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The Agricultural Implications of Climate Change Factors and their Projected Future Values on Rural Households in Bayelsa State, Nigeria

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Abstract
This study assessed the trend and projected future values of climate change factors in Bayelsa state. The main objective was to determine the trend of climate change factors and the specific objective was to determine the projected future values of climate change factors in the state. Annual mean time series data of climate change factors from 1971 to December 2009 were collected from Nigerian Meteorological Agency (NIMET) for the study. Multistage sampling techniques were used in the random selection of states, local government, communities and rural farming households. Data were analyzed through the use of descriptive statistics to describe the socio-economic characteristics of the rural farming households in the state. Line graph was used to determine the trend of the climate change factors (temperature, and rainfall) and Growth model was used to predict the future values of climate change factors (temperature, and rainfall) in Bayelsa state. The mean annual income of the rural farming households was ₦62, 678 ($404) revealing a low annual income of $1.1 a day which is less than the global poverty line of less than $2 a day. The projected future values of rainfall and temperature are increasing in the state. Also the coefficient of variability of the projected future value of rainfall was 2.27%, indicates that if temperature changes (increase) by 1%, rainfall will decrease by 2.27% in the state. The implication of this is that optimum temperature requirement of 25^{o}C to 30^{o}C of crops such as yam and cassava mostly grown in the state considering the present temperature situation of 31.21 ^{o}C has being exceeded. The agricultural implication of this trend is low agricultural yield and hunger. This is a threat to food security in the state. The study therefore recommends that meteorological station units should be established in the rural farming area especially in Bayelsa state where accessibility is extremely difficult. This will make available meteorological data (information) to the reach of the poor rural farming households for the attainment of food security status.
Keywords: Climate Change Factors, Rural Household, Bayelsa State, Nigeria

INTRODUCTION

Some published literature works that focused on the climatic trend in the rainforest zone of Nigeria (Nnaji and Duruji (2008); Nwajiuba *et al* (2008) fail to address the fundamental issue of climate change factors such as temperature and rainfall affecting crop performance (growth) and yield, which will in turn affect rural farming household food security especially in Bayelsa state. Hence this research study as climate change is creating increased uncertainty about future temperature and precipitation regimes which makes investments in agriculture and other weather – dependent livelihoods inherent more risky. The risk absorption capacity of poor people especially in Bayelsa state is such that they are unlikely to be able to cope with the added risk imposed by climate change. This is corroborated by the reports of Schneider *et al,* 2007; Adejuwon, 2004; EU, 2008: IPCC, 2001b) that mean annual temperature is increasing and mean annual rainfall is decreasing globally. Schneider and Tubiello (2007) reported that there will be global mean temperature increase (by 2100, relative to the 1990 – 2000 average level). According to Adejuwon (2004) "the humid areas of Southern Nigeria, the savanna areas of northern Nigeria have less rainfall, which coupled with the temperature increase. IPCC (2001b) also confirmed that precipitation decrease in the humid regions of West Africa, including Southern Nigeria, since the beginning of the century is about 10 – 25% or about 2 – 5% per decade. If this trend persists, rainfall in the humid region of Southern Nigeria may be about 50% to 80% of the 1900 values by 2100 with increase in ocean temperature. The European Union report on climate change (2008) showed that global warming followed the pattern predicted by earlier scholars. The report stated that the earth's temperature has undergone an annual increase of 0.6 degrees Celsius in the past 10 years as a result of the accumulation of the green house gases. Evidence from Sub-Saharan Africa indicates that rainfall variability, projected to increase substantially, also reduces GDP and increase poverty (Brown *et al*, 2009). The increase in projected future values of temperature was in accordance to the findings of Stern (2006) that if emissions continue at today's rate, the global average temperature is likely to rise by 2^{0}C – 3^{0}C over the next 50 years, with implications for rainfall and the frequency and intensity of extreme weather events. Growing consensus in the scientific literature on the future years or decades reveals that higher temperatures and changing precipitation levels caused by climate change will be unfavourable for crop growth in many regions and countries (Yesuf *et al*, 2008). The following research questions were addressed:

1) What is the trend of climate change factors in the state?
2) What are the projected future values of climate change factors in the state?
3) What are the agricultural implications of the trend of climate change factors in the state?

Methodology

The Study Area

Bayelsa State is located within Latitude 04° 15' North, 05° 23' South and longitude 05° 22' West and 06° 45' East. It shares boundaries with Delta State on the North, Rivers State on the East and the Atlantic Ocean on the West and South. A lot of her communities are almost (and in some cases) completely surrounded by water, making these communities inaccessible by road, (Nigeria exchange, N.D.).The entire state is formed of abandoned beach ridges and due to many tributaries of the River Niger in this plain, considerable geological changes still abound. The lower Delta plain is believed to have been formed during the Holocene of the quaternary period by the accumulation of sedimentary deposits. Sedimentary alluvium is the major geological characteristic of the state (Online Nigeria, 2003).

Bayelsa State covers a total land area of about 11,007 km^2 with a population of about 1,703,358 (NPC, 2006). More than three quarters of this area is covered by water, with a moderately low land stretching from Ekeremor to Nembe. The area lies almost entirely below sea level with a maze of meandering creeks and mangrove swamps. The network of several creeks and rivers in the South, all flow into the Atlantic Ocean via the major rivers such as San Bartholomew, Brass, Nun, Ramos, Santa Barbara, St. Nicholas, Sangana, Fishtown, Ikebiri Creek, Middleton, Digatoro Creek, Pennington and Dobo, (Bayelsa state union of great Britain and Ireland, N.D.**).**

The state experiences equatorial type of climate in the southern part and tropical rain towards the northern parts. Rain occurs generally every month of the year with heavy downpour. Precipitation in the state is high but this decreases from north to south. Akassa town in the state has the highest rainfall record in Nigeria. The amount of rainfall is adequate for all-year-round crop production. (Online Nigeria, 2003.)

Bayelsa State was created on October 1, 1996 out of the old Rivers State. The name, Bayelsa, is an acronym of three former Local Government areas (LGAs) – Brass, Yenagoa and Sagbama. The then Brass LGA has been divided into the present Nembe, Brass and Ogbia Local Government Areas while the then Yenagoa LGA consist of the present Yenagoa, Kolokuma/Opokuma and Southern Ijaw Local Government Areas. Sagbama and Ekeremor Local Government Areas were created from the old Sagbama LGA. (Bayelsa state Due process and e-governance DSP information technology center N.D.).

MATERIALS AND METHODS

Multistage sampling procedure was used in the randomly selection of local government, communities and rural farming households for the study. Firstly, three local government areas were selected from eight (8) local government areas in the state. Secondly, two (2) communities from each of the local government areas were selected, making it up to six (6) communities. Finally, fifty rural farming households were randomly selected from each of the sampled communities making it up to 300 households. Data for this study were obtained with the aids of structured questionnaire survey and out of the 300 respondents 278 were utilized for this study.

Data Collection

Annual mean time series data from Nigerian Meteorological Agency (NIMET) that include the following; temperature, and rainfall from January, 1971 to December, 2009 were collected for the study.

Method of Data Analysis

Trend Analysis

Line graph was used to determine the trend of the climatic variables (temperature, and rainfall) in Bayelsa state.

Growth Model

Growth model was used to predict the future values of climate change factors (temperature, and rainfall). This model was specified as linear, quadratic and cubic equations.

The equations are as follows:

$CH_f = a(1+i)^t + e$ (Linear) ……. i

$CH_f = a(1+i)^t + b(1+i)^{2t} + e$ (Quadratic)…….ii

$CH_f = a(1+i)^t + b(1+i)^{2t} + c(1+i)^{3t} + e$ (Cubic)……iii

Where CH_f = climatic variables (Temperature and Rainfall).

i = Rate of growth

t = Time horizon (integer values starting from 1 to 38 years)

e = Error term

a,b,c, and d = Coefficients of the model.

The cubic functional form that fits the data best was selected.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Respondents in Bayelsa state

The study reveals that most rural farming households were married with a mean age of 48 years. Primary school level of education was dominant in the state while the household size was with a mean size of 10 persons showing a large household size. The mean annual income of the rural farming households in Bayelsa was ₦62, 678 ($404) revealing a low annual income of $1.1 a day which is less than the global poverty line of less than $2 a day (Table 1).

Trend Analysis of Temperature in Bayelsa State

The results show that Temperature data collected from NIMET from 1971 – 2009 recorded an increasing trend with maximum temperature of 31.93^{0}C recorded in the year 1987 and minimum temperature 30.23^{0}C recorded in the year 1976. The mean value and its standard deviation of temperature recorded over the period 1971 – 2009 are 31.21^{0}C and 0.41^{0}C respectively. The coefficient of variability was 1.32%, indicating that if rainfall changes (decrease) by 1%, temperature will increase by 1.23% in the state. This will affect the consistent efficiency of agricultural production thereby leading to low crops output and food insecurity situation. The trend coefficient is 0.48 (^{0}C/year) and is statistically significantly, indicating an upward movement of temperature over the 38years period.

The graph equation is BT=16.26 + 0.48T where BT = Bayelsa temperature (^{0}C); T= Time (years). The trend line had a positive slope of 0.48 indicating that over the time period 1971 to 2009 annual mean temperature in Bayelsa state rose by 0.48^{0}C. The trend values and other statistics are shown in table 2 and figure 1

Predicted Future Values of Climate Change Factors in Bayelsa State

The future values of climatic variables (temperature and rainfall) projections are made as stated in the analytical framework of this study. The study shows that the temperature of Bayelsa State in Niger Delta region, Nigeria is projected to have a value of 31.71^{0}C by 2015, and 31.81^{0}C by 2020, 31.91 by 2025, 32.01^{0}C by 2030, 32.11^{0}C by 2035, 32.21^{0}C by 2040, 32.31^{0}C by 2045 and 32.41^{0}C by 2050. The projected values witnessed an increasing trend in temperature. The study also shows that rainfall is projected to have the following values of 197.88mm, 199.76mm, 201.66mm, 203.58mm, 205.52mm, 207.08mm, 207.48mm, 209.45mm and 211.44mm in 2015, 2020, 2025, 2030, 2035, 2040, 2045 and 2050 respectively. The predicted future values of temperature and rainfall show an increasing trend in the state. There was low coefficient of variability of the projected future values of temperature and rainfall in the state. The coefficient of variability of the projected future values of temperature was 0.75%, indicates that if rainfall changes (decrease) by 1%, temperature will increase by 0.75% in the state. Also the coefficient of variability of the projected future value of rainfall was 2.27%, indicates that if temperature changes (increase) by 1%, rainfall will decrease by 2.27% in the state. The implication of this is that optimum temperature requirement of 25^{o}C to 30^{o}C (Omoruyi *et al*, 1999) of crops such as yam and cassava mostly grown in the state considering the present temperature situation of 31.21 ^{o}C has being exceeded. The agricultural implication of this trend is low agricultural yield and hunger. This is a threat to food security in the state. The projected future trend values are shown in table 3

Growth Model Results of Projected Future Values of Temperature in Bayelsa State

The growth model results show that projected future values of temperature are increasing in Bayelsa state. The rate of growth of the model of temperature is 0.00063% indicating that over time period 1971 to 2050 annual mean temperature in Bayelsa state will rise by 0.00063% per unit change in time. Also the projected future values of rainfall are increasing in the state. The rate of growth of the model of rainfall is 0.00190% indicating that over time period 1971 to 2050 annual mean rainfall in Bayelsa state will rise by 0.00190% per unit change in time. The continuous increase in temperature will exceed crops such as yam and cassava mostly grown in the state optimum temperature requirement of 25^{o}C to 30^{o}C (Omoruyi *et al*, 1999). The growth trend of projected future values of temperature and rainfall are shown in figure 2 and 3 respectively.

CONCLUSION AND RECOMMENDATION

The study finding reveals that primary school level of education dominated the state with a large household size of 10 persons. The mean annual income of the rural farming households was ₦62, 678 ($404) revealing a low annual income of $1.1 a day which is less than the global poverty line of less than $2 a day. Most rural farming households were married with a mean age of 48 years. The trend line of temperature had a positive slope of 0.48 indicating that over the time period of 1971 to 2009 annual mean temperature in the state rose by 0.48^{0}C per unit change in time. The trend line of rainfall had a slope of 0.01 indicating that over the time period 1971 to 2009 annual mean rainfalls in the state rose by 0.01mm per unit change in time. Also the coefficient of variability of the projected future value of rainfall was 2.27%, indicates that if temperature changes (increase) by 1%, rainfall will decrease by 2.27% in the state. The implication of this is that optimum temperature requirement of 25^{o}C to 30^{o}C (Omoruyi *et al*, 1999) of crops such as yam and cassava mostly grown in the state considering the present temperature situation of 31.21 ^{o}C has being exceeded. The agricultural implication of this trend is low agricultural yield and hunger. This is a threat to food security in the state. The study therefore recommends that

meteorological station units should be established in the rural farming area especially in Bayelsa state where accessibility is extremely difficult. This will make available meteorological data (information) to the reach of the poor rural farming households for the attainment of food security status.

REFERENCE

Adejuwon, S.A. (2004). Impacts of Climate Variability and Climate Change on Crop yield in Nigeria. Lead paper Presented at the Stakeholders workshop on Assessment of Impacts and Adaptation to climate change, conference center, Obafemi Awolowo University, Ile-Ife 20-21 September, 2004.

Bayelsa state Due process and e-governance DSP information technology center N.D. http://www.bayelsa.gov.ng/about-us.html

Bayelsa State Government. (N.D.). *Bayelsa state.* Retrieved from http://www.bayelsa.gov.ng/about-us.html

Bayelsa state union of great Britain and Ireland.(N.D.). *Bayelsa State.* Retrieved From http://www.bayelsa.org.uk/toplinks/bayelsa-state/

Brown, C.R. Mecks, Y. Ghile , and K. Hunu (2009). "An Empirical analysis of the effects of climate Variable on national level economic growth" Background paper for the WDR 2010.

EU (2008) European union report of climate change. Research paper No. 12. Rome, Italy.

IPCC Online, (2001). Glossary of Terms Used in the IPCC Third Assessment Report Available at: www.ipcc.ch/glossary/index.htm.

National Population Census (NPC), (2006). Federal Republic of Nigeria, Federal Ministry of Women and Social Development, 2006.

Nigeria exchange. (N.D.). *Bayelsa State.* Retrieved from http://www. ngex.com/nigeria/places/states/Bayelsa.htm)

Nnaji A. and C. Duruji (2008). Implications of Climate Variation for Crop Yield. In C. Nwajiuba (ed), climate change and adaptation in Nigeria. Farming and rural systems economics by W. Doppler and S. Bauer volume 95, Margraf publishers, Weikersheim, Germany.

Nwajiuba C. U.; R. Onyeneke and J. Munouye (2008). Climate Change; perception and Adaptation by Poultry Farmers in Imo State. In Nwajiuba C. (ed) Climate Change and Adaptation in Nigeria. Farming and rural systems Economic by Doppler W. and Bauer S. Volume 95, margrave publishers, Hohenheim Germany.

Omoruyi, S.A; U.X. Orhue; A.A. Akerobo and C.I. Aghimien (1999). Prescribed Agricultural Science for Senior Secondary Schools; Idodo Umeh Publishers Limited, Benin City. ISBN 978-2340-97-9, pp151-154

Onlinenigeria.(2003).*physical setting*. Retrieved from http://www. onlinenigeria.com/links/deltaadv

Schneider, S. A. and F.N. Tubiello (2007). "Global food security under climate change". Proceedings of the National Academy of Science 104(50) ; 19703 – 08

Stern N. (2006). Stern Review; Economic of Climate Change. London, U.K; United Kingdom's Treasury

Yesuf M.; S. Difalce; T. Derassa; C. Ringler And G. Kohlin (2008). The Impact of Climate Change and Adaptation on Food Production in Low-Income Countries; Evidence Fiom The Nile Basin, Ethiopia, International Food Policy Research Institute Discussion (IFPRI) Paper No 00828. Environment and Production Technology Division, IFPRI, Washington D. C

Table 1: Socio-economic Characteristics of Respondents in Bayelsa State

Variables	Respondents	Percentages
Age (Years)	**(n=278)**	**(%)**
Below – 39	36	13
40 – 49	113	40.7
50 – 59	102	36.7
60 – 69	27	9.6
70 -Above	0	0.0
Mean	48 years	
Gender		
Female	124	44.6
Male	154	55.4
Marital Status		
Single	17	6.1
Married	179	64.4
Widow	49	17.6
Widower	6	2.2
Divorced	27	9.7
Educational Status		
Informal	82	29.5
Primary	116	41.7
Secondary	55	19.8
Tertiary	25	9.0
Mode	Primary school	
Household Size		
2 – 4	8	2.9
5 – 7	39	14.0
8 – 10	106	38.1
11 – 13	81	29.1
14 – 16	44	15.9
Mean (persons)	10	
Annual Income (₦)		
21,000-60,000	133	47.8
61,000-100,000	141	50.7
101,000-140,000	3	1.1
141,000-180,000	1	0.4
181,000-220,000	0	0.0
221,000-260,000	0	0.0
Mean (₦)	62, 678 ($404)	

Author computed result, 2013.

Table 2: Analysis of temperature record from 1971 – 2009 (Bayelsa State)

Variable	Coefficient	Std. error	t-statistic	Prob.
C	16.25554	4.552420	3.570748	0.0010
BT (-1)	0.479719	0.145978	3.288486	0.0023
Temperature		**Value**		
Mean (^{0}C)		31.21		
Standard deviation (^{0}C)		0.41		
Maximum temperature (^{0}C)		31.93		
Minimum temperature (^{0}C)		30.23		
Trend coefficient (^{0}C/year)		0.48		
Coefficient of Variability (CV)		1.32		

Source: NIMET and Author computed result, 2013.

Table 3: Predicted Future values of Climatic Variables (Bayelsa State)

Year	2015	2020	2025	2030	2035	2040	2045	2050	CV
Temperature (^{0}C)	31.71	31.81	31.91	32.01	32.11	32.21	32.31	32.41	0.75%
Rainfall (mm)	197.88	199.76	201.66	203.58	205.52	207.48	209.45	211.44	2.27%

Source: Author computed projected values, 2013

Figure 1:Trend of Temperature Data for Bayelsa State from 1971 – 2009.

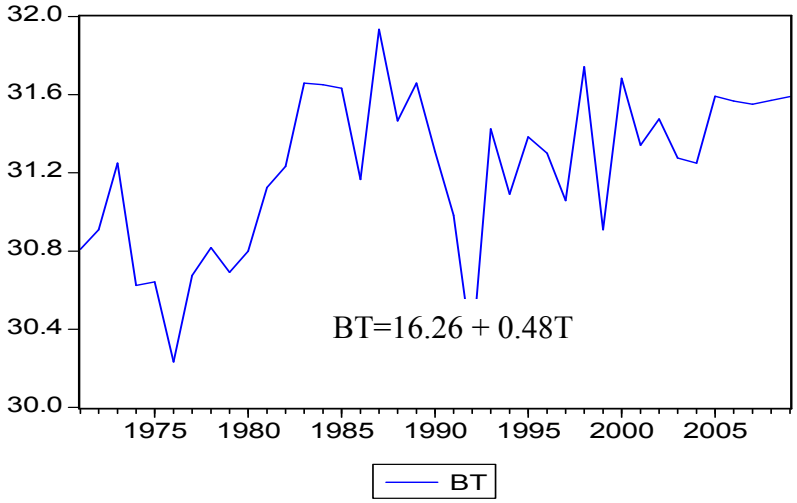


Figure 2: Predicted Future values of Climatic Temperature (Bayelsa State)

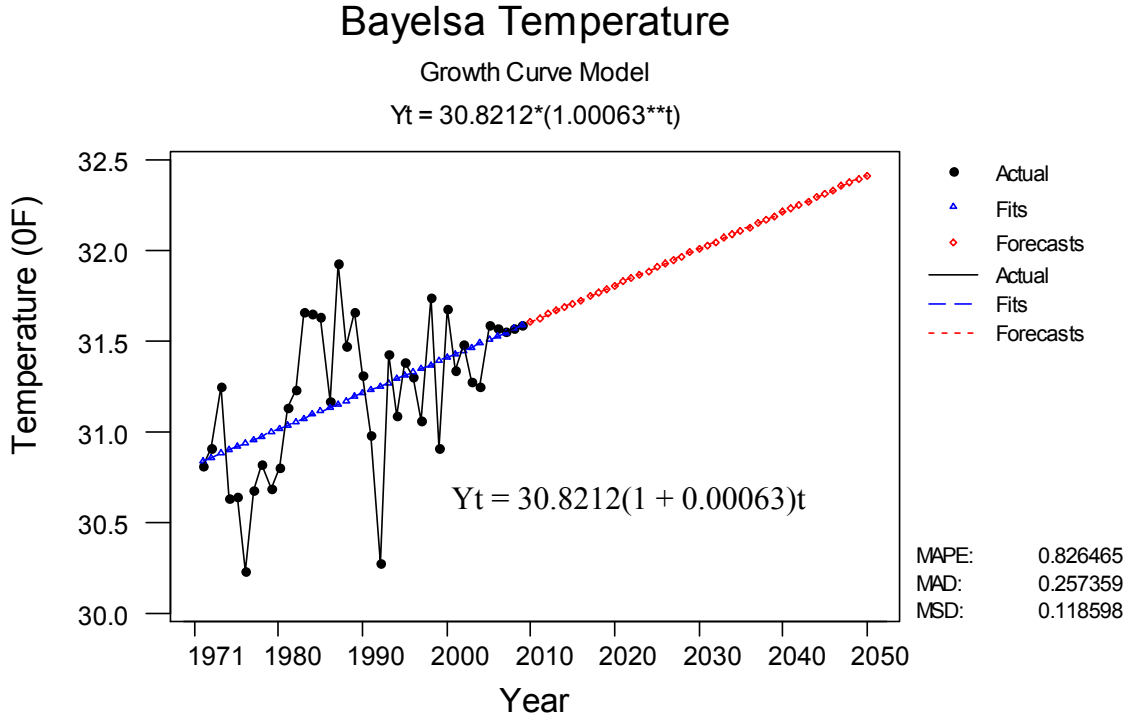
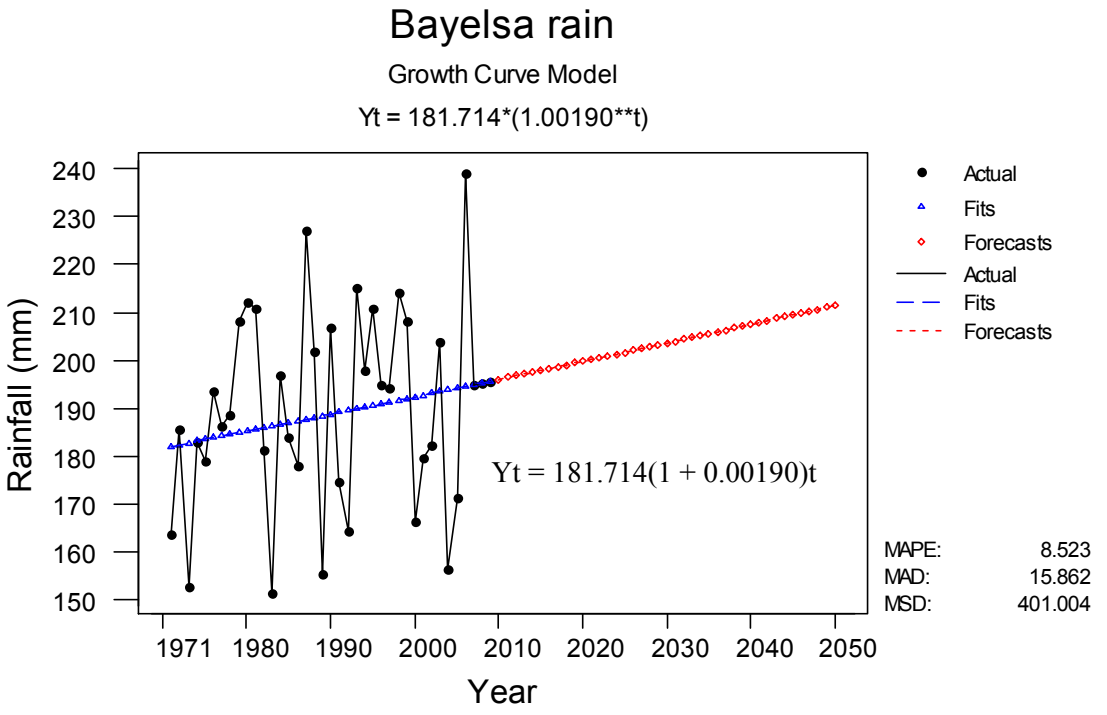


Figure 3: Predicted Future Values of Rainfall (Bayelsa State)



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