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**ASSESSMENT OF CLIMATE CHANGE ADAPTATION STRATEGIES  
ADOPTED BY VEGETABLE FARMERS IN JERE LOCAL GOVERNMENT AREA  
BORNO STATE NIGERIA**

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**Abstract**

*This study assessed climate change adaptation strategies adopted by vegetable farmers in Jere Local Government Area, Borno State. The objectives of the study were to level of awareness, perceived causes, effects, adaptation strategies adopted, and constraints to vegetable farmers' adoption of climate change adaptation strategies in the study area. Three wards (Dusuman, Gongulong and Old Maiduguri) were purposively selected, and twenty (20) vegetable farmers were randomly selected from each of the wards using simple random sampling giving sixty (60) respondents. The result on level of awareness revealed that perceived awareness of climate change variations among respondents were temperature fluctuation increases and rainfall disturbance (93.2%), increase in sunshine intensity and violence wind/storm (91.6%), drought (88.2%) and short dry season (75%). Result on perceived major causes of climate change among the respondents was reported to be bush burning (98.2%), gas emission and industrial revolution (96.6%), mono cropping (94.9%), deforestation (93.2%), excessive tillage (91.6%), and excessive pesticide application (90%). The respondents revealed that increased pest and disease outbreak, increased cost of production decreased crop yield (96.6%), alteration of planting time (93.3%), and low profit (93.2%) were the major effect of climate change in the study area. The adaptation strategies adopted by vegetable farmers were practice of agro-forestry, use*

*of early maturing varieties, intercropping, use of resistance varieties, and use of minimum/zero tillage. Moreover, the major constraints to adaptation of climate change in the study area were high cost of adaptation (46.6%), inadequate necessary inputs (30.0%), lack of appropriate technology (21.6%) and lack of government intervention (16.6%). The study concluded that vegetable farmers in the study area were aware of the challenges, causes and effects of climate and have embraced adaptation strategies to mitigate these impacts, thus recommended that more stalk holders should come in to ease the adaptation level of the farmers. In addition, emphasis should be placed on awareness creation on appropriate agronomic practices and adaptation to changes in climate.*

***Keywords:*** *Adaptation, Climate change, Awareness, Variations*

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## INTRODUCTION

Agriculture plays an important role in Nigerian economy contributing about 40% of the GDP and employing about 65% of the adult labour force (Adedipe *et al.*, 2004). Given the fundamental role of agriculture in human welfare, federal agencies and others regarding the potential effect of climate change on agricultural productivity have expressed concern. Interest in this issue has motivated a substantial body of research on farmer's indigenous knowledge of climate change and agriculture in recent decades (Nelson *et al.*, 2009; Lobell *et al.*, 2008; Darwin, 2004; Fischer *et al.*, 2002). Climate change has become more threatening not only to sustainable environmental quality but also as a major challenge to the fight against hunger, malnutrition, diseases and poverty in Africa through its impact on agricultural production. The threats of climate change cut across all the sub-sectors of Nigerian agriculture. The production crop particularly vegetable is significantly affected by the changes in climate and atmospheric carbon dioxide (CO<sub>2</sub>) (Rosenzweig and Hille, 1998). The changes in temperature and precipitation might further alter both arable and forest crop yields, water and nutrient budgets in the field thereby subjecting crops to stress (Tubiello *et al.*, 2002). In addition, Khanal (2009) noted that heat stress might affect the physiological development, maturation and finally yield of cultivated crops. This situation is worst in

Sub-Saharan African countries particularly Nigeria that already experiencing low crop yields because of extreme weather and climate change (Adebayo *et al.*, 2011)

In addressing this global threat, Tubiello and Rosenzweig (2008) stated that a wide range of adaptations exist within farming system to help maintain or increase crop and livestock yields under climate change. Adaptation practices are those strategies that enable the individual or the community to cope with or adjust to the impacts of the change in climate (Nyong *et al.*, 2007). It involves an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or explores beneficial opportunities (IPCC, 2001). In agriculture, adaptation helps farmers achieve their food, income and livelihood security objectives in the face of changing climatic and socio-economic conditions such as droughts, floods and volatile short-term changes in local and large-scale markets (Kandlinkar and Risbey, 2000). Adaptation measures are widely recognized as a vital component of any policy response to climate change. Such adaptation strategies for crop production include the adoption of efficient environmental resources management practices such as the planting of early maturing crops, mulching, small-scale irrigation, adoption of hardy varieties of crops, tree planting, early planting and staking to avoid heat burns (Nyong *et al.*, 2007). Recognizing the significance of adaptive response, Smit and Skinner (2002) stated that without adaptation, climate change is generally detrimental to the agriculture sector; but with adaptation, vulnerability can largely be reduced. The degree to which an agricultural system is affected by climate change depends on its adaptive capacity.

Climate change is a contributing factor to food price crises, and its impacts on agriculture in developing countries is expected to get more serious. Climate change poses great challenges for the rural poor in developing countries who tend to rely on natural resources for their livelihoods and have limited capacity to adapt to climate change. Long-term changes in temperature and precipitation and increases in climate variability and extreme weather-related events are already evident in many parts of the world. It has become increasingly clear that even serious strategies to adapt and mitigate climate change will be inadequate to prevent

devastating climate change impacts that threaten to reverse many of the economic gains made in the developing world in recent decades. In Nigeria, State like Borno State in Northeastern region, due to its location, size, and population is very vulnerable to the impact of climate change (Abbas, 2017). Crop Production particularly Vegetables are affected by many factors particularly those associated with climate change variability which include temperature, rainfall, and other extreme weather events. From the foregoing, it becomes imperative that adequate adaptation and mitigation strategies be explained to help cope with the challenges and impacts of climate change on the environment and agriculture. This study therefore seeks to unveil climate change adaptation strategies adopted by vegetable farmers in Jere Local Government Area, Borno State, Nigeria.

## **OBJECTIVES**

The objectives of this study were to:

- i. assess the level of awareness about climate change by vegetable farmers;
- ii. identify vegetable farmers perceived causes of climate change in the study area;
- iii. determine the vegetable farmers perceived effects of climate change on vegetable production in the study area;
- iv. identify the adaptation strategies adopted by vegetable farmers in the study area and
- v. identify the constraints militating against vegetable farmers' adoption of climate change adaptation strategies in the study area.

## **METHODOLOGY**

The study was carried out in Jere Local Government Area, one of the twenty-seven Local Government Areas of Borno State. The Local Government Area was carved out of Maiduguri Metropolitan Council (M.M.C) in 1996 (BSG, 2007). It lies within latitudes  $11^{\circ}40'$  and  $12^{\circ}05' N$  and longitudes  $13^{\circ}50' E$  and  $12^{\circ}20' E$ , it occupies a total landmass of 160 square kilometers (Ministry of Land and Survey, 2008). Within the state, it shares boundaries with Mafa Local Government Area to the east, Maiduguri Metropolitan Council to the north and Konduga Local Government Area to

the south. The climate of the area is characterized by dry and hot seasons, minimum temperature ranging from 15-20°C, while the maximum temperature ranges from 37-45°C. The annual rainfall ranges from 500mm to 700mm per annum (Nigerian Metrological Agency, 2008). The rainy season is usually from May to October with low relative humidity and short wet seasons. The topography is generally low land plain, and the soil is generally sandy with short grasses and thorny shrubs. Jere Local Government Area has a projected population of 211,204 persons with annual growth rate of 2.8% (NPC, 2006). Majority of the inhabitants are farmers, traders and civil servants. The major ethnic groups are Kanuri and Shuwa-Arab. Others include Hausa, Bura and Fulani and many immigrant settlers from within and outside Nigeria (BOSADP, 2008).

### **Sampling Procedure**

Three (3) wards namely: Dusuman, Gongulong and Old Maiduguri, out of the 12 wards in Jere L.G.A were purposively selected for the study due to large number of vegetable farmers in the area. A simple random sampling was employed to select twenty (20) vegetable farmers from each ward thus, giving a total of sixty (60) respondents for the study. Both primary and secondary sources of data were used in the study. The primary data were collected with the aid of a structured questionnaire administered to the vegetable farmers in the study area. Personal interview was conducted and results of the interview were interpreted in the questionnaire. While the secondary data were obtained from textbooks, journals, past projects, internet, conference papers, etc.

### **Analytical Techniques**

Descriptive statistics such as frequency distribution and percentage as well as ranking/likert scale were used to achieve all the objectives of the study.

### **Measurement of awareness on climate change**

Four (4) point likert scales were used to measure the awareness of vegetable farmers on climate change:

Strongly aware = 4

Aware = 3

Somewhat aware = 2

Not aware = 1

The cut up mean is = 2.5(10/4)

## RESULTS AND DISCUSSIONS

**Table 1: Distribution of Respondents According to Types of Vegetable Grown**

Vegetable Grown	Frequency	Percentage*
Tomato	30	50.0
Onion	28	43.3
Lettuce	14	23.3
Amaranthus/Sorrel	16	26.6
Okra	7	11.6
Others	1	1.6

Source: Field survey, 2019.

\* Multiple responses exists thus percentage > 100

Table 1 above shows distribution of vegetable farmers based on types of vegetable grown in the study area. The result revealed that majority (50.0%) of the respondents grows tomato, 43.3% grow onion, 26.6% grow amaranthus/Sorrel, 23.3% grow lettuce, 11.6% grow okra, and 1.6% grows other crops. This indicates that the main vegetables grown are Tomato, Onion, Lettuce, Amaranthus/Sorrel and okra.

**Table 2: Perceived level of awareness and observed climatic variations among vegetable farmers**

Response	S. Aware	Aware	Somewhat Aware	N. Aware
Temperature fluctuation increases	52 (86.6)	4 (6.6)	3 (6.6)	1 (1.6)
Sunshine intensity increases	50 (83.3)	5 (8.3)	3 (5.3)	2 (3.3)
Rainfall disturbance	46 (76.6)	10 (16.6)	2 (3.3)	2 (3.3)
Short dry season	30 (50.0)	15 (25.0)	11 (18.3)	4 (6.6)
Increase flooding	12 (20.0)	6 (10.0)	37 (61.6)	5 (8.3)
Violence wind/storms	51 (85.0)	4 (6.6)	2 (3.3)	3 (5.0)
Drought	46 (76.6)	7 (11.8)	4 (6.6)	3 (5.0)

Source: Field survey, 2019.

The result in Table 2 shows the perceived level of awareness and observed climatic variations among the respondents in the study area. The result shows that majority (93.2%) of the respondents claimed that they are aware of variations in climate change through temperature fluctuation increases and rainfall disturbance respectively. Moreover, 91.6% aware of changes in sunshine intensity and violence wind/storm, 88.2% aware of existence of drought, and 75% aware of shortened dry season, while 30% witnessed increased flooding over time.. Similar findings were reported by several studies in Africa (Gnangle, *et al.*, 2012; Loko *et al.*, 2013; and Mustapha *et al.*, 2012). These studies found that the main changes observed by farmers as a sign of change in climate were rainfall disturbances (rainfall delays, early cessation, bad rainfall distribution etc.), shortening of the small dry season, increasing temperature, sometimes-violent winds and other extreme events such as floods.

**Table 3: Perceived Causes of Climate Change Among Vegetable Farmers**

Response	Strongly Agree	Agree	Somewhat Agree	Not Agree
Deforestation	49 (81.6)	7 (11.6)	7 (11.6)	2 (3.3)
Mono-Cropping	53 (88.3)	4 (6.6)	1 (1.6)	2 (3.3)
Bush Burning	58 (96.6)	1 (1.6)	1 (1.6)	-
Tillage	49 (81.6)	6 (10.0)	3 (5.0)	2 (3.3)
Extensive Pesticide	51 (85.0)	3 (5.0)	3 (5.0)	3 (5.0)
Industrial Revolution	57 (95.00)	1 (1.6)	-	2 (3.3)
Gas Emission	56 (93.3)	2 (3.3)	-	2 (3.3)

Source: Field survey, 2019.

The result in Table 3 above indicated that majority (98.2%) of vegetable farmers believed that bush burning causes climate change, 96.6% agreed that gas emission and industrial revolution, respectively causes climate change. Moreover, 94.9% believed that mono cropping causes climate change variation, while 93.2% agreed that deforestation causes climate change. Furthermore, 91.6% believed that Climate change could be cause by continuous tillage, while 90% believed that excessive pesticide application causes climate change. This findings collaborates with parts of the results of Ndukhu *et al.* (2016) who found that farmers in Central

Kenya mentioned deforestation and poor agricultural practices (PAPs) such as; mono-cropping, burning of crop residues and excessive application of synthetic agrochemicals, while some reported emission of greenhouse gases (GHGs) as major causes of Climate Change Variability.

**Table 4: Effect of Climate Change on Vegetable Production**

Response	Strongly Agree	Agree	Somewhat Agree	Not Agree
Increase pest & disease outbreak	57 (95.0)	3 (5.0)	-	-
Increase cost of production	56 (93.3)	2 (3.3)	1 (1.6)	1 (1.6)
Change in planting time	51 (85.0)	5 (8.3)	2 (3.3)	2 (3.3)
Decrease crop yield	56 (93.3)	2 (3.3)	1 (1.6)	1 (1.6)
Low profit	52 (86.6)	4 (6.6)	2 (3.3)	2 (3.3)

Source: Field survey, 2019.

The result on effect of climate change on vegetable production among vegetable farmers in the study area is presented in Table 4. The result shows that all the respondents reported that increased pest and disease outbreak had great effect on vegetable production. Moreover, 96.6% indicated that increased cost of production and decreased crop yield affect vegetable production in the study area. Furthermore, 93.3% believed that climate change affect planting time, while 93.2% reported that the climate change causes low profit from vegetable production. This findings also similar to that of Nduku *et al.* (2016) who found that farmers reported reduced crop yields and/or crop failure, change in planting time and increased crop pest and disease attack were the most profound impacts of climate change and variability on agricultural productivity.

**Table 5: Adaptation Strategies Adopted by Farmers Against Climate Change Variations**

Response	Frequency	Percentage *
Use of early maturity varieties	16	26.6
Agro forestry practice	35	58.3
Use of Resistance varieties	8	13.3
Rain water harvesting	1	1.6
Minimum/Zero tillage	7	11.6

Inter cropping	9	15.0
Altered planting session	5	8.3
Crop rotation	6	10.0
Mulching	6	10.0
Others	3	5.0

Source: Field survey, 2019.

\* Multiple responses exists thus percentage > 100

Table 5 above shows results on adaptation strategies for climate change variation among vegetable farmers in the study area. The result shows that majority (58.3%) of the respondents used the practice of agro-forestry as their adaptation strategy; while 26.6% used early maturing varieties. Moreover, 15.0% responded intercropping, 13.3% responded use of resistance varieties, while 11.6% responded use of minimum/zero tillage. Furthermore, 10.0% each use crop rotation and mulching, respectively as adaptation strategies, while 8.3% responded alteration of planting session. About one percent and 5.0% of the respondents revealed that they harvest rainwater and use other adaptation measures, respectively. The result was in line with findings of Agbongiarhuoyi *et al.* (2013) who found that the major climate change strategies adopted by cocoa farmers in Kwara state include use of improved varieties, changes in cropping pattern, use of agro-forestry, climate predicting, control of soil erosion, fertilizer application, and use of irrigation facilities.

**Table 6: Constraint Militating Against the Adaption of Climate Change Variations**

Response	Frequency	Percentage*
Lack of appropriate technology	13	21.6
High cost of adaptation	28	46.6
Inadequate necessary input	18	30.0
Lack of government intervention	10	16.6
Poor of extension services	6	10.0
Lack of access to credit	4	6.6
Inadequate access to water for irrigation	4	6.6
Inadequate information on climate change	7	11.6

Others	6	10.0
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Source: Field survey, 2019.

\* Multiple responses exists thus percentage > 100

Table 6 above revealed that high cost of adaptation (46.6%), inadequate necessary inputs (30.0%), lack of appropriate technology (21.6%) and lack of government intervention (16.6%) were the major constraints militating against the adaptation of climate change adaptation measures. Furthermore, the result also shows that inadequate information on climate change (11.6%), poor extension services (10.0%), and lack of access to credit (6.6%), and inadequate access to water for irrigation (6.6%) among others (10.0%) constrained adaptation to climate change variations.

## CONCLUSION

The study assessed climate change adaptation strategies adopted by vegetable farmers in Jere Local Government Area, Borno state. Based on the findings of the study, it was concluded that vegetable farmers were aware of the challenges, causes and effects of climate and have embraced some adaptation strategies to mitigate these impacts. In the same token, farmers know the challenges they faced in vegetable production and have adopted coping measures.

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