.

The table also revealed that the number of farmers/ farm families per extension agents was statistically significant and related to personal and institutional constraints in disseminating CSA practices (p= 0.02, 0.08), with a negative correlation coefficient. The implication of this is that as the number of farm families increases, the lower the likelihood of having constrained in disseminating CSA practices to the rice farmers and vice versa. This is surprising because increase in number of farm families is expected to increase the constraints in disseminating CSA practices. However, in situation where the increase experienced is still from the same set of families, constraints in disseminating CSA might reduce. This results negates the findings of Nwosu et al., (2015) reported that increase in number of farm families covered significantly reduce the performance of extension agents.

Furthermore, the table shows that contact with agency was statistically significant and negatively related to personal and institutional constraints constraint in disseminating CSA practices (p= 0.01, 0.00). The implication of this is that the higher the numbers of contact with agency, the lesser the constraints faced in disseminating CSA practices to the rice farmers. Therefore, extension organization can improve the effectiveness of extension agents by increasing the numbers of trainings of the extension agents as well as increasing their contact with agencies so as to get more familiar with the practice which aids convenient dissemination of information.

Table 27: **Pearson Product Moment Correlation (PPMC) Analysis Results on the relationship between Selected Socio-economic characteristics of extension agents and constraints to dissemination of CSA practices**

Variable	r-value personal constraints	r-value institutional constraints	r-value external constraints	N	p-value personal constraints	p-value institutional constraints	p-value external constraints	Decision
Age	-.032	.135	-.111	88	0.767	0.211	0.303	Not significant
Educational attainment	.012	.083	.064	88	0.914	0.441	0.551	Not significant
Position of Extension Agents	-.125	-.057	-.129	88	0.247	0.601	0.231	Not significant
Years of experience	.078	.158	-.109	88	0.470	0.143	0.311	Not significant
Numbers of training	-.299	-.253	-.055	88	0.05	0.017	0.612	Significant
Numbers of farmers	-.244	-.184	-.080	88	0.02	0.08	0.460	Significant
Contact with Agency	-.363	-.447	-.036	88	0.01	0.00	0.741	Significant

***, **, * - Variable is significant at 1%, 5%, 10% respectively

Field Survey, 2020

4.13 Test of relationship between Attitude and Competence of the Extension Agents

Table 28 shows that attitude have a positive and significant impact on the competent of the extension agents (p = 0.035). This implies that the more favourable attitude display by the extension agents towards CSA practice, the more competent the extension agent will be. This could be due to the fact that having a positive or favourable disposition towards an innovation could motivate agents to learn more about CSA practice, hence increasing they competency in such areas, thereby making effective in performing their roles. The implications of this finding for extension organizations are that they must encourage extension agents to have a positive attitude toward their work by considering their needs when making decisions and motivating them to give it their all. This is in consonance with the findings of Ijeoma and Adesope, (2015) who concluded that there is a significant relationship between extension personnel's personality type and their job performance.

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Table 28: Chi-square test of relationship between Attitude of respondents and competence of extension agents

Variable	X^2	**df**	**p-value**	**Decision**
Attitude	6.716	2	0.035	Significant

4.14 Test of relationship between Knowledge and Competency of the Extension Agents

Table 29 shows that knowledge have a positive and significant impact on the competency of the extension agents (p = 0.035). This implies that increase in knowledge of extension agents on CSA practices, will lead to increase in competence of extension agents. This is because, the knowledge gained through training, will infer to increase in abilities and skills of the extension agents. This will automatically leads to increase in effectiveness of extension personnel in disseminating CSA practices. This conforms to the findings of Dormita & Bautista, (2016) reported that effectiveness of extension service delivery is highly dependent on the adequacy of extension workers and technical experts on postharvest handling. Also, Oladele & Tekena, (2010) stated that the effectiveness of extension service delivery is heavily reliant on the knowledge of extension agents on the various agricultural innovations they disseminate to farmers.

Moreover, the probit regression analysis on Table 29.1 further showed that knowledge of extension agents had a significant and positive effect on the competence of extension agents. This implies that an increase in knowledge of E.A's in CSA practice will result in increase in the competence of extension agents in the subject matter. The implication of this is that extension organizations need to strategize their system of training the extension agents so as to increase their knowledge on the CSA practice, thus resulting in increase in their performance.

Table 29: Pearson Product Moment Correlation (PPMC) Analysis of the relationship between knowledge and competence of extension agents

Variable	r-value	N	p-value	Decision
knowledge of extension agents	0.267	88	0.012	Significant

*** - Variable is significant at 1%

Source: Field Survey Data, 2020

Table 29.1: Probit Regression between knowledge and competence of extension agents

Variables	Coef.	Std. Err.	p>z value	Decision
Age	-0.013	0.025	0.598	NS
Years of experience of experience	0.071	0.19	0.000***	S
Knowledge of the E.A's	0.0.18	0.010	0.073*	S
cons	-5.228	2.941	0.076	

LR chi2 (4) = 20.90

Prob > chi2 = 0.0003

Pseudo R2 = 0.173

4.15 One way ANOVA for test of Difference in Effectiveness of Extension agents among Kwara, Kogi and Niger state

Result in Table 30 shows that there is a significant difference (F=803.23 and p= 0.000, since $p<0.05$) in effectiveness of extension agents among the three states. Therefore, we reject the null hypothesis. Hence the alternative hypothesis is hereby accepted.

This implies that the effectiveness of extension agents in disseminating CSA practices to rice farmers is varies across the three states (Kogi, Kwara and Niger state). That is the variation of effectiveness among group is more than within group. This could be attributed to the differences in the number of extension agents to farm families' ratio across the three states, as that of Niger state was higher compare to Kwara and Kogi. Therefore, extension organization should work on recruiting more staff in order to reduce this ratio, thereby making the extension agents more effective.

Table 30: ANOVA on Effectiveness of Extension agents among the three states

Effectiveness	Sum of squares	df	Mean square	F	Sig.	Decision
Between Groups	277898.962	1	277898.962	803.231	.000	Significant
Within Groups	120399.827	348	345.977			
Total	398298.789	349				

*** - Variable is significant at 1%

Source: Field Survey Data, 2020

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of major findings of the study

The main objective of the study is to evaluate the effectiveness of extension agents in disseminating CSA among rice farmers in North central, Nigeria. However, the specific objectives were to determine the knowledge level, competence, competency need, participation level of extension agents in disseminating CSA practices and the dissemination method used by the extension agents. As well as to evaluate factors that influence effectiveness of extension agents, and perceived constraints associated with dissemination of CSA.

The hypothesis of the study were stated in null form and they include; there is no significant relationship between the effectiveness of extension agents in disseminating CSA practices and selected farmers related characteristics, namely: age, sex, farm size, marital status, occupation, extension contact, farming system, household size, income, and years of experience; there is no significant relationship between personal & professional characteristics of extension agents and effectiveness of extension agents in disseminating CSA practices; there is no significant relationship between selected socio economic characteristics of extension agents and constraint/challenges to dissemination of CSA practices; there is no significant relationship between attitude and competency of the extension agents; there is no significant relationship between knowledge and competency of the extension agents; and there is no significant difference in the effectiveness of the extension agents' among the three states

The conceptual framework shows a relationship between knowledge and competence, attitude and competence, socio economic characteristics of farmers and effectiveness of Extension agents in disseminating CSAP, socio-economic characteristics of extension agents and attitude, knowledge, competence, competency need, participation of extension agents in disseminating and constraints in disseminating CSAP to rice farmers.

Multistage sampling technique was employed to select the study sample. The first stage purposive selection of Kwara, Kogi and Niger states out of the seven states in North central, Nigeria, based on their involvement in rice production. This was follow by purposive selection of zone B out of four ADP strata in Kwara state, zone A out of three ADP strata in Niger state, and zone D out of four ADP strata in Kogi state, based on their involvement in rice production. Forty percent of the LGAs (blocks) in the each ADP stratum were sampled proportionately based on the number of LGAs. Random selection of 2(two) cells/ rural communities from each block to give a total of 14 cells. Random selection of 30 contact farmers from each cells making a total of 420 contact farmers. However, 55 research instruments were not returned and 15 were not properly filled.

Descriptive statistical techniques such as frequency counts, means, standard deviation, graph, charts, bars and Borich need model analysis were used to describe and summarize the data collected. Inferential statistics such as correlation, chi-square, probit regression, linear regression and Analysis of Variance (ANOVA) were used to analyze the data.

The result obtained from the analysis revealed that majority of the extension agents were in their middle ages. The mean age was 48. Majority were males (93.2%), married (95.5%), and (85.2%) had tertiary education. Majority occupies the position of village extension officers (64.8%), and the mean years of experience were 20.5years. The mean household size, monthly income and in- service training attended on CSA practices was 9.5, ₦74,370 and 4.8 respectively. The mean contact with research agency and number of farmers/farm families per extension agents was 2.3 times in the last three years and 1935.6 respectively.

Majority (77.3%) of the respondents had moderate favourable attitude, while 12.5% had high favourable attitude towards their message and only 9 extension agents representing 10.2% had less favourable attitude towards their message.

More than half of the extension agents (53.4%) had high knowledge in soil smart mechanism, while 46.6% had low level knowledge on soil smart mechanism. Majority of the extension agents (56.8%) had high knowledge on crop smart mechanism and less than half (43.2%) had low knowledge level. More than half (52.3%) of the respondents had low level of knowledge on water smart mechanism, while almost half of the respondents (47.7%) had high level of knowledge. Majority (54.5%) of the extension workers had low level of knowledge on weather smart mechanism or practices. While less than half (45.5%) of the extension workers had a high knowledge level on weather smart mechanism or practices. More than half (51.1%) of the respondents had a low competence on CSA practices, while 48.9% had high competence on CSA practices.

Areas where the extension agents needs to be competent include; Operating the AWD irrigation technique by monitoring the water level and recognize when water level is below 15cm below the soil surface before irrigation is applied (MWDS = 4.21), Possess skills in relay cropping practice such as growing rice together with other crops such as maize (MWDS = 3.42) , Operating the rice grain planter in sowing seed directly into the soil, (MWDS = 3.03), Operate multiple inlet irrigation(MIRI), where polypipes are laid along the length of the field to fill each paddy at the same time (MWDS = 2.98), In using Site-specific nutrient management (SSNM), I have ability to establish the yield target (MWDS = 2.95), 'Use of Decision support system (DSS) to get help (MWDS = 2.77), Use ICTs such as computers to solve solutions (MWDS = 2.69), In Dry- DSR, ability to plant by drilling of seeds in rows after minimum tillage using a power tiller – operated seeder or raised bed (MWDS = 2.60), Micro-dosing: knowledgeable and ability to apply small and affordable quantities of fertilizer (MWDS = 2.50), Ability to identify the cropping calendar and determine when to plant (MWDS = 2.42, Ability operate the drip irrigation system on the rice field (MWDS = 2.35), Ability to operate the AWD technique by applying irrigation to about 2-5 cm above the surface(MWDS = 2.35). 'Able to optimally use the existing(indigenous) nutrients coming from the soil, organic amendments, crop residue, manure, and irrigation water (MWDS = 2.30), 'Use of Climate information services (CIS) to get new weather & climate information (MWDS = 2.29), 'Use of Index-based weather insurance and apply to farmers (MWDS = 2.18), and Posses skills in IPM(integrated pest management) by calculating appropriate pesticides/herbicides mixing (MWDS = 2.13).

Majority of the extension agents (53.4%) generally have low level of participation in disseminating CSA practices among rice farmers. While 46.6% have high level of participation in disseminating CSA. However, extension agents had high level of participation in disseminating the following soil smart mechanism; minimum tillage ($\bar{x}$ =1.42), planting of cover crops ($\bar{x}$ =1.39), Use of urea deep placement (UDP) ($\bar{x}$ =1.35), use of compost ($\bar{x}$ =1.16), and site specific nutrient managements (SSNM) ($\bar{x}$ =1.05) and have low level of participation in disseminating information on agro-forestry ($\bar{x}$ =0.66). Extension agents highly participated in disseminating certain Crop smart mechanisms: Use of healthy young rice seedling ($\bar{x}$ =1.60), Planting early maturing rice varieties ($\bar{x}$ =1.49), Seed priming ($\bar{x}$ =1.41), Planting of stress-resistant variety ($\bar{x}$ =1.39), crop rotation ($\bar{x}$ =1.39) and mixed cropping ($\bar{x}$ =1.35).While, practices which they had low level of participation were: Precision agriculture ($\bar{x}$ =0.91) and Integrated Pest Management (IPM) ($\bar{x}$ =0.62).

Extension agents highly participated in disseminating certain water smart mechanism: construction of water channels ($\bar{x}$ =1.35) and use of sand bags ($\bar{x}$ =1.20). However, they were less involved in disseminating alternate-wet-and-dry irrigation (AWD) technique ($\bar{x}$ =0.00), water harvesting ($\bar{x}$ =0.92), and drip irrigation ($\bar{x}$ =0.73).

Extension agents had high level of participation in disseminating climate information services ($\bar{x}$ =1.23) and seasonal weather forecast ($\bar{x}$ =1.17) under weather smart mechanism. However, they were less involve in disseminating index-based weather insurance ($\bar{x} = 0.00$), digital agricultural technology ($\bar{x} = 0.74$) and use of ICTs ($\bar{x} = 0.93$).

Extension agents in the study area had high level of participation in knowledge smart mechanism: farmers to farmers learning ($\bar{x} = 1.61$), off farm risk managements ($\bar{x} = 1.05$), seeds banks ($\bar{x} = 1.06$) and market information ($\bar{x} = 1.50$).

Dissemination pathway/ method mostly used by the extension in disseminating climate smart agricultural practices to the rice farmers include; individual contact methods; farm and home visits ($\bar{x} = 1.73$), group contact methods; (result demonstration ($\bar{x} = 1.66$), methods demonstration ($\bar{x} = 1.58$), meetings at results demonstrations ($\bar{x} = 1.57$) and leaders training meetings ($\bar{x} = 1.48$) and mass media methods: posters ($\bar{x} = 1.50$). while, dissemination pathway/ method rarely used by the extension agents include: films ($\bar{x} = 0.68$), personal letter ($\bar{x} = 0.78$), slide shows ($\bar{x} = 0.78$), flip charts ($\bar{x} = 0.82$), radio ($\bar{x} = 0.85$), drama ($\bar{x} = 0.85$) and circular letters ($\bar{x} = 0.86$).

The challenges/constraints impeding the extension agents in disseminating CSA practices include: Insufficient number of extension workers to provide services for large number of farmers (E.A: farm families) ($\bar{x} = 1.87$), Lack of incentives for staff motivation ($\bar{x} = 1.83$), Inadequate means of transportation ($\bar{x} = 1.83$), Inadequate training programs for extension agents in CSA ($\bar{x} = 1.76$), Non-payment of allowance to field staff ($\bar{x} = 1.75$), Low institutional/government support for agricultural extension ($\bar{x} = 1.70$), Non availability of inputs ($\bar{x} = 1.66$). Lack/ inadequate information from research institute ($\bar{x} = 1.49$) were ranked 1st,2nd, 3rd, 4th,5th , 6th and 7th respectively.

The mean age of the rice farmers was 48.8 years. Majority were males (88.9%), married (94%), and had attained secondary education (37.1%) with Islam (60.3%) as their religion. Majority (42.9%) had between 17 and 30 years of experience, practice low land farming (97.7%), had between 6 and 10 household size (53.1%). Majority were full time farmers (77.1%), and had farm size between 1 and 4 hectares of land. Majority had between 18 and 25 extension contact in the last three years (72.3%) and earn between ₦37,000 and ₦710,000 annually.

Generally, more than half of the rice farmers (54%) were aware of Climate Smart Agricultural Practices (CSAP). Specifically, 56.3% of the farmers were aware of soil smart mechanism, 62.6% were aware of crop smart mechanism, 54.3% were aware of weather smart mechanism and 44.3% were aware of water smart mechanism.

Generally, the rice farmers reported had low knowledge (56.0%) on CSA practices. Specifically, majority of the farmers had low knowledge (63.7%) on soil smart mechanism (like UDP (Urea Deep Placement), use of compost, zero & minimum tillage e.t.c), and water smart mechanism (61.1%) like AWD, water harvesting, drip irrigation e.t.c.) and weather smart mechanism (54.6%).

However, more than half of the respondents had high knowledge on crop smart mechanism (52.3%) like (crop rotation, mixed cropping, planting of stress-tolerant and early maturing varieties, changing of cropping calendar, micro dosing, manures, precision fertilizers e.t.c).

Generally, rice farmers had low uptake (52.6%). Specifically (57.9%) of the farmers had high on crop smart mechanism such as (crop rotation, mixed cropping, planting of stress-tolerant and early maturing varieties, changing of cropping calendar, micro dosing, manures, precision fertilizers e.t.c). Then, low uptake (54.9%) for soil smart mechanism (such as Agro-forestry, Urea Deep Placement (UDP), Minimum Tillage, and so on), water smart mechanism (62.6%) (such as water harvesting, drip irrigation, AWD, sandbags, construction of water channels) and weather smart mechanism (55.1%) (such as use of climate information services, index based weather insurance, use of ICT's and so on).

Knowledge sharing was generally low (54.6%). Specifically, the table revealed that 72.3% of the rice farmers do not share the knowledge on soil smart mechanism (such as Agro-forestry, Urea Deep Placement (UDP), Minimum Tillage, and so on) to other farmers. Ninety percent (90%) shared crop smart mechanism (crop rotation, mixed cropping, planting of stress-tolerant and early maturing varieties, changing of cropping calendar, micro dosing, manures, precision fertilizers e.t.c)information with others. Sixty five prevents (65.4%) do not share information on water smart mechanism (water harvesting, drip irrigation, AWD, sandbags, construction of water channels) and 61.4% do not share on weather smart mechanism (use of climate information services, index based weather insurance, use of ICT's and so on).

On the basis of effectiveness of extension agents, majority of the extension agents had low level of effective (52.9%) in disseminating CSA practices to rice farmers, while 47.1 had high level of effectiveness.

There was a negative and significant relationship between age and effectiveness of extension agents. There was a positive and significant relationship between educational level and effectiveness of extension agents. There was a positive and significant relationship between occupation and effectiveness of extension agents.

There was a positive and significant relationship between income and effectiveness of extension agents. There was a negative and significant relationship between years of experience and effectiveness of extension agents. There was a positive and significant relationship between household size and effectiveness of extension agents. There was a positive and significant relationship between extension contact and effectiveness of extension agents. There was a positive& significant relationship between competence and effectiveness of extension agents. A negative & significant relationship exist between external constraints and effectiveness of extension agents.

Attitude & knowledge had positive and significant impact on the competence of the extension agents.

Number of training, numbers of farmer/farm families, and contact with agency has a negative and significant relationship with constraints to disseminating CSA practices. There is a significant difference in effectiveness of extension agents among the three states.

5.2 Conclusion

The study on the basis of major findings concluded that:

In general, extension agents demonstrated a high level of knowledge in CSA practices. Specifically, their knowledge was high in soil smart mechanism, crop smart mechanism, and knowledge smart mechanism but low in water smart mechanism, and weather smart mechanism.

Extension agents had a low level of competency in CSA practices, so they have areas where they need to improve.

Extension agents had low level of participation in disseminating CSA practices.

Dissemination methods commonly used by the extension agents were farm & home visits, result demonstration, method demonstrations and posters.

Lack of incentives for staff motivation, non-payment of allowance to field staff and non-availability of input were the most significant constraints that limited extension agents' ability to effectively disseminate CSA practices.

Majority of the rice farmers were aware of Climate Smart Agricultural Practices (CSAP), had low knowledge on CSA practices, low uptake and low Knowledge sharing of the CSAP.

Majority of the extension agents had low level of effectiveness in disseminating CSA practices to rice farmers.

The following farmers' characteristics have positive and significant relationship with effectiveness of extension agents: educational level, occupation, income, household size and extension contact. However, age and years of experience have negative and significant relationship with effectiveness.

Competence had positive and significant relationship with effectiveness of extension agents. External constraints had a negative and significant

Attitude and knowledge of extension agents have a positive and significant impact on competency of extension agents and there was a significant difference in effectiveness of extension agents among the three states.

5.3 Recommendations

The following recommendations are made based on the major findings and conclusion of the study;

1. Educated and enlightened individuals should be recruited into the extension organization so as to enhance understanding of new CSA practices and aids dissemination.
2. Periodical training and retraining programmes should be organized for extension agents so as to improve their competency on CSA practices such as direct seeding of rice, irrigation techniques, AWD (alternate wet and dry) technique.
3. Extension agents should be evaluated after receiving training and be well remunerated by the government in order to enhance their effectiveness.
4. Incentives (awards, cash reward, promotion, staff recognition) should be given to

the extension agents so as to enhance their performance.

5. Government should ensure adequate linkage between international agencies, researchers and extension organization (ADP) in order to keep the extension agents abreast of new CSA practices that can help the rice farmers to increase their production.
6. Training and retraining should be organized for farmers by the Extension agents in order to increase their knowledge and competence on the CSA practices applicable to them.
7. Evaluation and follow-up should be carried out by the extension personnel after training the farmers.
8. Governmental and non-governmental organization should motivate farmers in uptaking CSA practices by providing subsidies on all the agricultural input such as seeds, fertilizers.
9. Effort should be intensified on presidential initiatives on rice projects, by providing improved technique to solve the water problem of the rice farmers such as AWD (Alternate wet & dry technique).
10. Extension agents to farmers' flow of information should be enhanced via the use of telephones and should be well trained on the use of ICT's in researching solutions so as to solve the farmer's problem.
11. Extension organization should be gender sensitive while recruiting their staff so that female farmers can also benefit from the trainings.
12. The skills that have been identified in this study can be integrated into both the pre-service and in-service training and development of extension agents in their line of work to improve their skills in sharing new technology.
13. Government should help farmers by soliciting with insurance companies so that they can help in safeguarding the farmer against climate risk.
14. Farmers should be encouraged to attend adult education programmes so as to increase their processing capacity and enhancing the effectiveness of extension agent.

5.4 Contribution to Knowledge

1. The study documented the personal and professional characteristics like age, numbers of training received on CSA practice, educational status, and years of professional experience of extension practitioners to the effectiveness of extension agents.
2. The study documented the socio-economic characteristics like age, sex, educational status, and years of professional experience of farmers to the effectiveness of extension agents in disseminating CSA practices.
3. The study provided quantitative data on the levels of knowledge exhibited by extension practitioners and ascertains their knowledge on different CSA practice in the study area.
4. The study provided quantitative data on the competency level of extension practitioners and further provided area of competency need of extension practitioners on CSA practice in the study area.
5. The study investigated the methods used in disseminating CSA practice by extension practitioners
6. The study ascertained the attitude of the extension practitioners towards CSA practice
7. The study ascertained the level of participation of extension agents in disseminating CSA practice.
8. The study determined the level of awareness, knowledge, uptake, knowledge sharing of the rice farmers on CSA practice and further ascertain the effectiveness of extension agents
9. The study determined the factors that influence effectiveness of extension agents.
10. The study established the constraints that limit the effectiveness of extension agents in disseminating CSA practice

5.5 Suggestion for Further Research

1. Factors that determine the knowledge of extension agents regarding CSA practices in Nigeria
2. Benefits derived from adopting CSA practice: Evidence from rice farmers in Nigeria.

3. Evaluation of the access to and utilization of CSA among other cash crop farmers in Nigeria.
4. Comparative study on effectiveness of extension in public and private organization in disseminating CSA practices.
5. Factors associated with adoption of CSA practices by rice farmers.

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APPENDICES

DEPARTMENT OF AGRICULTURAL EXTENSION AND RURAL DEVELOPMENT
FACULTY OF AGRICULTURE
LANDMARK UNIVERSITY, OMU ARAN,
KWARA STATE.

PROJECT TITLE*: *EFFECTIVENESS OF EXTENSION AGENT IN DISSEMINATING CLIMATE SMART AGRICULTURAL PRACTICES AMONG RICE FARMER IN NORTH CENTRAL, NIGERIA.

NOTE: This questionnaire is designed to obtain information on the above topic, which is purely for academic/research purpose. All information supplied will be treated with absolute confidentiality.

Thanks for your anticipated cooperation.

QUESTIONNAIRE NUMBER:………………………………………

DATE OF INTERVIEW:……………………………………………….

L.G.A:…………………………………………………………………

NAME OF COMMUNITY:……………………………………………..

INSTRUCTION: Please kindly tick ( ) as appropriate or fill in the gap where necessary

PART A: EXTENSION AGENTS

SECTION A: SOCIO - ECONOMIC CHARACTERISTICS

17. Age: ……..years
18. Sex: male { }, female { }
19. Marital status: single { }, married { }, divorced { }, separated { }.
20. Religion: Christians { }, Muslims { }, Traditional worshipper { } Others { }
21. Educational qualification: Non-formal { } Primary { } Secondary{ } Tertiary{ }.
22. Household size: ……………
23. Your occupation as an extension agents: Primary occupation { }, Secondary occupation. { }
24. Position of extension agent in the organization: Village Extension Agents { } Zonal Extension Officer { } Block Extension Officer { } Subject Matter Specialist { }Women in Agriculture { } Others specify……………..
25. Years of experience as an extension agents: …………

26. Participation in CSA training Yes { }, no { }
27. Numbers of training received quarterly on CSA practices …….
28. Numbers of Contact with agency on CSA practices ………
29. Numbers of farmers you are responsible for …….
30. Monthly income ……..
31. Job location

SECTION B: Knowledge level of extension agents towards CSA practices

S/N	**Knowledge of extension agents on CSA practices**	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
	General knowledge					
1	CSA is an approach that helps to guide actions to transform and change the direction of agricultural system.					
2	CSA practices when adopted can sustainably increase agricultural productivity and income					
3	CSA practices help famers to build resilience and withstand adverse weather conditions caused by climate change)					
4	CSA practices helps in reducing green house gas emissions					
5	Increasing tree covers in crop is one of the way in reducing green house gas emissions					
6	Reducing soil disturbance is one of the ways in reducing soil erosion, increases carbon sequestration					

	(removal of CO_2), and moisture increases moisture in the soil, which helps to increase rice yield.					
7	Diversification of production and income is a CSA practices that aids adaptation to climate change					
8	Building input supply systems and extension services that support efficient and timely use of inputs is a CSA practice that increase resilience to climate change					
9	Limiting soil erosion is one of the farm management methods of building resilience to mitigate the climate change.					
10	Minimum or zero tillage practices helps in minimizing carbon dioxide losses, correct compaction and hardpans, and also increase soil organic matter					
11	Enhancing management of water resources is a CSA practice that helps in building resilience to climate change.					
12	Conservative agriculture with trees helps to control pests and weeds thereby ensuring good harvests and reducing post-harvest losses.					
13	Planting of improved					

	seeds variety is one of the way of mitigating climate change					
14	Strengthening market linkages throughout the rice value-chain i.e improving market connections is also CSA practices					
15	Using of direct seeding of rice (DSR) method is a CSA approach that helps to reduce loss due to drought in a rain-fed environments					
16	Direct seeding of rice (DSR) method is a CSA approach that helps to reduce the cost of production (fertilizer, fuel and rent cost on both land preparation an irrigatioin					
17	Agroweather Tools such as climate information services (CIS) is a CSA approach that generates location specific information based on the forecast information and data provided, process this data and generate advise to the farmers through SMS and web portals.					
	Soil smart mechanism					
18	Minimum tillage practice such as ripping is a CSA practice used in breaking soil compacts and hardpans					

19	Planting of cover crops helps in retaining soil nutrient, increase soil organic matter leading to increasing soil structure, stability and controls crop erosion.					
20	Use of urea deep placement technique, where urea is made into briquettes(solid form) helps to reduce nitrogen loss compare to broadcasting methods of urea application and thus increase rice yield.					
21	Agro-forestry (i.e planting of trees) is a CSA practice that helps in controlling soil erosion					
22	Agro-forestry (i.e planting of trees) is a CSA practice that helps in water purification and water regulation					
23	Agro-forestry (i.e planting of trees) is a CSA practice that helps in fixing nitrogen and increase soil fertility by improving water infiltration into the soil					
24	Agroforestry helps in diversify farm production, which lowers both climate and market risks.					
25	Use of compost help in protecting against erosion					
26	Use of compost also add to the soil					

	nutrients					
27	Seed priming is an Integrated Soil Fertility Management (ISFM) that helps to improve emergence, produce more vigorous seedlings, flower and mature earlier, and yield better than non-primed and stand establishment under a wide range of field conditions.					
28	Site-Specific Nutrient Management (SSNM) is a technology, plant-need-based approach for optimally applying fertilizers such as nitrogen (N), phosphorous (P), potassium (K) to rice.					
29	In SSNM, fertilizer N management is identified through the use of the leaf color chart (LCC)					
	Crop smart mechanism					
30	Primed crops emerge fasters, more completely, produce more vigorous seedlings, flower and mature earlier and yield better than non primed.					
31	Crop rotation with legumes serve as a CSA solution for weed management					
32	Use of healthy young rice seedlings is a CSA approach that aids rice germination and					

	increase rice yield.					
33	Using DSR (direct-seeded rice) method help in reducing labour, energy, preparing field, emission of green house-gasses and transplanting cost					
34	Application of manure and compost helps to increases the soil fertility					
35	Planting of pest and disease-resistant is a CSA practice that increase rice yield.					
36	Planting of early maturing rice varieties is a CSA practice that increase rice yield					
37	Planting of stress-tolerant rice varieties is a CSA practice that increase rice yield					
38	Retention of crop residues or other surface cover increases water content and reduce runoff by evaporation					
39	Mixed cropping help in fixing nutrients like phosphorus, nitrogen and potash into the soil and thus increase yield					
40	Planting of cover crops such as sorghum help to increase soil organic matter, leading to improvements in soil structure, stability, and increased moisture and nutrient holding capacity for plant					

	growth					
41	Planting of leguminous crops helps in protecting the soil against any kind of erosion					
42	Construction of terraces that are reinforced with drought tolerant fodder grasses strips are used in increasing soil nutrients					
43	Micro-dosing(efficient application of fertilizers in split - small but repeated - dosages based on assessments of crop need) helps to increase farm productivity.					
44	Mulching is a CSA management practice that buffers the soil against extreme temperature and therefore maintaining soil nutrients.					
45	Organic fertilizers application is a CSA practice used in increasing the soil nutrients					
46	Integrated pest management(IPM) such as appropriate pesticides mixing calculation, identifying application times, frequency, and method is one of the CSA approach used in building resilience to climate change and increasing agricultural productivity and					

	income					
	Water smart mechanism					
47	Alternate-Wet-and-Dry (AWD) irrigation technique is a process where rice producers prevent the field from constant flooding by ensuring that it dries intermittently throughout the rice lifecycle.					
48	Planting of basins is method use for capturing rain water and therefore reduce crop failure due to unreliable rainfall					
49	Alternate-Wet-and-Dry irrigation technique helps to save water usage and reduce methane emission					
50	Alternate-Wet-and-Dry technique aid farmers in monitoring the water level of the crop					
51	Alternate-Wet-and-Dry technique entails keeping irrigation water applied whenever the perched water table falls to about 15cm below the soil surface during all other periods					
52	In AWD, a field is flooded , and allowed to dry alternately instead of remaining flooded continuously throughout season					

53	In AWD technique, shallow flooding is done for the first two weeks after transplanting so as to help the plant in recovering from shock and suppresses weed.					
54	AWD technique entails maintaining shallow pond from heading to the end of end of flowering stage, time when the crop has high growth rate and when the rice crop is very sensitive to water-deficit stress.					
55	Construction of water channels in farm helps in reducing effect of flood as a result of climate change on farm					
56	Multiple inlet irrigation reduce water waste due to runoff, and wear on levee gates due to over pumping					
57	Furrow irrigation involves pumping water into trenches of furrows dug in between rows of crops					
	Weather smart mechanism					
58	Decision Support System (DSS) tools are used to copy crop management practices on specific crop yields and subsequently generates climate-smart agroadvisory					

59	DSS collect, organize, and integrate all types of information required for producing a crop.					
60	DSS analyses and interprets the information and finally uses the analysis to recommend the most appropriate action for sustaining maximum yields					
61	Climate information services such as seasonalforecast is a CSA practice aimed to improve farmers' access to relevant information on weather and climate that help in mitigating climate change					
62	Climate information services (CIS), develop farm management capabilities in a context of climate change, raise awareness of the practical utility of agroweather information.					
63	Early warning system is also climate information service that helps in reducing the effect on climate change on farmers.					
64	Financial services such as credit and loans is a CSA practice used in increasing productivity and income					
65	New index-based					

	weather insurance products can increase the ability of farmers to invest in agriculture despite increasing climate variability					
66	Digital agriculture technology such as yield prediction involve the use of internet (remote sensing) to predict crop yields.					
67	Digital agriculture technology entails providing integrated and market advisories to farmers which helps farmers to make decisions on what to grow, when to plant, harvest and where to sell their produce.					
	Knowledge smart mechanism					
68	Farmer to farmer learning is one of the CSA practices					
69	Off farm risk management kitchen garden is a CSA practice that helps farmers to diversify their resources.					

SECTION C: Attitude of extension agents towards disseminating CSA

S/N	Attitudinal statement	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1.	I support the promotion of Climate smart agricultural (CSA) practices for efficient increase in rice yield.					
2.	I align with Building extension agents' capability on CSA practices					
3.	I have vital role to play in disseminating climate smart agricultural practices.					
4.	I align with providing farmers with CSA practices manuals so as to aid easy learning					
5.	My skills and knowledge as an EA's on CSA practices need to be frequently improved via training					
6.	I participate in enhancing farmers capacity through CSA practices as it increases their income					
7.	I support implementing CSA practice as an appropriate alternative for farmers to adapt and mitigate the effect of climate change.					
8.	I support CSA practice as a tool that ensures effective and efficient farming					
9.	I support CSA practice as an appropriate method for farmers to cope with environmental conditions/ climate change.					
10.	I support CSA practices					

	as a new platform for accessing current information on crops (rice) marketing					
11.	It is very important to have local leader with adequate knowledge on CSA practice so as to ensure follow up on how the CSA practices are being carried out					
12.	CSA practices should be included and taught at the village general meetings					
13.	It is very important to ensure adequate involvement of farmers while teaching them as CSA practice is more effective compare to the traditional method of rice farming.					
14.	It is appropriate to disseminate CSA practice that is applicable to farmers local environments					
15.	I have confidence in myself when teaching the farmers CSA practices needed for their production					
16.	It is very important to practically demonstrate CSA practices to farmers on their field based on their needs					
17	The output of farmers will be increase, if I as an extension agents disseminate appropriate CSA practice to farmers					
18.	It is appropriate to teach and implement CSA programmes in the rural					

	areas					
19.	It is very important to educate farmers with certain CSA practices that can help to reduce their yield loss					
20	I do not support the promotion of Climate smart agricultural (CSA) practices for efficient increase in rice yield.					
21	I don’t align with building extension agents’ capability on CSA practices					
22	I do not have vital role to play in disseminating climate smart agricultural practices.					
23	I don’t align with providing farmers with CSA practices manuals so as to aid easy learning					
24	My skills and knowledge as an EA’s on CSA practices do not need to be frequently improved via training					
25	I do not participate in enhancing farmers’ capacity through CSA practices.					
26	The output of farmers doesn’t increase even as I disseminate CSA practices to the farmers					
27	I do not support CSA practice as a tool that ensures effective and efficient farming					
28	I do not support CSA practice as an appropriate method for farmers to cope with environmental conditions/ climate change.					

29	I do not support CSA practices as a new platform for accessing current information on crops (rice) marketing					
30	It is not important to have local leader with adequate knowledge on CSA practice so as to ensure follow up on how the CSA practices are being carried out					
31	CSA practices should not be included and taught at the village general meetings					
32	It is not important to ensure adequate involvement of farmers while teaching them as CSA practice is more effective compare to the traditional method of rice farming.					
33	It is not appropriate to disseminate CSA practice that is applicable to farmers local environments					
34	I don’t confidence in myself when teaching the farmers CSA practices needed for their production					
35	It is not important to practically demonstrate CSA practices to farmers on their field based on their needs					

36	It is not necessary to disseminate appropriate information on CSA practices to farmers so as to provide an alternative strategy to adapt and mitigate the effect of climate change.					
37.	It is not appropriate to teach and implement CSA programmes in the rural areas.					
38.	It is not important to educate farmers with certain CSA practices that can help in their yield loss.					

SECTION D: Competence of extension agent

S/N	COMPETENCE OF EXTENSION AGENTS	Importance			Competence		
	Competence categories and statements	High	Moderate	Low	High	Moderate	Low
	Soil smart mechanism						
2	In minimum tillage able to ensure the soil is covered by keeping residue on top surface so as to protect the soil.						
3	Ability to grow the leguminous crop (cover crops), slash it and leave it on the surface of the soil so as to add nutrients and maintain the soil moisture.						
5	Ability to broadcast pre-germinated seed at 100 kg/ha						
6	Ability to operate drilling machine in sowing seed at 80km/ha directly into the soil.						
7	Ability to turn green manures into the soil to						

	provide organic matter and nutrients.						
8	Ability to place urea directly beside the paddy with 40 cm distance apart						
10	Agro-forestry: ability to incorporating trees into landscapes which helps reduce temperatures and improve infiltration of water into the soil.						
12	Grow trees in the midst of crops						
13	Grow trees in rows with crops in between (alley cropping)						
14	Select & combine different composting materials such as fruit scraps, rice husks, rice bran, straw, dry leaves, saw dust from untreated wood, egg shell e.t.c.						
18	Ability to prime seeds with water						
19	Ability to prime seeds with micronutrients such as Zinc.						
20	In using Site-specific nutrient management (SSNM), I have ability to establish the yield target						
21	Able to optimally use the existing(indigenous) nutrients coming from the soil, organic amendments, crop residue, manure, and irrigation water						
22	Able to apply moderate amount of fertilizer (N, P, K) to supplement the nutrients from indigenous sources and achieve the yield target						
23	Ability to identify and estimate the amount of supplemental N needed,						

	through the leaf N status.						
24	Ability to use leaf color chart (LCC) for assessing leaf N status and the crops need for N.						
	Crop smart mechanism						
27	Skills in teaching farmers on how to: effectively rotate rice with leguminous crops such as soy beans						
28	Able to mix rice together with other crops such as maize						
29	Ability to identify when the cropping calendar can be changed						
30	Able to identify and use healthy young rice seedling						
31	Ability to operate the rice grain planter in sowing seed directly into the soil						
32	Ability to sow seed directly into the soil manually i.e (direct-seeded rice) method						
33	Ability to carry out Direct seeding by sowing pre-germinated seed into a puddled soil (wet seeding) or prepared seedbed (dry seeding) or standing water (water seeding).						
34	In **Dry- DSR, ability to** plant by broadcasting of dry seeds on unpuddled soil after either zero tillage or conservative tillage						
35	In **Dry- DSR, ability to** plant rice by dibbled method in a well prepared field.						
36	In **Dry- DSR, ability to** plant by drilling of seeds in rows after minimum tillage using a power tiller – operated seeder or raised						

	bed.						
37	In **Wet- DSR**, Ability to plant by sowing peregrinated seeds(radical 1-3 mm) on or into puddled soil						
38	Ability to identify an improved rice variety(stress-resistant variety, pest and disease-resistant rice varieties, early maturing rice varieties)						
39	**Mulching:** Ability to mulch with soil with straws, plastic and paper						
40	Micro-dosing: knowledgeable and ability to apply small and affordable quantities of fertilizer onto the seed at planting time, or a few weeks after emergence						
42	IPM(integrated pest management):Able to identify herbicides/pesticides application times , frequency and method of application,						
	Water smart mechanism						
45	Ability to harvest water during excess rainfall so as to fill the field when necessary						
46	**Ability to operate the AWD technique by**: recognizing when water level is below 15cm below the soil surface, before irrigation is applied						
47	By applying irrigation to about 2-5 cm above the surface						
48	Have knowledge and have skills in conventional						

	flooding, where the highest paddy rice is filled with water and water to flow to the lower paddies though levee gates						
49	Ability to operate multiple inlet irrigation(MIRI), where polypipes are laid along the length of the field to fill each paddy at the same time						
50	Ability to operate the drip irrigation system on the rice field						
51	Able to operate furrow irrigation which involves pumping water into trenches o furrows dug in between rows of crops						
52	Posses knowledge and skills in keeping the field flooded during flowering						
53	Ability to operate canal irrigation						
	Weather smart mechanism						
54	Ability to use of Decision support system (DSS) to get help						
55	Ability to get information from Climate information services (CIS)						
56	Able to get information from Index-based weather insurance and apply to farmers						
57	Digital agricultural technology: ability to source information through internet in applying in solving farmers' challenge						
58	Ability to use ICTs such as computers to solve solutions and phones to communicate information to farmers using						

59	Able to source for credits and loans or farmers from reliable institute.						
	Knowledge smart mechanism						
60	Ability to train farmers so as to train others						
61	Ability to provide farmers with information on off farm risk management kitchen garden.						
62	Ability to source for seeds from a reliable source for the farmers						
63	Ability to provide necessary market information to the farmers						

SECTION E: Dissemination methods used by the extension agents

S/N	Dissemination methods	Often used	Rarely used	Never used
	Individual contact methods			
1	Farm and home visits			
2	Office calls			
3	Telephone Calls			
4	Personal letter			
	Group Contact methods			
5	Result demonstrations			
6	Method demonstration			
7	Leader training meetings			
8	Lecturer meetings			
9	Conferences			
10	Discussion meetings			
11	Meetings at result demonstrations			
12	Tours (field trips)			
13	Schools			
14	Miscellaneous meetings			
	Mass Contact methods			
15	Leaflets			
16	New Stories			
17	Circular letters			
18	Radio			
19	Television			

20	Exhibits			
21	Posters			
22	Bulletin			
23	Campaign			
24	News paper			
25	Extension journals			
26	Newsletter			
27	Pamphlet			
28	Folders			
29	Drama			
30	Films			
31	Slide shows			

Section E: Participation of extension agents in disseminating CSA practices

S/N	Climate smart agricultural practices	Actively	Passively	Not at all
	Soil smart mechanism			
1.	Zero tillage			
3.	Minimum Tillage			
4.	planting of cover crops			
5.	Use of urea deep placement (UDP)			
6.	Agro-forestry			
7	Use of compost			
8	Seed priming			
9	Site-specific nutrient management (SSNM)			
10	Mulching			
	Crop smart mechanism			
11	Crop rotation			
12	Mixed cropping			
13	Changing cropping calendar			
14	Use of healthy young rice seedling			
15	Use of DSR (direct-seeded rice) method			
16	Application of manure and compost			
17	Planting of stress-resistant variety			
18	Planting of pest and disease-resistant rice varieties			
19	Planting early maturing rice varieties			
20	Micro-dosing			
21	Organic fertilizer			
22	Precision fertilizer			
23	**Water smart mechanism**			
24	Alternate-wet-and-dry (AWD) irrigation technique			
24	Water harvesting			

25	Drip irrigation technology			
26	Sandbags			
	Construction of water channels			
27	**Weather smart mechanism**			
28	Use of Decision support system (DSS)			
29	Use of Climate information services (CIS)			
30	Index-based weather insurance			
31	Digital agricultural technology			
32	Use of ICTs such as phones computers e.t.c			
	Seasonal weather forecast			
33	**Knowledge smart mechanism**			
34	Farmer to farmer learning			
35	Off farm risk management kitchen garden.			
36	Seeds and folder banks			
37	Market info			

SECTION F: Factors that influence effectiveness of extension agents

S/N	Factors affecting effectiveness	Yes	No
1.	Number of community covered		
2.	Level of education		
3.	Years of experience		
4.	Position of extension agents in organization		
5.	Gender		
6.	Age		
7.	Sources of information		
8.	Job location		
9.	Skills of CSA practices		
10.	Knowledge on CSA practices		
11.	Participation in training		
12.	Household size		
13.	Competency of the extension agents		
14.	Attitude of the extension agents		
15.	Numbers of farmers trained		
16.	Access to transportation		

SECTION G: Challenges/ constraints in dissemination of CSA practices

Perceived Challenges associated with the effective dissemination of CSA practices	Major challenge	Minor challenge	Not a challenge
Personal challenges			

Low interest in CSA practices among extension agents			
Complexity of extension messages			
Low Agents-Farmers ratio			
Gender imbalance between farmers and extension agents			
Non availability of some inputs			
Limited capacity to implement the techniques			
lack of regular promotion			
Inability to flow with the target population			
Lack of incentives for staff motivation			
Non-payment of allowance to field staff			
Institutional challenges			
Insufficient number of extension workers to provide services for large number of farmers			
Inadequate means of transportation			
Dearth of subject matter specialist			
Inadequate training programs for extension agents in CSA			
Inadequate technology			
Low institutional support for agricultural extension.			
Lack/ inadequate information from research institute			
Delay in providing working material for field demonstration.			
External challenges			
Certain techniques associated with sustainable land management can be incompatible with traditional practices (cultural beliefs)			
Poor funding of CSA practices by governments and non-governmental organizations			
Deep religion beliefs by the farmers			
Lack/inadequate transportation			

FOCUS GROUP GUIDE FOR KEY INFORMANTS

1. What are the roles played by your organization in improving extension practitioners' level of knowledge on CSA for their extension work?

....
....
....
....
....
....

2. Are there any agencies that train extension personnel on CSA practices?

....
....
....
....
....

3. How accessible and available are the CSA inputs/ materials for training by extension practitioners' in your organizations?

……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
………………………………………..

4. Give an overview of things that could limit the extension practitioners' to disseminate CSA to farmers

……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
…………………………………………

DEPARTMENT OF AGRICULTURAL EXTENSION AND RURAL DEVELOPMENT
FACULTY OF AGRICULTURE
LANDMARK UNIVERSITY
OMU ARAN,
KWARA STATE.

PROJECT TITLE**:** ***EFFECTIVENESS OF EXTENSION AGENT IN DISSEMINATING CLIMATE SMART AGRICULTURAL PRACTICES AMONG RICE FARMER IN NORTH CENTRAL, NIGERIA.***

NOTE: This questionnaire is designed to obtain information on the above topic, which is purely for academic/research purpose. All information supplied will be treated with absolute confidentiality.

Thanks for your anticipated cooperation.

QUESTIONNAIRE NUMBER : ………………………………………

DATE OF INTERVIEW: ……………………………………………….

L.G.A : …………………………………………………………………

NAME OF COMMUNITY: ……………………………………………..

INSTRUCTION: Please kindly tick ( ) as appropriate or fill in the gap where necessary

SECTION A: SOCIO - ECONOMIC CHARACTERISTICS

1. Age: ……..years
2. Sex: male { }, female { }
3. Marital status: single { }, married { }, divorced { }, separated { }.
4. Religion: Christians { }, Muslims { }, Traditionalists { } Others { }
5. Educational qualification: non-formal { } Primary { } Secondary { } Tertiary{ }.
6. Household size: ……………
7. Annual income on rice ………..
8. Farm size ……………
9. Farming system practiced…….. Low land rice farming ( ) Upland rice farming()
10. Occupation: Full time { }, Part time. { }
11. Years of experience ………
12. Numbers of contact with Extension agents in the last two years ……….

SECTION B: Effectiveness of Extension agents in disseminating CSA practices

S/N	Climate smart agricultural practices	Awareness		Knowledge acquisition				Uptake of technology			Knowledge sharing	
		I receive information	I don't receive information	Not at all	some part	almost all	whole	Yes	No	Adopted but discontinued	Yes	No
	Soil smart mechanism											
1.	Ripping zero tillage											
2.	Sub soiling/ minimum tillage											
3.	planting of cover crops											
4.	Use of urea deep placement (UDP)											
5.	Agro-forestry											
6.	Use of compost/ Organic fertilizer											
7	Mulching											

S/N	Climate smart agricultural practices	Awareness		Knowledge acquisition				Uptake of technology			Knowledge sharing	
	Soil smart mechanism	I receive information	I don’t receive information	Not at all	some part	almost all	whole	Yes	No		Yes	No
8.	Site-specific nutrient management (SSNM)											
9.	Micro-dosing											
	Crop smart mechanism											
10.	Crop rotation											
11.	Mixed cropping											
12.	Changing cropping calenders											
13.	Use of healthy young rice seedling											

S/N	Climate smart agricultural practices	Awareness		Knowledge acquisition				Uptake of technology			Knowledge sharing	
	Crop smart mechanism	I receive information	I don't receive information	Not at all	some part	almost all	whole	Yes	No		Yes	No
14.	Use of DSR (direct-seeded rice) method											
15.	Planting of stress-resistant variety											
16.	Planting of pest and disease-resistant rice varieties											
17.	Planting early maturing rice varieties											
18	IPM(integrated pest management) such as identifying application times, frequency, method, and appropriate pesticides mixing											

S/N	Climate smart agricultural practices	Awareness		Knowledge acquisition				Uptake of technology			Knowledge sharing	
	Water smart mechanism	I receive information	I don't receive information	Not at all	some part	almost all	whole	Yes	No		Yes	No
19	Alternate-wet-and-dry (AWD) irrigation technique											
20	Water harvesting											
21	Drip irrigation technology											
22	Sandbags											
23	Construction of water channels											
	Weather smart mechanism											
24	Use of Decision support system (DSS)											
25	Use of Climate information services (CIS)											

S/N	Climate smart agricultural practices	Awareness		Knowledge acquisition				Uptake of technology			Knowledge sharing	
	Weather smart mechanism	I receive information	I don't receive information	Not at all	some part	almost all	whole	Yes	No		Yes	No
26	Index-based weather insurance											
27	Digital agricultural technology											
28	Use of ICTs such as phones computers e.t.c											
29	Market information (market price)											