International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 5 May 2021, pp: 1093-1102 www.ijaem.net ISSN: 2395-5252

Effects Of Climate Change And Its Impacts On Crops Yields In Arid Zone Of Yobe State

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Submitted: 05-05-2021 Revised: 18-05-2021 Accepted: 22-05-2021

ABSTRACT: This paper was formulated to investigate the effects of climate change and its impacts on crop yield in the region, the analysis on crop yield as a result of variability in fluctuating of temperature and rainfall in recent years, the result indicate that average annual rainfall and temperature are good factors for predicting crop yield in the region. These shows that there is increase in desertification in the regionthat lead to low yield in crop production, urgent measures should be taken in order to avert such problems.

KEYWORDS: Crop yield, Rainfall, Temperature, arid zone of Yobe.

I. INTRODUCTION

Climate change is the greatest challenge facing man's existence on earth in thiscentury. It is a process of global warming, in part attributable to the 'greenhousegases' generated by human activity. The impacts of climate change are being feltby both developed and developing countries. Climate change impacts are felt onagricultural production, health, bio-diversities, social and economic conditions onthe populace and on the environment in general. Climate change is predicted toworsen the incidence of drought and desertification and millions of people will beturned into refugees because of the disaster.

Food and Agriculture Organization [1] (FAO) Global Forest ResourcesAssessment showed that forest and woodland in sub Saharan Africa presentlycover about 530 million ha, compared to 710 million ha in 1975. This ongoingdegradation of natural resources is reducing the resilience of the agro-ecosystemsto drought, further undermining the region's future capacity to cope with climatechange. [2] According to World Health Organization skineruptions, heat fatigue, heat cramps, heat exhaustion and heat stroke are classicalheat related illnesses which are resultant from climate variations. [3]climate change results to socio-economic impactsin loss of revenue, economic opportunities and the practice of traditional culturewhich are expected to increase the social and cultural pressures on indigenouspeople. The out migration of indigenous youths to seek for economic opportunitieselsewhere because of climate change has limited further their opportunities in theirown communities; this could lead to erosions of indigenous economies andculture.

Northern part of Nigeria is not safe from climate change. For instance, more than two thirdsof the country are prone to desertification. States, such as Borno, Sokoto, Jigawa,Zamfara, Kebbi, Yobe, Kaduna, Kano Bauchi, Adamawa, Bauchi, Niger and othersare at risk. In the Sahel zone of northern Nigeria, the most pronounced climatechange-related forms of land degradation, wind erosion, sand duneformation, drought and desertification.In south-eastern Nigeria, sheet erosionwhich is the complete removal of arable land is a major threat to agriculture in theregion. Apart from the effects on cropping pattern, climate change brings with itproliferation of pests and diseases. These can hinder storage when the needarises because of temperature increases. Diseases tend to spread to area wherethey were previously unable to thrive. A good example is the spread of tse –tseflyto the drier regions of northern Nigeria from the southern part. The change alsoaffects the agro-pastoral system as animals have to trek very long distances insearch of green grass[4]. The movements ofanimals also contribute to spread of disease causing organisms and leads toconflict on available resources. The impacts of climate change are not limited tocropping and agro-pastoralism, they are being felt on fisheries and aquaculture.

Yobe State lies on the coordinates latitude $12^0$00'N and longitude $11^0$30'E with an estimated area of 45,502 km^2 (17,568 square miles) and population density of 31/km^2 (80/Square mile). The state boast an estimated population of 2.7 million people as per 2011 estimates, It shares an international boundary with the Republic of Niger to the North. Yobe State shares boundaries with Jigawa and Bauchi States to the West, Borno and Gombe to the South.Large portions of the population of the state are farmers. Major cashcrops grown in Yobe State are: Millet, Maize, Guinea Corn, Rice, Onion, Tomato, Pepper, Wheat, Beans, Groundnut, Watermelon, Melon and Beni Seed are grown in large quantity. Livestock rearing, fishing and trading are also major occupations.

The climate of Yobe State is hot and dry for most period of the year. The mean temperature for most stations in the state is about 37^0C. The highest temperature (about 42^0C) is normally experienced in April, while minimum temperatures (about 30^0C) are usually recorded in December. Rainfall in Yobe State decreases both in duration and amount from place to place. Generally, it lasts for about 120 days in the northern part of the state and more than 140 days in the south. Rainfall in the state is highly irregular in space and time, which makes farming difficult since small differences in the amount and timing of rain received at a site may determine the success or failure of critical stages in vegetation development and hence crop production. The development of agriculture would, therefore, effectively depend on irrigation farming especially in the Arid zone of the state.

There is a growing consensus in the scientific literature that in the coming decades the world willwitness higher temperatures and changing precipitation levels. The effects of this will lead tolow/poor agricultural products. Evidence has shown that climate change has already affectingcrop yields in many countries [5]. This isparticularly true in low-income countries, where climate is the primary determinant ofagricultural productivity and adaptive capacities are low [6].

Many African countries, which have their economies largely based on weather-sensitiveagricultural productions systems like Nigeria, are particularly vulnerable to climate change [7]. This vulnerability has been demonstrated by the devastating effects of recentflooding in the Niger Delta region of the country and the various prolonged droughts that arecurrently witnessed in some parts of Northern region. Thus, for many poor countries like Nigeriathat are highly vulnerable to effects of climate change, understanding farmers' responses toclimatic variation is crucial, as this will help in designing appropriate coping strategies.

Evidence from literature and past studies has revealed that the recent global warming hasinfluenced agricultural productivity leading to declining food production [8]. In order to meet the increasing food andnon-food needs due to population increase, man now rapidly depleting fertile soils, fossilgroundwater, biodiversity, and numerous other non-renewable resources to meet his needs [9] This resource depletion was linked with otherhuman pressures on the environment. Possibly the most serious of human impacts is the injectionof greenhouse gases into the atmosphere. The reality of the impact of climate change onagricultural development has started showing signs.[10],[11] A substantial body of research has documented these wide-ranging effects on manyfacets of A human societies. [6], [12] Rough estimates suggest that over the next 50 years or so, climate change may likely have aserious threat to meeting global food needs than other constraints on agricultural systems.[1], [9] Specifically, population, income, and economic growth could all affect theseverity of climate change impacts in terms of food security, hunger, and nutritional adequacy. Ifclimate change adversely affects agriculture, effects on human are likely to be more severe due to desertification in the region.[13] worry that risingdemand for food over the next century, due to population and real income growth, will lead toincreasing global food scarcity, and a worsening of hunger and malnutrition problemsparticularly in developing countries.

Recently, international tensions and concerns are heightening over what the impact of climatewill have on the environment and agricultural produce.[6], [14] Also, how agricultural and food-distribution systems will be further stressed up by theshifting of temperatures and precipitating belts, especially if changes are rapid and not plannedfor.[15] The crucial issue in this study is whether agricultural output supply can keeppace with population increase under this climate variability. This will depend; both on the scopefor raising agricultural productivity (including reducing waste during distribution), availability ofinputs used in the agricultural sector (land, labour, machinery, water resources, fertilizers, etc.)and having sufficient information on climatic variables for possible effective adaptation andmitigation strategies.

Consequently, attempt is being made in this study to investigate the effects of climate change onfood demand and production as well as population increase in Nigeria. Past studies that haveexamined the impact of climate change on food production at the country, regional, or

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globalscale[16][12][17][14] have failed to providecritical insights in terms of effective and future adaptation strategies, although insights from thesestudies created the background for the present study.

Studies on the impact of climate change (particularly rainfall and temperature) and climaterelatedadaptation measures on crop yield are very scanty. Studies by [9], [10], [12], [16], [18] are some of the economic studies that attemptto measure the impact of climate change on farm productivity. These studies imputed the cost ofclimate change as a proxy for capitalized land value and which are captured from farm netrevenue. However, while these studies were conducted using sub-regional agricultural data aswell as household-level it did not identify the determinants of effective adaptation methods topredict efficient adaptive measures. Also, its likely future effects on food production andpopulation growth were not assessed.

World meteorological organization report [19] the year 2020 is a decade of exceptional global heat, retreating ice and record sea levels driven by greenhouse gases from human activities. Average temperature for the five years (2015 – 2020) are almost certain to be the highest on record.

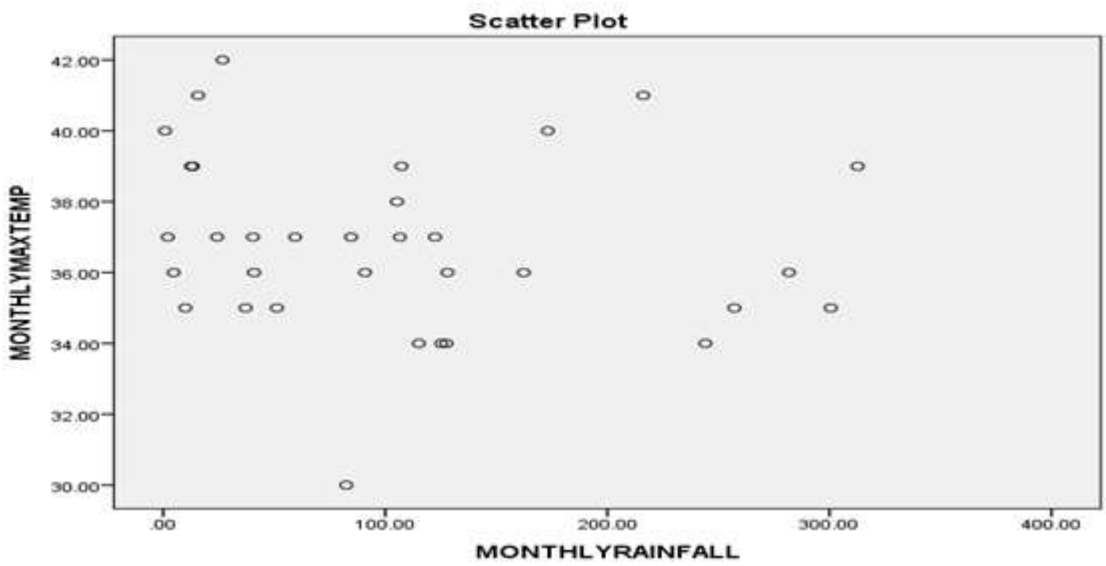
II. MATERIAL AND METHOD

This research work studies the pattern of climatic variables as it relates to crop yield and cashcrop production. Multiple regression and correlation model with ANOVA is use to estimate the parameters and to calculate the new values of the climatic variables (beyond those included in the output data) and confidence intervals for the predicted values.

The Multiple regression and correlationanalysis for this research work in on the effect of climate change and crop yield for the periods between 1992 to December 2018in the Arid zone of Yobe state namely: Damaturu, Nguru,Gashua, Machina, Yunusari, Bursari, Tarmuwa. Yusufari and Geidam and is restricted to Multiple regression, correlation and ANOVA only.

III. STATISTICAL ANALYSIS AND DISCUSSION

ANALYSIS ON MONTHLY RAINFALL, MAXIMUM AND MINIMUM



TEMPERATURE

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.582[a]	.339	.295	77.75704

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a. Prediction of Monthly minimum and Maximum Temperature:

Discussion of results:

The multiple linear regression model, with two explanatory variables, now has an R - squared value of 0.339. This means that only 33.9 % of the variation in monthly rainfall can be explained by this model, the remaining 66.1% are unexplained. This means that apart from maximum and minimum temperature, there are other factors (humidity, precipitation etc.) that contribute to the amount of rainfall experience monthly.

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	93031.351	2	46515.676	7.693	.002[b]
1	Residual	181384.705	30	6046.157		
	Total	274416.056	32			

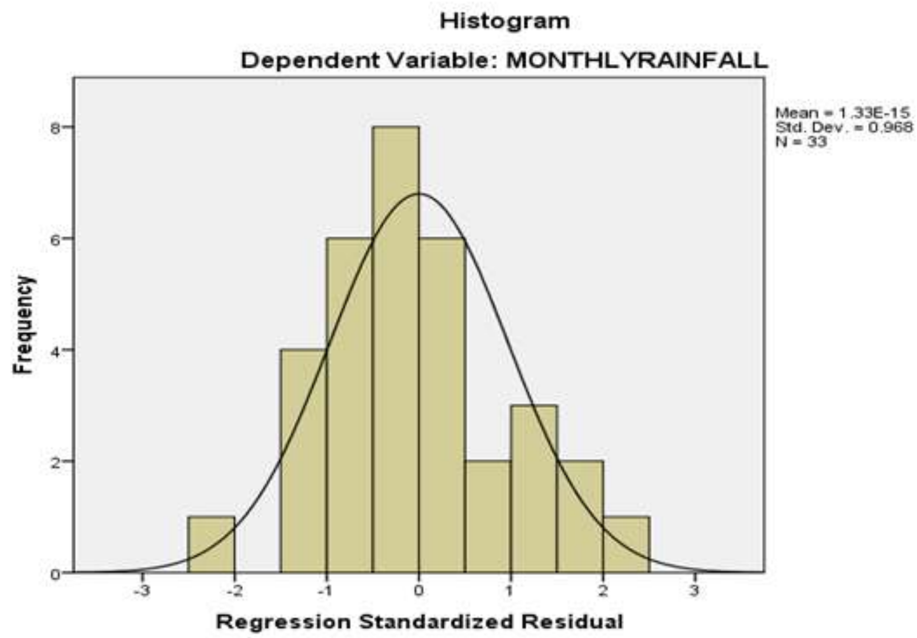
a. Dependent Variable: Monthly Rainfall
b. Predictors: (Constant), Monthly Minimum and Maximum Temperature.

H_0: Maximum and minimum temperature are good predictors for rainfall
H_1: Maximum and minimum temperature are not good predictors for rainfall

Acceptance region: $F_{calculated} < F_{Table} \frac{0.05}{2}$

Rejection region: $F_{calculated} > F_{Table} \frac{0.05}{2}$

Discussion of Result:From the above table, the calculated value of F is 7.693, while the tabulated value α = 0.025, (32, 30) degrees of freedom is 2.07. The calculated value (F_{Cal} = 7.693) is greater than the table value (F_{Table}= 2.07), so therefore we reject the null hypothesis (H_0) in favour of the alternative hypothesis (H_1) and conclude that maximum and minimum temperatures are not adequate factors for predicting future rainfall pattern.



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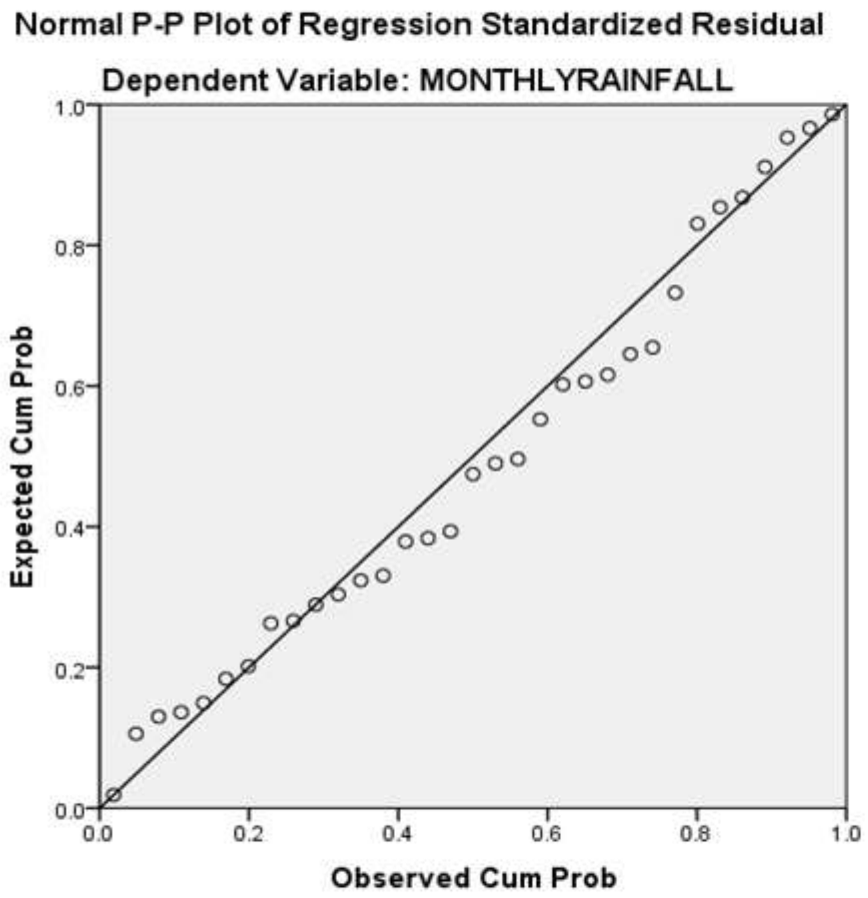

coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	905.018	255.958		3.536	.001
	MONTHLYMAXTEMP	.687	5.718	.019	.120	.905
	MONTHLYMINTEMP	-31.611	8.340	-.587	-3.790	.001

a. Dependent Variable: Monthly RainfallThe theoretical model here is:

Monthly Rainfall = $\beta_0 + \beta_1$Monthlymaxtemp + β_2Monthlymintemp

The estimated model here is:

b. Monthly Rainfall= 905.018 + 0.687Monthlymaxtemp–31.611Monthlymintemp

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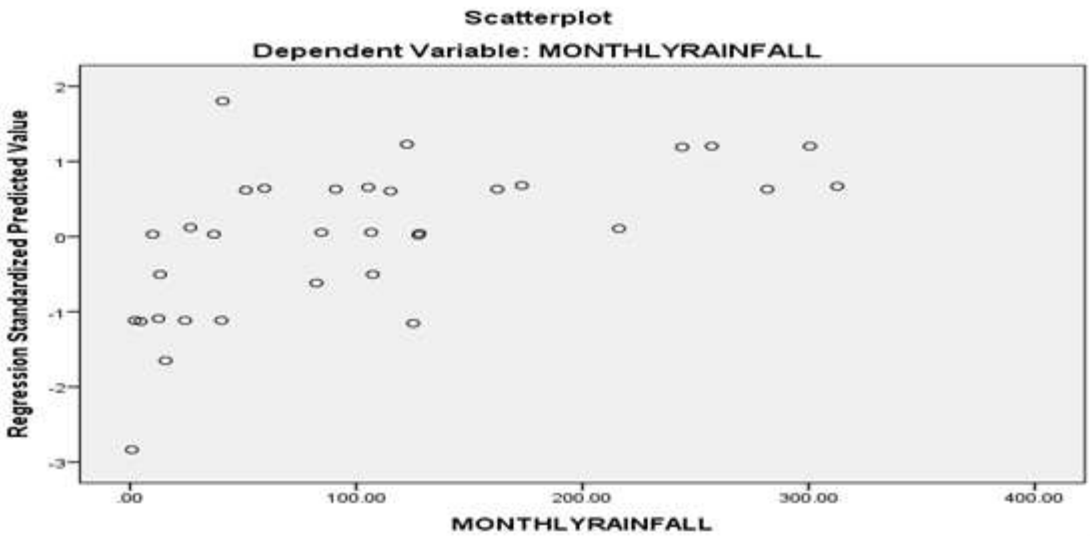

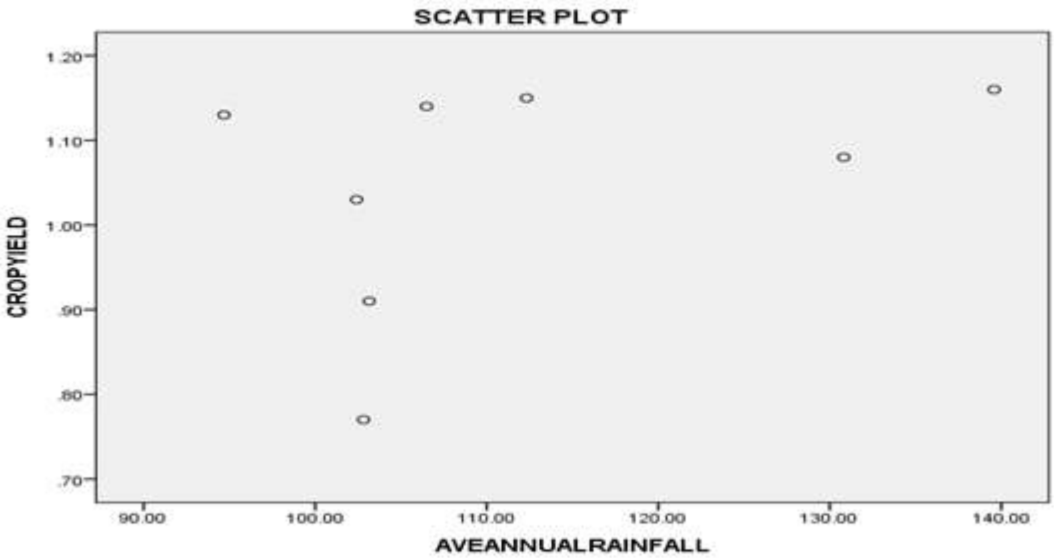

ANALYSIS ON AVERAGE ANNUAL; RAINFALL, TEMPERATURE AND CROP YIELD

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.491[a]	.241	-.062	.14353

a. Predictors: (Constant), Average Annual Temperature, Average Annual Rainfall

b. Dependent Variable: Crop yield

c. Predictors: (Constant), Average Annual Rainfall

Discussion of results:

The multiple linear regression model, with two explanatory variables has an R - squared value of 0.241. This means that only 24.1 % of the variation in annual crop yield can be explained by this model, the remaining 75.9% are unexplained. This means that apart from average annual rainfall and temperature, there are other factors (humidity, soil composition, sunshine hour etc.) that contribute to annual crop yield.

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ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.033	2	.016	.796	.501[b]
	Residual	.103	5	.021		
	Total	.136	7			

a. Dependent Variable: Crop yield
b. Predictors: (Constant), Average Annual Temperature, Average AnnualRainfall
c. Predictors: (Constant), Average Annual Rainfall

H_0: Average annual rainfall and temperature are good predictors for crop yield
H_1: Average annual rainfall and temperature are not good predictors for crop yield
Acceptance region: $F_{calculated} < F_{Table\frac{0.05}{2}}$
Rejection region: $F_{calculated} > F_{Table\frac{0.05}{2}}$

From the above table, the calculated value of F is 0.796, while the tabulated value α = 0.025, (7, 5) degrees of freedom is 6.85. The calculated value (F_{Cal} = 0.796) is less than the table value (F_{Table}= 6.85), so therefore we accept the null hypothesis (H_0) and conclude that average annual rainfall and temperature are good factors for predicting crop yield.

Discussion of results:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.559	2.790		-.559	.600
	Aveannualrainfall	.006	.005	.639	1.261	.263
	Aveannualtemp	.061	.076	.409	.807	.456

a. Dependent Variable: CROPYIELD

The theoretical model here is:
CROPYIELD = $\beta_0 + \beta_1$AVEANNUALRAINFALL + β_2AVEANNUALTEMP
The estimated model here is:
CROPYIELD = -1.559 + 0.006 AVEANNUALRAINFALL+0.061 AVEANNUALTEMP
From the table above we see that:

- All the explanatory variables are statistically significant.
- All have positive coefficients – for each explanatory variable
- There's a high correlation between average annual rainfall and average annual temperature

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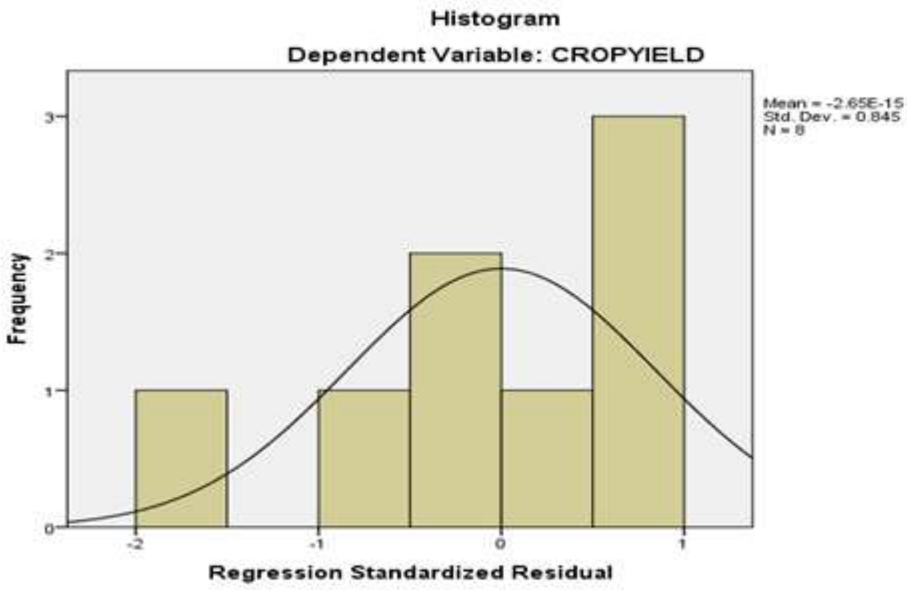

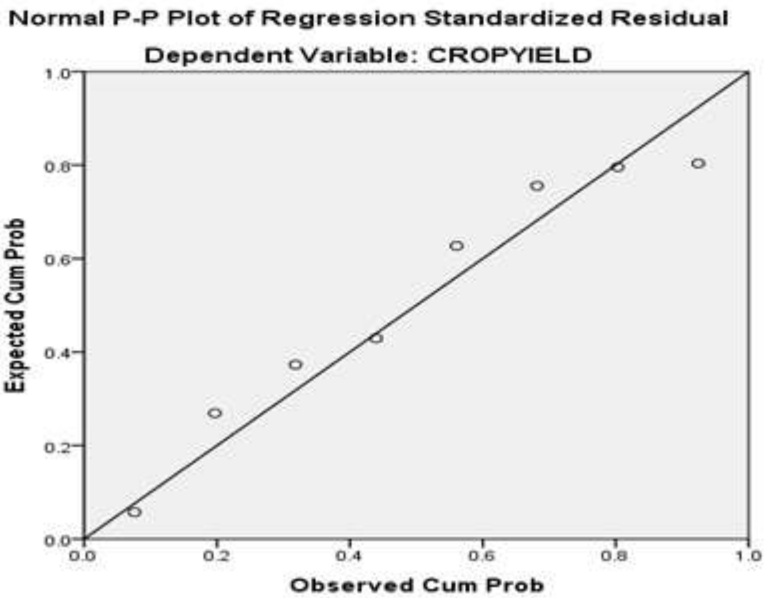

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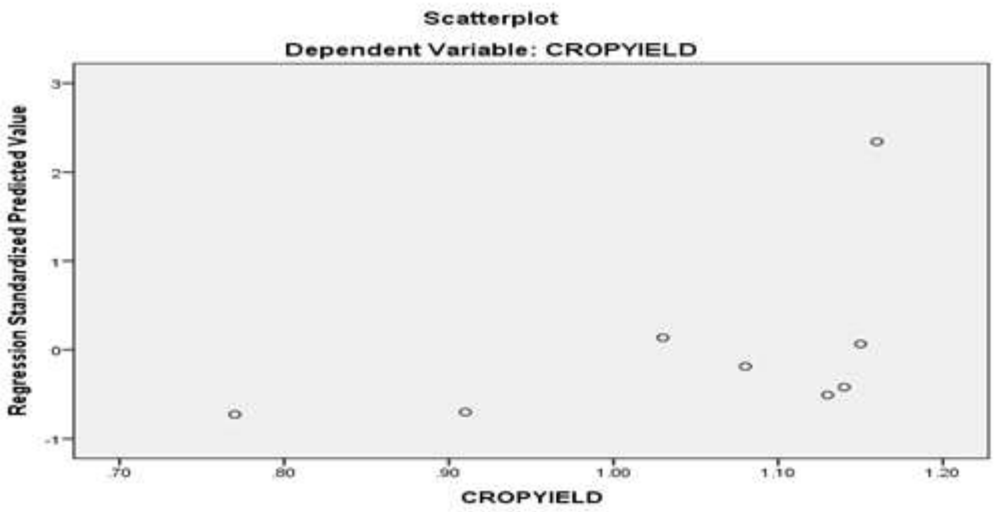

IV. CONCLUSION

Based on the findings of this paper it can be concluded that the climatic change in the arid zone of Yobe state due tovariability in rainfall and temperature rise which seriously affect the crop yield in the region.

REFERENCE

[1] United Nation report, Food Agriculture Oganisation of the united Nation 2018. 2018.

[2] B. State and U. Kingdom, "Farmers ' Adaptation Initiatives to the Impact of Climate Change on Agriculture in Northern Nigeria," vol. 16, no. June, 2012.

[3] A. A. Zemba, Y. Umar, and N. L. Binbol, "Climatic Information AS Evidence OF Desertification Processes IN Northern Yobe State, Nigeria : Implications FOR Agriculture AND Ecosystem," vol. 24, pp. 117–124.

[4] C. L. Egbule and C. Agu, Climate Change and Adaptation Measures in Northern Nigeria: Empirical Situation and Policy Implications, no. 62. 2011.

[5] T. Deressa, R. M. Hassan, and C. Ringler, "Measuring Ethiopian farmers ' vulnerability to climate change across regional states [in Amharic]: Measuring Ethiopian Farmers ' Vulnerability to Climate Change Across Regional States Temesgen Deressa," no. January, 2008.

[6] T. Apata, "Analysis of Climate Change Perception and Adaptation among Arable Food Crop Farmers in South Western Nigeria," no. November, 2014.

[7] A. Dinar and R. Mendelsohn, "Mendelsohn R , Dinar A , Williams L . The distributional impact of climate change on rich and poor countries . Environment and Developm .... The distributional impact of climate change on rich and poor countries," no. February, 2006.

[8] P. Kurukulasuriya, U. Nations, D. Programme, and R. Mendelsohn, "Crop switching as a strategy for adapting to climate change," no. January, 2008.

[9] E. B. Audu, H. O. Audu, N. L. Binbol, and J. N. Gana, "CLIMATE CHANGE AND ITS IMPLICATION ON AGRICULTURE IN NIGERIA," 2013.

[10] N. E. Ebele and N. V. Emodi, "Climate Change and Its Impact in Nigerian Economy," vol. 10, no. 6, pp. 1–13, 2016.

[11] M. L. Parry, C. Rosenzweig, A. Iglesias, M. Livermore, and G. Fischer, "Effects of climate change on global food production under SRES emissions and socio-economic scenarios," vol. 14, pp. 53–67, 2004.

[12] J. Hellin et al., "Climate change and food security in the developing world : Potential of maize and wheat research to expand options for adaptation and mitigation," vol. 4, no. October, pp. 311–321, 2012.

[13] Y. Abdulhamid, "The Impact of Climate Change in Nigeria .," vol. 2, no. 4, pp. 18–26, 2011.

[14] O. F. Reserve, "IMPACT OF FARMING ACTIVITIES ON VEGETATION IN," vol. 6, no. 2, pp. 131–140, 2004.

[15] W. Nordaus, The Challeges Of Global Warming : Economic Models and Environmental Policy. New Haven, 2007.

[16] A. G. Hassan, M. A. Fullen, and D. Oloke,

"Problems of drought and its management in Yobe State , Nigeria," Weather Clim. Extrem., vol. 23, no. November 2018, p. 100192, 2019.

[17] K. N. Ninan and S. Bedamatta, Climate Change , Agriculture , Poverty and Livelihoods : A Status Report Climate Change , Agriculture , Poverty and Livelihoods : A Status Report, no. June. 2015.

[18] R. Mendelsohn, "The Impact of Climate Change on Agriculture in Developing Countries The Impact of Climate Change on Agriculture in Developing Countries," vol. 0459, 2008.

[19] J. Cullmann et al., "2020 STATE OF CLIMATE SERVICES," 2020.