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Full Length Research

Impacts of Climate Change on Animal and Crop Production in the Niger Delta Region of Nigeria

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The study focused on the impacts of climate change on animal and crop production in Niger Delta Region of Nigeria. The study specifically evaluated the perceived extent of impacts of climate change on animal and crop production in the region. The study adopted descriptive survey research design. Two research questions and two hypotheses guided the study. The population for the study was 246,909 respondents made up of registered farmers and extension workers. Out of the nine Niger Delta states, Bayelsa and Delta states were randomly chosen for the study. Proportionate stratified random sampling technique was used to select a sample size of 4,936 respondents. Structured questionnaire and interview were used to collect data. The instruments were validated by three experts. Cronbach Alpha method was used to determine the internal consistency of the questionnaire items which yielded a coefficient of 0.81. The Statistical Product and Service Solutions (SPSS v 20.0) was employed for data analysis. The statistical tools used for data analysis were weighted mean to answer research questions and standard deviation to validate the closeness of the respondents from the mean and from each other in their responses while t-test was used to test the stated null hypotheses. The findings of the study revealed that the extent of impacts of climate change on both animal and crop production in the region is moderate. Findings further revealed that climate change has led to increased cost of production (input and labour cost). The study recommends, among others, that farmers in the region should be encouraged by providing incentives and subsidizing inputs for them by Federal and State governments as well as other non-governmental organizations, as this will go a long way in improving production especially as most farmers agree to continue production even with the observed impacts.

Key words: Climate change, Rainfall, Production, Flooding, Temperature.

INTRODUCTION

Agricultural production processes greatly rely on climate, thus a change in its composition is bound to have effects on the sector. Animal and crop production are, among others the most important part of agriculture affected by change in climate because they involve living things which directly depend on conducive climatic factors to strive. Climate change has been a global issue affecting various agricultural production processes. Climate change is the complete variation of the average state of the atmosphere over time, ranging from decades to millions of years in a region or across the entire globe, and can be caused by processes internal to the earth, external forces from space or anthropological activities (Lemke, 2006). In recent time, especially in the context of environmental policy, climate change has often been referred to as the noticeable variation in environmental and atmospheric composition attributable to human activities (Intergovernmental Panel on Climate Change, IPCC, 2007). Climate change is the variation in the statistical distribution of average weather conditions over a prolonged period of time in any region of the world, such as the Niger Delta region of Nigeria.

Niger Delta region of Nigeria is densely populated and occupies about 12% of the total land mass of Nigeria with

a land area of about 70,000km² out of which 2,370km^2 consist of rivers, creeks and estuaries, while stagnant swamp covers about 8,600km² (Ugolor, 2004). The region is endowed with great potentials for high productive and profitable agriculture (Fapojuwo *et al*., 2012). The region is divided into drier landward part where crop farming is the major agricultural activity and the seaward part (riverine and swampy areas) which is characterized by extensive creeks and water bodies where fishing and aquaculture replaces crop farming as the dominant aspect of the rural economy (Aweto, 2011). Economic activities of communities in the region are either land-based or water-based to include collection and processing of palm fruits, crop and animal farming, fishing and fish farming, forest resources utilization (such as game and raffia) and trading of agricultural goods (Rosemary *et al*., 2012). The region occupies greater area of Nigeria's most fertile land suitable for the cultivation of many arable crops while the availability of water bodies makes aquaculture (like fish farming) feasible (Abisola, 2013). The topical alteration in climate has become significance for worldwide discussion as it has resulted to varying effects in the environment.

The main effect of climate change is the increased average temperature which causes a variety of secondary effects (IPCC, 2007). The secondary effects caused by increased temperature include, change in precipitation affecting rainfall, rise in sea level leading to coastal erosion and flooding, altered patterns of agricultural/cultural practices, extreme weather events and expansion of range of tropical diseases (Ogundele, 2012). These secondary effects have affected the world in varying degree of impacts in different regions.Climate affects animal production in four ways: livestock feed-grain availability and price; impacts on livestock pastures and forage crop availability and quality; changes in the distribution of livestock diseases and pests; and the direct effects of weather and extreme events on animal health, growth and reproduction (Parry *et al*., 2004). The impact of climate change on pastures and rangelands include deterioration of quality subtropical grasses in temperate regions as a result of warmer temperatures and less frost as a consequence, productivity of grazing livestock could be altered (Osinem, 2005). The author further stated that alterations of temperature and precipitation regimes results in spread of diseases and parasites into new regions or produce an increase in the incidence of existing disease, which, in turn, would reduce animal productivity and possibly increase animal mortality.

Under high temperature conditions, the inability of animals to dissipate environmental heat results to heat stress especially during hot seasons. There is a range of thermal conditions within which various animals are able to maintain a relatively stable body temperature. Heat stress results from the animal's inability to dissipate sufficient heat to regulate body temperature (Osinem, 2005). Thus, an increase in temperature, such as that expected in different scenarios of climate change, would directly affect animal's performance by upsetting their heat balance. Heat stress affects animals behavior which in turn alters feed and water intake. Heat stress has a variety of detrimental effects on livestock, with significant effects on milk production and reproduction (Valtorta and Maciel, 1998). Heat stress was estimated to result in annual economic losses in the United States of about $1.69 billion to $2.36 billion in 2000, including $0.9-$1.5 billion for dairy, $370 million for the beef industry, $299-$316 million for swine, and $128-$165 million for poultry (St-Pierre, Cobanov and Schnitkey, 2003). In any particular location, climate change may not mean more animal pest, but introduction of new pests. In Europe, a northward expansion of the European castor bean tick, which carries and transmits Lyme disease, tick-borne encephalitis (TBE), and other diseases, has been reported in Norway, and increasing environmental temperatures have permitted the ticks to become established in larger geographic areas (Azar *et al*., 2006).

Given the natural rain forest vegetation of the Niger Delta, livestock production in the region is relatively small compared to crop farming. Local unimproved varieties of poultry are reared in rural regions under the free range system. Chicken and other indigenous birds usually scavenge for food, feeding on insects, food remnants thrown into dump sites behind houses and plant materials. However, in large towns in the region, commercial poultry production assumes considerable significance for the production of both meat and eggs, to meet the requirements of the urban dwellers with higher levels of income. Few goats and sheep, pigs, fish farm and occasionally rabbits, are also kept. There is very little or no integration of livestock and crop farming in the Niger Delta region, unlike in the drier savannah of northern Nigeria where livestock are allowed to graze on farmlands during the off-farm season and their droppings help to fertilize the soil (Aweto, 2011). The region is a hunter and fishermen delight as such are the natural occupations of the native people (Mayah, 2006).

Destruction of forests by resultants of climate change leads to loss of habitats and sources of food for many wildlife species. Wildlife such as antelope (*Bovidae family*), deer (*Cervidae family*), African rabbit (*Poelagus marjorita*) and grass cutters (*Thryonomyss winderlanus*) have drastically declined in population, in the Niger Delta (Aweto, 2011), largely due to deforestation and disappearance of biodiversity as climate changes. For domesticated animals, high temperature has hindered livestock (sheep, goat, poultry and piggery) production through retarded reproduction cycles, reduced meat and milk output. Livestock mortalities (stock losses) is on the increase under the influence of climate change which has cut investment profits in livestock production system (Idowu *et al*., 2011). Clearly, water and heat are factors affected by climate, but so are nutrients utilized by crops.

Crops need nutrients, water and heat to drive the

photosynthetic process to produce edible products. Some crops and other plants may respond favourably to increased atmospheric CO_2, growing more vigorously and using water more efficiently, at the same time, higher temperature and shifting climate patterns may change the areas where crops grow best and affect the makeup of natural plant communities (Karl *et al*., 2009). Changes in temperature and precipitation can have mixed results, compounded by the high sensitivity of crops to extreme events such as floods, wind storms and droughts, and seasonal factors such as periods of frost, heat spells, and change in rainfall patterns (Daniel and Jay, 2011). Crops are often more sensitive to averages than extreme temperature, as yields rise gradually up to a temperature threshold, then collapse rapidly as temperatures increase above the threshold (Frank and Elizabeth, 2013). It is obvious that most crops have an optimum temperature, at which their yields per hectare are greater than either higher or lower temperatures. Many crops are known to have temperature thresholds, in some cases varying temperatures for different stages of growth. Changes in climate could have significant impacts on crop productions around the world.

Temperature effects on yields of cereal (like maize and wheat) and legume (such as soybean) in the United States are strongly asymmetric, with optimum temperatures of 29 - 32°C resulting to rapid drops in yields for days (Spencer, 2007). According to the author, in maize production, replacing 24 hours of the growing season at 29°C with 24 hours at 40°C caused a 7% decline in yields. A very similar pattern was found in a study of temperature effects on maize yields in Africa, with a threshold of 30°C (Lobell *et al*., 2008). Under harsh conditions, yields declined faster with temperature increase. Reduced output in wheat production in northern India also suggests that temperature increase above 34°C becomes more harmful (Lobell *et al*., 2008). The author further stated that by mid-century, under the current climate scenario, yields are projected to drop by 17 to 22% for maize, sorghum, millet, and groundnuts (peanuts) and by 8 % for cassava. Among the crops most vulnerable to temperature increases are millet, groundnut, and rapeseed in South Asia; sorghum in the Sahel; and maize in southern Africa (Lobell *et al*., 2008).

In southern Europe, higher temperature and drought will reduce water availability for crop productivity while in Central and Eastern Europe, summer precipitation is projected to decrease, causing higher water stress, decrease in crop yield and frequency of peat land (Alcamo *et al*., 2007). Climate variability is projected to severely compromise agricultural production, in many African countries and regions. The greatest decreases in crop yields will likely occur in dry and tropical regions in some African countries; yields from rain-fed agriculture in drought years could decline by as much as 50% by 2020 (Mimura *et al*., 2007). In Cameroon, crop farming is a vital sector involving 80% of the country's poor and contributing about 30% to Gross Domestic Products (GDP), so changes in temperature and precipitation will seriously damage the nation's food production and the economy (Molua and Lambi, 2007). Heat stress, droughts, and flooding events will lead to reductions in total crop yields (Karl *et al*., 2009) affecting food security. In Nigeria, crop production is has been affected, as at 2011, agriculture contributed about 40.19% (crop; 35.78%, livestock; 2.58, forestry; 0.51%, fishing; 1.32%) to GDP and in 2012 its contribution declined to 39.19% (crop; 34.83%, livestock; 2.55, forestry; 0.50%, fishing; 1.31%) (National Bureau of Statistics, NBS, 2013). From the above data, crop production contribution dropped from 35.78% in 2011 to 34.83% in 2012 which was attributed to the impacts of climate change in the various cultivation states in Niger Delta region and other states of the country within the period.The Niger Delta region, is the most naturally endowed part of the country; from housing the oil and gas reserves that drive the nation's economy to the vast network of interwoven freshwater aquifers, extensive lowlands, tropical and freshwater forests, and aquatic ecosystems; to its biodiversity with temperature, sunlight, and rainfall in amount and combination that support cultivation and bountiful harvests of agricultural produce found in the region.

Given the annual rainfall that exceeds 2500mm, the main crops grown in Niger Delta are yam (*Dioscorea sp.*), cassava (*Manihot esculenta*), maize (*Zea mays*), okra (*Hibiscus esculentus*), melon (*Cucurbitaceous sp.*), cocoyam (*Colocasia esculenta*) and tree crops, especially rubber (*Hevea brasiliensis*), palm oil (*Elaeis guineensis*) and sparsely plantain (*Musa paradisiaca*), bananas (*Musa sapientum*), pawpaw (*Carica papaya*), coconut (*Cocos nucifera*), orange (*Citrus sinensis*), mango (*Mangifera indica*) avocado pear (*Persea gratissima*), guava (*Psidium guajava*) which are usually cultivated around homes (Aweto, 2011). Vegetables cultivated in the region include bitterleaf tree (*Vernonia amygdalina*), tomato (*Solanum lycopersicum*), pepper (*Piperaceae*) and pumpkin (*Telfairia occidentalis*), usually for domestic consumption. Yams, cassava, maize, okra and melon are usually intercropped on cultivated plots which rarely exceed 0.5 hectare (Uyigue and Agho, 2007).

Crop farming in the region is highly dependent on rain as irrigation is seldom practiced (Uyigue and Agho, 2007). Thus changes in the rainfall pattern is expected to have much effects on crop production in the region. Farmers in the region begin cultivation at the end of the dry season, when the rain begins to fall gradually (Akinro *et al*., 2008). They begin planting after the first or second rain. After the first rainfalls, the rain falls periodically till the months of June/July (the peak of the rainy season), when rain fall more or less continually. The predictable rainfall pattern made the local farmers efficient in cultivation. But due to changed rainfall pattern, farmers who planted after the first or second rain ran into loss as

crops were smoothed when the rain was delayed beyond the usual. The varying degree of rainfall within the planting period before the peak is necessary for the optimum performance of many crops cultivated in the region. The crops were scorched without water (rainfall) causing huge economic loss for the farmers (Uyigue and Agho, 2007). This was not the usual way, farmers were able to predict the rainfall pattern and they knew precisely when to plant their crops.

Irregular and unpredictable rainfall and sunshine hours (albedo and photoperiods) continue to take the toll on hitherto low-level harvests of cassava, maize, melon and yam with at least 2.5% decline of harvests per annum (Idowu *et al*., 2011). Furthermore, cocoa, cashew, oranges, oil palm and rubber production suffer severe setbacks under reduced photoperiods with flower and fruit abortion trends that shot down annual yields by 5.5 metric tons/ha. Pest and disease incidences which become varied and uncontrollable under altered weather events continue to cause decline in crop harvests. Heavier rainfalls have resulted to flooding of farm lands. Flooded farm lands/wetlands expansion leads to loss of arable land for crops such as tubers, and affects germination in other crops.

Before the observed changes in climate in the region, agriculture was known to be stable and farmers complained less. In these trending events, the cost of managing the land for cultivation, disease and pest control as well as labor in animal and crop production have all been affected which bears direct effecton the social and economic wellbeing of farmers. The farmers and agricultural extension agents are both directly involved in agricultural production. Agricultural production is necessary for the survival of man and industries, thus any variation in the production process demands immediate attention, which is the focus of this study with the following research questions and hypotheses:

Research Questions

1. To what extent has climate change impacted on animal production in the Niger Delta region of Nigeria?
2. To what extent has climate change impacted on crop production in the Niger Delta region of Nigeria?

Hypotheses

Ho_1. There is no significant difference in the mean responses of farmers and agricultural extension workers on the extent to which climate change has impacted on animal production in Niger Delta region of Nigeria.
Ho_2. There is no significant difference in the mean responses of farmers and agricultural extension workers on the extent to which climate change has impacted on crop production in Niger Delta region of Nigeria.

MATERIALS AND METHODS

The study was carried out to determine the extent to which climate change has impacted on the farmer and the farming families in agricultural production in Niger Delta region of Nigeria. The study also presented available adaptation strategies as being suggested by various authors for testing of conformity with rural farmers, following the view that environmental knowledge and resilience to climate change lay within societies and cultures. The study which span from November 2012 to May 2014 adopted descriptive survey research design and was carried out in the Niger Delta region of Nigeria. The region located in the Southern part of Nigeria is made up of 9 states, namely: Abia, Akwa-Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo and River. Bayelsa and Delta were randomly chosen for the study. The population for the study was 246,909, made up of farmers (67,551 + 179,256 = *246,807*) and extension agents (12 + 90 = *102*) who are registered with the state ministries of Agriculture in (Bayelsa+ Delta) states, respectively. The farmers and the extension agents were involved in the study because they have experienced the perceived impacts of climate change and bear firsthand information for answering the research questions of this study.

Proportionate stratified random sampling technique was used to select 2 percent of the farmers from each local government areas (strata) in both states (4,936), while all the extension agents (102) from both states where utilized due to their manageable size. Thus the total sample size for the study was 5,038 respondents. The instruments for data collection were structured questionnaire and interview developed from literature reviewed for the study. The use of the questionnaire was to generate quantifiable data while the interview was to enable the respondents to elaborate their view on each item and as well to state the nature of perceived impacts. The instruments were divided into two sections, each section corresponding to the research questions of the study. Each item both sections of the questionnaire instrument had a four point response options of High Extent (HE), Moderate Extent (ME), Low Extent (LE) and No Extent (NE) and were weighted 4, 3, 2 and 1 respectively. Three experts validated the instruments: one from Agricultural Development Programme (ADP) at Delta state Ministry of Agriculture and Natural resources and two lecturers from Agricultural Education Unit at the Department of Vocational Teacher Education, University of Nigeria, Nsukka. The reliability of the questionnaire instrument was established using Cronbach Alpha method and a co-efficient of 0.81 was obtained. The researchers with the help of 5 research assistants physically administered and collected the completed instruments from contact respondents (see Appendix A) who were available to respond to the instruments. Out of the 5,038 copies of both instruments administered, 3,214

copies (representing about 64 percent of the total copies) were successfully retrieved. However, only 2,922 copies were duly completed and found useful for data analysis. The Statistical Product and Service Solutions (SPSS v 20.0) was employed for data analysis. The statistical tools used for data analysis were weighted mean to answer research questions and standard deviation to validate the closeness of the respondents from the mean and from each other in their responses while t-test was used to test the null hypotheses. The research questions were answered using real limit of numbers as follows:

Response Option	*Nominal Value*	*Real limit of number*
High Extent (HE)	4	3.50 – 4.00
Moderate Extent (ME)	3	2.50 – 3.49
Low Extent (LE)	2	1.50 – 2.49
No Extent (NE)	1	0.50 – 1.49

In taking decisions for the research questions, any item with a mean value ranging from 3.50 – 4.00, 2.50 – 3.49 or 1.50 – 2.49 was interpreted as high, moderate or low extent of impact, respectively while any item with a mean value below 1.50 (0.50 – 1.49) was interpreted as no extent, meaning climate change has no perceived impact on the item. For the hypotheses:

If $p \leq a$ value at t value, then there is significant difference (S) in the compared means thus the decision was to reject the stated null hypothesis.

But if

$p \geq a$ value at t value, then there is no significant difference (NS) in the compared means thus the decision was to not reject but uphold the stated null hypothesis.

Where p is the Sig (2-tailed) value of t-calculated,
$a = 0.05$ (significant level) and
t is the t-test score (t-calculated).

The structured interview was analyzed qualitatively.

RESULTS

Research Question 1: *To what extent has climate change impacted on animal production in the Niger Delta region of Nigeria?*

Data obtained from the survey revealed that the impacts on various aspects and activities of animal production in the region are to moderate extent (ME) with slight variation on the observed extent for the farmers and the extension agents. However, on average response of both the farmers and the extension agents, impact was to a low extent (LE) for two items. The standard deviation of the average responses of the respondents for all the items ranged from 0.80–1.25 with an average value of 1.02; indicating that the respondents were close to the mean and to one another in their responses, as show in Table 1.

The information from the structured interview was in line with the data from the questionnaire as presented on Table 1. The respondents explained that climate change has impacted noticeably (though not to a high or low extent but) to a moderate extent on the activities of animal production in the region. The nature of the impact was revealed to be negative. As reported, inside the buildings are becoming hotter causing heat stress for the animals as well as frequent flooding of the farm houses.

Hypothesis 1

There was no significant difference (S) in the opinions of farmers and extension workers in twelve items (No. 2-7, 9, 10 and 14-17) and a no-significant (NS) difference in five items (No. 1, 8 and 11-13) as indicated in the data presented on Table 1. The cluster value indicated that the difference in their opinions was not significant (NS). The null hypothesis of no significant difference of the items with remark NS was upheld as p-value is greater than the a-value ($p \geq a$) at the t-calculated value of the items.

At the cluster level, $p = 0.18$ and $t = 1.92$ while $a = 0.05$. Thus the null hypothesis (H_{01}) of no significant difference was not rejected but upheld as $p \geq a$.

Research Question 2: *To what extent has climate change impacted on fish production in the Niger Delta region of Nigeria?*

Mean Ratings and Standard Deviation of Respondents on the Extent to which Climate Change has Impacted on Crop Production in the Niger Delta Region of Nigeria

Crop production usually begins with clearing of the farmland for land preparation and usually involves intense labor. The labor is often manual with majority of the farmers lacking the capacity for mechanized farming. The survey reports increased in the difficulty in land preparation, frequent flooding of farmland as well as altered rainfall pattern, all of which affected cultivation in the region.The standard deviation of the average responses of the respondents for all the items ranged from 0.57–1.25 with an average value of 1.05; indicating that the respondents were close to the mean and to one another in their responses, as show in Table 2.

The information from the structured interview complemented the data from the questionnaire as presented on Table 2. The nature of the impact was revealed to be negative. The respondents explained that climate change has impacted noticeably to a high extent on rainfall in the

Table 1. Mean Ratings, Standard Deviation t-test scores of Respondents on the Extent to which Climate Change has Impacted on Animal Production in the Niger Delta Region of Nigeria.

S/N	Effects on Animal Production	Respondents						Avg. Resp.			H_{01}		
		Farmers			Ext. Workers								
		$\bar{X}$	SD	Dec	$\bar{X}$	SD	Dec	$\bar{X}$	SD	Dec	*t*	*Sig	R
1.	Type of livestock raised	1.49	1.17	NE	1.80	0.96	LE	1.65	1.07	LE	0.05	0.96	NS
2.	Breeding (cycle)	2.34	0.79	LE	2.86	0.94	ME	2.60	0.87	ME	4.02	0.00	S
3.	The duration for pregnancy (Gestation period)	2.09	1.14	LE	3.04	1.13	ME	2.57	1.14	ME	6.01	0.00	S
4.	Growth rate of livestock	2.80	1.25	ME	2.35	1.24	LE	2.58	1.25	ME	-3.97	0.00	S
5.	Pest infestation and spread of diseases	2.73	1.20	ME	2.16	0.97	LE	2.45	1.09	LE	-3.14	0.02	S
6.	Death of young ones/still birth	2.83	0.94	ME	2.82	0.94	ME	2.83	0.94	ME	6.12	0.00	S
7.	Restlessness of the animals	2.19	1.08	LE	2.89	0.94	ME	2.54	1.01	ME	6.74	0.00	S
8.	The duration it takes to mature	2.76	1.13	ME	2.67	1.18	ME	2.72	1.16	ME	-0.65	0.52	NS
9.	Feed and water consumption	2.50	0.97	ME	2.77	0.98	ME	2.64	0.98	ME	2.53	0.02	S
10.	Availability of grass land for grazing animals	2.77	0.97	ME	2.42	1.18	LE	2.60	1.08	ME	-4.18	0.00	S
11.	Mortality rate	2.87	1.06	ME	3.01	0.96	ME	2.94	1.01	ME	0.48	0.62	NS
12.	Flooding of farm houses	2.82	0.82	ME	2.92	0.78	ME	2.87	0.80	ME	1.49	0.14	NS
13.	Quality of meat	2.74	0.99	ME	2.94	1.22	ME	2.84	1.11	ME	0.36	0.72	NS
14.	Livestock yield (number of litters)	3.04	1.00	ME	2.87	0.89	ME	2.96	0.95	ME	-2.15	0.03	S
15.	Destruction of animal houses	2.05	1.03	LE	2.63	1.16	ME	2.34	1.10	ME	5.43	0.00	S
16.	Per cost of rearing the animals	2.39	0.76	LE	3.20	0.84	ME	2.80	0.80	ME	10.95	0.00	S
17.	Livestock product marketing	2.70	0.93	ME	2.96	0.93	ME	2.83	0.93	ME	2.60	0.01	S
	Cluster Value	**2.54**	**1.01**	**ME**	**2.72**	**1.01**	**ME**	**2.63**	**1.02**	**ME**	**1.92**	**0.18**	**NS**

Note: Dec. – Decision. Avg. Resp.- Average Response. High Extent (HE=3.50 – 4.00) Moderate Extent (ME=2.50 – 3.49) Low Extent (LE=1.50 – 2.49) No Extent (NE=0.50 – 1.49).*Sig=p. R-Remark

region. Most of the respondents (especially the farmers) complained of the negative direct effect of this to cultivation in the region, cultivation is often delayed to avoid scorching of seedlings.

Hypothesis 2

There was no significant difference (S) in the opinions of farmers and extension workers in ten items (No. 5-7, 9-11, 13-15 and 19) and a no-significant (NS) difference in ten items (No. 1-4, 8, 12, 16-18 and 20) as indicated in the data presented on Table 1. The cluster value indicated that the difference in their opinions was not significant (NS). The null hypothesis of no significant difference of the items with remark NS was upheld as *p*-value is greater than the *a*-value ($p \geq a$) at the t-calculated value of the items.

At the cluster level, $p = 0.17$ and $t = 0.80$ while $a = 0.05$. Thus the null hypothesis (H_{02}) of no significant difference was not rejected but upheld as $p \geq a$.

DISCUSSION OF FINDINGS

Climate Change Impacts on Animal Production in the Niger Delta Region of Nigeria

Response from the respondents indicated that climate change has not affected the type of livestock reared in the area but has impacted moderately on other aspects of animal production. The findings of the study is in line with that of Parry *et al*. (2004), Osinem (2005) and Idowu *et al*. (2011) who predicted the effects of climate change to be negative on animal production.There is every reason from the results to conclude that significant difference does not exist in the mean responses of farmers and extension workers on the perceived impacts of climate change on animal production in the region, as indicated by the t-test. Any observed difference is not a

Table 2. Mean Ratings, Standard Deviation t-test Scores of Respondents on the Extent to which Climate Change has Impacted on Crop Production in the Niger Delta Region of Nigeria

S/N	Effects on Crop Production	Respondents						Avg. Resp.			H_{01}		
		Farmers			Ext. Workers								
		$\overline{X}$	SD	Dec	$\overline{X}$	SD	Dec	$\overline{X}$	SD	Dec	*t*	*Sig	R
1.	Clearing of farmland (land preparation)	3.52	0.59	HE	3.17	0.73	ME	3.35	0.66	ME	-0.56	0.57	NS
2.	Planting month	2.73	1.11	ME	2.57	0.86	ME	2.65	0.99	ME	-1.26	0.21	NS
3.	Spacing during planting	2.22	0.99	LE	1.75	1.16	LE	1.99	1.08	LE	4.56	0.09	NS
4.	Planting depth	2.23	0.94	LE	2.46	0.99	LE	2.35	0.97	LE	0.81	0.42	NS
5.	Germination of crop seeds	2.78	1.10	ME	2.27	3.32	ME	2.53	1.21	ME	-3.68	0.00	S
6.	Weed growth	3.12	1.10	ME	3.45	1.39	ME	3.29	1.25	ME	-4.97	0.00	S
7.	Quantity of fertilizer application	2.73	1.09	ME	3.41	1.28	ME	3.07	1.19	ME	-2.34	0.02	S
8.	Pest and disease infestation of crops	2.79	0.93	ME	2.71	1.10	ME	2.75	1.02	ME	0.65	0.52	NS
9.	Pest and disease control	2.89	1.16	ME	2.59	1.06	ME	2.74	1.11	ME	-2.87	0.01	S
10.	Rainfall pattern	3.51	0.62	HE	3.54	0.52	HE	3.53	0.57	HE	5.84	0.00	S
11.	Growth rate	2.64	0.95	ME	3.04	1.15	ME	2.84	1.05	ME	2.05	0.04	S
12.	Maturation duration of crops	2.89	1.06	ME	2.75	1.10	ME	2.82	1.08	ME	-1.79	0.07	NS
13.	Harvesting time/period	3.21	1.12	ME	2.88	1.16	ME	3.05	1.14	ME	4.03	0.00	S
14.	Quantity and Quality of produce	3.36	1.13	ME	2.77	1.08	ME	3.07	1.11	ME	3.78	0.00	S
15.	Storage and Marketing	2.61	0.94	ME	3.24	1.13	ME	2.93	1.04	ME	5.57	0.00	S
16.	Scorching of seedlings	2.76	1.10	ME	2.65	1.28	ME	2.71	1.19	ME	-0.92	0.36	NS
17.	Flooding of farmland	3.62	0.64	HE	3.48	1.23	ME	3.55	0.94	HE	0.58	0.56	NS
18.	Duration of dry season (drought)	2.19	1.09	LE	2.78	1.13	ME	2.49	1.11	LE	0.65	0.34	NS
19.	Erosion/leaching occurrence	2.76	1.18	ME	2.90	1.29	ME	2.83	1.24	ME	4.94	0.00	S
20.	Cost of production (labor and inputs)	3.43	0.92	ME	2.87	1.00	ME	3.15	0.96	ME	0.89	0.10	NS
	Cluster Value	**2.90**	**0.99**	**ME**	**2.86**	**1.20**	**ME**	2.88	1.05	**ME**	**0.80**	**0.17**	**NS**

Note: Dec. – Decision. Avg. Resp.- Average Response. High Extent (HE=3.50 – 4.00) Moderate Extent (ME=2.50 – 3.49) Low Extent (LE=1.50 – 2.49) No Extent (NE=0.50 – 1.49). *Sig=p. R-Remark
n_1=2829; n_2=93; N_T=2922

true difference, but a mere chance which could have resulted from sampling error.

Climate Change Impacts on Crop Production in the Niger Delta Region of Nigeria

Indications from the study revealed that rainfall pattern has changed, there is also increased cost of production which if not properly managedleads to poor quality and quantity of produce. This is supported by various observations and interview granted to farmers and essay from literature reviewed in this study, such as Awosika (1995), Oladipo (1995), IPCC (2007), Uyigue and Agho (2007) and Bhusal (2009) who reported changes in rainfall pattern across the world. The farmers indicated that climate change has impacted highly on clearing of farmland, rainfall pattern and flooding of farmland. Though the extension workers agreed with the farmers on rainfall pattern they indicated that the impact on clearing of farmland and flooding of farmland is moderate. Climate change has not impacted much (low extent) on spacing during planting and the planting depth as indicated by the respondents. This is likely due to the specified required planting space and depth of various plants for proper germination and reduced competition among closely planted crops. If the depth is increased beyond the required, the plants may not germinate well (and die in the ground suffering the same fate as scorched germination) or results to scanty germination as some of the seedlings may not successfully pass through the increased depth to germinate. The respondents further explained that the frequency of rainfall, though unpredictable, ensures supply of water thus checkmating

prolonged drought.This finding is in agreement with Lemke (2006) who stated that regions which are already dry today will become even drier while wet ones will receive more rain, according to different climate scenarios. Niger Delta is a coastal/wet region thus receiving more wet periods than dry (drought).Climate change has caused moderate but negative impact on crop production in the region. Though the perceived impact of climate change on crop production in the region is moderate, (and not high as purported), these findings are in agreement with reviewed literature indicating that average weather variation has caused a negative change to crop production (Molua and Lambi, 2007; Alcamo *et al*., 2007; Idowu *et al*., 2011). The results of the study helped to conclude that there was no significant difference in the mean responses of the respondents on the impacts of climate change in the region as indicated by t-test. This shows that any observed difference is not statistical thus can be attributed to mere chance of occurrence.

Recommendations

Based on the findings of this study, the following recommendations have been proffered:

1. Extension workers should be continuously trained and educated on current information about climate change and sent out to enlighten the farmers. This will enable them to update and synchronize ideas with the farmers.
2. Farmers in the region should be encouraged by providing incentives and subsidizing inputs for them. This will go a long way in improving production in the region and nation.
3. Most crop farmers in the region practice rain-fed agriculture. With the altered rainfall pattern the farmers are unable to effectively predict the trend. Thus it is necessary for the government and other relevant authorities to constantly provide information on rainfall distribution ahead of time to help the farmers plan.
4. Farmers, especially the animal farmers should be encouraged to use improved breeds/species. It is observed that the farmers still rear the same species and types of animal without consideration of change. This has a bad impact on the growth of the sector in the region as species' range is changing due to average weather variation.

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APPENDIX

Distribution of the Respondents (n=2922)

S/N	Grouping	Inclination to agriculture					
		Farmers		Ext workers		Total	
		F	%	F	%	F	%
1. Sex	Male	1170	41.4	56	60	1226	42
	Female	1659	58.6	37	40	1696	58
2. Age (years)	Below 20	328	11.6	5	4.8	333	11.4
	20 – 40	1754	62.0	67	72.3	1821	62.3
	Above 40	747	26.4	21	22.9	768	26.3
3. Educational status	[a]NFE	843	29.8	--	--	843	28.9
	[b]NVE	1731	61.2	28	30.1	1759	60.2
	[c]HE	255	9.0	65	69.9	320	10.9
1. 4. Experience in Agriculture(years)	Less than 20	1089	38.5	22	24.1	1111	38.0
	20 and above	1740	61.5	71	75.9	1811	62.0

Note. [a] = No Formal Education [b] =Not Very Educated [c]= Higher Education