International Journal of Innovative Human Ecology & Nature Studies 11(4):58-72, Oct-Dec., 2023

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Assessment Of The Impacts Of Climate Change On Rice Production In Bade L.G.A Yobe State Nigeria

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ABSTRACT
The study assesses the impacts of climate change on rice production in Bade Local Government Area, Yobe State, Nigeria. The study used purposive and systematic sampling technique in selecting wards and rice farmers for the study respectively. The study used questionnaire and focus group discussion for data collection. 399 farmers were surveyed. The data obtained on farmers' awareness and perception of climate change, the causes of climate change, and effects of climate change on rice production were analyzed using percentage and descriptive statistics with SPSS. Developing countries are the most vulnerable to climate change impacts because they have fewer resources to adapt: socially, technologically and financially. Climate change rate is gradually exceeding the adaptive capacity of a wide range of crops and tree population used in Nigeria ten years earlier than the prediction of the IPCC's climate model prediction of 2020. It is increasingly becoming clear that climate change is a real phenomenon and human activities such as burning of fossil fuel, deforestation, and so on are primarily to blame.
Keywords: climate change, human activities, rice production,

INTRODUCTION

It is increasingly becoming clear that climate change is a real phenomenon and human activities such as burning of fossil fuel, deforestation, and so on are primarily to blame. As such, the recent anthropogenic emission of greenhouse gases is at its highest level (IPCC 2014). The impacts of increased temperature and elevated CO_2 level, intense or no rainfall, are widespread on natural systems and on humans (IPCC 2000, 2014). It is evident that increase in temperature and carbon dioxide (CO_2) have a positive impact on some crops, but the nutrient levels, soil moisture conditions, water availability for irrigation, and other crop-related conditions should be favorable in order to have better crop yield (Maximay 2014). Moreover, changes in precipitation pattern such as intense rainfall during a particular month are becoming more frequent and such events could have a devastating effect on crop production especially if they occurred in a sensitive phase of the crop, e.g., the flowering stage (Joshi et al. 2011).

All these events associated with climate change would pose further stress on farmers to produce more and more food for an increasingly growing and wealthier population (FAO 2011). Climate change impact studies have shown that the productivity of agricultural activities is highly sensitive to climate change. The effect of changes in climate on agricultural activities both physical and economic has been shown to be significant for low input farming systems, such as subsistence farming in developing countries in Sub-Saharan Africa that are located in marginal areas and have the least capacity to adapt to changing climatic conditions (Audu, 2015).

According to the Intergovernmental Panel on Climate Change (IPCC, 2007) in the fourth assessment report, climate change is a change in the state of the climate that can be identified (e.g. using statistical tests) by the changes in the mean of temperature, precipitation and wind pattern, and that persists for an extended period typically decades or longer. Climate change is therefore the statistically significant deviation or shift from the average weather conditions of climatic elements. The change could be limited to a specific region or may occur across the globe.

Already, climate change rate is gradually exceeding the adaptive capacity of a wide range of crops and tree population used in Nigeria ten years earlier than the prediction of the IPCC's climate model prediction of 2020 (IPCC, 2007). Food production and access to food in many dry parts of the country is becoming more expensive and in some cases scarce, severely compromised, exacerbating food security problems, malnutrition, poverty, hunger, diseases and communal conflicts resulting from the loss of 92,000 hectares of land to drought and desertification (Commission for Sustainable Development, 2008). Researchers have linked these problems to climate change which invariably affects crop production in Sub-Saharan Africa (Audu, 2015).

Developing countries are the most vulnerable to climate change impacts because they have fewer resources to adapt: socially, technologically and financially. Climate change is anticipated to have far reaching effects on the sustainable development of developing countries including their ability to attain the United Nations Millennium Development Goals by 2015 (UN 2007). 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 (Farauta *et al, 2012*).

Vaghefi *et al, (*2013), the impact of climate change on rice production is of particular interest due to its importance as a food source in all over the world, especially in Asia. In different parts of the world, climate change may affect agriculture differently. It depends on current climatic and soil conditions, the direction of change and the availability of resources and infrastructure to face with change. And its estimated that about 60% increase in rice yield would be likely needed by year 2020 due to population growth. Thus, attention to climate change issue is urgency, as it poses a significant threat to food supplies and security. Ramirez (2010) notes that unforeseen changes associated with global warming in temperature, carbon dioxide and rainfall are expected to impact rice production. Studies have shown that increase in temperature, due to climate change, adversely affect rice crop physiology ultimately decreasing crop yield and grain quality. Gumm (2010) re-affirms that rising temperature during the past 25 years have already cut rice yield growth rate by 10-20 percent in several locations. He further adds that unless there is a change in the rice production methods or new rice strains that can withstand higher temperatures, are developed, there will be a loss in rice production over the next few decades as days get hotter.

The Sudano-Sahelian zones of Nigeria is characterized by persistent drought, wet and dry spells (Sawa, 2002), declining rainfall intensities and increasing the dry season (Ojonigu, 1990). Olaniran, (2002) summarized all these anomalies and confirm that there has been climate change in rainfall regions in the area. Bade local government area fall under this zone there by making these problems mention pronounce in the area, even though irrigated Rice production in most of the areas were not long been practice not more than 10 years old.

Statement Of The Problems/Justification

In spite of man's remarkable development in science and technology, his economy and social welfare is still dependent on climate and affected by long-term and short-term fluctuations in climate (Dey, 1982). Different studies were conducted on climate change, climate variability and its impacts on agriculture and

rice production in different parts of the world. Mahdu, (2019) in his studies finds out that excess rainfall lead to flooding and drought which cause damage to the rice grains resulting in lower quality and quantity at harvest. Stuecker, Tigchelaar & Kantar (2018) in their study on impact of climate variability on rice yield and production in the Philippines. The study revealed that rice production is affected by variations in soil moisture, which are largely driven by the El Niño–Southern Oscillation (ENSO) and temperature variability. Chowdhury & Khan, (2015) conducted a study in Bangladesh on the impact of climate change on rice yield, the study revealed that maximum temperature is statistically significant and negatively affect the yield of all three rice crops.

The effect of climate change is becoming more pronounced and more frequent, Bade is an area in the semi-arid region of Yobe State, an area with high temperature, less rainfall, extreme heat wave, high evaporation, flooding and evapotranspiration. In this area deforestation and emission of greenhouse gasses are high due to high population. Rapid population growth, clearing of land for rice cultivation and demand for food (rice) forces many people to engage in different farming system such as rice production, these farmers are face with different problems and most of these problems are climate related. Since many people/farmers in the study area (Bade) are engage in Rice production there is need for good information and knowledge of climate and climate variability to help farmers make a good planning and decision. Its reasons mention above that makes the researcher develop interest in the topic of the study. ‘’***assessment of Impacts of climate change on Rice production in Bade Local Government Area of Yobe State, Nigeria’’***

Aim and Objectives Of The Study

The objectives of this study were:

i. To examine the causes of climate change in Bade Local Government Area of Yobe State.
ii. To assess the impact temperature on Rice production in Bade Local Government Area of Yobe State.
iii. To assess the impact of rainfall on Rice production in Bade Local Government Area of Yobe State.
iv. To examine the effects of climate change on rice production in Bade Local Government Area of Yobe State.

Research Questions

The research questions are in line with the objectives:

i. What are the causes of climate change in Bade Local Government Area of Yobe State?
ii. In what ways does temperature has an impact on Rice production in Bade Local Government Area of Yobe State.
iii. In what ways does rainfall has an impact on Rice production in Bade Local Government Area of Yobe State.
iv. To examine the effects of climate change on rice production in Bade Local Government Area of Yobe State.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

This study will look at a theory called Anthropogenic Global Warming theory (AGW) which is a theory of climate change contends or propose that human emissions of greenhouse gases, principally carbon dioxide (CO2), methane, and nitrous oxide, are causing a catastrophic rise in global temperatures. The theory added that certain gases in the atmosphere, called “greenhouse gases,” absorb the internal thermal radiation, resulting in Earth’s atmosphere becoming warmer than it otherwise might be (Bast, 2013). Proponents of the AGW theory believe man-made CO2 is responsible for floods, droughts, severe weather, crop failures, species extinctions, spread of diseases, ocean coral bleaching, famines, and literally hundreds of other catastrophes. All these disasters will become more frequent and more severe as temperatures continue to rise, they say. Nothing less than large and rapid reductions in human emissions will save the planet from these catastrophic events (Bast, 2013). Based on the above theory it show that climate fluctuation and change have an impacts on agriculture which may lead to crops failure as

proponent by the theory, another issues proponent by the theory are floods, droughts, severe weather, species extinctions, spread of diseases which will have a devastating impacts on agriculture and rice production as proving by Ayinde et al., (2013) drought and flood already cause widespread rice yield losses across the globe and the expected increase in drought and flood occurrence due to climate change and variability would further add to rice production losses in the future.

Mahdu, (2019) conducted a research on the Impacts of Climate Change on Rice Production and Small Farmers' Adaptation in Guyana Virginia USA, the study used secondary data of Average annual rainfall and temperature data for Guyana and its obtained from the Climate Research Unit (CRU) country dataset, the study used descriptive statistics, a simple trend model, and a two-sample t-test for the analysis whereas the study revealed that analysis of farm-level data provides strong evidence of shifts in rainfall patterns and Changes in precipitation have included an increase in intensity and out of season rainfall, which has impacted harvesting due to poor dams, wet fields, and the lodging of plants so as also Changes in temperature have resulted in hotter days, accelerating the evaporation of water from fields. In response, farmers replenish water in their fields, when available. The study also finds out that Excess rainfall and resulting Flooding, drought, and heavy winds have been the primary extreme weather events observed. The primary change in insects and pests reported by farmers has been an increase in paddy bug infestations, which cause damage to the grains resulting in lower quality and quantity at harvest.

Sekhar, (2018) conducted a study to analyses rice economy in Asia in the context of climate change. The study adopted secondary data and General Circulation Models which include; Geophysical Fluid Dynamics Laboratory (GFDL), Goddard Institute for Space Studies (GISS) and United Kingdom Meteorological Office (UKMO), were used to simulate the effect of climate change on rice production in various countries in respect of economy. The study find out that Climate change impacts manifest in gradual yield declines (long-term) and sudden floods and storms (short-term). A two-pronged strategy is needed to cope with this new reality and also the study suggest that Asian countries – both importing and exporting- have intensified efforts to attain self-sufficiency through domestic production in recent years, particularly after the world food crisis in 2008. This is because of the perceived non- reliability of international market for sourcing supplies during emergencies. Therefore, there is a greater need for dovetailing trade policies in the region and refrain from disruptive policies such as sudden export bans.

Chowdhury, & Khan, (2015) conducted a study on the impact of climate change on rice yield in Bangladesh, the study used Empirical Model Specification and also a multiple regression analysis using OLS method is employed to assess the climate-crop yield interrelations on the basis of country level time series data for the period 1972-2014. The study finds out that all the climate variables have had significant impact on rice yield over the period under study and also research revealed that maximum temperature is statistically significant and negatively affect the yield of all three rice crops. Rainfall is found significant for all rice yields with positive effects on Aus rice and Aman rice and adverse effects on Boro rice.

Earth's climate is driven by the amount of solar energy that is absorbed at the surface. Increased concentrations of greenhouse gases, primarily carbon dioxide, methane, and nitrous oxide in the atmosphere absorb the outgoing energy radiated by the surface, resulting in Earth's atmosphere becoming warmer (Mahdu, (2019). Rice is the basic staple food for about one-half of the world's population and provides over 20 percent of the global calorie intake. Asia accounts for more than 80 percent of global rice production and 75 percent of global consumption, and 70 percent of exports (FAO, 2017 as cited in Sekhar, (2018)). Mahdu, (2019) believed that agricultural sector is perhaps the most vulnerable to a constantly changing climate and this is because climate is a key determinant of agricultural output given that outdoor production practices depend heavily on particular levels of temperature and precipitation. Climate change also causes variation in precipitation in terms of the timing, quantity, intensity, and distribution (Simpson 2016 as cited in Mahdu, (2019)). No rainfall causes water deficits, which reduces soil moisture. This may cause farmers to abandon planting the crop altogether, crop failure, or low yields due to water deficiency (Mahdu, 2019).

METHODOLOGY AND STUDY AREA

This chapter gives the methodological approach of the study. This includes location and extent, climate, vegetation and soil, drainage, agriculture and other human activities, research design, sources of data, methods of data analysis, sampling techniques, and method of data collection.

STUDY AREA

Location and Extent

Bade Local Government Areas of Yobe State, Nigeria, has it headquarter at Gashua town. Bade is located on Coordinates: 12°28′2″ N, 12°52′5″ N and 10°35′3″ E, 11°2′47″E (Dauda, John & Bukola, 2018). Bade covers a land area of 772km^2 and with a population of 139,782 base on the census 2006 (National Population Commission, 2006 as cited in Oladimeji, 2014). There are 10 political wards under Bade L G A; these are Sugum/Tagali, Dagona, Sarkin Hausawa, Lawan Fannami, Zango, Katuzu, Lawan Musa, Gwio-Kura, Usur/Dawayo and Sabon Gari wards (Alhassan et al., 2018).

Climate

The Bade climatic condition is characterized by two distinct seasons; dry and wet seasons and the atmospheric temperature ranges between 39^{o}C and 42^{o}C with average annual rainfall of 500mm1000mm (NEAZDP, 2011 as cited in Oladimeji, 2014). The hottest months are March and April with temperature ranges of 38^o-40^{o}C and the months of June to September are characterized with average rainfall of between 500 mm to 1000 mm and temperature of 23^o -28^{o}C. (Dauda, John & Bukola, 2018)

Vegetation and Soil

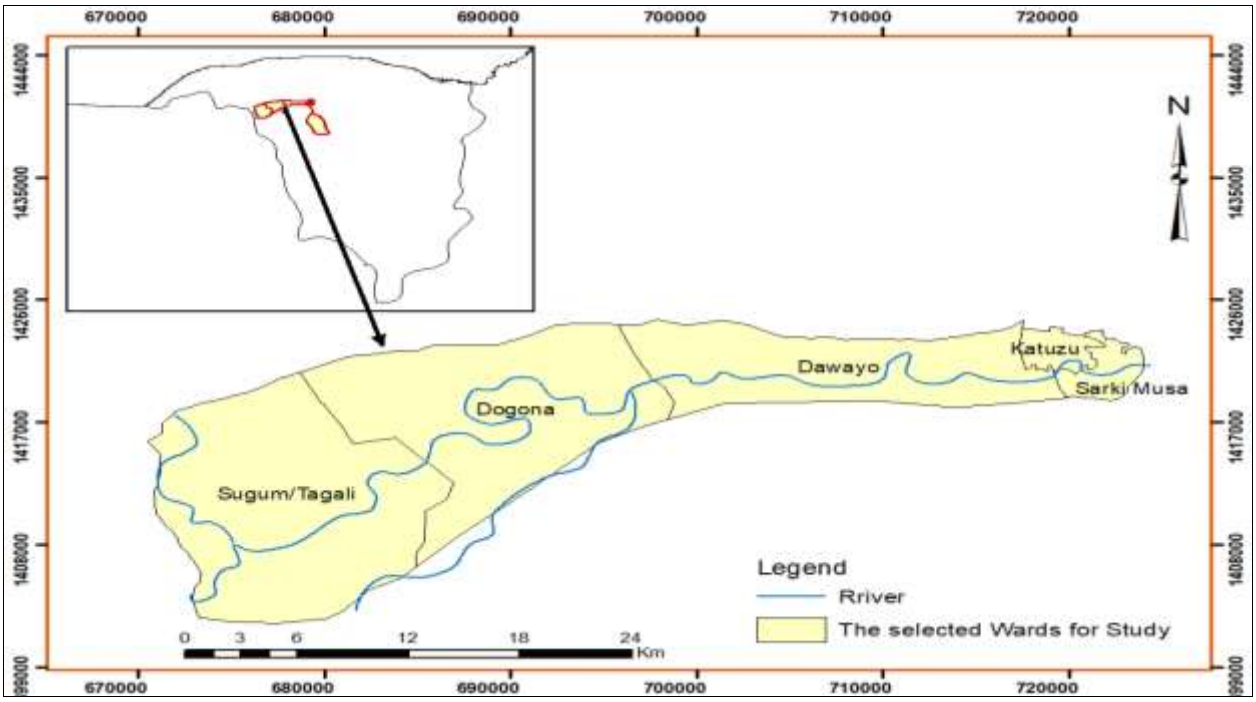
Bade Local Government Areas is located in the Sahel savannah with semi-arid conditions (Oladimeji, 2014). The major vegetation type of Bade is the Sahel savannah and consists of open thorny savannah with short trees and grasses. The trees are about 5 to 10 m high (Alhassan et al., 2018). Alhassan et al. (2018) in their study showed that the soils of Bade LGA are Sandy loam, high in bulk density, low porosity, and weak structure and very low in organic matter content.

Drainage

Bade is located along river Yobe and its tributaries, in the north western part of the state (Daniel, (n.d)). Bade is well drained area which comprises of marshy areas along the River basin, and a few miles west of the confluence zone of the Hadejia and Jama'are Rivers which flows in the area. The Hadejia-Jama'are-Komadugu Yobe River system take it origin from north central highland of Nigeria flows down in north-east direction and cover about 9% of the Nigeria's land area. It has catchment area of about 85,000 square kilometers with three main tributaries. The Jama'are River joins the Hadejia River near Gashua specifically Karege to form the Hadejia-Jama'are while the Komadugu Gana joins the Hadejia-Jama'are near Geidam to form the Komadugu Yobe River Basin (North East Arid Zone Development Programme, 1992).

Agriculture and other human activities

Agriculture is the major occupation of the local population who are engaged in crop production during both rainy and dry season (Oladimeji, 2014). Fishing is one of the most important human activities after farming in the area and Fishing festivals are performed yearly in every village along the river. The famous one in which the Emir of Bade use to attend was the 'Kadiran' at Duwagaru (Daniel, (n.d)).



Sources: GIS Lab. (2020), Department of Geography, Yobe State University
Fig. 1 Map of the Study Area Showing the political Selected Wards

METHODOLOGY

The following methodology was applied so as to help us achieve the above mention objectives of the study.

Research Design

The study will adopt survey research design so as to achieve the objectives of the study. The survey research design will help the study to obtain vast and accurate data/information on the topic under study so as to draw a final conclusion.

Sources Of Data

The data for this study will be obtained from both primary and secondary sources. The primary data will be collected from rice farmers using questionnaire method and Focus Group Discussion which will help the study to achieve its objectives; farmer's awareness and perception on climate change, nature of rice production, causes of climate change, and impacts of climate variability on rice production at the study area. In trying to collect data using FGD, a single group will be created in each of the six (6) wards selected for the study in which the groups will be monitors and organize by a moderator and assistant moderator (justification)

Techniques of Data Analysis

The data obtain on farmer's awareness and perception on climate change, nature of rice production, causes of climate variability, and impacts of climate variables (temperature and rainfall) on rice production will be analyze using SPSS for computation and analysis of data using descriptive and inferential statistical analysis. While the secondary data obtained on trend of climate variability will be analyzed using GIS system (ArcMap 10.4.1) which will be guided by the research objectives.

Sample Frame And Techniques

This research will apply purposive sampling techniques in which six (6) wards out of ten (10) wards are going to be selected because it's not all the wards in the study area that are involve in rice production. From the known population of rice farmers in six ward in Bade local government area of Yobe state as 3721, Yamane's method was used in calculating a sample size at 95% confidence level as shown in equation 3.1: A sample size of 399 rice farmers were selected using confidence level of 95% from the

total population of 3721from the six wards of the study area. The number of rice farmers from a particular ward will be selected using systematic sampling at the interval of five (5), 399 questionnaires will be distributed to 6 wards selected where by the number of questionnaires to be distribute in each ward selected will be based on number of rice farmers at the particular ward. 77 questionnaires will be distributed in Zango ward, 57 in Katuzu ward, and 67 in Sarkin Hausawa ward, while 67 questionnaires will be distributed in Sugum/Tagali ward, and also 70 questionnaires will be distributed in Usur Dawayo ward and 61 in Dagona ward.

Table 2: Population Sample

S/No.	Wards	No. Of Rice Farmers	Percentage	Sample size
1.	Zango	**722**	**19.4%**	**77**
2.	Katuzu	**528**	**14.3%**	**57**
3.	Sarkin Hausawa	**622**	**16.7%**	**67**
4.	Dagona	**573**	**15.3%**	**61**
5.	Sugum/Tagali	**624**	**16.8%**	**67**
6.	Usur/Dawayo	**652**	**17.5%**	**70**
Total	**6**	**3721**	**100%**	**399**

Sources: RIFAN, 2019

Method Of Data Collection

Different methods of data collection will be use which includes: Questionnaire and Focus Group Discussion which will help the study to achieve its objectives; farmer's awareness and perception on climate change, nature of rice production, causes of climate variability, and impacts of climate change on rice production. GIS method (ArcMap 10.4.1) will also be used in collecting record of satellite maps that will explain the trend of climate variability.

RESULTS AND DISCUSSION

This chapter presents and discusses the results of data analyses based on collected data in the study. The presentation and discussions were guided by the objectives of the study as well as the responses from the field. Results are displayed with the use of tables and figures according to the objectives of the study.

Socio-Economic Characteristics Of The Farmers

Findings of socio-economic characteristics play a prominent role in sampled wards, the study revealed the location of rice farms across the geo-political ward in Bade LGA. The findings from table 1 revealed that majority of rice farms are located in Usur Dawayo ward of Bade LGA with 37.3%, while Sarkin Hausawa ward had the least rice farmers with 4.1%, this may be attributed to the nature of the soil and water availability in these areas. The study shows that 87.7% of the respondents were male only 12.3% are female and it may be attributed to the culture and family hierarchy in the study area. Majority of the respondents 83% were married while the figures for widowed and divorced were generally very low across the study area. The educational status of the farmers revealed that 75.5% had tertiary education, while 10.9% had secondary education, 4.1% had primary education and 8.2% had informal education.

Given the age profile of the respondents across the study area, it could be seen that 9% of the respondents are less than 29 years of age and 91% are above 29 years of age. These indicate that about 91% of the respondents were at their productive age. The study added that majority of the respondents are full-time farmers 82.3%, while only 15% out of the total respondents that are not full-time farmers. The farming system engage in the study area, out of the total respondents 61.3% are engage in mixed farming, while 30.5% engage in irrigated farming, 4.1% engage in rain-fed farming and 2.7% engage in both irrigated

and rain-fed farming. The primary occupation of the respondents, out of which 41.4% are engage civil servant, 45% engage in farming, 30 8.2% engage in business, and 4.1% are privately employed. The study revealed that majority of the farmers had about 10 years of faming experience, this shows that majority of the respondents are experience farmers.

Table 1: Socio-Economic Characteristics of the Farmers

Rice farmers location	**Frequency**	**Percent %**
Sarkin Hausawa	17	4.1
Zango	39	9.5
Katuzu	82	19.1
Usur Dawayo	137	37.3
Dagona	63	13.6
Sugum/Tagali	61	16.3
Total	399	100.0
Gender of Respondents		
Male	349	87.7
Female	50	12.3
Total	399	100
Marital Status		
Married	335	83.7
Single	44	10.9
Divorced	13	2.7
Widower	7	1.4
Total	399	100
Educational level		
Informal Education	36	8.2
Primary school	17	4.1
Secondary school	46	10.9
Tertiary	300	75.5
Total	399	100
Age		
19-28	39	9.5
29 and above	360	90.5
Total	399	100
Are you a full-time farmer		
Yes	329	82.3
No	70	15.0
Total	399	100
Which type of farming do you do		
Irrigated farming	121	30.5
Rain-feed farming	17	4.1
Mixed farming	251	61.3
Irrigated and Rain-feed	10	2.7
Total	399	100
Occupation		
Civil servant	167	41.4
Farming	180	45.0
Business	35	8.2
Privately employed	17	4.1
Total	399	100.0
Years of farming experience		
1.00 to 10.00	194	48.6
11. 00 to 20.00	122	30.5
21.00 and above	83	20.8
Total	399	100.0

Source: Field work, 2022

Causes Of Climate Change In Bade Local Government Area Of Yobe State

Table 2 revealed that 85.8% had about climate change while, 10.9% did not had about climate change and 1.4% they don't know. The findings revealed that the majority of the farmers had about climate change. During the focus group discussion sessions, it was indicated that about 80% of the farmers are aware of climate fluctuation, and the climate change is a product of Nature some said Human activities such as bush burning and cutting down of trees. Some of the farmers narrated a story that, in the year 2019 there is an early rainy season with high amount of rainfall and low temperature, in the year 2020 the weather is a little bit normal with lead high rice yield but in the year 2021 its seen clearly that the rainy season came very late and doesn't last long which lead to reduce in rice yield and economic problems that rain-fed farmers have to buy generator and fuel to help the rice matured. Based on the above findings, it was clearly indicated that there is climate change at the study area.

Table 2: Awareness of Climate Change

		Frequency	Valid Percent	Cumulative Percent
Valid	Yes	351	87.9	87.9
	No	42	11.1	98.6
	I don't know	6	1.4	100.0
	Total	399	100.0	

Source: Field work, 2022

Table 3: revealed the view of the respondents with regard to the causes of climate change in the study area, 62.7% are of the view that human activities such as deforestation, burning of fossil fuels, construction of houses and agriculture are the cause of climate change in the study area while 31.1% are of the view that nature is the main causes of climate change in the study area and 4.1% they don't know what causes climate change in the study area. The findings revealed that the majority of the respondents are of the view that human activities are the major cause of climate change in the study area.

Table 3: Causes of Climate Change

		Frequency	Valid Percent	Cumulative Percent
Valid	Human activities	255	64.1	64.1
	Nature	127	31.8	95.9
	I don't know	17	4.1	100.0
	Total	399	100.0	

Source: Field work, 2022

Impact Temperature And Rainfall On Rice Production In Bade Local Government Area Of Yobe State

Table 4.4 reveals the problems faced during rice production season, the findings from the table revealed that 8.2% believed that insufficient underground water for irrigation and fluctuation of rainfall for rainfed farming is their problem, 21.8% indicates flooding as a problem that affect rice production, 16.3% believed high intensity of sun is their problem which in turn affects the nature of watering rice plants at the irrigated rice farm, 1.4% indicates shortage of rainfall as the problem for rainfed farming, 9.5% shows strong wind storms as the problem which damages rice crops, 5.4% said metrological drought during

farming is problem face by rice farms. The findings revealed that the problems faces by rice farmers are flooding, strong wind storms, insufficient underground water for irrigation and fluctuation of rainfall for rainfed and high intensity of sun. Lansigan, Santos & Coladilla, (2019) supported the above findings that Weather and climate have a direct influence on cropping systems and plant yield. Whether fluctuations and climate variability play a significant role in crop growth and yield, thus, weather fluctuations and climate variability play a significant role in crop growth and yield. According to Verburg *et al.* (2009), the increased risk of seasonal droughts and limited access to water resources will negatively affect rice production.

Table 4.4: What Are the Problems You Face During Your Rice Production Season?

		Frequency	Valid Percent	Cumulative Percent
Valid	No availability of water	89	22.3	22.3
	Water flooding	102	25.5	25.5
	High intensity of sun	68	17.0	17.0
	Shortage of rainfall	37	9.2	9.2
	Lack of finance	10	2.2	2.2
	Problem of wind storms	31	7.7	7.7
	Drought during farming	28	7.1	7.1
	Materials are too expensive	17	4.2	4.2
	Total	399	100.0	100.0

Source: Field work, 2022

Table 4.5 revealed that 95.4% of the respondents revealed that temperature and rainfall fluctuation affects rice production in rice farm while only 2.7% said temperature fluctuation is not affecting their rice farm. The findings revealed that the majority of the respondents said temperature fluctuation affects their rice production in rice farm as it result into stunted in growth of the rice plant and the plants take a long period of time to produce.

Table 4.5: Does Temperature (Change) Fluctuation Affects Rice Production in Rice Farm and Productions

		Frequency	Valid Percent	Cumulative Percent
Valid	Yes	388	97.2	97.2
	No	11	2.8	100.0
	Total	399	100.0	

Source: Field work, 2022

Table 4.6: revealed whether rainfall fluctuation affects rice production in irrigated rice farm, 64.6% revealed rainfall fluctuation affects rice production rice farm, 35.4% of the farmers said rainfall fluctuation is not affecting their rice production in rice farm. The findings revealed that the majority of the respondents said that rainfall fluctuation affects their rice production in rice farm as it may lead to low yield and persistent crop failure.

Table 4.6: Does Rainfall Fluctuation Affects Rice Production in Rice Farm and Production

		Frequency	Valid Percent	Cumulative Percent
Valid	Yes	258	64.6	64.6
	No	141	35.4	100.0
	Total	399	100.0	

Source: Field work, 2022

Table 4.7: revealed whether there is an occurrence of the climate change extreme events (flooding, meteorological drought and high intensity of sun) in the study area or not, 73.6% believed that there is an occurrence of the climate change extreme events in the area while only 21.8% believed that there is no occurrence of the climate change extreme events and 3.3% said they don't know whether there is occurrence of the climate change extreme events in their area or not. The findings revealed that the majority of the respondents said there is an occurrence of the climate change extreme events in their area mostly flooding which use to occur frequently.

Table 4.7: Occurrence of the Climate Variability Extreme Events in Rice Farm

		Frequency	Valid Percent	Cumulative Percent
Valid	Yes	298	74.6	74.6
	No	89	22.1	96.7
	I don't know	12	3.3	100.0
	Total	399	100.0	

Source: Field work, 2022

Table 4.8: indicate whether climate change will lower rice production or not, 38.1% out of the total respondents ranked whether climate change will lower rice production as higher, 35.4% ranked it as moderate and 26.4% rank it as low. The findings from the table revealed that the majority of the respondents ranked whether climate will lower rice production as higher, also from both table 4.37and table 4.38, the respondents ranked the effect of climate change on the yield of rice production as higher, meaning climate will boost rice production and climate change will lower rice production.

Table 4.8: Climate Variability Will Lower Rice Production

		Frequency	Valid Percent	Cumulative Percent
Valid	Higher	152	38.1	38.1
	Moderate	140	35.4	73.6
	Low	107	26.4	100.0
	Total	399	100.0	

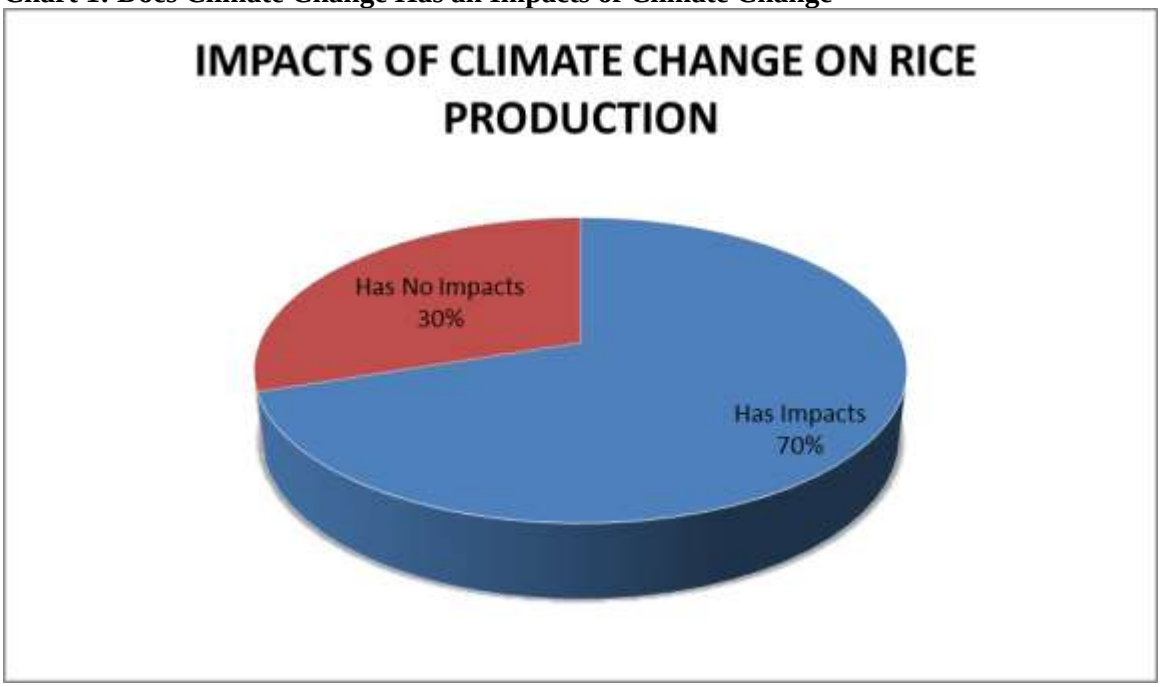
Source: Field work, 2022

Effects Of Climate Change On Rice Production In Bade Local Government Area Of Yobe State

The below chart show the impacts of climate change on rice production, the chart indicate that 70% of the rice farmers believed that climate change has an impacts of rice production only 30% of the rice farmers believed that climate change has no any impacts on rice production. The findings can be supported by

Lansigan, Santos & Coladilla, (2019) which believed that Weather and climate have a direct influence on cropping systems and plant yield. Whether fluctuations and climate variability play a significant role in crop growth and yield, thus, weather fluctuations and climate variability play a significant role in crop growth and yield.

Chart 1: Does Climate Change Has an Impacts of Climate Change



DISCUSSION OF RESULTS

The study focused on climate change and its impacts on rice production in Bade Local Government Area of Yobe State, The study findings indicated that across the geo-political wards, 87.7% of the respondents were male while only 12.3% are female and this indicate that male engage more in rice farming than female in the study area, this may be attributed to the cultural household hierarchy in the study area.

The findings indicated that majority of the respondents are full-time farmers and engaged in mixed farming and had about 10 years of faming experience; this shows that majority of the respondents are experience farmers and also know what weather and climate is, this may be attributed to their long time experience in farming activities, also are aware of weather and climate fluctuation in the area. The focus group discussion indicated that about 80% of the respondents are aware of climate fluctuation, and believed that climate variability is a product of Nature. Some of the respondents believed human activities such as bush burning and cutting down of trees are the factors responsible for climate variability and in turn affecting rice farming in the area. Some of the farmers narrated a story that, in the year 2019 there is an early rainy season with high amount of rainfall and low temperature, in the year 2020 the weather is a little bit normal which lead to high rice yield, but in the year 2021 rainy season came very late and doesn't last long which lead to reduction in rice yield and economic problems that rain-fed farmers have to buy generator and fuel to help the rice matured. Based on the above findings, it was clearly indicated that there is climate fluctuation at the study area and the farmers are aware of it. The findings revealed that the major kind of climate variability in the study area is rainfall variability. Mahdu & Mills, (2019) in their studies found out that excess rainfall leads to flooding which damages rice resulting in lower quality and quantity of rice at harvest. The findings revealed that the majority of the respondents are with the view that human activities are the major cause of climate variability. It is well recognized that climate

variability has a wide range of direct and indirect impacts on crop production (Lansigan, Santos & Coladilla, 2019). Climate variability already has substantial impacts on biological systems and the smallholders, communities, and countries that depend on them (Thornton et al., 2014).

The findings revealed that temperature fluctuation affects rice production in the irrigated and paddy rice farm and also rainfall fluctuation affects rice production in both irrigated and rain-fed rice farm. The finding revealed that majority of the respondents indicates that there is an occurrence of the climate variability extreme events in the study area. Flooding and meteorological drought are the main climate variability extreme events affecting the rice farm and rice production, the study also ranked the risk of climate variability on rice production as higher. Weather and climate have a direct influence on cropping systems and plant yield. Whether fluctuations and climate variability play a significant role in crop growth and yield, thus, weather fluctuations and climate variability play a significant role in crop growth and yield (Lansigan, Santos & Coladilla, 2019). The findings revealed that the majority of the respondents' rank continues rise in annual temperature reduces rice production as low and ranked annual rainfall not supporting rice production as before as moderate. It is well recognized that climate variability has a wide range of direct and indirect impacts on crop production (Lansigan, Santos & Coladilla, 2019). Climate variability already has substantial impacts on biological systems and the smallholders, communities, and countries that depend on them (Thornton et al., 2014).

CONCLUSION

The change in the global climate or climate change will undoubtedly influence the future food security by exerting pressure on agriculture in which rice production is included and water resources, which presents a significant challenge to society(Yang, Xiao & Zhao, 2018).Climate change has led to a lot of devastating consequences and effects in various parts of Nigeria which include flooding, deforestation, desertification, erosion, drought, sea-level rise, heat stress, pests, diseases and erratic rainfall patterns, and (Ayinde, 2014). It's in line of such the study concluded that majority of the farmers are full-time farmers and are engage mixed farming. The study concluded that the majority of the rice farmers know what weather and climates is and heard about climate change and also are aware of weather and climate change in the study area; this may be attributed to their long time experience in farming activities. The study indicates that the major kind of climate variability in the study area is rainfall variability and human activities are the major cause of climate variability in the study area.

The study also concluded that there is an occurrence of the climate variability extreme events in their area, flooding is the climate variability extreme events affecting their rice farm and ranked the risk of climate variation on rice production as higher and also ranked the risk of climate variation than benefits on rice production as moderate. The study added that the majority of the rice farmers ranked continue rise in annual temperature reduces rice production as low, also ranked annual yearly rains are not supporting rice production as before as moderate and ranked poor germination rate of rice due to climate variation as higher, meaning climate variation is playing a vital role in rice germination process and also ranked climate variation will lower rice production as higher, and also effect of climate variation on the yield of rice production as higher, meaning climate will boost rice production and climate variation will lower rice production.

RECOMMENDATIONS

In the light of the problems associated with impacts of climate change on rice production as revealed in this study; it therefore recommends that:

1. As climate variability and change is becoming more frequent, it will be good if rice farmers are given updates on climate and weather forecast in local languages so that rice farmers can make wise decision for the coming seasons.
2. Government should help rice farmers and provide them with short seasoned and improve variety of rice that are suitable to the climate of the area.

3. Training, seminars and workshops should be organizing from time to time to build the capacity of rice farmers to adopt the use of farming calendar based on NIMET, NIHSA advice for better yield.

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