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Strategies for coping with climate change among farmers in Anambra State, Nigeria

***Mgbakor, M.N.,[1] Nnenna, M.G. [2] and Onwubuyae. A.[3]**

[1 and 2]Department of Agricultural Economics and Extension, Enugu State University of Science and Technology

3. Department of Extension. University of Nigeria, Nsukka, Enugu State, Nigeria.

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Corresponding Author's E-mail Address:

miriamngo2000@yahoo.com

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ABSTRACT

The paper assessed the strategies for coping with climate change among farmers in Anambra State, Nigeria. A structured interview schedule that was validated by experts in the Department of Agricultural Extension was used to collect data from 120 respondents, using a multi-stage sampling technique. The result showed that young, literate and experienced farmers that sourced their information mainly through personal observation dominated the farmers in the area. The majority (98.33%) of the respondents were aware of what climate change is all about. Cassava and poultry were the major crops and livestock grown and reared. Yearly rainfall begins late, crop failure, pest and disease infestations were the more challenges facing crops and livestock grown and reared. Changes, as indicated by the respondents, included; decreased yield of crops, increased poverty of the farmers, and change in rainfall pattern. The respondents indicated a ban on deforestation and diversification of crops as the best ways of coping with the impact of climate change. Pearson's correlation analysis showed that age, educational level and membership of social organization were statistically significant at a 5% probability level. The paper suggests that extensionists should use all possible extension structures to sensitize the farmers more on strategies for coping with climate change and the production of crops and animals that are more tolerant to adverse weather conditions. Finally, adequate information should be made available to farmers to enable them to salvage the agricultural sector from its present predicaments.

1.0 Introduction

Agriculture is one of the oldest economic activities in the world and gainfully employed over 70% of the world's population. It depends highly upon weather and climate to produce the food and fibre necessary to sustain human life. Hence, it is deemed to be an economic activity that is expected to be vulnerable to climate variability and change (Obiorah and Madukwe, 2011). According to Nwakushue et al. (2010), climate change can be described as the variations that are taking place in the climatic conditions of an area due to human activities as observed over a long period. Also, Umar et al. (2008) defined climate change as a change occurring in range naturally or artificially from decades to centuries. These changes include temperature changes (rise or fall), rainfall pattern or quantity, wind, relative humidity and solar radiation. They further state that climate change is a constant deviation from the average values of these parameters monitored over a long period, indicating a change in what is known to be the existing pattern. These changes emanating from climate change are bound to compromise agricultural production such as crop, livestock, fisheries activities, nutritional and health statuses, tourism, recreation among others.

It is now quite obvious that the most serious challenge facing agricultural production and indeed mankind is climate change. The current catastrophic incidence of climate change recorded world over present new challenges to agricultural production in developing countries, particularly in sub-Sahara Africa, intergovernmental Panel on Climate Change (IPCC) (2007) stated that Africa may be the most vulnerable to climate change impacts, because of its dependence on rain-fed agriculture, high level of poverty,

low levels of human and physical capital, inequitable land distribution and poor infrastructures. Also, Adedire (2010) opined that the adverse effects of climate change would be felt more in the sub-Sahara African environment, especially in rural areas where livelihood and the economy are largely dependent on subsistence agricultural production. This is because when plant warms, rainfall pattern shift and extreme events such as drought, floods and forest fire would become more frequent.

Awotodunbo and Adewumi (2012) observed that rural resource-poor farmers, who depend on natural resources for their livelihood, are the most vulnerable to environmental shocks and stresses. They stated further that climate change will seriously degrade many of the natural resources and ecosystems on which these people and the communities depend for their livelihood. They further opined that climate change will expose an additional 75 to 250 million people in Africa to water shortages and that 300 million Africans already live in drought or drought-prone areas. The inability to adapt to the changes in climate variations is more devasting to the agricultural sector, the main source of income, employment and sustainable livelihood to the majority of the population in Africa, including Nigeria.

It is projected that crop yield in Africa may fall by 10 to 20% by 2050 or even up to 50% due to climate change (Ozor et al., 2010), particularly because, African agriculture is predominantly rain-fed and hence fundamentally dependent on the vagaries of weather. As Africans strive to overcome poverty and advance economic growth, this phenomenon threatens to deepen vulnerabilities, erode hard-won gains and seriously undermine prospects for development (Zoellick, 2009). Kisoyan (2011) opined that climate change accounts for 90% of the world's natural disasters and causes over 95% of all deaths attributed to natural disasters occurring in developing countries and its cost in Africa could be as high as 7 to 10% of the Gross Domestic Product (GDP) by 2010. These disasters are worsened by pollution, over-exploitation and mismanagement of natural resources; hence, there is the need for concerted efforts towards tackling this menace.

Ozor and Nnaji (2010) observed that in Nigeria, reduced deforestation, diversification of crops, tree planting, mulching, early planting, planting crops that are resistant to pests and diseases are the major strategies for coping with climate change. Others include; use of drought-resistant crop varieties, planting at the appropriate time, raising pets and disease tolerant animals, use of organic manure and irrigation (Kamau, 2011; Gowland-Mwangi, 2012).

However, strategies for coping with climate change and ensuring an improved and sustainable livelihood for the farmers depends largely on the knowledge, practices, attitudes and belief systems of the farmers. Gaps probably exist in farmer's indigenous knowledge of their understanding of the effect and coping strategies of climate change. Therefore farmers' knowledge of climate change should be documented as well as identify gaps in their knowledge and areas where the stakeholders could provide vital inputs to assist farmers. The pertinent questions to ask therefore are; Are the poor resource rural farmers capable of coping with the effects of climate change? What are the possible strategies to reduce the perceived effects to sustain agricultural production? These questions need to be given serious consideration, because Nigeria is facing social and economic challenges resulting from climate change, leading to a reduction in land quality, salinity, increased poverty, low agricultural yield and food. This paper was designed to examine the strategies for coping with climate change among farmers in Anambra State, Nigeria. Specifically, the objectives were to; (i) Characterize farmers in the study area, (ii) Ascertain the available sources of information on climate change adaptation, (iii) Describe the climate change indicators observed by farmers, (iv) ascertain the effects of climate change on farmers, and (v) identify strategies adopted to adapt to the perceived effects of climate change.

2.0 Methodology

Data for the study were collected from primary and secondary sources, Primary data were sourced from a structured interview schedule that was validated by experts in agricultural extension and was administered to the respondents with the help of extension agents covering the selected communities. While secondary data were sourced from published journal articles and books, among others. A multi-stage sampling technique was used to select the respondents from whom primary data were collected. Data were collected on the socio-economic characteristics of the farmers, and sources of information on climate change. Additional in-depth data on climate change and its effects were collected through focus group discussion (FGD) held at each of the selected study agricultural zones. Additionally, expert opinions were carefully obtained. The multi-stage sampling employed a random selection of two out of the 4 agricultural zones. Anambra and Aguata agricultural zones were selected. of the two agricultural zones, two local government areas (LGAs) were randomly selected, giving a total of 4 L.G.A.s. The L.G.A.s were Ayamelum and Anambra-West LGAs and Orumba south and Aguata L.G.A. From the four LGAs, three communities each were randomly selected, giving a total of 12 communities. Ten respondents were randomly selected from each of the 12 communities, thus yielding a sample size of 120 respondents.

The various strategies and effects were measured with the help of a 4-point Likert type scale (Whose scores ranged from a minimum of 1, depicting "strongly disagree" to a maximum of 4, depicting "strongly agree"). The independent variables sex, age, marital status, educational level, household size, occupation, years of experience, size of farm holding, systems of farming, and sources of information were measured either directly or by devising categorical scales (Yahaya and Olajide, 2005). Data were analyzed using frequency counts, percentages, mean, and Pearson Product Moment Correlation (PPMC).

3.0 Results and Discussion

3.1 Socio-economic profile

The findings provided an interesting insight into the respondent's socio-economic backgrounds. Results in Table 1 show that most of the farmers (71.7%) were males while 28.3% were female. This indicates that there are more men involved in agricultural activities than the women counterparts. This finding agrees with that of Ozor and Nnaji (2010) who showed that more men were engaged in farming than women in Enugu State. A greater proportion of the respondents (48.33%) were aged between 51 to 60 years with a mean age of 49.7 years. This finding corrbortes the expression of Amos (2007) that an average

cocoa farmer in Ondo State is old. Also it agrees with the observation of Courtney (2011) that rural farming is dominated by aged people. A good percentage of the farmers (74.17%) were married. This confirms the position of Onwubuya et al. (2008) that vast majority of the adult population of any society consists of married people. The result shows that 75.83% of the farmers were literate. This may positively affect abilities to assess situations, obtain relevant information and adopt strategies to adapt to the effects of climate change. This is in line with the assertion of Aphunu and Atoma (2010) who observed that farmers with good level of education are eager to learn and receptive to new ideas. Most (63.335) of the farmers had household size of 6 to 10 persons with a mean household size of eight persons. This implies that the farmers has a fairly large household, which in an agrarian setting is the major determinant of wealth and could probably serve as an insurance against short-falls in supply of farm labour as observed by (Nenna, 2014). This is similar to the finding of Enete and Okon (2010) who observed that 60%of the farmers in their sample had mean household size of 8 persons. Majority (78%) of the farmers were engaged in farming as their major occupation. About 10% were civil servants and traders. This is not surprising because rural dwellers are predominantly involved in agricultural production. A reasonable percentage (56.67%) of the farmers had farming experience ranging between 11 and 15 years with mean experience of 13.1 years, indicating that the farmers were knowledgeable in the technicalities and methods of farming which could serve as an added advantage in coping with climate change. This finding is in line with the observation of Onwubuya, et al. (2008) that at 13 years, farmers had fairly long period of experience which could served as an added advantage for increased production, having acquired enough skills and wealth of knowledge and to take right decisions concerning farm management. A good number of the farmers (68.33%) belonged to 3 to 4 farmers' organizations with a mean membership of 3, indicating a high level of social participation among the farmers Unnayan (2010) notes that promotion of farmers' organization and reinforcing capacities of

Table 1. Socio-economic characteristic of the respondents (n=120).

Variable	Frequency	Percentage	mean
Sex			
Male	86	71.67	
Female	34	28.33	
Age			
21-30	2	1.67	
31-40	16	13.33	
41-50	36	30.00	
51-60	58	48.33	
61 and above	8	6.67	49.7
Marital status			
Married	89	74.17	
Single	22	18.33	
Widowed	9	7.50	
Educational level			
No formal education	29	24.17	
Primary education	72	60.00	
Secondary education	16	13.33	
Tertiary education	3	2.50	
Household size			
1-5	12	10.00	
6-10	76	63.33	
11-15	32	26.67	8.8
Occupation			
Farming	94	78.33	
Trading	8	6.67	
Civic service	12	10.00	
Artisan	6	5.00	
Years of experience			
1-5	6	5.00	
6-10	16	13.33	
11-15	68	56.67	
16-20	30	25.00	13.1
Membership of farmers' organization			
1-2	32	26.67	
3-4	82	68.33	
5-6	6	5.00	3.1
Systems of farming			
Crop only	34	28.33	
Livestock only	14	11.67	
Crop and livestock	72	60.00	
Climate change awareness			
Yes	118	98.33	
No	2	1.67	

Table 2: Farmers by most important crops and animals grown/reared (n=120)

Most important crops grown			Most important animals reared
Crop	Percentage	Animal	Percentage
Cassava	85.00	Goat	55.00
Yam	75.00	Sheep	46.67
Maize	53.33	Poultry	76.67
Rice	65.83	Fish	23.33
Coco0yam	36.67	Pig	3.33
Melon	48.33	Cattle	0.00
Varieties of vegetables	37.50	Rabbit	17.50
Plantain/banana	45.00		
Cowpea/beans	47.50		

Source: Field survey, 2011.

the producers will enhance access to improved services. This has implication for extension organization to encourage farmers to form groups to enable them gain better access to resources. Majority (60%) of the farmers were involved in crop and livestock production. 28.33%) were engaged in crop production only while livestock production accounted for 11.67%. This implies that most of the farmers were involved in mixed farming. Ozor et al. (2010) observe that mixed farming is generally the most popular farming activity in Nigeria, particularly in the southern part. Table 1 further reveal that 98.33% of the respondents were aware of climate change effect on farming activities and on the environment at large. This awareness is more from personal observations and experience over time. The reason for this could be attributed to the fact that the respondents have lived in different communities for a long time (m = 49.7 years) and would have observed changes in climate over these period of years.

3.2 Major crops and animals grown/reared in the area

Among the crops considered, farmers cited cassava (85%) as the most important crop grown in the area (Table 2). This implies that cassava is the most promising and adaptable crops to climate change situation in the area. This confirms the position of Adebayoo et al. (2009) that cassava is one of the most important food crops in Africa. Its high resilience and adaptability to a wide range of ecological conditions has sustained its production through many generations. And compared to other crops, cassava is the most resistant to extreme weather events. It is therefore most often described as a hardy crop and may in this sense be the most adaptable crop to climate variations as observed by (Enete, 2003). Apu and Eze (2012) stated that cassava is one of the most important staple food crops in Nigeria and Africa as a whole and generally regarded as the foremost food security and poverty alleviation crop for Nigeria and entire sub-Saharan Africa (SSA), because of its special attributes which include; ability to make return of root yield even at extreme stress conditions, high tolerance to unfavourable conditions, requiring minimal external inputs, all year round availability, highly suitable to various farming and food systems in Africa as well as efficient production of food energy. Also Adeniji et al. (2012) opined that cassava is important as cash crop because of its ability to break the vicious cycle of poverty which hitherto has bedeviled some households in Nigeria, and has proved more egalitarian than other crops. This is due to the fact that most other arable crops are greatly affected by global warming, but cassava plants have the propensity to convert excess carbohydrates in their roots. Hence, it is regarded as a fall back crop (Simonyan and Joshua, 2014). Also Benhin (2006) noted that one of the strategies which served as an important form of insurance against rainfall variability is increasing diversification by planting crops that are drought tolerant and/or resistant to temperature stresses. The second most important crops as indicated by the farmers was yam (75%), indicating the sacred accorded to it as the "king" of all the crops in South Eastern Nigeria, as it is generally honoured every year with a heavy celebration known as "New Yam Festival" in all the communities in the

Table 3. Distribution of respondents by climate change indicators.

Variable	Frequency	Percentage
Yearly rainfall begins late	102	85.00
Yearly rainfall begins early	86	71.67
Yearly rainfall ends late	96	80.83
Yearly rainfall ends early	85	70.83
Increased temperature	90	75.00
Crop failure	100	83.33
Decline in animal production	64	53.33
Pest and disease infestation	88	73.33
Increased coldness	54	45.00
Early dryness of water	60	50.00
Early dryness of pasture	58	48.33
Multiple responses recorded		
Source: field survey, 2011.		

zone. On the other hand, the farmers indicated poultry (76.67%) as the most popular animals reared in the area. This implies that poultry is the most popular domesticated animals found in the area. Also poultry production accounts for the major part of meat in developing countries as is being reared in nearly all rural and urban households. Poultry is of considerable significance to rural as well as national economics and

an important source of animal protein.

3.3 Sources of Information on climate change

As shown in Figure 1, the major source of information on climate change was through personal experience (30%). This finding agrees with Tologbonse et al. (2010) that the main source of information on climate change was through personal experience. Also, Iwuchukwu and Udoye (2014) identified personal observation, friends, radio and television as rural farmer's major sources of information on climate change. The result also shows that only 13.33% of the farmers learnt of climate change information through extension agents, which might not be unconnected with the dwindling number of extension agents in the Nation's Agricultural Development Projects (ADPs) as found by NAERLS (2009). This finding of extension service implies that in order not to lose sight of their major role of working with the rural people along lines of immediate and felt needs, which involves enhancing their living standards and improving their immediate surroundings, there is the need to train and retrain field extension workers on the dangers, being imposed by climate change on agriculture and human health and also emerging adaptation measures on climate change as observed by (Egbule and Agwu, 2011). The majority (86.67%) learnt of climate change through other non-extension sources, indicating a gap in extension service delivery. Extension service holds great potentials for improving the productivity of natural resources, promoting the right attitude among natural resource managers. The extension service is recognized as an essential mechanism for information delivery and advice as input into modern resource management (Adebayo et al., 2009). The implication of this is that the resource-poor farmers gain little or no access to information on climate change through extension services.

3.4 Climate change indicators observed by farmers

Table 3 shows climate change indicators as observed by the farmers in the area. A majority (85.00%) of the farmers reported that yearly rainfall begins late and 71.67% indicated that yearly rainfall begins early. This is clear evidence of climate change increasing rainfall in most coastal areas and decreasing rains in the continental interiors (Nigerian Environmental Study/Action Team, 2003). A greater proportion of the farmers cited crop failure (83.33%) as another major climate change indicator observed in the area. The implication of this is that soil fertility is affected by global warming. This probably explains the

Table 4: Perceived effect of climate change (n= 120).

Effect	Weighted sum	Weighted mean	Interpretation	Rank
Decreased yield of crops	480	4.00	Strongly agree	1st
Increased poverty of farmers	480	4.00	Strongly agree	1st
Changes in rainfall pattern	473	3.94	Agree	3rd
Increased incidence of pests and diseases	462	3.85	Agree	4th
Decreased productivity of livestock	448	3.73	Agree	5th
Increased cost of production	442	3.68	Agree	6th
Increased weed infestation	350	2.91	Agree	7th
Increased heat stress on livestock	338	2.82	Agree	8th
Increase in temperature	328	2.78	Agree	9th
Increased drought	301	2.51	Agree	10th
Increased flooding	300	2.50	Agree	11th
Increased productivity of livestock	205	1.71	Disagree	12th
Increased yield of crops	150	1.25	Disagree	13th
Increased family income	140	1.17	Disagree	14th

Source: Filed survey, 2011.

resultant poor crop yields as experienced by the farmers (Egbule and Agwu, 2011). The result further shows that 75% of the respondents indicated increased temperature as one of the major indicators of climate change as observed in the area. This implies that excessive sunshine contributed to the increase in temperature, which probably brought about the incidence of early dryness of water source and pasture. According to Odjugo (2010), the temperature trend in Nigeria between 1910), the temperature trend in Nigeria between 1901 and 2005 was 26.6^0c, while the temperature increase for the 105 years was 1.1^0c. This according to Intergovernmental Panel on Climate Change (IPCC) (2007) is higher than the global mean temperature increase of 0.74^0c recorded since 1860 when actual scientific temperature measurement started. Odjugo (2010) noted that if this trend continues unabated, Nigeria may experience between the middle (2.5^0C) and high risk (4.5^0C) temperature increase by the year 2010. This is just 88 years from now. Increased incidence of pest and disease (73.33%) were among the major indicators of climate change indicated by the respondents in the area. This could be attributed to high humidity which is a favourable condition for the breeding of pests and diseases.

3.*5 Effect of climate change*

Table 4 shows the effect of climate change on crops and animals as observed by farmers. Of the 14 variables considered, farmers cited decreased yield of the crop (x=4.00) and increased poverty (x=4.00) as the major effects of climate change. This implies that rural farmers who depend largely on farming as their major source of livelihood have been negatively affected by climate change variations because either heavy downpours or droughts are likely to reduce crop yields. Tologbonse et al. (2010) observed that in their study of farmers' perception of the effects of climate change and coping strategies in three agro-ecological zones of Nigeria that cli-

mate change reduces the yield of crops and increases the poverty rate of farmers generally. Also, this is in line with the assertion of Oyerinde and Osanyande (2010) that rural farmers are becoming poorer because their farming systems are characterized by low and declining productivity due to climate change and this is why FAO (2007) has earlier called for mitigation effort or else there would be grave food shortage of about 50% by 2020. The farmers indicated a change in rainfall pattern (x=3.94) and increased incidence of pests and diseases as their 3rd and 4th effects. On the incidence of pests and diseases infestation, global warming would cause an increase in rainfall in some areas, which would lead to an increase in atmospheric humidity and the duration of the wet season. Combined with higher temperatures, these could favour the development of fungal diseases. Similarly, because of higher temperatures and humidity, there could be an increased pressure from insects and disease vectors as observed by Egbule and Agwu (2011).

3.6 Strategies for coping with the impact of climate change

All the farmers (100%) indicated a ban on deforestation as one of the best ways of coping with the impact of climate change (Table 5). This gives credence to UNFCCC's (2007) assertion that tropical deforestation is responsible for about 20% of global greenhouse gas emissions, more than what all the cars, trucks, planes, boats and trains in the world jointly emit. This devastation is not only a huge

Table 5: Strategies to cope with the effect of climate change (n= 120).

Effect	Weighted sum	Weighted mean	Interpretation	Rank
Ban on deforestation	480	4.00	Strongly agree	1st
Diversification of crops	470	3.92	Agree	2nd
Raising different types of animals	468	3.90	Agree	3rd
Ban on forest fire	460	3.83	Agree	4th
Planting pests and disease resistant crop varieties	452	3.77	Agree	5th
Planting drought resistant varieties	450	3.75	Agree	6th
Raising pest and diseases tolerant animals	446	3.71	Agree	7th
Planting short season varieties of crops	412	3.43	Agree	8th
Increase in the use of organic manure	350	2.92	Agree	9th
Tree planting to moderate temperature	344	2.87	Agree	10th
Increase in fluid intake	340	2.83	Agree	11th
Protecting water from contamination	312	2.60	Agree	12th
Mulching of crop to reduce water loss	305	2.54	Agree	13th
Varying planting dates	300	2.50	Agree	14th
Stop the use of fertilizer	208	1.73	Disagree	15th

Source: Field survey, 2011

Table 6: Pearson's correlation analysis of some selected socio-economic characteristics and source of information on climate change.

Variable	R value	P. value	Decision
Gender	0.185	0.583	NS
Age	0.275	0.005 x xx	S
Farming experience	0.032	0.629	NS
Educational level	0.147	0.001 x xx	S
Membership of social organization	0.354	0.007 x xx	S
Household size	0.0071	0.928	NS

***=** significant at P<0.05; S= significant; NS = Not Significant.

threat to our climate, but also deprives wildlife and people of benefiting from gains in the forest. The farmers also agreed that diversification of crops (x = 3.92), raising different types of animals (x =3.90), a ban on forest fire (x=3.84) among others were coping strategies to reduce the effect of climate change. Some of the findings gave credence to Mutekwa (2009) who found in a study of climate change impacts and adaptation among smallholder farmers in Muowa ward of Zimbabwe that the most popular adaptation strategies to climate change include diversification of crops, planting short-season varieties of crops, varying planting dates. The main thrust of these strategies is increased diversification and escaping sensitive growth stages through crop growth stages that do not coincide with harsh climate conditions in the season, such as mid-season droughts (Nhemachena and Hssan, 2007). Crop diversification improves household food security since different crops are affected differently by the same climatic conditions. However, the farmers disagreed with the statement to stop the use of fertilizer, showing that farmers were aware that fertilizer is one of the most important crop yield increasing technologies in agricultural production.

3.7 Relationship of selected socio-economic characteristics of the respondents' sources of information on climate change

Table 6 shows the summary of Pearson's correlation analysis of some selected socio-economic characteristics and the sources of information on climate change. Findings reveal that there is a positive and significant relationship between respondent's age, educational level and membership of the social organization and the sources of information on climate

change at a 5% level of probability. The variations of the impacts of climate change across the zones are most likely to be the reason for the positive and significant relationship to farmer's observations because they have witnessed climate change based on its manifestation in their environment for years. The educational significant level as shown in Table 6 implies that the higher the level of education, the more a respondent is likely to search for more information on climate change. The older farmers are more likely to have observed climate change impact based on the generational changes they have witnessed within their environment over time (Tologbonse et al., 2010). The result also shows that membership of the social organization is positively and significantly correlated to the sources of information, indicating a high level of social participation and interaction and, hence, increased awareness among respondents due to the group dynamic effect. On the other hand, respondents' gender, farming experience and household size found to be positive but had no significant relationship to the source of information on climate change.

4.0 Conclusion and Recommendation

Climate change is the most serious environmental challenges to the fight against hunger, malnutrition, disease and poverty in the Africa sub-region, essentially because of its impact on agricultural production productivity. The study showed that young, literate and experienced farmers that sourced their major climate change information through personal observations dominated the area. Yearly rainfall begins late, crop failure, pest and disease infestation were the major climate change indicators while the major effect of climate change includes; decreased yield of crops, increased poverty of farmers, and changes in rainfall pattern. Diversification of crops and animals, planting of short-season crop varieties and varying the planting of short-season crop varieties and varying the planting dates of crops were the major coping strategies favoured by the respondents to reduce the effects of climate change. Pearson's correlation analysis showed that age, educational level, and membership of social organization were positively and significantly correlated with the sources of information on climate change at a 5% probability level.

The paper recommended that there is the need to sensitize farmers more on the possible strategies to cope with climate change by all tiers of governments, including non-governmental organizations using the available extension system structures. Also, improved crops and livestock that are tolerant to adverse conditions associated with climate change should be made available to farmers. Finally, there is the need to provide effective and reliable access to information on climate change that would enable the farmers to salvage the agricultural sector from its present predicaments.

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