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Farmers' Perception of Climate Change in Ikwuano Local Government Area of Abia State, Nigeria

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Abstract
This study examines farmers' general understanding of climate change in Ikwuano LGA of Abia State, Nigeria. Data were collected by use of structured questionnaire administered to 420 farmers randomly selected from eight communities in the study area. Descriptive statistics was used to analyze data obtained from the survey. A 4-point Likert Rating Scale was used to gauge farmers' response to 29 perception questions posed in the questionnaire. The result showed that the prevalent changes in climate in the study area are increased temperature, change in patterns of rainfall, uncertain patterns of relative humidity, high sunshine intensity and change in harmattan period. The consequence of climate change included poor health conditions of the farmers as well as poor yields from their farms. The main causes of climate change, by the farmers' perception, include deforestation, overgrazing of farm lands, blockage of water ways, careless discharge of liquid waste and air pollution from automobile exhaust. The major techniques employed by farmers to mitigate the effects of climate change were planting of more resistant local varieties and diversification of their portfolios.
Key words: Farmers, perception, climate, change.

1.0 Introduction

Climate change is a long term shift in the climatic patterns of a specific place or region measured by changes in the behaviour of climate elements such as temperature, wind patterns and precipitation resulting in changes in ecosystems and socioeconomic activities. Such changes bring about uncertainties in the sustainability of agriculture and agro-allied ventures (Urama and Ozor, 2011). Climate change is seen as the most serious environmental threat facing farmers today. It is known that as the planet earth warms, rainfall patterns shift and extreme events such as drought, flood or forest fires become more frequent (Zoellick, 2009). This has resulted in poor and unpredictable yields from agriculture and agro-allied activities (UNFCCC, 2007). The impact of climate change is more pronounced in climes that agriculture still remains the main source of livelihood as in developing countries like Nigeria (Agwu *et. al.,* 2010).

Paradoxically, agriculture is considered both culprit and victim of climate change. Culprit in the sense that 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. The world's 130 million ha of rice paddies are estimated to produce 50 to 100 million metric tonnes of methane annually (Shrotriya and Prakash, 2011).

Human activities involving deforestation and other activities that alter the equilibrium of the ecosystem like mining, road construction, housing development activities reduce the natural sinks that withdraw green house gas from circulation. A balance between sources and sinks of green house gases determines the level of extreme weather events occurrence (Khanal, 2009).

In Africa, climatic change is expected to, and in some parts, it has already begun to, alter the dynamics of droughts, rainfall and heat waves, and trigger secondary stresses such as the spread of pests, increased competition for resources, and attendant biodiversity losses (Enete and Amusa, 2010). Rapid changes in the behaviour of climate elements are expected to undermine the systems that provide for food security in Africa (Gregory *et al.,* 2005).

Whilst farmers in some regions may benefit from longer growing seasons and higher yields, the general consequences for Africa (Mendelsohn *et al.,* 2000) are expected to be adverse, and particularly more adverse for the poor and marginalized farm households, who do not have the means to withstand drastic changes. Evidence from the IPCC suggests that areas south of the Sahara are likely to emerge as the most vulnerable to climate

[1] *The author wishes to acknowledge all sources and contributions cited in this paper while accepting responsibility for all errors found in the paper.

change with likely agricultural losses ranging from 2 to 7%.

A Nigerian study applied the Erosion Productivity Impact Calculator (EPIC) crop model to give projections of crop yield during the 21st century. The study modelled worst case climate change scenarios for maize, sorghum, rice, millet and cassava (Adejuwon, 2006). The indications from the projections are that in general there will be increases in crop yield across all low land ecological zones as the climate changes during the early parts of the 21st century. However, towards the end of the century, the rate of increases will tend to slow down. This could result in lower yields in the last quarter than in the third quarter of the century.

The decreases in yield could be explained in terms of the very high temperatures which lie beyond the range of tolerance for the current crop varieties and cultivars. Another study carried out in Egypt compared crop production under current climate conditions with those projected for 2050 and forecast a decrease in national production of many crops, ranging from -11% for rice to -28% for soybeans (Eid *et al.,* 2006). Other potential impacts linked to agriculture include erosion that could be exacerbated by expected increased intensity of rainfall and the crop growth period that is expected to be reduced in some areas (Agoumi, 2003).

Changes are also expected in the onset of the rainy season and the variability of dry spells (Peason, 2007). Thornton *et al.* (2006) mapped climate variability with a focus on the livestock sector. The areas they identified as being particularly prone to climate change impacts included arid-semiarid rangeland and the drier mixed agro-ecological zones across the continent, particularly Southern Africa and the Sahel, and coastal systems in East Africa. An important point they raise is that macro-level analyses can hide local variability around often complex responses to climate change.

It is projected that crop yield in Africa may fall by 10-20% by 2050 or even up to 50% due to climate change (Jones and Thornton, 2003). This has dire consequences for Africa in view of the World Bank's projection that food demand will double by 2030 (Birchall, 2008).

Nigeria is an agrarian nation and despite the oil boom agriculture remains a core economic activity that provides food for the nation. Agriculture will still remain in the foreseeable future, the linchpin of the economy and the primary source of ensuring national food security. Hence any threat to its optimal productivity need to be handled with all amount of seriousness (Adejuwon, 2006).

Fundamentally, the location, size and characteristic relief of Nigeria give rise to a variety of climates ranging from tropical rainforest climate along the coast to the Sahel climate in the Northern part of the country, each being different in its annual precipitation, sunshine and other climate elements (Adejuwom, 2004). In spite of this Nigeria is yet to put in place an agency that would negotiate and co-ordinate the nation's climate change activities (Agwu, *et al.,* 2011).

Farmers in trying to come to terms with climate change have developed strategies for adaptation and mitigation of its effects. Some of these measures include cover cropping, early planting, prompt weeding, regulated use of agro-chemicals and use of tolerant varieties (DelPHE, 2010). However, reports from the field indicate that previous adaptive measures used by farmers become rapidly obsolete and ineffective due to the pace at which adverse climate events take place (Enete *et al.,* 2011).

Action Aid (2008) reports that farmers in the Southeastern 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 washing 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 who still engage in traditional forms of slash and burn system of farming (Agwu *et al.,* 2011). Evidence abounds in climate change literature that farmers are aware that the climate has changed and that this change has affected negatively their output (Enete *et al.,* 2011) but what they do not seem to appreciate is how their farming activities drive climate change.

It is, therefore, important to investigate how farmers, who are major environmental stakeholders, perceive the issue of climate change, what types of changes they have observed in the past and how they have coped with them. Answers to these and other several related questions constitute the purpose of this study.

2.0 Objectives of the Study

The main objective of this study was to examine how farmers in Ikwuano Local Government Area (LGA) perceive the phenomenon. In specific terms the study was intended to:

i. assess the farmers' general understanding of climate change in the study area;
ii. identify the types of climate change experienced by these farmers;
iii. identify the causes of climate change observed in the area; and

iv. identify measures used by these farmers to reduce the effects of climate change.

3.0 Materials and Methods

Ikwuano LGA in the humid forest zone of Nigeria. The LGA has an average rainfall of 2351 mm, average minimum diurnal temperature of 22.9^{0}C and relative humidity range between 80-90% (NRCRI, 2011). The people are predominantly farmers. Most of the crops grown in the area are okra, maize, cassava, yam, potato, garden egg and cocoyam.

A multi-stage random sampling technique was used in the selection of respondents. First step involved random selection of eight out of the 13 autonomous communities in the LGA. Further, 53 farm households were randomly selected from each of the autonomous communities. This gave a total sample size of 424 respondents. The head of each household was interviewed irrespective of gender. Structured questionnaires were used to collect information. At the end of the survey four questionnaires were not properly completed such that 420 were used for analysis.

Descriptive statistical tools were used to draw inferences from data collected while the perception of respondents was gauged by use of Likert Rating Scale. Twenty-nine perception questions on climate change were asked and responses were received based on respondents' level of agreement or disagreement. A 4-point Likert Rating Scale was employed. The mean score of respondents was computed as follows: $4 + 3 + 2 + 1 = \frac{10}{4} = 2.5$. Using an interval scale of 0.05, the upper limit is 2.55 while the lower limit is 2.45. Scores equal to or above 2.55 are accepted as significant while those equal to or below 2.45 are regarded as not significant.

4.0 Results and Discussion

4.1 Farm Level Information

Farm level information in respect of years of farming/farming experience, nature of farming, farm size, cropping system, membership of farmer organisations, farm tools used and cultural practices often used was obtained from respondents (Table 1). Majority (84.28%) of the respondents had more than 15 years of unbroken farming experience (Table 1A). This is long enough time to give credible evidence of climate change and its effects. More than 50% of the respondents are full time farmers (Table 1B). This also adds credibility to information received from them. Though the average farm size in the survey was 0.9 ha (Table 1C) there were respondents with farm size of up to 3 hectares. This size is substantial in view of the subsistence agriculture practiced in this area with its characteristic atomistic farm sizes (Enete *et al.,* 2011).

Most of the farmers (66.67%) practiced mixed cropping (Table 1D). Mixed cropping increases the intensity of soil nutrient utilization which if not properly balanced may lead to poor yield. Majority of the farmers (61.67%) do not belong to any farm organisation. This might limit their ability to share experiences with other farmers on issues pertaining to climate change.

Most of the farmers (66.91%) still engage in use of crude farm implements that exacerbate the effects of climate change (Table 1F). Land clearing involving slashing and burning constituted the most frequently used cultural practice (Table 1G). This practice, as has already been noted, aggravates the effects of climate change.

4.2 Farmers' Perception of Climate Change

To establish the farmers' perception of climate change 29 perception questions were raised. These questions were structured to capture issues like general understanding of the farmers of what climate change is, types of changes being experienced, causes of these changes and measures they have adopted in the past to mitigate the effects of climate change (Tables 2-7).

On the whole, majority of the farmers indicated that they are aware of the various changes in the climate that have affected their agricultural enterprise (Table 2) their perception of the types of climate change experienced in the study area was captured by use of Likert Scale Rating. Likert scores below 2.55 were tagged 'Disagree' equal to or above 2.55 were tagged 'Agree' (Table 3). Only excessive storm/lightening was rejected as a common climate change phenomenon in the study area. Respondents agreed that the type of climate change experienced in the area include increase in temperature, change in pattern of rainfall, poor relative humidity, high sunshine intensity, change in harmattan period, poor fertility of most soils, increased rate of erosion, increased drought, overflooding in many places, decrease in agricultural yield, and poor health condition of farmers.

When Likert ratio was computed for respondents perception of causes of climate change they disagreed that seven out of the 17 items they were asked to rate cause climate change. These included agrcohemicals, continuous cropping, over-grazing, swamp crop production, animal droppings, bush burning and over-construction on land (Table 4). Though these can be veritable causes of climate change elsewhere but in the specific case of the study area their influence on the environment has not been adjudged prominent.

Respondents rating of the severity of the identified causes of climate change confirmed the fact that variables mentioned earlier (Table 4) either did no damage to the environment or they did not know the effects of these variables on the environment.

On the strategies employed by the respondents to mitigate the effects of climate change on their outputs quite a few of them (4%) stated that they adopted agricultural innovation. About 5.2% made adjustments to their farm operations to cope with changes emanating from climate conditions (Table 6). Other measures adopted included mixed cropping (8.6%), crop rotation (3.87%), cover cropping (7.6%) and use of organic manure (7.9%).

Majority of the respondents (10.13%) engaged in traditional measures like diversification of portfolio and planting resistant local breeds of their crops. The local varieties of crops were found to be more successful than their improved counterparts when confronted by adverse environmental and climatic conditions. Soil conservation was another very important measure adopted by respondents.

Majority of the respondents identified financial handicap, poor climatic information, insufficient extension visits and insufficient environmental scientists as constraints to climate change mitigation in the study area (Table 7).

5.0 Summary, Conclusion and Recommendations

5.1 Summary

The study confirmed that farmers in the study area were aware of the incidence of climate change. Perception results indicate that most of the farmers were aware of some specific changes including the fact that temperature is increasing and the level of rainfall is declining. The area is getting warmer and drier with increased frequency of drought stemming from high sunshine intensity and poor relative humidity. Observed trend of change in harmattan period, poor fertility of most soils, increased rate of erosion, over-flooding in many places, decrease in agricultural yield, and poor health condition of farmers were perceived as the evidences of climate change in the area. The implication is that farmers need to adjust their management practices to ensure that they keep pace with the changing situation of the climate in order to stay in business.

The farmers agreed that the major drivers of climate change are deforestation, industrialization, wrong pathways, lack of estate plan, over congestion of animal on land, blockage of water pathway, overexploitation of mineral resources, liquid waste, air pollution, and engine oil/gas. Farmers identified financial handicap, poor climate information, insufficient extension workers and insufficient environmental scientists as important constraints to checkmating the drivers of climate change in the study area.

5.2 Conclusion

The farmers' socioeconomic characteristics had serious implications for their awareness of climate change and the knowledge of the measures to combat it. Farmers age, level of education, farming experience are some of the important socio-economic characteristics that influence farmers' adaptation strategies. Farmers in the study area need to adjust to the changing climate trend in order to save their means of livelihood. Addressing the climate change issues observed in the study will significantly help famers remain in business.

5.3 Recommendations

Supporting farmers to increase their adaptation capacities through providing the necessary resources such as credit, information and training can significantly help them increase and sustain high levels of productivity even under changing climatic conditions. Government policies need to support research and development of appropriate technologies to help farmers adapt to changes in climatic conditions. Government responsibilities include putting in place policy measures to mitigate the adverse effects of climate change on farmers. Examples of these policy measures include introduction of drought resistant crop varieties, improving climate information forecasting and dissemination, or promoting farm-level adaptation measures, such as the use of irrigation technologies. Accessibility to key agricultural production information like water and soil conservation techniques as well as the other adaptation options identified is expected to boost farmers' coping strategies.

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Table 1: Farm Level Information

(A)	**Farming experience**		
	1 – 5	15	3.57
	6 – 10	11	2.62
	11 – 15	40	9.52
	16 – 20	203	48.33
	21 – 25	151	35.95
	Total	**420**	**100**
	Mean farming experience = 18.52		
(B)	**Nature of farming**		
	Part-time	180	42.86
	Full-time	240	57.14
	Total	**420**	**100**
(C)	**Farm size (Hectare)**		
	0.1 – 0.5	100	23.81
	0.6 – 1.0	163	38.81
	1.1 – 1.5	140	33.33
	1.6 – 2.0	11	2.62
	2.6 – 3.0	6	1.43
	Total	**420**	**100**
	Mean farm size = 0.9		
(D)	**Cropping system**		
	Sole cropping	58	13.81
	Mixed cropping	280	66.67
	All of the above	82	19.52
	Total	**420**	**100**
(E)	**Membership to a farm organization**		
	Member	161	38.33
	Not a member	259	61.67
	Total	**420**	**100**
(F)	**Farm tool used mostly**		
	Hoe	281	66.91
	Cutlass	129	30.71
	Rake	6	1.43
	Shovel	2	0.48
	Tractor and its implements	2	0.48
	All of the above	0	0
		420	100
(G)	**Cultural practices done the most**		
	Land cleaning	156	37.14
	Burning	140	33.33
	Tilling	5	1.19
	Weeding	119	28.33
	Total	**420**	**100**

Source: Field Survey, 2012

Table 2: Awareness of Respondents Based on the Type of Climate Change Experienced in the Study Area

Climate Factors	Highly Aware	Aware	Fairly Aware	Not Aware	Verdict
Increase in temperature	40	260	104	16	Aware
Change in pattern of rainfall	180	209	29	2	Aware
Poor relative humidity	76	177	159	8	Aware
High sunshine intensity	200	83	130	7	Highly Aware
Change in harmattan period	121	215	73	11	Aware
Excessive storm/lightening	33	111	270	6	Fairly Aware
Poor fertility of most soil	70	220	103	27	Aware
Increased rate of erosion	100	150	100	70	Aware
Increased drought	169	200	50	1	Aware
Over flooding in many places	203	169	48	0	Highly Aware
Decrease in agric. output	150	213	48	9	Aware
Poor health condition of farmers	211	100	100	9	Highly Aware

Source: Field Survey, 2012

Table 3: Analysis of Farmers' Perception of the Type of Climate Change Experienced in the Study Area

Climate Factors	H.A	A	F.A	N.A	L.R	Verdict
Increase in temperature	160	780	208	16	2.77	Agree
Change in pattern of rainfall	720	627	58	2	3.35	Agree
Poor relative humidity	304	531	318	8	2.76	Agree
High sunshine intensity	800	249	260	7	3.13	Agree
Change in harmattan period	484	645	146	11	3.06	Agree
Excessive storm/lightening	132	333	540	6	2.41	Disagree
Poor fertility of most soil	280	660	206	27	2.79	Agree
Increased rate of erosion	400	450	200	70	2.67	Agree
Increased drought	676	600	100	1	3.28	Agree
Over flooding in many places	812	507	96	0	3.37	Agree
Decrease in agric. output	600	639	96	9	3.20	Agree
Poor health condition of farmers	844	300	200	9	3.22	Agree

Where: **Verdict**

L.R = Likert Ratio
H.A = Highly Aware
A = Aware
F.A = Fairly Aware
N.A = Not Aware

Ratio < 2.55 = Disagree
Ratio $\geq$ 2.55 = Agree

Table 4: Analysis of Farmers' Perception of the Causes of Climate Change

		Extent of Damage					
S/N	**Environmental/Human Factors**	**G.D**	**L.D**	**N.D**	**I**	**L.R**	**Verdict**
1	Agrochemicals	672	150	0	202	2.44	Disagree
2	Continuous cropping	32	105	218	68	1.01	Disagree
3	Overgrazing grazing	240	480	34	183	2.23	Disagree
4	Swamp crop production	32	309	224	197	1.81	Disagree
5	Animal droppings	4	195	700	4	2.15	Disagree
6	Bushing burning	252	390	296	79	2.42	Disagree
7	Deforestation	844	195	24	94	3.03	Agree
8	Industrialization	560	390	82	89	2.81	Agree
9	Over-construction on land	204	309	34	258	1.85	Disagree
10	Wrong pathways	876	450	6	9	3.47	Agree
11	Lack of estate plan	444	282	120	49	2.89	Agree
12	Over congestion of animal on land	524	567	238	50	2.79	Agree
13	Blockage of water pathway	704	600	30	29	3.25	Agree
14	Overexploitation of mineral resources	1108	264	8	51	3.41	Agree
15	Liquid waste	1236	291	16	6	3.69	Agree
16	Air pollution	1200	279	0	27	3.59	Agree
17	Engine oil/gas	1248	318	0	2	3.73	Agree

Where:
L.R = Likert Ratio
G.D = Great Damage
L.D = Little Damage
N.D = No Damage
I = Indifferent

Inference
Ratio < 2.55 = Disagree
Ratio ≥ 2.55 = Agree

Table 5: Severity of Climate Change in the Study Area

S/N	Environmental/Human Factors	Extent of Damage G.D	L.D	N.D	I	Verdict
1	Agrochemicals	168	50	0	202	Indifferent
2	Continuous cropping	8	35	109	68	No Damage
3	Overgrazing grazing	60	160	17	183	Indifferent
4	Swamp crop production	8	103	112	197	Indifferent
5	Animal droppings	1	65	350	4	No Damage
6	Bushing burning	63	130	148	79	No Damage
7	Deforestation	211	103	12	94	Great Damage
8	Industrialization	140	150	41	89	Little Damage
9	Over-construction on land	51	94	17	258	Indifferent
10	Wrong pathways	219	189	3	9	Great Damage
11	Lack of estate plan	111	200	60	49	Little Damage
12	Over congestion of animal on land	131	120	119	50	Great Damage
13	Blockage of water pathway	176	200	15	29	Little Damage
14	Overexploitation of mineral resources	277	88	4	51	Great Damage
15	Liquid waste	309	97	8	6	Great Damage
16	Air pollution	300	93	0	27	Great Damage
17	Engine oil/gas	312	106	0	2	Great Damage

Source: Field Survey, 2012.

Where:
G.D = Great Damage
L.D = Little Damage
N.D = No Damage
I = Indifferent

Table 6: Measures/Strategies Employed by Farmers to Reduce the Effect of Climate Change in the Study Area

Variables	Frequency*	Percentage (%)
Adoption of agricultural innovation	161	4.00
Application of different farming system	209	5.19
Good cropping system	240	5.96
Mixed cropping	350	8.69
Crop rotation	156	3.87
Use of cover crops	307	7.62
Change of planting time	119	2.95
Use of organic manure	319	7.92
Land rotation	97	2.41
Bush fallow	158	3.92
Erosion control measures	203	5.04
Mulching	297	7.37
Planting of shed trees	200	4.96
Expert advice	103	2.56
Communal effort	217	5.39
Government assistance	100	2.48
Traditional measures	408	10.13
Soil preservation	385	9.56

Source: Field Survey, 2012.
**** = Multiple responses***

Table 7: Constraints to Control of Climate Change

Constraints*	**Yes %**	**No %**
Financial handicap	350(83)	70(17)
Poor climatic information	309(74)	111(26)
Lack of education	216(51)	204(49)
Insufficient extension visits	344(82)	76(18)
Personal constraints	128(30)	292(70)
Insufficient environmental scientists	288(69)	132(31)

Source: Field Survey, 2012

**** = Multiple responses***