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CHANGES IN CLIMATIC CHARACTERISTICS AND CROP YIELD IN KWARA STATE (NIGERIA)

ABSTRACT. This paper assessed the vagaries of climatic elements on crop yield in Kwara State with a view to predicting the future climatic suitability level for selected crops in the state. Descriptive and infrential statistics analytical methods were used to examine the pattern of climatic elements for a period of 30 years. Analysis of variance was used to examine the variations in crop yield and also to determine whether or not significant differences in the harvests of the period under investigation. Correlation analysis was used to determine the relationship between climatic elements and crop yield while multiple regression analysis was used to determine the contribution of each climatic elements to crop yield. Time series analysis was used to project crop yield from 2014 to 2025. GAEZ model was adopted to determine the climatic suitability for the selected crops over time 1960 - 2050 and ArcGIS 10.3 software was used to produce the crop suitability maps. The result revealed that cassava, yam, maize and cowpea would be less suitable for production with the rate at which the climate is changing. The result also revealed that the climatic suitability level for cassava, yam, maize and cowpea would reduce drastically with time. The prediction shows severe impacts of changes in the selected climatic elements on both overall climatic suitability and crop the selected crops yield for by 2050.

KEY WORDS: Climatic elements, Climate change, Crop yield, Crop production, Crop suitability

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INTRODUCTION

According to IPCC 2009, agricultural production, including access to food, in many African countries is projected to be severely compromised. Projected reductions in yield in some countries could be as much as 50% by 2020, and crop net revenues could fall by as much as 90% by 2100, with small-scale farmers being the most affected. This would adversely affect food security in the continent and exacerbate malnutrition.

Researchers have shown that Nigeria is already being plagued with diverse ecological problems, which have been directly linked to the on-going climate change [Odjugo 2001; NEST 2003; Mshelia 2005; Ayuba et al. 2007]. However, the intent of this study is to assess the vagaries of climatic elements on crop yield in Kwara State with the view to predicting the future climatic suitability level of crop in the state. This study will specifically examine the pattern of climatic elements from 1985 –

2014; examine the variations in crop yields over a period (2002 – 2013); determine the relationship between climatic elements and crop yield; identify the contribution of each climatic elements to crop yield; map the current climatic suitability level of crops; project the crop yield from 2014 – 2025; and predict what the climatic suitability level would be by 2020 and 2050.

THE STUDY AREA

Kwara State is situated between latitudes 8°05′N and 10°05′N and longitudes 2°50′E and 6°05′E of the Greenwich meridian [Akpenpuun and Busari 2013]. It is one of the 36 states that make up the Federal Republic of Nigeria, Africa's most populous country. The State was created on May 27, 1967, when the Federal Republic of Nigeria was split into twelve states. It falls within the North-Central Geopolitical Zone of the country (Fig. 1). Kwara State consists of sixteen (16) Local Government Areas. Namely; Asa, Baruten, Edu, Ekiti, Ifelodun, Ilorin East, Ilorin South, Ilorin West, Irepodun, Isin, Kaiama, Moro, Offa, Oke-Ero, Oyun, and Pategi. Ilorin, the state capital is about 300kilometers away from Lagos and 500kilometers away from Abuja the federal capital of Nigeria [Tunde et al., 2013].

Kwara State landscape consists of a relatively flat and undulating land, lying at an altitude of between 265 and 480 meters above sea level [Ajibade, 2008]. The state is composed of Precambrian basement complex rocks – metamorphic and igneous rocks which is about 95% and sedimentary rock along the Niger River bank which is about 5% of the total area. According to Food and Agricultural Organization [FAO, 2003], Kwara State soils are classified into ferric luvisols, district nitosols, fluvisols and lithosols.

Kwara State lies within a region described as humid tropical climate. The Tropical Maritime air mass from the Atlantic Ocean is prevalent from March to October, while the Tropical Continental air mass from the Sahara desert takes over from November to February (Olaniran, 2002 adapted from [Jimoh and Adeoye, 2011]). The annual rainfall ranges from 800 mm to 1500 mm [Oladimeji et al., 2014] with minimum temperature ranging from 21.1^{0}C to 25^{0}C while average

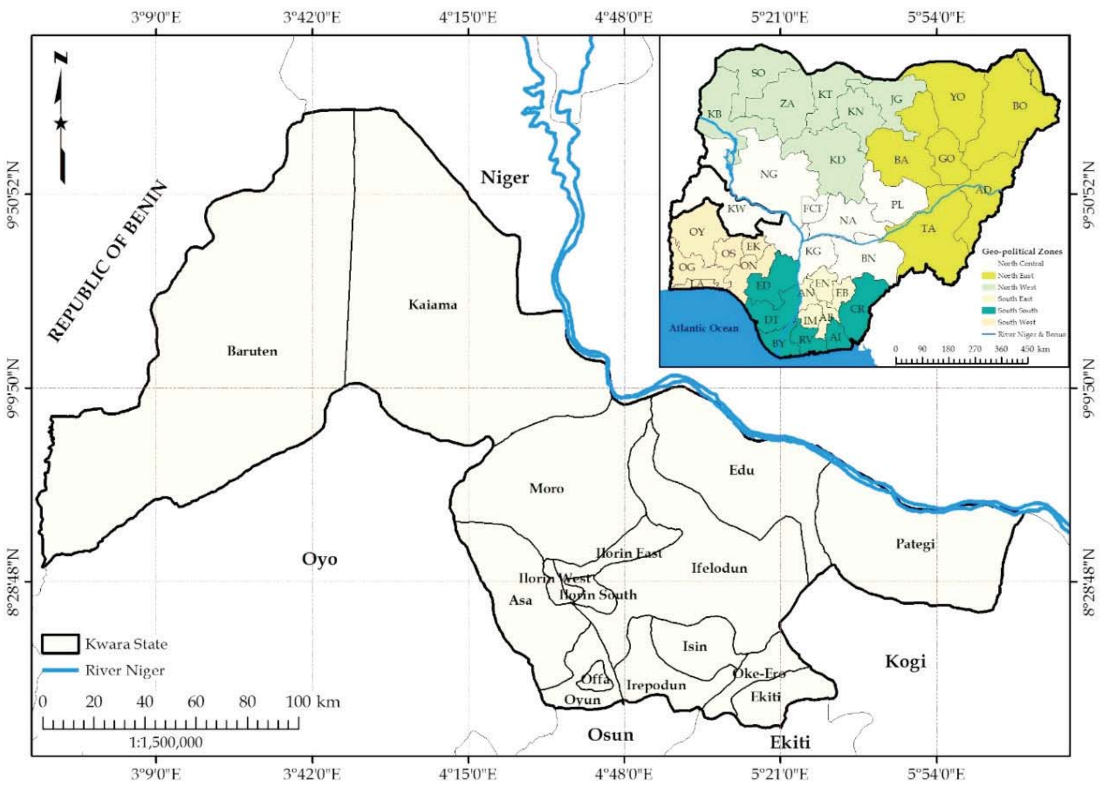

Fig. 1. Map of Kwara State Showing the Sixteen Local Government Areas
Inset: Map of Nigeria Showing the Six Geo-political Zones

maximum temperature ranges from 30⁰C to 35⁰C [Adesiji et al., 2012]. Relative humidity varies seasonally ranging from 75% to 80%. The daytime is sunny and the sun shines brightly for about 6.5 to 7.7 hours daily from November to May [Akpenpuun and Busari, 2013].

The natural vegetation cover of Kwara State belongs to the tropical savannah which comprises of derived savannah and guinea savannah. The derived savannah (rainforest) is found in the southern part of the state while the guinea savannah (woodland) is to the north.

According to the 2006 census reports, the population of Kwara State stood at 2.37 million consisting mainly of Yoruba, Nupe, Fulani and Baruba ethnic groups. The figure was projected with the annual growth rate of 3.2 percent to be 3.14 million in 2015 [National Population Commission 2015]. The average population density of the state as at 2015 is about 95 people per square kilometer. The three major religious faiths in Nigeria – Islam, Christianity and traditional, coexist within the state.

The population of the state is predominantly farmers that specialized in arable crops. Crops such as maize, cowpea, yam, cassava, groundnut, tomato, sorghum, millet, and sweet potato among others are cultivated on upland areas while rice cultivation is done on the lowland and floodplain of river Niger [KWADP, 2010]. Agriculture is the main productive economic activity in the state as farmers account for about 70% of the total population. It has about 260,528 farm families [KWADP, 2010] and approximately 25% of the land area of Kwara State (32,500 square kilometers) is used for farming.

MATERIALS AND METHODS

The descriptive analytical method was used to examine the pattern of climatic elements for a period of 30 years (1985 – 2014). Analysis of variance (ANOVA) was used to examine the variations in crop yield and also to determine whether or not significant differences exist between the harvests of the period under investigation. Correlation analysis was used to determine the relationship between climatic elements and crop yield while; multiple regression analysis was used to determine the contribution of each climatic elements to crop yield. Time series analysis was used to project crop yield from 2014 to 2025, GAEZ model was adopted to determine the climatic suitability (%) for the selected crops for 1960-1990, 1990–2020 and 2020–2050 and ArcGIS 10.3 software was used to produce the crop suitability maps.

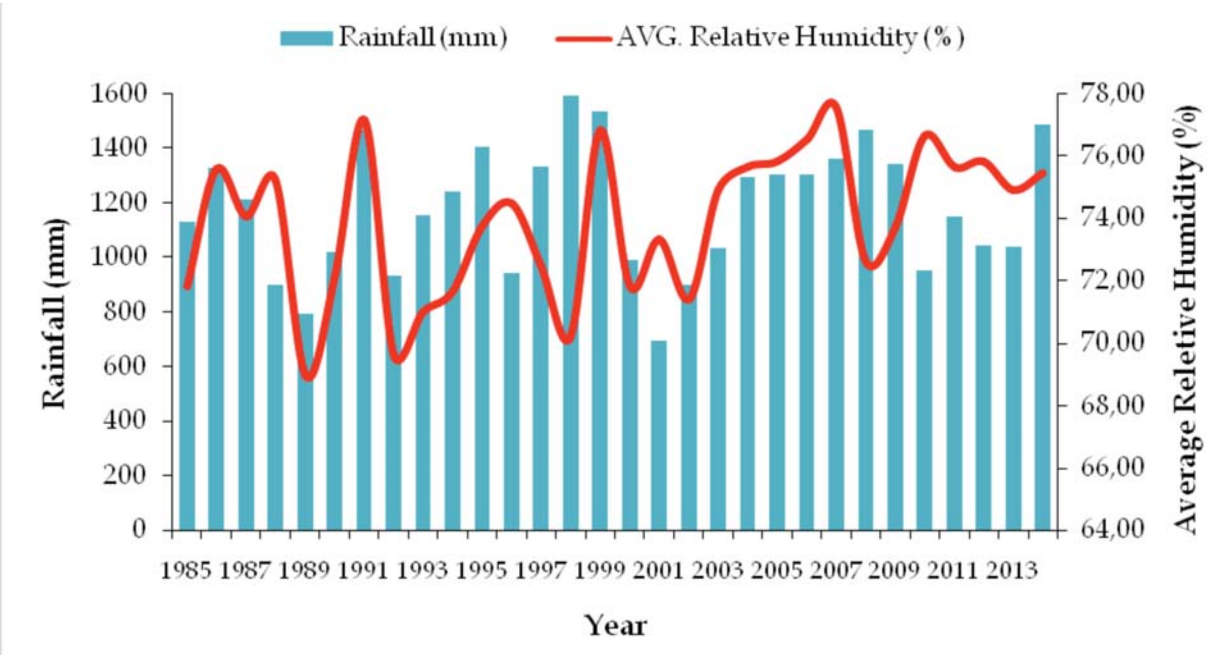

Fig. 2. Trends of Average Relative Humidity and Rainfall

Source: Researchers' computation, 2016

Table 1. Climatic Data for 1985 - 2014

Year	Rainfall (mm)	AVG. Relative Humidity (%)	Temperature (max)	Temperature (min)
1985	1133.3	71.83	32.49	21.68
1986	1328.4	75.58	31.88	21.59
1987	1213.7	74.08	33.10	21.99
1988	898.9	75.25	32.23	21.88
1989	794.6	69.00	32.19	20.69
1990	1020.1	72.08	32.42	21.77
1991	1468.4	77.17	31.76	21.73
1992	931.6	69.67	31.95	21.14
1993	1157.9	71.00	31.73	21.01
1994	1242	71.67	31.93	21.27
1995	1409.2	73.75	32.06	21.35
1996	945.3	74.50	32.38	21.51
1997	1334.4	72.50	31.87	21.48
1998	1595.5	70.25	32.41	22.04
1999	1539.3	76.83	31.88	20.79
2000	990.3	71.83	32.72	22.24
2001	697.1	73.33	33.18	21.63
2002	902.3	71.42	32.68	21.82
2003	1033.5	74.92	32.35	22.08
2004	1294	75.67	32.27	21.98
2005	1305.9	75.83	32.42	22.25
2006	1303.8	76.58	32.23	21.67
2007	1361.4	77.58	32.50	21.42
2008	1470.5	72.67	32.15	21.59
2009	1342.7	73.75	31.29	21.03
2010	953.6	76.67	32.33	21.19
2011	1150.8	75.67	32.27	21.63
2012	1046.3	75.83	32.42	21.82
2013	1040.6	74.92	33.03	22.03
2014	1490.5	75.48	32.92	22.13

Source: Nigeria Meteorological Service (NIMET) – Ilorin, 2016.

RESULTS AND DISCUSSION

The pattern of the climatic elements – rainfall, average relative humidity, minimum temperature and maximum temperature of Kwara State for the period 1985 – 2014 is presented in Table 1

For a better visual and comprehension of the pattern of the selected climatic elements, the results in Table 1 are hereby represented graphically in Figures 2, 3 and 4. Fig. 2 reveals that there are variations in the climatic elements tested. It is observed that rainfall amount fluctuates through the years under study with the highest value 1595.5mm recorded in 1998 and the lowest value 697.1mm in 2001. Average rainfall amount from 1985 to 2014 was 1179.86mm, therefore the values recorded in the years 1985, 1988, 1989, 1990, 1992, 1993, 1996, 2000 - 2003, and 2010 - 2013 are below the average. This can be regarded as years with low rainfall amount. Values for 1986, 1987, 1991, 1994, 1995, 1997, 1998, 1999, 2004, 2005 - 2009 and 2014 are above the average value and are said to have high rainfall amount.

Average relative humidity also experienced fluctuations over the year under study (Fig. 2) with the highest value in 2007 (77.58%) and lowest value in 1989 (69%). This is in conformity with the findings of Jimoh and Adeoye [2011] and [Tunde et al., 2011] where they also observed that there are variations in Kwara State's rainfall and average relative humidity over the years.

Figures 3 and 4 clearly show the fluctuations in minimum and maximum temperature over a period of 30 years (1985 – 2014). The highest minimum temperature was recorded in the year 2005 (22.25°C) while the lowest was recorded in 1989 (20.69°C) (see Fig. 3). The maximum temperature has been increasing and was highest in the year 2001 (33.18°C) and lowest in year 2009 (31.29°C) (see Fig. 4). The computed R^2=0.0436 and R^2=0.0417 in minimum temperature (Fig 3) and maximum temperature (Fig 4) respectively show an upward of temperatures in the study area. The computed R^2 implies that minimum temperature increased at the rate of 4.36%, while maximum temperature was 4.17%. The minimum temperature increased faster than the maximum temperature.

Table 2 presents the yield of the selected crops in Kwara State for the year 2002-2013. The table reveals that there are variations in the yield of the selected crops. The crops are of two types: Tubers – Cassava and Yam and Grains – Maize and Cowpea. The table revealed that tuber crops are produced more than grains in the study area. However, the rate of change in crop production yield in the four crops varies (negative and positive) over the years.

Fig. 5 shows the trend of the yield. Cassava which is the leading crop has the highest yield in the year 2013 (17.48), lowest in 2004 (12.21), increase steadily from 2009 to 2013. Yam has its highest output in 2013 (14.45) and lowest output in 2003 (10.86),

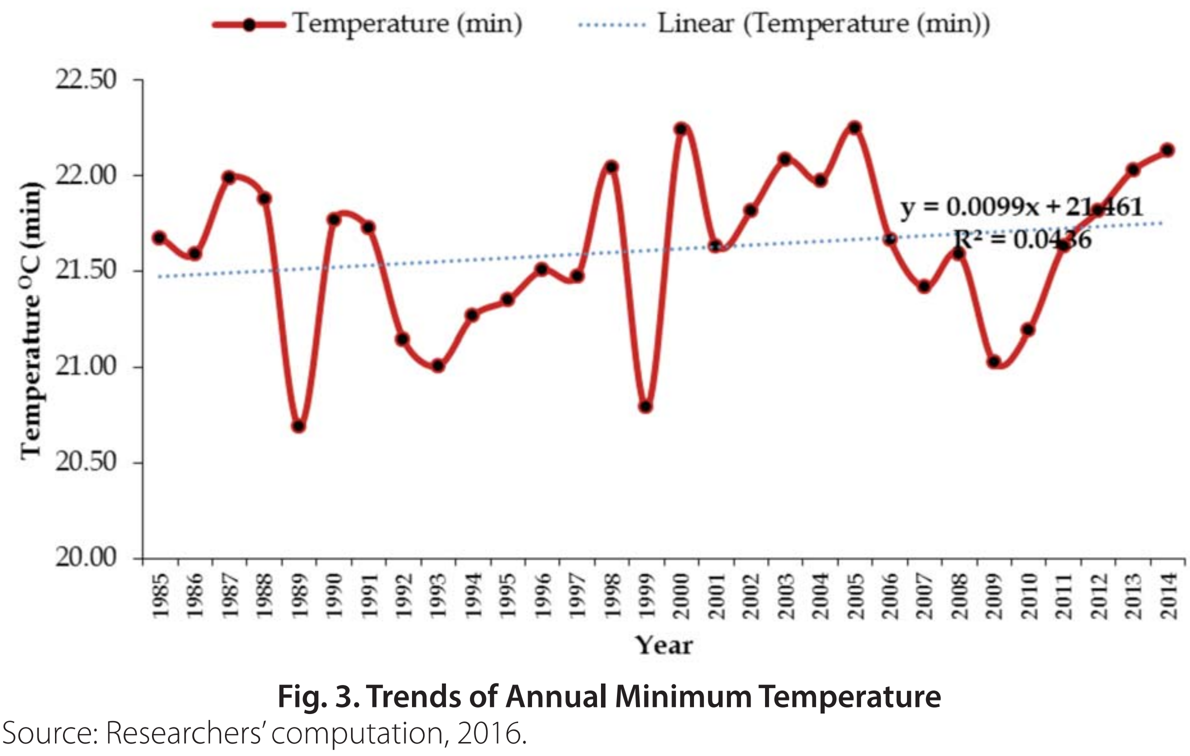

Fig. 3. Trends of Annual Minimum Temperature

Source: Researchers' computation, 2016.

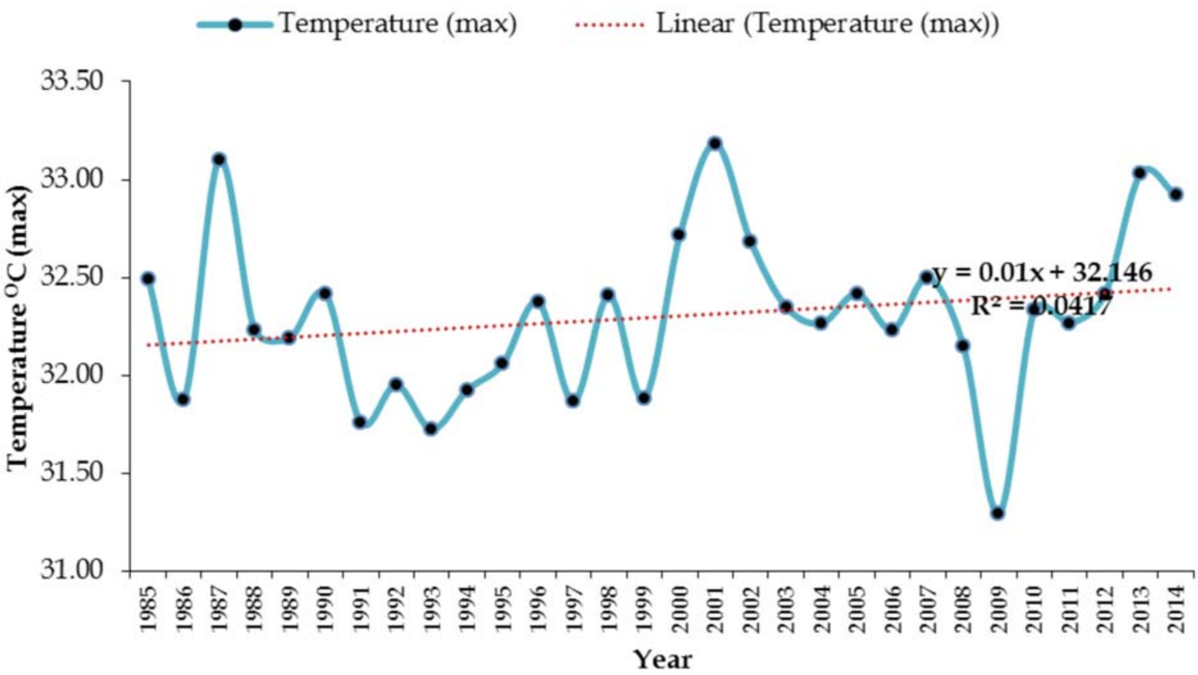

Fig. 4. Trends of Annual Maximum Temperature

Source: Researchers' computation, 2016.

Table 2. Crop Yield (Tons/Ha) in '000 (2002 – 2013)

Year	Tuber				Grain			
	Cassava	%	Yam	%	Maize	%	Cowpea	%
2002	12.94	0.00	12.33	0.00	1.3	0.00	0.14	0.00
2003	12.56	-2.94	10.86	-11.92	1.47	13.08	0.17	21.43
2004	12.21	-2.79	11.7	7.73	1.25	-14.97	0.13	-23.53
2005	12.46	2.05	11.63	-0.60	1.35	8.00	0.25	92.31
2006	15.28	22.63	11.85	1.89	1.58	17.04	0.26	4.00
2007	16.99	11.19	11.66	-1.60	1.37	-13.29	0.44	69.23
2008	17.14	0.88	12.46	6.86	1.43	4.38	0.4	-9.09
2009	15.97	-6.83	12.46	0.00	1.5	4.90	0.45	12.50
2010	16.48	3.19	12.53	0.56	1.47	-2.00	0.43	-4.44
2011	16.8	1.94	13.14	4.87	1.49	1.36	0.46	6.98
2012	16.98	1.07	13.83	5.25	1.58	6.04	0.65	41.30
2013	17.48	2.94	14.45	4.48	1.59	0.63	0.91	40.00

Source: Kwara State Agricultural Development Project (KWADP), 2016.

while there is no much variation in the output of maize and cowpea. The changes were attributed to variations in the climatic condition of the study area.

The result of the descriptive statistics of the yield of selected crops is presented in Table 3. The table shows that the annual average yield was 6.68 in 2002, 6.27 in 2003, 6.32 in 2004 and 6.42 in 2005. However, the annual average yield was not less than 7.24 from 2006 up till 2011, this rose to 8.26 and 8.61 in 2012 and 2013 respectively. Since 2007 the annual average has been above the cumulative average (7.38) for the year under study (Table 3).

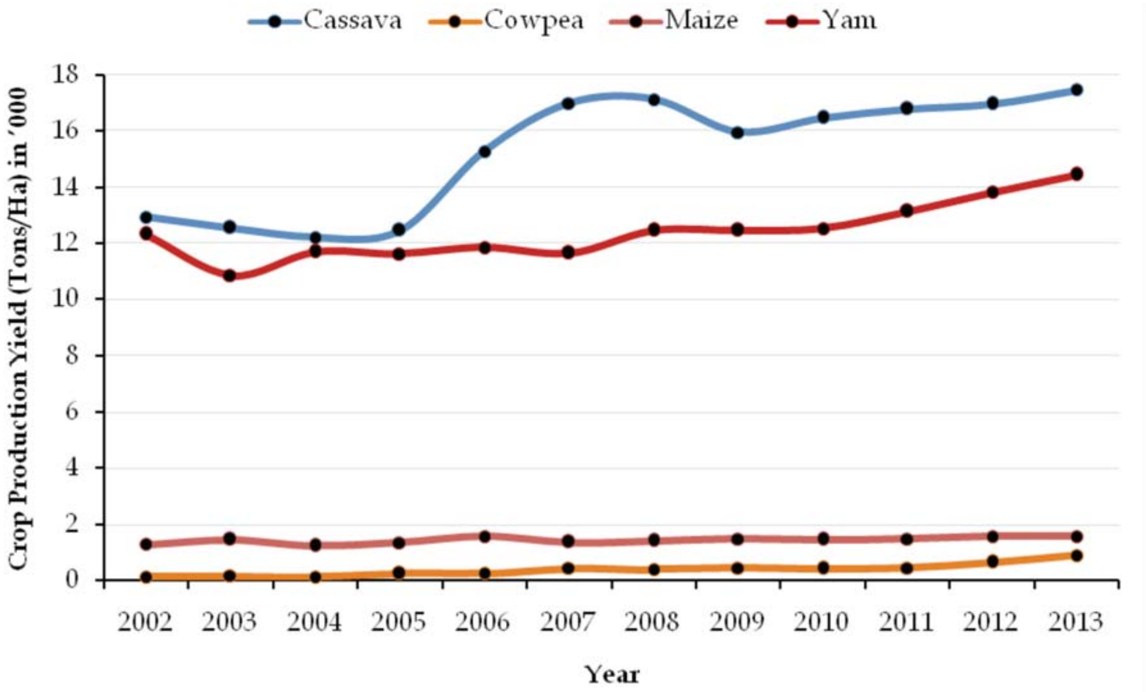

Fig. 5. Line Graph Showing Crop Production Yield (2002 - 2013)

Source: Researchers' computation, 2016.

The result of the Analysis of Variance is presented in Table 4. It is clear that the years of crop production has no effect on the crop yields (F (11, 36) = 0.43, p>.05). The result revealed that there was no significant variation in the crop yields for the years under study (2002 to 2013).

Table 5 reveals the relationship between climatic data and crop yield. There was no

Table 3. Descriptive Statistical Results of Crop Yield in 2002 - 2013

Year	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2002	4	6.678	6.900	3.450	-4.30	17.66	0.14	12.94
2003	4	6.265	6.348	3.174	-3.84	16.37	0.17	12.56
2004	4	6.323	6.523	3.262	-4.06	16.70	0.13	12.21
2005	4	6.423	6.517	3.258	-3.95	16.79	0.25	12.46
2006	4	7.243	7.453	3.727	-4.62	19.10	0.26	15.28
2007	4	7.615	8.057	4.028	-5.21	20.44	0.44	16.99
2008	4	7.858	8.252	4.126	-5.27	20.99	0.40	17.14
2009	4	7.595	7.789	3.895	-4.80	19.99	0.45	15.97
2010	4	7.728	8.002	4.001	-5.00	20.46	0.43	16.48
2011	4	7.973	8.228	4.114	-5.12	21.06	0.46	16.80
2012	4	8.260	8.359	4.179	-5.04	21.56	0.65	16.98
2013	4	8.608	8.590	4.295	-5.06	22.28	0.91	17.48
Total	48	7.380	6.716	0.969	5.43	9.33	0.13	17.48

Source: Researchers' computation, 2016.

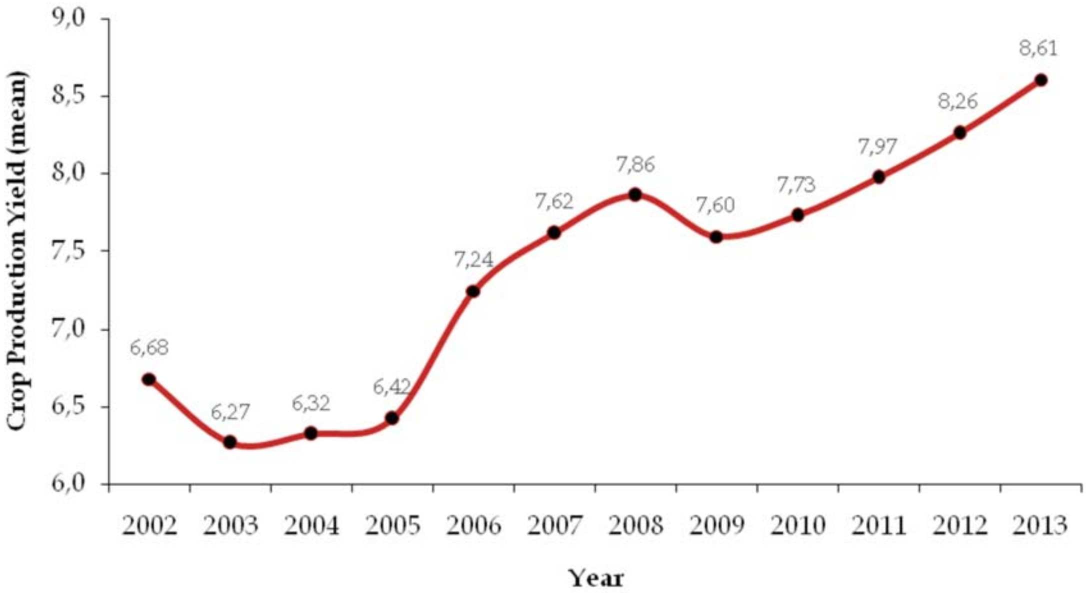

Fig. 6. Line Graph Showing the Mean Crop Yield (2002 - 2013)
Source: Researchers' computation, 2016.

Table 4. Statistical Variation in Crop Yield

	Sum of Squares	*df*	Mean Square	F	Sig.
Between Groups	27.493	11	2.499	.043	>.05
Within Groups	2092.551	36	58.126		
Total	2120.044	47			

Source: Researchers' computation, 2016.

significant association between rainfall and cassava (r=0.107), cowpea (r=-0.127), maize (r=-0.155). This indicates that increase or decrease in the rainfall did not significantly relate to increasing or decrease in the yield of cassava, cowpea, and maize. Rainfall has a negative relationship with yam (r=-0.311), the result implies that increase in rainfall significantly related to decrease or poor yield of yam.

The result further revealed that AVG relative humidity has no significant positive relationship with cassava (r=0.189), cowpea (r=0.168) and yam (r=-0.103). This implies that increase or decrease in AVG relative humidity did not significantly relates to increase or decrease in the yield of cassava, cowpea and yam. However, there was significant positive and weak relationship between AVG relative humidity and maize

Table 5. Correlation of Climatic Elements and Crop Yield

Crop	Rainfall (mm)	AVG. Relative Humidity (%)	Temperature (max)	Temperature (min)
Cassava	.107	.189	-.011	-.552
Cowpea	-.127	.168	.250	-.151
Maize	-.155	.214	-.034	-.190
Yam	-.311	-.103	.290	-.076

Correlation is significant at the 0.05 level (2-tailed).
Source: Researchers' computation, 2016.

(r=0.214), indicating that increase in AVG relative humidity significantly relates to high yield of maize. Meaning that the high AVG relative humidity will lead to high yield of maize

Furthermore, maximum temperature have no significant positive relationship with cassava (r=-0.011), and maize (r=-0.034), indicating that increase or decrease in maximum temperature did not significantly relates to increase or decrease in the crop yield. The result of the analysis further reveals that there was a significant positive though weak relationship between maximum temperature and yield of cowpea (r=0.250), and yam (r=0.290). The result indicates that maximum temperature is needed for good yield of cowpea and yam. The result also shows that minimum temperature has an inverse and a weak relationship with maize (r=-0.190). This implies that increase in the minimum temperature leads to a significant decrease in the yield of maize.

Multiple Regression analysis was employed to determine the percentage contribution of each of the climatic elements to crop yield (Table 6). The regression equation used for this analysis is; $Y = a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+e$, where Y = Crop yield, X_1 = Rainfall, X_2 = Relative Humidity, X_3 = Minimum Temperature, X_4 = Maximum Temperature, e = error term, a = intercept i.e. the value of 'y' when x_1x_2 - - - - - x_n are zero b_1b_2 - - - - - , b_n = gradient of the multiple regression line.

The regression analysis computed for the crops (Table 6) revealed that cassava, cowpea, maize, and yam have the following coefficient of determination 0.55, 0.22, 0.13 and 0.23 respectively. The result accounted for 55%, 22%, 13% and 23% of the change observed in the variance of the crops. The result indicates that 45%, 78%, 87% and 77% of the differences in cassava, cowpea, maize and yam can be explained by other factors that were not included in the model. By implication, the climatic condition has a significant influence on cassava. This is in line with Olanrewaju [2010] findings in her study on the effect of Climate on Yam Production in Kwara State, Nigeria which established that climatic elements plays crucial roles in the productivity rate of yam in Kwara State. Similarly, Tunde, et al, [2011] in their study on the effects of climatic variables on crop production in Pategi L.G.A., Kwara State reported that variation in rainfall, relative humidity, maximum and minimum temperature have a great effect on crop yield.

Time series analysis was used to project the obtained crop yield data (2002-2013) from Kwara State Agricultural Development Project (KWADP) office in Ilorin. The result of the projection (2014 - 2025) reveals that there would be a steady increase in cowpea yield, while cassava, maize, and yam would experience variations over the projected years (see Table 7). The result also follows the pattern of the data used for the projection. For example, the crop yield for cassava, maize and yam drop in 2009 which is the 8th year and the same trend was observed in the year 2021 (also the 8th year). The result obtained in both years (2009 and 2021) are less than their previous years (2008 and 2020). The result is illustrated in Fig. 6. It must however be noted that the projection was done based the obtained crop yield data from KWADP and therefore any change in the inputs and management levels, climatic condition and

Table 6. Regression of Climatic Elements and Crop Yield

Crop	R	R^2	Standard Error	F	P-Value
Cassava	0.740	0.547	1.77276	2.115	.182
Cowpea	0.474	0.224	0.25035	0.506	.734
Maize	0.358	0.128	0.13090	0.257	.896
Yam	0.479	0.229	1.10700	0.520	.725

Source: Researchers' computation, 2016.

Table 7. Projected Crop Yield for 2014-2025

Year	Cassava	Cowpea	Maize	Yam
2014	14.23	1.54	1.43	13.56
2015	13.82	1.87	1.62	11.95
2016	13.43	1.43	1.38	12.87
2017	13.71	2.75	1.49	12.79
2018	16.81	2.86	1.74	13.04
2019	18.69	4.84	1.51	12.83
2020	18.85	4.40	1.57	13.71
2021	17.57	4.95	1.65	13.71
2022	18.13	4.73	1.62	13.78
2023	18.48	5.06	1.64	14.45
2024	18.68	7.15	1.74	15.21
2025	19.23	10.01	1.75	15.90

Source: Researchers' computation, 2016.

so on could affect the projected yields (Fig. 7).

CROP CLIMATIC SUITABILITY LEVEL

Climatic suitability for the crop is the level of current climatic characteristics that permit successful crop growth. This entails matching crop/LUT requirements with the prevailing climatic conditions. GAEZ model was used to produce the suitability maps in this study using the combined climate related constraints. The model provides information on the climate-related constraints affecting crop yields. These constraints include temperature, moisture, and yield due to pests, diseases and soil.

In GAEZ, three generic levels of agricultural practices are defined: low, intermediate, and high levels. However, the intermediate level was used for this study, because it is believed

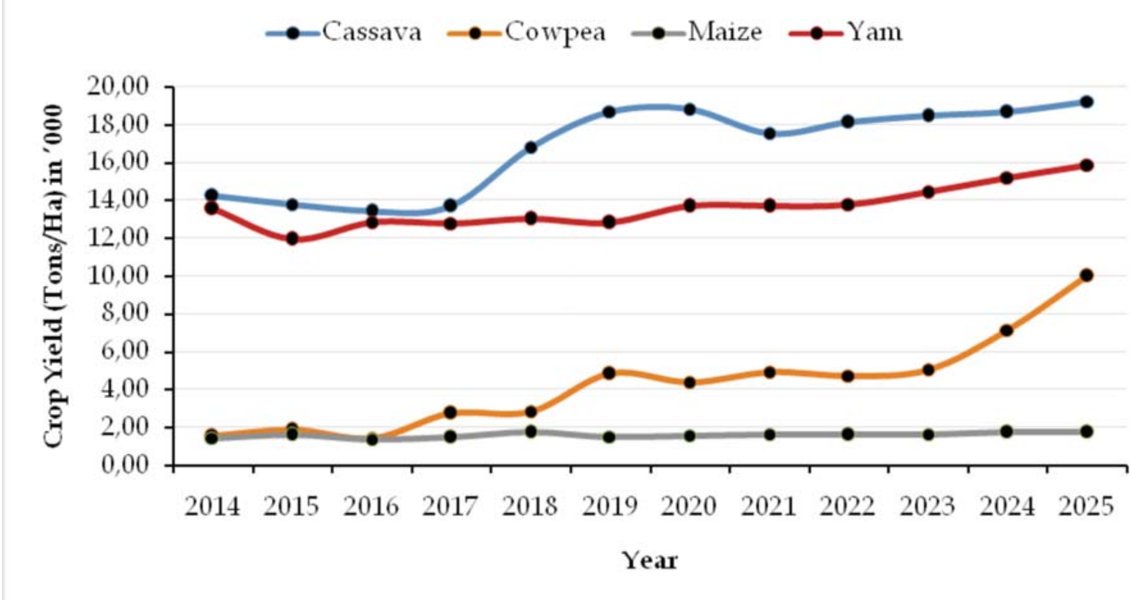

Fig. 7. Line Graph Showing the Projected Crop Yield (2014 - 2025)
Source: Researchers' computation, 2016.

to be the most appropriate level of agricultural practice to use in this type of research. Under an intermediate level, the farming system is partly market oriented. Production for subsistence plus commercial sale is a management objective. Production is based on improved varieties, on manual labor with hand tools and/or animal traction and some mechanization, is medium labor intensive, uses some fertilizer application and chemical pest disease and weed control, adequate fallows and some conservation measures. The model has been applied considering the 30-year period (climatic cycle) i.e. the baseline period 1960-1990, 1990–2020 and 2020-2050.

The climate data from the Canadian Centre for Climate Modeling and Analysis (CCCma) Coupled Global Climate Model (CGCM2) of IPCC (Intergovernmental Panel on Climate Change) SRES (Special Report on Emissions Scenarios) A2 scenarios was adopted in the model used. CGCM2 is the second generation coupled global climate model. The A2 scenario describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing the global population. Economic development is primarily regionally oriented, and per capita economic growth and technological change are more fragmented and slower than in other scenarios [FAO/IIASA, 2011].

Figures 8, 9 and 10 show Kwara state climatic suitability maps of cassava for years 1961-1990, 2020 and 2050 respectively. The suitability values are given in percent (0-100) i.e. > 0.95, 0.9-0.95, 0.8-0.9, 0.7-0.8, 0.6-0.7, 0.5-0.6, 0.4-0.5, 0.3-0.4, 0.2-0.3, < 0.2 which is 95-100%, 90-95%, 80-90%, 70-80%, 60-70%, 50-60%, among others. The result reveals that cassava suitability decreases with time as a result changes in the climatic elements; rainfall, relative humidity, minimum temperature and maximum temperature. Cassava is 70-100% suitable in the base period (Fig. 8) while some parts of the state fell below 70% in years 2020 and 2050 (Figs 9 and 10).

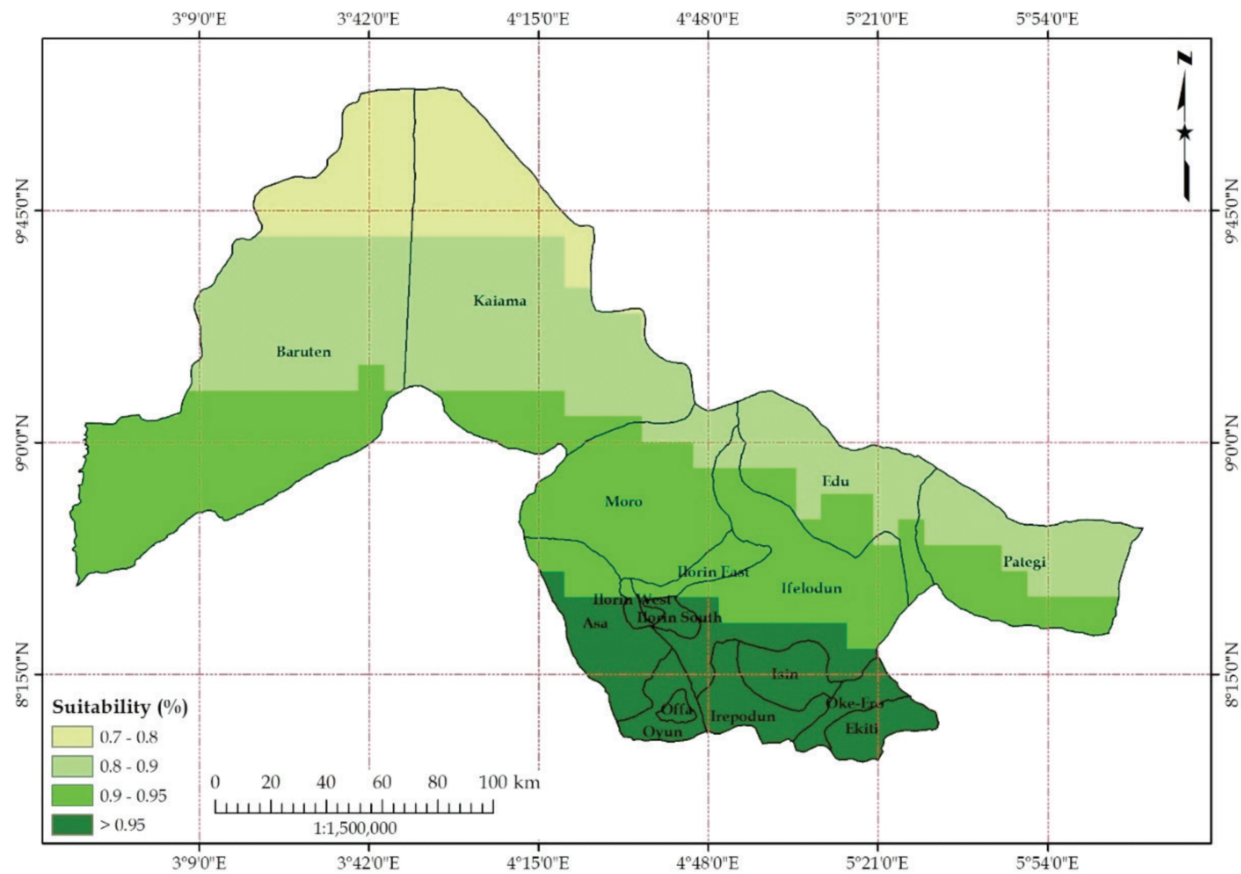

Fig. 8. Cassava Suitability Map for Baseline Period (1961-1990)

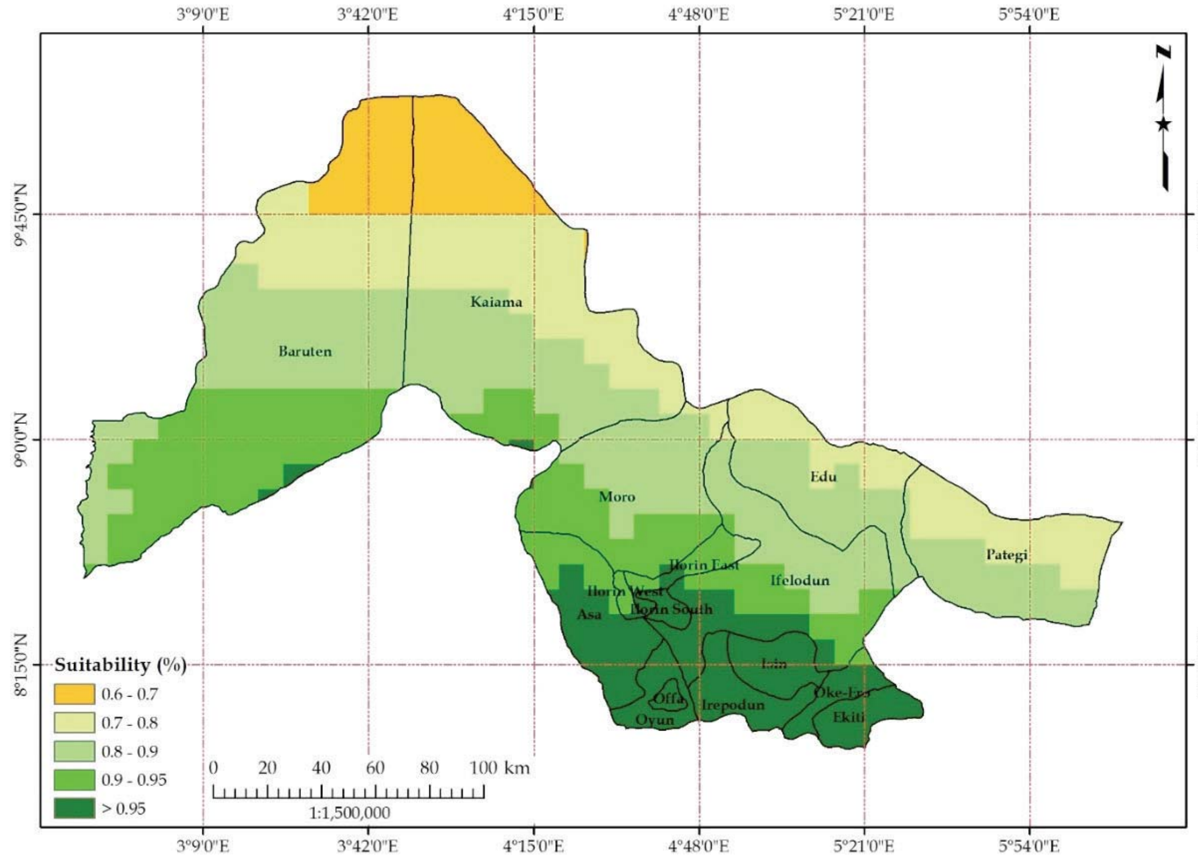

Fig. 9. Cassava Suitability Map for 2020

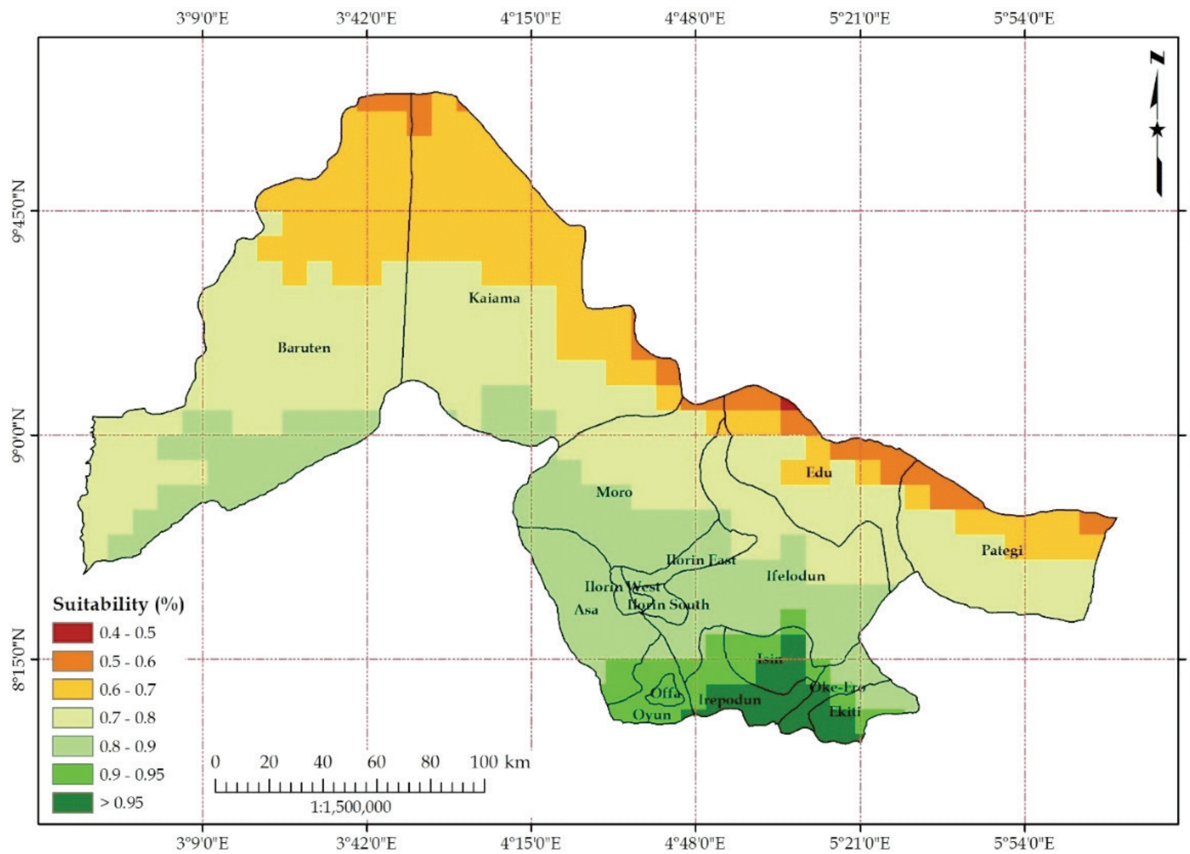

Fig. 10. Cassava Suitability Map for 2050

Figures 11, 12 and 13 show Kwara state climatic suitability maps of cowpea for years 1961-1990, 2020 and 2050 respectively. The suitability values are given in percent (0-100). The result reveals that cowpea is 95-100% suitable for years 1960-1990 and 2020. However, it reduces to 90-95% in parts of Kaiama, Moro, Edu and Pategi Local Governments areas of the state in year 2050 (Fig. 13).

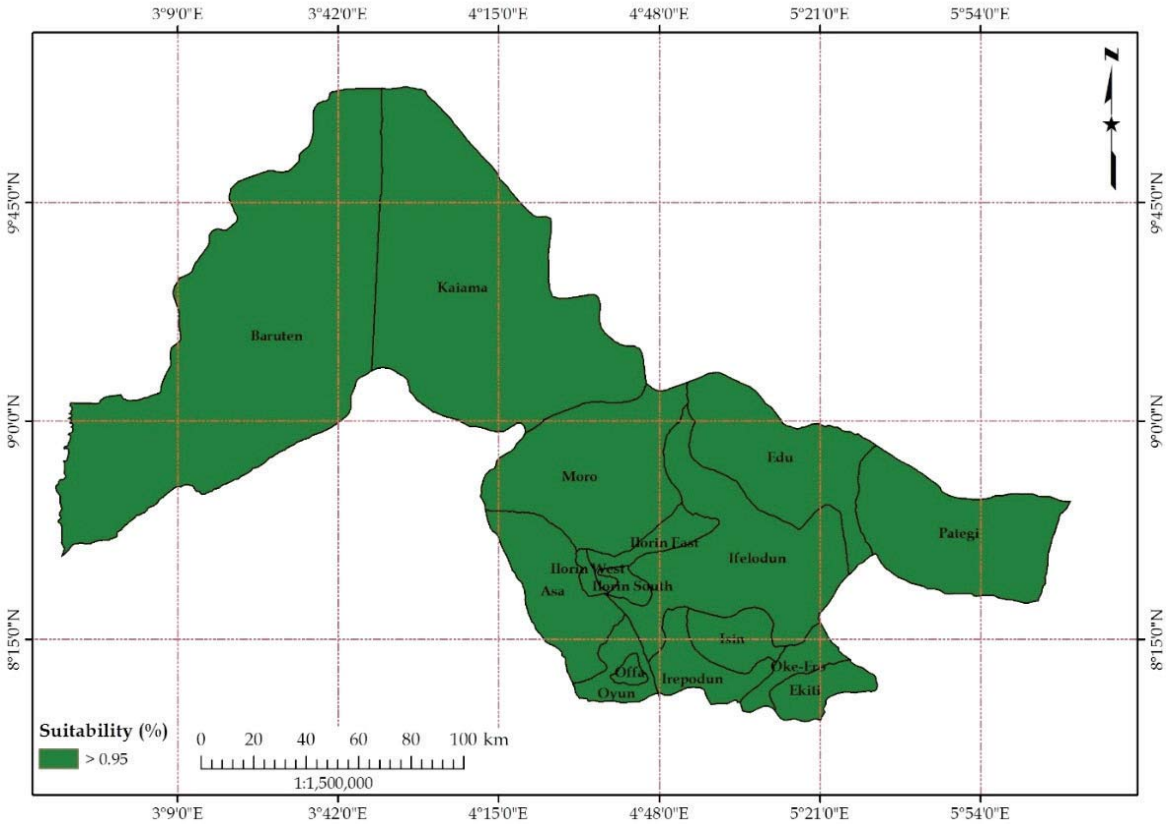

Fig. 11. Cowpea Suitability Map for Baseline Period (1960-1990)

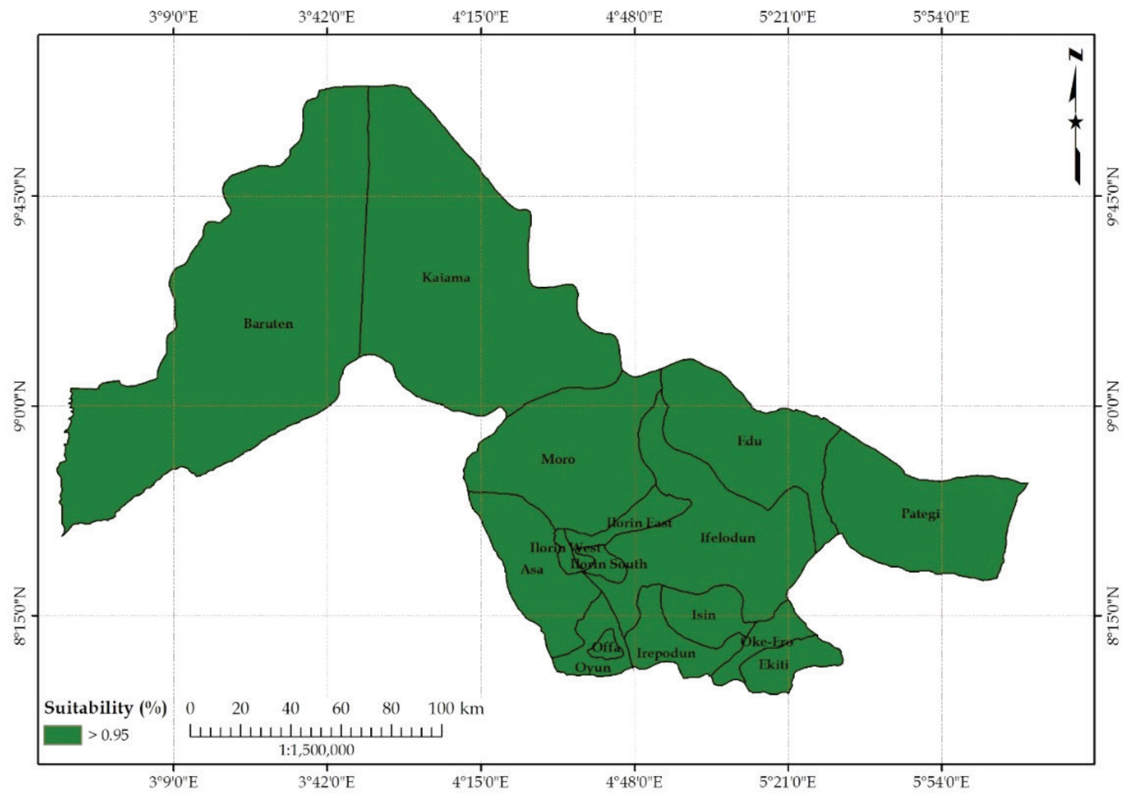

Fig. 12. Cowpea Suitability Map for 2020

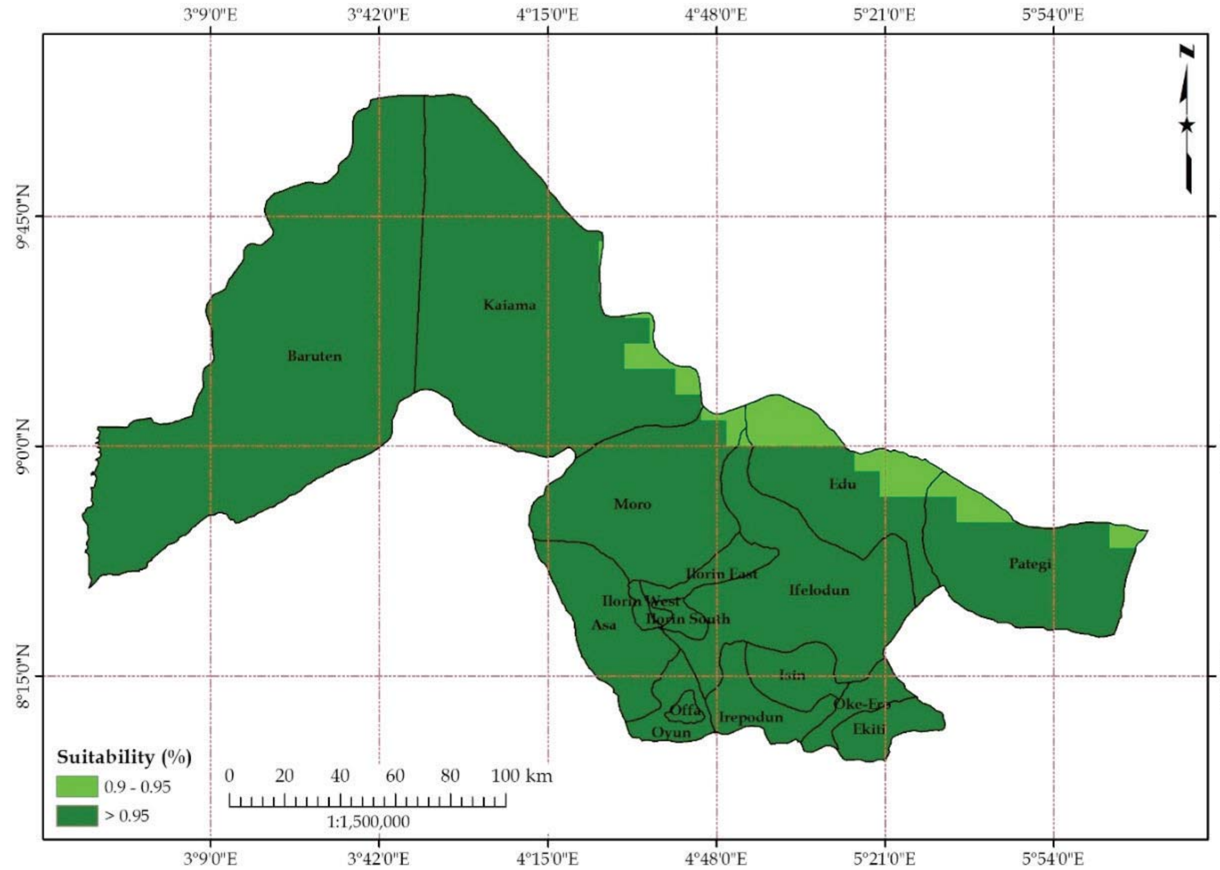

Fig. 13. Cowpea Suitability Map for 2050

Figures 14, 15 and 16 show Kwara state climatic suitability maps of maize for years 1961-1990, 2020 and 2050 respectively. The result reveals that maize is 80-100% suitable for years 1960-1990, 2020 and 2050.

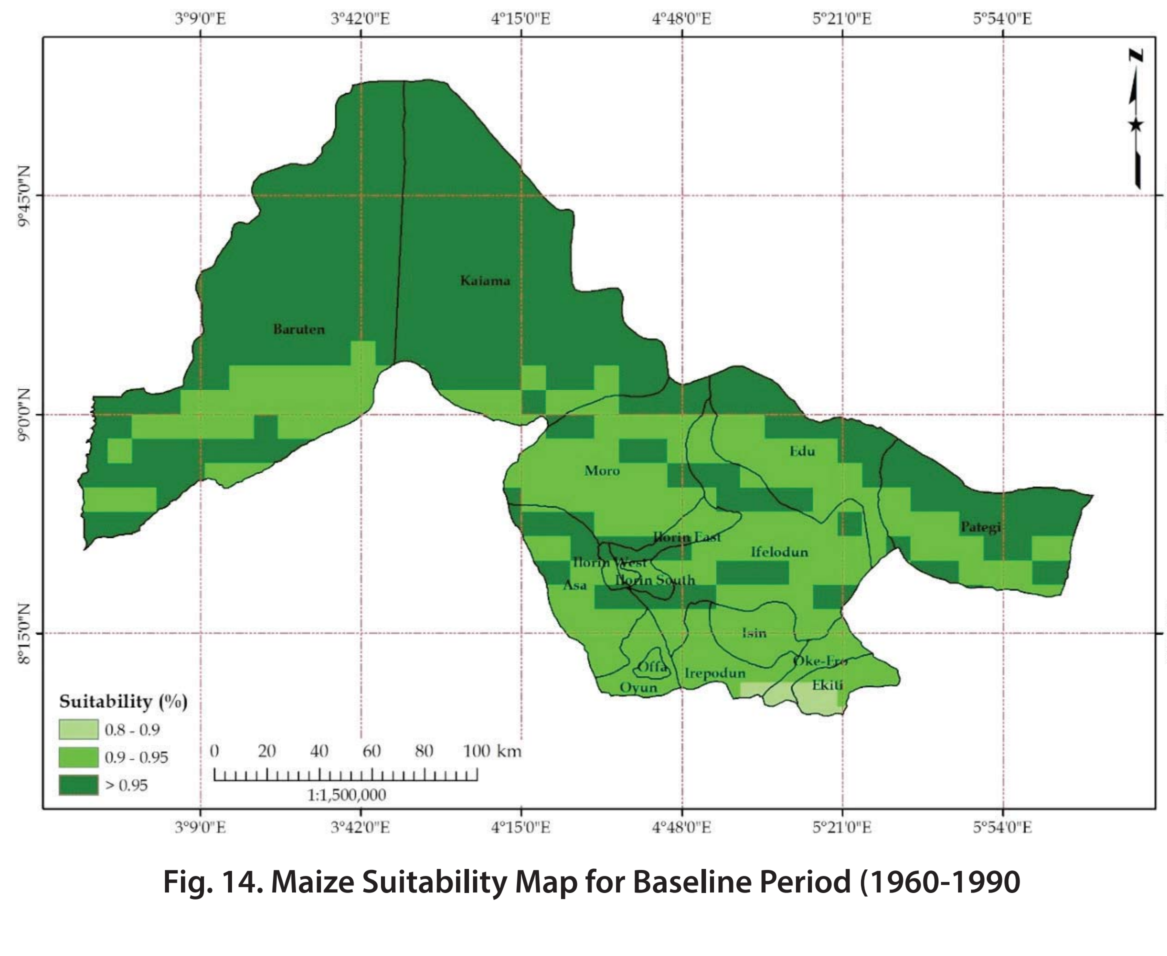

Fig. 14. Maize Suitability Map for Baseline Period (1960-1990

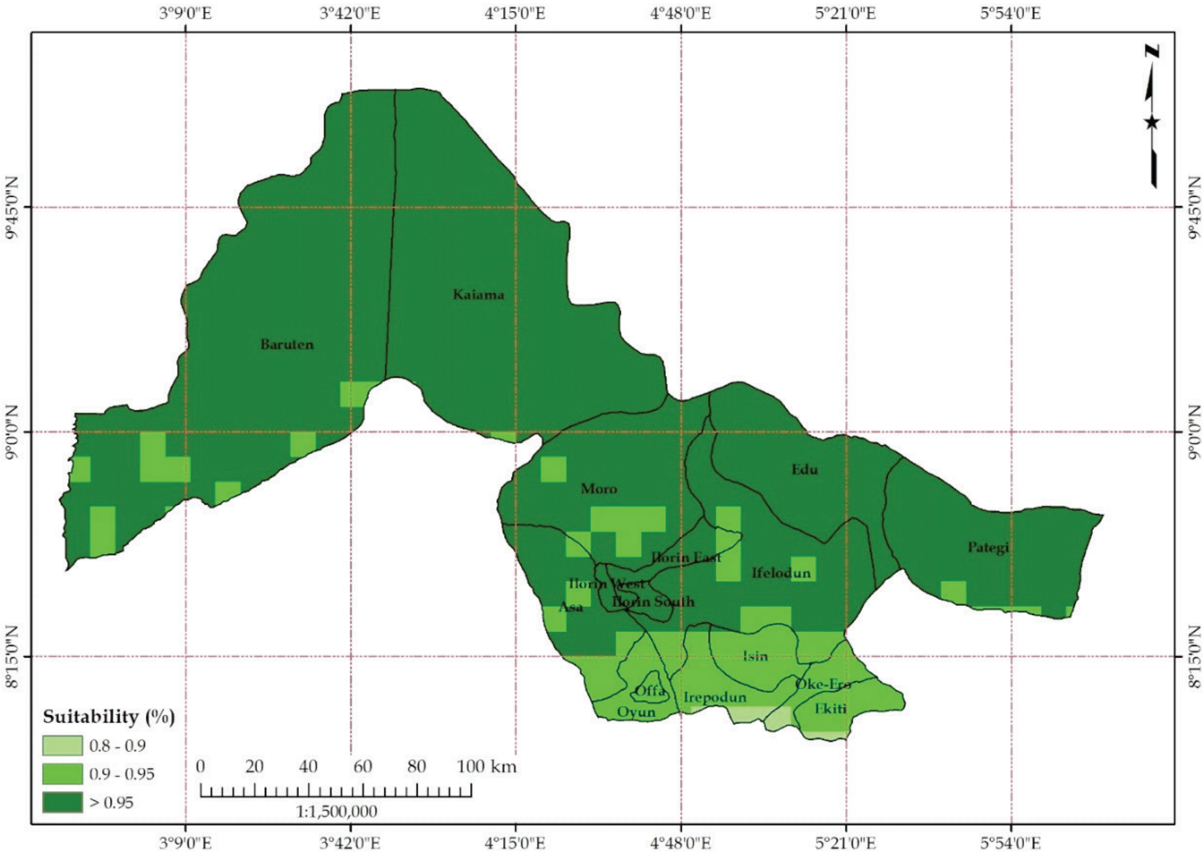

Fig. 15. Maize Suitability Map for 2020

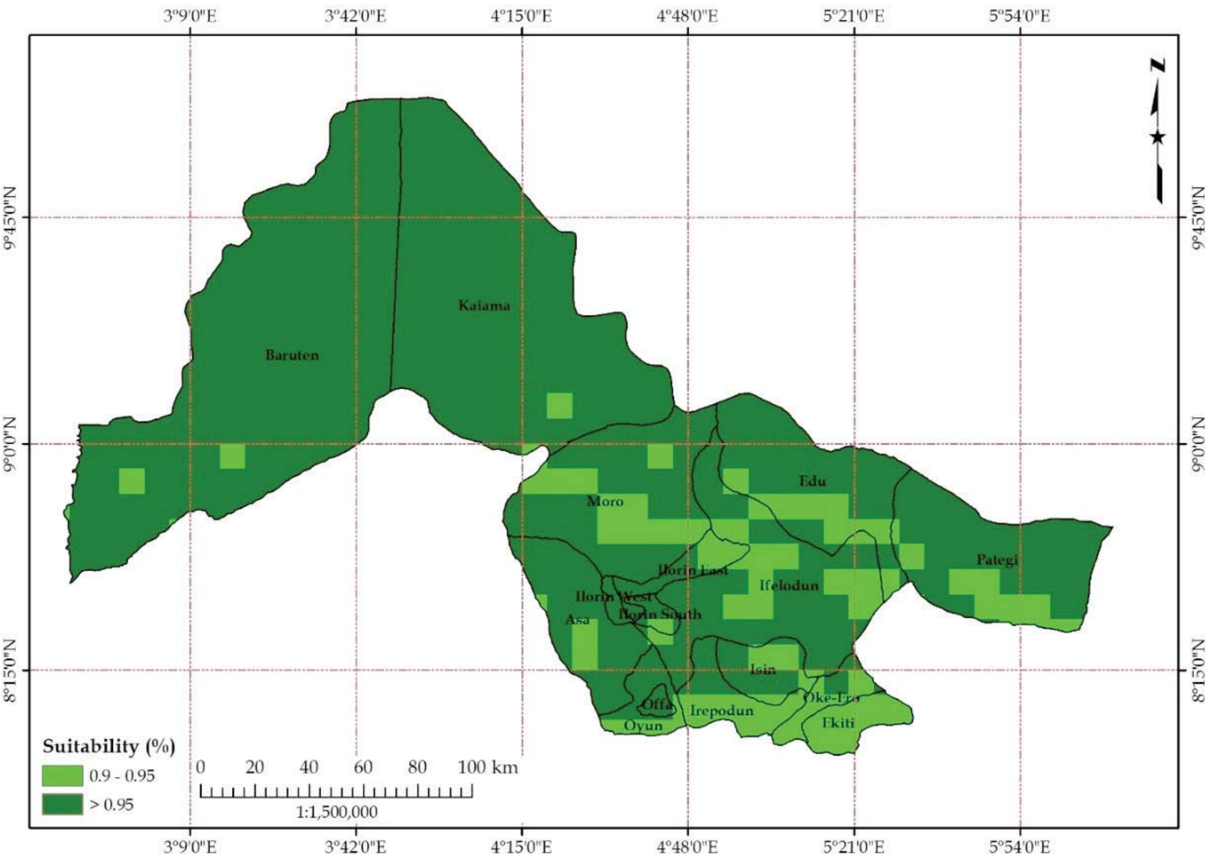

Fig. 16. Maize Suitability Map for 2050

Figures 17, 18 and 19 show Kwara state climatic suitability maps of yam for years 1961-1990, 2020 and 2050 respectively. The result reveals that maize is 70-100% suitable for years 1960-1990 and 2020. However, parts of Kaiama, Moro, Edu and Pategi Local Governments areas of the state would not be suitable for yam production by year 2050 (Fig. 19).

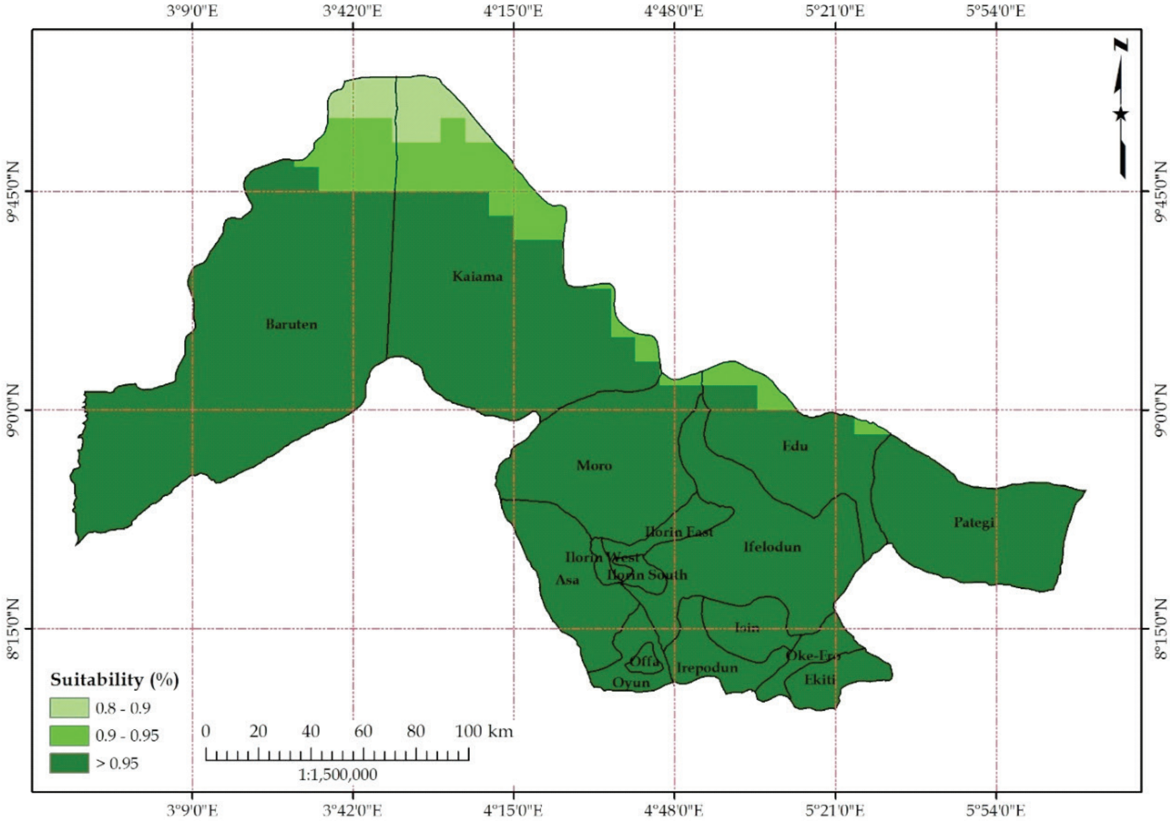

Fig. 17. Yam Suitability Map for Baseline Period (1960-1990)

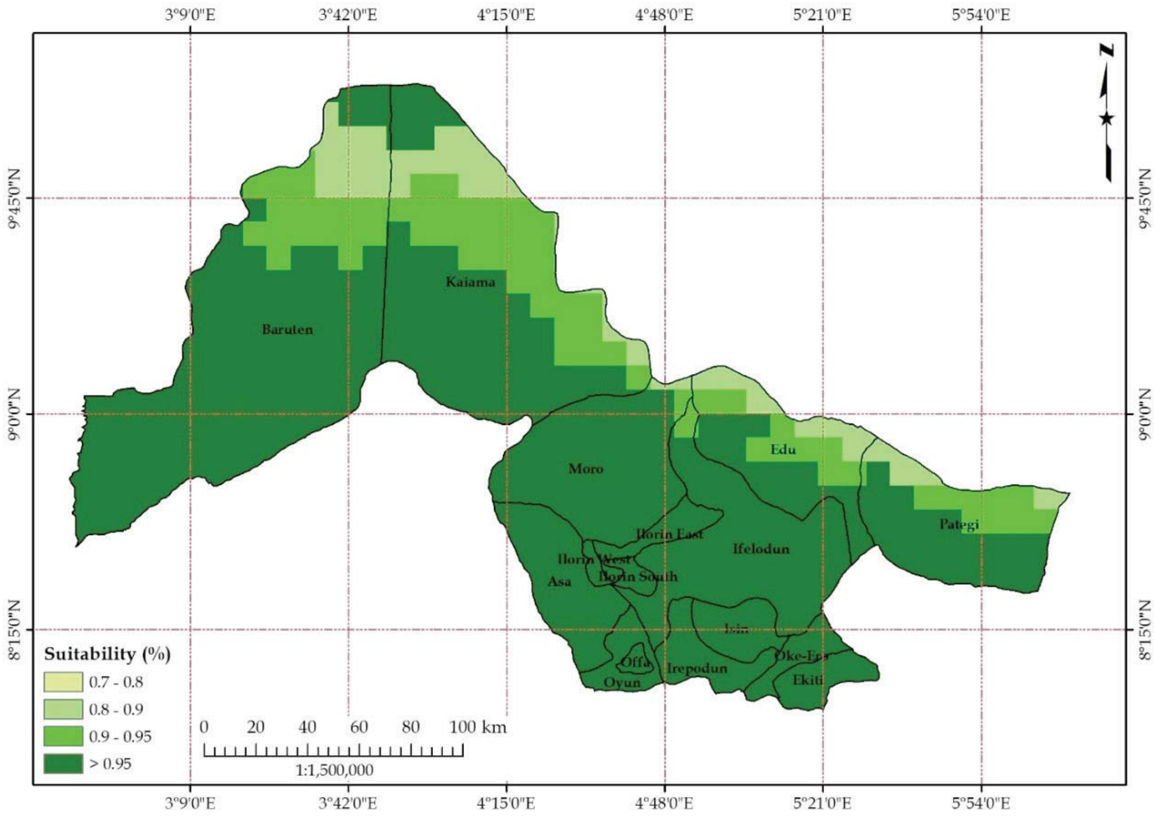

Fig. 18. Yam Suitability Map for 2020

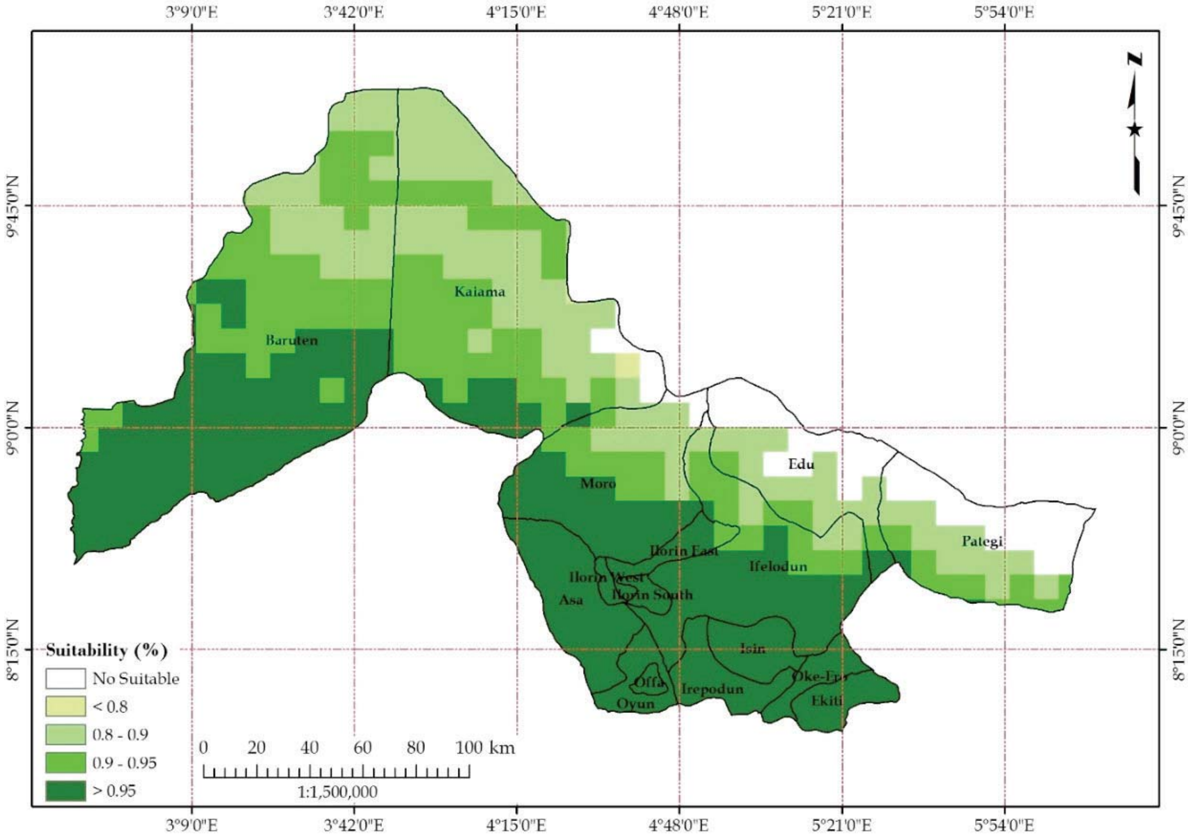

Fig. 19. Yam Suitability Map for 2050

CONCLUSION AND RECOMMENDATIONS

This study revealed the strong relationship between some climatic elements and agricultural crop yield in Kwara state, Nigeria. It has become obvious that climate has a significant influence on crop yield and change in the temperature, humidity and rainfall will affect crop yield. The effect will be very serious because the farming activities in the state depends largely on the vagaries of weather i.e. rain fed agriculture.

A projection of the climatic variation in the state revealed that climatic suitability level for predominant crops tuber (yam and cassava) and grain (maize and cowpea) in the state will reduce in the future because their production is dependent on rainfall. Consequently, their yield will continue to reduce unless necessary actions are taken against the challenges posed by climate. The study therefore, recommends sensitizing and educating the farmers about the trend in the influence of climate on their farming activities, adoption of new technologies to adapt to changes in climate and development of improved seedlings that has potentials to adapt to the changing climate.

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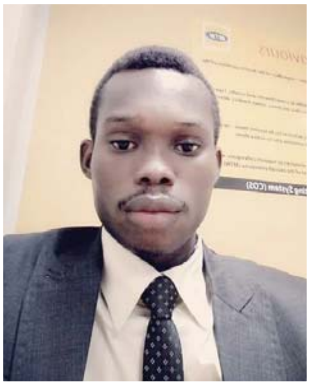

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