**AN ASSESSMENT OF THE IMPACT OF CLIMATE CHANGE ON RICE PRODUCTION AT KATCHA, NIGER STATE**

**\*Usman, M.N. M.Sc., Department of Geography, Federal University of Technology, Minna, Niger State**

**nmayadi@gmail.com** **07068986557**

**\*\*Usman, A.A. M.Tech., Department of Geography, Federal University Of Technology, Minna, Niger State**

**Alfa.usman@futminna.edu.ng** **09024742257**

**\*\*\*Adama, C.K. M.Sc., Department of Geography, Ibrahim Badamasi Babangida University, Lapai, Niger State**

**kolochristiana@gmail.com** **08033608014**

**Abstract**

*The production of enough food to match population growth while preserving the environment is a key challenge, especially in the face of climate change. This study analyses the relationship between climatic variable (rainfall) and rice production. The extent of variability in the annual rainfall and rice production at Katcha, Niger State, Nigeria has been determined. Data on annual rainfall (mm) and rice production (tonnes) were collected for a period from 1987 to 2011. The analytical tools used were Pearson’s Product Moment Correlation, Standard deviation, Coefficient of variation, line graph and questionnaire. The final result of the correlation (0.72) shows that there is significant relationship between rainfall and rice production in Katcha. The final result of Coefficient of variation shows that 9.1% variability in the amount of rainfall led to a great loss of 37.7% of annual rice production within twenty five years (1987-2011). This is equivalent to 1% (297.0 mm) variability in rainfall amount led to 4.1% (17,830.2 tonnes) loss of rice production during the period. The questionnaire revealed that erratic pattern of rainfall has largely affected rice production farmers in the study area. It is suggested that rice varieties that can survive with good yield in adverse climatic conditions be developed by breeders to reduce rainfall effects on rice production. It is also recommended that religious and traditional rulers be engaged to convince the farmers to accept daily, monthly and annual rainfall forecast irrespective of their religious believe.*

**Key Words:** Climate Change, Rainfall Variability, Rice Production, Katcha, Niger State.

**Introduction**

The variability of weather and climate has been a topical issue in a sustainable environment (Aremu, 2014). This is because the conclusions of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) published in early 2007 left no doubt that the Earth’s climate is changing in a manner unprecedented in the past 400,000 years. The report also opined that some African countries may see yields from rain-fed agriculture fall by as much as 50% by 2030, if production practices remain unchanged (IPCC 2007). Since 20th century, climate change has been a menace to the entire world due to its impacts on agriculture especially rice that is very sensitive to weather (Ayinde *et al.,* 2013). Agriculture is primarily and heavily dependent on weather and climate. Agriculture, especially rain-fed rice production is always vulnerable to unfavourable weather and climate conditions (Jayanta *et al.,* 2010). Despite technological advancement, such as improved crop varieties and irrigation systems, weather and climate are still key factors in rain-fed rice production. Often the linkage between these key factors and production losses are obvious, but sometimes the linkages are less direct.

 Although, Aondoakaa (2012) and Ayinde *et al. (*2013) have carried out research on this topic: “Effects of Climate Change on Rice Production” at Abuja-Nigeria and Niger State respectively. Parthasarathy *et al.* (1992) in India, Mahmudul, *et al*. (2011) and Mahmudul, *et al*. (2014) in Malaysia, Raza and Anwer (2015) in Punjab- Pakistan. Specifically, there is no research that has been done in the study area on this topic with the same methodology that has been adopted here. Since rainfall variability has been a plaguing issue in the study area to local rice farmers, study like this is necessary to mitigate the impact of climate change on rice production in achieving food security in the local areas and the nation at large. The objective is to understand the relationship between climatic variable (rainfall) and rice production and to determine the extent of variability in annual rainfall and rain-fed rice production in Katcha LGA from 1987-2011.

**Methodology**

***Study Area***

Katcha is one of the Local Government Areas (LGA) of Niger State located on Lat. 7°08ꞌN to 9°00ꞌN of the Equator and Long. 8°02ꞌE to 9°00ꞌE of the Greenwich meridian with an area of 1681$km^{2}$ (Niger State Bureau of Statistics, 2011). The study area experiences two distinct dry and wet seasons with annual rainfall varying between 1100mm-1500mm (Aremu, 2004). The maximum temperature (30-38°C) is recorded between March and June, while the minimum (14-17°C) is usually between December and January of the following year in the study area (NCRI, 2012). Map of the study area is shown in fig. 1.1 below.



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**Fig. 1.1: Niger State Showing the Study Area**

Source:Niger State Bureau of Statistics, 2012.

***Data Collection and Analysis***

The data used were that of rainfall and rice production. The data on rainfall (mm) was collected from National Cereals Research Institute (NCRI), Badeggi Meteorological station. The data on rainfall was collected on monthly basis for a period of 25years (1987-2011). The data on rice production (tonnes) was collected from Niger State Ministry of Agriculture and Rural Development for a period of 25years (1987-2011). Pearson’s Product Moment Correlation*,* Standard deviation, Coefficient of variation and line graph were used as the analytical tools. Questionnaire was also used to collect first-hand information about the factors that affects rice production in the study area.

**Results and Findings**

The variability in rainfall and rice production in the study area is graphically illustrated in fig.1.2.

**Fig. 1.2: Trend of Rainfall and Rice Production in Katcha**

***Rainfall Variability and Rice Production in the study Area***

Rainfall effectiveness is the actual amount of precipitation that seeps into the ground and make use of by cultivated crops (Aremu, 2014). If rainfall is measured in terms of significance, one will agree with me that rain which falls in any brief spell at the appropriate time is more significant than the average or actual total spread over a long period of time. All that matters in every rainy season to the farmers in the study area are: concentration, intensity and reliability of rainfall. The amount of rainfall and the number of rainy days may be quite sufficient to meet the annual requirement of successful rice production, provided that rain is received at the time it is required. However, this is not the case in the study area as far as rainfall intensity and reliability are concerned.

From fig. 1.2 above, there was drastic fall in the total annual rainfall of 1995 which also affected rice production. The decrease in the annual rainfall of 0.2% led to 0.23% decrease in the annual rice production compared to the immediate previous year. The decrease of 0.2% which is equivalent to 59.39mm of rainfall led to 0.23% loss of rice equivalent to 1000.23tonnes. In the subsequent years, there was slight rise of 0.12-0.23% in rainfall amount which led to rise (0.04-0.31%) in the output of rice. After then, there was another fall of 0.33% in the annual rainfall of 1998 cropping season compared to 1996. The fall in rainfall led to a drastic decrease of 0.53% in rice production which is equivalent to 2,304.88tonnes. Another drastic decrease of 0.7% in the annual rainfall led to 1.24% decrease in rice production of 2002 cropping season. This is equivalent to 219.76mm and 5,392tonnes of rainfall and rice production respectively. The decrease of 5,392tonnes is more than half of the total annual rice production of the first seven years. This is a great shock which implies that climate change has impact on rice production in the study area. However, the production output took a positive step forward until 2009 with an increment of 2% compared to 2002 rice production. The increment of 2% is equivalent to 8,697.66tonnes which outweigh the total annual rice production of the first seven years as shown in fig. 1.2 above.

The data was analyzed statistically using correlation method to show the relationship between rainfall and rice production in the study area during the period (1987-2011). The final result of the correlation gotten was 0.72 which shows that there is significant relationship between rainfall and rice production in the study area as illustrated in fig. 1.2. The average rainfall (mm) for the period (1987-2011) was calculated to be 1187.5mm. About 64% of the total annual rainfall falls below average. This shows that there is variability in the pattern of annual rainfall (fig. 1.2) in the study area and this has negative effect on rice production. The extent of the variability in the annual rainfall which in turn affected rice production is the resultant impact of climate change on rice production in the study. The final result of coefficient of variation shows that 9.1% variability of annual rainfall amount yielded 37.7% variability in the annual rice production during the period (1987-2011). The variability of 9.1% in the annual amount of rainfall implies negative impact of climate change on rice production in the study area. The result also shows that 9.1% variability in the annual amount of rainfall led to a great loss of 37.7% of annual rice production within twenty five years (1987-2011). This is equivalent to 1% (297.0 mm) variability in rainfall amount led to 4.1% (17,830.2 tonnes)loss of rice production. According to Tilman *et al.* 2002, variability in excess of 20% implies a great risk to farming. Since 9.1% variability in the annual amount of rainfall led to a great loss of 37.7% of annual rice production within twenty five years (1987-2011) in the study area, therefore climate change has impact on the quality and quantity of rice production in the study area.

***Factors Affecting Rice Production in the Study Area***

One hundred (100) samples of questionnaire were directly applied to rice production farmers in the study area. The questionnaire was randomly administered to rice production farmers in the study area and the percentages of the respondent is shown in table 1.1 below. The table 1.1 below presents summary of factors affecting rice production in the study area. About forty percent (40%) of the respondents are of the view that unfavourable pattern of rainfall is the major factor affecting rice production. In the study area, the pattern of rainfall is becoming worrisome. According to the respondents, they do receive information on the annual rainfall forecast through radio and television but does not believe in it. The religious belief of the respondents does not allow them to believe with the annual rainfall forecast. The respondents also said that there is no accuracy in the annual rainfall forecast and as such not reliable to them. They don’t rely on the annual rainfall forecast for farm planning. They only believe in God with their normal tradition of critical observation of rainfall. The belief to accept rainfall forecast for farm planning is a problem in the study area. Non-acceptance of annual rainfall forecast by the farmers in the study area is one of the factors influencing the impact of climate change on rice production. Erratic pattern of rainfall couple with their belief does not give them actual time to plant rice and as such affect rice production. According to these respondents, rice production has been unsatisfactory despite their efforts. Some respondents (40%) as shown in table 1.1 attributed unsatisfactory yield to erratic pattern of rainfall.

**Table 1.1: Factors Affecting Rice Production in the Study Area**

|  |  |  |  |
| --- | --- | --- | --- |
| S/No. | Factors | Respondent | Percentage (%) |
| 1 | Erratic Pattern of Rainfall | 40 | 40 |
| 2 | Lack of Input Facilities | 35 | 35 |
| 3 | Fragmented Land | 10 | 10 |
| 4 | Poor Soil Fertility | 10 | 10 |
| 5 | Lack of Extension Workers | 5 | 5 |
|  Total 100 100 |

 Source: Field Work, 2016.

In addition, about thirty five percent (35%) of the respondents from table 1.1 above are of the view that inadequate input facilities such as ploughing machine (tractor), improved seed varieties and credit facilities are the major factors affecting rice production. These respondents cried bitterly of high cost of hiring tractor and purchase of agro-chemicals (Oryzo+, 24D and fertilizer). According to these respondents, rice production is capital intensive but finance is always a problem to them even with their courage to produce in large quantity.

From table 1.1 above, about ten percent (10%) of the respondents hold to the view that fragmented land is the only factor affecting rice production. According these farmers, erratic pattern of rainfall is natural but if they own more hectare of land they will produce in large quantity. The elites who own large hectare of land in their communities have left them idle and are not ready to give them out for farming.

More so, ten percent of the respondents are of the opinion that poor soil fertility is a factor that affects rice production. This is because same hectare of land has been cultivated for many years without fallowing. According to these farmers, non-practice of soil management influences poor fertility of the soil.

Lastly on table 1.1 above, five percent (5%) of the respondents hold to the view that lack of extension workers is a factor affecting rice production. The relationship between farmers and extension workers is very paramount in rice production. According to these respondents, they can only be updated about any new technology, improved seed varieties, sustainable system of farming and soil management practices through extension workers. Hence, absence of extension workers affects rice production in the study area.

**Conclusion**

From the findings of this research, it can be inferred that there is significant relationship between rainfall and rice production in the study area and that rainfall variability largely existed during the period. It was found that climate change has impact on rice production in the study area as shown by the shock which exist in the trend of rainfall and rice production (fig. 1.2).

**Recommendation**

* It is suggested that rice varieties that can survive with good yield in adverse climatic conditions be developed by breeders to reduce rainfall effects on rice production.
* Religious and traditional rulers should be engaged to convince the farmers to accept daily, monthly and annual rainfall forecast irrespective of their religious faith.
* It is also suggested that government should be consistent in its agricultural policies such as provision of credit facilities, ban on importation of cereal crops especially rice and subsidizing agricultural inputs.
* Government should find ways to make credit facilities work better for farmers with easy accessibility and interest free to boost rice production.
* Rice processing and storage facilities should be provided in the local areas where rice is largely produced to enhance all year round food sufficiency.

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