

**COMPETENCE NEEDS OF EXTENSION AGENTS FOR AGRICULTURAL
ADAPTATION TO CLIMATE CHANGE IN ANAMBRA STATE, NIGERIA**

MSc. RESEARCH FINDINGS

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DECEMBER, 2014

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**THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL
EXTENSION, FACULTY OF AGRICULTURE, UNIVERSITY OF
NIGERIA, NSUKKA IN PARTIAL FULFILLMENT OF THE AWARD
OF MASTERS OF SCIENCE IN AGRICULTURAL EXTENSION
(AGRICULTURAL EXTENSION ADMINISTRATION)**

DECEMBER, 2014

CERTIFICATION

ONWUATUDO, CHIZOBA RUFINA a postgraduate student in the Department of Agricultural Extension, University of Nigeria, Nsukka with registration number PG/M.Sc/10/52932 has satisfactorily completed requirements for the course and research work for the award of Degree of Masters of Science (M.Sc) in Agricultural Administration. The work embodied in this project is original and has not been in part or whole for the award of any diploma or degree in this or any university.

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(Project supervisor)

DATE

DEDICATION

This work is dedicated to Almighty God for his infinite mercy throughout this academic programme. Glory be to his holy name.

ACKNOWLEDGEMENT

My heartfelt gratitude goes to the Almighty God for his grace and unfailing love in my life throughout this programme. My profound gratitude goes to my supervisor Dr. (Mrs.) M.U. Dimelu for her guidance, immeasurable assistance and motherly advice throughout the period of this work. She largely chartered the course of this work and saw to its conclusive end. May God bless her abundantly.

My immense gratitude goes to my lovely and caring husband Mr. Christian Okenwa for his immeasurable care and assistance throughout this programme and my wonderful and blessed daughter Okenwa Chisom Anthonia for the favour she brought to me.

With sincere gratitude, I acknowledge my parents Sir & Lady R.A.C. Onwuatudo for their maximum supports and cares throughout the period of this research work and all my stay in the programme. I acknowledge my beloved brother and sisters Ebubechukwu, Chioma and Chiamaka for their cares and supports.

I wish to thank all the staff of the Department of Agricultural Extension; Prof. Madukwe, Prof. Igbokwe, Prof. Agwu, Prof. Onwubugha, Dr(Mrs. Dimelu), Dr (Mrs) Chah, Dr. (Mrs) Iwuchukwu, Dr. Olu, and many others for their encouragement and assistance. I acknowledge all the PG students, my friends and well wisher for their support and assistance. May God see you through in all endeavor. I thank and love you all. May God bless your life and endeavours. I remain grateful.

ABSTRACT

The overall purpose of the study was to determine the competence needs of extension agents for agricultural adaptation to climate change. Specifically, the study sought to ascertain the knowledge level of extension personnel on climate change; ascertain perceived roles of extension in agricultural adaptation; identify perceived competence needs of extension agents for agricultural adaptation; determine factors militating against competence building of extension agents for agricultural adaptation and identify the possible strategies to building competence of extension agents. The study tested the hypothesis that there is no significant relationship between personal/institutional characteristics and knowledge level of extension personnel on climate change and there is no significant relationship between personal factors and attitude of extension personnel to climate change. Data were collected using questionnaire administered to 93 extension personnel in the state Agricultural Development Programme. Data were presented with percentage and bar chart and analysed using mean score, standard deviation, factor analysis. The hypotheses were tested using logit model. Result of the study showed that 57.3% of extension personnel were females, while 43.0% were males. The mean age of the respondents was 45.2 years and 93.5% of the respondents were married. Majority (53.3%) of the personnel had B.Sc/HND, 33.7% had OND/NCE, while 13.0% had M.Sc. Majority (63.4%) of the respondents had high knowledge of climate change and favourable attitude ((93.5%)) towards climate change. The respondents perceived roles of extension in climate adaptation were conducting workshops, seminars for creating awareness/knowledge of climate change and adaptation (M=3.74), facilitating access to relevant information (M=3.54), carrying out demonstration for teaching farmers measures used to mitigate or adapt to the effect of climate change (M=3.45) and others. The respondents perceived communication (M=2.93), technical knowledge/skill/information on climate change (M=2.89), participatory extension strategies (M=2.81), use of information communication technology (M=2.72), facilitation (M=2.72) as major areas of competence needs of extension agents. The major constraints militating against competence building of extension agents for climate change adaptation include inadequate fund (M=3.80), inadequate knowledge and technology on climate change (M=3.70), lack of incentives/motivation of extension agents (M=3.64) and others. The position of the extension personnel in extension organization and year spent in the organization were significantly ($B = -5.844, p < 0.05$) ($B = 0.487, p < 0.05$) related to knowledge level of extension personnel, respectively. The study recommends that extension workers should possess mix of competence in the areas of subject matter, communication, ICTs and others for agricultural adaptation. The government should provide the needed infrastructure and funds to extension organization for training of extension personnel. Also there should be regular update of extension agents on climate change through in-house training underpinned by strong linkage and networking with research and other institutions.

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INTRODUCTION

1.1 Background information

Agriculture is a strong and efficient activity which plays pivotal roles in provision of food, fibre, fuel and income for human existence. It gainfully employs over 70% of the world's population and main source of income for rural households in developing countries (Chayal, Dhaka and Suwalka. 2010). Agriculture is an important sector of the Nigeria's economy because eighty percent of the rural dwellers depend on it as their major occupation, engaging in such activities as farming, hunting, fishing and livestock farming (Ekong, 2003). However in Nigeria, most of the agricultural production is rain fed. It depends highly on weather and climate in order to produce food and fiber necessary to sustain human life. Consequently, it is expected to be vulnerable to climate variability and change (Intergovernmental Panel on Climate Change (IPCC), 2007).

Climate change is defined as a change in the average climatic condition of a place. (Anyadike, 2009). It refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer) (IPCC, 2007). According to Seiz and Foppa (2007) in Ummnakwe (2011) climate change is the result of many factors including the dynamic processes of the earth, external forces including variations in sunlight intensity and more recently, human activities or anthropogenic factors. The most concern of anthropogenic factors are the increase in the carbon dioxide (CO₂), Chlorofluoro carbons (CFC), Methane (CH₄), nitrous oxide (N₂O), and water vapour level due to emissions from fossil fuels, cement manufacture, agriculture and deforestation (Steinfeld, 2006; Oyebade, 2009).

According to IPCC (2007), agriculture contributes significantly to climate change, primarily through the production and release of greenhouse gases (GHGs) such as carbon dioxide, methane and Nitrous oxide among others. Ebil (2000) in Okolo (2011) reported that it is responsible for approximately fifteen percent (15%) of all the greenhouse gas emission that help

to aggravate climate change. The ñSlash and Burnò practice associated with farming system of forest and savannah regions is blamed for its enormous contribution to the accumulation of carbon dioxide and nitrous oxide in the atmosphere which contribute to climate change (Cleaver, Kevin and Goetz, 1994 in Okoroh, 2011). Fertilizer also is a significant source of emission in the agricultural sector. Chemical fertilizers typically contain the CHC; N₂O and the application of fertilizer to vegetation leads to N₂O emission over a 100 years time span (United Nation Framework Convention on Climate Change (UNFCCC), 2007). Natural decay of waste water, crop waste (e.g.basgasse from sugar cane, empty palm fruit from oil production) and animal waste (e.g. from piggeries or cattle herds) can cause emission of the potent CHC methane (CH₄).

Globally, climate change has a lot of negative effect to life . It is considered as one of the serious threats to sustainable development, with the adverse impacts expected on the human health, food security, environment, and physical infrastructure (African-Wide Civil Society Climate Change Initiative for Policy Dialogues (ACCID), 2010). FAO (2009), reports that it alters the condition for food safety by increasing diseases on plants and animals. Due to increase in temperature caused by climate change, the oceans expand raising sea levels and reducing the amount of land available for agriculture (Devereux and Edwards 2004). Warmer oceans experience greater exploration resulting in higher rainfall which together with rising sea levels, contribute to erosion and flooding (McCarthy, Canziani, LelaryDokkemet *al.*, 2001; Lama and Derkota 2009). Many parts of Africa are suffering severe drought and floods which destroyed roads and buildings and wiped out millions of hectares of farmlands (Spores, 2008).

Climate change is projected to have significant impacts on conditions affecting agriculture, including temperature, carbon dioxide, gracial runoff, precipitation and the interaction of these elements (Yesuf, Difalce, Deressa, and Kohlin, 2008). It affects agriculture seriously through change in availability of water which leads to frequent floods and drought resulting in variability in crop yields in different ecological zones (IPCC, 2007). Adverse effect is also

expected from the likely rise in the distribution and intensity of existing pests, diseases, and weeds, due to higher temperatures and humidity (Tubiello, Soussana and Howden, 2007). In the long run, climate change could affect agriculture in several ways including productivity, in terms of quantity and quality of crops, agricultural practices and inputs, environmental effect like soil erosion and soil drainage (leaching), rural spaces (through loss and gain of cultivated lands) and adaptation in which organisms may become more or less competitive. This results to substantial decline in agricultural productivity, including labour-productivity, leading to increase in food insecurity, malnutrition, poverty and mortality rates (FAO, 2009).

As climate change is already here with us, threatening human life, food security, health and the environment, adaption to its effect is crucial for continued existence of humanity and increased resilience of the environment particularly in agrarian economy (e.g Nigeria). According to IPCC (2007), adaptation is the adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, to moderate harm or exploits beneficial opportunities. It refers to all those responses to climate change that may be used to reduce vulnerability or actions designed to take advantage of new opportunities that may arise as a result of climate change (Burton, Huq, Lim, Pilifosova and et al, 2002). Edoka (2012) refers to agricultural adaptation as adopting new farming practices, such as vermicomposting, to improve soil organic content, which is basic and essential in coping with and adapting to climate change. It is the actions taken by farmers to help them cope with the change or effects caused by climate change to reduce vulnerability on agriculture.

The need for adaptation to climate change presents a serious challenge to government, planners, managers, researchers, extension system, private organizations, communities etc. It calls for multi-stakeholders approach to measures, policies, strategies and competency building aimed at addressing climate change phenomenon. Adaptation to climate change requires building competency of all stakeholders in the agricultural sector particularly the extension professionals

and farmers. According to Ozor and Nnaji (2011), agricultural extension has a key role to play in changing the knowledge, attitude, resilience capacity and skills of the people (farmers) for efficient adaptation to climate change. As information brokers, educators and service provider to most vulnerable rural farmers, they occupy critical position in the forefront for agricultural adaptation to climate change.

Essentially, extension professionals play pivot role in disseminating useful information on climate change adaptation to farmers. To perform these duties properly, extension workers need to possess certain competencies. Thus, there is the need to address the competence needs for significant contribution to agricultural adaptation and resilience of farming communities to climate change.

The term competence is used to describe the job requirements that the individual needs to know or to have in order to perform a task required by a specific occupation (Winterton 2009). According to American Academy of Physician Assistants (AAPA), (2010), competence is the totality of knowledge, skills, attributes, behaviors and attitudes (or competencies), as well as, the ability to orchestrate these competencies into the full range of activities necessary for professional practice. In another words, it is the ability of an individual to perform a required task in their job.

Mulder (2001), states that continuing competence development is necessary for professionals. This is particularly true of agricultural extension agents due to the changing pattern of agricultural system caused by changing climate. Trede and Whitaker (2000) also reiterated the fact that agricultural extension professionals need to constantly develop and enhance their capabilities along with ongoing changes and challenges. Rapid changes in agricultural technology, in planning and delivery of educational programs, and the changing structure of the farming industry clearly indicate that agricultural extension instructors and trainers need to reassess their roles and responsibility in the planning and delivery of farmers's education (Koukel and

Cummings, 2002). It is an imperative particularly when there is a discrepancy between professionals' competence and the needs of their clients, hence the need for the study.

1.2 Problem statement

Climate change is seriously threatening rural communities and farmers. According to Agwu and Okimanhe (2009), evidence of the unpleasant impact of climate change abound in the southeast of Nigeria. These include increased cases of flooding and numerous gully erosion sites which have resulted to loss of farmlands, farmstead, economic trees and biodiversity. Higher rainfall observed in the southern part of the country coupled with sea-level rise also resulted to crop losses due to water logging, loss of arable land and increased pest infestation (Nigeria First Communication Commission (NFNC), 2003). Recently, there are cases of flooding which destroyed people's properties, buildings and lives in Anambra, Bayelsa, Delta and Kogi States of Nigeria. Nweke (2010) reports showed that Anambra State which is the study area is seriously affected by erosion and flooding due to climate change and there is low production of agricultural produce due to loss of nutrients. These resulted to numerous social problems such as forced migration, unemployment and poverty (Nweke, 2010). Building adaptation capability of farming communities in the state and Nigeria as a whole is therefore a formidable challenge.

According to International Food Policy Research Institute, farmers reported lack of information and knowledge of appropriate adaptation measures as barriers to adaptation (<http://www.ifpri.org>). In Nigeria, many farmers especially the illiterate farmers do not know what these changes are all about; they lack a precise and comprehensive understanding of climate change and this can lead to misconception and inability to adapt to the changes (Okolo, 2012). According to Okali, (2004) in Okoro (2012), Nigeria's high vulnerability to climate change is due to limited capacity to adapt which is attributed to low levels of awareness, financial resources, institutional and technological capability. The effectiveness with which farmers adapt to climate change significantly depends on how well it is understood by individual farmers. Ozor, Madukwe,

Onokala, Enete et al. (2010) opined that farmers' ability to effectively respond to climate change challenges is determined by the quality of information available to them and how easily they access the information. Unfortunately most farmers seem to lack the needed knowledge/information and resources for climate change adaptation. In south-east agro-ecological zone of Nigeria, Obiora, 2012 reported that there was no investment capability in terms of both equipment and human resource. In other words, farmers are not adequately positioned to tackle the negative impact of climate change.

The above scenario suggests gap in extension role for agricultural adaptation to climate change. According to Davis (2009), Extension should play crucial role in technologies and management of information, capacity development, facilitating and implementing policies and programmes aimed at building local capacity for adaptation. Extension is expected to facilitate generation of knowledge, building awareness, transfer knowledge/technologies and implement effective actions for management of risks (FAO, 2008). To perform these roles, there is need to develop relevant competence among extension personnel. Specifically, building competence of extension agents who are directly in contact with farmers and rural communities is an imperative. Therefore the pertinent questions are: what are the competence needs of extension agents for agricultural adaptation to climate change? What are the attitude and knowledge level of extension agents on climate change? What are the specific skills, knowledge, behaviour/attitude required in areas of competence needs? What strategies are appropriate for acquiring the needed competence by extension agents? What are the possible constraints to competency building of extension agents for agricultural adaptation to climate change?

1.3 Purpose of the study

The general purpose of the study was to determine the competence needs of extension agents for agricultural adaptation to climate change in Anambra state, Nigeria.

Specifically, the Objectives were to:

1. ascertain the knowledge level of extension personnel on climate change ;
2. ascertain the attitude of extension personnel to climate change;
3. ascertain perceived role of extension in agricultural adaptation to climate change;
4. identify perceived competence needs of extension agents for agricultural adaptation to climate change;
5. determine factors militating against competence building of extension agents on agricultural adaptation to climate change and
6. identify the possible strategies to building competence of extension agents;

1.4 Hypothesis of the study

1. There is no significant relationship between personal characteristics and knowledge level of extension personnel on climate change.
2. There is no significant relationship between personal factors and attitude of extension personnel to climate change.

1.5 Significance of the study

Climate change has significant effect on agriculture due to its dependent on climate. The farmers are vulnerable to changes associated with climate and extension agents have critical roles to ply, given their roles in agricultural development and direct contact with the farmers. The study will sensitize and increase awareness among extension professionals of their pivot role in addressing the problem of climate change. Information/findings on the specific skills, knowledge and attitude required by extension agents are useful to extension practitioners and administrators in developing training manuals, workshops or programmes for developing competences of extension agents for agricultural adaptation to climate change. Also results of the study will be useful to policy makers in formulating holistic and multi-stakeholder approach to capacity building for climate change adaptation in Nigeria. The study will also serve as a reference guide for further studies in the area and related areas of climate change.

2.0 LITERATURE REVIEW

Literature was reviewed under the following headings:

2.1 Concept of climate change

2.2 Interdependence of agriculture and climate change

2.3 Roles of extension in agricultural adaptation to climate change

2.4 Concept of competence

2.5 Concept of attitude

2.6 Areas of competence needs of extension agents for agricultural adaptation to climate change

2.7 Factors influencing competency of employees

2.1 Concept of climate change

Climate change has become a global issue in recent times manifesting in variations of different climate parameters including cloud cover, precipitation, temperature ranges, sea levels and vapour pressure (Ministry of Environment of the Federal Republic of Nigeria (MOE FRN), 2003). The variations in climate parameters affect different sectors of the economy such as agriculture, health, water resources, energy etc.

Climate change refers to any change in climate overtime, whether due to natural variability or as a result of human activity (Inter-governmental panel on climate change, IPCC, 2001). In Wikipedia, (2012), the most general definition of climate change is a change in the statistical properties of the climate system when considered over long periods of time, regardless of cause. It includes shifts in the frequency and magnitude of sporadic weather events as well as the slow continuous rise in global mean surface temperature (Enete, Madu, Mojekwu, Onyekuru, Onwubuya and Eze (2011)).

Climate change therefore is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. The earth's climate system has been demonstrated to change on global and regional scales since the preindustrial era, with some of these changes attributed to human activities. Emissions of greenhouse gases (GHGs) and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate (Enete et al, 2011).

2.1.2 Evidence/Indications of climate change

There is clear scientific evidence that high concentrations of greenhouse gases (GHGs) in the atmosphere, due to human activities, are intensifying the natural "greenhouse effect" thus increasing the Earth's temperature. Concentrations of GHGs, mainly carbon dioxide (CO₂), have increased by 70 % since 1970. (http://ec.europa.eu/agriculture/index_en.htm).

Globally the climate system is changing bringing about significant shift in known climatic pattern (Molua, 2002). He also stated that recently there have been increased earth's surface temperature, sea level rise, flooding, violent storms, long periods of drought, changing rainfall pattern and other weather related disaster.

The climate change trend has already had a significant influence on many physical and biological systems (water, habitats, health), which are becoming more fragile. Rainfall and snowfall have significantly increased in northern Europe, with floods becoming more common, while in southern Europe rainfall has fallen considerably and there are more frequent droughts (http://ec.europa.eu/agriculture/index_en.htm). Temperatures have become more extreme. Economic losses due to extreme weather events have increased greatly in recent decades.

There is a wide range of evidences which indicate that our climate is warming. These include:

1. **Global temperature rise:** The Earth has been warming since 1880. It has already increased by about 0.75°C globally, and by almost 1°C in Europe alone

(http://ec.europa.eu/clima/sites/campaign/index_en.htm). The 1990s were the warmest decade in the past 1,000 years (http://ec.europa.eu/clima/sites/campaign/index_en.htm), with the 20 warmest years having occurred since 1981 (<http://climate.nasa.gov/>). Current climate models predict an increase in average temperature in the region of 3 to 5°C over the next 100 years, with an increase in frequency of extremely hot periods and generally warm years (IPCC, 2007).

2. **Warming oceans:** Oceans have been absorbing more than 80 percent of the heat added to the atmosphere, with the top 700 metres of the ocean showing the greatest warming (<http://climate.nasa.gov/>).
3. **Sea level rise:** Since 1900, sea levels have risen by about 17 centimeters globally. Evidence shows the rate of sea level rise is increasing (<http://climate.nasa.gov/index.cfm>).
4. **Shrinking ice sheet:** The Greenland and Antarctic ice-sheets, which between them store the majority of the world's fresh water, have both started to shrink (IPCC, 2007).
5. **Declining Arctic sea-ice:** Arctic sea-ice has been declining since the late 1970s, reducing by about 0.6 million square kilometers per decade- an area around the size of Madagascar. Average Arctic temperature has also increased at almost twice the global average rate in the past 100 years (IPCC, 2007).
6. **Glacial retreat:** Glaciers are retreating almost everywhere around the world- including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa (<http://www.metoffice.gov.uk/climate-change/>). It is likely that 75 percent of the glaciers in the Swiss Alps will disappear by 2050 (http://ec.europa.eu/clima/sites/campaign/index_en.htm).
7. **Extreme events:** In the last decade, there were three times more weather-related natural catastrophes in the world than in the 1960s, including heat waves, floods, droughts and

forest fires (http://ec.europa.eu/clima/sites/campaign/index_en.htm). More intense and longer droughts have also been observed over wider areas since the 1970s, particularly in the tropics and subtropics (IPCC, 2007).

8. **Ocean acidification:** The carbon dioxide content of the Earth's oceans is increasing by about 2 billion tonnes per year. This has increased ocean acidity by about 30 percent (<http://climate.nasa.gov/index.cfm>).
9. **Wildlife behaviour:** Many species are changing their behaviour, from butterflies appearing earlier in the year to birds starting to change their migration patterns (<http://www.metoffice.gov.uk/climate-change/>).

According to Salami (2011), the effects of climate change have already been felt in many parts of Nigeria with the modifications of: intensity and seasonal nature of the rains, elevation of average annual temperatures and increased frequency of widespread, high impact weather phenomena including drought and flooding. According to Molua, (2002), climate change is already evident and capturing the attention of Nigeria because of two major processes. First, the revelations from the various scientific research studies have brought sufficient clarity to the process of climate change. Already research studies in Nigeria, show unusual weather patterns. Institutions such as the Nigerian Meteorological Agency (NIMET), the Centre for Energy Research and Development, Obafemi Awolowo University, Ife, Centre for Climate Change and Freshwater Resources, Federal University of Technology, Minna, and the Nigerian Environmental Study/Action Team (NEST), have in their studies collected evidence of changing weather patterns in Nigeria. The Nigeria's First National Communication under the United Nations Framework Convention on Climate Change project that the mean minimum temperatures will increase by 3oC to 5oC and sea level rise of about 1m, capable of submerging 75 % of the Niger Delta, is expected towards the end of the 21st century. Secondly is the

increasing frequency and magnitude of extreme weather-related events experienced all over the country such as floods, storms and drought which can no more be overlooked.

Experience from various parts of Nigeria reveals unprecedented violent storms destroying houses and other infrastructure, some that had withstood the vagaries of weather for several decades ago (Benhin, 2006). High temperatures have impacted on human health leading to increased cases of Cerebra-spinal meningitis in the arid part of the country (Tubiello et al. 2008). Also, along the coastal borders of the country are visible signs of coastal erosion on sides not covered by *Nypa* palm.

2.1.3 Causes of climate change

According to Seiz and Foppa (2007) climate change is the result of many factors including the dynamic processes of the earth itself, external forces including variations in sunlight intensity and more recently, human activities or anthropogenic factors. In Wikipedia, (2012) Climate change is caused by factors that include oceanic processes (such as oceanic circulation) variations in solar radiation received by earth, plate tectonics and volcanic eruptions and human-induced alterations of the natural world.

The main cause of climate change has been attributed to anthropogenic (human) activities. For example, the increased industrialization in the developed nations has led to the introduction of large quantities of greenhouse gases (GHGs), including carbon (IV) oxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) into the atmosphere. These GHGs are the primary causes of global warming (IPCC, 2007). These gases trap the terrestrial radiations from the earth and re-radiate the heat.

The most concern of the anthropogenic factors is the increase in the carbon dioxide (CO_2) level due to emissions from fossil fuels, combustion followed by aerosols, cement manufacture, ozone layer depletion, animal, agriculture and deforestation (Steinfeld, 2006). The global

increases in CO₂ concentration are primarily due to fossil fuel use and land use change, while those of CH₄ and N₂O are primarily due to agriculture (IPCC, 2007).

Carbon dioxide is produced when coal, oil, and natural gas (fossil fuels) are burnt to produce energy used for transportation, manufacturing, heating, cooling, electricity generation and other applications. Clearing of land for logging, ranching and agriculture also leads to carbon dioxide emissions (www.gcric.org). Fossil fuel currently accounts for 80-85% of carbon dioxide being added to the atmosphere while land use changes are responsible for 15-20 % (www.gcric.org).

Agriculture also contributes to climate change, producing significant effects through the production and release of GHGs in addition to the clearing of forests for agricultural production replacing forests with crops thereby reducing the rate at which carbon sequestration (trapping and absorbing carbon (IV) oxide gas) occurs. (www.gcric.org). It releases GHGs into the atmosphere, though on a smaller scale than other economic sectors. Agriculture hardly emits CO₂ – the most widespread GHG. In fact farmland holds large carbon reserves that help reduce CO₂ in the atmosphere. But still needs to address the double challenge of reducing its GHG emissions while adapting to the new climate conditions.

Agriculture is an important source of two powerful GHGs: nitrous oxide (N₂O) and methane (CH₄). (United Nation Framework Convention on Climate Change (UNFCCC), 2007). Nitrous oxide (N₂O) is released into the atmosphere from farmland, mainly due to microbial transformation of nitrogen fertilizers in soils. Emissions of N₂O represent over half of total agricultural emissions. CH₄ emissions come largely from the digestion processes of ruminant animals (mainly cows and sheep). Both CH₄ and N₂O emissions are produced from the storage and spreading of animal manure.

These greenhouse gases are relatively transparent to incoming solar radiation, allowing the sun's energy to pass through the atmosphere to the earth.

(<http://www.gcrio.org/ocp/ocp96/p30box.html>). The energy is then absorbed by the earth's surface, used in processes like photosynthesis or emitted back to space as infrared radiation. Some of the emitted radiation passes through the atmosphere and travels back to space but some are absorbed by greenhouse gas molecules and then re-emitted in all directions. The effect of this is to warm the earth's surface and the lower atmosphere which is known as greenhouse effect. Without the greenhouse effect, earth's average temperature would be -0.4°F (-18°C), rather than the present 59°F (15°C) a condition that would have made the world inhabitable (National Oceanic and Atmospheric Administration (NOAA) in <http://www.ciesin.columbia.edu>). Thus greenhouse effect occurs as a result of greenhouse gases trapping the sun's heat and keeping it close to the earth.

National Aeronautic and Space Administration (<http://www.climate.nasa.gov/index.cfm>) describe the greenhouse gases as follows:

1. Carbon dioxide (CO_2): It is a very important component of the atmosphere; carbon dioxide is released through natural processes such as respiration and volcanic eruptions and through human activities such as deforestation, land use changes, and burning of fossil fuels. Humans have increased atmospheric CO_2 concentration by a third since the Industrial Revolution began. This is the most important long-lived forcing of climate changes.
2. Methane (CH_4): It is a hydrocarbon gas produced both through natural sources and human activities, including the decomposition of waste in landfills, agriculture and especially rice cultivation, as well as ruminant digestion and manure management associated with domestic livestock. On a molecule for molecule basis, methane is a far more active greenhouse gas than carbon dioxide, but also one which is much less abundant in the atmosphere.

3. Nitrous oxide (N_2O): A powerful greenhouse gas produced by soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production and biomass burning.
4. Water vapour (H_2O): This is the most abundant greenhouse gas, but importantly, it acts as a feedback to the climate. Water vapour increases as the earth's atmosphere warms, but so does the possibility of cloud and precipitation, making these some of the most important feedback mechanisms to the greenhouse effect.
5. Chlorofluorocarbon (CFCs): Synthetic compounds of entirely industrial origin used in a number of applications, but now largely regulated in production and release to the atmosphere by international agreement for their ability to contribute to destruction of the ozone layer. They are also greenhouse gases.

Water vapour (H_2O) and carbon dioxide (CO_2) are the two largest contributors to the greenhouse effect; methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbon (CFCs) and other greenhouse gases are only in trace amounts, but can still have a powerful warming effect due to their heat-trapping abilities and their long residence time in the atmosphere (Rosenzweig and Solecki 2012). Poor forest management policies, including unrestricted logging, excessive harvesting of firewood and road construction also contribute to climate problem in recent times (www.gcric.org).

Apart from man, change in climate can be caused also by nature. Some of the natural causes of climate change are; variation in the sun's energy output which would vary the amount of solar radiation received by the earth's surface; volcanic eruptions when large volumes of sulphur dioxide (SO_2), water vapour, dust and ash are released into the atmosphere. Sulphur dioxide can combine with water to form tiny droplets of sulphuric acid (H_2SO_4) which fall as acid rains thereby acidifying the soil; ocean current- much of the heat

that escapes from the oceans is in the form of water vapour. This vapour later condenses in the clouds there by cooling the earth's surface (Edoka, 2012).

2.1.4 Effects/ Impacts of climate change

Climate change is now recognized as one of the most serious environmental, societal and economic challenges facing the world. Climate change affects many sectors. It is considered as one of the serious threats to sustainable development, with the adverse impacts expected on the human health through the spread of infectious disease like fever, malaria and sleeping sickness; food security by increasing the disease presence from vector, water and food-borne disease; environment and physical infrastructure (African-Wide Civil Society Climate Change Initiative for Policy Dialogues (ACCID), 2010). The result is the substantial decline in agricultural productivity, including labour-productivity, leading to increase in food insecurity, malnutrition, poverty and mortality rates (FAO, 2009).

Agriculture is one of the most exposed due to its dependence on weather conditions. Climatic variability year-by-year is one of the main causes of variability in crop yields and the inherent risks of farming (Ibrahim et al, 2010). Farming is thus in the front line of the battle against climate change impact.

Experts believe that even small amounts of global warming will reduce crop yields and trigger higher yield variability in low-latitude world regions (Molua, 2002). Negative effects on agricultural yields will be exacerbated by more frequent extreme weather events such as floods, heat waves and drought (Benhin, 2006). Smallholders and subsistence farmers will be particularly affected as they also have less capacity to adapt. This is expected to increase the risk of famine, particularly in the African continent.

The impacts of climate change on agriculture include the following:

Change in the availability of water

Most of the impacts of climate change on agriculture come through water (Intergovernmental Panel on Climate Change 2007). Water shortages have a major impact on agricultural production. Increased rainfall variability leads to frequent floods and drought resulting in variability in crop yields in different ecological zones. Drought conditions, brought about by lower amount of precipitation have several consequences on both crop and livestock production (Squires and Sidahmed 1998; Ibrahim et al, 2010). The effects on crops will be either direct or indirect or both. Decrease in rainfall resulting to drought, increases moisture stress on crops directly by increasing evapotranspiration as well as the atmospheric holding capacity for water vapour (Ibrahim et al, 2010). Indirectly, it increases temperature which has caused the breakdown of organic matter in soils, leading to lower levels of soil organic matter culminating in less soil moisture retention and additional crop moisture stress, which have effects on crop yields (Ibrahim et al, 2010). Crop yields suffer if dry period occur during critical developmental stages such as reproduction.

Livestock production, an important agricultural sector is vulnerable to climate change. A decrease in rainfall in the Sudan Savanna and the Sahel would reduce available pastureland, surface water resources and increase salinity at watering points because of increasing temperature and evaporation (Ibrahim et al, 2010). Drought diminishes rangeland productivity; it also adversely affects feed quality and species diversity (Benhin, 2006).

In the arid and semiarid zones, livestock density is above the potential carrying capacity most of the year and these are the area where desertification takes place (Benhin, 2006). The excessive heat due to warming in dry lands of Nigeria resulting from changing weather and climate also reduce the feed intake, feed conversion efficiency and weight gain of livestock (Ibrahim et al, 2010). The consequences of this are changes in milk and meat production and

reduced reproduction. This has a negative feedback in the economy when supplies of protein and hides and skin are reduced.

The warmer atmospheric temperatures observed over the past decades are expected to lead to a more vigorous hydrological cycle, including more extreme rainfall events. Erosion and soil degradation is more likely to occur; the increase in precipitations would probably result in greater risks of erosion and flooding (Fisher, Shah and van Velthuis, 2002 and Lama and Devkota 2009).

Infestation by pest, insect, diseases and weeds

Adverse impacts can also be expected from the likely rise in the distribution and intensity of existing pests, diseases, and weeds, due to higher temperatures and humidity (Tubello et al. 2008). The effect is likely to be highly regionalized. The increase in rainfall caused by climate change which leads to increase of atmospheric humidity, the duration of the wet season, and higher temperature could favour the development of insects and disease vectors (Chang, 2002 and Lama and Devkota, 2009). Higher temperatures provide a conducive environment for the majority of insect pests. Longer growing seasons, higher night temperatures and warmer winters help insect pests undergo multiple life-cycles and increase the chances of affecting plant production. In the long term projected climatic changes will affect the level and variability of crop yields and cultivation of several agricultural crops.

Rising sea level

Climate change expands oceans, raise sea levels reducing the amount of land available for agriculture. Sea temperatures are increasing, causing polar ice caps to melt, arctic ice flows to retreat and sea levels to rise. Warmer oceans experience greater evaporation resulting in higher rainfall, which together with sea levels contribute to coastal erosion and flooding (Lama and Devkota, 2009).

Rising seas contaminate coastal fresh water aquifers with salt water. Several small Island states are already having serious problems with water quality, which is affecting agriculture productivity (Bryant, Smit, Brklacich, John et al. 2000 and Arnell, Cannel, Hulme, Kovats *et al* 2002). Higher seas also make communities more vulnerable to storm surges which can be 5-6 meters high. The storm surge from cyclone Nargis travelled 35 kilometers inland, killing 140,000 people and flooding around 14,400km, an area one third the size of Switzerland; a rise in the sea level would result in an agricultural land loss due to flooding and salinization of surface water and ground water (Devereux and Edwards 2004). Rising sea levels in Nigerian coastal areas have led to cases of flooding of farms and homes, especially in Niger Delta region. This phenomenon has led people homeless and loss of Valuable properties (Ukudolo, 2010).

Increase in Temperature

Climate change leads to increase in annual temperature and rainfall (Baidya, Shrestha and Sheikh, 2008). According to the Intergovernmental Panel on Climate Change (IPCC) (2007), increase in greenhouse gas emission has been associated with an increase in the mean global temperature of 0.3⁰ C-0.6⁰ C since the late 19th century. By the end of the 21st century, according to IPCC, greenhouse gas emission could cause the mean global temperature to rise by another 1.4⁰ C ÷ 5.8⁰ C (Darwin, 2001). Greenhouse gases absorb energy radiated from Earth to space and warm the atmosphere. Longer growing seasons, higher night temperatures and warmer winters help insect pests undergo multiple life cycles and increase the chances of affecting plant production. Higher temperatures lead to heat stress for plants, increasing sterility and lowering overall productivity.

Higher temperatures also increase evaporation from plants and soils, increasing water requirements while lowering water availability (Kahanal, 2009). It affects both physical and chemical properties in the soil. When temperatures exceed the optimal level for biological processes, crops often respond negatively with a steep drop in net growth and yield. Heat stress

might affect the whole physiological development, maturation and finally yield of cultivated crops. As temperature increases, drought has some direct consequences for animal productivity (Mader and Davis, 2004 and Baidy et al). Increased thermal stress will reduce animal eating and grazing activity, increase the mortality of animals especially if kept in intensive livestock system. Drought may also reduce the productivity of grasslands such that they are no longer sufficient for livestock.

Changing season patterns

The changing climate results to change in growing seasons, shifting of ecological niches and rainfall becoming more unpredictable and unreliable both in its timing and its volume (Olsen, 2007). This leads to greater uncertainty and heightened risks for farmers, and potentially eroding the value of traditional agricultural knowledge such as when to plant particular crops (IPCC, 2007).

2.1.5 Climate change Adaptation

The concept of adaptation

According to Iglesias, Avis, Benzie, Fisher et al (2007), adaptation is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. It refers to all those agricultural responses to climate change that may be used to reduce vulnerability or actions designed to take advantage of new opportunities that may arise as a result of climate change (Burton, Huq, Lim, Pilifosova et al 2002). The IPCC, 2007 defines adaptation as having three possible objectives: to reduce exposure to risk of damage; to develop the capacity to cope with unavoidable damages; and to take advantage of new opportunities

Adaptation includes activities that are taken before impacts are observed (anticipatory) and after impacts have been felt (reactive). It can be 'autonomous' or 'spontaneous' in that the response is unplanned and happens unconsciously; 'planned' in that adaptation is the result of a

deliberate policy decision, (based on an awareness that conditions have or are about to change); or anticipatory (proactive), in that adaptation takes place before impacts are observed.

Emphasizing on the importance of adaptation, Eboh (2009) opined that even if efforts to reduce greenhouse gas (GHG) emissions are successful, it is no longer possible to avoid some degree of global warming and climate change. This is supported by Francesco (2008) which stated that as a result of greenhouse gases already in the atmosphere from past and current emissions, our planet is already committed to at least as much warming over the 21st century as it has experienced over the 20th century. This implies that in addition to mitigation practices being developed to combat climate change, adaptation to the anticipated climate change is essential. This fact is also made more explicit in Ozor and Nnaji (2011) which stated that while mitigation is necessary to reduce the rate and magnitude of climate change, adaptation is essential to reduce the damages from climate change that cannot be avoided. The Nigerian agricultural sector in the 21st century will therefore be facing dual significant challenges, arising from the need to increase the nation's food supply as well as adjusting to variation in climate.

Intergovernmental Panel on Climate Change (2007), in its Fourth Assessment Report, recognizes that some adaptation is occurring, but on a very limited basis, and affirms the need for extensive adaptation across nations and economic sectors to address impacts and reduce vulnerability using adaptation strategies. An adaptation strategy is a broad plan of action that is implemented through policies and measures. Adaptation strategies are not only reactions to posed threats of climate change, but can comprise at the same time a large number of technical, social, economic and environmental challenges (Olesen and Bindi, 2002). According to UNFCCC (2007) some of the adaptation strategies to climate include use of drought and disease resistant crops, afforestation and reforestation, early planting, protecting coastal zones, protecting natural resources and ecosystem e.g. forestry, protecting health, diversifying economic activities, disaster management, safeguarding water resources and establishing water reservoirs and

irrigation trenches. Farmers have always carried out adaptive changes to their businesses based on the weather and respond in the short-term by altering cropping patterns and management practices. However, this is unlikely to be enough to ensure that livelihoods can be sustained in the face of climate change.

Historically, new techniques have diffused through the industry, with innovative farmers being the first to introduce new techniques, and others adopting these approaches as they are seen to be successful (Olesen and Bindi, 2002). The changing climate will impact upon such a breadth of agricultural enterprises and associated sectors, and some of these changes may be extreme and relatively rapid, so that even the innovators may not be sufficiently responsive to adapt successfully without support. Therefore, some studies have considered that larger-scale, more permanent and structured proactive adaptations may be needed (Iglesias et al, 2007). For example, there may be a need for state-funded research to help drive change in breeding and cropping programmes, while the installation of new infrastructure may require financial support.

However, with a move away from agricultural support, the cost of most adaptive measures may have to be borne by farmers themselves. This is a great risk mainly on those farming on marginal land, where incomes are low. The risks are not just long-term; in the short-term, extreme weather events could cause major loss of income or increase in costs and lead, in turn, to more rapid abandonment of land (Iglesias et al, 2007). Adaptation is a major issue for maintaining incomes across rural communities.

Adaptation measures

According to Iglesias et al (2007), adaptation measures have been categorized into three types of adaptation options in the agriculture sector: management, technical/equipment and infrastructural. The type of measure will largely determine the extent to which farmers can adopt them without additional assistance. Farmers should be able to carry out some changes in management measures

without support. This will also be true, to a large extent, for technical measures, while infrastructural measures are likely to require significant capital investment. Some examples of this simple classification are given below:

1. Management measures

The choice of crop variety and pesticide are management decisions which farmers make every year. These decisions are based on information taken from a number of sources: agrochemical industry publications and representatives, government extension service advisers, discussions with other farmers and articles in the farming press; larger farmers may employ professional consultants to provide guidance. To a large extent, the market forces that have driven historic innovation and adaptation may continue to drive the adoption of new measures.

2. Technical/equipment measures

The distinction between technical/equipment and management measures are somewhat arbitrary, as technical understanding is needed to implement the management decisions. However, the introduction of new crops or livestock, together with the agrochemicals needed, may be considered technical since the husbandry requirements may be new to the farming community. The introduction of improved irrigation equipment may also be regarded as a technical measure. Advice may be needed from government agencies, as commercial firms may be slow to develop products in these areas, waiting instead to see if markets can be established before committing resources to product development and promulgation. Extensive breeding and testing programmes may be necessary to identify cultivars and breeds appropriate to changing local conditions.

3. Infrastructural measures

Infrastructural measures will vary greatly in scale and expense, but all will require an element of capital investment. The introduction of on-farm harvesting and storage of rainwater is one example of such a measure. A second example is the encouragement of farmers to effectively

manage flood plains. This is likely to need public support investment to provide incentives for them to relinquish current practices and adopt protective measures.

The fact that agriculture is practiced across a broad range of climates and environmental conditions makes it necessary for the country to develop an array of adaptation options that will meet the different conditions of the different ecological locations of the nation. Ifeanyi-Obi, Etuk and Jike-Wai, (2012) mentioned that a lot of adaptation options have been tried on the different areas of agriculture. Some yielded positive results while the effects of the rest are still being observed. Some of the generally used adaptation options include;

1. In livestock management, the common adaptation strategies employed by producers include;
 - a. modifying the time of grazing;
 - b. altering forage and animal species/breeds;
 - c. altering the integration within mixed livestock and crop systems including:
 - d. the use of adapted forage crops;
 - e. ensuring adequate water supplies and
 - f. the use of supplementary feeds and concentrate.
2. In crop production, a lot of cropping options are also available, these include:
 - a. altering of the timing or location of cropping activities;
 - b. improved water management through use of technologies to harvest water and conserve soil moisture (for example, through crop residue retention);
 - c. altering inputs such as crop varieties and species to those with more appropriate thermal time and vernalization;
 - d. diversifying livelihood strategy to include income from other farming and non-farming activities;

- e. improving the effectiveness of pest, disease and weed management practices through wider use of integrated pest and pathogen management, development and the use of varieties and species resistant to pests and diseases
- f. maintaining or improving quarantine capabilities and monitoring programs and
- g. using climate forecasting tools to reduce production risk.

These adaptation options/strategies must not be used in isolation, farmers can combine two options where necessary in order to achieve the desired result. The fact that agricultural practices are still climate sensitive and variations in climate may not be avoided in the nearest future. Building up adaptation strategies to cope with the varying climate becomes the most realistic option for farmers to employ in combating climate change risk.

Adaptation is, at least in part, a policy-driven process and information on options may reflect differing perceptions about the long-term future of the environment, economies and society. The capacity to adapt to environmental change is also implicit in the concept of sustainable development. While some adaptation options may initially seem costly, projections of the potential environmental and economic damages from climate change indicate the importance of investing in adaptation.

2.2 Interdependence of agriculture and climate change

Climate change and agriculture are interrelated processes, both of which take place on a global scale. Climate plays an important role in agriculture by setting up limits for crop production. The main climatic elements in agriculture are temperature, moisture, sunlight, wind and evaporation. Yesuf, et al (2008), projected climate change to have significant impacts on conditions affecting agriculture, including temperature, carbon dioxide, glacial run-off, precipitation and the interaction of these elements. These conditions determine the carrying capacity of the biosphere to produce enough food for human population and domesticated animals. According to Urama and Ozor (2011), global climate change adversely affects

agriculture through long-term alteration in weather patterns, especially increases in temperature and storm activity which are consequences of the greenhouse gas effects. Most crops are sensitive to episodes of high temperature. Air temperatures between 45 and 55°C that occur for at least 30 minutes directly damage crop leaves in most environments (Fitter and Hay, 1987; Ibrahim et al, 2010). It is as a result of variations in climate that certain crops perform well in some regions than the others. For instance in Nigeria, onion does not do well in the southern part of the country as in the northern part.

The change in climate may result in pest and disease out-break, degradation of soil and desert encroachment. It alters planting pattern, reduces yield of crops and animals, affect flowering periods of crops, gestation and reproduction in wide life (Akpa, et al, 2010).

Similarly, agriculture has been identified to produce significant effects on climate change, primarily through the production and release of greenhouse gasses (GHGs) such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) among other (IPCC, 2007). Agriculture also alters the earth's land cover, which can change its ability to absorb or reflect heat and light, thus contributing to radioactive forcing (Okoroh, 2010). According to the Intergovernmental Panel on climate change (IPCC) (2007), the three main causes of the increases in GHGs observed over the past 250 years have been fossil fuels, land use and agriculture.

Report produced by Organization for Economic Co-operation and Development (OECD) (2001) stated that agriculture contributes over 20% of global anthropogenic GHG emissions. Pans (2009) have rightly reiterated that agriculture affects atmosphere by releasing GHGs and gets affected in turn, from climate change. In addition to being a significant user of land and consumer of fossil fuel, agriculture contributes directly to GHG emissions through practices such as rice production and raising of livestock. Intergovernmental Panel on Climate Change (IPCC) (2007) asserted that, the agricultural sector contributes to GHG emissions through land use in four major ways:

1. carbon dioxide releases linked to deforestation
2. methane releases from irrigated paddy rice cultivation,
3. methane releases from enteric fermentation in cattle production, and
4. nitrous oxide releases from fertilizer application.

The production of agro-chemicals is an important source of GHG emissions, particularly fertilizer production which accounts for 0.6-1.2% of the world's total GHGs (Bellarby, Foereid, Hasting and Smith, 2008). Synthetic fertilizers, pesticides and herbicides are made from non-renewable raw materials such as mineral oil and natural gas or from minerals that are depleting such as phosphate and potassium; a substantial portion of these chemical residues end up in the environment, causing pollution and biodiversity decline (Znaor, Morrison, Pretty and Todorovic, 2005). Pimentel (2005) asserted that the intensification in the use of pesticides has resulted in pesticide resistance in pest and adverse effects to beneficial natural predators and parasites.

2.3 Concept of Attitude

The concept of attitude arises from attempts to account for observed regularities in the [behaviour](#) of individual persons. For example, one tends to group others into common classes (i.e., all of the people in this room are wearing basketball uniforms). One also classifies objects such as paintings or events such as battles.

An attitude is the psychological response to a person, an object, to a situation, to society and to life itself that generally influence our behaviors and actions. Attitudes are either positive or negative. In social psychology, attitude is the belief, perception and judgment that reflects the classification and evaluation of persons, objects, situations, with a like or dislike label. Attitudes are inferred; they are not objectively observable, though they are manifested in conscious experience, verbal reports, overt behavior and physiological indicators.

The quality of one's attitudes is judged from the observable, evaluative responses that are made. While one might consult one's inner experiences as evidence of one's own attitudes, only public behaviour can receive objective study. For this reason investigators rely heavily on behavioral indexes of attitudes— e.g., on what people say, on how they respond to questionnaires, or on such physiological signs as changes in heart rate.

Some investigators account attitudes for observed regularities in the behavior of individual persons towards persons, events presenting the same characteristics. To another group of investigators, attitudes correlate with your values. For example, a person who highly values justice and the person categorize politicians as interfering with justice, the person's attitude is taken to be negative. They formed by our judgments or evaluations of people, society, objects, events and occurrences etcé based on our values and beliefs. These beliefs include our beliefs in our ourself and in life or our belief in the future.

However our attitudes are not always dictated by our values and beliefs. Other factors in a given situation may influence our behavior. We can also have different attitudes towards the same thing depending on whom we are dealing with, the actual context of an exchange or an event or occurrence. For example, I may not enjoy Rap music, but I go to a rap concert because my daughter loves rap music and wants me to accompany her to a rap concert. So my non-appreciation of rap music did not influence my decision. They can also be ambivalent, that is you feel both positive and negative attitudes towards the same thing at the same time.

The different components of attitude formation

Attitudes, according to psychology, is a three component construct which is known as the ABC (Van Den Berg et al., 2006; Eagly and Chaiken, 1998)

A-is the affective, or emotional component that will influence our behavior, whether we feel good or bad or ambivalent.

B-is the typical behavioral tendency of a person

C-is the cognitive evaluation or belief of a person, based on what that person learnt from experience or observations.

2.4 Roles of extension professionals in Agricultural adaptation to climate change

Agricultural extension is a comprehensive programme of services deliberately put in place for expanding, strengthening and empowering the capacity of the present and prospective farmers, farm families, other rural economic operators (processors, marketers, rural agro-industrialists, farm managers, farm labour force etc), farmers associations and communities entrepreneurial, managerial and communication skills that they need to succeed in farming and farm related occupations (Adedoyin, 2002). According to Leeuwis (2006), it is a series of embedded communicative interventions that are meant, among other things, to develop and/or induce innovations which supposedly help to resolve (usually multi-actor) problematic situations.

Extension professionals therefore, are the people involved in carrying out extension activities. According to Ozor and Nnaji (2011), they include extension agents, block extension agents, block extension supervisors, subject matter specialists, zonal extension officers, zonal managers, directors of extension services, directors of rural institutions development, and the programme managers of agricultural extension agencies such as the Agricultural Development Programmes (ADPs). Ajieh et al (2008) categorized them as follows; Programme manager (PM), Extension agents (EAs), Block extension agents (BEAs), Block extension supervisors (BESs), Subject matter specialists (SMSs), Zonal extension officers (ZEOs), Zonal managers (ZMs), Directors of sub-programmes and Heads of component programmes.

The roles of these extension professionals are the things, functions and duties which they perform for the development of agriculture. According to Onwubuya (2011) the roles of extension professionals are:

1. Dissemination of useful information needed by the farmers to them.
2. Assisting farmers determine their problems, helping them find desirable solution and encourage them to take action.
3. Helping the farmers gain managerial skills on their farm like how to handle inputs and output and
4. Putting the farmers in a frame of mind to adopt the innovation.

In agricultural adaptation to climate change, the perceived roles of extension according to Ozor and Nnaji (2011) include;

1. Re-training its staff to acquire the capability (knowledge and skills) in managing the risks that climate change poses especially in rural areas where the greater part of agricultural activities take place. The retraining program will mostly involve staff who are directly in contact with farmers and those that supervise and manage them. They will include extension agents, block extension agents, block extension supervisors, subject matter specialists, zonal extension officers, zonal managers, directors of extension services, directors of rural institutions development, and the programme managers of agricultural extension agencies such as the agricultural development programmes (ADPs).
2. Establishing emergency management units within every extension agency that will be trained to take charge of victims of disasters emanating from climate change risks such as flooding, erosion, acid rains, drought, submergence and poisoning from agricultural chemicals (insecticides, pesticides, herbicides, fertilizers, etc). The role of extension in emergency management is advocated because they work very closely and live with the

rural farmers and can provide at least the best first aid assistance before the arrival of experts. It therefore makes it important for extension to be linked to the state emergency services, health workers, and the police.

3. The primary role of extension is in the dissemination of innovations to targeted clientele ranging from farmers, pastoralists, fisher-folks, hunters, foresters, wine-tappers and other rural residents who depend on agriculture in one way or the other. Therefore, it behooves on extension to disseminate the best practices and innovations currently being developed by numerous research efforts across the globe on how to boost the adaptive capacity and resilience of vulnerable people to the effects of climate change.
4. Another significant role of extension in agricultural adaptation to climate change is its feedback role to government and other interested agencies on climate change issues. Extension agents live and work with the people in rural areas. This affords them the opportunity to be knowledgeable on issues that border on climate change in their areas of coverage. During the fortnightly meetings (FNTs) and block meetings (BMs), extension agents are expected to give situation reports on their duty stations. From this, government and non-governmental bodies can become aware of climate risk situations in the rural areas and then be able to render assistance, make policies, or execute programmes to manage the challenges identified by agents.
5. Other significant roles of extension in agricultural adaptation to climate change border on the use of groups to achieve wide scale adoption of innovations. Areas identified include organizing seminars, conferences, field days and workshops; use of farmer field schools, use of farmer to farmer extension strategy; and the use of young farmers club.
6. Use of demonstration methods in teaching farmers the measures used to mitigate or adapt to the effects of climate change.

7. Use of farmer-to-farmer extension strategy to promote awareness and adoption of best practices in climate risk management.
8. 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.
9. 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 and
10. Use of farmer field schools (FFS) to promote faster learning of measures used to mitigate and adapt to the effects of climate change by farmers.

2.5 Concept of competence

Meanings of competence vary widely, depending largely on the perspective and ideological viewpoints involved and on the underlying objectives associated with the use of the term, both in scientific discussion and in the policy realm. According to Weinert, (2001), the term 'competence' is used to refer both to high-achieving individuals and successful social groups that master specific tasks and reach important goals, it is always concerned with the necessary learning dispositions that are acquired by individuals and/or the members of social groups and that must be used to solve demanding problems. Dominique and Laura (2002), define competence as the ability to meet a complex demand successfully or carry out a complex activity or task. In this definition, competence is taken as ability to provide external results. The concept of competence is used to refer to the necessary or desirable prerequisites required to fulfill the demands of a particular professional position, of a social role, or a personal project. The focus is on what the individual achieves in results, in an action, or in a way of behaving. Competence is the general capability of persons or organisations to perform an activity, a task, solve a problem and if the programme is successfully completed, the candidate receives a license (Mulder, 2007).

The most common definition of professional competence used today is Epstein and Hundert's which defines it as "the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and community being served." (American Academy of Physician Assistants (AAPA), 2010).

According to Herringer's (2002) competence can be defined as the ability of an individual to perform a task using his/her knowledge, education, skills, and experience. It is the application of knowledge, technical skills, and personal characteristics leading to outstanding performance (Stone and Bieber, 1997).

Core competencies are defined as the basic knowledge, attitudes, skills and behaviors that contribute to excellence in Extension education programs (Cooper Graham, 2001). Competences consist of:

1. **Knowledge and intellectual skills** (theories, classifications, etc.) which may also be divided;
 - a. General knowledge, related to the overall learning experience
 - b Academic knowledge related to a certain subject
 - c. Professional knowledge
2. **Abilities and transferable skills** (organizing, manipulating, designing, etc.), where we find:
 - a) Intellectual skills
 - b) Communication skills
 - c) Interpersonal skills
 - d) Personal organization and management skills
3. **Attitudes and values** (responsibility, independence, initiative), divided into:
 - a. Attitudes and values for professional development

b. Attitudes and values related to personal engagement

A competence is more than just knowledge and skills. It involves the ability to meet complex demands, by drawing on and mobilizing psychosocial resources (including skills and attitudes) in a particular context. For example, the ability to communicate effectively is a competence that may draw on an individual's knowledge of language, skills and attitudes towards those with whom he or she is communicating (Organisation for Economic Co-operation and Development (OECD), 2005).

The distinction between 'competence' and 'competency' should be made, as the terms are often used interchangeably. They are not necessarily synonymous though they may sound similar. Competence refers to a potential ability and/or a capability to function in a given situation while competency focuses on one's actual performance in a situation (Kathryn, 2008). This means that competence is required before one can expect to achieve competency. Thus, competence makes one capable of fulfilling his/her job responsibilities. Competency is determined by comparing current work functioning with established performance standards developed in the work environment according to a specific role and setting.

Webster's dictionary defines a 'competency' as an 'ability or fitness.' A competency is a single skill or function, yet it includes the underlying knowledge, abilities and attitudes necessary for optimal performance. It must be performed to a specific standard under specific conditions. A competency is usually written as a broad composite statement detailing an observable set of behaviors reflecting components of knowledge, skills and attitudes. Competence, on the other hand, is more expansive and all encompassing. It represents the *totality* of knowledge, skills, attributes, behaviors and attitudes (or competencies), as well as, the ability to orchestrate these competencies into the full range of activities necessary for professional practice. Competence also implies a minimum level of proficiency or threshold in performance (AAPA, 2010).

Approaches to the concept of competence

There are various approaches and definitions of the concept of competence since the middle of the last century (Wesselink, Biemans, Van den Elsen, et al, 2005). These include: the behaviourist, the generic and the cognitive.

The *behaviourist approach* stresses the importance of observing successful and effective job performers and determining what differentiates them from their less successful counterparts.

McClelland's competency approach advocated the use of the concept of competence, rather than the concept of intelligence, in testing and showed how to identify competencies by means of behavioural-event interviews (Mulder, Weigel and Collins, 2006). According to the author, competencies in this respect are acquired through training and development and competence is based on the description of observable behaviour or performance in situ.

The definitive characteristics of the behavioural approach are demonstration, observation and assessment of behaviour. Competencies are thus the characteristics of a person that are related to superior performance in a job and can be common across situations (Delamare and Winterton, 2005).

The *generic approach* is aimed more at identifying the common abilities that explain variations in performance (Mulder, Weigel and Collins, 2006). Again, in this approach, the most effective performers and their distinguishing characteristics are identified. Then, through statistical analysis, the main and generic characteristics of top performers are defined. Competencies determined in this way can be applied to different professional groups. Gonczi et al (2005) confirmed the diverse forms that generic competencies could take depending on the workplaces context.

Hager (2000) highlights two crucial features of generic competencies: firstly they serve to direct attention onto broader approaches to competence, and secondly, they are sensitive to work context changes. Competence, in this sense, is 'more about framing an overall performance that

is appropriate to a particular context. It is not about following simplistic recipes (Hager, 2000). According to Mulder, Weigel and Collins, (2006), research into the big five personality dimensions, first elaborated to explain the variations in job performance, as well as the research on generic and basic skills in the field of curriculum development are good illustrations of the generic approach.

The definition of competence in the *cognitive approach* includes all of the mental resources of individuals that are used to master tasks, acquire knowledge and achieve a good performance (Weinert, 2001). It is often used simultaneously with intelligence or intellectual abilities. The classical cognitive approaches focusing on general cognitive competencies include psychometric models of human intelligence, information processing models and the Piagetian model of cognitive development (Mulder, Weigel and Collins, 2006). A more narrow interpretation of this cognitive approach focuses on specialized cognitive competencies. These specialized competencies refer to a cluster of cognitive prerequisites that individuals must possess to perform well in a special area. Another interpretation of the cognitive approach is to differentiate competence and performance; first stressed by Chomsky (2000). He defined linguistic competence as an ability to acquire the mother tongue; it is rule-based language learning and language use which is necessary for linguistic performance.

2.5.1 Competence and Extension Work

Wisconsin Cooperative Extension (2002) defined competence as having sufficient knowledge, attitudes and skills that can contribute to excellence in extension education programmes. Therefore, competence is a sufficient quantity of knowledge, skill and ability to accomplish a particular task or purpose. Mitchell (2002) advised each extension professional to possess personal strengths, capabilities as an educator, capabilities in information technology and expertise in their academic specialty. The author asserted that, employees are the most valuable assets of the extension system and to enhance the competence of extension professional, training

opportunities that are focused on areas relating to competence needs should be stressed. A competence assessment is designed to evaluate individual knowledge, education skills, experience and proficiency to perform those assigned responsibilities.

There have been attempts to develop competency profiles for extension professionals before. Shim (2005) reviewed these and developed a competency profile for the consultancy role of extension professionals in Korea. This is especially interesting because of the fact that many extension services have been or are being privatised. Chizari and Mirikhoozani in Karbasioun, (2011) and Mulder and Biemans (2007) concluded that in general more Human Resource Development (HRD) professionals, and more specifically, more agricultural extension professionals are needed, and they need to become more competent to be able to effectively contribute to performance improvement of the agro-food sector. Supporting this idea, Mulder (2001) stated that at present, human resource development (HRD) professionals are required to have a broad perspective and to address multidimensional client needs.

Extension, as a profession, requires professional competencies as well as high level of professional performance. Agents with abilities to perform effectively in the professional task in extension education are the best desired. Extension workers most constantly are involved in continuous programme of personal development and professional improvement (Okwoche, Ejemba and Obinna, 2011).

2.5.2 Areas of Competence Needs of Extension Agents for Agricultural Adaptation to Climate Change

Agricultural extension has been defined as a series of embedded communicative interventions which supposedly help to resolve problematic situations (Leeuwis, 2006). This definition confers to agricultural extension the mandate to accommodate the issue of climate change in its duties (Ozor, 2009). Capacity development is important within extension. Extension agents have traditionally been trained only in technical expertise and often lack soft skills such as

communication, development of farmer groups, systems thinking, knowledge management, and networking (Davis, 2009). To improve extension competence and outcomes in rural development, farmers and extension agents need new skills that will require agricultural education and extension curriculums to include valuing and understanding the knowledge and experiences of rural people and co-learning (that is, farmers and extension agents learning together rather than extension agents training farmers in a one-way, information transfer).

However, in order to achieve results, there are areas of competence needs of extension agents to perform the duties to achieve the needed adaptation to climate change. These areas include;

1. Information management and communication

The issue of creating awareness on issues of climate change- its effects and adaptation options available to farmers is very important. Studies have shown that the level of awareness on issues of climate change is still low (Nzeadibe et. al. 2010 and Nzeh and Eboh 2010). There is a need for massive awareness to be created in all regions of the country on issues concerning climate change. This will in no small measure help farmers to be alert as well equip themselves to combat issues of climate change.

Extension traditionally plays a role in providing information and promoting new technologies or new ways of managing crops and farms. There is need for competence in this by extension agents. There is a great need for simple information management and technology in order to increase effective dissemination information on climate change by extension to farmers.

Today's farmers need to quickly respond to climate change and manage risk. This is especially challenging for extension in terms of knowledge and information systems. Farmers need to have access to information— be it climatic information, forecasts, adaptive technology innovations, or markets— through extension and information systems (Anyadike, 2009). Extension agents can introduce locally appropriate technologies and management techniques that enable farmers to adapt to climate change by, for example, disseminating local cultivars of drought-resistant crop

varieties with information about the crops. Additionally, extension staff can share with farmers their knowledge of cropping and management systems that are resilient to changing climate conditions such as intercropping, sequential cropping, and no-till agriculture (Davis, 2009). Some of these practices have the added advantage of improved natural resource management. It is important to provide farmers with information about how the various options will potentially increase income and yields, protect household food security, improve soils, enhance sustainability, and generally help to alleviate the effects of climate change. At the same time, extension staff can play an important role in transferring indigenous technical knowledge to help farmers worldwide.

A core challenge for extension in the future is to shift from providing “packages” of technological and management advice to, instead, supporting farmers with the skills they need to choose the best option to deal with the climate uncertainty and variability (Mustapha, Undiandeye and Gwary 2012). Farmers also need access to new technologies and management options in those areas where climate change renders their current farming systems unviable. This can only be done by proper transfer of information on those new technology and management by extension agents. Extension is responsible for providing information using techniques ranging from flyers and radio messages to field demonstrations (Davis, 2009; Anyadike, 2009).

Communication i.e. the interaction of the extension agent with the farmer (or group of farmers) (verbal, non-verbal, written and mass communication) is the vehicle through which extension takes place. The extension agent must be able and confident to exchange information and ideas in a clear and concise manner appropriate to the audience in order to explain, persuade, convince and influence others to achieve the desired outcomes. In communication, the EA should have; interpersonal communication skill, mass communication, information conveyance skill etc. The extension should be able to make use Information Communication Technology (ICT) in communicating to the farmers. This will help the EAs source for new information and equally communicate with their clientele effectively and faster.

2. Extension Education/Strategies

One of the extension's major activities over time has been adult and non-formal education. This role continues today and is even more important in light of the changing climate. Recent innovative extension activities include the adult education and experiential learning approaches utilized in farmer field schools, an extension and education approach already working with farmers on issues of climate change.

Climate change will initiate extreme events like sudden onset disasters and new vectors of human and livestock diseases. Evidence is emerging that the biggest impacts is in the form of small droughts, floods, and other events that cause severe hardship but do not attract the attention of the international community. The capacity of farmers to cope with such different forms of risk becomes ever more crucial, and extension efforts must pay special attention to educating farmers about their options to enhance resilience and response capacity (IPCC, 2007). There is a need for capacities to engage new sets of actors, including humanitarian agencies. Extension education/strategy must thus move beyond technical training to enhance farmers's abilities for planning, problem solving, critical thinking, and prioritizing, negotiating, building consensus and leadership skills, working with multiple stakeholders, and, finally, being proactive. This thereby builds the capacity development of the farmers.

In extension education/strategy, there is the use of extension methods. Competence of extension agents on this while educating the farmers, improves climate change adaptation by farmers.

3. Linkage/Networking

Another area of competence need of extension, which will be critical for climate change adaptation, is that of bringing together different actors within the rural sector. There is a need to encourage creation of linkages and development of partnerships between the government and other actors in climate change issues.

Traditionally this means linking farmers to transport agents, markets, and inputs suppliers, among others (Davis, 2009). With climate change, it will be increasingly important for extension system to link farmers and other people in rural communities directly with private and public institutions that disseminate adaptation technologies, and funding programs for adaptation investments. Increased access to meteorological information will be imperative.

Extension also has an enormous challenge in bringing together farmers's concerns and those of other actors as they address both climatic and market uncertainties together. Extension has the chance to make a significant contribution to overcoming this gap through enhanced farmer decision making. Extension agents may also play a role in assisting farmers in implementing policies and programs that deal with climate change adaptation. For instance, extension agents could be employed to educate farmers in their area; assist in forming community groups; link farmers to governmental, nongovernmental, and private organizations at the national and international levels; and perhaps assist with proposal preparation or negotiations with other players.

The extension agents also link the farmers with the researchers which help reduce the idea of duplicating efforts and loss of information. Farmers, extension agents, and researchers must work together on farmers's fields to prioritize, test, and promote new crop varieties and management techniques (Davis, 2009; Ozor, 2011).

4. Technical knowledge and skills

Technical support (technical knowledge and skills) is an important extension principle that underlies an effective extension approach. According to the Agricultural Extension Landscape and the Upstream Concept as described by Terblanché (2008), knowledge (agricultural subject matter) is a prerequisite and therefore a qualification. At least one field of technical agriculture is a necessity for the Extensionist. If the Extensionist wants to be successful he/she must be able to communicate in agriculture (i.e. a technical agricultural message is essential). What is expected

today is that every extension agent must be an expert in at least one field of technical agriculture. To be successful the extension agent must be technically empowered in agriculture to deliver a service of excellence. The extension agent must have the knowledge and skills to plan a farm physically, biologically and economically, as well as the skills to adapt and transform the technical message to be applicable (and sustainable) to the specific farm and farmer.

Extension agents need technical knowledge and skills on climate change for effective dissemination of climate change information and proper education to the farmers. This can be achieved through appropriate training on climate change. Training on causes, effects/impacts, adaptation and mitigation of climate change. This develops the capacity of the EAs on climate change adaptation.

Extension agents as well as the entire staff of extension service need to be trained on issues of climate change. This will no doubt help them acquire the needed knowledge that will enable them help farmers and rural people to adapt to the variations in climate. In-depth knowledge of climate change, its effect and adaptation strategies relevant and available for farmers and rural people need to be well understood by the extensionists in order to be able to help the farmers and rural people adapt to the changing climate situation. Technologies that help the farmers/rural dwellers to mitigate as well as adapt to climate change need to be identified and brought to their knowledge (feanyi-obi, Etuk and Jike-wai, 2012). Pests and disease resistant crop and animal species need to be also identified and brought to their knowledge.

5. Community/Group mobilization skill

According to Stevens and Terblanché (2006) effective farmer groups are a prerequisite for accelerated agricultural development. Effective farmer groups are the ñvehicleò working collectively towards change at farm level and can help with the farmersò empowerment. There is the need to mobilize people to form group of it encourages faster implementation of the innovation being transferred. This suggests that the quality of facilitation and the attention

required to the social processes of group development are crucial for sustainable agricultural development.

1. Group facilitation in the Extension Landscape as described by Terblanché (2008) includes the following:

2. Group dynamics and theories;
3. Group forming and utilization;
4. Facilitation methods and techniques;
5. Leadership and leadership development; and
6. Adult education.

7. Effective negotiation and conflict resolution skills are often decisive to ensure successful group functioning.

Other areas of competence needs of extension agents include;

- a. Use of Information Communication Technology (ICTs)
- b. Documentation of indigenous knowledge and
- c. Facilitation

2.6 Factors influencing competence of employees

Le Boterf, (2000), stated that competence of employees is affected by the following:

1. Personal resources: (knowledge, abilities, qualities, experiences, cognitive capacities, emotional resources etc.). He draws four elements from the individual personality:
 - Knowledge: This includes: Theoretical knowledge, (understanding a phenomenon, objectives, situation, an organization or a process). Environmental knowledge, (the context, comprising knowledge regarding systems, processes, materials and products, strategies, organizational structure and culture, etc.). Procedural knowledge (Knowing how an action must be conducted; it involves procedures, methods, adequate operational modes and a set of actions performed in an established order).

- Know-how: This includes: Formalized know-how (how to use procedural knowledge). Empirical know-how (learning from practical experiences which require sight, discernment, reflexes, intuition, sensitivity, etc.). Cognitive know-how (the intellectual operations necessary for the formulation, analysis and resolution of problems, conceiving and conducting projects, decision making, creation, invention, generalization, analogical reasoning, etc) which is very similar to what Zarifi (1999) described when defining competency. Å Aptitude or quality: related to knowing-how-to-be, and referred to as behavioural competencies; such as abilities in relationships, flexibility, pro-activity, etc.
- Emotional and physiological resources: related to knowing how to control emotional reactions which in the end may help in avoiding obstacles and risks or may give an advantage in solving a problem.
- Environmental resources: as stated by Le Boterf (2000) includes technology, databases, books, relationships, networks. In this sense, the individual can recognize those areas that need to be developed in order to improve their personal resources that will help him/her to perform in a more competent way.

Mazin, (2012) identify variety of factors that affects employees' competence/performance in an organization. These include:

1. Personal factors e.g. knowledge, education, qualification, experience, training, physical fitness etc.
2. Company-based factors e.g. motivation, rewards, funding, administration and management and
3. External factors e.g. environment, family and emotions

Constraints to building competence of extension employees

Building competence of employees is crucial for the performance of an organization to achieve its goal to the best. In building the competence, there are lots of constraints hindering its attainments. Some of these constraints according to Edoka (2012) are:

- ✓ ***Inadequate Funding:*** Employees require adequate funding to ensure successful performance of the organization (Agbam, 2011). Finance is needed to get the needed things to train the workers. For e.g. in extension, finance is needed to purchase extension teaching aids such audio-visual and other communication-related facilities for training extension agents and in turn the farmers, provision of transport facilities to field workers and to pay salaries and allowances of staff in the service.

In the country, extension outfit is grossly underfunded due to the withdrawal of World Bank assistance for funding Agricultural Development Project (ADP). Zaria in Ogunbameru (2005) asserted that the agricultural extension service has been experiencing dwindling funding from government.

The reluctant effect of poor funding are mass retrenchment of field extension workers, high staff mobility, poor/inadequate training, stagnation of both field and supervisory work, low morale of staff and invariably decreased agricultural production, among others. Due to this inadequate funding, implementing of most of the agricultural adaptation to climate change becomes difficult as extension personnel tend to be reluctant to carry out their duties effectively, thereby exposing farmers to intense weather risks.

- ✓ ***Inadequate knowledge on climate change and its adaptation:*** Most of extension agents lack the needed knowledge on climate change adaptation. Without this needed knowledge, their competence in work will be seriously affected for they cannot give what they do not have. Extension agents cannot help farmers in their problem when they are not aware of it and how to solve it.

According to Oruwari, Jev and Owei, (2002), it is crucial to acquire and strengthen the competence in knowledge and skills to produce technology synergies needed to effectively address climate change. Extensive training is needed by extension agents to increase their knowledge thereby improve their competence.

- ✓ ***Inadequate trained/qualified extension personnel:*** Extension organisations in developing countries face the major problems of professional incompetence and lack of motivation among their employees. Many of the agricultural extension departments of developing countries do not have a well- defined system of human resource development and management. According to Vijayaragavan and Singh in Edoka, (2012) proper planning and management of human resource extension organization is essential to increase the capabilities, motivation and overall effectiveness of extension personnel.

As agriculture develops and intensifies, the agricultural extension worker must develop his/her skills and knowledge. Although Nigeria's recommended standard specified that two or four year college/polytechnic diploma holders and bachelor of sciences be recruited as agricultural extension officers. But majority of extension workers especially at the village levels are not well educated (Agbamu, 2011). Since the educational level of majority of the extension workers is still low thereby affecting their competence and the quality of extension services offered to farmers in the developing countries is still poor. This was blamed on poor type of pre-service training that the staff had prior to joining the extension service.

A study conducted by Obiora, (2012) revealed that 43.0% of extension personnel in southeast of Nigeria had either degree or Higher Diploma certificates. Given the role expected from extension personnel which include coordination of actors in Agricultural Innovation System (AIS), the poor educational status of these professionals could be a hindrance, (Obiora, 2012). The poor knowledge level of extension workers greatly affect

their competence thereby hamper efficient relay of climate change information to the rural people and then exposing farmers to climatic risks.

- ✓ ***Unavailability/poor access to needed input and infrastructure:*** According to Inobeme and Ayanwale (2010), input and infrastructural facilities are vital resources that facilitate all-round development of man and his environment. Unavailability or lack of access to infrastructure by extension professionals or farmers can worsen the already bad climatic situation in Nigeria. For instance, good communication system (such as good road network, telecommunication audio-visuals e.t.c.) can facilitate exchange of climate change information and prompt response to climate change effects. When extension agents lack these inputs, they cannot be able to perform well in their work thereby affecting their competence.
- ✓ ***Inadequate provision of logistic support for field staff:*** This is anchored on poor planning and organization (Gao and Zhang, 2009, Agbamu, 2011). The major challenge as far as logistics are concerned is transportation of agricultural extension agents to different locations where they offer services to farmers on daily basis. Mobility and accommodation of field staff is vital in operating an efficient agricultural extension service.

Mobility helps extension workers to reach different farm families at the schedule days and to meet their obligations to farmers on time thereby improving their competence. But in some developing countries like Nigeria, few vehicles meant for field workers are hijacked by extension administrators at both zonal offices and headquarters.

These have negative effects on the competence of extension workers in educating farmers on climate change related problems and provision of adaptive measures to ameliorate climate change risks witnessed today in most rural Nigeria.

- ✓ ***Extension workers-farmer ratio:*** According to Oladele and Afolayan (2011), Nigeria is an agricultural country from where people earn their living. This situation calls for a virile extension system that will link farmers with researchers effectively. However, this is impaired by wide extension agents-farmers ratio across states in Nigeria. The overall national average of 1:1968 is the case in Nigeria as against the ratio of 1:500 recommended by FAO (Okoye and Ihimodu, 2004).

With this inadequate number of extension staff in the country, a very small number of farmers will receive climate change information thereby leaving a large number of farmers in ignorance of their farm operations which aggravate or exacerbate climate change problems and adaptation strategies. This large number of farmers as against one extension agent makes the extension agent unable to perform his duty well thereby resulting to low competence.

2.7 Conceptual Framework

Agricultural adaptation to changing climate is very important for increasing food production, preventing the extinction of plants and animal species, poverty alleviation, improving the social and economic status of farmers and creating friendly environment for man. Climate change is considered as one of the serious threats to sustainable development, with adverse impact on the environment, human health, food security and physical infrastructure. In agriculture, the incidence of climate change like changes in soil moisture, soil quality, crop resilience, timing/length of growing seasons, yield of crops and animals, atmospheric temperatures, weed insurgence, flooding, unprecedented drought, sea level rise affect food production. For agricultural adaptation to be achieved, agricultural extension has key roles to play. This is because adaptation to climate change impacts requires change in knowledge, attitude, resilience capabilities and skills of the farmers which is best handled by agricultural extension.

Agricultural extension is a series of embedded communicative interventions that are meant, among other things, to develop and/or induce innovation to resolve problematic situations. It is involved in public information and education programmes that could assist farmers in adapting to climate change effects. Extension agents (EAs) are the personnel that work directly with the farmers who are most vulnerable to this climate change impact. Thus the need to build/develop the competence of the EAs for efficient performance of the expected roles in agricultural adaptation to climate change. Competence in this context includes; having sufficient knowledge, attitudes and skills that can contribute to excellence adaptation to climate change.

In the schema, block A shows climate change which is the main issues that affect agriculture seriously. For this issue to be solved, the presence of extension agents is needed as shown in block B. The knowledge level and attitude of extension personnel on climate change developed from the existence of this climate change as shown in block C ascertain the roles and competence needs of extension agents to climate change adaptation which identify the areas of competence needs and skills needed in those areas as shown in block D and E respectively. The roles of extension and the competence needs of extension agents leads to proper adaptation to climate change as in block H which then results to sustainable production and livelihood in block I. Block F identifies some factors affecting competence needs and roles of extension like inadequate funding, unqualified extension workers etc and block G identifies the possible strategies of achieving competence building of extension for proper adaptation and sustainable production and livelihood.

3.0. METHODOLOGY

3.1 Study Area

The study was carried out in Anambra State. The state is located at the south-east region of Nigeria, between longitude $6^{\circ} 35^{\circ}\text{E}$ and $7^{\circ} 21^{\circ}\text{E}$ and latitude $5^{\circ} 38^{\circ}\text{N}$ and $6^{\circ} 47^{\circ}\text{N}$. It is bounded in the north by Enugu State; in the east by Imo State; at the south by Delta State and in the west by Kogi State. Anambra State has an estimated population of 4.18 million and land area of approximately 4,416sq.km (NPC, 2006). The climate can generally be described as tropical with two clear identifiable seasons, the wet and dry season. It lies within the tropical region with early rainfall usually in January/February with full commencement of rainy season in March and stopping in November of each year. The dry season lasts between four to five months. It has relatively high rainfall and moderately high temperature. The highest rainfall is recorded from July to October with little break in August. The average highest annual rainfall is about 1952 mm. The temperature pattern has mean daily and annual temperatures as 28°C and 27°C respectively (Igbokwe, *et al.* 2008). The vegetation consists of rainforest. The state is highly vulnerable to climate change. It is affected by gully erosion and flooding mainly in Onitsha and Anambra zones areas.

The primary occupation of the people in the state is farming, though there is diversification into non-farm occupations such as petty trading, handicraft among others. Major arable crops cultivated are; yam, cassava, cocoyam, maize and vegetables, while major perennial crops grown in the state are oil palm, mango, oil bean, pear, breadfruit among others. Livestock raised in the state include; sheep, goat and poultry. The state has 21 local government areas (LGAs) and is divided into four agricultural zones namely; Aguata, Anambra, Awka and Onitsha zones (Figure 1).



Fig 2: Map of Anambra State showing the Local Governments in the state

Source: <http://www.anambrastatemap.com>

3.2 Population and sampling procedure

The population of the study comprised all extension personnel in Anambra State Agricultural Development Programme (ADP) which is the main public agency with government mandate for extension services. These personnel included those at the headquarters and the different zones. There are four different zones in the state namely; Aguata, Awka, Anambra and Onitsha zones. All the extension personnel in Anambra State ADP were used for the study due to low population of the extension workers in the State.

At the headquarters level, there are directors of extension, communication (DCOM) and women in agriculture (WIA) (3) and their deputies (3) with five (5) chief subject matter specialists. At the zonal level, each zone has one zonal manager (ZM), one zonal extension officer (ZEO), five (5) subject matter specialists (SMSs) and four (4) block extension supervisors (BESs). Also Aguata zone has two (2) block extension agents (BEAs) and six (6) extension agents (EAs), Onitsha zone has two (2) block extension agents (BEAs) and twelve (12) extension agents (EAs), Awka zone has two (2) block extension agents (BEAs) and eight (8) extension agents (EAs), while Anambra zone has three (3) block extension agents (BEAs) and nine (9) extension agents. This gave a total of eleven (11) extension personnel at the headquarters level, four (4) ZMs, four (4) ZEOs, twenty (20) SMSs, sixteen (16) BESs, nine (9) BEAs and thirty-five (35) EAs at the zonal level. Thus, giving a total of ninety-nine (99) respondents for the study.

Table 1: Sample frame for the study

Headquarters		Zones	Aguata	Awka	Anambra	Onitsha
DEO	2	ZMs	1	1	1	1
DWIA	2	ZEOs	1	1	1	1
DCOM	2	SMSs	5	5	5	5
CSMS	5	BESs	4	4	4	4
		BEAs	2	2	3	2
		EAs	6	8	9	12
Total	11		19	21	23	25
Grand total						99

3.3 Data collection:

Data for the study were collected using questionnaire. The instrument for data collection was divided into six sections based on the objectives. Section A elicited information on personal characteristics of the respondents. Section B sourced information on the knowledge level and attitude of extension workers to climate change; section C obtained information on the perceived roles of extension in agricultural adaptation to climate change; section D identified perceived competence needs of extension agents for agricultural adaptation to climate change; section E elicited information on the factors militating against competence building of extension agents for agricultural adaptation to climate change, while section F elicited information on the possible strategies to achieving competence needs of extension agents.

Content validity was used to ensure that the instruments collected accurate data. Some lecturers in the Department of Agricultural Extension, University of Nigeria, Nsukka were given copies of the instrument to validate before administering them to respondents.

3.4 Measurement of variables

In measuring the variables, the respondents were grouped into three different categories; the administrative staff, technical staff and the field staff. The administrative staff include; the directors, the deputies, the zonal managers, the zonal extension officers and the block extension supervisors. The technical staff are the chief subject matter specialists and the subject matter specialist. Then the field staff are the block extension agents and extension agents.

Section A measured the personal and institutional characteristics of the respondents in areas such as sex, age, marital status, educational qualification, year of experience and others. The respondents were asked to indicate their sex by ticking either 'male' or 'female'. They were asked to indicate their actual age in years which was later categorized. Similarly the marital status of the respondents were ascertained by asking them to tick whether they are 'single', 'married', 'divorced' or 'widowed'. Information on household size of the respondents was elicited by asking the respondents to indicate the actual number of persons in the households. The respondents were asked to indicate the actual number of years spent in school (years) and the highest educational qualification as follows: OND, B.Sc./HND, MSc and PhD. Years of experience of the respondents were determined by asking them to specify the number of years they have worked in their organization.

In ascertaining the secondary occupation of the respondents, the respondents were asked to indicate any of the following: farming, trading, etc. Participation in climate change related activities was addressed by asking the respondents to indicate their attendance to climate change related activities (training, outreach, research, field trip etc) and frequency (terms of number of time) of participation. It was ascertained from the respondents if they have received any training on climate change by asking them to tick 'yes' or 'no'. If yes, the respondent were asked to indicate number of training received.

Section B ascertained the knowledge level and attitude of respondents to climate change related issues. In achieving these, the knowledge level was ascertained by asking the respondents 45 knowledge questions on climate change were asked. The respondents responded to the questions by answering 'yes' or 'no'. One mark was assigned to each correct question, making a total of 45. Later the respondents were categorized based on their scores into:

High knowledge: 31-45.

Moderate knowledge: 16-30

Low knowledge: 1-15.

The attitude of respondents to climate change was ascertained using attitudinal statements. The respondents indicated their agreement to the attitudinal statement on a five point Likert-type scale of strongly agree (5), agree (4), undecided (3) disagree (2) and strongly disagree (1). These values were later summed up to 15 and divided by 5 to give a mean score of 3.0 which was used for decision rule. Attitudinal statement with mean score of ≥ 3.0 was considered a favourable attitude and < 3.0 regarded as unfavourable attitude. The weighted values were reversed for every negative statement. Respondent's agreement with the favourable statement indicated positive attitude towards climate change, while agreement with unfavourable statements indicated negative attitude towards climate change.

Also, the attitudinal index of respondents was obtained based on the scale and the weighted values. The 20 attitudinal statements has a maximum score of 100 and a minimum score of 20 on five point Likert type scale. This gave a mid-point score of 60. Thus, respondents with scores mid-point and below (20-60) were tagged as the percentage of personnel with unfavourable attitude (less supportive) to climate change; while above mid-point (61-100) were tagged as the percentage of farmers with favourable attitude (more supportive) to climate change.

Section C ascertained the respondents' perceived roles of extension for agricultural adaptation to climate change. Respondents expressed their opinion on fourteen (14) possible roles

using a four-point Likert-type scale of strongly agree, agree, disagree and strongly disagree with weighted values of 4, 3, 2 and 1, respectively. The mean score was obtained for each response option and items with mean score ≥ 2.50 were regarded as major roles of extension, while items with mean score < 2.50 were considered as minor role of extension for agricultural adaptation to climate change.

Section D identified the competence need of extension agents for agricultural adaptation to climate change. Respondents were requested to indicate the extent of importance of listed areas of competence on a three point Likert type scale as follows: great extent (3), little extent (2) and no extent (1). The mean score for each area was obtained and areas with mean score (M) ≥ 2.00 was regarded as major area needed by extension agents. On the other hand, any area with mean score (M) < 2.00 was regarded as minor area needed by extension agents.

Specific skills required in the areas of competence needs of extension agents were ascertained. To achieve this, a list of skills in different areas of competence needs was provided for the respondents to indicate the extent the skills are needed on a three point Likert-type scale of 'great extent', 'little extent' and 'no extent' with nominal values of 3, 2 and 1 respectively. Mean score for the response was computed ($3+2+1=6/3=2$) and items with mean score ≥ 2.00 was regarded as major areas of competence needs by extension agents. On the other hand, items with mean score < 2.00 was regarded as minor competence needs of extension agents for agricultural adaptation to climate change

Section E determined the factors militating against competence building of extension agents for agricultural adaptation to climate change. List of possible factors was provided and respondents were asked to indicate the extent the factors militate against competence building of extension agents. A four point Likert-type scale great extent, an extent, little extent and no extent with nominal values of 4,3,2 and 1 were used respectively. The mean scores for the responses were computed as follows: $4+3+2+1=10/4 =2.5$. the items with mean values of 2.5 and above

(≥ 2.5) were regarded as major factors militating against competence building of extension agents while the ones with mean score below 2.5 (< 2.5) were regarded as minor factors.

Section F identified the possible strategies for achieving competence building of extension agents for agricultural adaptation to climate change. In achieving this, the respondents were asked to indicate from the list provided, the possible strategies and the extent they think the strategies will help to achieve competence building of extension agents for agricultural adaptation to climate change. A four point Likert-type scale of great extent (4), an extent (3), little extent (2) and very little extent (1) were used. The values were added up to get 10 which was later divided by 4 to get 2.5 (mean). Variables with mean values of 2.5 and above (≥ 2.5) were regarded as a major strategy for achieving competence building of extension agents for agricultural adaptation to climate change. While variables with mean score below (< 2.5) was regarded as a minor strategy for achieving competence of extension agents.

3.5 Data Analysis

Personal and institutional characteristics were presented in percentages while objectives 1, 2, 3 and 5 were analyzed using mean score and standard deviation. Also objective 4 was analyzed using mean score and factor analysis. Exploratory factor analysis was employed in grouping the constraint variables into major constraint factors. In analysis, the factor loading under each constraint (beta weight) represents a correlation of the variable (constraint areas) to the identified constraint factor and have the same interpretation as any correlation coefficient. However, only variable with loading of 0.4 and above (10% overlapping variance, was used in naming the factors.

Logit model was used to test research hypothesis 1 and 2. Logit model is a qualitative choice model used to model relationship between dependent variable (Y) and one or more independent variable (X) where the dependent variable (Y) is a discrete variable that represents a choice or category from a set of mutually exclusive choices or category. Categorical variables

such as sex, marital status, secondary occupation, area of academic specialization will be coded in order to transform them into dichotomous variable. While the other variables such as age, number of years spent in school, years of experience, number of training received will be entered directly into the equation.

Specifically, multinomial logit model will be used to analyze hypothesis one since the categorical responses are more than two; high knowledge, average knowledge and low knowledge having n (12) independent variable and k (3) categories of response variables. Assuming K as the base level, and π_j = the multinomial probability of an observation falling in the j th category. To find the relationship between this probability and the m explanatory variables ($X_1, X_2 \dots X_m$) the equation is as follows;

$$\log\left(\frac{\pi_j(x_i)}{\pi_k(\pi_i)}\right) = \beta_0 j + \beta_1 j x_{1i} + \beta_2 j x_{2i} + \dots \beta_m j x_{mi}$$

$$j = 1, 2, \dots, (k-1); i = 1, 2, \dots, n$$

Now since all the π s add to unity, we have

$$\log \pi_j(x_i) = \frac{\exp(\beta_0 j + \beta_1 j x_{1i} + \beta_2 j x_{2i} + \dots \beta_m j x_{mi})}{1 + \sum_{j=1}^{k-1} \exp(\beta_0 j + \beta_1 j x_{1i} + \beta_2 j x_{2i} + \dots \beta_m j x_{mi})}$$

(Source: Chatterjee and Hadi, 2006)

Where;

b_0 = constant term,

β_i = coefficient effect of each variable

X_{ij} = independent variables

$b_0 + b_1$ = input

$\pi(x)$ = output

$g(x)$ = the logit function of some predictor X

$\log$ = natural logarithm

$\pi(x)$ = probability of being a case

e = exponential function

Y = dependent variable i.e the level of knowledge on agriculture related climate change issues which is categorized into 3;

High knowledge = 3

Average knowledge = 2

Low knowledge = 1

X_1 = Sex (male = 1, female = 0)

X_2 = age (years)

X_3 = marital status (married =1, not married = 0)

X_4 = household size (actual no of household)

X_5 = secondary occupation (farming =1, non-farming =0)

X_6 = years spent in school (actual number of years in school)

X_7 = area of academic specialization (agricultural extension =1, others =0)

X_8 = position in extension organization (field agent = 1, None field staff =0)

X_9 = years of experience in extension work (actual number of years spent in work)

X_{10} = participation in climate change activities (outreach, fieldtrip, workshop,) (yes =1, no =0)

X_{11} = no of training received on climate change (actual no of training received)

X_{12} = no of contact with the agency on climate change (actual no of agencies)

Binomial or binary logistic regression was used to test hypothesis two. The response variable has only two possible values; favourable and unfavourable attitude that is the dependent variable has only two categories or cases (binomial). The outcome is coded as 0 and 1 where the target group (referred as a case) is coded 1 and the reference group (referred as a non- case) is coded 0. In this case the dependent variable (Y) is dichotomized into two (favourable attitude with value of 1 and unfavourable attitude = 0). A binary logistic model will be employed as follows:

First;

$$\text{The probability of favourable attitude} = P_i = \frac{\exp^{z_i}}{1 + \exp^{z_i}} \quad (1)$$

Where z = a random variable that predicts the probability of the i th personnel having a favourable attitude towards climate change.

Therefore the model is expressed for individual personnel as

$$= Z_i = \ln \frac{p_i}{1 - p_i} = \beta_0 + \sum_{n=1}^n \beta_n X_{ji} \quad (2) \quad (\text{logit i.e.})$$

log-odds or natural logarithm of the odds which is equivalent to the linear regression equation).

Where;

P_i = probability of favourability

β_0 = constant term, β_n = coefficients

X_{ij} = independent variables

Also the coefficient = effect of each explanatory variable on log odds expressed thus:

$$Z_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_n X_{ni} \quad (3)$$

Thus, the model specification is thus summarized as

$$Z_i = Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon \quad (4)$$

Y = Attitude of extension agents to climate change

The explanatory variables are $X_{1i} \in \dots X_{ni}$

X_1 = Sex (male = 1, female = 0)

X_2 = age (years)

X_3 = marital status (married =1, not married = 0)

X_4 = household size (actual no of household)

X_5 = secondary occupation (farming =1, non-farming =0)

X_6 = years spent in school (actual number of years in school)

X_7 = area of academic specialization (agricultural extension =1, others =0)

X_8 = position in extension organization (field agent = 1, none field staff =0)

X_9 = years of experience in extension work (actual number of years spent in work)

X_{10} = participation in climate change activities (outreach, fieldtrip, workshop) (yes =1, no =0)

X_{11} = no of training received on climate change (actual no of training received)

X_{12} = no of contact with the agency on climate change (actual no of agencies)

4.0 Results and Discussion

4.1 Personal and institutional characteristics of respondents

4.1.1 Sex

Table 2 shows that greater proportions (52.6%) of the administrative staff were males while 47.4% were females. Similarly, majority (80.0%) of technical staff were males and 20.0% were females. Females accounted for 80.0% of the field staff. Overall, 57.0% of the respondents were females, while 43.0% were males. There were more women extension professional than men. However, the men constituted greater population in administrative and technical cadre of extension workers, while the female extension workers dominated the field staff. This could be as a result of increasing gender sensitivity of agricultural workforce accentuated by the dominance of women in most agricultural activities. Spores (2012) observed that women dominated in the agricultural sector because they are marginalized in other forms of employment. Above all, the pattern/ structure of rural labour force with more able bodied men migrating to the cities/urban areas has exacerbated this in recent times.

4.1.2 Age

Majority (66.7%) of administrative staff were within the ages of 41-50 years, while 22.2% were between 31 and 40 years. Similarly, 42.9% of technical staff were within the ages of 41-50 and another 42.9% were between 51-60 years. Only 14.3% were between the ages of 31 and 40 years. The field staff (62.2%) were between the ages of 41 and 50 years, while 27.0% were between 31 and 40 years (Table 2)

Generally, 60.3% of the respondents were between 41 and 50 years of age. A lesser proportion (23.1%, 12.8%, 2.6% and 1.3%) were within the ages of 31-40, 51-60, 21-30 and 61-70, respectively. The mean age of the respondents was 45.2 years. Largely this conforms Obiora (2012) who reported that the mean age of ADP staff was 47years which shows a relatively youth

work force. Majority of the respondents are still in their active years and as such can actively contribute to addressing the challenges of adapting to climate change if adequately equipped with right mix of skills, knowledge and attitude. This is because age has been associated with productivity and responsiveness of personnel to challenges in the working environment.

4.1.3 Marital status

Majority (94.7%) of administrative staff were married, 2.6% single and another 2.6% widowed. All (100%) the technical staff and 90% of field staff were equally married. Only 10% of the field staff were not married (Table 2). Overall, 93.5% of the respondents were married, 5.4% were single while, 1.1% were widowed. This shows a workforce of married people. This is in agreement with the study carried out by Obiora (2012) which reports that majority (63.3%) of ADP staff are married. Married people tend to be more committed to work (Onu, 2003). They could be more responsible with lots of experiences and tend to carry their work properly. Besides, the rate of staff mobility and subsequently staff turnover in an organisation among married workforce might be lesser compared to the unmarried. Hence investment in training such category of staff could be more rewarding and beneficial to attaining long and short term goals of an organization.

4.1.4 Participation in climate change activities

Data on Table 2 show that majority (78.9%) of administrative staff had participated in climate change activities, while, 21.1% had not. About 93% of technical staff had participated in climate change activities, while 6.7% had not. In the same vein, greater proportion (65.0%) of field staff had participated, while 35.0% never participated in any climate change activities. This suggests that administrative and technical staff have more opportunity and greater exposure to climate change activities than extension agents. Ideally field staff should be the target for any climate change activities because they are at the interface between extension and vulnerable farm families.

The significant number of field staff that have not participated in climate change activities could largely translate to gap in knowledge and competence; and subsequently, poor performance of roles towards ameliorating the problem of climate change in rural communities. It could also mean that not much is down by extension at the grass root in creating awareness and training farmer for climate change adaptation. However, the participation of the different categories of extension workers in climate change activities could positively influence their attitude, knowledge and commitment to addressing the threat of climate change.

4.1.5 Number of training received

Table 2 show that greater proportion (38.5%) of administrative staff had one training. About 31%, 19%, 7.7% and 3.8% had twice, five, three and four times respectively. A greater proportion (49.2%) of technical staff had once. A lesser proportion(32.3%) had twice while only 7.7% and 3.1% had three and four times, respectively. Majority (65.4%) of field staff had one training while 26.9% had two trainings. This indicates very low training on climate change by field staff and point to the need for training. Investment on training for extension professional particularly extension agents is an imperative for functional participation in agricultural adaptation to climate change. Invariably, it will translate to efficient and sustainable adaptive capability at the farm/ community level.

In all, greater proportion (49.2%) of the respondents had one training and 32.3% had two trainings. Only about 8% and 3.1% had three, five and four trainings, respectively. The mean number of training received by the respondents was 2.0. Generally, it shows low capability of extension system both in terms of human resource and investment and probably linkages for agricultural adaptation to climate change. In other words, the degree of preparedness of public extension system for functional participation the problem and threat of climate change to life, food

security and livelihood is still at a very low ebb. Training of extension professionals is an imperative for requisite competence in building responsive and resilience community.

Table2: Percentage distribution of respondents according to personal and institutional characteristics

Socio-economic characteristics	Administrative staff		Technical staff		Field staff		All the respondents	
	Percentage (%) (n= 38)	Mean (M)	Percentage (%) (n= 15)	Mean (M)	Percentage (%) (n= 40)	Mean (M)	Percentage (%) (n= 93)	Mean (M)
Sex								
Male	52.6		80.0		20.0		43.0	
Female	47.4		20.0		80.0		57.0	
Age(years)								
21-30	-		-		5.4		2.6	
31-40	22.2		14.3		27.0		23.1	
41-50	66.7	46.9	42.9	47.8	62.2	43.0	60.3	45.2
51-60	11.1		42.9		2.7		12.8	
61-70	-		-		2.7		1.3	
Marital status								
Single	2.6		-		10.0		5.4	
Married	94.7		100		90.0		93.5	
Widowed	2.6		-		-		1.1	
Participation in climate change extension activities								
Yes	78.9		93.3		65.0		75.3	
No	21.1		6.7		35.0		24.7	
No of training received								
1-2	69.3	2.0	71.5	2.0	72.3	1.0	61.5	2.0
3-4	11.5		10.8		7.6		10.8	
5 and above	19.2		7.7		-		7.7	

4.1.6 Highest academic qualification

Figure 2 shows that majority (56.8%) of the administrative staff were HND/B.Sc holders, while 29.7% and 13.5% were OND/NCE and M.Sc holders, respectively. Greater percentage (60.0%) of technical staff were HND/B.Sc holders, while 33.3% and 6.7% had M.Sc and OND/NCE, respectively. In the same vein, the field staff (47.5%) each had OND/NCE and HND/B.Sc, while only 5.0% were M.Sc holders. The technical staff are more educated followed by administrative staff and then the field staff.

In overall, greater proportion (53.3%) of the respondents had B.Sc/HND, 33.7% had OND/NCE, while 13.0% had M.Sc. This shows that extension personnel are highly educated. It

indicates high knowledge structure of extension workforce compared to what existed few decades ago. This is crucial given the level of technological advancement in agriculture, ever-increasing challenges in farming system and corresponding changes in the knowledge structure of the agriculture/rural labour. According to Acker (1999) higher education in agriculture increases the chances of realizing food security and development which is the key aim of climate change adaptation among extension workers and farmers.

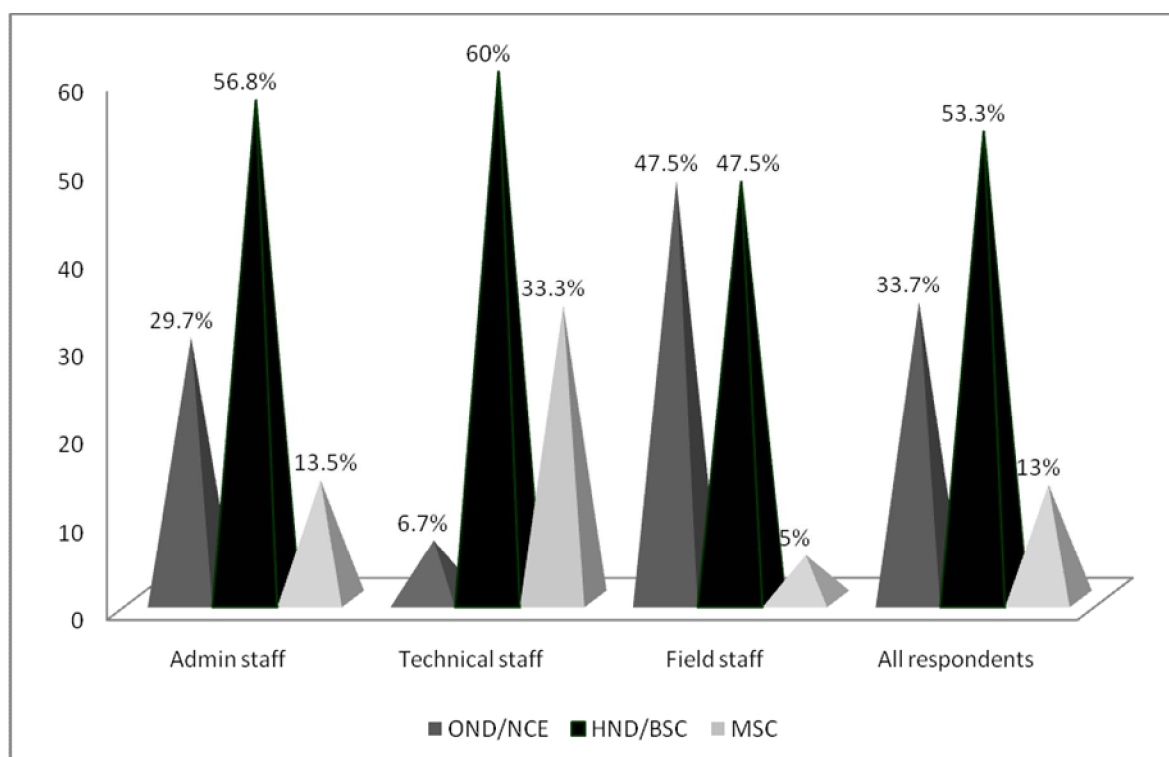


Fig 3: Distribution of respondents based on academic qualification

4.1.7 Area of academic qualification

Majority (56.8%) of the administrative staff studied agricultural extension (figure 3). About 16% and 14% studied crop science and agricultural economics respectively. About 27% of technical staff specialized in agricultural economics, 26.7% in crop science and 20.0% studied agricultural extension. Greater proportion (41.0%) of field staff studied agricultural extension,

23.1% specialised in crop science, while 10.3% each studied agricultural economics, animal science and other subjects areas, respectively.

Generally, greater proportion (44.0%) of the respondents studied agricultural extension, 20.9% were crop scientists, while 14.3% and 7.7% specialized in agricultural economics and animal science, respectively. There is mix of basic background, skills and knowledge among extension professional, most importantly a significant proportion have extension background. This is very crucial especially among extension agents who need competency in several areas of extension such as communication, social mobilization, group dynamism, facilitation, in addition to technical skills to effectively work with rural farmers. Technical expertise often over- emphasized by administrators and educators is just one out of many requisite capabilities for effective performance of extension agents in the field.

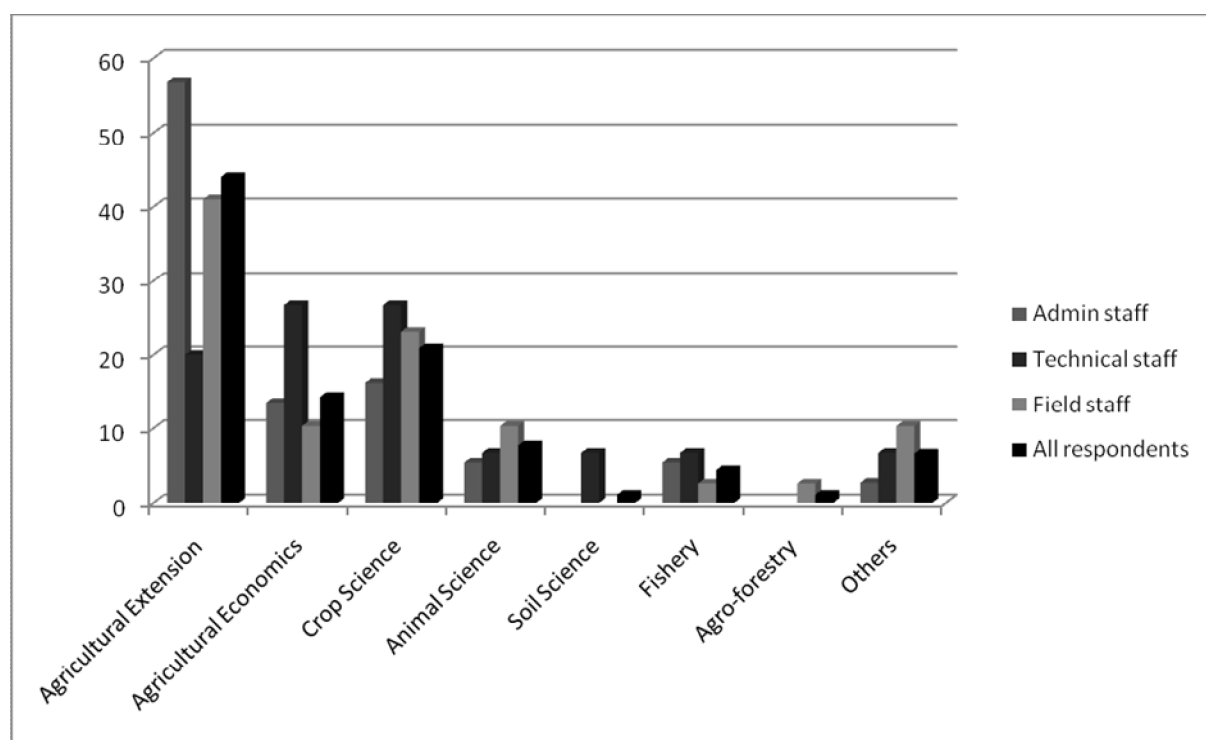


Fig 4: Percentage distribution of respondents by area of academic qualification

4.1.8 Years of working experience

Figure 4 shows that greater percentage (55.3%) of administrative staff had between 21 and 30 years of experience, while 42.1% and 2.6% had within 11-20 and above 30 years of work experience, respectively. The mean years of working experience was 20.7 years. Majority (50.0%) of technical staff had 21 to 30 years of working experience while 35.7% and 14.3% had 11-20 and 1-10 years of working experience, respectively. The mean years of working experience by technical staff was 19.4 years. Majority (65.0%) of the extension agents had 11-20 years of working experience, while 20.0% and 15.0% had between 21 and 30 years and 1-10 years of experience, respectively. The mean years of experience by field staff was 15.3 years.

In all, majority (51.1%) of the respondents had between 11 and 20 years of experience in extension and 39.1% had 21-30 years of working experience.. The mean years of experience in extension work was 18.2 years. The results show that extension professionals particularly the administrative and technical staff have quite a considerable experience in extension work. Extension agents are less experience probably due to high labour mobility and turnover often common among lower cadre staff of public system. Poor remuneration, motivation and low career prospect of staff at this level most times necessitates labour migration for greener pasture. On another hands, experience staff are assets for enhanced and sustained performance of an organization. According to Chikezie, Ibekwe, Ohajianya, Orebiyi, Obasi et al (2011) the longer a person is in a business, the more skilled and experienced he becomes in its management. Invariably, administrative and technical staff who have stayed long in the work could have more experience and skill compared to extension agents, though their job description differ.

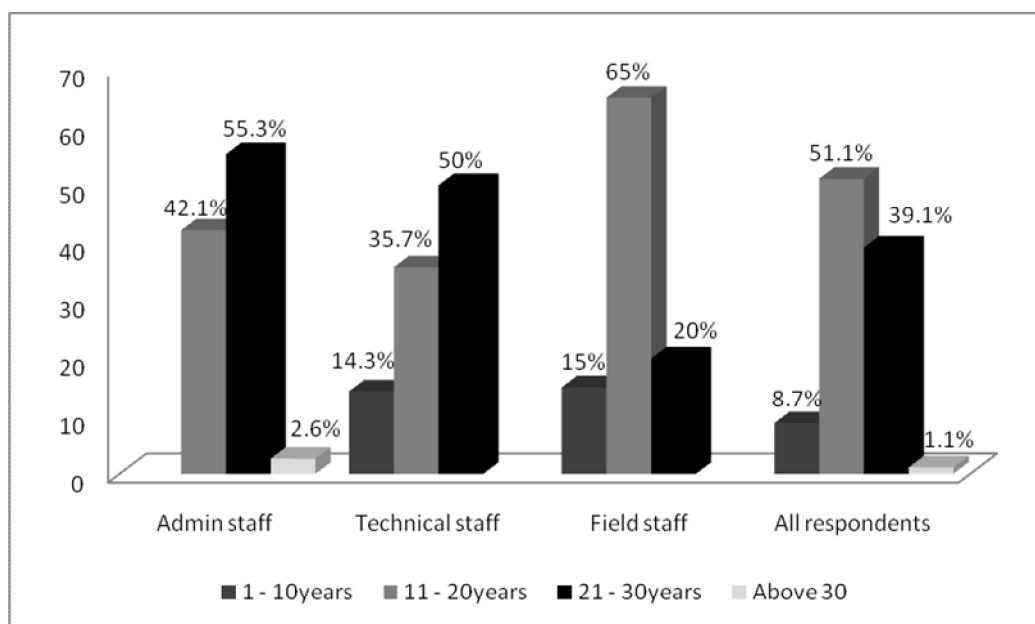


Fig 5: Years of experience

4.2 Knowledge and attitude to climate change

4.2.1 Knowledge of causes of climate change

Table 3, indicates that majority (86.0%, 83.9%, 79.6%, 77.4%, 71.0%) of the respondents perceived emission of greenhouse gases, increased industrialization, bush burning, human activities like burning of fossil fuel and deforestation respectively as some of the causes of climate change. The respondents further indicated that climate changes are caused by respiration and volcanic eruptions (58.1%), agriculture/land use (55.9%) and natural decay of waste water, crop and animal (52.7%)..

Also a lesser proportion (34.4% and 33.3%) perceived use of fertilizer, use of pesticides and end of the world as the causes of climate change. Significant proportion (30.1% and 29.0%) perceived climate change as a punishment from God due to disobedient and sins of the world as some of the causes of climate change. Storage and spreading of animal manure (10.8%) and digestion process of ruminant animals (9.7%) were lowly perceived as causes of climate change.

Relatively, the respondents have knowledge of some causes of climate change, but expressed poor knowledge of others like use of fertilizer and pesticides and other anthropogenic activities. Of greater concern is the significant number that holds to the idea that climate change is as a result of God's wrath and sin. Largely the finding is an indication of divergent views of the causes of climate change and consequently, the need for increase knowledge through training and orientation of professionals particularly extension agents. It was also revealed that among these staff, technical staff is more knowledgeable on causes of climate change followed by field staff and then the administrative staff.

Table 3: Percentage distribution of respondents according to knowledge on causes of climate change

Knowledge questions on causes of climate change	Administrative staff	Technical staff	Field staff	All respondents
	Percentage (%) (n=38)	Percentage (%) (n=15)	Percentage (%) (n=40)	Percentage (%) (n=93)
Signs of end of the world causes climate change	21.7	33.3	45.0	33.3
Deforestation causes climate change	63.2	73.3	77.5	71.0
Sins of the world causes climate change	15.8	46.7	35.0	29.0
Bush burning causes climate change	71.1	73.3	90.0	79.6
Use of fertilizer causes climate change	18.4	53.3	42.5	34.4
Use of pesticides causes climate change	21.1	46.7	40.0	33.3
Punishment from God due to disobedient is the cause of climate change	13.2	46.7	40.0	30.1
Human activities like burning of fossil fuel causes climate change	65.8	80.0	87.5	77.4
Agriculture/Land use causes climate change	50.0	60.0	60.0	55.9
Increased industrialization causes climate change	76.3	80.0	92.5	83.9
Emission of greenhouse gases like CO ₂ causes climate change	76.3	93.3	92.5	86.0
Natural decay of waste water, crop and animal causes climate change	36.8	60.0	65.0	52.7
Digestion process of ruminant animals causes climate change	5.3	6.7	15.0	9.7
Storage and spreading of animal manure causes climate change	5.3	33.3	7.5	10.8
Respiration and volcanic eruptions causes climate change	57.9	46.7	62.5	58.1

Multiple response**4.2.2 Knowledge of effects of climate change**

Table 4, indicates that the respondents perceived fourteen (14) out of the fifteen (15) items as effects of climate change. They include; abrupt changes in weather condition (92.5%), rising sea level (84.9%), increased temperature (83.9%), change in season pattern (82.8%), increase flooding, erosion and change in availability of water/rainfall (81.7%), frequent heat waves and drought (78.5%), drying of rivers and lakes (73.1%) and others. On the contrary, lower proportion

(34.4%) of the respondents which include administrative (28.9%), technical staff (40.0%) and extension agents (37.5%) perceived increase in pest, insects, disease and weed infestation as effects of climate change. Largely, the respondents are highly knowledgeable of the effects of climate change on human, animals, environment and the entire ecosystem. This could be attributed to the report that the evidence of unpleasant impact of climate change abound in the southeast, Nigeria which Anambra State is one of them (Agwu and Okimanhe, 2009). According to Nweke (2010), Anambra State is seriously affected by erosion and flooding due to climate change. The findings further confirm knowledge of the fact that climate change is one of the serious threats to sustainable development with the adverse impacts on the human health, food security, and physical environment (ACCID, 2010). The respondents may have been directly or indirectly affected by the negative impact/effect of climate change. It points to the need for concerted efforts on building adaptive capability of all stakeholders.

Tale 4: Percentage distribution of respondents according to knowledge of effects of climate change

Knowledge questions on effects of climate change	Admin staff	Technical staff	Field staff	All respondents
	(%)(n=38)	(%)(n=15)	(%)(n=40)	(%)(n=93)
Abrupt changes in weather condition are caused by climate change	89.5	93.3	95.0	92.5
Increase flooding and erosion	68.4	100	87.5	81.7
Increase in pest, insect, disease and weed infestation	28.9	40.0	37.5	34.4
Drying of rivers and lakes	65.8	73.3	80.0	73.1
Reduction in soil nutrient and poor yield of crops i	52.6	66.7	72.5	63.4
Increased temperature	76.3	100	85.0	83.9
Frequent heat waves and drought	68.4	80.0	87.5	78.5
Change in availability of water/rainfall	71.1	73.3	95.0	81.7
Rising sea level	73.7	100.0	90.0	84.9
Change in season pattern	73.7	80.0	92.5	82.8
Soil drainage (leaching)	44.7	53.3	67.5	55.9
Shrinking of ice sheet	55.3	60.0	52.5	54.8
Ocean acidification	55.3	80.0	70.0	65.6
Change in wild life behavior	39.5	60.0	62.5	57.3
Increase in food insecurity and malnutrition	50.0	60.0	62.5	57.0

Multiple response**4.2.3 Knowledge of climate change adaptation measures**

Table 5 shows that the respondents perceived all (15) items as climate change adaptation measures. These measures include; dissemination of useful information and practice by extension to farmers (88.2%), change in the timing of farm operation(84.9%), afforestation and disaster management (82.8%), generating technologies and building capacity for mitigation and adaptation to climate change (80.6%), use of improved/resistant crop and animal varieties (77.4%), altering cropping pattern and management practices (75.3%) and others. Specifically, a lesser proportion (26.3%) of administrators perceived prompt and intensive weeding as measures to climate change adaptation.

The result shows that the respondents have knowledge of climate change adaptation measures. This might be due to the educational experience, training and contact with farmers. It equally confirms the earlier findings of the study that the respondents have been involved in climate change activities like outreach, field trip, e.t.c. Knowledge of adaptation measures is fundamental for the performance of extension roles in agricultural adaptation to climate change.

Table 5:Percentage distribution of respondents according to knowledge of adaptation to climate change

Knowledge questions on adaptation measures	Admin staff	Technical staff	Field staff	All respondents
	(%)(n=38)	(%)(n=15)	(%)(n=40)	(%)(n=93)
Change in the timing of farm operation	89.5	73.3	85.0	84.9
Use of improved/resistant crop and animal varieties	68.4	73.3	87.5	77.4
Afforestation is an adaptation measure	76.3	80.0	90.0	82.8
Prompt and intensive weeding	26.3	86.7	62.5	51.6
Irrigation	63.2	66.7	72.5	67.7
Alteration in the location of cropping activities	60.5	66.7	75.5	67.7
Building competence of extension workers on climate change	68.4	66.7	82.5	74.2
Generating technologies for adaptation	71.1	80.0	90.0	80.6
Dissemination of useful information and practices	81.6	100.0	90.0	88.2
Investment on stakeholder's forum	76.3	80.0	85.0	80.6
Improving soil organic content	60.5	66.7	77.5	68.8
Community awareness and disaster management	81.6	100.0	77.5	82.8
Altering cropping pattern and management practice	73.7	66.7	80.0	75.3
Safeguarding water resources	71.1	73.3	70.0	71.0
Diversifying economic activities	68.4	80.0	75.0	73.1

Multiple response

4.2.4 Knowledge level of the respondents on climate change

Majority (63.4%) of the respondents had high knowledge of climate change, 22.6% had moderate knowledge, while 14.0% had low knowledge of climate change (figure 5).

Specifically, about 55.3% of administrative staff had high knowledge, 23.7% had low knowledge, while 21.1% had moderate knowledge. Greater percentage (66.7%) of technical staff had high knowledge, 20.0% had low knowledge, while 13.3% had moderate knowledge. On the other hand, majority (70.0%) of field staff had high knowledge, 27.5% had moderate knowledge, while 2.5% had low knowledge.

Relatively, greater proportion of field staff has high knowledge of climate change followed by technical staff and then the administrative staff. This may be because the field staff has direct contact with farmers who are the most vulnerable due to their high dependence on agriculture for livelihood. According to Kahlor and Rosenthal (2009) knowledge about climate change may lead to a more engaged citizenry and subsequently adaptation potential and resilience of farmers to climate change effects. Sarkar and Padaria (2010) found out that low level knowledge retards the adaptation potential and make people to be more vulnerable to climate change effects.

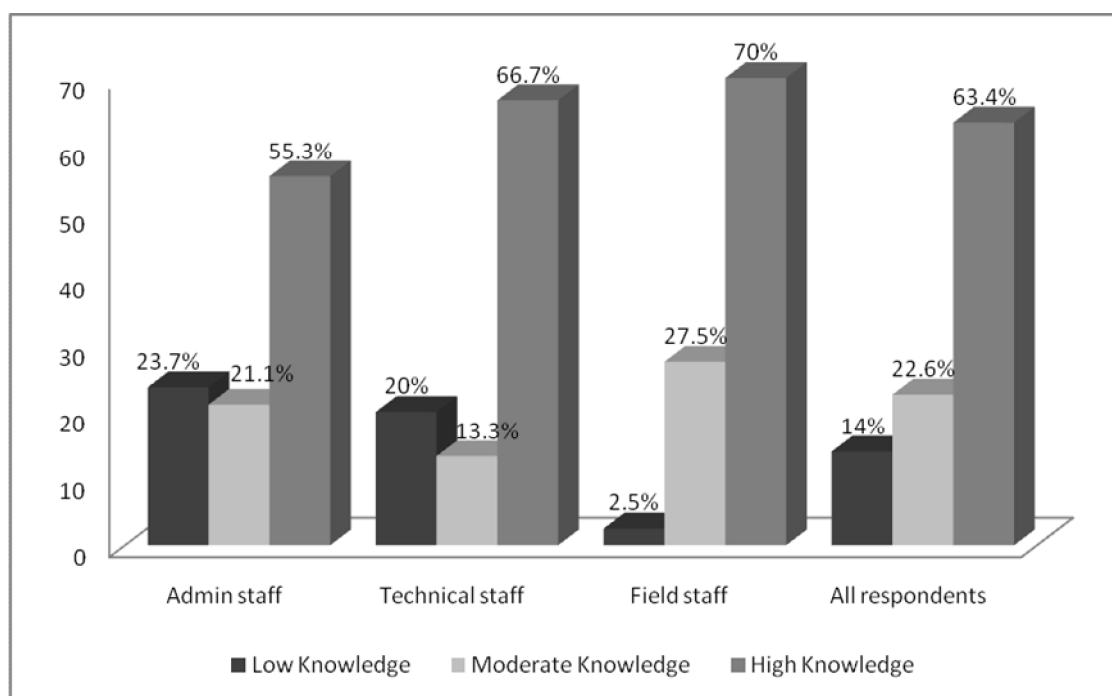


Fig 6: Knowledge level of the respondents on climate change

4.2.5 Attitudes of respondents towards climate

Entries in Table 6 show that respondents had favourable attitude towards all the attitudinal statements. These statements include: there is an evidence of climate change in Nigeria (M=4.41), adaptation to climate change is of vital importance and needs urgent attention (M=4.38), adaptation to climate change has potential for improved production, food security and poverty alleviation (M=4.30), climate change affect crop production very badly (M=4.30), building the capability of extension agents on climate change adaptation is of importance (M=4.27), extension has vital role to play on climate change adaptation and mitigation (M=4.23) and others.

On the other hand, the technical (M=2.87) and field (2.92) staff expressed unfavourable attitude towards land use having an effect on climate. This shows their disagreement with IPCC (2007) which stated that the global increases in CO₂ concentration are primarily due to fossil fuel and land use change, while those of CH₄ and N₂O are primarily due to other anthropogenic activities in agriculture.

Generally, Figure 6 shows that majority (93.5%) of the respondents had favourable attitude towards climate change while 6.5% expressed unfavourable attitude. Specifically, all (100%) the technical staff, 92.5% of field staff and 92.1% of administrative staff showed positive attitude towards climate change. A lesser percentage (7.9%, 7.5%, 7.9%) of administrative, technical, and field staff showed negative attitude to climate change, respectively. This could be attributed to adequate knowledge of climate change phenomenon shown by the respondents. It suggests that extension workers are very much aware of the effects of climate change and they equally believe that climate change can be mitigated and adapted to. This is crucial given the pivot roles of extension in building capacity of farm communities. According to Ozor and Nnaji (2011), the primary role of extension is in the dissemination of innovations to targeted clientele ranging from farmers, pastoralists, fisher-folks, hunters, foresters, wine-tappers and other rural residents who depend on agriculture in one way or the other.

Table 6: Mean distribution of respondents' according to attitude towards climate change

Attitudinal statement	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Climate change is not scientific jargon	4.13*	1.02	3.87*	1.36	3.61*	1.26	3.87*	1.20
Climate change is not a punishment from God	4.18*	.87	3.87*	.99	3.55*	1.29	3.87*	1.11
Agricultural production is affected by climate change	4.39*	1.03	4.27*	1.10	3.95*	1.32	4.18*	1.18
Human activities cause climate change	3.65*	1.44	4.43*	.85	3.84*	1.00	3.85*	1.20
Agricultural practice causes climate change	3.14*	1.48	3.53*	1.41	3.30*	1.24	3.27*	1.36
Building the capability of extension agents on climate change adaptation is of importance	4.32*	1.30	4.20*	1.08	4.26*	.95	4.27*	1.11
Climate change affect crop production very badly	4.47*	.86	4.27*	.70	4.15*	.71	4.30*	.78
Adaptation to climate change is of vital importance and needs urgent attention	4.29*	1.09	4.47*	.52	4.44*	.64	4.38*	.84
Increase in pest disease and weed infestation is caused by climate change and should be addressed	3.25*	1.32	3.40*	1.06	3.59*	1.12	3.42*	1.19
Extension has vital role to play on climate change adaptation and mitigation	4.11*	1.11	4.27*	1.03	4.35*	.75	4.23*	.96
Land use has an effect on climate	3.61*	1.15	2.87	1.12	2.92	1.04	3.19*	1.14
Climate change can be mitigated or adapted to	3.92*	1.26	3.20*	1.01	3.69*	1.00	3.71*	1.13
Awareness of climate change effect, causes, adaptation and mitigation among farmers is very relevant.	4.13*	1.04	4.13*	.52	4.21*	1.13	4.16*	1.01
Generating technologies for climate change adaptation should be research/extension priority	4.03*	1.28	4.13*	.99	4.23*	.74	4.13*	1.03
There is an evidence of climate change in Nigeria	4.43*	.96	4.36*	.50	4.41*	.75	4.41*	.81
Extension system should not concentrate on transferring knowledge/technologies for increase production and income of farmers rather than educating farmers on climate change phenomenon	3.82*	1.43	3.93*	.88	4.10*	1.05	3.96*	1.19
Farmers need technologies for climate change adaptation rather than credit for increased production.	3.54*	1.24	3.33*	1.23	3.67*	.96	3.56*	1.12
Concern on formulating climate change policy should be evidence based or society oriented rather than political motivated	3.97*	1.24	3.13*	1.36	3.77*	1.06	3.75*	1.21
Irregularities in rainfall, increased temperature and cases of flooding are associated with change in climate	4.03*	1.40	4.00*	.93	4.05*	1.03	4.03*	1.17
Adaptation to climate change has potential for improved production, food security and poverty alleviation	4.34*	.78	4.80*	.41	4.08*	.87	4.30*	.89

*Favourable attitude

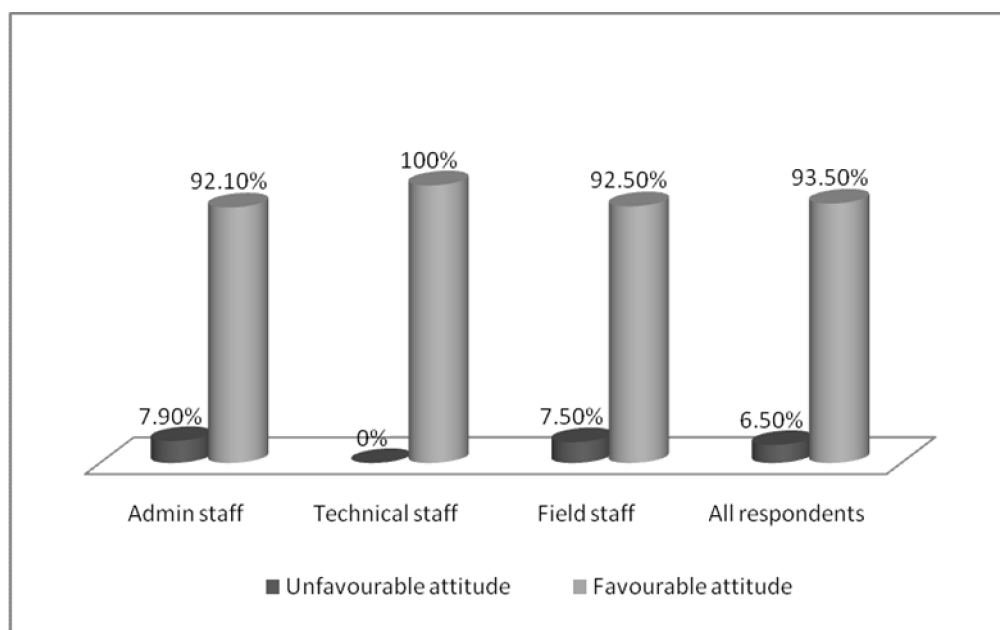


Fig 7: Percentage distribution of respondents based on attitude towards climate change

4.3: Roles of extension in agricultural adaptation to climate change

Table 7 shows that the respondents perceived 11 out of 14 identified roles as major roles of extension for agricultural adaptation to climate change. These included; conducting workshop, seminar for creation of awareness/knowledge of climate change and adaptation ($M=3.74$), facilitating access to relevant information (weather forecast, new practices, government policies/regulatory measures etc) ($M=3.54$), carrying out demonstration for teaching farmers measures used to mitigate or adapt to the effects of climate change ($M=3.45$), dissemination of innovation/technologies on best practices for climate change adaptation ($M=3.44$), providing feedbacks to governments and research institutions on situation of rural farmers with respect to climate change to link practices to new policies and research ($M=3.44$), use of farmer-to-farmer extension strategy to promote awareness and adaptation of best practices on climate risk management ($M=3.38$), mobilization of group/communities for mitigation and adaption to climate change effects ($M=3.37$) and others. The standard deviation further shows strong homogeneity in

the opinion of the respondents with respect to the roles of extension in adaptation to climate change.

On the other hand, selling of the needed input to farmers for easy adaptation ($M=1.72$), formulating policy for climate change adaptation ($M=1.69$) and provision of financial back up to the farmers to increase adaptation rate ($M=1.67$) were not considered as roles of extension for climate change adaptation. The findings suggest that the respondents are adequately aware of the place of extension in mitigating and adapting to the affects of climate change. It reveals the education, facilitation and information management roles of extension. The results corroborate with Davis (2009) who recommends that extension should play crucial role in technologies and management of information, capacity development, facilitation and implementation of policies. In other words, extension professionals are expected to facilitate generation of knowledge/technologies, build awareness, transfer knowledge/technologies and implement actions for effective management of climate change risks (FAO, 2008) and programs. However, this does not annul the general idea and consensus in most stakeholders forum that addressing the challenges of climate change is a multi-stakeholders responsibility given the multi-sectoral and multidisciplinary dimensions of the phenomenon.

On the other hand, marketing of inputs and provision of fund is traditionally a non-extension roles for extension professionals. Rather extension could provide information and facilitate access to inputs; and mobilize farmers for access and efficient use of credit. Also it facilitates formulation of evidence-based policies through documentation and feedback mechanism. The standard deviation indicates strong agreement of the respondents in their perception of expected roles of extension for climate change adaptation and mitigation.

Table 7: Mean distribution of respondents' perceived roles of extension on climate change adaptation

Roles	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Conducting workshop, seminar for creation of awareness/knowledge on climate change and adaptation	3.74*	.72	3.80*	.41	3.73*	.45	3.74*	.57
Dissemination of innovation/technologies on best practices for climate change adaptation	3.58*	.76	3.47*	.52	3.30*	.72	3.44*	.71
Carrying out demonstration in teaching farmers the measures used to mitigate or adapt to the effects of climate change	3.47*	.51	3.53*	.64	3.40*	.55	3.45*	.54
Use of farmer-to-farmer extension strategy to promote awareness and adaptation of best practices on climate risk management	3.34*	.48	3.47*	.52	3.38*	.59	3.38*	.53
Providing feedbacks to governments and research institutions on situation of rural farmers with respect to climate change to link practices to new policies and research	3.32*	.62	3.67*	.49	3.48*	.51	3.44*	.56
Facilitating access to relevant information (weather forecast, new practices, government policies/regulatory measures etc)	3.58*	.50	3.67*	.48	3.45*	.50	3.54*	.50
Facilitate implementation of programme or policies on climate change related issues	3.39*	.50	3.33*	1.05	3.33*	.77	3.36*	.72
Mobilization of group/communities in mitigating and adapting to climate change effects	3.29*	.87	3.73*	.46	3.30*	.65	3.37*	.73
Fostering linkages among actors in climate change innovation system	3.32*	.62	3.47*	.64	3.10*	.75	3.25*	.69
Plan and manage disaster and risk associated with climate change	3.53*	.56	3.33*	.62	3.15*	.83	3.33*	.71
Documentation of indigenous knowledge/practices on adaptation to climate change	3.29*	.77	3.27*	.70	3.28*	.45	3.28*	.63
Provision of financial back up to the farmers to increase adaptation rate	1.74	.69	1.33	.49	1.73	.75	1.67	.70
Selling of the needed input to the farmers for easy adaptation	1.66	.75	1.53	.52	1.85	.74	1.72	.71
Formulating policy for climate change adaptation	1.55	.83	1.40	.74	1.88	.85	1.69	.85

4.4 Area of competence needs of extension of agents on climate change adaptation

4.4.1 Areas of competence needs of extension agents for agricultural adaptation to climate change

The respondents perceived all the areas identified as major areas of competence needs of extension agents for agricultural adaptation to climate change. They include; communication

(M=2.93), technical knowledge/ skills/ information on climate change (M=2.89), participatory extension strategies (M=2.81), use of information communication technology (M=2.72), facilitation (M=2.72), community/Group mobilization (M=2.70), networking/Linkage (M=2.60) and documentation of indigenous knowledge (M=2.57) (Table 8). This agrees with the definition of professional competence as the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and community being served. (American Academy of Physician Assistants (AAPA), 2010). It supports the fact that extension professionals require not only technical knowledge of subject matter but also organizational, institutional, management and communicational skills to effectively and efficiently carry out their education and facilitation functions.

Table 8 : Mean distribution of respondents' perceived area of competence needs of extension agents on climate change adaptation

Areas	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Communication	2.91*	.28	3.00	.00	2.92*	.27	2.93*	.25
Technical knowledge/ skills/ information on climate change	2.92	0.27	2.87	0.35	2.88*	0.34	2.89*	0.31
Networking/Linkage	2.68	.47	2.73	.46	2.48*	.60	2.60*	.53
Community/Group mobilization	2.61	.64	2.87	.35	2.73*	.45	2.70*	.53
Participatory extension strategies	2.79	.41	2.87	.35	2.80*	.41	2.81*	.40
Use of Information Communication Technology (ICTs)	2.71	.61	2.73	.46	2.73*	.45	2.72*	.52
Documentation of indigenous knowledge	2.45	.65	2.67	.62	2.65*	.48	2.57*	.58
Facilitation	2.68	.47	2.80	.56	2.73*	.51	2.72*	.50

4.4.2 Communication skills/knowledge needed by extension agents

Table 9 shows that the respondents perceived twelve communication skills/knowledge as major skills needed by the extension agents for climate change adaptation. These skills/knowledge were knowledge of subject matter, treatment and content analysis (M=2.83), use of clear language, appropriate tone and style in communicating (M=2.65), knowledge of socio-cultural environment (M=2.63), observation skill (M=2.63), skill in providing/managing feedback (M=2.62), listening skill (M=2.62), planning skill for communication (M=2.60), skill in selecting appropriate communication channel/method (M=2.57), and others.

Skills for creating adult learning situation (M=1.67), flexibility to encourage creativity (M=1.52), empathy (M=1.49) and audience analysis (M=1.37) were not perceived as requisite skills needed by the extension agents for communicating climate change information. The standard deviation shows uniformity in the opinion of the respondents. The findings indicate the need for mix of communication skills to increase awareness and responses of farmers to climate change challenges. Communicating climate change information for increase climate science literacy, resilience of farming communities is crucial given the accelerating impacts of climate change on food security, health and human survival. Advances in literature show that farmers and the public at large still have low knowledge/awareness and capacity to adapt to the impacts of climate change (Nzeadibe, *et al.* 2010; Nzeh and Eboh, 2010; Onwubuya & Obiora, 2011; Dimelu, Enwelu,& Igbonazobi, 2014;). The FAO (2008) remarked that extension professionals are expected to facilitate generation of knowledge/technologies, build awareness, transfer knowledge/technologies and implement actions for effective management of climate change risks. Thus, acquiring mix of communication competence is an imperative. Besides the cultural diversity, divergent views and understanding of climate change phenomenon underpin the importance of adequate communication skills necessary to explain, persuade, convince and

exchange information and ideas in a clear and concise manner, and influence clients to be responsive and proactive for a desired outcomes in adapting to climate change.

Table 9: Mean distribution of respondents' perceived communication skills/knowledge needed by extension agents on climate change adaptation

Communication skills/knowledge on climate change	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Knowledge of socio-cultural environment	2.55*	.72	2.80*	.41	2.65*	.58	2.63*	.62
Skill in selecting appropriate communication channel/method	2.42*	.50	2.87*	.35	2.60*	.55	2.57*	.52
Skill in providing/managing feedback	2.57*	.65	2.79*	.43	2.62*	.49	2.62*	.55
Knowledge of subject matter, treatment and content analysis	2.87*	.34	2.87*	.35	2.76*	.42	2.83*	.38
Listening skill	2.49*	.51	2.73*	.46	2.70*	.52	2.62*	.51
Skills for creating adult learning situation	1.53	.73	1.93	.88	1.73	.78	1.67	.79
Audience analysis	1.24	.49	1.53	.64	1.48	.68	1.37	.62
Providing learning experience	2.57*	.50	2.67*	.62	2.49*	.56	2.55*	.54
Use of clear language, appropriate tone and style in communicating	2.66*	.48	2.73*	.46	2.60*	.55	2.65*	.50
Planning skill for communication	2.63*	.49	2.80*	.41	2.50*	.51	2.60*	.49
Flexibility to encourage creativity	1.37	.54	1.73	.70	1.55	.64	1.52	.64
Timing skill (use of appropriate for different issues)	2.55*	.65	2.67*	.49	2.43*	.59	2.52*	.60
Encouragement skill to build the confidence of the audience	2.50*	.65	2.73*	.46	2.45*	.68	2.52*	.64
Observation skill	2.46*	.65	2.93*	.26	2.68*	.57	2.63*	.59
Empathy	1.13	.34	1.33	.62	1.33	.57	1.49	.60
Summarizing skill by picking out main issues	2.37*	.71	2.93*	.26	2.53*	.60	2.53*	.64

4.4.3 Technical knowledge/skill/information needs of extension agents for agricultural adaptation to climate change

Table 10 indicates that the major technical knowledge/skills/information required by extension agents were knowledge of climate change, causes and effect (M=2.78), weather forecast or information (M=2.75), adaptation technologies/practices (M=2.66), skill on application of innovative adaptation practices (M=2.53) and knowledge of new laws, policies or programmes on

climate change (M=2.52). On the other hand, skill for diagnostic survey (M=1.49) and knowledge/skills of indigenous/local adaptation practices (M=1.53) were not considered major skills for extension agents. The standard deviations were less than one, indicating homogeneity in the opinion of the respondents. The low perception of competence need in knowledge of indigenous adaption practices is contrary to the findings of Adisa and Balogun (2012) who reported that extension agents needs training on indigenous adaptive practices. The characteristic features of indigenous knowledge in terms of scope, practicability, location specificity and the need for wide application and integration into modern research underpin the need for competence in the area. Besides, the evolving and dynamic features of local innovation in the face of the ever changing climate and weather vagaries call for regular update of practices. However, this does not undermine the need for knowledge of the existing and emerging modern technologies/information for climate change adaptation. Technologies that help farmers to mitigate as well as adapt to climate change need to be identified and brought to their knowledge (Ifeanyi-Obi, and Jike-Wai, 2012). In either case, effective networking and collaboration with stakeholders at different levels are pertinent.

Table 10: Mean on perceived technical knowledge /skill/information needed by extension agents on climate change adaptation

Technical knowledge /skill/information on climate change	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Knowledge of climate change, causes and effect	2.76*	.43	2.80*	.41	2.80*	.41	2.78*	.41
Knowledge of modern adaptation technologies/practices	2.63*	.49	2.73*	.59	2.65*	.48	2.66*	.50
Skill on application of innovative adaptation practices	2.53*	.56	2.60*	.74	2.50*	.72	2.53*	.65
Knowledge of weather forecast or information	2.76*	.49	2.87*	.52	2.70*	.46	2.75*	.48
Knowledge of new laws, policies or programmes on climate change	2.57*	.56	2.93*	.27	2.33*	.70	2.52*	.62
Skill for diagnostic survey	1.53	.51	1.87	.74	1.33	.57	1.49	.60
Knowledge/skills on indigenous/local adaptation practices	1.39	.55	1.80	.68	1.58	.68	1.53	.64

* Major skills

4.4.4 Community/group mobilization skills needed by extension agents for climate change adaptation

Entries on Table 11 show that the respondents perceived group formation skills/techniques (M=2.55) and legitimization (M=2.36) as the major skills required by extension agents under community/group mobilization for climate change adaptation. Only field agents perceived that leadership (M=2.23) and conflict management skills (M=2.25) were required to functionally perform their role for climate change adaptation. This could be due to their experience over years in working with farmers. On the other hand, power structure (M=1.52), situation analysis (M=1.76) and persuasive skills (M=1.68) were perceived by both categories of professionals as minor skills for group mobilization.

Skills for group mobilization is crucial in this era of popular use of participatory approaches to interventions and development. It has advantages both for wider participation, coverage, ownership, accountability, cost effectiveness and sustainability of development programmes. However, experience over years shows that these groups collapse almost at the rate at which they are being formed. Hence, competency of extension agents for formation of functional, viable and sustainable rural groups is highly important in addressing the formidable challenges of climate change. More over, the need for such competence hinges on the facts that extension agents have the responsibility to build farmers' abilities for planning, problem solving, critical thinking, prioritizing, negotiating, building consensus and leadership skills, working with multiple stakeholders, and, finally, being proactive (Davis 2009). In addition they need to mobilize and assist farmers and communities in implementing policies, programs and managing disaster challenges.

Table 11: Mean scores on perceived community/group mobilization skills needed by extension agents on climate change adaptation

Community/group mobilization skills	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Power structure	1.53	.51	1.87	.74	1.28	.51	1.52	.62
Legitimation	2.31*	.47	2.60*	.51	2.31*	.66	2.36*	.57
Group formation skills/techniques	2.46*	.77	2.67*	.62	2.59*	.50	2.55*	.64
Leadership skill	1.55	.65	1.64	.82	2.23*	.83	1.87	.84
Conflict management	1.50	.69	1.60	.74	2.25*	.87	1.84	.85
Situation analysis	1.63	.71	1.73	.70	1.85	.83	1.76	.79
Persuasive skill	1.53	.65	1.87	.74	1.75	.81	1.68	.74

***Major skills needed**

4.4.5 ICT skills needed by extension agents for climate change adaptation

Table 12 shows that all the three categories of extension workers (administrative staff, technical staff and field staff) perceived basic computer literacy (M=2.66), use of internet facilities (M=2.63), SMS facilities (M=2.61), mobile phone in providing timely information on climate change adaptation (M=2.57), skills in use of traditional media (T.V, radio, printer, etc.) (M=2.54) and use of multimedia facilities (projectors, audiovisuals, etc.) (M=2.50) as major skills essential for extension agents. Also technical (M=2.21) and field staff (M =2.08) perceived skills in use of computer wares as major skills required by extension agents.

On the other hand, skills for providing information through flyers, posters, handbills, etc were not perceived as major skills needed by extension agents for climate change agricultural adaptation. Competence of extension agents in the use of ICTs facilities is crucial because it is widely believed that the capacity of nations to mitigate and adapt to climate change largely depends on informed decision process, access to locally appropriate information, and the

availability of an enabling environment. The poor perception of traditional ICTs facilities (print media) could be due to their popular use for most extension work, but the extent of competency in preparing them is not ascertained. Generally, ICTs plays important role for faster, wider and more efficient dissemination of information to people in different geographical locations particularly persons in highly dispersed and risk- prone rural areas. It presents unprecedented opportunities for combating the increasing challenges of climate change from use of innovative SMS-based early warning systems aimed at delivering more effectively weather alerts, to computer training to strengthen local livelihoods, or radios used to raise awareness on sustainable practices in marginalized areas,. According to Prasad. & Heeks (2011) the use of ICTs can also assist stakeholders to integrate local and indigenous knowledge and experiences, strengthen international, national, and local-level decision-making processes on adaptation, and improve the planning, implementation and monitoring of adaptation initiatives and approaches that integrate different technologies, emergent and traditional knowledge.

Table 12: Mean distribution of respondents' perceived ICT skills needed by extension agents on climate change adaptation

ICT skills	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Basic computer literacy	2.51*	.70	2.80*	.56	2.74*	.44	2.66*	.58
Use of internet facilities	2.49*	.56	2.93*	.26	2.64*	.49	2.63*	.51
Skills in use of traditional media (T.V, radio, printer, etc.) in building capacity of farmers for adaptation	2.46*	.56	2.87*	.35	2.50*	.56	2.54*	.54
Skills on use of flyers, posters, handbills, etc.	1.53	.65	1.60	.74	1.45	.68	1.51	.67
Use of multimedia facilities (projectors, audiovisuals, etc.)	2.32*	.82	2.93*	.26	2.50*	.56	2.50*	.67
Use of mobile phone in providing timely information on climate change adaptation	2.53*	.61	2.80*	.41	2.53*	.51	2.57*	.54
Use of SMS facilities	2.48*	.76	2.75*	.62	2.68*	.47	2.61*	.62
Skills in use of computer wares (soft and hardware)	1.76	.75	2.21*	.80	2.08*	.90	1.96	.79

***Major skills**

4.4.6 Participatory and skills in extension methods

Data on Table 13 show that all categories of the respondents perceived use of farmer-to-farmer (M=2.76), skills in use of extension methods e.g. demonstration, group discussion, seminars etc. (M=2.73) and use of rapid rural appraisal for rural situation analysis (M=2.64) as the major participatory and extension approach/skills required by extension agents for climate change adaptation. Technical ((M=2.80) and field staff (M=2.38) indicated skills in co-learning or interactive learning as major skills needed for climate change adaptation.

On the other hand, only technical personnel perceived knowledge and skill in participatory rural appraisal (M=2.13) as a major skill required by extension agents. The variation in the perception of both categories of extension workers could be attributed to the difference in the role performed and experiences in extension work. The extension agents and technical staff are closer to rural farmers and may have been confronted with the challenge of creating an interactive platform rather than prescriptive teaching environment which are often projected through the use of conventional extension methods like seminars, lectures, demonstration etc. The last ten decades has witnessed increased emphasis, concern and promotion of participatory approaches by the government and international community because of the potential for increase community participation and sustainability of development programmes. Report has shown that farmers are often not involved in identifying most climate change adaptation strategies which can lead to poor adoption of such strategies by rural people (UNESCAP 2009). This is also common in most extension outfit in Nigeria and could be attributed to poor competency of professionals in the use of participatory methods. Participatory extension approaches requires a paradigm shift from conventional top-down technology transfer to people oriented ,decentralized, empowerment, and problem solving strategies. Thus, the need for tailored training and competence in the relevant skills for effective implementation of participatory strategies given the multi- dimensional impacts of climate change across the globe.

Table 13: Mean scores on perceived participatory skills and extension strategies needed by extension agents on climate change adaptation

Participatory and extension strategic skills	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Use of Rapid Rural Appraisal for rural situation analysis	2.66*	.48	2.73*	.46	2.60*	.59	2.64*	.53
Use of innovative approach/strategies in extension e.g. farmer-farmer extension, farmer field school.	2.80*	.41	2.79*	.43	2.73*	.51	2.76*	.45
Skills in co-learning or interactive learning	1.87	.70	2.80*	.41	2.38*	.74	2.26*	.75
Skills in use of extension methods e.g. demonstration, group discussion, seminars etc.	2.83*	.38	2.80*	.41	2.60*	.59	2.73*	.50
Knowledge and skill in participatory rural appraisal	1.89	.69	2.13*	.83	1.75	.81	1.87	.77

*Major skills

4.4.7 Linkage and networking skills

Table 14 indicates that the respondents perceived knowledge and skill in use of linkage mechanisms (M=2.62), partnership skill (M=2.62) and knowledge of relevant actors, establishing and fostering linkage with them (M=2.54) as major skills needed by the extension agents for agricultural adaptation to climate change.

On the other hand, favourable attitude to linkage in agricultural innovative system (M=1.74), skills in analyzing cost and benefit of linkage (M=1.46) and skill in budgeting for linkage (M=1.51) were not perceived as major skills for extension agents. The low standard deviation shows that the respondents share common views about linkage knowledge /skills required by extension agents.

The effects and impact of climate change cut across all sectors, discipline and human livelihood activities and thus, efforts towards adaptation and mitigation requires active stakeholders' participation, collaboration and networking at local, national, regional and

international levels. This is crucial in order to build upon and leverage existing areas of expertise and technical know-how and information from different research domain in climate change innovation system. Davis (2009) reiterated that it is increasingly important for extension to link farmers and other people in rural communities directly with private and public institutions that disseminate adaptation technologies and funding programmes for adaptation investment. Generally, reports show that agricultural research system in Nigeria is characterized by a top-down, centralized, monolithic and isolated structures, (Agwu, Dimelu and Anyanwu., 2008). Linkage/ interaction, exchange of information and resources within agricultural research-education-extension-farmer-input/private system (agricultural innovation system) have been generally weak (Dimelu and Anyanwu, 2008). According to Farautu, Egbule, Idrisa and Agu (2011) there are many climate actors in the country but there is no platform or framework within which they can operate in a coordinated manner for meaningful impact. Furthermore, Agwu, Egbule, Amadu, Morlai et al. (2012) reported that there is concurrently non-existence of oversea collaboration/linkages among climate change actors particularly with farmers and other actors in the climate change innovation system in Nigeria, Sierra Leone, and Liberia. According to the authors, linkage among actors in climate change and food security innovation system is essential for relevance, capacity building and increase innovation performance of the actors and the system in general.. Thus, acquiring relevant skills, knowledge and altitude to linkage by extension agents is apt for effective contribution to building local capacity for adaptation.

Table 14: Mean scores on the perceived linkage and networking skills needed by extension agents on climate change adaptation

Linkage and networking knowledge/skills	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Knowledge and skill for use of linkage mechanisms	2.47*	.51	2.80*	.41	2.68*	.47	2.62*	.49
Favourable attitude to linkage in agricultural innovative system	1.68	.74	1.87	.74	1.75	.81	1.74	.77
Knowledge of relevant agencies, establishing and fostering linkage with them.	2.51*	.69	2.87*	.35	2.45*	.55	2.54*	.60
Partnership skill with key actors involved in climate change	2.64*	.68	2.87*	.35	2.50*	.68	2.62*	.65
Skills in analyzing cost and benefit of linkage	1.50	.69	1.40	.63	1.48	.68	1.46	.67
Skill in budgeting for linkage	1.68	.74	1.67	.62	1.30	.52	1.51	.64

*Major skills

4.4.8 Facilitation skills

Table 15 shows that respondents perceived 14 out of 17 items as major facilitation skills needed by the extension agents for climate change adaptation. The variables included assisting agencies institutionally and managerially in implementing climate change/disaster related programme or intervention (M=2.76), record keeping (M=2.72), skill in selecting suitable and accessible information media for delivering of information in rural community (M=2.71), group facilitation (M=2.70), facilitating broadcast of agricultural programmes on local radio stations (M=2.68), assisting farmers to implement programmes and policies related to climate change adaptation (M=2.64), advocacy on climate change affected areas (M=2.64), planning and management skills in times of ecological disaster (M=2.62), and others.

On the other hand, skill for dialogue and arriving at consensus (M=1.37), skill for lobbying and facilitating documentation of indigenous knowledge practices (M=1.29) were perceived as minor skills for extension agents. There is uniformity in the views of the respondents given the low standard deviation across the items. However, the low perception of some items like

lobbying, dialogue and others which are among the key features of facilitation suggests low knowledge or commitment to facilitation of programmes by extension professionals. Facilitation of agricultural programmes brings out or stimulates community intellect and energies to be able to plan their resources for the benefit of the generality of the communities and the key stakeholders or groups. Extension education has the responsibility of enhance farmers's abilities for planning, problem solving, critical thinking and prioritizing, negotiating, building consensus and leadership skills, and working with multiple stakeholders (Davis, 2009). These comprise the facilitation roles of extension agents evidenced in some agricultural development programmes like Fadama Development Project (1, 11, 111), Commercial Agriculture Development Programme (CADP)etc. It is thus, gaining popularity in development arena as a veritable strategy for delivering public and non-governmental interventions, underpinning the need for building the competence of extension professionals.

Table 15: Mean scores on perceived facilitation skills needed by extension agents for climate change adaptation

Facilitation skills	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
1. Skills for assisting farmers to implement programmes and policies related to climate change adaptation	2.51*	.66	2.73*	.59	2.73*	.51	2.64*	.59
2. Assisting agencies institutionally and managerially in implementing climate change/disaster related programme or intervention	2.76*	.55	2.87*	.35	2.73*	.51	2.76*	.50
3. Skill for dialogue and arriving at consensus	1.12	.031	1.60	.51	1.53	.68	1.37	.57
4. Planning and management skills in times of ecological disaster	2.55*	.50	2.73*	.46	2.64*	.63	2.62*	.55
5. Skills for advocacy on climate change affected areas	2.66*	.58	2.87*	.35	2.54*	.56	2.64*	.55
6. Skills for lobbying	1.21	.47	1.53	.64	1.28	.51	1.29	.53
7. Skill in addressing the needs of farmers	2.42*	.76	2.67*	.49	2.64*	.67	2.55*	.69
8. Skill in selecting suitable and accessible information media	2.74*	.45	2.87*	.35	2.62*	.54	2.71*	.48
9. Facilitating the documentation of indigenous practices	1.68	.75	1.87	.74	1.58	.68	1.66	.72
10. Record keeping	2.58*	.64	2.87*	.35	2.81*	.40	2.72*	.52
11. Role modeling	2.43*	.69	2.53*	.64	2.44*	.64	2.45*	.65
12. Group facilitation skill	2.66*	.53	2.67*	.62	2.76*	.49	2.70*	.53
13. Management of participatory decision making	2.51*	.65	2.73*	.59	2.67*	.48	2.62*	.57
14. Vision consensus and participation benefit	2.53*	.56	2.67*	.62	2.36*	.71	2.48*	.64
15. Group leadership and management skill	2.61*	.55	2.80*	.56	2.49*	.64	2.59*	.60
16. Balance/equal participation	2.39*	.76	2.67*	.62	2.39*	.68	2.44*	.70
17. Skill in facilitating broadcast of agricultural programmes on local FM radio stations	2.70*	.52	2.87*	.35	2.59*	.55	2.68*	.51

*Major skills

4.4.9 Documentation of indigenous Knowledge/skills needed by extension agents on climate change adaptation

Data on Table 15 indicated that the major indigenous knowledge/skills needed by extension agent were: validation and/ integration into research for wider application (M=2.66), knowledge of indigenous practices on adaptation to climate change (M=2.59), knowledge, valuing

and understanding of indigenous knowledge (M=2.58), knowledge of location specificity of indigenous knowledge (M=2.54) and skills for documentation of indigenous knowledge (M=2.53).

On the other hand, only the technical staff found skills for application in specific localities (M=2.13) as a major skill needed by extension agents for climate change adaptation. Indigenous people have developed adaptation methods and coping strategies to manage their environments over the millennia, and these can be redeployed for facing the great challenge of climate change (Julie Mollins, 2013). They are key sources of information and insight for environmental management and sustainable development in several important domains such as agroforestry, traditional medicine, biodiversity conservation, customary resource management, impact assessment, and natural disaster preparedness and response (unn.edu/publications/articles/why-traditional-knowledge-holds-the-key-to-climate-change.html). Besides, indigenous or traditional knowledge may prove useful for understanding the potential of certain adaptation strategies that are cost-effective, participatory and sustainable. Many African farming communities have thrived for decades and centuries even in the face of changing climate (Ozor, Madukwe, Onokala, Enete et al.2010) because of the use and application of several indigenous knowledge/ techniques most of which have been modified continually and passed on from one generation to another. (Ozor, Kelvin and Mwangi, 2012). The limitation however, is the fact that several valuable indigenous knowledge (IK) is now gradually disappearing and remains only in the memory of some aged people who live in remote rural areas and constitute the majority of the farming population.(Das-Gupta and Saha, 2009); thus, upgrading local knowledge with more scientific observations and establishing collaboration among neighbours and neighbouring countries to transfer knowledge from areas already experiencing these changes as recommended by FAO, 2008) may be a mirage without proper documentation. Also Ozor, Urama, Mwangi (2012) in their study on climate change vulnerability and the use of indigenous technologies for adaptation among smallholder

farming communities in sub-saharan Africa noted the need to out scale and up scale indigenous knowledge in other parts of African communities with similar climate change challenges. These all point to the need for documentation competence among actors particularly extension professional who relate directly with farmers

Table 16: Mean distribution of respondents' perceived documentation of indigenous Knowledge/skills needed by extension agents on climate change adaptation

Knowledge/skills in documentation of indigenous knowledge	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
1. Knowledge, valuing and understanding of indigenous knowledge	2.53*	.69	2.67*	.49	2.59*	.50	2.58*	.58
2. Knowledge of indigenous practices on adaptation to climate change	2.53*	.65	2.67*	.49	2.62*	.54	2.59*	.58
3. Skills for application in specific localities	1.76	.75	2.13*	.83	1.58	.68	1.74	.75
4. Validation and/ integration into research for wider application	2.66*	.48	2.93*	.26	2.54*	.51	2.66*	.48
5. Skills for documentation of indigenous knowledge	2.34*	.63	2.80*	.41	2.62*	.49	2.53*	.56
6. Knowledge of location specificity of indigenous knowledge	2.63*	.54	2.60*	.63	2.44*	.64	2.54*	.60

*Major skills

4.5 Factors militating against competence building of extension agents

Data on Table 16 show that the major constraints militating against competence building of extension agents for climate change adaptation were inadequate fund (M=3.80), inadequate knowledge and technologies on climate change and its adaptation (M=3.70), lack of incentives/motivation of extension agents (M=3.64), inadequate trained/qualified resource persons

(M=3.59), inadequate provision of logistic supports for field staff (M=3.57), poor availability of training opportunities (M=3.51), and others

Only the administrative staff perceived poor understanding of climate change concept (M=2.53) as a major factor affecting competence building of extension agents. The respondents perceived poor documentation of indigenous knowledge (M=2.25), location specificity of indigenous knowledge (M=1.88), lack of interest in climate change (M=2.20) and undefined roles of actors in climate change adaptation (M=2.39) as minor constraints to acquisition of requisite competence for extension agents. Largely, these problems are associated with the commonly reported impediments inherent in the public extension system. For instance, Ogunbameru (2005) reported that extension outfit has been experiencing dwindling funding from government since after the withdrawal of World Bank assistance to Agricultural Development Programme. Others problems variously highlighted include extension- farmer ratio, poor logistic supports, poor infrastructure, inadequate qualified extension workers etc (Agbamu, 2011, Okoye and Ihimodu, 2004). Competence of employee is affected by several factors ranging from personnel resources, knowledge, know-how, environmental resources, and external factors (Boterf, 2000; Mazin, 2012). Thus, building competence of extension agents for climate change adaptation is a function of economic, organizational, infrastructural, institutional, personnel- related factors.

Lack of the necessary empowerment like finance, knowledge, technologies, training, logistic support, reliable weather forecast, infrastructure etc. to the extension system affect both attitude, behavior, knowledge/skills, motivation and general performance of expected roles of extension agents. Also poor access or lack of training opportunities, poor ICTs skills and low moral limit access to appropriate technical knowledge and information; and efficiency of dissemination activities/efforts of extension agents

Table 17: Mean scores on perceived factors militating against competence building of extension agents

Factors	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
1. Inadequate fund	3.74*	.64	4.00*	.00	3.79*	.47	3.80*	.52
2. Inadequate knowledge and technologies on climate change and its adaptation	3.61*	.70	3.93*	.26	3.69*	.61	3.70*	.66
3. Poor skills on the use of ICT facilities (E-learning in climate change	3.37*	.82	3.60*	.51	3.33*	.70	3.39*	.73
4. Inadequate trained/qualified resource persons	3.47*	.73	3.67*	.62	3.67*	.53	3.59*	.63
5. Lack of function reliable weather forecasts/climate information	3.42*	.68	3.67*	.49	3.51*	.68	3.50*	.66
6. Unavailability/poor access to needed infrastructure	3.37*	.94	3.53*	.52	3.40*	.74	3.41*	.80
7. Lack of interest on climate change by extension agents	2.05	0.73	2.40	.77	2.25	.78	2.20	.72
8. poor coordination among agencies in agriculture and rural development	3.24*	.85	3.50*	.52	3.30*	.61	3.30*	.71
9. Inadequate provision of logistic supports for field staff	3.61*	.89	3.47*	.64	3.58*	.81	3.57*	.81
10. Poor recognition/documentation of indigenous knowledge	2.18	.61	2.33	.72	2.28	.75	2.25	.69
11. Lack of incentives/motivation of extension agents	3.60*	.83	3.73*	.46	3.64*	.63	3.64*	.69
12. Poor moral/career development opportunity	3.22*	.92	3.27*	.59	3.40*	.67	3.30*	.77
13. Poor policy formation and implementation on climate change	3.47*	.80	3.40*	.51	3.24*	.91	3.36*	.81
14. Undefined roles among actors on climate change adaptation	2.37	.59	2.47	.64	2.25	.75	2.39	.68
15. Corruption/bad governance	3.42*	1.00	3.60*	.83	3.44*	.94	3.46*	.94
16. Poor disaster risk management on climate change	3.61*	.68	3.53*	.92	3.20*	.97	3.42*	.86
17. Poor availability of training opportunities	3.55*	.65	3.47*	.83	3.48*	.68	3.51*	.69
18. Poor linkage to relevant institutions	3.45*	.72	3.27*	.88	3.30*	.76	3.35*	.76
19. Location specificity of indigenous adaptation to climate change	2.05	.70	1.73	.70	1.63	.77	1.88	.78
20. Poor policy framework/political instability	3.40*	.72	3.67*	.62	3.25*	.90	3.38*	.79
21. Poor understanding of the climate change concept	2.26	.89	2.53*	.92	2.33	.73	2.34	.81
22. Non availability and attendance to workshops, conferences, seminars	3.53*	.65	3.60*	.91	3.38*	1.08	3.47*	.89

*Major factors

4.6 Factor analysis of constraints to building competence of extension agents for agricultural adaptation to climate change.

Table 17 represents factor analysis of perceived constraints to competence building of extension agents for climate change adaptation. Based on the loading of the items four factors were identified namely logistic problem (1), institutional factor (2), financial and technical problem (3) and extension agents's altitude (4).

Factors that loaded on logistic problem were unavailability/poor access to needed infrastructure (.794), poor coordination among agencies in agriculture and rural development (.811), Inadequate provision of logistic supports for field staff (.856), Lack of incentives/motivation of extension agents (.906) and non-availability of workshops, conferences, seminars (.503). Unavailability or lack of access to infrastructure by extension professionals or farmers can worsen the already bad climatic situation and vulnerability of rural communities in Nigeria. For instance, good communication/transport system (such as good road network, telecommunication e.t.c.) can facilitate exchange of climate change information and prompt response to climate alert and disaster management challenges. . Input and infrastructural facilities are vital resources that facilitate all-round development of man and his environment (Inobeme and Ayanwole, 2010). The major challenge as far as logistics are concerned is transportation of agricultural extension agents to different locations where they offer services to farmers on daily basis. Mobility and accommodation of field staff is vital in operating an efficient agricultural extension service. These have negative effects on the competence of extension workers in educating farmers on climate change related problems and provision of adaptive measures to ameliorate climate change risks witnessed today in most rural Nigeria.

Variables that loaded under institutional factor (Factor 2) include corruption/bad governance (.738), poor disaster risk management on climate change (.883), poor availability of training opportunities, (.683), poor linkage to relevant institutions (.611) and poor policy

framework/political instability (.660). Institutional factors compose policy infrastructures in terms of government policy provisions, governance which are pivotal to functioning of other policy related mechanisms like linkage, staff development and response to climate disasters. Agbamu (2011) reported that over the last 100 years (1912-2012) of government presence in agricultural extension in Nigeria, policy, institutional and programme instabilities/inconsistency have bedeviled its operations. The Nigerian governments have initiated several agricultural and ecological policies or programmes, but due to political instability and corruption, most of these policies were either reversed or abandoned. Also policies that establish interdependent sectors like research, education and extension often inhibit interaction, linkage and cooperate learning/knowledge sharing and synergies of efforts towards agricultural development, even in the face of challenging threat of climate change to production, livelihood and health..

Factors that loaded under financial and technical problem (Factor 3) were inadequate fund (.569), inadequate knowledge and technologies on climate change and its adaptation (.882), poor skills on the use of ICT facilities (E-learning in climate change) (.860), inadequate trained/qualified resource persons (.855) and lack of functional reliable weather forecasts/climate information (.505). This supports the earlier findings on the under-funding of extension work in Nigeria. Funds is one of the fundamentals, indispensable for efficient functioning of any extension system and when inadequate could highly affect the entire working environment, development and management of personnel, technological capacity of professionals and performance of the whole system. Acquisition of technical knowledge for adaptation, ICTs skills and training of extension professional anchor on availability of fund to extension organization. It could also lead to retrenchment of field extension workers, high staff mobility, poor/inadequate training, stagnation of both field and supervisory work, low morale of staff and invariably poor dissemination/ implementation of agricultural adaptation practices to climate change.. Extension

system requires adequate funding to ensure successful performance of the organization (Agbam, 2011).

Extension agents' attitude (factor 4) included lack of interest on climate change by extension agents (.764), poor recognition/documentation of indigenous knowledge (.824), undefined roles among actors on climate change adaptation (.840) and poor understanding of the climate change concept (.601). Competence needs for agricultural adaptation to climate change is both a function of knowledge, skill, behavior and attitude of extension agents. The attitude of extension agents, though a function of personal and organizational/institutional factors, determines the commitment to learning, acquisition of knowledge and dissemination of the same to end users. A favourable disposition or attitude of extension agents could translate to greater participation, capacity building and resilience of rural communities to climate change.

Table 18: Factor analysis of perceived constrains to effective competence building of extension agents on climate change adaptation

Constraints	Logistic problem (Factor 1)	Institutional factor (Factor 2)	Financial and technical problem (Factor 3)	Extension agents altitude (Factor 4)
1. Inadequate fund	.297	.040	.569	.003
2. Inadequate knowledge and technologies on climate change and its adaptation	-.055	-.057	.882	-.017
3. Poor skills on the use of ICT facilities (E-learning in climate change	.094	.049	.860	.099
4. Inadequate trained/qualified resource persons	-.020	.121	.855	.129
5. Lack of function reliable weather forecasts/climate information	.105	.208	.505	.140
6. Unavailability/poor accessto needed to infrastructure	.794	.166	-.019	.156
7. Lack of interest on climate change by extension agents	.046	.015	.222	.764
8. Poor coordination among agencies in agriculture and rural development	.811	.137	.100	.115
9. Inadequate provision of logistic supports for field staff	.856	.167	.181	.098
10. poor recognition/documentation of indigenous knowledge	-.082	.084	.198	.824
11. Lack of incentives/motivation of extension agents	.906	-.029	.064	.012
12. Poor moral/career development opportunity	.700	.408	-.101	-.036
13. Poor policy formation and implementation on climate change	.552	.505	.381	-.004
14. Undefined roles among actors on climate change adaptation	.106	-.043	-.039	.840
15. Corruption/bad governance	.171	.738	.067	.054
16. Poor disaster risk management on climate change	.039	.883	-.008	-.044
17. Poor availability of training opportunities	.300	.683	-.077	.105
18. Poor linkage to relevant institutions	.215	.611	.161	-.041
19. Location specificity of indigenous adaptation to climate change	-.297	.383	.063	.075
20. Poor policy framework/political instability	.357	.660	.290	-.114
21. Poor understanding of the climate change concept	.131	-.012	-.029	.601
22. Non-availability and conducting of workshops, conferences, seminars	.503	.159	.158	.028

4.7 Possible strategies for building competence of extension agents for climate change adaptation

Data in Table 8 indicate that all (100%) the variables listed were considered as effective strategies required to build the competence of extension agents for agricultural adaptation to climate change. These strategies were adequate funding of extension services (public system) (M=3.85), provision of short-course for extension agent on climate change (M=3.82), employment of trained/qualified extension agents (M=3.77), organizing/attendance to workshops conferences, seminars etc (M=3.77), orientation courses for extension agent for attitude change (M=3.76), in-services/in house training of extension agents (M=3.66), availability of functional and reliable weather forecasts/climate information stations (M=3.65), institutional and policy support for researches on climate change (M=3.62), and others. Both categories of extension professionals shared similar views on the effective strategies for building necessary competence of extension agents. The low standard deviation further indicates homogeneity of perception within categories. Climate science education is fundamental in building competence of stakeholders for adaptation, particularly among extension agents as educators and broker of information/technologies to the most vulnerable group in the population. Infact Ernst, *et.al* (1994) opined that increase in general education could help develop technological capability in the workforce especially for climate change. This could be achieved through certificate short course, conferences/seminars, in-house training of extension agents. NRC& (2010) recommended that The federal government should establish a national task force that includes formal and informal educators, government agencies, policymakers, business leaders, and scientists, among others, to set national goals and objectives, and to develop a coordinated strategy to improve climate change education and communication. In service training, workshops, conferences etc makes for gap in knowledge and keep workers abreast of emerging issues in related subject areas. It may also require that curricular content, teaching materials, methods and delivery approaches be designed

in such a way as to equip students with necessary skills and knowledge to tackle climate change global challenges and their interpretation in specific local situations (Chakeredza *et al.*, 2008) who are the future extension workforce.

Favourable policy and adequate funding of extension and research organisations are indispensable for provision of essential infrastructure, working environment and fostering linkages required for acquisition of relevant competence by extension agents. Strong linkages with stakeholders like research, education and private/NGOs is apt to develop contextualized information; enhanced access to appropriate adaptation technologies as well as information flow, learning and cooperation necessary for the required competence. According to Collins and Ison (2009) in Bartels, Furman, Diehi, Royce, & Doure *et al.*, (2012) stakeholders network and participatory processes have been proposed as venues and mechanisms for repeated knowledge sharing, dialogue and learning about climate change and adaptation. Furthermore, policy and funding should be such that promote adequate logistic supports, encourage positive attitude, interest and commitment of extension agents. The presence of functional climate change policy with guide on building capacity or competence of stakeholders at all levels is required.

Table 19: Mean distribution of respondents' perceived possible strategies for competence building of extension agents on climate change adaptation

Possible strategies	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
1. Adequate funding of extension services (public system)	3.84*	.37	3.93*	.26	3.83*	.64	3.85*	.49
2. Orientation courses for extension agent for attitude change	3.76*	.49	3.80*	.41	3.75*	.49	3.76*	.48
3. Provision of short-course for extension agent on climate change	3.84*	.37	3.80*	.56	3.80*	.61	3.82*	.51
4. Employment trained/qualified extension agents	3.71*	.52	3.80*	.56	3.82*	.45	3.77*	.49
5. Availability of functional and reliable weather forecasts/climate information stations	3.63*	.63	3.87*	.35	3.58*	.71	3.65*	.64
6. Provision of needed input and infrastructures	3.34*	.85	3.80*	.56	3.56*	.60	3.51*	.72
7. Institutional and policy support for researches on climate change	3.55*	.65	3.87*	.35	3.60*	.74	3.62*	.66
8. Collaboration with other agencies	3.58*	.64	3.60*	.51	3.10*	.90	3.38*	.78
9. Provision of logistic supports for field staff	3.65*	.63	3.60*	.63	3.58*	.71	3.61*	.66
10. Availability of functional policy instrument on climate change mitigation and adaptation	3.47*	.76	3.73*	.46	3.30*	.76	3.44*	.73
11. Inclusion of climate change issues into school curriculum (secondary, high institutions)	3.50*	.73	3.60*	.63	3.55*	.71	3.54*	.70
12. Organizing/attendance to workshops conferences, seminars etc.	3.76*	.54	3.93*	.27	3.73*	.64	3.77*	.55
13. Presences of climate change related policies in rural development	3.39*	.76	3.40*	.51	3.25*	.78	3.33*	.73
14. Promoting of indigenous knowledge in research-extension system	3.50*	.73	3.47*	.64	3.30*	.72	3.41*	.71
15. In-services training of extension agents	3.62*	.68	4.00*	.00	3.56*	.88	3.66*	.73

*Most effective

4.8 Relationship between personal and knowledge of climate change of extension personnel

The result of multinomial logistic regression analysis shows that among the personal and institutional characteristics, the position of the extension personnel in extension organization was

found significant and negatively ($B = -5.844$, $p < 0.05$) related to low knowledge level of extension personnel on climate change. This means that the probability that extension personnel will have low knowledge is a function of his position in the organization. This could be true because the position occupied determines the job description and the people served and possibly the degree of participation and commitment to climate phenomenon particularly at the grassroots. The frontline extension workers are closer and have more regular contact with farmers and ecological system of rural communities than the administrators and often the technical workers. They receive and process feedback from farmers and could be more versatile with challenges experienced by rural communities. Consequently, may be more responsive to climate change information and training opportunities.

Similarly, year spent in extension organization was significant ($B = 0.487$, $p < 0.05$) and positively related to knowledge level of extension workers. The probability that extension personnel will have low knowledge of climate change is positively related to the number of years spent, invariably experience gained in extension work. Climate change is an aged long phenomenon and its impacts in terms of decreasing crop yield, loss of marginal lands, increase pest and diseases, displacement, poverty etc on communities are evident and global concern. The experienced extension workers may likely have higher knowledge of climate change because of their involvement in delivering emerging technologies, information, farmers' experimentation and practices for adaptation and sustainability of ecosystem.

The number of trainings and involvement in climate change activities had no significant relationship with the probability of having low knowledge by extension workers. This is possible because most extension organizations especially the public extension system are yet to evolve climate-related activities and trainings or integrate climate information/role in the portfolio of extension services. The perception and responsiveness to the expected role for agricultural

adaptation to climate change is still at a very low ebb, perhaps due to multi-dimensional problems confronting the system.

Age, sex and marital status of extension were not significantly related to the knowledge level of the extension workers, though younger extension workers are expected to be more proactive and responsive to change, particularly changes. Also sex and marital characteristics could explain the probability of low or high knowledge of climate change by extension workers. Male extension workers could have more access to information through print media, television and radio because of less tight personal schedule, unlike the female counterpart who traditionally operate very busy and extra curriculum- packed schedules. Also the married extension workers has lower rate of job mobility, more experience on the job and possibly greater exposure to climate change challenges than younger ones who most often display high mobility in search of greener pasture.

Furthermore, the year spent in school and area of specialization of extension professionals were not significantly associated with low knowledge of climate change. The finding is not surprising because most institutions of higher learning and disciplines have not included climate change issues in the curriculum; though there has been much emphasis and promotion of curricula review to increase climate change content of courses offered in universities, which is in accordance with general recommendation that climate change issues should be infused into the curricula of universities as a matter of urgency (Chakeredza et al., 2009).

Table 20: Multinomial logit model for hypothesis 1: The association of the personal and socio-economic factors with knowledge level

		Logistic				Odd	ratio
Knowledge scores grouped ^a		coefficient (B)	S. E	Wald	P-value	[Exp(B)]	
Low Knowledge	Intercept	-21.561	4.668	21.335	.000		
	Participation in Climate change activities	.412	2.445	.028 ^{NS}	.866	1.509	
	Number of trainings on Climate change	-.185	1.254	.022 ^{NS}	.883	.831	
	Number of contact	-19.353	4514.841	.000 ^{NS}	.997	3.935E-9	
	Age	.006	.039	.020 ^{NS}	.887	1.006	
	Household size	.488	.312	2.441 ^{NS}	.118	1.628	
	Years spent in extension	.487	.208	5.482***	.019	1.628	
	Marital status	14.230	.000	.	.	1.514E6	
	Secondary occupation	2.454	1.687	2.117 ^{NS}	.146	11.635	
	Area of specialization	-.757	1.672	.205 ^{NS}	.651	.469	
	Position in extension organization	-5.844	2.086	7.852***	.005	.003	
	Sex	-3.036	1.822	2.776 ^{NS}	.096	.048	
	Years spent in school	-.280	.164	2.893 ^{NS}	.089	.756	

a. The reference category is: High Knowledge.

Note: *** indicates significant at 5% level of probability. NS shows not-significant.

4.9 Relationship between personal and attitude of extension personnel to climate change

The result of the binomial regression analysis showing the association of the personal and institutional characteristics of extension personnel and their attitude towards climate change are shown in Table 20. The year spent in school was significant ($B = 0.398$, $p < 0.05$) and positively related to the altitude of extension workers to climate change. In other words, the probability that extension professionals will have positive altitude to climate change adaptation challenges is a function of the number of years spent in school. Ideally, the number of years in school explains the level of education, exposure, knowledge and information about emerging issues like climate change and probably altitude and commitment to change. The more educated the extension professionals the more they may be positively disposed to climate change issues and challenges.

Also year spent in extension work is an important explanatory variable for altitude of extension workers. The result shows that it is significantly but negatively ($B = -0.503$, $p < 0.05$) associated with the altitude of extension workers. This means that the probability of displaying favourable altitude to agricultural adaptation to climate change decreases with increase in number of years in extension work. This is surprising because it is expected that as the year of experience increases, the more informed, abreast, concern and committed they will be in enhancing livelihood of the clients within the context of emerging challenges. But where there is low morale, motivation and poor career advancement opportunities as is common in most public extension system, the reverse may be the case and hence unfavourable altitude to climate change and related issues, despite the years of experience in extension work

Other explanatory variables namely sex, marital status, participation in climate change activities, training, and others have no significant relationship with probability of positive altitude towards climate change. This is probably true because extension worker whether male or female, married or unmarried, administrative or field workers may not have been adequately exposed or

participated in any climate change training or activities given the general low capacity and involvement of extension system in climate issues.

Table 21: Binomial logit model for hypothesis 2: The association of personal and socio-economic factors with attitude

		Logistic coefficient (B)	S.E.	Wald	P-value	Odd ratio [Exp(B)]
Step 1 ^a	Sex	.916	1.618	.321 ^{NS}	.571	2.499
	Age	.027	.047	.333 ^{NS}	.564	1.028
	Marital status	5.820	3.372	2.978 ^{NS}	.084	337.094
	Household size	-.636	.437	2.119 ^{NS}	.145	.529
	Secondary occupation	1.841	1.742	1.117 ^{NS}	.290	6.303
	Years spent in school	.398	.198	4.044***	.044	1.488
	Number of contact area of specialization	.077	.676	.013 ^{NS}	.910	1.080
	Number of training onC.C	2.693	2.241	1.444 ^{NS}	.229	14.777
	Number of training onC.C	.331	.569	.339 ^{NS}	.560	1.393
	Position in extension organization	-2.323	1.677	1.919 ^{NS}	.166	.098
	Participation inC .C activities	-7.249	3.983	3.312 ^{NS}	.069	.001
	Years spent in extension organisation	-.503	.231	4.729***	.030	.605
	Constant	9.885	4.888	4.089	.043	1.964E4

Note: *** indicates significant at 1% level of probability. NS shows non-significant

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The overall purpose of the study is to identify competence needs of extension agents on climate change adaptation in Anambra state. Specifically, the study was design to; ascertain the attitude of the extension personnel to climate change; ascertain the knowledge level of extension personnel on agriculture climate change related issues; ascertain perceived roles of extension in agricultural adaptation to climate change; identify perceived competence needs of extension agents for agricultural adaptation to climate change; determine factors militating against competence building of extension agents and identify the possible strategies to achieving competence building of extension agents. Two hypotheses were tested in the study: personal and socio-economic factors have no significant relationship with the knowledge level of extension personnel on climate change and; there is no significant relationship between personal and socio-economic factors and attitude of extension personnel to climate change.

The study was carried out in Anambra state. Extension personnel in the state constitute the population of the study. All the extension agents and other categories of extension personnel in the state were selected. Both those at the headquarters and those at the four different agricultural zones in the state were selected. This is because of small number of extension personnel in the state which is ninety-nine personnel. Eight (8) personnel from the headquarters, twenty (20) personnel from Aguatazone, twenty-two (22) from Awka zone, twenty-three (23) from Anambra zone and twenty-six (26) from Onitsha zone. However, ninty-three (93) copies of interview schedules were correctly answered and used for analysis. Percentages, mean scores, standard deviation and expository factor analysis and logistic regression analysis were used in analyzing the date.

Results of the analysis show that majority (57.0%) of the respondents were female which consist more of field staff while 43.0% were male. Majority (60.3%) of the respondents were between the ages of 41-50. Also majority (93.5%) of the respondents were married. Greater percentage (53.3%) of the respondents had university first degree and/or Higher Diploma (B.Sc/B.ED/HND). Greater proportion (44.0%) of the respondents studied agricultural extension. Majority (51.1%) of the respondents have had between 11-20 years of experience in extension.

Only 24.7% of the respondents have participated on climate change activities, out of this, 87.1% received training, 8.6% had fieldtrip while 4.3% had outreach. Majority (87.1%) of the respondents had no contact with agency on climate change.

The result of the respondents' knowledge level on agricultural related climate change issues indicated that the majority (63.4%) of the respondents have high knowledge on climate change issues. These respondents consist more of field staff followed by technical staff and then administrative staff. Majority (93.5%) of the respondents have favourable attitude towards climate change while 6.5% have unfavourable attitude. The respondents perceived conducting workshop, seminar for creation of awareness/knowledge on climate change and adaptation (M=3.74), facilitating access to relevant information (weather forecast, new practices, government policies/regulatory measures etc) (M=3.54), carrying out demonstration in teaching farmers the measures used to mitigate or adapt to the effects of climate change (M=3.45), dissemination of innovation/technologies on best practices for climate change adaptation (M=3.44), providing feedbacks to governments and research institutions on situation of rural farmers with respect to climate change to link practices to new policies and research (M=3.44), and others as major roles of extension agents to climate change.

On the areas of competence needs, the respondents perceived all the areas identified in the study as major areas of competence needs of extension agents on climate change. They include; communication (M=2.93), technical knowledge/ skills/ information on climate change (M=2.89),

participatory extension strategies (M=2.81), use of Information Communication Technology (M=2.72), and others.

Knowledge of climate change, causes and effect (M=2.78), Knowledge of weather forecast or information (M=2.75), knowledge of weather forecast or information (M=2.66), skill on application of innovative adaptation practices (M=2.53) and knowledge of new laws, policies or programmes on climate change (M=2.52) were considered as the major skills needed by the extension agents on technical knowledge/skills/information. All the respondents perceived group formation skills/techniques (M=2.55) and legitimization (M=2.36) as the major skills needed by extension agents under community/group mobilization on climate change adaptation. Then the field agents themselves perceived that leadership (M=2.23) and conflict management (M=2.25) skills are among the major skills they needed for their competence building on climate change.

The findings also indicated that the three categories of the respondents perceived basic computer literacy (M=2.66), use of internet facilities (M=2.63), use of SMS facilities (M=2.61), and others as major skills needed under ICT by the extension agents. Technical and administrative staff perceive skills in use of computer wares (soft and hardware) (M=2.21 & M=2.08 respectively) as part of the major skills needed by extension agents on the competence building of the extension agents. All the three groups of the respondents perceived use of innovative approach/strategies in extension e.g. farmer-field school (M=2.76), skills in use of extension methods e.g. demonstration, group discussion, seminars etc. (M=2.73) and use of rapid rural appraisal for rural situation analysis (M=2.64) as the major skills needed by extension agents under participatory and extension strategic skills on climate change adaptation. Technical and field staff highly believe that skills in co-learning or interactive learning (M=2.80 & M=2.38 respectively) as one of the major skills needed.

On the linkage and networking skills, the respondents perceived knowledge and skill for use of linkage mechanisms (M=2.62), partnership skill with key actors involved in climate change

(M=2.62) and skills for linking farmers to other agencies in the rural areas (inputs, markets, humanitarian agencies) (M=2.54) as major skills needed by the extension agents. Assisting agencies institutionally and managerially in implementing climate change/disaster related programme or intervention (M=2.76), record keeping (M=2.72), skill in selecting suitable and accessible information media for delivering of information in the rural community (M=2.71) and others were the major skills perceived by the respondents under facilitation skills as needed by the extension agents for their competence building.

Under documentation of indigenous knowledge/skills needed by extension agents, all the respondents perceived validation and/ integration into research for wider application (M=2.66), knowledge of indigenous practices on adaptation to climate change (M=2.59), knowledge, valuing and understanding of indigenous knowledge (M=2.58), knowledge of location specificity of indigenous knowledge (M=2.54) and skills for documentation of indigenous knowledge (M=2.53) as the major skills needed. Technical staff found skills for application in specific localities (M=2.13) as one of the major skills needed by the extension agents to carry out their work perfectly on climate change adaptation.

The findings also indicated that the following were the major factors affecting competence building of extension agents on climate change adaptation as perceived by the respondents: inadequate fund (M=3.80), inadequate knowledge and technologies on climate change and its adaptation (M=3.70), lack of incentives/motivation of extension agents (M=3.64), inadequate trained/qualified resource persons (M=3.59), and others. Only the administrative staff among the respondents perceived poor understanding of the climate change concept (M=2.53) as one of the major factors.

The effective strategies that could be employed for competence building of extension agents as indicated by the respondents include: adequate funding of extension services (public system) (M=3.85), provision of short-course for extension agent on climate change (M=3.82),

employment trained/qualified extension agents (M=3.77), organizing/attendance to workshops conferences, seminars etc (M=3.77), and others.

5.2 Conclusion

Based on the findings of the study, the following conclusions were drawn:

- 1) Majority of the respondents had high knowledge of agriculture related climate change issues. This will go a long way in building rural capacity for adaptation to climate change.
- 2) Extension personnel had favourable attitude towards climate change and this will positively influence their interest and eagerness to acquire requisite competence for adaptation to climate change by the farmers.
- 3) Extension agents have a lot of roles to play for climate change adaptation.
- 4) Extension agents requires competence in the areas communication, technical knowledge, participatory extension strategies, use of ICT, facilitation, community/group mobilization, networking/linkage and documentation and indigenous knowledge.
- 5) Infrastructural, financial, governmental, technical, logistics and institutional factors were the major factors affecting the competence building of extension agents.
- 6) Building competence of extension agents could be achieved through provision infrastructure, finance, favourable government policy, short course, conferences, workshops and others

5.3 Recommendations

- Extension workers should possess mix of competence in the areas of subject matter, communication, ICTs, innovative extension strategies, and others for agricultural adaptation to climate change.
- The government should provide the needed infrastructure and funds to extension organization for training of extension workers for climate change adaptation.

- There should be regular update through in- house training and orientation of extension agents on climate change effects, causes, impact, mitigation and adaptation options by extension system and research institutions. .
- There should be strong linkage and networking with research and other institutions on climate change, and policy actors and government should be proactive in strengthening the linkage.
- The government should enact functional climate change policy that stipulates roles and guides for building capacity of stakeholders particularly extension workers who are both the educators and information brokers to the public.
- Government should provide necessary infrastructure (weather forecast), logistic supports and incentive for extension work for sustained favourable attitude and participation in building capacity for adaption to climate change.
- The government should provide institutional, policy and logistics support for researches on agricultural adaptation to climate change.
- There is need for inclusion of climate change issues into school curriculum (secondary and higher institutions).
- The indigenous knowledge in research-extension system should be promoted. This will contribute immensely to climate change adaptation by farmers.
- The government should provide adequate funding and proper motivation to actors in order to promote/strengthen their linkages with one another.

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Department of Agricultural Extension,
University of Nigeria,
Nsukka.

Dear Sir/Madam

Interview Schedule on Competence Needs of Extension Agents on Agricultural Adaptation to Climate Change in Anambra State, Nigeria.

I am an M.Sc student of University of Nigeria, Nsukka carrying out a research on the competence needs of extension agents on agricultural adaptation to climate change in Anambra State, Nigeria. The purpose of the study is to identify and document the competence need of extension agents on agricultural adaptation to climate change.

You have been chosen as one of the important personnel in extension who can provide accurate information needed in carrying out this research. Your assistance in responding to the questionnaire will make the research a successful one. This research work is purely for academic purpose and all the information supplied will be solely for the purpose. Be assured that your responses will be treated in high confidence.

Thanks for your anticipated co-operation.

Yours sincerely,

Onwuatudo, Chizoba. R.

Interview Schedule on Competence Needs of Extension Agents on Agricultural Adaptation to Climate Change in Anambra State, Nigeria.

Section 1: Information on the socio-economic characteristics of the respondents

1. Sex : Male ☐ Female ☐
2. Age:
3. Marital status : Single ☐ Married ☐ Divorced ☐ Widowed ☐
4. Household size
5. Secondary occupation: Farming (), Trading (), Civil/public service (), Artisan (), Others (specify).....
6. Years spent in school
7. Highest educational qualification: OND (), HND/B.Sc. (), MSc (), PhD (),
8. Area of academic Specialization: Agricultural extension (), Agricultural economics (), Crop science (), Animal science (), Soil science (), Fishery (), Agro-Forestry (), others (specify).....
9. Position in Extension Organisation: Director (), Deputy Director () Zonal Manager (), Zonal Extension Officer (), Chief Subject Matter Specialist (), Subject Matter Specialist (), Block Extension Supervisor (), Block Extension Agent (), Extension Agents ().
10. Years of experience in extension work
11. Number of training received (in-service training).....
12. Have you participated in any climate change extension activities? Yes () No ()
13. If yes, which kind of extension activities? Training (), Outreach (), Field trip (), Workshop (), others ().
14. Have you received any training on climate change? Yes () or No ()
15. No of training received on climate change.....
16. Have u had any contact with other agencies on issues related to climate change Yes (), No ()
17. If yes, which agency/agencies?
18. How many times did you have contact with the agency on climate change?

Section B. Attitude and Knowledge Level of Extension Workers on Climate Change Related Issues.

Attitude of extension workers on climate change related issues

Please indicate your agreement with the issues by rating correctly at table below

S/N	Climate change related issues	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	Climate change is a scientific jargon					
2	Climate change is a punishment from God					
3	Agricultural production is not affected by climate change					
4	Human activities causes climate change					
5	Agricultural practices causes climate change					
6	Building the capability of extension agents on climate change adaptation is of no need.					
7	Climate affect crop production very badly					
8	Adaptation to climate change is of vital importance and needs urgent attention					
9	Increase in pest, disease and weed infestation is caused by climate change and should be addressed					
10	Extension has vital role to play on climate change adaptation and mitigation					
11	Land use has no effect on the climate as reported					
12	Climate change cannot be mitigated or adapted to					
13	Awareness of climate change effect, causes, adaptation and mitigation among farmers is not relevant					
14	Generating technologies for climate change adaptation should not be research/extension priority.					
15	There is no evidence of climate change in Nigeria					
16	Extension system should concentrate on transferring knowledge/technologies for increase production and income of farmers rather than educating farmers on climate change phenomenon.					
17	Farmers need credit for increase production more than technologies for climate change adaptation.					
18	Concern on formulating climate change policy is politically motivated rather than evidence based or society oriented					
19	Irregularities in rainfall, increased temperature and cases of flooding are not associated with change in climate.					
20	Adaptation to climate change has potential for improved production, food security and poverty alleviation					

Knowledge Level of Extension Workers on Climate Change Related Issues

Please tick ☐ or ☐ to indicate your agreement on these climate change issues

S/N	Climate change related issues	Yes	No
A	Have you noticed any change(s) in the environment like excessive heat of the sun, abrupt weather changes, unpredicted rainfall etc. within the past few years?		
B	Which of these causes these changes		
1	Signs of end of the world		
2	Deforestation		
3	Sins of the world		
4	Bush burning		
5	Use of chemicals like fertilizer and pesticides		
6	Punishment from God due to disobedience		
7	Human activities like burning of fossil fuel, bush burning		
8	Agriculture/Land use		
9	Increased industrialization		
10	Emission of green house gases like CO ₂ , N ₂ O, CH ₄ , etc		
	Which of these are as a result of climate change		
11	Abrupt changes in weather condition		
12	Increased flooding and erosion		
13	Increased in pest, insect, disease and weed infestation		
14	Drying of rivers and lakes		
15	Reduction in soil nutrient and poor yield of crops		
16	Increased temperature		
17	Frequent heat waves and drought		
18	Change in availability of water/rainfall		
19	Rising sea level		
20	Change in season pattern		
	Which of these measures can serve as an adaptation measures		
21	Change in the timing of farm operation		

22	Use of improved/resistant crop and animal varieties		
23	Afforestation		
24	Prompt and intensive weeding		
25	Irrigation		
26	Alteration in the location of cropping activities		
27	Use of fertilizer and pesticides		
28	Generating technologies for adaptation to climate change		
29	Dissemination of useful information and practices by extension to the farmers		
30	Investment on building capacity for mitigation and adaptation of climate change		

Section C. Perceived Roles of Extension Agents on Agricultural Adaptation to Climate Change

Please indicate your agreement with the roles by rating correctly in the table below

S/N	Roles	Strongly Agree	Agree	Disagree	Strongly Disagree
1	Conducting workshop, seminar for creation of awareness/knowledge on climate change and adaptation				
2	Dissemination of innovation/technologies on best practices for climate change adaptation				
3	Carrying out demonstration in teaching farmers the measures used to mitigate or adapt to the effects of climate change.				
4	Use of farmer-to-farmer extension strategy to promote awareness and adoption of best practices on climate risk management.				
5	Providing feedbacks to governments and research institutions on situation of rural farmers with respect to climate change to link practices to new policies and research.				
6	Facilitating access to relevant information (weather forecast, new practices, government policies/regulatory measures etc)				
7	Facilitate implementation of programme or policies on climate change related issues.				
8	Mobilization of group/communities in mitigating and adapting to climate change effects.				

9	Fostering linkages among actors in climate change innovation system.				
10	Plan and manage disaster and risk associated with climate change.				
11	Documentation of indigenous knowledge/ practices on adaptation to climate change.				

Section D. The Competence Needs of Extension Agents on Agricultural Adaptation to Climate Change

Areas of Competence Needs of Extension Agents

Please indicate the extent to which these areas are needed in the competence of extension agents

S/N	Areas of Competence Needs	Great Extent	Little Extent	No Extent
1	Communication			
2	Technical Knowledge/ skills/ information on climate change			
3	Networking/Linkage			
4	Community/ Group mobilization			
5	Participatory extension strategies			
6	Use of Information Communication Technology (ICTs)			
7	Documentation of indigenous knowledge			
8	Facilitation			

Skills Needed in the Different Areas of Competence Needs of Extension Agents

Please indicate the extent to which these skills/knowledge are needed by extension agents for competence on climate change agricultural adaptation.

S/N	Skills/Knowledge Needed in the Different Areas of Competence Needs	Great Extent	Little Extent	No Extent
A	Communication			
1	Knowledge of socio-cultural environment			
2	Skill in selecting appropriate communication channel/method			
3	Skill in providing/managing feedback			
4	Knowledge of subject matter, treatment and content analysis			
5	Listening skill			
6	Skills for creating adult learning situation			
7	Audience analysis			

8	Providing learning experience			
9	Use of clear language, appropriate tone and style in communicating			
10	Planning skill for communication			
11	Flexibility to encourage creativity			
12	Timing skill (use of appropriate for different issues)			
13	Encouragement skill to build the confidence of the audience			
14	Observation skill			
15	Empathy			
16	Summarizing skill by picking out main issues			
B	Technical knowledge/skill/information on climate change related issues			
1	Knowledge of climate change, causes and effect			
2	Knowledge of adaptation technologies/practices			
3	Skill on application of innovative adaptation practices			
4	Knowledge of weather forecast or information			
5	Knowledge of new laws, policies or programmes on climate change			
6	Skill for diagnostic survey			
7	Knowledge/skills on indigenous/local adaptation practices.			
C	Community/Group mobilization			
1	Power structure			
2	Legitimation			
3	Group formation skill/techniques			
4	Leadership skill			
5	Conflict management			
6	Situation/gap analysis			
7	Persuasive skill			
D	Use of ICT			
1	Basic computer literacy			
2	Use of internet facilities			
3	Skills in use of traditional media (T.V, radio, print, etc.) in building capacity of farmers for adaptation			
4	Skills for providing information through flyers, posters, handbills, etc.			
5	Use of multimedia facilities (projectors, audiovisuals, etc.)			
6	Use of mobile phone in providing timely information on climate change and adaptation.			
7	Use of SMS facilities			
8	Skills in use of computer wares (soft and hardwares)			
E	Participatory and /or extension strategies			
1	Use of Rapid Rural Appraisal for rural situation analysis			
2	Use of innovative approach/strategies in extension e.g. farmer-field school.			
3	Skills in co-learning or interactive learning			
4	Skills in use of extension methods e.g. demonstration,			

	group discussion, seminars etc.			
5	Knowledge and skill in participatory rural appraisal			
F	Linkage/Networking			
1	Knowledge and skill for use of linkage mechanisms			
2	Favourable attitude to linkage in agricultural innovative system			
3	Skills for linking farmers to other agencies in the rural areas (inputs, markets, humanitarian agencies).			
4	Skills for partnership with key actors involved in climate change			
5	Skills in analyzing cost and benefit of linkage			
6	Skill in budgeting for linkage			
G	Facilitation			
1	Skills for assisting farmers to implement programmes and policies related to climate change adaptation			
2	Assisting agencies institutionally and managerially in implementing climate change/ disaster related programme or intervention			
3	Skill for dialogue and arriving at consensus.			
4	Planning and management skills in times of ecological disaster.			
5	Skill in preparing proposal for advocacy on climate change affected areas			
6	Skill in lobbying			
7	Skill in addressing the needs of the farmers			
8	Skill in selecting suitable, sustainable and accessible information media for delivering of information in the rural communities			
9	Appreciating the community indigenous knowledge			
10	Respecting the people's belief			
11	Skill in support system			
12	Group process facilitation skill			
13	Open participatory decision making			
14	Vision consensus and participation benefit			
15	Group leadership skill			
16	Group sustainability skill			
17	Skill in facilitating broadcast of agricultural programmes on local FM radio stations			
H	Documentation of Indigenous knowledge			
1	Knowledge, valuing and understanding of Indigenous knowledge			
2	Knowledge of indigenous practices on adaptation to climate change			
3	Skills for application in specific localities			

4	Validation and/or integration into research for wider application			
5	Skills for documentation of Indigenous knowledge			
6	Knowledge of location specificity of Indigenous knowledge			

Section F. Constraints to Competence Building of Extension Agents on Agricultural Adaptation to Climate Change.

To what extent do you think the following items could impede competence building of extension agents on agricultural adaptation to climate change?

S/N	Constraint factors	Great Extent	An Extent	Little Extent	No Extent
1	Inadequate fund				
2	Inadequate knowledge and technologies on climate change and its adaptation				
3	Poor skills on the use of ICT facilities (E-learning in climate change)				
4	Inadequate trained/qualified resource persons				
5	Lack of functional reliable weather forecasts/climate information				
6	Unavailability/poor access to needed infrastructure				
7	Lack of interest on climate change by extension agents				
8	Poor coordination among agencies in agriculture and rural development				
9	Inadequate provision of logistic supports for field staff				
10	Poor recognition/documentation of indigenous knowledge				
11	Lack of incentives/motivation of extension agents				
12	Poor moral/career development opportunity				
13	Poor policy formulation and implementation on climate change				
14	Undefined roles among actors on climate change adaptation				
15	Corruption/bad governance				
16	Poor disaster risk management on climate change				
17	Poor availability of training opportunities				
18	Poor linkage to relevant institutions				
19	Location specificity of indigenous adaptation to climate change				
20	Poor policy framework/political instability				
21	Poor understanding of the climate change concept				

Section G. Possible Strategies for Competence Building of Extension Agents on Agricultural Adaptation to Climate Change.

To what extent do you think the following items could be possible strategies for competence building of extension agents on climate change?

S/N	Possible Strategies	Great Extent	An Extent	Little Extent	No Extent
1	Adequate funding of extension services (public system)				
2	Orientation course for extension agent for attitude change				
3	Provision of short-courses for extension agents on climate change				
4	Employment of trained/qualified extension agents				
5	Availability of functional and reliable weather forecasts/climate information stations				
6	Provision of needed input and infrastructure				
7	Institutional and policy support for researches on climate change				
8	Collaborations with other agencies				
9	Provision of logistic supports for field staff				
10	Availability of functional policy instrument on climate change mitigation and adaptation				
11	Inclusion of climate change issues into school curriculum (secondary, high institutions)				
12	Organising/attendance to workshops, conferences, seminars etc.				
13	Presence of climate change related policies in rural development				
14	Promoting of indigenous knowledge in research-extension system				
15	In-service training of extension agents				