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## Farmers' Adaptation Initiatives to the Impact of Climate Change on Agriculture in Northern Nigeria

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### Abstract

*The study ascertained the innovative adaptive measures used by farmers in northern Nigeria to cushion the harmful effects of climate change. Quantitative and qualitative approaches (Rapid Rural Appraisal, focus group discussions, and semi – structured interview schedule) were used to elicit information from a total of 500 farmers, which were selected using multistage random sampling technique. Findings revealed that 84% and 79% of the farmers were aware and knowledgeable of climate change issues, respectively, while 81% of them noted that they had at various times experienced climate change incidences. Farmers reported that factors which informed their perception of climate change incidence were: unusual early rains followed by weeks of dryness (M= 2.84), erratic rainfall pattern (M= 2.66), drought (M=2.68), reduction in farm yields (M=2.68) and high rate of disease incidence (M= 2.67). Adaptive measures used by the farmers in northern Nigeria included: changes in planting dates (88.4%) and harvesting dates (85.4%), multiple cropping (81.8%), intensive manure application (69.2%), shift to different sites (56.8%) and use of wetland/river valley (fadama) for farming (52.6%). The study concludes that there is need for government to make concrete efforts to enact appropriate policies on climate change adaptation and assist local farmers in the short and long term to improve their resilience to climate change impact.*

*Keywords: Climate Change, Innovative Adaptive Measures, Northern Nigeria, Climate Change Knowledge and Incidences.*

### **Acknowledgement**

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### **Introduction**

Climate change is the greatest challenge facing man's existence on earth in this century. It is a process of global warming, in part attributable to the 'greenhouse gases' generated by human activity. The impacts of climate change are being felt by both developed and developing countries. Climate change impacts are felt on agricultural production, health, biodiversities, social and economic conditions on the populace and on the environment in general. Climate change is predicted to worsen the incidence of drought and desertification and millions of people will be turned into refugees because of the disaster.

The 2005 Food and Agriculture Organization (FAO) Global Forest Resources Assessment showed that forest and woodland in sub Saharan Africa presently cover about 530 million ha, compared to 710 million ha in 1975. This ongoing degradation of natural resources is reducing the resilience of the agro-ecosystems to drought, further undermining the region's future capacity to cope with climate change (Anuforum, 2009). According to World Health Organization (2004) skin eruptions, heat fatigue, heat cramps, heat exhaustion and heat stroke are classical heat related illnesses which are resultant from climate variations. De Chavez and Tauli-Corpus (2008) assert that climate change results to socio-economic impacts in loss of revenue, economic opportunities and the practice of traditional culture which are expected to increase the social and cultural pressures on indigenous people. The out migration of indigenous youths to seek for economic opportunities elsewhere because of climate change has limited further their opportunities in their own communities; this could lead to erosions of indigenous economies and culture.

No part of Nigeria is safe from climate change. For instance, more than two thirds of the country is prone to desertification. States, such as Borno, Sokoto, Jigawa, Zamfara, Kebbi, Yobe, Kaduna, Kano Bauchi, Adamawa, Bauchi, Niger and others are at risk. In the Sahel zone of northern Nigeria, the most pronounced climate change-related forms of land degradation are wind erosion and related sand dune formation, drought and desertification. In south-eastern Nigeria, sheet erosion which is the complete removal of arable land is a major threat to agriculture in the region. Apart from the effects on cropping pattern, climate change brings with it proliferation of pests and diseases. These can hinder storage when the need

arises because of temperature increases. Diseases tend to spread to area where they were previously unable to thrive. A good example is the spread of tse tse fly to the drier regions of northern Nigeria from the southern part. The change also affects the agro-pastoral system as animals have to trek very long distances in search of green grass (De Chavez and Tauli-Corpus, 2008). The movements of animals also contribute to spread of disease causing organisms and leads to conflict on available resources. The impacts of climate change are not limited to cropping and agro-pastoralism, they are being felt on fisheries and aquaculture.

The concern with climate change is heightened given the linkage of the agricultural sector to poverty. In particular, it is anticipated that adverse impacts on the agricultural sector will exacerbate the incidence of rural poverty. Impacts on poverty are likely to be especially severe in Nigeria where the agricultural sector is an important source of livelihood for a majority of the rural population. Over 80% of Nigeria's population cites agriculture and fishing as their primary occupation and with the Nigerian agriculture being rain fed, food production system will be adversely affected by the variability in timing and amount of rainfall, frequent outbreaks of crop pests and diseases and heat stress. Food shortages will increase and many farmers could lose their sources of livelihood due to climate change.

Although Nigeria has made some efforts to adapt and mitigate climate change risks, these efforts in Nigeria are still rudimentary especially when compared with the impending catastrophe. With appropriate adaptation practices in place, the vulnerability to climate change will be highly reduced/minimized; hence this research effort. Pertinent questions that guided this research effort included: are farmers in northern Nigeria knowledgeable on climate change and its incidences? What are the factors that informed farmers of the incidence of climate change? And what are the farmers' adaptive initiatives to reduce the impacts of climate change in the area?

### **Purpose of the study**

The purpose of the study was to determine farmers' adaptation initiatives to the impact of climate change on agriculture in northern Nigeria. The specific objectives were to:

1. examine the level of awareness of climate change impact in the area;
2. identify factors which informed farmers of the incidence of climate change; and
3. identify farmers adaptation initiatives to reduce the impacts of climate change.

### **Methodology**

Quantitative and qualitative approaches (rapid rural appraisal, focus group discussions, and semi – structured interview schedule) were used to elicit

information from a total of 500 farmers, which were selected using multistage random sampling technique. In the first stage, four states were selected for the study, one from each of the ecological zones. Starting with the semi-arid zone, Borno was selected. Since there were over-laps in the states belonging to different zones, a state may belong to more than one agro-ecological zone, those that belong to the previous zone from which a state was selected were removed from the list of states belonging to the next. This was to make sure that only states that have predominantly the characteristics of such ecological zone were considered in the selection and that states that were selected did not have the same characteristics with respect to agro-ecological delineations. Thus, Adamawa, Kaduna and Kogi states were randomly related from dry-sub humid, sub humid and humid ecological zones respectively, giving a total of four states in all.

In the second stage, one local government area (LGA) was randomly selected from each of the senatorial zones of each state. This constituted the sampling frame. Hence, a total of twelve LGAs were sampled. From each of the three LGAs in each state, three town communities were randomly selected. The last stage was the selection of 15 farmers from each of the town communities; this gave a total of 45 farmers for each LGA. Hence a total of 540 respondents were used for the study. Data for the study were based on a cross-sectional farm household survey in the different LGAs. In all, a total of 500 completely filled interview schedule were selected for analysis.

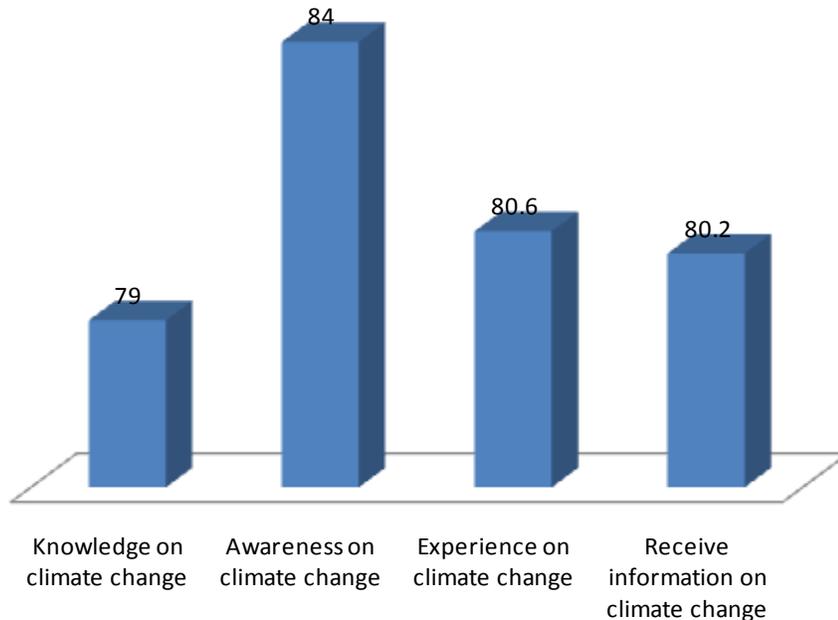
Objectives 1 and 3 were realized using percentages, while mean scores and standard deviation were used to achieve objective 2. To ascertain awareness on climate change, respondents were asked to indicate by ticking a “Yes” or “No”, if they knew of climate change, or have heard about it. To identify factors which informed farmers of the incidence of climate change, a three point Likert – type scale with response options of “to a great extent”, “to a little extent” and “to no extent” was used to elicit information from the respondents. Values of 3, 2, and 1 were assigned to these options. These were later summed up to arrive at 5, which was later divided by 3 to obtain 2.0. Factors with scores greater than 2.0 were taken as those which informed respondents on the incidence of climate change in the study area. To identify respondents adaptation initiatives to reduce the impacts of climate change, a list of measures was provided and the respondents were required to tick against an appropriate option of “Yes” and “No”. The options provided on the list included: mulching, processing to minimize post harvest loss, use of resistant varieties, increased weeding, changes in planting and harvesting dates etc.

## **Results and Discussion**

### **Respondents’ Knowledge and Awareness of Climate Change**

From Figure 1, about 84% of the respondents noted that they were aware of climate change, and 79% also affirmed that they had knowledge of the changing climate. This knowledge can be deduced from observation. About 81% respondents also noted that they had in various times experienced the incidence

of climate change. The respondents (80.2%) noted that they receive information on climate change. This implies that the respondents were aware and knowledgeable on the issues of climate change. This awareness is a necessary step in adapting to the changing climate.



*Figure 1: Awareness of climate change*

### **Incidence of Climate Change**

The mean scores of respondents' perceived prevalence of climate change (Table 1) reveal that uncertainties in the onset of farming season; extreme weather events and increase in farming problems were the manifestations of the incidence of climate change in the study area. Factors that informed them of the incidence of climate change with regards to uncertainties in the onset of farming season include: unusual early rains that are followed by weeks of dryness (M=2.84), higher temperature (M=2.81), delay in onset of rain (M=2.72), less rainfall (M=2.70), erratic rainfall pattern (M=2.66), long period of dry season (M=2.62), no or reduced harmattan (M=2.23), long period of harmattan (M=2.23) and heavy and long period of rainfall (M=2.12).

The factors which support their understanding of climate change with regard to extremities of weather events are: desertification (M=2.83), heavy rainfall (M=2.77), increase in atmospheric temperature (M=2.73), drought (M=2.68), among others. Also, the respondents noted that the incidence of climate change with regard to increased farming problems include: loss of soil fertility (M=2.90), reduction in farm yields (M=2.68), high rate of disease incidence (M=2.67) etc.

This increasing incidence of climate change is further highlighted by the report of Hir (2010), where he noted that a team of experts from Network of Nigerian Environmental Study/Action Team (NEST), one of the groups building Nigerians' adaptation to the effects of climate change, has warned that sand dunes and the harsh arid climate in Sahel area Toshua in Yobe State of North-Eastern Nigeria, are another climate change reality. The report further noted that for the third consecutive year, this area in the extreme North East recorded below normal rainfall and higher than normal temperatures during the hot season. In addition to the low rainfall, desertification (as a result of wind erosion), is of particular concern as encroaching sand dunes threaten the few surviving oases and even houses within the settlement.

**TABLE 1**  
**Mean distribution responses about changing climate phenomenon**

<b>Worsening climate phenomenon*</b>	<b>M</b>	<b>Standard Deviation</b>
<b>Uncertainties in the onset of farming season</b>		
Unusual early rains that are followed by weeks of dryness	2.84*	0.46
Delay in the onset of rains	2.72*	0.57
Long period of dry season	2.62*	0.67
Heavy and long period of rainfall	2.12*	0.47
Less rainfall	2.70*	0.60
No or reduced harmattan	2.23*	0.74
Long period of harmattan	2.23*	0.72
Higher temperature	2.81*	0.48
<b>Extreme weather events</b>		
Unusual dust that covers the atmosphere making it difficult for people to work	2.36*	0.67
Thunderstorms	2.11*	0.60
Heavy winds	2.50*	0.65
Floods and erosion	2.61*	0.60
Drought	2.68*	0.58
Heat waves	2.53*	0.77
Increase in atmospheric temperature	2.73*	0.58
High sun intensity	2.77*	0.51
Heavy rainfall	2.18*	0.45
Desertification or lost of forest resources	2.83*	0.44
Increase in the volume of sand encroachment	2.41*	0.71
<b>Increase in farming problems</b>		
High rate of disease incidence	2.67*	0.61
Increase weed infestation	2.62*	0.60
Loss of soil fertility	2.90*	0.36
Drying up of streams/rivers	2.81*	0.46
Overflowing of streams/rivers	2.14*	0.54
Reduction in farm yields	2.68*	0.59

*Source: Field survey, 2010*



*Fig. 3: Shrinking river bed*

### **Extent of Climate Change on Farms**

From Table 2, the respondents noted that changes due to uncertainties in the onset of farming season reveal that factors like higher temperature (M=3.68), unusual early rains followed by weeks of dryness (M=3.63), long period of dry season (M=3.57), delay in onset of rain (M=3.50), less rainfall (M=3.41) among others informed them that the climate has changed to a considerable extent.

The data further revealed that the respondents noted that extremities of weather events include: high sun intensity (M=3.77), desertification or loss of forest resources (M=3.68), increase in atmospheric temperature (M=3.55), droughts (M=3.44) and heavy winds (M=3.18), among other factors, have increased to a large extent.

Increase in farming problems include: reduction in crop yields (M=3.60), loss of soil fertility (M=3.43), and high rate of disease incidence (M=3.03) also informed them of the large extent of the changing climate. These findings are in support of a work by Finance and Development (2008) which noted that the impacts of climate change could affect agriculture in a variety of ways; beyond a certain range of temperatures, warming tends to reduce yields because crops speed through their development periods thereby producing less grain in the process. The work also noted that higher temperatures also interfere with the ability of plants to get and use moisture. Evaporation from the soil accelerates when temperatures rise and plant increase transpiration (lose moisture from their leaves) (F&D, 2008). This

problem is reflected majorly in reduction in crop yields. There has been a drastic reduction of yields of crops in northern Nigeria, and this is making the realization of attaining food sufficiency in the country unrealizable. Environmental degradation and attendant desertification are major threats to the livelihoods of the inhabitants of the northern states of Nigeria. This will subsequently lead to increase in population pressure, intensive agricultural land use, overgrazing, bush burning; and extraction of fuel wood and other biotic resources.

**TABLE 2**  
**Mean distribution on extent of the changing climate phenomenon**

<b>Extent of change*</b>	<b>M</b>	<b>Standard Deviation</b>
<b>Uncertainties in the onset of farming season</b>		
Unusual early rains that are followed by weeks of dryness	3.63*	0.93
Erratic rainfall pattern	3.45*	1.00
Delay in the onset of rains	3.50*	1.11
Long period of dry season	3.57*	1.14
Heavy and long period of rainfall	3.12*	1.26
Less rainfall	3.41*	1.11
No or reduced harmattan	3.00*	1.08
Long period of harmattan	3.21*	1.65
Higher temperature	3.68*	1.11
<b>Extreme weather events</b>		
Unusual dust that covers the atmosphere making it difficult for people to work	3.56*	1.27
Thunderstorms	2.94	1.12
Heavy winds	3.18*	1.11
Floods and erosion	3.16*	1.20
Drought	3.44*	1.26
Heat waves	3.33*	1.15
Increase in atmospheric temperature	3.55*	1.09
High sun intensity	3.77*	1.05
Heavy rainfall	3.27*	1.24
Desertification or lost of forest resources	3.68*	1.22
Increase in the volume of sand encroachment	3.24*	1.24
<b>Increase in farming problems</b>		
High rate of disease incidence	3.03*	1.22
Increase weed infestation	2.91	1.18
Loss of soil fertility	3.43*	1.09
Drying up of streams/rivers	3.52*	1.18
Overflowing of streams/rivers	3.17*	1.19
Reduction in farm yields	3.60*	1.18

*Source: Field survey, 2010*

### Adaption Initiatives Adopted by Respondents

Results on Table 3 show the indigenous adaptive measures being used by farmers to cushion the harmful effects of climate change. The measures being used include: changes in planting dates (88.4%), changes in harvesting dates (85.4%), multiple cropping (cropping of many crops on same piece of land) (81.8%), intensive manure application (69.2%), intercropping main crops planted with subsidiaries at low densities (61.8%), expansion of cultivated land area (59.2%), movement to different site (56.8%) mixed farming (54.6%) and use of wetland/river valley (e.g. Fadama) (52.6%).

**TABLE 3**  
**Percentage distribution of indigenous adaptive strategies used by farmers**

<b>Adaptive strategies</b>	<b>Yes %</b>
Mulching	43.2
Use of wetlands/river valleys (e.g. Fadama)	52.6
Contour cropping across slopes	35.8
Planting deeper than the usual planting depth	32.2
Expansion of cultivated land area	59.2
Intensive manure application	69.2
Increased weeding	77.0
Move to a different site	56.8
Changes in the timing of land preparation activities	79.8
Changes in planting dates	88.4
Changes in harvesting dates	85.4
Multiple cropping (planting of many crops in the same piece of land)	81.8
Mixed farming (crop and animal production)	54.6
Relay cropping- planting and harvesting in succession	38.6
Intercropping- main crops planted with subsidiaries at low densities	61.8
Decreasing animal stock	31.8
Change from crop production to animal rearing	17.8
Change from animal production to crop production	21.2
Agro-forestry practice	34.2
Change from production to marketing of agricultural products	20.6
Prayers for God's intervention	88.2

*Source: Field survey, 2010*

From Table 4, it is evident that the emerging adaptive measures being used by respondents include: planting of early maturing crops (87.2%), use of chemicals e.g. herbicides and pesticides (79.0%), increased use of fertilizers (78.6%), use of resistant varieties (78.4%), processing to minimize post harvest losses (61.4%), and afforestation i.e. planting of trees (60.4%).

These findings are in support of strategies put forward by First National Communication (2003) and Canada-Nigeria Climate Change Capacity Development Project reports (2004). These reports emphasized the need for diversification to new plant species and varieties that would have higher resistance to anticipated temperature increase and reduced rainfall, adopting zero/minimum tillage and other appropriate technologies to reduce soil erosion and loss of organic nutrients, but increase soil moisture availability and reduce weed and pest infestation.

**TABLE 4**  
**Percentage distribution of emerging adaptive strategies used by farmers**

<b>Adaptive strategies</b>	<b>Yes %</b>
Purchase/use of water for irrigation	27.8
Construction of drainage or dam within the farm/household	23.2
A forestations: planting of trees	60.4
Use of resistant varieties	78.4
Processing crops to minimize post-harvest losses	61.4
Increased used of fertilizers, seeds	78.6
Cultivation on marginal lands	50.6
Use of chemicals: herbicides, pesticides etc	79.0
Changing of crops formerly grown and replacing with new types	46.0
Total change from farming to other occupations	21.0
Planting of early maturing crops	87.2

*Source: Field survey, 2010*

## **Conclusion**

Based on the findings of the study, the following conclusions were made:

1. That the respondents were aware and knowledgeable on the issues of climate change.
2. The incidence of climate change in northern Nigeria is on the increase as highlighted by low rainfall, higher temperature, desertification and encroaching sand dunes, increased weed infestation and low crop yield, among other factors.
3. Respondents perceived that the increase in uncertainties with regard to the onset of farming season, extreme weather events and increase in farm problems to be prominent in the recent past.
4. Adaptive measures (indigenous and emerging) being used by respondents in cushioning the effects of climate change included: changes in planting and harvesting dates, multiple cropping, use of wetland/river valley (fadama), use of resistant varieties, processing of farm produce and afforestation.

## **Recommendations**

1. There is need for Nigeria to partner with international agencies that can help build capacities in relevant government agencies at all levels (national, state, local) to strengthen the country's capacity to develop and implement adaptation response strategies and plans that would reduce her vulnerability to the impacts of climate change.
2. There is need for government to make concrete efforts to ensure that appropriate policy on climate change adaptations and mitigations are enacted. Building adaptive responses to climate change is not a one-time affair. Concrete efforts should be placed on grounds to ensure that the indigenous people are carried along in the design and formulation of policies on climate change.

## References

- Anuforum, C. A. (2009). Climate change impacts on different agro-ecological zones of West Africa humid zones. Retrieved from [www.wwamis.org/agm/meetings/wacc.09/S3-Anuforum.pdf](http://www.wwamis.org/agm/meetings/wacc.09/S3-Anuforum.pdf)
- Canada-Nigeria Climate Change Capacity Development project reports (2004)
- De Chavez and Tauli-Corpus (eds.) (2008). Guide to climate change. Retrieved on 26<sup>th</sup> June, 2009 from [www.tebtebba.org](http://www.tebtebba.org)
- First National Communication (2003)
- Finance and Development ([www.imf.org/fandd](http://www.imf.org/fandd) 2008).
- Hir, J (2010). Sand dunes threaten Northern Nigeria – Climate Change group. ([http://dailytrust.dailytrust.com/index.php?option=com\\_content&view=article&id=4517:sand-dunes-threaten-northern-nigeria--climate-change-group&catid=10:environment&Itemid=11](http://dailytrust.dailytrust.com/index.php?option=com_content&view=article&id=4517:sand-dunes-threaten-northern-nigeria--climate-change-group&catid=10:environment&Itemid=11)). Retrieved 20<sup>th</sup> February, 2011
- World Health Organization (WHO) (2004). In de Chavez and Tauli-Corpus. (eds.) (2008). Guide to climate change. Retrieved on 26<sup>th</sup> June, 2009 from [www.tebtebba.org](http://www.tebtebba.org)