

# Climatic Variation: Implications on Sustainable Rice Production in Igbemo - Ekiti, Ekiti State, Nigeria

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## Abstract

Rice constitutes the bulk of an average Nigerian's calorie intake. This study assessed how climate change brings about some adverse conditions on rice production with specific focus on increased temperature levels and rainfall anomalies in Igbemo-Ekiti, Nigeria. Primary data through questionnaire administration elicited background information of farmers who involve in rice farming in the study area; and data on climatic variables such as rainfall, temperature and humidity; and rice yield from 1997-2012 were collected and treated using descriptive and correlation analysis. Results show that; majority of farmers (80.8%) engaged fully in farming; rainfall is positively correlated with temperature (0.39) but has negative correlation with rice yield (-0.38) which indicates that rice production in this area does not absolutely rely on rainfed but supplementary water from irrigation; that high temperature (34<sup>0</sup>C) recorded in 1997 was responsible for the low rice production (55,000t) in the year; and while reduced level of temperature (32<sup>0</sup>C) induced high yield of rice (95,000t) recorded in 2012. It is therefore recommended that farmers in the study area should embark on intensive farming that is capable of regulating activities of climatic variables towards continuous farming system.

**Keywords:** temperature; rice; ekiti; farmers; rainfall

## 1. Introduction

As reported by the [1], the overall situation of rice production in Nigeria shows that rice production decreases by 17% per annum due to climatic events. This is more so when rice production is under pressure on the demand side due to population growth and the supply side is further exposed to natural pressures of climate change. It was equally observed that it is difficult to achieve sustainable rice production in a situation where serious threat is being posed on its sustainable growth as a result of dramatic changes in global climate [2].

[3] carried out a study on how climate change influences satisfactory yield of rice and rural agro-based livelihoods in Nigeria. In another study, [4] focused on the livelihoods of people in the rice-producing areas, which are particularly vulnerable to droughts, sea level rise and floods. However, these studies have not been able to reveal the effect of a slight change in climate variables on crop production. The above scenario shows that researches are not comprehensive and conclusive enough to establish the impacts of climate change on spatial and temporal dimensions.

The need to study the impact of climate change on sustainable rice production in the study area is essential. Climate change brings about some adverse conditions; prominent among them are increased temperature levels and rainfall anomalies. These conditions make the growth of rice difficult for the farmers.

Temperatures in Nigeria have been increasing, particularly during the dry season, over the past three decades [5]. Average temperatures were found to have risen by 0.7oC per decade across Nigeria [6]. Moreover, the country is expected to experience an increase in average temperature overall by 1°C by 2030 and by 1.4°C by 2050 [7], [8].

Rainfall in the country is highly variable and has demonstrated an increasingly uneven distribution. The number of days without rain is increasing, although the total annual rainfall remains almost the same. This erratic behaviour of rainfall produces extreme events like floods and droughts which have noticeable adverse impacts on rice yields [5].

Rice is one of the important staple crops grown in Ekiti State, with intensive cultivation in Igbemo where it attracts significant processing and marketing

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activities [9]. Also, rice generally constitutes the bulk of an average Nigerian's calorie intake. Hence, the need to study the implications of climate change on sustainable rice production. This study focuses on difficulties that arise through climate variability and thereby suggest viable solutions on how to reduce the effect of climate change on rice production in the study area.

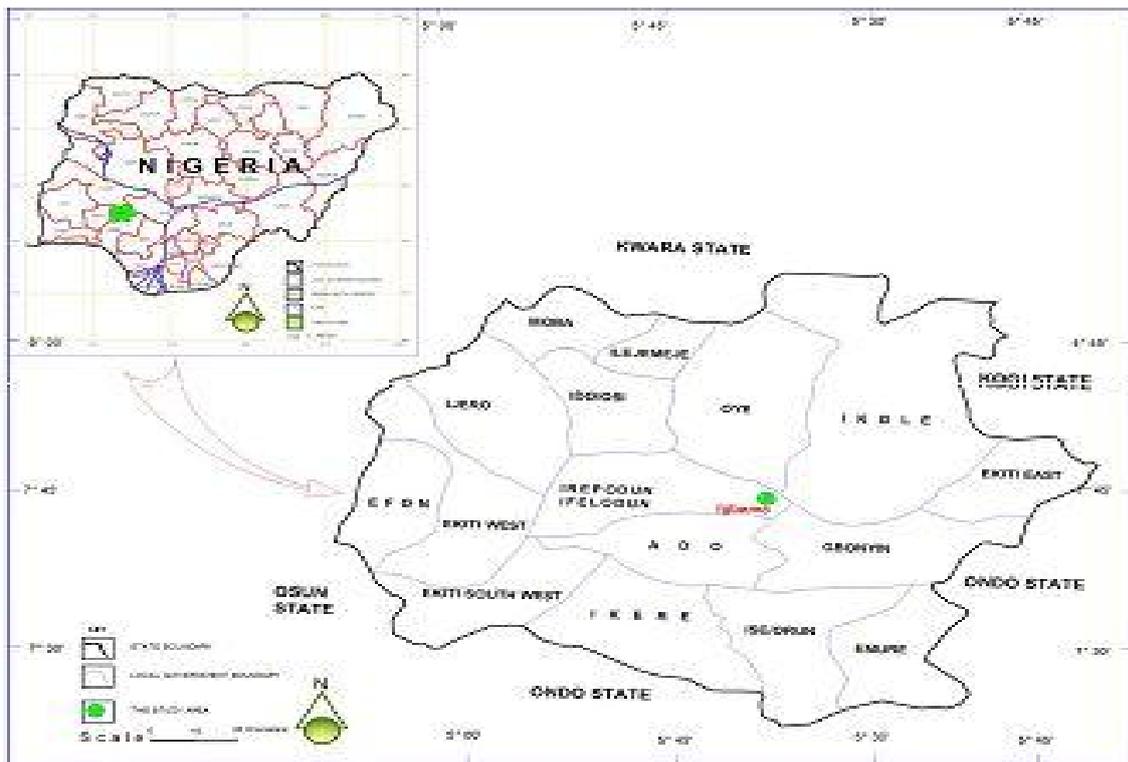
**2. Materials and Methods**

This study used primary data to elicit the background information of farmers who involve in rice farming in the study area. In determining the impact of climate variations on sustainable rice production in the study area, data on climatic variables such as rainfall, temperature and humidity from 1997-2012 were collected from Ado-Ekiti Agro-Climatological Unit and rice yields that form the

dependent variable were obtained from Ekiti State Agricultural Development Project. Data were subjected to descriptive and correlation analysis. Simple percentage, tables, chart and graph were used to present the results.

**2.1 Study Area**

The study area is Igbemo-Ekiti in Ekiti State, Nigeria. It is located between longitude 5°23` and 5°24` East of the Greenwich Meridian and latitude 7° 4` and 7° 42` North of the Equator with an altitude of 463m above sea level. It is a settlement in Irepodun/Ifelodun Local Government Area by the West of Ado-Ekiti, the state capital. The area was chosen for this study based on its predominant involvement in rice production. Thus referred to as "The Home of Rice".



**Figure 1:** Map of Ekiti State showing Igbemo Ekiti

Tropical Climate prevails in this area and consists of dry and wet seasons. Igbemo-Ekiti experiences Rainy Season between June and September, with the rainfall peak coming between July-August. Its dry season is from December to March, with its peak between December and February. March is the warmest with an average temperature of 33.2°C, while December is the coldest with 18.6°C at night [10].

The vegetation consists of the evergreen high forest composed of many varieties of hardwood timber such as; procera Terminalia superba, Melicia and antiaris Africana. Igbemo Ekiti has typical rainforest vegetation, with tall trees and some grassland areas. The soil derived from the basement complex rocks, where the study area falls, is mostly well drained, having a medium-to-fine texture. The soil in Igbemo is of high value to arable crops.

Igbemo has a population of 23,024 which consists of male and female inhabitants [11]. The area is densely populated with 184 people per km<sup>2</sup>. Majority of the men are farmers while the women engage in petty trading. The people specialize in both cash and food crops on large scale and subsistence level. The major cereal crop is rice, other crops grown include; yams, maize, melon and cassava.

### 3. Results and Discussions

#### 3.1 Characteristics of the rice farmers

The overall characteristics of farmers who engaged in rice farming are summarized in table 1. The study identified male (74.2%) farmers as having higher involvement in farming activities which is above the female (25.8%) counterpart. This finding could be attributed to the fact that men are the bread winner at homes and responsible for providing for their homes through farm produce. Also, rice farming demands high level of energy of which only men

could engaged in it. It has been confirmed in this study that the productive age (ages 31-40) are the dominant producer of rice in the study area. Though, most of the farmers are at average educational level of secondary school with 50%. The remaining 50% is shared by primary (32%), higher (28%) and other mode of education with (10%). These levels of education majorly determine the nature of farming activities that is prevalent in this area; most especially when it comes to dependability of most farmers on rice farming. For instance, this study revealed that 80.8% of the sampled farmers choose farming as major occupation while 5% and 14.2% engaged in civil servant and other activities respectively. The study further established that larger percentage (79%) of the farmers are married and the family depend entirely on the income generated from farming activities. Hence, subsistence system of agriculture prevails in this environment as a means of individual and family sustenance.

**Table 1:** Characteristics of rice farmers in Igbemo-Ekiti

Variables	Category	Frequency (n = 120)	Percentage (%)	Mode
Sex	Male	89	74.2	Male
	Female	31	25.8	
Age (years)	20 – 30	40	33.3	31 – 40
	31 – 40	60	50	
	>40	20	16.7	
Education	Primary	32	26.7	Secondary
	Secondary	50	41.7	
	Higher	28	23.3	
	Others	10	8.3	
Marital status	Single	28	23.3	Married
	Married	79	65.8	
	Divorced	8	6.6	
	Widowed	5	4.2	
Occupation	Civil servant	6	5	Farmer
	Farmer	97	80.8	
	Self-employed	17	14.2	

Source: Author's Field Survey, 2014.

#### 3.2 Climatic trend and rice production in Igbemo-Ekiti

The three major factors of climate in rice production are rainfall, temperature and humidity. This study concentrates on how these factors have affected adequate production of rice in the study area.

##### 3.2.1 Effect of Rainfall on Rice Production in Igbemo-Ekiti

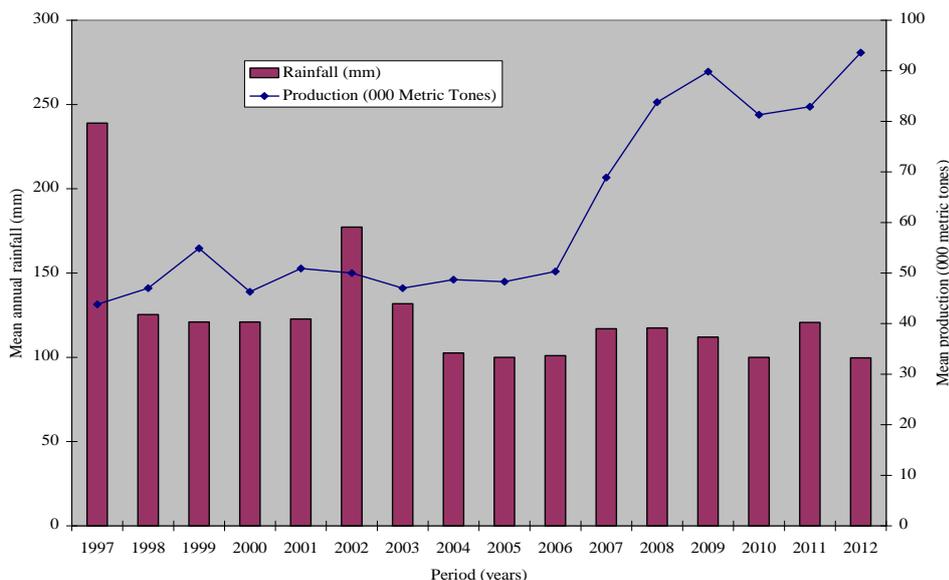
Rainfall patterns have a significant impact on sustainable rice production in the studied area. This is

true for most of the period under consideration with the exception of year 2012 when the mean annual rainfall was 100mm and rice production was 95,000 metric tones (Figure 2).

This study indicates a steady growth in rice production from 19997 to year 2006, though, amount of rainfall (120mm) received in the years equally shows a steady pattern with exception of 1997 and 2002 where higher rainfalls (235mm and 170mm) were received could not impact much significance on the yield. However,

the area under study experienced increase in rice yield between years 2007 and 2012 when the annual mean rainfall received still at about 100mm. This scenario

revealed the discrepancies that might not be unconnected with the improved rice seedlings, irrigation system and other management techniques.

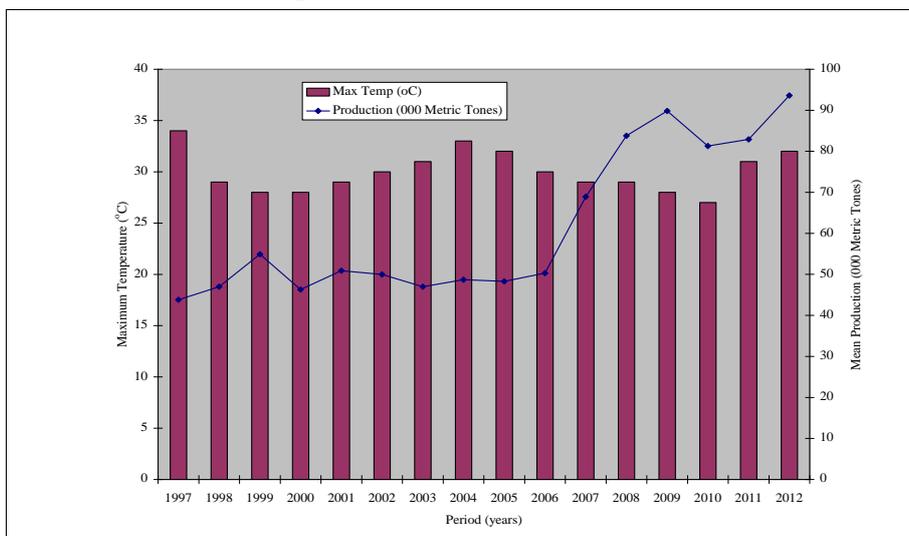


**Figure 2:** Relationship between rainfall and rice production

### 1.2.2 Effect of Temperature on Rice Production

Intense temperature inhibits the sustainable production of rice in Igbemo-Ekiti. Figure 3 shows a situation where the highest average maximum temperature of 34°C in 1997 produced 55 metric tonnes of rice, of which the highest rice production at 95 metric tonnes was recorded in year 2012 with average maximum temperature of 32°C. This indicates that the high temperature recorded in 1997 was responsible for

low rice production; while reduced level of temperature induced high yield recorded in 2012. The work of [12] confirms this finding while considering temperature as one of the major climatic factors that affect rice production in Niger state of Nigeria. It was recorded that 1% increase in minimum temperature led to 52.3% decrease in rice production in the area. To this, [13] supported that high temperatures would cause a marked decrease in world rice production.

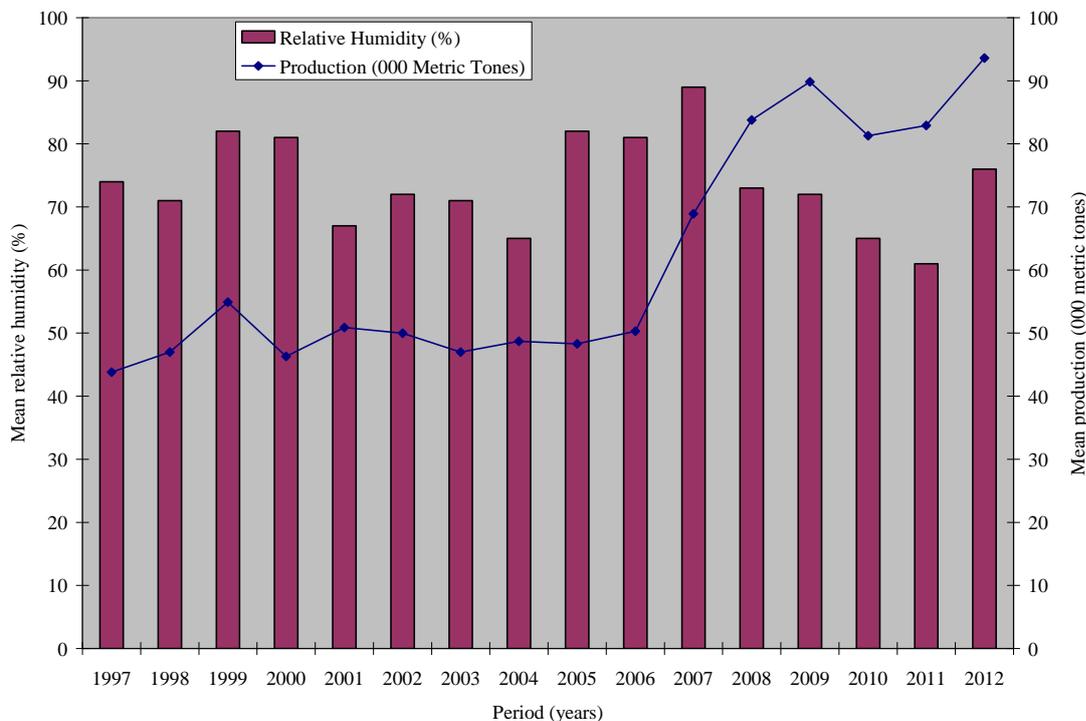


**Figure 3:** Relationship between maximum temperature and rice production

### 3.2.3 Effect of Relative Humidity on Rice Production

Results presented in figure 4 show that year 2007 have the highest mean relative humidity of 90% with a rice production of 69,000 metric tonnes, while

in contrast, 2011 has the lowest relative humidity of 60% with a rice production of 83,000 metric tonnes. This implies that rice production will thrive better at a low humidity. Though, this may not be unconnected with improved technology that enhances rice yield in the recent years.



**Figure 4:** Relationship between relative humidity and rice production

This finding confirms the submission of [12] that humidity and minimum temperature are the climatic factors that affect the rice production of Niger state in Nigeria, such that 1% increase in humidity caused 17% reduction in rice production of the State, which shows that high relative humidity will react negatively to yield.

### 3.3 Relationship between Rice yield and the climatic variables

Correlation analysis was employed to examine the relationship between rice yield and the three elements of climate in the study area, which represent rainfall, temperature and relative humidity. Out of 8 pairs in correlation matrix 5 pairs showed significant relationships among and between rice yield with other climatic variables.

The correlation matrix in Table 2 shows that rainfall is positively correlated with temperature (0.39\*) but has negative correlation with rice yield (-0.38\*). The correlation values recorded here indicate

that rainfall does not only correlated with these two variables but also significant to their availability. The study indicates the relevance of evaporation that produces water vapour. Existing relationship between rainfall and rice yield shows that rice production in this area does not absolutely rely on rainfed but its survival is majorly enhance with irrigation system. Heavy rainfall, apart from affecting rice production at flowering stage, also destroy crops through flooding activities and thereby resulted into reduced yield. Though, rice require abundant water to survive, while too much water will damage its proper production. Irrigation system in the study area does not only enable sufficient water during the dry season but also allows regular control of required water for rice production by the farming practices.

This observed relationship between temperature (-0.26\*) and rice yield identified this two variables with negative significant relationship. This indicates that high temperature impedes rice production in this

area. The effect of intense temperature shows on the reduction of crop yield. Though, rice could thrive under certain level of temperature which is also essential in controlling the activities of pest as well as enhancing seed development. The situation in the study area reflects the negative impact of temperature on rice production where rice yields experience reduction due to increase rate of atmospheric heat.

The relationship between Relative Humidity (-0.19\*) and rice yield shows that this climatic parameter has significant relationship on sustainable rice production in Igbemo Ekiti. The situation in this study reflects that available air moistures are inadequate to support proper yield effect. That is, high level of temperature affects high level of moisture under which intensive production could thrive.

**Table 2:** Correlation matrix between assessed variables

<i>Variables</i>	Rainfall (mm)	Max temperature (°C)	Relative humidity (%)	Production (000 metric tonnes)
Rainfall (mm)	1			
Max temperature (°C)	0.39*	1		
Relative humidity (%)	-0.05	-0.11	1	
Production (000t)	-0.38*	-0.26*	-0.19*	1

\*significant level at  $p < 0.05$ .

#### 4. Conclusion and Recommendations

This study has examined the impact of climate on rice production in Igbemo-Ekiti, Ekiti state, Nigeria. It was observed that apart from fertile soil, pest control, proper weeding among others factors that constitute good production of rice, other factors like atmospheric temperature, rainfall and relative humidity were as well strong to influence proper cultivation of rice farming in the study area. The existing relationship among the climatic variables and rice yield shows that proper examination of the variables is a precondition for sustainable crop production in this area and other related environment. It is therefore recommended that farmers in the study area should embark on intensive farming that is capable of regulating activities of climatic variables towards continuous farming system.

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