

Evaluation of the Correlation Between Climate Change and the Most Reported Cases of Diseases Due to Climate Change in the Study Area Over the Period of 11 Years (2010-2020) in Selected South-Western States (Ekiti, Osun and Ondo), Nigeria.

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ABSTRACT

Climate change, acting via less direct mechanisms, would affect the transmission of many infectious diseases (especially water, food and vector-borne diseases). The aim of this study is to evaluate the correlation between climate change and emerging and re-emerging diseases in selected south-west states (Ekiti, Osun and Ondo) Nigeria. This study covered the entire population of three south western states (Ekiti, Osun and Ondo) and relied more on secondary data from the Health records department (Data Bank) from the Federal Ministries of Health with additional data from NIMET (weather data or reports). Selection of health care facilities in each of the three states, health data indicating disease distribution and records from 2010 -2020 alongside climate data from Ekiti, Osun and Ondo State. An integrated approach using correlation study was employed in assessing the effect of climate change in particular reference to emerging and re-emerging disease in the study areas. Findings revealed that the higher the temperature the higher the emergence of Measles and Chicken pox, but the lower the temperature the higher the emergence of influenza and Pneumonia. The emergence of Lassa Fever however does not depend on the climatic change either with high or low temperature in South-West, Nigeria. Hence it was concluded that there is correlation between climate change and emerging and re-emerging of diseases.

Keywords: Climate Change, Disease Distribution, Health Data

INTRODUCTION

According to Maiden *et al.*, (2015) “Human alteration of Earth is substantial and growing. Between one-third and one half of the land surface has been transformed by human action; the carbon dioxide concentration in the atmosphere has increased by nearly 30% since the beginning of the Industrial Revolution; more atmospheric nitrogen is fixed by humanity than by all natural terrestrial sources combined; more than half of all accessible surface fresh water is put to use by humanity; and about one-quarter of the bird species on Earth have been driven to extinction. By these and other standards, it is clear that we live on a human-dominated planet.”(Janicot *et al.*,2011)

Shuman (2011) stated that there is now widespread consensus that the Earth is warming at a rate unprecedented during post hunter-gatherer human existence. The last decade (2000 – 2010) was the warmest

since instrumental records began in the nineteenth century, and contained 9 of the 10 warmest years ever recorded. The causes of this change are increasingly well understood. The Third Assessment Report of the Intergovernmental Panel on Climate Change, published in 2001, goes further than its predecessors, stating that “There is new and stronger evidence that most of the warming observed over the last 50 years is likely to be attributable to human activities”, most importantly the release of greenhouse gases from fossil fuels.

There is growing realization that the sustainability of population health must be a central consideration in the public discourse on how human societies can make the transition to sustainable development (Davis *et al.*, 2010). Hence, public, policymakers and other scientists have an increasing interest in hearing from population health researchers, moving towards a view of population health as an ecological entity: an index of the success of longer-term management of social and natural. (Mari *et al.*, 2012). Indeed this recognition will assist in altering social and economic practices and priorities, to avert or minimize the occurrence of global environmental changes and their adverse impacts.

Change in world climate would influence the functioning of many ecosystems and the biological health of plants and creatures. Likewise, there would be health impacts on human populations, some of which would be beneficial. For example, milder winters would reduce the seasonal winter-time peak in deaths that occurs in temperate countries, while in currently hot regions a further increase in temperatures might reduce the viability of disease-transmitting mosquito populations (Alexander *et al.*, 2013). All of these changes are inextricably linked to the health of human societies. Climatic conditions affect human well-being both directly, through the physical effects of climatic extremes, and indirectly, through influences on the levels of pollution in the air, on the agricultural, marine and freshwater systems that provide food and water, and on the vectors and pathogens that cause infectious diseases.

STATEMENT OF THE PROBLEM

The incidence of infectious disease has been dramatically reduced over the past century by increasingly sophisticated vaccines however new research found that:

1. Climate change could again; potentially lead to a resurgence of some of the deadliest illnesses on earth (Abdulsalam, 2014).
2. Climate in the future might become more suitable for malaria transmission in the tropical highland regions, as being modeled. Malaria is transmitted to humans by mosquitoes of the genus *Anopheles*, which are highly sensitive to climatic variations, generally requiring moist conditions, and a temperature of around 25-28 degrees centigrade to breed (Abeku, 2004).
3. Scientists suspect that rising global temperatures could cause the range of *Anopheles* mosquitoes to expand, and thereby increase the spread of malaria to humans. One of the places most at risk could be Africa. The continent is already the world’s malaria hotspot, with 92 percent of the world’s malaria deaths occurring there, but a growing number of scientific studies are suggesting that climate change could make malaria matters even worse in Africa. Malaria is not the only mosquito-borne disease that risks being exacerbated by a changing climate. (Colwell, 2004; Michael *et al.*, 2006; Mari *et al.*, 2012).
4. Studies have also found that climate variability increases the risk of dengue fever, and there are concerns that the same could be true for yellow fever, encephalitis, hantavirus and even ebola (Adedokun and Emofurieta, 2009)
5. There are even signs that climate change could already be altering the distribution of some of these diseases. Recent studies have found that some mosquito-borne diseases, including malaria, dengue fever and yellow fever, as well as tick-borne diseases like Lyme disease and tick-borne encephalitis, have begun to spread to higher latitudes, possibly due to increased temperatures. (Akanda *et al.*, 2009). The spread of insect-borne pathogens is serious enough, but it is not the only way that climate change

could impact human diseases.

6. Increased precipitation, another likely result of climate change, is believed to increase the spread of waterborne infections, which can cause deadly diarrheal illness and flourish in the wake of heavy rainfalls. (Collier *et al.*, 2008). Other infectious diseases, such as salmonellosis, cholera and giardiasis, may show increased outbreaks due to flooding and elevated temperature (Forgor , 2007)
7. Scientists are also concerned that the melting of permafrost soils in polar regions due to climate change could release ancient viruses and bacteria that may be capable of coming back to life (James, 2013)

Objectives Of The Study

The specific objectives are to:

1. Determine the variation in climate change in the study area over the period of 11 years (2010-2020).
2. Identify the most reported cases of diseases due to climate change in the study area over the period of 11 years (2010-2020).

Research Hypotheses

H_0 : There exists no significant relationship between climate change and emerging and re-emerging diseases.

H_1 : There exists a significant relationship between climate change and emerging and re-emerging diseases.

Southwest Nigeria is no doubt vulnerable to the impact of climate change and variability because of its physical and socioeconomic characteristics, such as heavy rainfall, ecological disruption, high population growth rate and extreme weather events. The selected states are Ekiti, Osun and Ondo who are known to report extreme weather condition after Lagos State.

METHODOLOGY

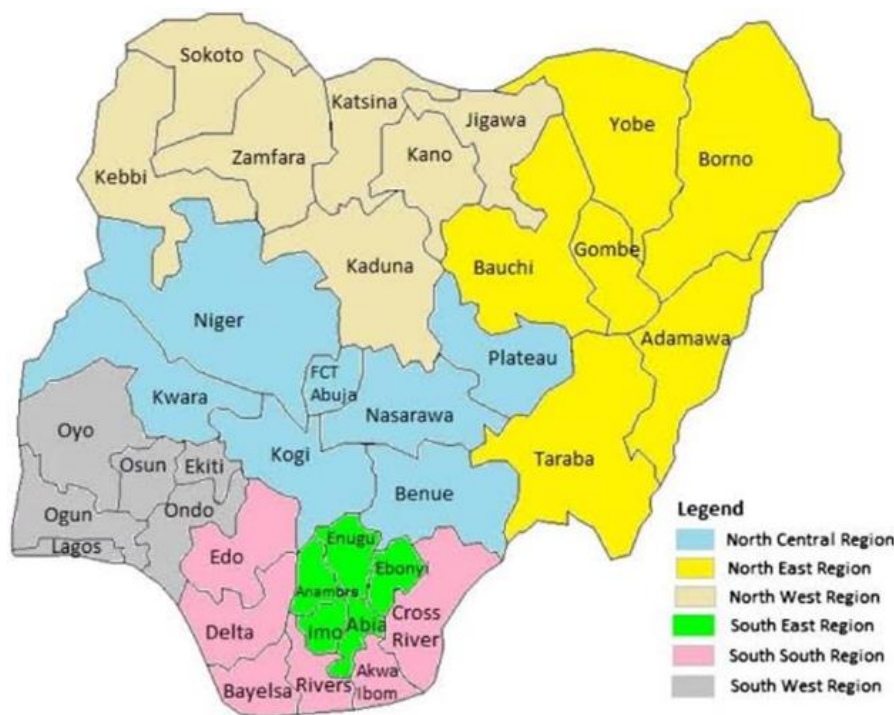


Figure 1 Map of Nigeria



Figure 2 Map of southwest Nigeri

Scope Of The Study

This study is limited to Ekiti, Osun and Ondo State, South-Western, Nigeria.

Sample Size

This study covered the entire population of three south western states (Ekiti, Osun and Ondo). The population of Ondo State is 3,460,877 as at 2006 census. The population of Ekiti State stands at 2,384,212 as at 2006 census while Osun state population is 3,416,959. The total population covered is 9,262,048.

Data Collection Method

This study relied more on secondary data from the Health records department (Data Bank) from the Federal Ministries of Health with additional data from NIMET (weather data reports).

Selection of health care facilities in each of the three states, health data indicating disease distribution and records from 2010 -2020 alongside climate data from Ekiti, Osun and Ondo State were used.

An integrated approach using correlational study was employed in assessing the effect of climate change in particular reference to emerging and re-emerging disease in the study areas.

Statistical Analysis

With the data obtained from health care facilities and the climate data across the three study area, a correlation statistical analysis was done to find the commonalities of climate change on emerging and re-emerging disease.

RESULTS

Weather report from NIMET was obtained to show minimum temperature, Maximum Temperature and Rainfall. The study area are some selected south-west states(Ekiti, Osun and Ondo) and as such, the data is relevant to the study.

Table 1: Maximum and minimum temperatures and rainfall variations averaged over the Ekiti State stations in south-west Nigeria for the period of 11 years (2010 – 2020).

Year	Maximum Temperature (<i>in Degree Celsius)</i>	Minimum Temperature (<i>in Degree Celsius</i>)	Rainfall (<i>In millimeters</i>)
2010	35.2	24.2	1,228
2011	34.3	23.4	1,111
2012	31.8	19.2	1,000
2013	32.2	21.3	1,223
2014	34.1	24.4	891
2015	34.2	24.3	1,221
2016	36.2	19.6	1,245
2017	34.6	25.2	1,323
2018	37.3	23.4	1,409
2019	36.2	26.3	1,623
2020	35.2	26.8	1,532

Table 2: Maximum and minimum temperatures and rainfall variations averaged over the Ondo State stations in south-west Nigeria for the period of 11-years (2010 – 2020).

Year	Maximum Temperature (<i>in Degree centigrade</i>)	Minimum Temperature (<i>in Degree centigrade</i>)	Rainfall (<i>In millimeters</i>)
2010	32.2	22.1	1,301
2011	29.4	23.2	1,210
2012	34.6	23.6	1,101
2013	33.6	24.7	1,247
2014	34.4	20.7	932
2015	32.3	21.6	1,354
2016	35.6	20.4	1,266
2017	33.7	23.8	1,300
2018	36.2	22.3	1,399
2019	36.2	21.3	1,544
2020	35.2	22.6	1,500

Table 3: Maximum and minimum temperatures and rainfall variations averaged over the Osun State stations in south-west Nigeria for the period of 11-years (2010 – 2020).

Year	Maximum Temperature (<i>in Degree centigrade</i>)	Minimum Temperature (<i>in Degree centigrade</i>)	Rainfall (<i>In millimeters</i>)
2010	29.3	19.1	1,202
2011	30.1	20.2	1,200
2012	33.2	22.5	1,220
2013	36.4	21.4	1,207
2014	32.6	23.2	890

2015	32.4	20.3	1,211
2016	32.5	22.2	1,181
2017	34.3	22.6	1,214
2018	31.1	25.2	1,316
2019	32.7	22.1	1,216
2020	31.4	21.3	1,413

Table 4 Pooled Populations Of People Infected With Measles And Chicken Pox In The Study Area

YEAR	MEASLES		CHICKEN POX	
	Dry Season	Wet Season	Wet Season	Dry Season
2010	2,356	958	546	1290
2011	2,458	764	725	2980
2012	2,654	632	937	3027
2013	2,301	1,003	536	2540
2014	2,367	708	463	2006
2015	2,424	832	756	2562
2016	2,309	534	423	1906
2017	2,355	730	290	1894
2018	2,734	791	203	1702
2019	2,844	827	278	1453
2020	2,578	521	301	1204

Table 5 Pooled Populations Of People Infected With Influenza And Lassa Fever In The Study Area

Year	INFLUENZA		LASSA FEVER	
	Wet season	Dry season	Wet Season	Dry season
2010	5340	2034	6	7
2011	5329	1893	5	9
2012	6782	2182	7	8
2013	5302	983	4	6
2014	7392	2637	9	5
2016	5473	2216	2	5
2017	8673	1936	8	4
2018	5343	989	6	5
2019	6920	1290	5	7
2020	7821	1870	8	10

Table 6: Pooled Population Of People Infected With Pneumonia In The Study Area

YEAR	PNEUMONIA	
	Wet Season	Dry season
2010	4502	1004

2011	4201	932
2012	5232	873
2013	5301	739
2014	4802	846
2015	4902	786
2016	5032	874
2017	4823	850
2018	4702	893
2019	6032	1302
2020	7043	1542

Source: Federal Bureau of Statistics (FMOH) 2020.

DESCRIPTIVE STATISTICS

Research Question 1

What are the most reported cases of diseases in southwest Nigeria?

This question was answered using descriptive statistics and the result is presented in table 4 – 6 above.

The table revealed that Chicken pox with mean of 6428.82 cases is the leading disease emerging during dry season followed by Measles (2489.09), Pneumonia (967.36), Influenza (496.18), respectively. Pneumonia with a mean of 5142.91 cases is found to be the prevailing disease in the raining season followed by, Influenza, (2051.27) and Lassa Fever (6.00) respectively. It can be deduced from the table 6 below shows that Chicken Pox, Pneumonia and Measles are the most occurring and prevailing diseases considering the two seasons all together followed by others. Lassa Fever appears to be the least.

Table 7: Descriptive analysis of reported cases of diseases in southwest Nigeria

Diseases	Seasons	N	Mean	Std. Deviation
Measles	Dry Season	11	2489.09	185.649
	Wet Season	11	754.18	153.870
Influenza	Dry Season	11	496.18	232.137
	Wet Season	11	2051.27	643.389
Chicken Pox	Dry Season	11	6428.82	1184.618
	Wet Season	11	1851.91	543.572
Lassa Fever	Dry Season	11	5.45	1.864
	Wet Season	11	6.00	2.023

Pneumonia	Dry Season	11	967.36	241.139
	Wet Season	11	5142.91	788.354

Table 8: Descriptive analysis of the level of variation in climate change in southwest Nigeria

Variable	N	M	Std	Percentage of Variation
Dry Season Temperature	11	100.97	3.493	3.46%
Wet Season Temperature	11	67.68	2.885	4.26%

Objective 1: Determine the Variation in Climate Change in the study area over a period of 11years (2010-2020)

There exists a little variation in the temperature and amount of rainfall recorded from (2010-2020) in southwest Nigeria i.e. the climate change was to a large extent, stable across the years. This agrees with the result of Adedokun 2019 who stated in his findings that, the seasonal variation in south-west Nigeria is slightly different but stable. He explained further that, the climate report indicated that, rainfall in the year 2013 – 2016 has average numbers which means, the variation is slightly different. However, Forgor (2012), had a different result indicating high variation in season in Ghana from 2005-2012.

Objective 2: Identify the most reported case of disease due to climate change or variation in the study area over the period of 11years (2010-2020)

The most reported case of disease identified in this study is Chicken pox and Pneumonia. This disagrees with the result of Abdusallam (2014), who identified typhoid as the most recorded cases in his study. This also negates the findings of Tobias (2011) who identify avian and swine Influenza as the most reported cases due to climate change in his study area (Angola).

CONCLUSION

Based on findings it was concluded there is correlation between climate change and emergence and re-emergence of diseases in South-West Nigeria.

RECOMMENDATIONS

The following recommendations were made:

1. The general public should be educated on the need to improve upon sanitation of their environment and also to sensitize the general public more on the importance of immunization against immunizable diseases
2. There is a scientific need for the quantification of the relationship between climate and diseases, and to investigate the geographical range and extent of the impacts of climate change on infectious disease.
3. Government through NIMET should project the potential impact of climate change on meteorologically-sensitive infectious diseases especially for regions where the projected climate changes impact is likely to change the distribution, and seasonality of these diseases. For example, the Sahel and tropical West Africa, where northwest Nigeria lies.

4. Furthermore, in order to assess long-term climate influences on disease trends, d must span numerous seasons and utilize proper statistics to account for seasonal fluctuations as this will allow the Government to develop a blueprint for seasonal disease monitoring and control.

Conflict of Interest

The Authors declared no conflict of interest.

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