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Impact of Climate Change on Agricultural Extension Services Delivery in Southern Region Kebbi State, Nigeria

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Abstract

This article analyses the Impact of Climate Change on Agricultural Extension Services Delivery in Southern region of Kebbi State, Nigeria. The specific objectives for the Study were to describe the socio-economic characteristics of respondents, identify evidence of climate change on extension service delivery, and determine the impact of climate change on extension services activities and to describe adaptation strategies adopted by extension agents when delivering services. A Simple random sampling technique was used to select one hundred and thirty (130) respondents. Data were collected with the aid of a structured questionnaires using simple random sampling techniques. The instrument given out to thirty (30) ADP staff and one hundred (100) contact farmers. Data were analyzed using descriptive statistics. The results showed that the most observed evidence of climate change in the study area after comparing responses from agricultural extension staff, ADP staff and contact farmers was flooding, and the most serious impact observed on extension services delivery was failure in implementation of farm management and new farm technologies. One of the successful adaptation strategies to climate change practices by extension agent was participatory planning and implementation of agricultural extension projects. It is therefore recommended that extension agents should educate and enlighten their clientele regularly on climate change adaptation strategies for improved agricultural output.

Keywords: Impact, climate change, agriculture, extension, services, delivery

INTRODUCTION

Any change in climate makes it difficult for the farmers to grow the crops on land as there are a lot of factors involved in such processes to establish agricultural practices. The change in climate, such as drought, can make the soil barren and infertile, due to which the nutrients in crops are not available, and the crops are also not able to grow due to increased scarcity of water. Agricultural extension services have been seen to mitigate such issues (Christoplos, 2010a). The farmers would be educated enough to control the situations with better handling skills so that climate change does not impact their farms. Climate change has become a very prominent issue in the media and in international and national policy processes. The 4th Assessment Report of the International Panel on Climate Change (IPCC, 2007) summarized the expected impacts of climate change and served as a wake-up call for policy-makers and the public alike. The main projected future climate changes are a continued rise in temperature, increased incidence of heat waves and heavy precipitation events, decrease of rainfall in sub-tropical areas, rising sea levels and the increased likelihoods that these aspects will develop in a non-linear and non-predictable manner. In many mountain areas, vanishing glaciers and reduced snow cover will reduce and change patterns of water flow in river and irrigation schemes. These changes have the potential to cause heavy damage to crops and reduce harvests in many developing countries. In some countries in Africa, yields from rain-fed agriculture could be reduced by 20-50% by 2025 (Giger, 2010). Nevertheless, the impact of climate change could also have positive effects in some regions. For instance, growing seasons might become longer where the climate is cold i.e. in the high latitude and in high land areas. Increased Carbon (IV) Oxide content in the atmosphere could also have a positive influence in plant growth, even though in practice the beneficial effect of this factor is expected to be rather low because of other limitations on plant growth (Giger, 2010). Rise in temperature is one of the most firmly established forecasts and the chances that this will take place have been estimated as very likely. The temperature changes projected for the Sahel during summer could mean that the average future temperature

range would probably exceed the normal variation in summer temperature experienced so far in the region (Battisi and Naylor 2009), a development that would severely challenge the ability of the agricultural system to adapt to these changes. Many crops (among them rice, wheat, sorghum) are very susceptible to heat stress, if it occurs during the specific vegetation period (Giger, 2010). Agriculture has received a lot of attention from climate modelers because of the dependence of agriculture on climate. Human dependence on agriculture, particularly in developing countries, also means that agriculture has an important role in debates about adaptation to the impacts of climate change in countries (Chikaire, Nnadi and Orusha. 2011). Currently, agriculture accounts for 24% of the world's Agricultural extension has a key role to play in initiating the change. This is because adaptations to climate change impacts require change in knowledge, attitudes, resilience capacities and skills of the people, and agricultural extension can bring this change. Agricultural extension, according to Leeuwis (2006), is a series of embedded communicative interventions that are meant, among other things, to develop and/or induce innovations which supposedly help to resolve problematic situations. It has been observed that agricultural extension is involved in public information and education programs that could assist farmers in mitigating the effects of climate change (MOE FRN, 2003). According to them, such involvements include awareness creation and knowledge brokerage on the issues of climate change; building resilience capacities among vulnerable individuals, communities and regions; encouragement of wide participation of all stakeholders in addressing climate change issues and developing appropriate frameworks for coping/adapting to climate change effects/impacts. Besides, there is very little documentation on local adaptation to climate change (Pandey, 2006), especially when it is known that some African communities have developed traditional adaptation strategies to cope with climate variability and extreme events (Osman-Elasha, 2007). From the background of the study, it is understood that climate change has become a global issue in recent times, manifesting itself in variations of different climate parameters including cloud cover, precipitation, temperature ranges, sea levels and vapors pressure (Ministry of Environment of the Federal Republic of Nigeria, MOE FRN, 2003). The variations in climate output, employs 22% of the world's population and uses 40% of land area (FAO, 2003). Most studies on the impacts of climate change on agriculture indicate that there will be negative effects over the next century. Some estimate that 600 million additional people may be at risk of hunger if global temperature increases by 3 degrees Celsius (Warren, Arnell and Nicholas., 2006), particularly in developing countries where people are already at risk. Agriculture is doubted the most important sector in the economies of most non-oil exporting African countries. It constitutes approximately 30% of Africa's GDP and contributes about 50% of the total export value, with 70% of the continent's population depending on the sector for their livelihoods.

parameters affect different sectors of the economy such as agriculture, health, water resources, energy etc. The main cause of climate change has been attributed to anthropogenic activities. For example, increased industrialization in the developed nations has led to introduction of large quantities of greenhouse gasses (GHGs), including carbon (iv) oxide (CO2), methane (CH4) and nitrous oxide (N2O) into the atmosphere. According to Cline (2007) Agriculture in developing countries like Nigeria is expected to be most affected by climate, since most of it is in tropical and subtropical zones, often already suffering from drought, water scarcity and heat stress. The broad objective of this research was to analyze the impacts of climate change on agricultural extension services delivery in southern region of kebbi state, Nigeria. The specific objectives for the study were: To describe the socio-economic characteristics of respondents, to identify evidence of climate change, to describe the impacts of climate change on extension services delivery and to determine adaptation strategies in extension services provision. This research paper will serve as a reference material to students and other researchers who may wish to carry out researches on the impacts of climate change on agricultural extension services or related fields. For government, policy makers and NGOs, this paper will broaden their knowledge and be of aid through provision of statistical information that will guide them in their exploit for adaptive methods through this period of global climate change. It will also suggest solutions to some problems associated with agricultural extension services delivery as a whole.

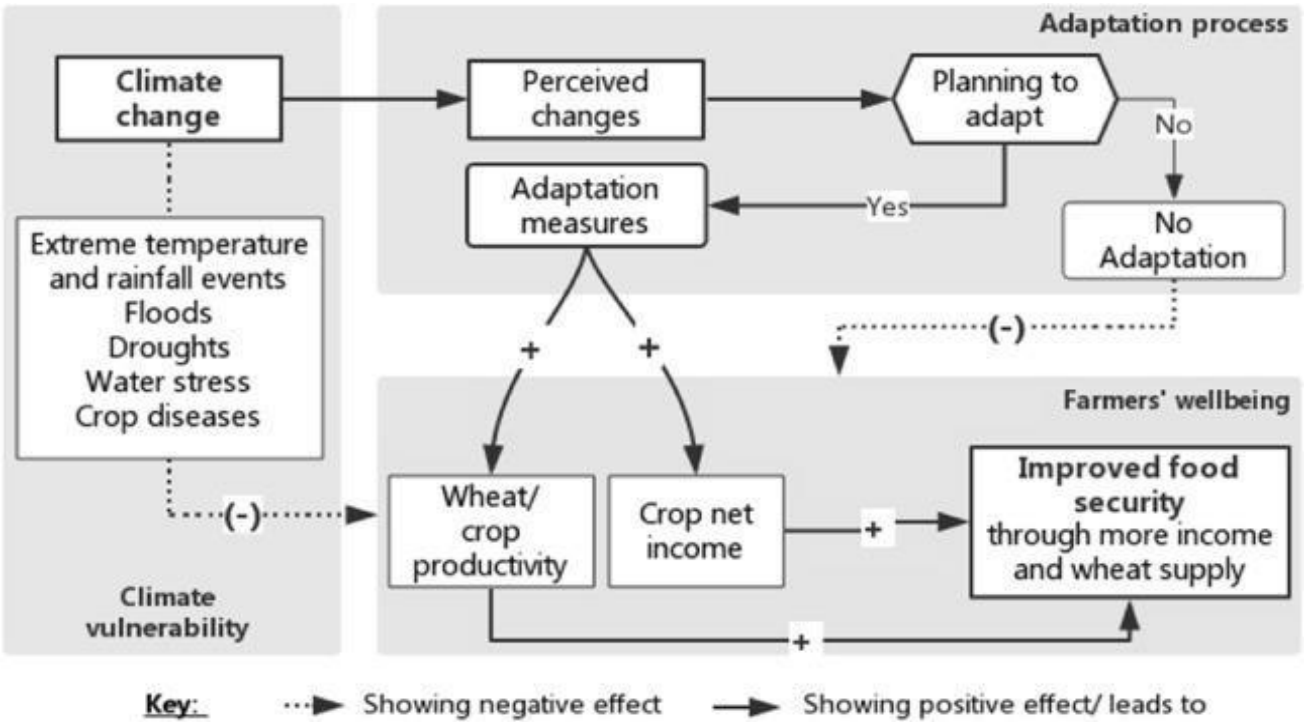

Fig 1 Diagrammatic Representation of Impacts of climate change on Extension Services

METHODOLOGY

Study Area

Southern Kebbi State (Zuru Emirate), Nigeria is one of the four Emirates in Kebbi state which comprises of four Local Government Areas (LGAs) namely; Danko-Wasagu, Fakai, Sakaba and Zuru. The Emir-ate is located at latitudes 11o and 12o N and longitudes 4o and 5o E of the equator and in the extreme south-eastern part of the state on a 9,000 square kilo-meters landmass. Southern Kebbi is hilly and bound-ed to the north by Gummi Local Government Area of Zamfara State, North-west by Koko Local Government Area, South-west by Yauri Local Government Area, North-east by Bukkuyum Local Government Area of Zamfara State, south by Rijau Local Government Area of Niger state and a population of 582, 106people (NPC, 2006; Yahaya, 2015)

The area is inhabited by the following ethnic groups; Dakkarkari, Fakkawa, Dukkawa, Kelawa, Kambarawa, Katsinawan laka and Achifawa. Other settlers in the area are the; Hausa, Fulani, Yoruba, Igbo etc. The different religions found in the area are Islam, Christianity and traditionalist. However, the traditional worship of different deities is still upheld in the area with many festivals celebrated at various times of the year. The climate is marked by both wet and dry seasons of which wet season dominates between April to October and dry season between November to February. Average rainfall is between 1025mm and 1050mm annum, mean temperature range between 31oC and38oC and soil type is sandy loam which is suitable for agriculture. Animal husbandry is practiced side by side with crop production, on limited scale. The people of Zuru Emirate depend largely on the pastoral Fulani for meat, milk and butter. Hunting is an important economic activity after crop production and a supplement for meat production, hides and skin for shoes, warfare robes and local drums. Other economic activities are pot-making and weaving by women and blacksmithing by men

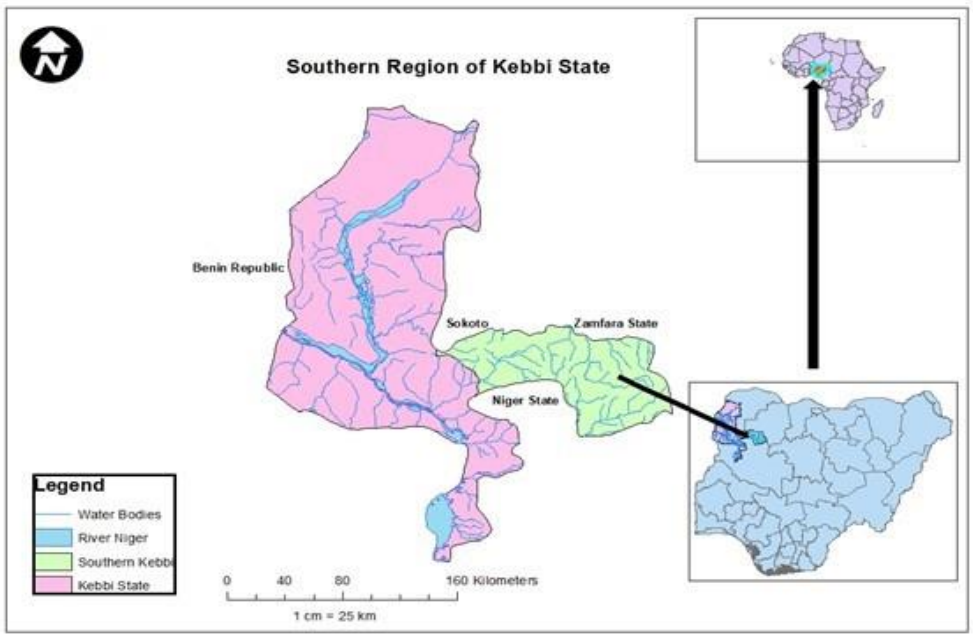

Fig 2.*Map of the study area*

Sampling Procedure and Sample size

The population of the study was composed of contact farmers and ADP staff whose main work is purely reaching out to the farmers. The entire 30 field staff of the southern region of Kebbi State Agricultural Development Project KSADP was sampled. Again the estimated number of contact farmers from the study area was over 1000 which was obtained from the Kebbi State Agricultural Development Project in Southern Kebbi State. They were into mixed cropping system of farming. From the list containing one thousand (1000) contact farmers, 10% percent of the total number was randomly selected for questioning. This gives a total of one hundred (100) contact farmers. This gives a grand total of 130 respondents. The study made use of both primary and secondary data. The primary data were collected by administering questionnaires to household heads. Secondary data sources were utilized to provide background information and other necessary information to achieve some objectives of the study. The secondary data sources included textbooks, journals and proceedings of scientific conferences.

Method of data Analysis

Basically, descriptive statistics were used to achieve all the objectives. Mean, frequency, tabulation and percentages were used to achieve the study objectives.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Respondents

Table 1 show that 33.1% of the respondents were in their prime age of 40 to 49 years, while 23.8% were within the age bracket of 50 – 59 years. These are energetic individuals who do their various engagements for their survival. Again, 22.3% were very young people within 30 – 39 years with 20.8% who were 60 years old and above.

It is also showed in Table 1 that, among the respondents 60% and 40% were male and female respectively. The majority (63.1%) were married, while 23.8% were widows. On educational attainment, 44.6% had secondary education; 20.8% had attended tertiary institutions; and 24.1% had primary education only. The levels of education of these individuals attest to their ability to work as contact farmers and change agents and be able to observe climate changes. The majority (78.5%) belonged to various organizations, while 28% did not belong to any organization. A household with plenty members had also labour that worked for the family. The respondents with higher family members were 38.5%, with 7 – 9 members. The second group had 4 – 6 members, while 15.4% had 10 members and more. These numbers would help provide labour needed to produce family food. A good number of the contact farmers (48%) had spent between 11 to 20 years farming; 18% had put 21 – 30 years, while 16% had spent over 30 years on farming. This explains why they were able to identify and observe evidence of climate change. The majority (43.3%) of the agents had spent 11 to 15 years in civil service; they were followed by 30% who had put in 6 to 10 years, while 20% had spent above 15 years working. Experience gained doing this work helped them to persevere and adapt to challenging weather and also adjust when the need arose. Experience gained doing this

work helped them to persevere and adapt to challenging weather and also adjust when the need arose.

Table 1: Socioeconomic Characteristics of the Respondents

Age	Frequency	Percentage
30-39	29	22.3
40-49	43	33.1
50-59	31	23.8
60 and above	**27**	**20.8**
Sex		
Male	78	60
Female	52	40
Marital Status		
Married	82	63.1
Single	13	20
Widow	31	23.8
Widower	4	3.1
Educational Level		
Primary	32	24.6
Secondary	58	44.6
Tertiary	27	20.8
Adult	13	10.0
Membership of Association		
Member	102	78.5
Non Member	28	28
House Hold Size		
1-3	15	11.5
4-6	45	34.6
7-9	50	38.5
10 and above	20	15.4
Farm Size		
<2	25	25
2-4	53	53
>4	22	22
Years of Farming Experience		
1-10	14	14.0
11-20	48	48.0
21-30	18	18.0
31 and above	16	16.0
Years of Service as agent		
1-5	2	6.7
6-10	9	30.0
11-15	13	43.3
15 and above	6	20.0

Source: Field Survey, 2022

Evidence of Climate change

Climate change was evident in a number of ways as shown in Table 2. Both the extension agents and contact farmers corroborated their responses. Climate change was evident in increasing surface temperature with 86.7% and 88% respectively by both the extension agents and contact farmers. Other signs of climate change included increase in rainfall intensity with 80%, flooding with over 83%, unpredictable weather patterns, high winds, rise in water levels, land degradation, constant loss of biodiversity, change in relative humidity, and increase in frequency of thunder and lightning. In a study on adapting public agricultural extension in Kenya, Ifejika (2009) posited that district extension administrators and the frontline extension officers are well aware of the climate change problems. They perceived climate change as changes of weather patterns over a long period of time and the disruption of the annual weather pattern/change of trend of annual weather patterns. They found that the area studied was affected by climate change in several ways: more frequent and prolonged droughts, change of rainy seasons not following pattern as before, more variability of short rains as compared to the long rains, high temperature levels; increased aridity; increased rainfall failures; untimely rains hence not able to advise farmers,

drying up of water sources, reduced rainfall amounts, delayed onset of rains, decreased foliage grasses have dried up and some species have disappeared (Ifejika, 2009). The officers perceived the natural environment to be also changing. They found forests and bushes to have depleted as farmers clear more bushes for farming. Forests have also been cleared for settlement, farming, for charcoal production; building materials (timber) and the rate of depletion is not equal to the rate of replacement. The officers report that natural water sources have decreased with water levels going down in rivers and many rivers have become seasonal. They have also noted that artificial water sources are on the increase especially earthen dams, water pans, and shallow wells. These changes have affected agricultural productivity through crop failures thereby decreasing agricultural productivity, increasing food shortages and prolonged famines. Pasture is a problem, and water for livestock is scarce and people have to move long distances in search for water and pastures. The decrease in animal forage has led to a decrease in livestock production and livestock mortality has increased during droughts. Thus farming has become a more costly undertaking than before to failures, thereby discouraging new entries into the sector. As a result, many people, especially men migrate to mostly urban areas in search of jobs, leaving fewer people in production in rural areas.

Table 2: Distribution of the respondents based on Evidence of climate change

Evidence of Climate Change	**Extension Agents**		**Contact Farmers**	
Response	**Freq****	**Perc (%)**	**Freq****	**Per (%)**
Increase surface temperature	26	86.7	88	88.0
Increased rainfall intensity	24 9	80.0	83	83.0
Low rainfall intensity	11 8	30.0	35	35.0
Irregular rainfall(not more than 3months)	18	36.7	53	53.0
Increase rate of evaporation from the earth	25	26.7	41	41.0
Rise in water level of rivers	22	60.0	31	31.0
Observed flooding	10	83.3	84	84.0
Observed drought	16	40.0	38	38.0
Heavy Precipitation event	13	33.3	21	21.0
High wind frequency	14	60.0	56	56.0
Increase disruption in climate patterns	14	43.3	30	30.0
Increasing frequency of thunderstorm	15	46.7	61	61.0
Increased frequency of lighting	16 3	46.7	63	63.0
Increased observed bushfires	20 9	50.0	52	52.0
Unpredictable weather patterns	18	53.3	73	73.0
Increased observed desertification	13	10.0	15	15.0
Land degradation		66.7	62	62.0
Drying up of rivers/lake		30.0	28	28.0
Constant loss of biodiversity		60.0	27	27.0
Change in relative humidity		43.3	67	67.0

** Multiple response were recorded, **Source**: Field Survey, 2022

Impacts of Climate Change on Extension Services Delivery

Climate change also affects extension service delivery in a number of ways as revealed by the responses of the extension agents. Table 3 reveals the impacts of climate change on extension service delivery at a glance. Climate change makes the implementation of farm management decisions and new farm technologies impossible as testified by 86.7% of the respondents. There is difficulty in convincing farmers to invest more in agriculture (76.7%), and difficulty in planned work implementation due to excessive rainfall (70%). Training of both farmers and extension staff (63.3%) is made difficult by climate variability. Others are questionable relevance and validity of extension advice with (70%), increase work burden of extension agents (60%), and decrease in agricultural labour due to rural urban migration. Concerning the above, Ifejika *et al*., (2009) said climate change is thus worsening the work

Table 3: Distribution of the Respondents according to Impacts of climate change on Extension services

Impacts	Frequency**	Percentage (%)
Difficulty in convincing farmers to invest more in Agriculture	23	76.7
Difficulty in planned work implementation due to variability in rainfall condition	21	70.0
Difficulty in timely and relevant training of farmers		
Failure in implementation of farm management or new farm technologies	19	63.3
Decrease in agriculture labour due to rural-urban migration from affected zones	25	86.7
Questionable relevance and validity of extension advice and officers		
Increase in work burden of extension officers High cost of training	14	46.7
	21	70.0
	18	60.0
	16	53.3

Multiple Response were Recorded. **Source: Field Survey, 2022

conditions for extension services through several ways. Through frequent crop failure, farmers invest more into farming. It therefore becomes more difficult for extension officers to convince farmers to undertake investments that are exposed to climate risks. In addition, the increased variability in rainfall conditions means the planned work cannot be implemented. The extension officers must then change their planned work to fit the conditions. Due to the adverse impacts of climate change like crop failures and livestock deaths, male household heads often migrate to urban centers in search for employment. Through this increased rural-urban migration, women and the old are left to practice farming, thereby reducing agricultural labour and increasing the work burden of women (Ifejika et al., 2009). The variable weather conditions also question the expertise, relevance and validity of extension officers and extension advice respectively. This arises also because when farmers implement extension advice and the weather conditions under which they do so no longer corresponds to that needed for implementation, thereby jeopardizing the outcomes, the farmers often blame extension officers for giving them wrong advice. The question then is how to adjust extension services to a more uncertain weather. As such extension messages on adaptation to climate change are embedded into extension advice on maintaining crop and livestock production and reducing risk.

Table 4: Coping strategies on extensions services by contact farmers

Coping strategies	Frequency**	Percentage (%)
Use of resistant crop and animal varieties/species	73	73.0
Use of organic manure	44	44.0
Mixed farming	33	33.0
Diversifications in crop enterprise	77	77.0
Changes in planting dates	70	70.0
Changes in harvesting dates	69	69.0
Use of cover cropping	61	61.0
Changes in the timing of land preparation activities	58	58.0
Contour cropping across hill slopes	43	43.0
Changes in planting depth of seeds and seedlings	41	41.0
Reduced deforestation	63	63.0
Changes from production to marketing	12	12.0
Use of weather forecasts	33	33.0
	63	63.0
	12	12.0
	33	33.0

Coping Strategies for Extension Services Delivery

The contact farmers employed various coping strategies among which are use of resistant crop and animal varieties with 73% responses (Table 4). Crop enterprise diversification with 77% is yet another, changes in planting dates 70%, changes in harvesting dates 69%, planting of cover crops 61%, changes in time of land preparation 58%, agro-forestry practices 63%, use of

organic manures 44% and mixed farming 33%. Other adaptive measures include contour cropping with 43%, and use of weather forecast with 33%. Continuing, Ifejika *et al*., (2009) posits that, although farmers perceive changing climate variability as a challenge to their crop and livestock production, they are more conscious of other production challenges like lack of ready markets for their produce, crops and livestock pests and diseases, inadequate tools and implements, and lack of or inadequate water for crops and livestock. Coping Strategies for Extension Services to adapt to climate change impacts, the agents need to be trained and re-trained on climate change management skills as indicated by 63.3% response (table 5). Participatory planning of agricultural extension projects with 80% response was the most important adaptation strategy. Diversity of extension was another important adaptation strategy with 66.6%, extension collaboration with other agencies with 73.3%, liberalization of services, transformation of extension approaches with 46.6% and 66.6% respectively. To be able to facilitate adaptation, extension personnel need to be trained in the various dimensions of coping to climate change. Although, early or late onsets, dry spells and droughts as well as wet spells and floods are long recognized constraints in agriculture, climate change is not yet an issue in many public extension departments in Africa. In order to address this perception and knowledge gap, various new adaptation and development programmes have an extension component whereby they focus on increasing the awareness of extension personnel on climate change and related issues (World Bank 2008a; CIAT 2009). Because government resources are limited, ongoing efforts to train extension personnel on emerging issues like climate change depend significantly on donor funding. Climate change and its associated uncertainties imply that extension services need to regularly access new knowledge and extend it in an adequate and timely manner to the farmers. It also entails harnessing the local using the two sources of knowledge to improve adaptation practices. Since climate change will bring about the development or spread of technologies that enhance resource use efficiency, extension needs to take the opportunity to use and disseminate the new technologies. However, in a project on improving internet access to world scientific literature in Ghana, the International Institute for Communication and Development (IICD 2009) reports that while the service became popular with researchers and students, surveys showed minimal use by extension services and farmers. Yet, the capacity to learn contributes to resilience against risks, those arising from climate included, hence there is need to establish cross-scale and multi-actor feedback mechanisms currently lacking in extension services. However, demand driven extension only succeeds where the groups have market value. Considering that many private extension services are externally driven, collaboration of public extension with private extension services ensures that the knowledge generated during a project remains within the institutional structure in the country and locality. Involving local people within the institutions is also another sustainable way of building capacity yet many externally funded projects are implemented without their involvement. The implications are that knowledge gained through such projects is difficult to access by local experts and remains elusive for integration into existing local knowledge (Christoplos, 2010)

Conclusion / Recommendations

Much evidence of climate change has been observed due to direct or indirect human activities that alter the atmospheric conditions at large. The effects of climate change has seen to affect agricultural activities of most part of the nation and also affected the services of extension agents bringing failure to new farm technology they render to their clientele. Climate change threatens agricultural production through higher and variable temperature changes in rainfall patterns and increased occurrences of extreme events such as droughts and floods. In the light to the above finding of the report and facts of evidence of climate changes which brings treats to the Nigerian Agricultural extension Services, the following recommendation are made: Firstly, staff of extension organization needs to be retrained so as to acquire necessary skills and knowledge in climate risk management. They have to be aware of the immediate and remote causes of climate change, its impacts and the local knowledge and practice used by communities to mitigate or cope with climate change. The use of information exchange strategies with people at climate risk sites i.e. the research extension farmers‟ linkage should be more effective. Adaptation and mitigation funds could be used to support extension services that deliver new technologies, information and education about increasing carbon sequestration and reducing greenhouse gases emission. A climate change extension program should also include mitigation strategies that are technically sound and affordable Examples are tillage energy conservation, bio-fuels, conservation practice and improve nitrogen management.

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