

Effects of Climate Change On Food Production and Farm Level Adaptation Practices in South-East Nigeria

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Received: May 18, 2016; **Published:** July 21, 2016

Abstract

The study investigated the effects of climate change on food production and farm level adaptation practices in South-east Nigeria. In carrying out the study, four research questions were developed and answered. The study adopted descriptive survey research design to sample the opinion of 240 small holder farmers from Enugu and Imo States in South-east Nigeria. The instrument for data collection was a 76-item close ended questionnaire structured into 4-point rating scale to answer the level of climate change awareness of farmers, the intensity of the effects of climate change on food production and adaptive practices by the farmers. The instrument was face-validated by three experts while Cronbach Alpha reliability coefficients of 0.81, 0.76, 0.79 and 0.73 were obtained for climate change awareness of farmers, effects of climate change on food production, adaptation practices in crop production and livestock production clusters respectively. Out of the 240 copies of the questionnaire administered to the farmers, 227 copies were retrieved and completely filled representing 96% return rate. The data collected were analyzed using mean (\bar{x}). Based on the data collected and analyzed, the study found that farmers in southeast Nigeria are aware of climate change. The intensity of heat, prolonged drought, decreased rainfall amount, unusual heavy rainfall, flooding, drying up of rivers, lakes and streams among others were identified as serious effects of climate change on agricultural production in Southeast Nigeria. Despite these effects, the study also found that, adaptive capacity of small holder farmers is still very low.

Keywords: Climate change; Awareness; Adaptation; Crop; Livestock production; Southeast Nigeria

Introduction

Climate change is a significant shift in the climatic conditions (precipitation, temperature, wind patterns) of a place or region over a long period of time resulting in changes in ecosystems and socioeconomic activities. According to IPCC [1], climate change is an alteration in the climatic conditions over a period of time due to the effects of natural variability and/or as a result of human anthropogenic activities. The impact of climate change is global, but the most adverse effects is expected to be felt in developing countries, especially those in Africa [2]. On country specific, Ayinde., *et al.* [3] stated that the vulnerability of African farmers to the effects of climate change is expected to be most severe in Nigeria, due to their low coping capability. Agriculture is considered both culprit and victim of climate change. This is because, Green House Gas (GHG) emissions from food and the agriculture sector account for over one-third of the current annual total emissions; the livestock sector accounts for about 18% of global green house gas emissions, deforestation also accounts for 18% of carbon dioxide emissions [4] which further aggravate the effects of climate change on food production.

The effects of climate change cut across all the sub-sectors of Nigerian agriculture such as livestock, crop production, agroforestry, fishery, agricultural products processing and so on [5]. In affirmation, Urama and Ozor. [6] noted that effects of climate change bring about uncertainties in the sustainability of agriculture and agro-allied ventures. For instance, climate change affects animal production through changes in pastures and forage crop availability, changes in the distribution of livestock diseases and pests; effects of weather and extreme events on animal health, growth and reproduction. On the damages to aquatic lives, climate change affects the metabolism, growth and distribution of many aquatic organisms as well influence diseases that afflict them. For agricultural processing, Enete., *et al.* [7] reported that climate change has significantly affected cassava processing through poor storage quality of processed cassava products. In addressing this global threat, Tubiello and Rosenzweig [8] stated that, a wide range of adaptation practices exist within farming system to help maintain or increase crop and livestock yields under climate change.

Climate change adaptation practices according to Nyong., *et al.* [9] are those farm activities that enable the individual or the community to cope with or adjust to the impacts of the change in climate. Some of the adaptation measures among farmers include cover cropping, early planting, prompt weeding, regulated use of agro-chemicals and use of tolerant varieties [10]. Adaptation helps farmers achieve their food, income and livelihood security objectives in the face of changing climatic and socio-economic conditions including climatic variability, extreme weather conditions such as droughts, floods and volatile short term changes in local and large-scale markets [11]. Farmers' adaptation to the effects of climate change is often time shaped by their awareness of the changes in the climatic conditions.

Climate change awareness is the aggregate of knowledge, attitudes or beliefs held by the society on climate change and global warming. According to Oruonye [12], climate change awareness is a synthesis of the people's conception, interpretation and perceptions of climate change related issues which affect their behaviour, and the quality of responses and reactions to the problems. Nzeadibe., *et al.* [13] stated that the perception of climate change governance by stakeholders, such as farmers, is important as awareness can shape the preparedness of these actors to adapt and change or modify their farm practices. Maddison [14] noted that awareness of climate change is a necessary prerequisite for adaptation practices by farmers. This is because, improved awareness through education and farming experience will positively influence farmers' readiness and decision to take up climate change adaptation measures. Improved education and disseminating strategies constitute important policy measures for stimulating awareness and local participation of farmers in various development and national resource management initiatives [15].

Inadequate information about climate change among the farmers limits their level of awareness of the global phenomenon and worsen their vulnerability to the devastating effects of climate change. Action Aid International [16] reported that farmers in the South-eastern part of Nigeria have continued to complain of reduction in farm output arising from the uncertainty of rainfall patterns, increased erosion resulting from heavy down pour which simultaneously destroy the fertility and at times wash away of plants and human settlements. The unfortunate aspect of the climate change dilemma in Nigeria is that most of the farmers do not understand or appreciate their contributions to climate change devastations. This is more so among rural farmers in southeast Nigeria who still engage in traditional forms of slash and burn system of farming [17]. It is therefore imperative to empirically investigate level of climate change awareness among south-eastern farmers, the effects of climate change of food production and farm level adaptation practices for coping with the threats of climate change in crop and livestock production in southeast Nigeria.

Purpose of the Study

The purpose of the study was to investigate the effects of climate change on food production and farm level adaptation practices adopted by small holder farmers in South-east Nigeria. Specifically, the study:

- a. ascertained the level of awareness of climate change among small holder farmers in Southeast Nigeria.
- b. identified the effects of climate change on food production activities of farmers in Southeast Nigeria.
- c. identified farm level adaptation practices for sustainable crop production in Southeast, Nigeria.
- d. identified farm level adaptation practices for sustainable livestock production in Southeast, Nigeria.

- e. Research Questions
- f. What is the level of awareness of climate change among small holder farmers in Southeast Nigeria?
- g. What are the effects of climate change on food production activities of farmers in Southeast Nigeria?
- h. What are the farm level adaptation practices for sustainable crop production in Southeast, Nigeria?
- i. What are the farm level adaptation practices for sustainable livestock production in Southeast, Nigeria?

Methodology

The study was carried out in Southeast Nigeria. Southeast is made up of five states which include: Abia, Anambra, Ebonyi, Enugu and Imo States. Southwest Nigeria falls within longitudes 5°30' & 9°30' E and latitudes 4°30' & 7°00' N. Notable food crops cultivated in the area include: cassava, maize, yam, cocoyam, cowpea, vegetables and cash crops such as cashew, mango and oil palm. Livestock such as goat, pig, sheep and poultry are predominantly reared in southeast Nigeria.

In carrying out the study, four research questions were formulated and answered. The study adopted descriptive survey research design. Descriptive survey research design according to Nworgu [18] is one in which a group of people or items are studied by collecting and analyzing data from a few people or items considered to be the representative of the entire group. Through survey design, Osuala [19] stated that researchers obtain vital information and facts about people, their beliefs, opinions, attitudes and behaviors through the use of questionnaire. Therefore, descriptive survey design was found suitable for this study because questionnaire was used to collect data from selected farmers on their awareness, effects of climate change on food production and the adaptation practices put in place by the farmers for coping with the effects of climate change.

Multistage random sampling technique was used for selecting 240 small holder farmers that constituted the sample for the study. Firstly, through random sampling technique, two states were selected from the five south-eastern states namely Enugu and Imo states. Secondly, from each of the selected two states, two agricultural zones were randomly selected making four agricultural zones for the study. In Enugu State, Nsukka and Awgu agricultural zones were selected while in Imo State, Okigwe and Owerri agricultural zones were selected. Thirdly, two Local Government Areas (LGAs) were randomly selected from each of the four agricultural zones making eight LGAs for the study. The fourth stage of the sampling involved the random selection of two farming communities from each of the eight LGAs making 16 farm communities. The fifth stage of the sampling involved purposive random sampling of 15 farmers from each of the 16 farming communities totalling 240 small holder farmers for the study. The purposive sampling at this study was to ensure that small holder farmers who are engaged in both crop and livestock production were selected. With the cooperation and assistance of Extension Services Department (ESD) in the two states, the list of farmers engaging in both crop and livestock farm enterprise was compiled.

The instrument for data collection was a questionnaire structured on a 4-point rating scale. For the level of awareness of climate change, the instrument was structured into: High Awareness (HA); Moderate Awareness (MA); Low Awareness (LA) and Very Low Awareness (VLA). For effects of climate change on food production, the instrument was structured into: Very Serious (VS), Serious (S), Less Serious (LS) and Not Serious (NS). On adaptation practices put in place by the farmers, the instrument was structured into: Highly Practiced (HP), Moderately Practiced (MP), Less Practiced (LP) and Not Practiced (NP) with corresponding values of 4, 3, 2, and 1 respectively in each of the cases. The instrument was face-validated by three experts. For the purpose of ascertaining the internal consistency of the instrument, Cronbach Alpha reliability method was used which yielded a coefficient of 0.81 for climate change awareness cluster, 0.76 for effects of climate change cluster, 0.79 for adaptation practices in crop production cluster and 0.73 for adaptation practices in livestock production cluster. To ensure quality data collection, eight research assistants were hired for data collection from the respondents. Each of the assistants covered one LGA each. Out of the 240 copies of the questionnaire administered to the farmers, 227 copies were retrieved and completely filled representing 94.6% rate of return. The data collected were analyzed using mean for answering the research questions.

In taking decision on the research questions, boundary limit was used such that any item with mean values within 3.50 - 4.00 was regarded as High Awareness, Very Serious or Highly Practiced as the case may be. Items with mean values within 2.50 - 3.49 were regarded

as Moderate Awareness, Serious or Moderately Practiced as the case may be. Items with mean values within 1.50 - 2.49 were regarded as Low Awareness, Less Serious or Less Practiced as the case may be while items with mean values within 1.00 - 1.49 were regarded as Very Low Awareness, Not Serious or Not Practiced as the case may be.

Results

Research Question One

What is the level of awareness of climate change among small holder farmers in South-east Nigeria?

The data for answering research question one are presented in Table 1 below.

S/N	Climate change indicators	\bar{x}	SD	Rmks
1	Decreased rainfall amount in the continental interiors	2.97	0.45	MA
2	Increased rainfall in the coastal areas	2.84	0.82	MA
3	Unpredictable rainfall patterns	3.53	0.80	HA
4	Increase in temperature (heat)	3.62	0.62	HA
5	Prolonged drought than before	3.56	0.73	HA
6	Delay in arrival of annual rainfall	3.61	0.70	HA
7	Gradual disappearing of the usual harmattan periods	3.66	0.63	HA
8	High winds and heat waves	3.45	0.87	MA
9	Fast water evaporation from the ground	2.87	0.55	MA
10	Unusual heavy rainfall	3.20	0.53	MA
11	Reduced length of growing season	3.21	0.80	MA
12	Decrease in ice fall during rainfall unlike before	3.59	0.42	HA
13	River surface temperature rise	2.42	0.64	LA
14	Variations in bloom date (fruiting of crops)	2.44	0.63	LA
15	Rising sea level	2.39	0.59	LA
16	Increased flooding/erosion menace	3.43	0.88	MA
17	Crop and animal species extinctions	2.23	0.61	LA
18	Increased desertification	2.77	0.80	MA
19	Drying up of rivers, lakes and streams	3.33	0.73	MA
20	Increased post-harvest deterioration of crops	3.41	0.82	MA

Note: X: Mean; SD: Standard Deviation; N: Number of respondents; HA: High Awareness; MA: Moderate Awareness; LA: Low Awareness

Table 1: Mean Ratings of the Responses of Farmers in Southeast Nigeria on their Level of Awareness of Climate Change Phenomenon (N = 227).

The result presented in Table 1 showed that the mean ratings of the responses of farmers in Southeast Nigeria on 6 out of the 20 identified climate change indicators ranged between 3.53 to 3.66 which were within the boundary limit of 3.50 - 4.00 on 4-point rating scale. This indicated that small holder farmers in southeast Nigeria are highly aware of the 6 indicators of climate change in the area. The mean ratings on 10 out of the 20 identified climate change indicators ranged between 2.77 to 3.45 which were within the boundary limit of 2.50 - 3.49 on 4-point rating scale. This implied that small holder farmers in southeast Nigeria are moderately aware of the 10 indicators of climate change in the area.

The mean values on items 13, 14, 15 and 17 were 2.42, 2.44, 2.39 and 2.23 respectively which were within the boundary limit of 1.50 - 2.49 on 4-point rating scale indicating that farmers in southeast Nigeria are less aware of the 4 indicators of climate change in the area. The findings of this study showed that small holder farmers in southeast Nigeria are generally aware of the phenomenon climate change. The standard deviation values of the 20 items in the Table ranged from 0.42 to 0.88 which showed that the responses of the farmers on the items are close to the mean and one another.

Research Question Two

What are the effects of climate change on food production activities of farmers in Southeast Nigeria?

The data for answering research question two are presented in Table 2 below.

S/N	Effects of climate change on agriculture	\bar{x}	SD	Rmks
1	Decreased rainfall amount for agricultural production	2.83	0.63	S
2	Unusual heavy rainfall affecting crops on the field	3.65	0.82	VS
3	Higher temperature and heat stress on crop and livestock	3.67	0.65	VS
4	Heavy winds causing damage to crops	2.41	0.81	LS
5	Increased cases of flooding resulting in crops	3.58	0.52	VS
6	Prolonged drought resulting in food shortage	3.63	0.69	VS
7	Increased desertification	2.53	0.57	S
8	Increase in pest and disease problems of crop and livestock	2.11	0.84	LS
9	Extinction of crop species as a result of climate change	1.84	0.69	LS
10	Decreased soil moisture for plant growth	3.58	0.59	VS
11	Premature ripening of fruits	1.66	0.44	LS
12	Reduction in crop yield	2.73	0.80	S
13	Poor quality of storage farm produces as a result of heat	3.52	0.60	VS
14	Stunted growth of crops	2.50	0.68	S
15	Drying up of rivers, lakes and streams for food production	3.51	0.72	VS
16	Increased drying up of seedlings after germination	3.50	0.59	VS
17	Increased heat stress on crop and livestock	3.64	0.85	VS
18	Intense weed growth	2.40	0.55	LS
19	Increased soil erosion resulting from unusual heavy rains	3.62	0.83	VS
20	Storage losses in roots and tubers	2.45	0.81	LS
21	Increased salinity/water pollution due to climate variability	1.81	0.68	LS
22	Decrease in fish population due to salinity, water level, ocean currents or speed	2.23	0.52	LS
23	Increased post-harvest spoilage of harvested crops	2.85	0.72	S

Note: X: Mean; SD: Standard Deviation; N: Number of respondents; VS: Very Serious; S: Serious; LS: Less Serious

Table 2: Mean Ratings of the Responses of Farmers in Southeast Nigeria on their Perception of Effects of Climate Change on Food Production (N = 227).

From the result presented in Table 2 above, it was revealed that the mean ratings of the responses of farmers in Southeast Nigeria on 10 out of the 23 identified effects of climate change ranged between 3.51 to 3.67 which were within the boundary limit of 3.50 - 4.00 on 4-point rating scale. This implied that the identified 10 items in the table are very serious effects of climate change on agricultural produc-

tion in southeast Nigeria. The mean ratings on 5 out of the 23 identified effects of climate change ranged between 2.50 to 2.83 which were within the boundary limit of 2.50 - 3.49 on 4-point rating scale. This indicated that the 5 identified items are serious effects of climate change on agricultural production in southeast Nigeria.

The mean values on the remaining 8 items in the table ranged from 1.66 to 2.45 which were within the boundary limit of 1.50 - 2.49 on 4-point rating scale indicating that the remaining 8 items in the table are less serious effects of climate change on agricultural production in southeast Nigeria. Generally, the findings of this study showed that climate change is seriously affecting agricultural production in southeast Nigeria. The standard deviation values of the 23 items in the Table ranged from 0.44 to 0.85 which showed that the responses of the farmers on the items are close to the mean and one another.

Research Question Three

What are the farm level adaptation practices for sustainable crop production in Southeast, Nigeria?

The data for answering research question three are presented in Table 3 below.

SN	Climate change adaptation practices in crop production	\bar{x}	SD	Rmks
1	Use of irrigation system	2.42	0.75	LP
2	Early or late planting of crops as adaption strategies	2.45	0.52	LP
3	Planting different varieties of crop (multiple cropping)	3.70	0.50	HP
4	Planting of trees (afforestation, reforestation, agroforestry)	2.35	0.64	LP
5	Planting cover crops to help conserve soil moisture	3.33	0.66	MP
6	Minimum/zero tillage for conserving soil nutrients	2.47	0.60	LP
7	Increased mulching for conserving moisture and reduce heat	3.40	0.54	MP
8	Staking of crawling crops such as yam to avoid heat burns	3.61	0.56	HP
9	The use of organic manure	3.67	0.89	HP
10	Mixed farming / diversification of farm enterprise	3.58	0.70	HP
11	The use of inorganic manure (fertilizers)	3.56	0.90	HP
12	Making ridges across farms to reduce effects of erosion	3.43	0.65	MP
13	Planting pest and disease resistant crops	2.40	0.80	LP
14	Planting of drought tolerant crop varieties	2.36	0.85	LP
15	Making of contour bunds around farmland	2.48	0.63	LP
16	Planting of fast maturing crop varieties	2.31	0.68	LP
17	Avoiding eroded/erosion prone area for farming	2.42	0.88	LP
18	Adopting recommended planting distance	2.13	0.75	LP
19	Changing crop harvesting dates	2.27	0.60	LP
20	Processing of crops to minimize post-harvest losses	2.28	0.54	LP
21	Construction of drainages across the farmland	2.37	0.59	LP
22	The use of wetlands/river valleys for production	2.56	0.58	MP
23	Consultation with rain maker during prolonged drought	1.52	0.68	LP

Note: X: Mean; SD: Standard Deviation; N: Number of respondents; HP: Highly Practiced; MP: Moderately Practiced; LS: Less Practiced

Table 3: Mean Ratings of the Responses of Farmers in Southeast Nigeria on Climate Change Adaptation Practices for Sustainable Crop Production (N = 227).

The result presented in Table 3 showed that the mean ratings of the responses of farmers in Southeast Nigeria on 5 out of the 23 identified climate change adaptation practices ranged between 3.56 to 3.70 which were within the boundary limit of 3.50 - 4.00 on 4-point rating scale. This indicated that the identified 5 items in the table are highly practised adaptation measures by farmers for coping with climate change in crop production in southeast Nigeria. The mean ratings on items 5, 7, 12 and 22 were 3.33, 3.40, 3.43 and 2.56 respectively which were within the boundary limit of 2.50 – 3.49 on 4-point rating scale. This indicated that the 4 identified items are moderately practised adaptation measures by farmers for coping with climate change in crop production in southeast Nigeria.

The mean values on the remaining 14 items in the table ranged from 1.52 to 2.48 which were within the boundary limit of 1.50 - 2.49 on 4-point rating scale indicating that the 14 adaptation strategies are less practised by farmers for coping with effects of climate change in crop production in southeast Nigeria. The findings of this study revealed that adaptation to the effects of climate change by south-eastern farmers in crop production is still generally low. The standard deviation values of the 23 items in the Table ranged from 0.52 to 0.90 which showed that the responses of the farmers on the items are close to the mean and one another.

Research Question Four

What are the farm level adaptation practices for sustainable livestock production in Southeast, Nigeria?

The data for answering research question four are presented in Table 4 below.

SN	Climate change adaptation in livestock production	\bar{x}	SD	Rmks
1	Intensify supplementary feeding system	2.65	0.81	MP
2	Dip and Dose system in livestock rearing	2.09	0.62	LP
3	Improved fence camps for livestock	3.57	0.53	HP
4	Rearing of disease and pest resistant livestock varieties	2.43	0.84	LP
5	Constructing livestock pens with poor conductors of heat	3.26	0.71	MP
6	Culling of infected animals	2.37	0.62	LP
7	Decrease in stocking rate of animals	2.45	0.84	LP
8	Distributing livestock herds to reduce disease spread	2.44	0.79	LP
9	Rainwater harvesting for livestock rearing	3.38	0.55	MP
10	Intensify shading of livestock pens	2.47	0.73	LP

Note: X: Mean; SD: Standard Deviation; N: Number of respondents; HP: Highly Practiced; MP: Moderately Practiced; LS: Less Practiced.

Table 4: Mean Ratings of the Responses of Farmers in Southeast Nigeria on Climate Change Adaptation Practices for Sustainable Livestock Production (N = 227).

The result presented in Table 4 revealed that the mean ratings of the responses of farmers in Southeast Nigeria on item 3 was 3.57 which indicated that improved fence camps for livestock is highly practised adaptation measures by farmers for coping with climate change in livestock rearing in southeast Nigeria. The mean ratings on items 1, 5, 9 and 10 were 2.65, 3.26, 3.38 and 3.42 respectively which were within the boundary limit of 2.50 – 3.49 on 4-point rating scale. This indicated that the 4 identified items are moderately practised adaptation strategies by farmers for coping with climate change in livestock production in southeast Nigeria.

The mean values on the remaining 5 items in the table, specifically items 2, 4, 6, 7 and 8 were 2.09, 2.43, 2.37, 2.45 and 2.44 respectively which were within the boundary limit of 1.50 - 2.49 on 4-point rating scale indicating that the 5 adaptation strategies are less practised by farmers for coping with effects of climate change in livestock production in southeast Nigeria. The findings of this study revealed that adaptation to the effects of climate change by south-eastern farmers in livestock production is still generally low. The standard deviation

values of the 10 items in the Table ranged from 0.53 to 0.84 which showed that the responses of the farmers on the items are close to the mean and one another.

Discussion of Results

The findings of this study on climate change awareness showed that small holders farmers in southeast Nigeria are aware of climate change indicators which include: unpredictable rainfall patterns, increase in temperature (heat), prolonged drought than before, delay in arrival of annual rainfall, gradual disappearing of the usual harmattan periods, decrease in ice fall during rainfall, decreased rainfall amount in the continental interiors, increased rainfall in the coastal areas, unusual heavy rainfall, high winds and heat waves, reduced length of growing season and Drying up of rivers, lakes and streams among others. The findings of this study on level of awareness of climate change is related to the findings of the study of Ozor & Nnaji [20] who found out that effects of climates change as perceived by farmers in Enugu State, Nigeria include: heat from high temperature, drying of rivers, lakes and surface water bodies, drought and change in storage quality of fruits and vegetable. Findings of this study on awareness also conformed with the report of the study of Sofoluwe, Tijani and Baruwa [21] who confirmed that most Nigerian farmers are already aware of the changes in climate; through variation in the indicators.

Maddison [14] reported that preliminary evidences from a number of studies across African countries showed that large number of farmers already perceive that the climate has become hotter and the rain has become less predictable and shorter in duration.

This study identified the effects of climate change on agricultural production in southeast Nigeria to include: decreased rainfall amount for agricultural production, unusual heavy rainfall affecting crops on the field, higher temperature and heat stress on crop and livestock, increased cases of flooding resulting in crops, prolonged drought resulting in food shortage, deceased soil moisture for plant growth, drying up of rivers, lakes and streams for food production, increased drying up of seedlings after germination, increased heat stress on crop and livestock, stunted growth of crops and reduction in crop yield among others. The findings of this study corroborated that of Ishaya and Abaje [22] who reported that the threat of climate change is more on health, food supply, biodiversity lost and fuelwood availability than on businesses and instigating of disaster; and it is the poor, who depend heavily on the natural resources that are mostly affected by incidence of climate change. The findings of this study also agreed with the findings of Adebayo., *et al.* [23] who found that in terms of climate change effects on farming enterprises, reduction in crop yield were reported by 60% of the farmers interviewed in southwest Nigeria while about 46.7% of the farmers also noted a general low level of farm productivity as a consequence of climate change. The finding of this study also supported that of Ozor and Nnaji [20] who found that intense weed growth, incidence of pests and diseases, premature ripening, heavy winds are effects of climate change on agricultural production in Enugu State.

This study found that adaptation strategies for coping with the effects of climate change in crop production in southeast are still less practiced. These include: use of irrigation system, early or late planting of crops as adaption strategies, planting of trees, minimum/zero tillage for conserving soil nutrients, planting pest and disease resistant crops, planting of drought tolerant crop varieties, making of contour bunds around farmland, planting of fast maturing crop varieties among others. This study found that adaptation strategies for coping with the effects of climate change in livestock production in southeast are still less practiced. These include: dip and dose system in livestock rearing, rearing of disease and pest resistant livestock varieties, culling of infected animals, and intensify shading of livestock pens. The findings of this study revealed that adaptation to the effects of climate change by south-eastern farmers in crop production is still generally low. The findings of this study conformed with that of Amusa [5] on gender and climate change adaptation decision in southwest Nigeria where the author found that the coping capacity among Nigerian farmers to the effects of climate change is still low. Oruonye [12] reported that the relatively low level of awareness about climate change in developing countries is an impediment to effective implementation and adaptation to the effects of climate change.

Conclusion and Recommendations

From the results of this study, it can be concluded that a reasonable percentage of farmers in Southeast Nigeria are aware of climate change, even though, there is still room for intensified effort in awareness creation about the global phenomenon. The intensity of heat, prolonged drought, decreased rainfall amount, unusual heavy rainfall, flooding, reduction in crop yield, drying up of rivers, lakes and streams and heat stress on crop and livestock among others are serious effects of climate change on agricultural production in Southeast Nigeria. Despite the perceived devastating effects of climate change on food production in southeast Nigeria, the adaptive capacity of small holder farmers is still very low. Based on these findings, the study therefore recommended:

- a. Proactive awareness creation among farmers about climate change using media such as radio/television, newspapers, internet and farmers' cooperatives.
- b. Effort should be made by government at all levels towards capacity building of the farmers through improved education and extension visits.
- c. Agricultural extension services should be made more effective towards improved farmers' training on adaptive responses to the observed effects of climate change on food production activities of the farmers.

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Volume 3 Issue 4 July 2016

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