
EVALUATION OF THE EFFECT OF CLIMATE CHANGE ON BUILDING COLLAPSE IN LAGOS STATE

BY

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Abstract

This paper evaluated of the effect of climate change on building collapse in Lagos State. This study compares 10-years changes in temperature and precipitation to determine whether the rate of flooding increases or decreases with increasing temperature and precipitation. The data used were 10-year mean annual and monthly precipitation (mm) and maximum and minimum temperature (0 C) data obtained from the Nigerian Meteorological Agency (NIMET) responsible for measurement, control and monitoring, Storage of Hydrometeorological Data for Nigeria. Data were also collected by the National Emergency Management Agency (NEMA) and the Lagos State Emergency Management Agency LASEMA. This data covers flood/storm frequency in Lagos State from 2011 to 2021. A list of collapsed buildings in Lagos State was also collected by the Lagos State Regional Planning Department. Mean annual precipitation and mean annual temperature for Lagos were calculated for a decade (2011 to 2021). Averages for each climatic period were determined to allow comparison of changes between these periods. Subtracting the value of the first climate period from the second climate period gives the temperature change over the study period. Analysis of the data used simple linear regression analysis to postulate a stochastic relationship between mean temperatures within the considered annual intervals. The purpose of regression analysis is to check whether the data are statistically significant. Result was presented in graphs which revealed that: temperatures are rising and the number of wet days per year is decreasing in Lagos state. It was also found that rainfall intensity increased while the number of rainy days decreased. This is a strong indicator that the climate in the study area is changing. During the 10-year study period, it was observed that the temperature in the study area increased by 0.387 C. Changing climatic conditions are having a negative impact on buildings and infrastructure in Lagos State. Floods in Lagos show an increasing trend, and the frequency of floods in Lagos State has gradually increased over the last five years of the study period. Along with this, the number of flood-affected and collapsed buildings increased during the same period. Observed statistically significant changes in both temperature and precipitation clearly support that climate change is occurring.

Keywords: Climate Change, Building Collapse, Flood and Temperature

1.0 Introduction

1.1 Background of the Study

In recent years, climate change has become one of the greatest global challenges facing mankind. The Earth's climate has been changing for millions of years, but the rate of change observed since the industrial revolution is very alarming. These changes are associated with several natural phenomena and human activities, such as fossil fuel burning, large-scale industrial pollution, deforestation, and land-use changes associated with urbanization and human settlement worldwide (UN-Habitat, 2011). Many recent disasters are manifestations of degradation processes caused by climate change. Three indicators commonly used to describe global climate trends are: Atmospheric greenhouse gas concentrations, rising temperatures, rising sea levels. All of these factors are increasing worldwide. Although there is uncertainty about how climate change data will be interpreted, there is a growing consensus that human activity is the main cause of global climate change (McCarthy, 2001). Until recently, the impact of human activity on climate change was thought to be negligible, but as climate and environmental change threaten human existence, the world now wants to know more about this unpredictable phenomenon. I think. Nigeria as a country is not left behind in this global climate change trend. Heavy rains, floods, rising sea levels, droughts, heat waves and other extreme weather events are increasing in frequency and intensity in different parts of the country. Climate change is already being felt in Nigeria. Weather-related disasters have become more frequent over the last 40 years, and the trend is growing. Lagos is in many ways particularly vulnerable to climate change impacts because of its geography, climate, vegetation, soils, economic structure, poor physical infrastructure, population and settlement, energy demand, and agricultural activities (Okali, 2004).

Currently one of the largest and fastest growing cities in the world, Lagos is a major manufacturing and port city in the West African sub-region and the center of business and economic development in Nigeria. Home to about 10% of Nigeria's estimated population, Lagos is the country's major industrial center, with a concentration of industries and automobiles that emit CO₂ and other greenhouse gases into the atmosphere. The city is close to the sea, with about 22% of its total area being water bodies and surrounded by bodies of water or lagoons. Lagos has a very inadequate supply of basic infrastructure to deal with flooding from regular rainfall, and flooding occurs frequently in many parts of the state, mainly due to inadequate drainage. Since much of Lagos State's land is below sea level, increased intensity of storms and storm surges as a result of climate change could increase flooding problems. In many parts of the state, roads are built without supplemental drainage and not where drainage systems exist. Often not built and maintained properly. The lack of viable solid waste collection methods exacerbates the problem as the waste blocks drainage systems. In addition, many low-income buildings are constructed in ways that block storm water channels, increasing the risk of flooding. The importance of Lagos as Nigeria's economic hub, its coastal location, and unique infrastructure development makes it an ideal state to study the effects of global climate change on the built environment.

Based on the projections of the Intergovernmental Panel on Climate Change (IPCC, 2007), Nigeria is expected to be characterized by an increase in both temperature and precipitation, which will adversely affect the built environment and reduce the current impact on Nigeria's buildings and infrastructure. An inappropriate state of Heavy rains have intensified flooding, putting buildings and infrastructure near the coast at great risk of being destroyed by floodwaters. Global climate change will also lead to sea level rise with associated consequences, especially in the flat areas of Lagos.

Changes in temperature and precipitation due to global warming are already evident in many parts of the world and many parts of Nigeria (Ede, 2010). Severe disasters such as floods, droughts and hurricanes exacerbated by climate change are on the rise in Nigeria like never before. In 2010, the National Emergency Management Agency (NEMA) reported that more than 250,000 Nigerians were displaced by devastating floods that devastated many communities across the country. Floods in July 2011 overwhelmed Lagos residents as all drainage systems could not handle the intensity of his two hours of heavy rain. In August 2012, all of Nigeria came to a standstill when the Rokoja Bridge and much of the country was flooded, splitting the country into her two halves, creating the worst ever emergency scenario for Nigerians.

Given these facts, it is imperative that Nigeria responds better to climate change. Therefore, studying the impact of climate change on buildings and infrastructure is a bold step towards finding ways to mitigate this threat to the built environment. Climate change is a pervasive phenomenon that borders on and impacts many areas of human endeavor in complex and contradictory ways of research and analysis. For these reasons, this study focuses on identifying the impacts of floods (a natural disaster exacerbated by climate change) on buildings and infrastructure in Lagos and providing sustainable means to mitigate and adapt to these impacts. is guessing. In this study, we analyzed precipitation and temperature data from the Nigerian Meteorological Agency (NIMET) and the National Emergency Management Agency (NEMA) to find out how changes in these data correlate with environmental vulnerability to climate change, flood propensity, Determine how to check the impact of flooding on buildings and infrastructure located in the Lagos cosmopolitan metropolitan area.

1.2 Statement of Problem

In recent times, there has been frequent collapse of buildings across the country this might be due to the effects of changes occurring in the environment. When buildings are frequently exposed to harsh environmental conditions than the developers of those buildings could have ever imagined damages will definitely occur to such structures. These changes in the environmental factors may come in the form of more frequent flooding, increased flood, or flooding in areas previously not prone to flooding, more violent weather, including increased frequency and severity of tropical storms and tornadoes, more extreme temperatures, particularly longer, hotter summers.

However, many scholars have not been able to look in these factors. Hence, this research will look deeply in these climatic factors that constitute change in the environment in order to determine their effect on building collapse.

1.3 Purpose of the Study

The aim of this study is to evaluate the effect of climate change on building collapse in Lagos State. Specifically the study seeks to:

1. Evaluate the impact of temperature on climate changes; the trend of rainfall in Lagos cosmopolitan urban area.
2. Assess the impact of rainfall on climate changes; the trend of flooding in Lagos cosmopolitan urban area.
3. Appraise the impact of flooding on buildings collapse in Lagos cosmopolitan urban area.

1.4 Research Questions

The report is guided by the following research questions:

1. What is the impact of temperature on climate changes; the trend of rainfall?
2. What is the impact of rainfall on climate changes; the trend of flooding?
3. What is the impact of flooding on buildings collapse in the Lagos cosmopolitan urban area?

2.0 Methodology

This study compares 11-years changes in temperature and precipitation to determine whether the rate of flooding increases or decreases with increasing temperature and precipitation. The data used were 11-year mean annual and monthly precipitation (mm) and maximum and minimum temperature (0°C) data obtained from the Nigerian Meteorological Agency (NIMET) responsible for measurement, control and monitoring, Storage of Hydrometeorological Data for Nigeria. Data were also collected by the National Emergency Management Agency (NEMA) and the Lagos State Emergency Management Agency LASEMA. This data covers flood/storm frequency in Lagos State from 2002 to 2011. A list of collapsed buildings in Lagos State was also collected by the Lagos State Regional Planning Department. This data was supplemented by articles and journals published by eminent scientists.

Mean annual precipitation and mean annual temperature for Lagos were calculated for a decade (2011 to 2022). The decade was further divided into two climatic periods of five years each: the first climatic period (2002 to 2006) and the second climatic period (2007 to 2011). Averages for each climatic period were determined to allow comparison of changes between these periods. Subtracting the value of the first climate period from the second climate period gives the temperature change over the study period.

Analysis of the data used simple linear regression analysis to postulate a stochastic relationship between mean temperatures within the considered annual intervals. The purpose of regression analysis is to check whether the data are statistically significant.

The impact of climate change on flooding was determined by comparing increases in temperature and maximal increases in rainfall intensity (indications of climate change) to flooding trends. In examining the relationship between these parameters, a graph was created using Microsoft Excel to correlate increased flood incidence with an increasing trend of increasing temperature/rainfall intensity. After establishing the relationship between climate change and flooding, you'll compare flood frequency to decade-by-decade building collapse rates to determine collapse trends.

3.0 Result and Discussion

Temperature analysis shows an increasing trend in temperature, which indicates that Lagos is getting warmer. The average temperature during the first climatic season (2001-2007) was 31.482 °C compared to 31.86 °C during the second climatic season. This indicates that the temperature in the study area has increased by 0.387 °C over the decade, a strong indicator of a warming climate. The obtained value $R^2 = 0.690$ indicates that the temperature data are statistically significant. Figure 1 shows the trends in maximum temperature over the 10-year study period. Analysis of precipitation data obtained from NIMET shows a decreasing trend in annual precipitation. These results concluded that precipitation trends in

Nigeria from 1901 to 2005 showed an overall decline over the 105 years of his study, as precipitation in Nigeria had decreased by 81 mm.

Figure 2 shows annual precipitation data for Lagos. Our results show that the low rainfall periods of the last 5 years produced almost the same amount of precipitation as the wet 5-year periods, providing a strong indication that precipitation in recent years is much more intense than in previous periods. It became clear. These heavy rains mean more dangerous flood risks. According to Lagos State Emergency Agency (LASEMA) data, there were four major flood events during the last three years of the study period (2009-2011). The 2009 flood destroyed 4 buildings, the 2010 flood destroyed a total of 6 buildings, and the 2011 flood destroyed a total of 12 buildings. This scenario was further confirmed by rainfall on July 10, 2011. This rainfall lasted for 17 hours and flooded most parts of Lagos State due to inadequate drainage systems.

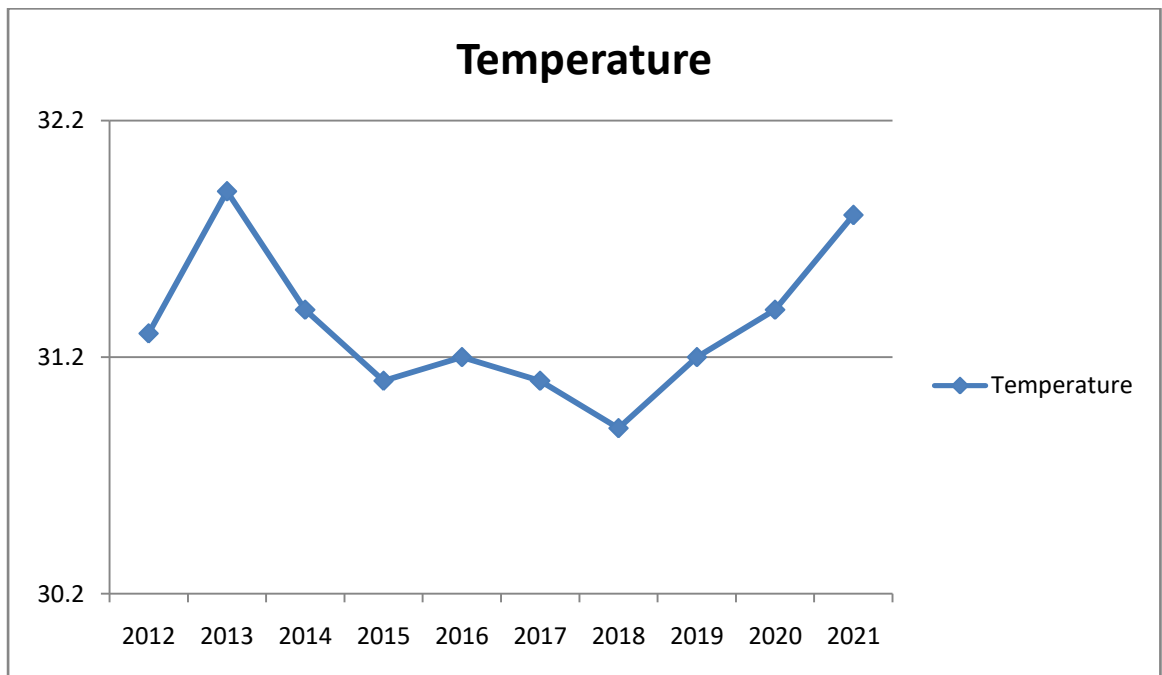


Figure 1: Trend of Maximum Temperature in Lagos for the Period of 2012 to 2021

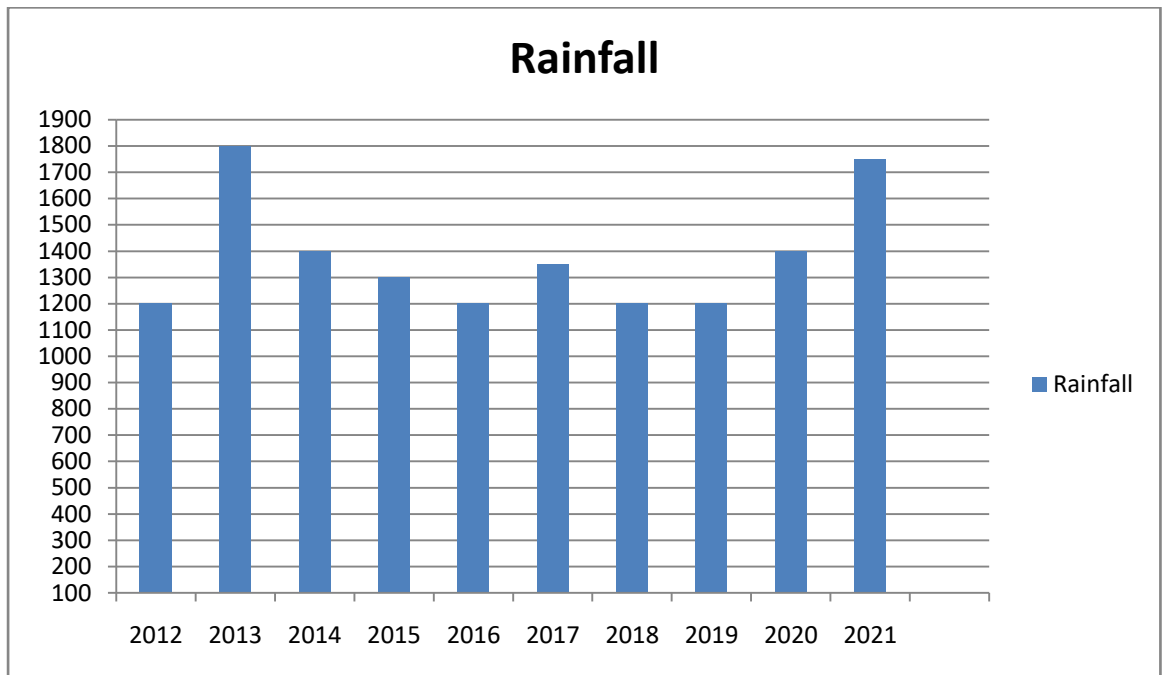


Figure 2: Recorded Annual Rainfall (2012-2021)

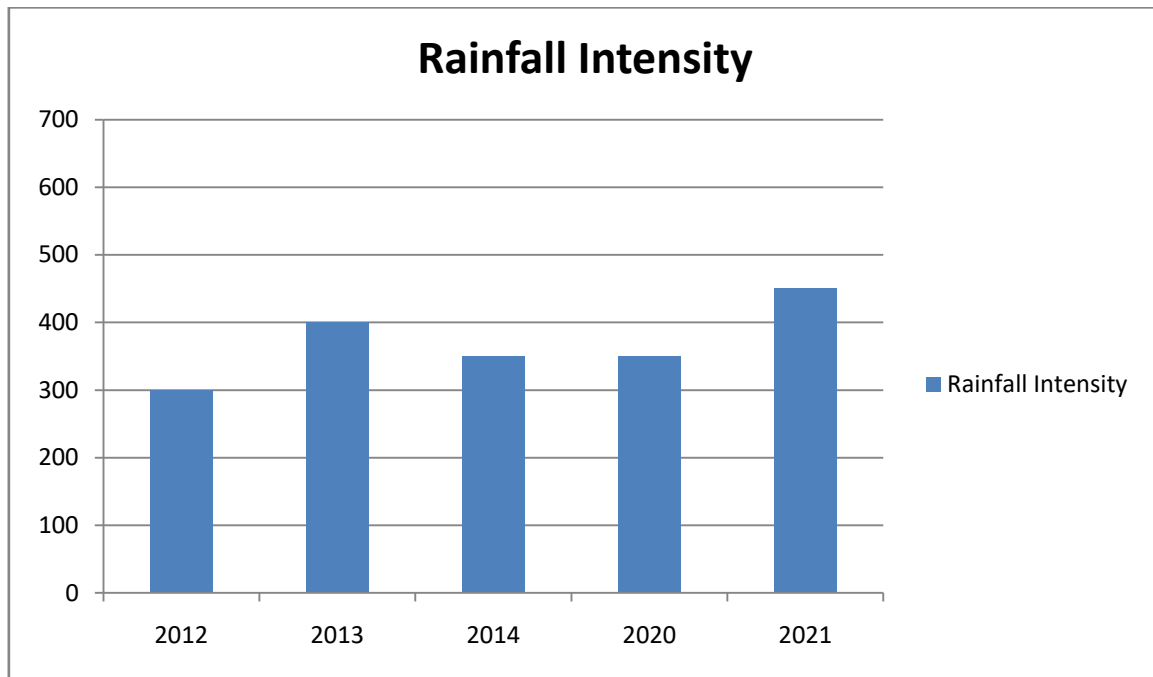


Figure 3: Maximum Rainfall Intensity from 2012-2021

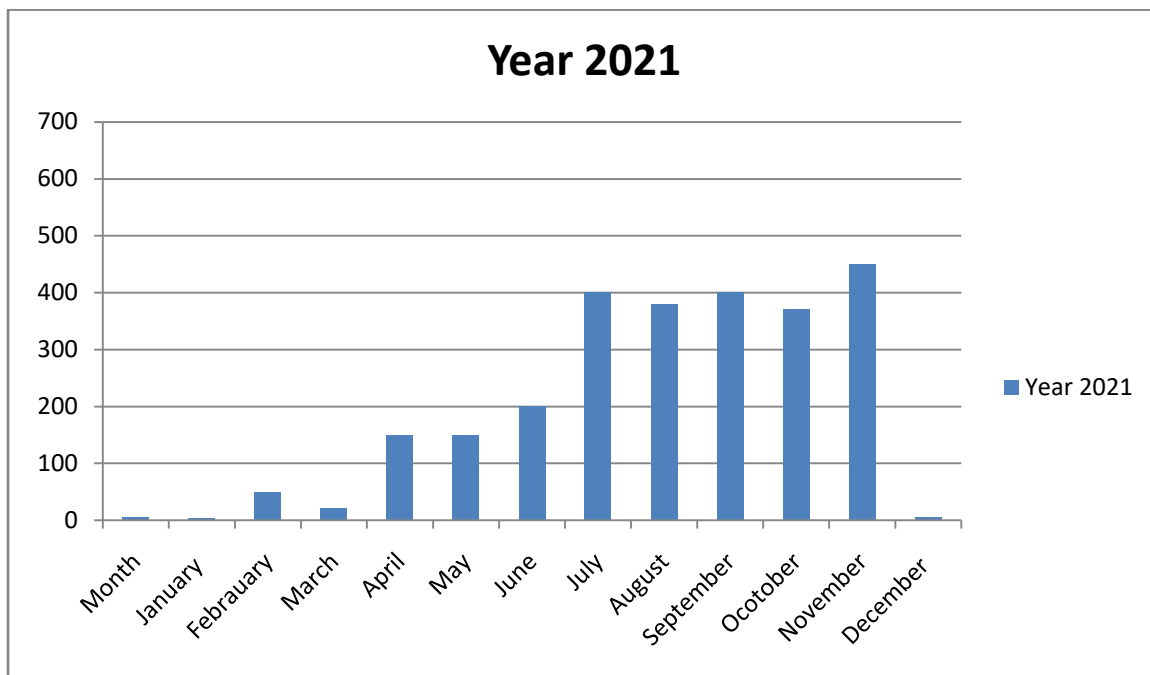


Figure 4: Monthly Maximum Rainfall Intensity of the Year 2021

Figures 3 and 4 show the recorded maximum rainfall intensity for 2004-2011 period and the monthly rainfall intensity for the year 2011. Figure 5 captured the monthly building collapse pattern in Lagos State for 2011. It can be seen that the pattern of monthly collapse marched very well the pattern of monthly rainfall intensity.

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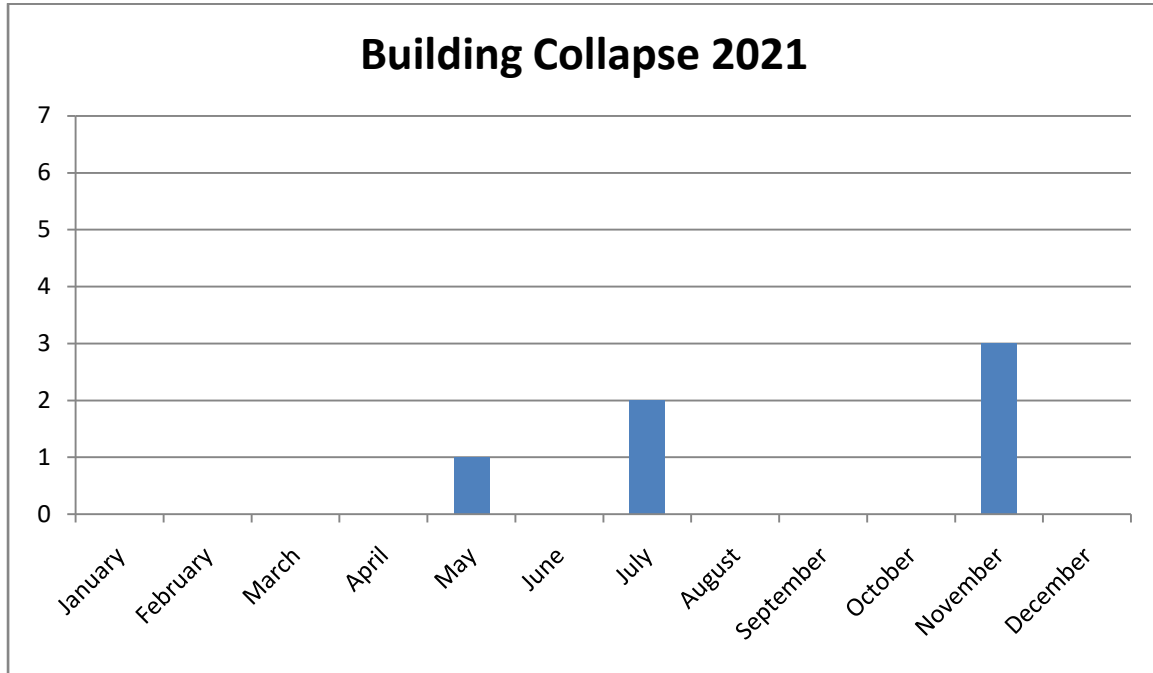


Figure 5: Building Collapse in Lagos 2021

From this analysis, it is clear that floods/storms are the leading cause of building collapses in Lagos State and this issue should not be taken lightly. Therefore, as Lagos State's population grows, so does human activity, increasing stress on the environment, and rising temperatures in Lagos State and the associated heavy rains and more dangerous flood risks are much greater than before. It is very important to note that the current level.

4.0 Conclusion

The study shows that temperatures are rising and the number of wet days per year is decreasing in Lagos state. It was also found that rainfall intensity increased while the number of rainy days decreased. This is a strong indicator that the climate in the study area is changing. During the 10-year study period, he observed that the temperature in the study area increased by 0.387°C . Changing climatic conditions are having a negative impact on buildings and infrastructure in Lagos State. Floods in Lagos show an increasing trend, and the frequency of floods in Lagos State has gradually increased over the last five years of the study period. Along with this, the number of flood-affected and collapsed buildings increased during the same period. Observed statistically significant changes in both temperature and precipitation clearly support that climate change is occurring.

To stop this growing threat to our buildings and infrastructure, governments and all stakeholders must develop concrete and substantive policies and planning measures that can mitigate the impact. Regardless of the actions taken to stem the impacts of climate change

around Lagos and Nigeria, the results of this study suggest the following mitigation approaches.

The problem of climate change cannot be tackled in isolation, but must be faced together with all the factors that affect it, especially man-made causes. To bring the increasing symptoms of climate change detected in Lagos State under control, intense human activity in Lagos State must be taken into account. Actions include long-term national/regional planning programs to stem the uncontrolled rural-to-urban migration tide and reduce stress in Lagos State. The current rate of population growth in the state is far beyond the state's capacity, and unless this rate of growth is stopped, problems related to climate change will surely spiral out of control. New industries should be strongly encouraged to locate outside Lagos State. This allows the state to plan better and cope better with changing climate conditions. Another action to consider is to anticipate future challenges and invest in innovative technology and people that can meet them when they arise. Adopting these measures will reduce the risk of climate change in Lagos State, protect the built environment, human life and save investment.

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Appendix I

| S/N | Location | Data of Collapse | Type of building | Causes | Casualties |
|-----|--|---------------------|--|--------|-------------------|
| 1 | No 9B Adenubi close ikeja Lagos State | 13th March 2011 | 5- storey hotel under construction | | 3 |
| 2 | No 6 Magaji close idumota Lagos | Jul-11 | 3-storey building | | 18 |
| 3 | MuriOkunola street Eti-Osa LGA of Victoria Island Lagos | 4th November 2012 | Collapsed building under construction | | 3 dead 50 trapped |
| 4 | Jakande estate in Oke-Ake-Afa, Isolo Lagos | 20th November 2012 | Collapsed of a building (in use) | | 3 |
| 5 | 74 Corporation drive Dolphin Estate, Ikoyi Lagos | 20th November 2012 | Collapsed of a building | | - |
| 6 | Ojodu, Lagos | 8th May 2013 | 2-storey Building under construction Illegal approval | | 1 |
| 7 | Ojodu, Lagos | May-13 | Three storey building | | 2 |
| 8 | Agege motor road, Mushin Lagos | 11th June 2013 | Three storey building | | 1 |
| 9 | Ishago road, Surulere Lagos | 21st July 2013 | 2-storey uncompleted building under construction | | 4 |
| 10 | Ebeute-meta, Lagos | 11th July 2013 | Residential Building | | 7 |
| 11 | Lagos Island | 25th September 2013 | Three storey building fell on a bungalow | | 2 |
| 12 | Pedro police station, somolu Lagos | 30th June 2014 | 2-storey barrack building | | - |
| 13 | Bucknor estate, Jakande-Isherioshun Rd. Ejigbo/isolo Lagos State | 30th July 2014 | The collapse of three storey building | | - |
| 14 | Lagos | 12th September 2014 | The collapse of a warehouse at synagogue church | | 4 |
| 15 | Ebute Meta Lagos | 15th July 2015 | 3-storey Residential | | 4 rescued |

| | | | Building | | |
|----|--|------------------------|--|--|-----------------------|
| 16 | Swamp street Odunfa Lagos island | 21st October 2015 | 3-storey Residential Building | | 4 rescued |
| 17 | Lekki, Lagos | 9th March 2016 | Five storey Building Under | | 34 |
| 18 | Mile 12, Lagos | 19th March 2016 | Two storey building | | 1 dead 1 injured |
| 19 | Lagos Island | 27th August 2017 | Residential Building | | 8 |
| 20 | Lagos | February 3rd, 2019 | 3-storey Building | | 2 dead 1 injured |
| 21 | Ita-faji, Lagos Island | 13th March 2019 | 3-storey building | | 20 dead 41 Injured |
| 22 | No 26, Afolabi Alasia Street, Gaskiya Road, Ijora-Badia, Lagos State | September 10, 2020, | A story building | | - |
| 23 | Excel College, in Ejigbo | September 19, 2020, | a three-storey edifice | | - |
| 24 | Lagos Island | October 11, 2020 | a three-storey building | | 4 dead, 8 injured |
| 25 | Police Barracks in Ikeja | May 4, 2021 | a bungalow | | 1 dead, 4 injured |
| 26 | No. 19, Church Street, off Adeniji Adele Street, Lagos Island | July 8, 2021 | a three-storey building | | 1 dead |
| 27 | 77, Tapa Road, Oke-Ojo, Isawo in Ikorodu, Lagos | July 20, 2021 | a two-storey building under construction | | 1 |
| 28 | Gerrard Road, Ikoyi | November 1, 2021 | a 21-storey building | | 26 |
| 29 | Osapa London area of Lekki | November 1, 2021 | 21-storey building. | | - |
| 30 | Magbon in the Badagry area | November 17, 2021 | two-storey building under construction | | 4 |

Source: Obi. I. Nicholas¹, Nwalusi, M. Dickson², Francis O. Okeke, 2022