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Determination of Farmers' Perception on the Influence of Seasonal Variations for Augmenting Agricultural Activities in Extreme Northern Nigeria

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ABSTRACT
This study determines impacts of seasonal variations for augmenting farmers' agricultural activities in extreme Northern Nigeria. The data were mainly derived from several sources including maps of Nigeria and the selected States, population figures from records of the National Population Commission and from internet and library sources, as well as from questionnaire survey of farmers' opinion. Stepwise sampling technique was employed in the selection of respondents for the questionnaire survey. Simple descriptive statistics, Analysis of Variance (ANOVA) and Chi-square test were used in analysing the variations within and between states in the influence of seasonal variations on agricultural activities, on one hand, and testing association between influence of seasonal variations and agricultural activities, on the other. It was concluded that 91% of agricultural activities are influenced by seasonal variations in the extremeNorthern Nigeria, to the extent that the association between the influences and agricultural activities ($\chi 2 = 15.47$), explained with no variations (F-value = 0.008), indicated influences on farmers' socio-economic status, market value and water availability. It was recommended among others that Governments and Non-Governmental Organizations (NGOs) should support and motivate farmers by enhancing their welfare, job security improvement and adequate supply of equipment and materials.

Key words: Perception, Seasonal Variations and Agricultural Activities.

I. INTRODUCTION

The growth of human population coupled with increased economic activities and increased consumption of goods and services in towns and cities can focus our minds on understanding the relevance of seasonal variations on peoples' daily economic activities. For instance, temperatures are usually high in the summer due to higher insolation and low in winter due to lower insolation. Equally, days are usually longer in summer and shorter during winter. These seasonal changes are widely experienced all over the globe as they originate from the regular orbit around the sun (Iwena, 2007).

One of the Bottom–up theories of perception pointed out by Démuth (2017)showed that the content and quality of sensory input play a determinative role in influencing the final percept. Sensory input, in their view, represents the cornerstone of cognition and by its own nature it determines further sensory data processing. For example, when perceiving a tree, our sensors collect the basic data (such as points, horizontal or vertical lines) as the main individual characteristics of the object which are later connected to build more complex, assembled surfaces and shapes in order to create complex perception of the object we identify as a tree. Therefore we can call this data-driven processing perception. With respect to the emphasis, these theories put on the nature of sensory input, it is not surprising that most of them significantly correlate with philosophical realism, which suggests that our precepts are directly induced by external objects and more or less correspond to them.

Patterns of impact of climate change on agriculture were classified by Khanal (2009) into biophysical and socioeconomic impact. The biophysical impacts include; physiological effects on crop and livestock, change in land, soil and water resources, increased weed and pest challenges, shifts in spatial and temporal distribution of impacts, sea level rise and changes to ocean salinity and sea temperature rise causing

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fish to inhabit in different ranges. The socioeconomic impacts result in decline in yield and production, reduced marginal GDP from agriculture, fluctuation in world market price, changes in geographical distribution of trade regime, increased number of people at risk of hunger and food insecurity, migration and civil unrest. Adaptation measures to climate change involve living with the climate change itself. For example agroforestry, conservation agriculture, inter-cropping, biodiversity and collection of rainwater for agricultural use referred to as rain water harvesting. This process is particularly important in the arid and semi-arid Northern Nigeria.

The Northern Nigeria is characterized by rainy and dry seasons as the two major distinct seasons. The former usually occur between May to September whereas the latter between October to April (Iwena, 2007). For instance, Agricultural activities comprising livestock and crop production are some of the most important economic activities in the study area. Northern Nigeria is an agricultural region with vast fertile soils as an added advantage for agricultural production. Agriculture might therefore, contribute greater percentage of the peoples' income in the region.

The scientific knowledge on the impact of seasonal change is increasing all the time, as are practical experiences in responding to adaptation needs. This knowledge needs to be exploited. It is well known in Northern Nigeria, like in the other regions of the world, that seasonal changes have resulted in several pervasive effects to people economic activities. The rainy season is meant for the planting and weeding while the dry season is a period for harvesting and trading. Farmers are conditioned to adapt their activities to seasons. The question now is: what influence do seasonal variations have on agricultural activities in extremeNorthern Nigeria?Why is it that when rainfall starts earlier than expected after the dry season, farmers are sometime obliged to plant earlier? Is it not proper if farmers' level of awareness will be used to determine the scope of implementation that needs to be taken to tackle the problems of seasonal variations? It is therefore important to know the influence of seasonal variations on the agricultural activities.

Despite the relevance of agriculture as an occupation and source of food supply in the study area, it might however, be envisaged that the seasonal variations can impact on this great economic activity, hence the need for determining farmers' perception on the influence of seasonal variations for augmenting agricultural activities in the extremeNorthern Nigeria, with the view of creating more awareness on climatic influence towards achieving profitable agricultural productivity.

The Study Area

Northern Nigeria is located between Longitudes 3º and 15º east of Greenwich Meridian and Latitudes 9º and 14º north of the Equator. The extreme Northern Nigeria can be described as all the states that are fully located in the far Northern portion of the Country. The States located in this zone are Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe – in the North East and Jigawa, Kano, Kaduna, Katsina, Kebbi, Sokoto and Zamfara – in North West (Fig. 1).

The climate of the region is characterized by alternate wet and dry seasons in response to the changes in pressure patterns, the rainy season in this region is associated with late onset and earlier cessation, the onset and cessation are also characterized by destructive storms which destroy lives and property (Abdulkadiret al., 2013). Further to that, the seasonal and latitudinal variations affect diurnal and seasonal temperature ranges. Also, in areas north of latitude 9º within Northern Nigeria, maximum and minimum air temperatures recorded mainly occur between March/April and between December/January, respectively.

The general relief of this belt is between 300m to 900m, except the Niger-Benue trough, Sokoto and Chad Basins that are below 300m. Extreme Northern Nigeria is dominated by savanna vegetation types; Guinea, Sudan and Sahel savanna, the density of trees and grasses decrease northwards responding to climatic conditions. Agriculture is the most dominant economic activity in the region.

Review of Related Literature

Climate change may impact on alteration in evapotranspiration, photosynthesis and biomass production and land suitability for agricultural production. For instance, Third Worldcountries, particularly Africa are threatened by the predicted effects of climate change

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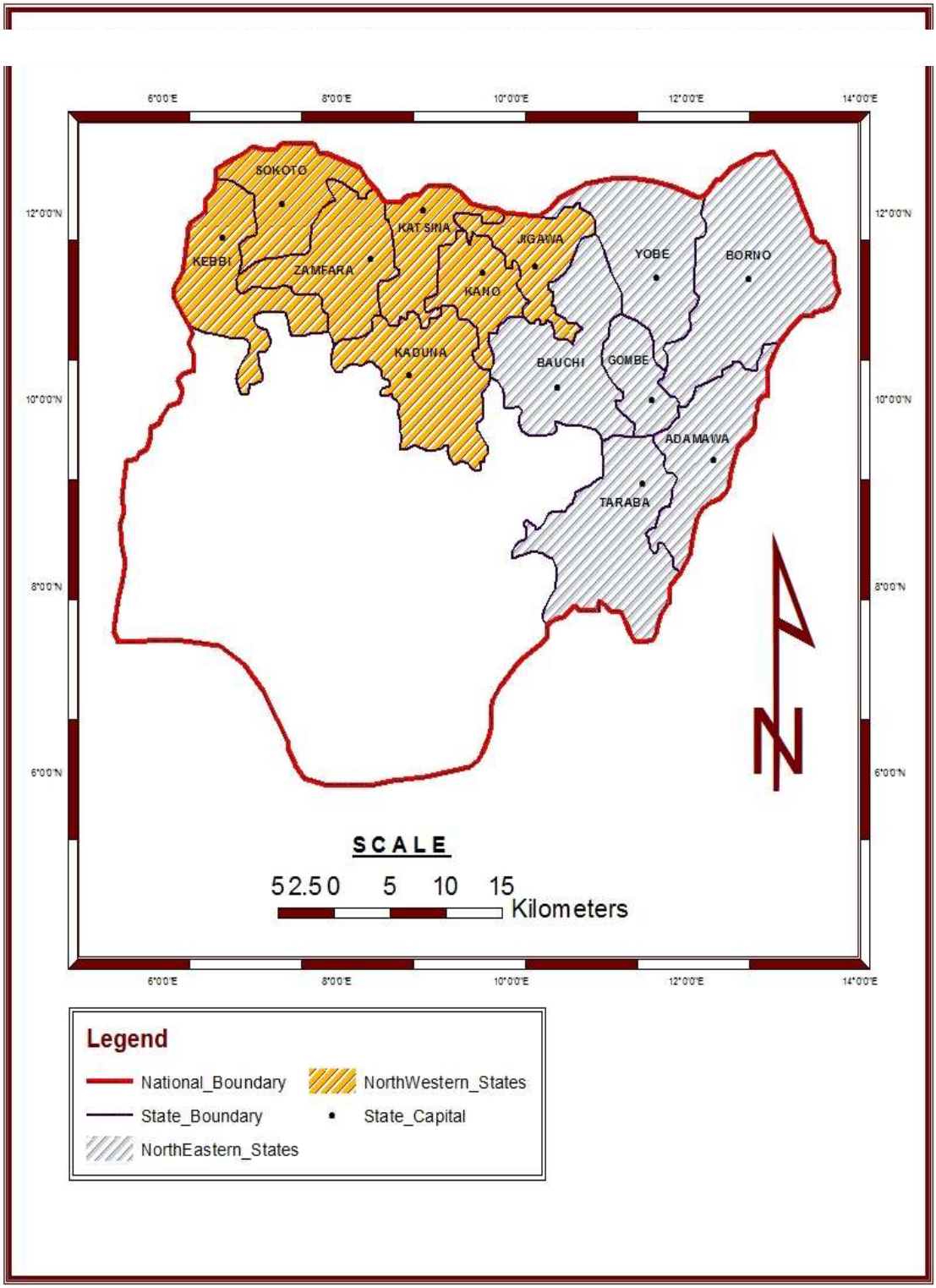

Figure 1: Location of the Study Area

because of their economic dependence on climate for development whose backbone is agriculture (Khaoma and Ngaira, 2007). The effects of climate change may include: reduced agricultural land use due to submergence of coastal regions and increased aridity in the tropical high agricultural potential regions, there will be increased incidences of farm pests and diseases,

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over cultivation, food insecurity and poverty especially in tropical regions. Africa will face serious challenges in her endeavour to adapt to new mechanisms of food production for sustainable development.

Mark et al., (2008) highlighted some of the direct impacts of climate change on agricultural system as:a) seasonal changes in rainfall and temperature, which could impact agro-climatic conditions, altering growing seasons, planting and harvesting calendars, water availability, pest, weed and disease populations;b) Alteration in evapotranspiration, photosynthesis and biomass production; and c) Alteration in land suitability for agricultural production.Some of the induced changes are expected to be abrupt, while others involve gradual shifts in temperature, vegetation cover and species distributions. However, when looking critically on plant production, the pattern of climate change has both positive and negative impacts. Rises in temperature for example helps to grow crops in high altitude areas and towards the poles. In these areas, increases in temperature extend the length of the potential growing season, allowing earlier planting, early harvesting and opening the possibility of completing two crop cycles in the same season. The warmer conditions support the process of natural decomposition of organic matter and contribute to the nutrient uptake mechanisms. The process of nitrogen fixation, associated with greater root development is also predicted to increase in warmer conditions and with higher CO_2, if soil moisture is not limiting (F.A.O., 2007).

While suitable adaptation strategies for vulnerable populations to cope with climatic impacts and increasing their resilience have been established as a priority, it has been distinguished from development, and many funding agencies have specified that funding is to be used for adaptations that specifically address climatic impacts (Patterson et al., 2016) . Critics of this approach have highlighted the fact that current poor health and poverty are the largest contributors to sensitivity to climate impacts. This highlight indicated the role social factors play in mediating seasonal impacts on environment and support calls to treat climate associations with health outcomes as non-stationary and mediated by social sensitivity.

Climate and management can affect the incidence of insect, pests and diseases, which in turn have an influence on crop yields and quality of produce and producer's costs and returns. In this regard, Ayanladeet al., (2018) observed significant relationship between the length of farming experiences and farmers' perceptions of climate change adaptation techniques. The researchers pointed out that water-related (about 53%) and nutrient related (about 52%) technologies appear to have a high preference among the farmers. The major driver that determines farmers' preference for climate change adaptation techniques is their incomes and experiences.Temperature and water supply also vary over the long-term, including response to climate change, with major implication for crop yield. This was exemplified by the recent climatic condition of 8th June, pointed out by Nigeria Meteorological Agency (NiMet) (Daily Trust, 2021), that severe dry spell will hit Northern states, especially the states of Sokoto, Zamfara, Yobe, Kebbi, Katsina, Niger and some parts of Borno.

Climatic factors are key determinants to crop production processes; solar radiation, rainfall and temperature fluctuations lead to water shortage, rising tide, altering soil moisture content, pest and disease occurrence that restrict crop growth and can account for 15 - 80% of the deviation of inter-annual yield resources (Dahiyaet al., 2018). Therefore, studying the major determinants of climate on crop productivity will extremely be beneficial.In this vein, the researchers pointed out that:Temperature mainly indicates the heat concept of a physical structure. It shows the intensity of heat energy or degree of hotness or coldness. Temperature mainly affects the plant activities that govern the mechanisms of hormones and genes. Temperature affects crops from sowing to final yields with various degrees. The growth and development of plant occurs in the range of about 0 to 35°C. Within most of this range, with every 10°C rise in the temperature, increases the growth by 2-3 times. However, hot-temperature fruits and vegetables that require hot temperatures to grow such as watermelons, peppers and tomatoes, grow faster and have better quality including higher sugar content, as temperatures rise until it reaches the growth inhibition limit (35°C). On the contrary, for open-field vegetables that favour cool temperatures such as radish and Korean cabbage, high temperatures may result in lowered quality.

Further to that, Light quality (sunshine), duration and intensity influence plant growth and development to varying level in different plants; Full range of visible spectrum of light is needed for the normal growth and development; Duration of light extremely affects vegetative as well as reproductive growth; The rate of photosynthesis increases logarithmically with the increasing light intensity. But there occurs a point at which further increases in light intensity will not increase

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photosynthesis, known as light saturation intensity. Radiation (solar radiation) is the principal sources of energy for various agricultural purposes. Out of total spectrum, the visible part of spectrum (0.4 to 0.7 μ) contributing about 45% of the total global radiation, which affects a number of plant functions and controls the plant growth and developments (Dahiyaet al., 2018). Rainfed crops directly depend on rainfall. Rainfall is the most important climatic factor for agriculture. In agriculture, rainfall mainly manifests itself through its effect on edaphic factors (soil moisture, soil temperature and aeration). In this regard, agricultural management practices have been encouraged by Mutimuraet al., (2019) to improve productivity of crop species, considering the low farmers' adoption level.

II. METHODOLOGY

This study adapted stepwise sampling approaches. Based on Griffin and Hauser (2013) that recommend selecting a sample size of 20 - 30 in a homogenous target audience/segment, purposive sampling technique was used to select four settlements practicing agricultural activities. The selection was done LGA wise from the randomly selected states in extreme Northern Nigeria. Accordingly, 40 sample size per sample point was employed which yielded a total sample of 640 (Table 1 and 2). Structured questionnaire developed by the researchers was the data collection instrument used to generate information from the farmers as regards their perception on the influence of seasonal variations on agricultural activities in the Northern region.

Quantitative and qualitative data were analysed using the Statistical Package for Social Sciences (SPSS - Version 20),frequencies and percentages respectively. Furthermore, farmers' opinions were examined using ANOVA and Chi-square analysis to analysing variations within and between states in the influence of seasonal variations on agricultural activities, on one hand, and testing association between seasonal variations' influence and agricultural activities in the extreme Northern States, on the other.

Table 1: Districts and Major Settlements in Northern Nigeria by LGAs

STATE	LGA	Settlements
Adamawa	Numan	Numan
	Mayo Belwa	Mayo Belwa
	Shelleng	Kiri
	Girei	Girei
Bauchi	Itas/Gadau	YashinGabu
	Katagum	Madara
	Ningi	Nasaru
	Kirfi	Kirfi
Jigawa	Hadejia	Hadejia
	Birnin kudu	Birnin Kudu
	Kafin Hausa	Kafin Hausa
	Kiyawa	Kiyawa
Zamfara	Gusau	Mada
	KauraNamoda	Kaura
	Tsafe	Tsafe
	TalataMafara	Mafara

Source: Field work, 2017

Table 2: Sampling points and sample size Distribution by LGA

STATE	LGA	Settlements	Number of respondents by settlements	Total
Adamawa	Numan	Numan	40 x 4	160
	Mayo Belwa	Mayo Belwa		
	Shelleng	Kiri		
	Girei	Girei		
Bauchi	Itas/Gadau	YashinGabu	40 x 4	160
	Katagum	Madara		
	Ningi	Nasaru		
	Kirfi	Kirfi		

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Jigawa	Hadejia	Hadejia	40 x 4	160
	Birnin kudu	Birnin Kudu		
	Kafin Hausa	Kafin Hausa		
	Kiyawa	Kiyawa		
Zamfara	Gusau	Mada	40 x 4	160
	KauraNamoda	Kaura		
	Tsafe	Tsafe		
	TalataMafara	Mafara		
Total				**640**

Source: Field work, 2017

III. RESULTS AND DISCUSSION

Sex and Age Characteristics of Respondents

The respondents in this work were farmers in the extreme Northern Nigeria whose data on demographic characteristics were presented in Table 3. The Table showed that 97% of the respondents were males, while females representing about 3% in the sample appear disproportionately fewer. Even though there is a wide discrepancy in the proportion of males to females in the sample, it is a true representation of the population, because the males turn out to be the dominant agriculturalists in Northern Nigeria. This could further beexplained by the common fact that,in the structure of farming activities in most of our communities in Northern Nigeria, the males dominated in the activity, hence influencing their representativeness in the sample.In terms of age distribution, it has shown that about 74% of the respondents from this sector were in the age range of 30 - 50 years and represented the active age group. About 24% were aged less than 30 years. By implication,a substantial majority of the people engaged in Agricultural activities were in their active (productive) age group.This age structure may havepositive implication for job performance and effectiveness in agricultural productivity.

Based on the above presentation, it would appear that majority of the respondents in this research were males, whereas by age they mostly fall between ages of 30 - 50 years. This showed that, they are also within the active economic age group with enabling and better

Table 3: Sex and Age Characteristics of the Respondents by State and LGAs

STATE	LGA	Sex (Number)		Age (Number)			
		Male	Female	Years			
				<30	30 - 40	41 -50	50>
Adamawa	Numan	33	07	11	25	4	0
	Mayo Belwa	40	00	12	24	3	1
	Shelleng	36	04	5	30	4	1
	Girei	39	01	10	23	7	0
Bauchi	Itas/Gadau	40	00	12	22	6	0
	Katagum	40	00	10	25	5	0
	Ningi	37	03	11	23	6	0
	Kirfi	38	02	9	26	4	1
Jigawa	Hadejia	40	00	10	25	4	1
	Birnin kudu	40	00	9	23	6	2
	Kafin Hausa	40	00	11	27	2	0
	Kiyawa	40	00	6	29	5	0
Zamfara	KauraNamoda	40	00	9	23	7	1
	Tsafe	39	01	10	25	5	0
	TalataMafara	40	00	12	22	3	3
	Maru	40	00	9	28	3	0
Total		622	18	156	400	74	10
Percentage (%)		97.19	2.81	24.38	62.50	11.56	1.56

Source: Field work, 2020

perception, understanding to actively involve, serve and contribute to community development in various capacities in the extreme Northern Nigeria. What needs to be provided in motivating the level of perception and productivity of farmerswith this caliber is government support

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through enhancing their welfare, job security improvement and adequate supply of equipment and materials, among others. These if fully actualized, improved productivitywill be realized, and thence the augmentation and actualization of more awareness on climatic influence, benefits/difficulties as well as modifying measures towards achieving profitable agricultural productivity.

Influence of Seasonal Variation on Agricultural Activities

A summary assessment of farmers' perception about influence of seasonal variation on agricultural activities is presented in Table 4. The farmers in extremeNorthern Nigeria were presented with 14 items on influence of seasonal variation and asked to give their opinions. Their opinion responses under the 5 - point Likert scale options weremeasured and aggregated in respect of each item in the questionnaire. The Table showed that about 91% (2325) of the respondents agreed with the influence of seasonal variations on farm activities. On the contrary, only about 9% (235) held a different opinion and disagree. Also, 95% agree with the influence on crops, 90% on livestock and 94% on famers' socio-economicstatus,

Table 4: Farmers, Perception about Influence of Seasonal Variations on Agricultural Activities in Extreme Northern Nigeria

Influence Indicators	Responses			
	Agree	%	Disagree	%
Influence on Farm Activities				
Seasonal variations single handedly is the determining factor of when to plant crops	615	96.09	25	3.91
Determines the survival or otherwise of all crops on the farms in terms of water availability and soil water retention capacity	597	93.28	43	6.72
Seasonal variations determine when crops from the farm can be harvested	536	83.75	104	16.25
Responsible for crop health in terms of pests and diseases	577	90.16	63	9.84
Influence on Crops				
Determine the type of crops to be cultivated across different communities	595	92.97	45	7.03
Influences the productivity of all crops across zones and states	620	96.88	20	3.13
Influence on Livestock				
Severity of the variations in seasons determines the livestock specie to be reared across different locations in northern Nigeria	581	90.78	59	9.22
Variations in seasons affects the health and wellbeing of all varieties of livestock	572	89.38	68	10.63
Influence on the Farmer				
Seasonal variations directly controls the farmers socio-economic status and capacity	621	97.03	19	2.97
Seasonal variations indirectly affects the health status of the farmer and thereby controlling his ability to farm	576	90.00	64	10.00
Market Influence				
Seasonal variations directly controls	574	89.69	66	10.31

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the market value of all agricultural produce				
Seasonal variations controls the value chain of the agricultural products from the farm through to the consumers	604	94.38	36	5.63
Influence on Water Resources				
Seasonal variations is responsible for availability and/or difficulty of water resources for all agricultural activities	619	96.72	21	3.28
Seasonal variations affect the quality and quantity of water from all sources (e.g. Rain, Streams/Rivers, and ground water)	610	95.31	30	4.69

Source: Field work, 2020.

92% on market value/value chain and 96% on water resources. In the opposite, very From the above findings, it may be deduced that the aspect of seasonal variations very few held a contrary opinion and disagree with them respectively (5%), (10%), (6%), (8%) and (4%).

Furthermore, the Table showed farmers general positive perception about influence of seasonal variations on farm activities as determining factor of planting crops (96%), their survival (93%), harvest (84%), and crop health (90%). Also, it was depicted that seasonal variations influence crops and livestock by determining the type of crop to be cultivated (93%), their productivity (97%), on one hand, and livestock specie to be reared (91%) as well as their health and wellbeing (89%). Seasonal variations directly control farmers' socio-economic status (97%) and indirectly affect their health (90%). Further to that, market value (90%) and value chain (94%) of agricultural products were considered controlled respectively. In the long run, seasonal variability influenced agricultural activities by water availability (97%) and quantity (95%).

On the other hand, the data in Table 4 was extracted to show the spatial distribution ofinfluence of seasonal variations on agricultural activities, and the results are presented in Table 5. The Table showed that 94% farmers' acceptance of the influence of seasonal variations on agricultural activities in Adamawa State, as against only 6%who held a contrary opinion and disagree with the influence. Similarly, in the other States, 91% (Bauchi), 92% (Jigawa) and 94% (Zamfara) agreed with the influence of seasonal variations on agricultural activities. On the contrary, only about 9%, 8% and 6% in the respective States held a negative opinion and disagree with the influence.

The data in Table 5 was further subjected to Analysis of Variance (ANOVA) and Chi-Square (χ^2)to test for variations between and within state (Table 6), in one hand, and testing association between influence of seasonal variations and agricultural activities (Table 7) across extreme Northern Nigeria, on the other. From Table 6, the calculated F-value of 0.008 is less than the critical F-value of 3.84 at 0.05% level of significance. Hence the null hypothesis that "there is no variation betweenstatesin the influence of seasonal variations on agricultural activitiesof extreme Northern Nigeria" was accepted. As such it can deduce with 95% confidence level that there is no variation in influence of seasonal variations on agricultural activities across the region.

Again, the result in Table 7 showed that calculated Chi-square (χ^2) value (15.47) is greater than the criticalvalue (7.82) at 0.05% level of significance. As such, the null hypothesis that there is no association between influences of seasonal variations on agricultural activities between statesin extreme Northern Nigeria is rejected and the alternative hypothesis is accepted. Therefore, it may be concluded that farmers' acceptance level of the association between influences of seasonal variations and agricultural activities across all the sampled states in the regionis very high.

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Table 5: Spatial Pattern ofInfluence of Seasonal Variations on Agricultural Activities in Extreme Northern Nigeria

State	Frequency of responses				Total	
	Agree	%	Disagree	%	Perception	(%)
Adamawa	2100	93.75	140	6.25	2240	100.00
Bauchi	2041	91.12	199	8.88	2240	100.00
Jigawa	2061	92.01	179	7.99	2240	100.00
Zamfara	2095	93.53	145	6.47	2240	100.00

Source: Fieldwork, 2020.

Table 6: Variation Within and Between States in the Seasonal Influence andAgricultural Activitiesin Extreme Northern Nigeria

Source of variation	Sum of squares	Degree of freedom	Mean square	F ratio	Critical F
SSA	0.010	1	0.010	0.008	3.84
SSE	11199.99	8958	1..250		
SST	11200.00	8959			

Table 7: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.472[a]	3	0.001
Likelihood Ratio	15.381	1	0.002
N of Valid Cases	8960		

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected count is 165.75.

From the above findings, it may be deduced that the aspect of seasonal variations greatly influence agricultural activities in the extreme Northern Nigeria. Categorically, thesevariations are the determining factors of crops' planting and harvesting period as well as their health and survival. This way, the type of crops to be cultivated, their productivity, livestock specie to be reared as well as their health and wellbeing are greatly determined by seasonal variations in the region. Furthermore, the general farmers' high level of acceptance of the association between influences of seasonal variations and agricultural activities is explained by the fact that, these variations directly control farmers' socio-economic status and indirectly affect their health, control market value and value chain of agricultural products as well as water availability and quantity in the extreme Northern Nigeria.

These findings are in conformity with Khanal (2009) who classified the patterns of impact of climate change on agriculture into biophysical and socio-economic impact. Where the biophysical impacts were pointed out as; physiological effects on crop and livestock, change in land, soil and water resources, increased weed and pest challenges, shifts in spatial and temporal distribution of impacts, sea level rise and changes to ocean salinity and sea temperature rise causing fish inhabitation in different ranges.

IV. CONCLUSION

From the findings in this work, it was concluded that about 91% of agricultural activities are influenced by seasonal variations in the extreme Northern Nigeria. This influence was explained by the seasonal variations in determining periods for planting (96%) and harvesting (84%) crops as well as their health (90%) and survival (93). This way, the type of crops to be cultivated, their productivity, livestock specie to be reared as well as their health and wellbeing are greatly determined by seasonal variations in the extreme Northern Nigeria. The general farmers' high level of acceptance of theseinfluences, indicated strong association between influences of seasonal variations and agricultural activities (χ^2 = 15.47), explained with no variations across the Northern States (F-value =0.008). As such, seasonal variationsdirectly influence farmers' socio-economic status and indirectly affect their health. The influence here extends to market value and value chain of agricultural products as well as water availability and quantity in the extreme Northern Nigeria.

V. RECOMMENDATION

In consideration of the findings in this work, the following recommendations are hereby offered:

1. Governments and Non-Governmental Organizations (NGOs) should support and

motivate farmers by enhancing their welfare, job security improvement and adequate supply of equipment and materials, among others.

2. Farmers need to be more enlightened about climatic influence, its associated benefits/difficulties as well as modifying measures towards achieving profitable agricultural productivity. These if fully actualized, agricultural activities will be augmented and improved productivity is guaranteed in extremeNorthern Nigeria.
3. Governments and NGOs should support extension service providers to educate farmers on the influence of seasonal variations. This in essence, will enlighten farmers and equipped them with strategies of coping with recurrent seasonal variations associated with climatic changes. This way, farmers' will succeed and agriculture will be development in the extreme Northern Nigeria.

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