EFFECTS OF CLIMATE CHANGE ON ROOT AND TUBER CROP PRODUCTION IN OBI LOCAL GOVERNMENT AREA, NASARAWA STATE, NIGERIA

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Abstract

The study assessed the effects of climate change on root and tuber crop production in Obi Local Government Area of Nasarawa State, Nigeria. A multi stage sampling technique was used to select 80 respondents. Data were analyzed using descriptive statistics. The result revealed that most (36.3%) of the respondents were aged between 25 and 35 years, with mean age of 41 years. Majority (93.8%) of respondents were male. Their average age of farming experience was 22 years. Some (36.3%) of the respondents had both secondary and tertiary education. Majority (86.3%) of them used inherited farmlands. The mean annual income was ₦324,04. Majority of the respondents (61.0%) relied on radio as their major source of information on climate change. Perceived indicators of climate change in the area were intense sunlight (73.0%), high temperature (70.0%), and short duration of rainfall (61.3%). Majority of the respondents perceived overgrazing (93.8%), burning of fire wood (85.0%), burning waste (83.8%) and deforestation (81.3%) as activities that cause climate change. Also, the findings revealed that common climate change mitigation practices in the area were minimum soil tillage (88.8%), agro forestry practice (75.0%) and afforestation (75.0%); while common climate adaptation activities practice include mulching (97.5%) and crop diversification (91.3%). The study further revealed the major effects of climate change onroot and tuber production were soil nutrient depletion ($\bar{X} = 2.80$); delay maturity ($\bar{X} = 2.78$); poor yield ($\bar{X} = 2.67$); and root and tuber rot ($\bar{X} = 2.62$). It was recommended that adequate and regular information on agricultural activities that could cause as well as mitigate climate change beprovided by relevant organizations through mass media and focus group meetings.

Keywords: Effects, climate change, root and tuber crop production

Introduction

Root and stem tuber are some of the popular staple food grown in most partn of Nigeria, particularly north-central and southern parts of the country. It is also commonly grown all over the sub-saharan region of Africa.Cassava is the dominant root crop in Nigeria, while yam, cocoyam, potato and ginger are common stem tubers in the country. Climate change has been identified as number one threat to natural environment and agricultural sustainability in Nigeria and other regions of the world. Climate change affects not only agricultural production and prices, trade and food sufficiency but also environmental conditions like water resources, land use and coastal infrastructure, among others (Onu and Ikehi, 2016). The Inter-

governmental Panel on Climate Change-IPCC (2007) defined climate change as changes in the mean and/or the variability of its properties persistently for decades due to natural variability and/or human activities.

In Nigeria, roots and tubers yield fluctuate substantially in recent years owing largely to climatic factors and poor resource base of the farmers. According to Idumahet al. (2016), rainfall and temperature are the climatic elements that significantly influence root and tuber crops production and output in Nigeria. Also, Obioha (2008) observed that Nigeria is one of the countries that are vulnerable to climate change and that the agricultural sector is under threat.The effects of global climate change on agricultural production are becoming source of worry to farmers in Nigeria and sub-Saharan Africa. This is because their livelihood mainly depends on agriculture which is now being threatened by climate change. Meanwhile, any efforts made toward unveiling empirically, the extent of climate change impact on agriculture is considered imperative for policy purpose.Hence, this study is designed to assess the effect of climate change on root and tuber crop production in Obi Local Government Area, Nasarawa State. Specific objectives of the study are to:

i. assess the awareness of climate change in the study area;
ii. identify the activities of farmers that can cause climate change in the study area;
iii. identify farmers activities that can mitigate climate change;
iv. identify farmers adaptation strategies to climate change; and,
v. assess the effect of climate change on root and tuber production in the study area.

Methodology

The study was conducted in Obi Local Government Area (LGA) of Nasarawa State. It has a total population of about 148,874 people with a land mass OF 599km^2 (NPC, 2006). Obi Local Government has ten (10) districts namely; Adudu, Agwatashi, Dadere, Riri, Kyakale, Gidinye, Gude, Gidanausa, Obi and Daguru.Most of the people are farmers who also engageinpetty trading and artisan work as part time commercial activities to supplement income. Some food crops grown in the area are cassava, yams, cocoyam, rice and maize.

Sampling Techniques and Sample Size

Root and Tuber farmers in the area constituted the population of the study. A two-stage sampling technique was used to select the respondents. First stage of the sampling involved purposive selection of eight districts with preference for farmers with long years of farming experience in order to obtain relevant information from them. In the second stage of sampling, 10 root and tuber crop farmers were randomly selected from each of the 8 districts making a total of 80 respondents for the study.

Primary data were collected and usedfor the study. The data were generated through a structured questionnaire administered on farmers for the 2018cropping season. Descriptive statistics such as frequency counts, percentage, mean and weighted mean were used to satisfy objectives i, ii, iii andiv. Weighted mean was used to achieve objective v.

The 3-point likerratings were: very serious (3); serious (2) and not serious (1). Thereafter, the weighted mean of the ratings was computed as follows:

WM= [3(FVS) +2(FS) +1(FNS)]/TF.

Where, WM= weighted mean; FVS= frequency of very serious; FS= frequency of serious; FNS= frequency of not serious; and TF= total frequency

Results and Discussion

Socioeconomic Characteristics of the Respondents:

Result in Table 1 shows many (36.3%) of the respondents were between the age range of 25-35 years, 33.8% of the respondents were between the age range of 36-45 years while the respondents with age range between 46-55 years and 56-66 years were about 13.8% and 16.3%. The mean age of the respondents was 41 years. This implies that majority of the respondents were within their middle age as well as active years and the results agreed with Girei and Giroh (2013) who reported that farming activities grew with age. Table 1 also revealed that most (93.8%) of the farmers were males and while 6.3% were females. This implies that male participated more in farming activities than females in the study area. Table 1 indicate that a greater proportion (38.8%) of the farmers had 5-15 years of farming experience, 33.8% of them had farming experience of 16-25 years, while 18.8% of them had farming experience of 26-35 years which was followed by 7.5% and 1.3% of the farmers had above 36 and 46 years respectively. This implies that most of the respondents have been in the farming activities for a long period of time.

Some (36.3%) of the respondents had both secondary and tertiary education followed by 21.3% who completed primary school, while 6.3% had no formal education. This implies that a good number of the respondents were learned. Table 1reveals that majority (36.3%) of the respondents had a farm size of 1-5 hectares, while 12.3% had a farm size of 6-10 hectares followed by 1.3% having 11-15 hectares of land respectively. This implies that majority of the farmers cultivated a reasonable farm land. The mean farm size was 3.93 hectares. Majority (78.8%) of the farmers had annual income between ₦10,000-₦400,000, which was followed by 13.8% of the respondents that had 410,000-800,000, 3.85% of the respondents had annual income of ₦810,000-₦1,200,000 and ₦1,210,000-₦1,600,000 respectively. The mean annual income was ₦324, 037.5 per annum. As can be seen in Table1 majority (95%) of the respondents did not receive any form of credit, while 5.0% of the respondents received credit of ₦50, 000-100,000. This implies that majority of the farmers do not have access to credit facilities which complicated their farming production problems, which reduced their income.
Result inTable 1 shows the type of land tenure system used by the respondents. Majority of the respondents (86.3%) used inherited land. while 7.5% of the respondents used hired land and 5.0% and 1.3% used family/communityand purchased land, respectively. This implies that most of the respondents in the study area used inherited land.

Farmers Awareness of Climate Change:

Due to its influence on the farming activities, all (100%) the respondents agreed that they were aware of climate change and its negative effects as evidenced in the continuous change or variability of climatic parameters. Table 2 shows that a sizeable number of respondents (61.0%) opined that their major source of information about climate change was from radio, 57.5% of the respondents got theirs from experience and observations of happenings, while 47.5% of the respondents got their information from television. The respondents that got information on climate change from fellow farmers, internet, extension agents and meteorological station accounted for 22.5%, 8.8%, 3.8% and 1.3% respectively. This implies

that the major source of information on climate change in the study area was through the use of radio station programme.

Indicators (evidence) of Climate Change According to Respondents:
As depicted in Table 3, a total of 73.8% of the respondents perceived excess sunshine as evidence of climate change while 70.0% of the survey farmers regarded high temperature distribution as the major indicators of climate change in the study area and 61.3% opined that short duration of rainfall was an evidence of climate change. Temperature and rainfall are the two climatic variables that influence farming the most in the study area. Table 3 also shows that 51.3%, 37.5% and 35.0% of the respondents identified high rainfall, Low rainfall, and extreme cool temperaturerespectivelyas perceived indicators of climate change in the study area. This implies that excess sunshine, high temperature and short duration of rainfall are the most perceived indicators of climate change in the study area.

Table 1: Socio-economic characteristics of respondents

Variables	Frequency	Percentage	Mean
Gender			
25-35	29	36.3	
36-45	27	33.8	41
46-55	11	13.8	
56-65	13	16.3	
Total	80	100	
Sex			
Male	75	93.8	
Female	5	6.3	
Total	80	100	
Years of Farming Experience			
5-15	27	33.8	
16-25	31	38.8	
26-35	15	18.8	22.86
36-45	6	7.5	
46-55	1	1.3	
Total	80	100	
Educational Level			
Primary	17	21.3	
Secondary	29	36.3	
Tertiary	29	36.3	
None	5	6.3	
Total	80	100	
Farm Size			
1-5	69	86.3	
6-10	10	12.3	3.93
11-15	1	1.3	
Total	80	100	
Social organization belonged			
None	75	93.8	

1-2	4	13.8	
3-4	1	1.3	
Total	80	100	
Income Level			
10,000-400,000	63	78.8	
410,000-800,000	11	13.8	₦324,037.5
810,000-1,200,000	3	3.8	
1,210,000-1,600,000	3	3.8	
Total	80	100	
Amount of Credit			
None	76	95.0	
50,000-100,000	4	5.0	
Total	80	100	
Land Tenure System			
Inherited	69	86.3	
Purchased	1	1.3	
Hired	6	7.5	
Family/community	4	5.0	
Total	80	100	

Source: Field survey, 2019

Table 2: Distribution of respondents according to awareness and sources of information on climate change

Sources	Frequency	Percentage	Rank
Radio	49	61.0	1
Experience	46	57.5	2
Television	38	47.5	3
Fellow farmers	18	22.5	4
Internet	7	8.8	5
Extension agents	3	3.8	6
Meteorological station	1	1.3	7

Source: Field survey, 2019 *Multiple responses recorded

Table 3: Indicators (evidence) of climate change according to respondents

Indicators	Frequency	Percentage	Rank
Excess sunshine	59	73.8	1
High temperature	56	70.0	2
Short duration of rainfall	49	61.3	3
High rainfall	41	51.3	4
Low rainfall	30	37.5	5
Extreme cool temperature	30	37.5	5
Raising level flood	30	37.5	5
Low duration of rainfall	28	35.0	6
Drought occurrence	15	18.8	7

Source: field survey, 2019 multiple responses recorded

Farmers Activities that Causes Climate Change

The results as presented in Table 4 shows the percentage distribution of respondents according to perception of activities that cause climate change. Majority (93.8%) of the respondents perceived overgrazing, while 85.0% of the respondents perceived burning of firewood as cause of climate change. About 83.8% of the respondents opined that burning waste is part of the major activities they perceived as the cause of climate change. While 81.3% of the respondents believed deforestation as the cause of climate change.Bush burning as an activity that causes climate change accounted for 78.8% of the respondents, while the use of inorganic fertilizer, excess tillage and burning of fossils as perceived activities that cause climate change accounted for 66.3%, 30.0%, and 1.3% respectively. This implies that, overgrazing, burning of firewood, burning waste and deforestation were the major activities perceived as causes of climate change among others in the study area. This agreed with the findings of intergovernmental panel on climate change (IPCC, 2007).

Activities that Mitigate Climate Change:

Result in Table 5 shows percentage distribution of respondents according to the types of activities that farmers engaged that can mitigate climate change, though the practices were not deliberately performed to mitigate climate change. Minimum tillage activity accounted for 88.8% of the respondents and ranked first; while afforestation and agro-forestry practices accounted for 75% respondents each. Use of organic manure among respondents accounted for 72%. According to IPCC (2007), activities that mitigate climate change include agro-forestry, afforestation, minimum tillage and use of organic manure.

Table 4: Distribution of respondents based on perceived causes of climate change

Activities	Frequency	Percentage	Rank
Overgrazing	79	98.8	1
Burning of firewood	68	85.0	2
Burning waste	67	83.8	3
Deforestation	65	81.3	4
Bush burning	63	78.8	5
Use of inorganic fertilizer	53	66.3	6
Excess tillage	24	30.0	7
Burning of fossils fuels	01	1.3	8

Source: Field survey, 2019 multiple responses were recorded

Table 5: Distribution of respondents-based mitigation activities.

Activities	Frequency	Percentage	Rank
Minimum soil tillage	71	88.8	1
Agro-forestry practice	60	75.0	2
Afforestation	60	75.0	2
Use of organic manure	58	72.5	3
Use of biochar	14	17.5	4
Irrigation farming	08	10.0	5

Source: Field survey, 2019 multiple responses.

Adaptation Activities Practiced by Root and Tuber Crop Farmers

The result in table 6 shows the percentage distribution of respondents according to farmers' climate change adaptation practices. Majority (97.5%) of the respondents practiced mulching as an adaptation measure to meliorate the effect of climate followed by 91.3% of the respondents who practice crop diversification as a way of lessen effect of climate change. Cover crops like legumes constituted 87.5% of the respondents. Other climate change adaptation activities practiced by the farmers include planting of short maturing varieties, planting of disease resistant varieties and adoption of irrigation techniques and these accounted for 53.8%, 13.8%, and 5.0% of the respondents respectively. This outcome is in agreement with the findings of IPCC (2007).

Effects of Climate Change on Root and Tuber Crop Production

As can be seen in table 7, the major effects of climate change on root and tuber crop production as perceived by the farmers in the study area were rapid rate of nutrient depletion ($\bar{X} = 2.80$); delay maturity in the crops ($\bar{X} = 2.78$); poor yield ($\bar{X} = 2.67$); root and tuber rotting ($\bar{X} = 2.62$)and, disease and pest infestation (($\bar{X} = 2.46$). These effects of climate change on the crops as perceived by root and tuber farmers were in line with the report of IPCC (2007).

Table 6: Distribution of adaptation activities practiced by farmers.

Adaptation activities	Frequency	Percentage
Mulching	78	97.5
Crop diversification	73	91.3
Use of cover crop	70	87.5
Planting of short maturing varieties	43	53.8
Planting of disease resistant varieties	11	13.8
Adoption of irrigation techniques	04	5.0
Farm insurance	04	5.0

Source: Field survey, 2019 multiple responses.

Table 7: Distribution of the respondents according to the effect of climate change on root and tuber cropfarms

Effect	Very serious (3)	Serious (2)	Not Serious (1)	Total Scores	Mean Score
Soil Nutrient Depletion	195	28	1	224	2.80*
Delay Maturity	195	26	2	223	2.78*
Poor yield	168	44	2	214	2.67*
Root and Tuber rot	153	56	1	210	2.62*
Disease and Pest infestation	129	62	6	197	2.46*
Soil erosion	117	64	8	189	2.36*
Flood	81	12	9	102	1.27^{NS}

Source: Field survey, 2019 *=Significant, ^{NS}= Not significant

Conclusion and Recommendations

The root and tuber crpops farmers in the study area were aware of the global climate change phenomena and have pretty knowledge about the cause. The farmers'climates change mitigating practices were minimum soil tillage, agro-forestry and afforestation. The farmers practice meant to cope with the effect of climate change included mulching, crop diversification, planting of leguminous and short maturity variety. Fast soil nutrient depletion, delay maturity of crop, poor yield and, diseases and pest infestation were major effects of climate change on root and tubers production in the area. It is recommended that adequate and regular information on agricultural activities that could cause as well as mitigate climate change be provided by relevant organizations through mass media and focus group meetings.

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