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Analysis of Climate Change Manifestations among Sesame Farmers in Benue State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author MPN designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors BCA and GCA managed the analyses of the study. Author GCA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study was carried out to analyse climate change manifestations among sesame farmers in Benue State. A combination of purposive and random sampling techniques was used to select 372 sesame producers. Data were analysed using descriptive statistics. The result showed that climate change manifested as follows: Changes in time of rains (98.66%), drought (96.51%), extreme temperatures (96.24%), floods (92.74%), excess rainfall (90.05 percent), nutrient leaching (91.13%), soil erosion (90.59%) and pest/disease infestation (94.62%). The result also showed that sesame production in the study area were adversely affected by changed timing of rains (98.92%), drought (96.77%), extreme temperatures (95.16%), floods (93.28%), excess rainfall (91.13%), nutrient leaching (90.86%), soil erosion (90.32%) and pest/disease infestation (97.31%). The result further showed overall level of adverse effects of climate change manifestations among the respondents in descending order from low to high. The result indicates that the overall mean score (*M*) was 3.53. While about most (48.12%) of the sesame farmers in the study area indicated that climate change had a moderate level of adverse effects of on their sesame production. 37.37% of them indicated high level adverse effects of climate change on their sesame production and

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14.52% indicated low level adverse effects of climate change on their sesame production. It was therefore recommended that agricultural extension service should play a crucial role of informing its clientele (farmers) on how best to adapt to climate change impacts. Researchers and extension agents must as a matter of urgency work closely with sesame farmers to create awareness on the adverse effects of climate change as it affects their farming activities. They must also strengthen the confidence of farmers by expressing faith in such adaptive measures for a sustainable agricultural development.

Keywords: Climate change; manifestations; climate change effects; sesame farmers; Benue State.

1. INTRODUCTION

Climate change adds a new threat to rural livelihoods especially for subsistence or smallholder farmers because it affects economic growth and efforts to reduce poverty, thereby jeopardising many of the development gains made in recent decades [1]. Furthermore, rural area is very vulnerable to changes in climate patterns because a significant percentage of its economy and some of its workforce depend primarily on weather-sensitive agriculture. The changing climate could also hurt the productivity of rural workers and the health of their families because it may affect the quality and quantity of farming produce.

Most of the rural poor live in heterogeneous risk-prone areas with marginal resources and fragile ecosystems whose agriculture depends on rainfall. Climate variability will push these poor people, who are the least responsible for climate change, further beyond their capacity to cope with such changes. Many small farmers in rural areas who already live in harsh environments may become very vulnerable to climate change impacts because of their geographic exposure to extreme events, low incomes, dependence on agriculture, and few options to pursue other livelihoods [2]. Due to environmental threats resulting to declining crop yields, some farmers in Nigeria are abandoning farming for non-farming activities [3].

Sesame (*Sesamum indicum*) belongs to the plant family *Pedaliacea* commonly called beniseed in Nigeria. It is an important oilseed crop believed to have originated from tropical Africa, where there is the greatest genetic diversity. It was later taken at a very early date to India where a secondary centre of diversity was developed [4]. Oplinger et al. [5] indicated it to be a highly prized oilseed crop in Babylon and Assyria about 4,000 years ago.

There is a growing consensus in the scientific literature that in the coming decades the world will witness higher temperatures and changing precipitation levels. The effects of this will lead to low/poor agricultural products. Evidence has shown that climate change has started affecting crop yields in many countries [6,7,8]. This is particularly true in low- income countries, where climate is the primary determinant of agricultural productivity and adaptive capacities are low [9,10]. Hence, concerted efforts toward tackling these menaces are necessary. The study of analysis of climate change manifestations on sesame production in Benue State is therefore critical, given its impact in changing livelihood patterns in the country.

2. METHODOLOGY

2.1 The Study Area

Benue State derives its name from River Benue, the second largest River in Nigeria. The State, created in 1976, is located in the middle Belt region of Nigeria, approximately between latitudes 6½˚ and 8½˚ North and longitude 7½˚ and 10˚ East. The State shares boundaries with five states namely, Nasarawa to the North, Taraba to the East, Cross River to the South-East, Enugu to the South- West, and Kogi to the West. The Southern part of the State also shares boundary with the Republic of Cameroon. The State is also bordered on the North by 280 km River Benue, and is traversed by 202 km of River Katsina-Ala in the inland areas. Benue State has a tropical climate, which manifests two distinct seasons. The rainy season is from April to October while the dry season is from November to March. Annual average rainfall varies from 1750 mm in the Southern part of the State to 1250 mm in the North crops grown.

2.2 Population and Sampling Procedure

A combination of purposive and random sampling techniques was used for sample selection. Benue State is divided into three (3) agricultural zones such as: Zone A, Zone B and

Zone C. Two local government areas each were purposely selected from Zone A and Zone B while three local government areas were purposely selected from zone C on the basis of high level of sesame production. Based on this, Kwande and Logo Local Government Areas were purposively selected from Zone A. Guma and Tarka Local Government Areas were purposively selected from Zone B. Oju, Obi and Ohimini Local Government Areas were purposively selected from Zone C. From each of the selected Local Government Areas, households were randomly selected on the basis of its population size using 0.2% sampling fraction. Based on the foregoing, 372 sesame producers were randomly selected for this study.

2.3 Data Collection and Analysis

The primary data were obtained through the use of a structured questionnaire, copies of which were administered to the selected 372 sesame farmers in Benue State. Data were analysed using descriptive statistics.

2.4 Variable Specification

2.4.1 Level of an adverse effect of perceived dimensions of climate change manifestations

Climate change was perceived by the respondents to have manifested in the following dimensions: changed timing of rains, drought, extreme temperatures, floods, excess rainfall, nutrient leaching, soil erosion and pest/disease infestation. The level of adverse effect of perceived dimensions of climate change manifestations among the respondents was measured on a five-point scale.

The five-point scale measurement of the level of adverse effect of perceived dimensions of climate change manifestations among the respondents was done as follows: Very low adverse effect = 1; Low adverse effect = 2; Moderate adverse effect = 3; High adverse effect = 4; Very high adverse effect = 5. No adverse effect was however scored zero (0). Mean score of between 1.00 and 2.35 was regarded as low level of adverse effect as perceived by the respondents; mean score of between 2.36 and 3.65 was regarded as moderate level of adverse effect as perceived by the respondents; mean score of between 3.66 and 5.00 was regarded as high level of adverse effect as perceived by the respondents.

3. RESULTS AND DISCUSSION

3.1 Climate Change Manifestations among the Respondents

The result in Table 1 shows that climate change manifested as follows: changed timing of rains (98.66percent), drought (96.51 percent), extreme temperatures (96.24 percent), floods (92.74 percent), excess rainfall (90.05 percent), nutrient leaching (91.13 percent), soil erosion (90.59 percent) and pest/disease infestation (94.62 percent). The implication of these findings is that it will lead to a decline in sesame production as a result of unpredicted time of rainfall; prolonged dryness that make the sesame plant to wither; high scorching temperature that facilitate evapo-transpiration; floods that amount to excessive run-off that destroy both sesame plant and nutrient through erosion; nutrient leaching that deprive the sesame plant for available nutrient that make it go beyond the sesame plant root and eventually it exposes the sesame plant to pest and disease attack. This result agrees with the findings of Araya and Adjaye [11], Anim [12] who reported that farmers are aware and perceive soil erosion problem as being the result of changes in climate. According to Nhemachena and Hassan [13], most farmers perceived that long-term temperature is increasing.

Nhemachena and Hassan [13] further observed that the overall perception on long-term changes in precipitation is that the region is getting dryer and that there are pronounced changes in the timing of rains and frequency of drought. Maruf, et al. [14] reported that increase in floods, moisture stress and salinity intrusion were climate change manifestations that affected all major users of water in Bangladesh thereby adversely affecting the overall socio-economy of Bangladesh. Garcia et al. [15] noted that changes in Earth's climate over time can manifest in many ways. The different manifestations of climate change represent alternative dimensions of climate change, each with distinct implications for biodiversity conservation and other sectors.

3.2 Climate Change Manifestations that Adversely Affected Sesame Production

The result in Table 2 shows that sesame production in the study area were adversely affected by changed timing of rains (98.92 percent), drought (96.77 percent), extreme

temperatures (95.16 percent), floods (93.28 percent), excess rainfall (91.13 percent), nutrient leaching (90.86 percent), soil erosion (90.32 percent) and pest/disease infestation (97.31 percent). The implication of these findings is that it will lead to a decline in sesame production as a result of unpredicted time of rainfall; prolonged dryness that make the sesame plant to wither; high scorching temperature that facilitate evapo-transpiration; floods that amount to excessive run-off that destroy both sesame plant and nutrient through elusion; nutrient leaching that deprive the sesame plant for available nutrient that make it go beyond the sesame plant root and eventually it exposes the sesame plant to pest and disease attack. These results agree with the findings of Oyekale AS. [16] who observed that the major direct effects of climatic change on agricultural production in Nigeria are through changes in temperature, precipitation, length of growing season, and timing of extreme or critical threshold events. Sensitivity of sesame production to hours of sunshine, rainfall, soil conditions and temperature makes it vulnerable to climatic change. Changing climate can also alter the development of pests and diseases and modify the sesame plants' resistance.

Extended drought will cause the young sesame plants and some mature sesame plants to wither, while major pests and diseases of sesame are promoted by unfavourable climatic situations.

Onyibe JE. et al. [17] pointed out that sesame yields are affected by length of growing season rainfall, weather and plant density among other factors. Several pests attack sesame with the potential to reduce yield of the crop. Onyibe JE. et al. [17] noted that every aspect of sesame production from seedling to matured plant has one form or the other types of pests and diseases. Most of these field problems, including insects, cause a drastic reduction in the yield of sesame. Depending on the weather and time of the year, the sesame crop is constantly attacked by a wide range of insect pests.

Table 1. Distribution of respondents based on climate change manifestations

Climate change manifestations	Frequency	Percentage
Changed timing of rains	367	98.66
Drought	359	96.51
Extreme temperatures	358	96.24
Floods	345	92.74
Excess rainfall	335	90.05
Nutrient leaching	339	91.13
Soil erosion	337	90.59
Pests and disease infestation	352	94.62

Source: Field Survey, 2015
**Multiple Responses*

Table 2. Distribution of respondents based on based on their recorded CC effects on sesame production

Climate change manifestations	Frequency	Percentage
Changed timing of rains	368	98.92
Drought	360	96.77
Extreme temperatures	354	95.16
Floods	347	93.28
Excess rainfall	339	91.13
Nutrient leaching	338	90.86
Soil erosion	336	90.32
Pests and disease infestation	362	97.31

Source: Field Survey, 2015
**Multiple Responses*

3.3 Level of Adverse Effects of Climate Change Manifestations among the Respondents

The result of level of adverse effects of climate change manifestations among sesame farmers in Benue State is presented in Table 3. The result shows overall level of adverse effects of climate change manifestations among the respondents in descending order from low to high. The result indicates that the overall mean score (*M*) was 3.53, suggesting that climate change had moderate effects among the respondents. While about most (48.12 percent) of the sesame farmers in the study area indicated that climate change had a moderate level of adverse effects of on their sesame production. 37.37 percent of them indicated high level adverse effects of climate change on their sesame production and 14.52 percent indicated low level adverse effects of climate change on their sesame production. These findings showed that climate change affect crops from the time of planting till harvesting and are responsible for low productivity especially in the area where there is a high prevalent case.

The foregoing finding agrees with Luka, E. G. and Yahaya H. [18] who found that climate change increases flooding which results in soil erosion, thus degrading soil fertility and quality which invariably reduces agricultural productivity. This finding is also in agreement with Onyibe JE. et al. [17] who noted that every aspect of sesame production from seedling to matured plant has one form or the other types of pests and diseases, which cause a drastic reduction in the yield of sesame. According to Ortiz R. [19], the impacts of climate change in agriculture can be measured by productivity loss due to extreme temperatures, which affect growth cycles, and water stresses that reduce yield.

Table 3. Distribution of respondents based on the level of adverse effects of climate change manifestations

Dimension	Level	Mean score	Frequency	Percentage	Mean
Changed timing of rains	Low	1.00-2.35	108	29.03	3.82
	Moderate	2.36-3.65	118	31.72	
	High	3.66-5.00	146	39.25	
Drought	Low	1.00-2.35	105	28.23	3.77
	Moderate	2.36-3.65	123	33.06	
	High	3.66-5.00	144	38.71	
Extreme temperatures	Low	1.00-2.35	104	27.96	3.37
	Moderate	2.36-3.65	124	33.33	
	High	3.66-5.00	144	38.71	
Floods	Low	1.00-2.35	115	30.91	3.18
	Moderate	2.36-3.65	136	36.56	
	High	3.66-5.00	121	32.53	
Excess rainfall	Low	1.00-2.35	104	27.96	3.24
	Moderate	2.36-3.65	139	37.37	
	High	3.66-5.00	129	34.68	
Nutrient leaching	Low	1.00-2.35	116	31.18	3.07
	Moderate	2.36-3.65	131	35.22	
	High	3.66-5.00	125	33.60	
Soil erosion	Low	1.00-2.35	117	31.45	3.10
	Moderate	2.36-3.65	132	35.48	
	High	3.66-5.00	123	33.06	
Pest/disease	Low	1.00-2.35	107	28.76	3.72
	Moderate	2.36-3.65	130	34.95	
	High	3.66-5.00	135	36.29	
Overall	Low	1.00-2.35	54	14.52	3.53
	Moderate	2.36-3.65	179	48.12	
	High	3.66-5.00	139	37.37	

Source: Field Survey, 2015.
Minimum Mean = 1; Maximum Mean = 5

4. CONCLUSION

This study was undertaken to analyse climate change manifestations among sesame farmers in Benue State. The study showed that climate change manifestations were perceived by the respondents in the following dimensions: changed timing of rains, drought, extreme temperatures, floods, excess rainfall, nutrient leaching, soil erosion and pest/disease infestation. The study also showed that sesame production in the study area were adversely affected by the changed timing of rains, drought, extreme temperatures, floods, excess rainfall, nutrient leaching, soil erosion and pest/disease infestation. The study showed that while about a half of the sesame farmers in the study area indicated that climate change had a moderate level of adverse effects of on their sesame production, 37.37 percent of them indicated high level adverse effects of climate change on their sesame production and 14.52percent indicated low level adverse effects of climate change on their sesame production.

5. RECOMMENDATIONS

Agricultural extension service should play a crucial role of informing its clientele (farmers) on how best to adapt to climate change impacts. Researchers and extension agents must as a matter of urgency work closely with sesame farmers to create awareness on the adverse effects of climate change as it affects their farming activities. They must also strengthen the confidence of farmers by expressing faith in such adaptive measures for a sustainable agricultural development.

Other stakeholders should invest in improved agricultural technology in order to cope with climate change. Nigeria should start to invest on irrigation farming rather than relying more on rain-fed agriculture that is highly unreliable and becoming more unpredictable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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