Weather Conditions and Crimes Prevalence in Ifako-Ijaye (Lagos State, Nigeria)

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Purpose:

This paper aims to establish how weather parameters influence crimes with a view to understanding the varying levels of crime in the study area.

Design/Methods/Approach:

Data referring to maximum and minimum temperature, relative humidity, rainfall amount and wind speed, murder, assault, rape, armed robbery, breach of public peace, criminal conspiracy, theft, kidnapping, slave dealings, cultism and burglary were collected from the Nigerian Meteorological Agency, the Oshodi and Nigerian Police Force, Divisional Headquarters, Ifako-Ijaiye, Lagos State.

Findings:

Results of regression analysis revealed a relationship exists between weather parameters and the prevalence of crimes at a magnitude of 91%; multiple correlation analysis results showed that a relationship exists between rape and weather at a magnitude of 90%.

Research Limitations/Implications:

This research focused on the role played by the observed weather elements on crime activity in the study area. However, the study suggests further studies on other factors capable of inducing crimes.

Originality/Value:

The paper deals with an issue not given much attention in the area under study. In Nigeria, criminal activities are typically viewed in terms of peer group influence rather than the weather. Generally, the study has the potential to help realign security measures and inform people of the possibility of being morally influenced by the prevailing weather conditions.

UDC: 343.3/.7+551.515(669.1)

Keywords: climate, weather, crime, trend, environment, relationship

Vremenske razmere in razširjenost kaznivih dejanj v Ifako-Ijaye (država Lagos, Nigerija)

Namen:

Cilj prispevka je ugotoviti vpliv vremenskih razmer na pojavnost kaznivih dejanj, z namenom razumeti razlike v stopnjah razširjenosti kriminalitete na obravnavanem območju.

Metode:

Podatke, ki vključujejo najvišjo in najnižjo temperaturo, relativno vlažnost, količino padavin in hitrost vetra ter število umorov, napadov, posilstev, oboroženih ropov, kršitev javnega reda in miru, hudodelskega združevanja, kraj, vlomov, ugrabitev in primerov trgovanja s sužnji, sta priskrbeli nigerijska meteorološka agencija in nigerijska policija.

Ugotovitve:

Rezultati regresijske analize so pokazali, da vremenske razmere vplivajo na razširjenost kaznivih dejanj. Rezultati večkratne korelacijske analize pa so pokazali, da obstaja močna povezava med pojavnostjo posilstev in vremenom.

Omejitve/uporabnost raziskave:

Raziskava se osredotoča na vpliv vremenskih razmer na razširjenost kriminalitete na obravnavanem območju. Avtorji predlagajo nadaljnje študije o drugih dejavnikih, ki lahko vplivajo na pojavnost kriminalitete.

Izvirnost/pomembnost prispevka:

Prispevek obravnava vprašanje, ki na obravnavanem območju še ni bilo deležno veliko pozornosti. Pretekle študije v Nigeriji so obravnavale predvsem vpliv vrstniških skupin na kriminalno aktivnost, ne pa vpliv vremenskih razmer. Na splošno ima raziskava potencial za vpeljavo varnostnih ukrepov in tudi informiranje ljudi o možnostih, kako lahko na njihovo življenje vplivajo vremenske razmere.

UDK: 343.3/.7+551.515(669.1)

Ključne besede: podnebje, vreme, kriminaliteta, trend, okolje, razmerje

1   INTRODUCTION

Weather is dynamic and contains elements such as rainfall, temperature, pressure, cloud, wind and humidity. The weather at a certain point in time can be observed through its main elements; for instance, everyone can see if it is raining, windy, sunny or cloudy and can also find out how hot it is by checking a thermometer or simply feeling it. Climate is therefore the accumulation of daily and seasonal weather events at a given location over a period of 30–35 years (Ayoade, 2004). Climate also includes statistics other than the average, such as the magnitudes of day-to-day or year-to-year variations. The Intergovernmental Panel on Climate Change (2007) defined climate as the "average weather" or, more rigorously, as a statistical description in terms of the mean and variability of relevant quantities

over a period ranging from months to thousands or millions of years. The notion that acts like murder, rape and theft are prohibited is found across the world. What precisely is a criminal offence is defined by the criminal law of each country. While many have a catalogue of crimes called a criminal code, in some common-law countries no such comprehensive statute exists (Law & Martin, 2003).

According to Gottfredson and Travis (1990), crimes are legally defined as acts or omissions forbidden by law that can be punished by imprisonment and/or a fine. Murder, robbery, burglary, rape, drunk driving, child neglect, and failure to pay taxes all are common examples. There are different types of crime, ranging from common-law crime, cybercrime, crimes of passion, and crimes of violence among others. Many reasons explain why murder is criminalised, including its costs for society as well as being considered intrinsically wrong. For example, murder may be regarded as intrinsically wrong because it violates the right to life or is oppressive; murder may be costly for society by undermining law and order, squandering the potential accomplishments of the victims, risking the escalation of violence, or by spreading fear and grief.

In modern societies, investigations and trials must follow certain procedures. If found guilty, an offender may be sentenced to a form of reparation such as a community sentence or, depending on the nature of their offence, to undergo imprisonment, life imprisonment or, in some jurisdictions, execution. This theory about the causes of crime focuses on the idea that the physical body, through inherited genes, evolutionary factors, brain structures, or the role of hormones, has an influence on an individual's involvement in criminal behaviour.

Criminal activities continue to be a major concern of contemporary society. Most developing nations, including Nigeria, face unacceptable levels of delinquency and crime. The discomfort index, which is a combined measure of temperature and humidity, is a tool used for analysing the relationship between heat and violence. This was applied in Dallas, Texas, USA over an eight-month period in 1980 and provided evidence in favour of the notion that heat influences assaults (Cohn, 1990). Cohn (1993) also analysed the relationship between heat and robbery, homicide, domestic violence, and rape. He provided evidence that heat does affect crime entailing aggression and violence, thus establishing a correlation between heat and crimes involving aggression.

In an article entitled the "Effects of Temperature on Crime" published in the British Journal of Criminology, Field (1992) discusses his research findings. His research focused on locations in England and Wales. The weather variables used in his research study included: rainfall, hours of sunlight, and temperature. He found a positive relationship between higher temperatures and property crime. When temperatures rose, people spent more time outside their home, and this also increased the rate of property crime such as car theft and burglary (Field, 1992). The study is significant for the locations covered by the study. England and Wales are located in Europe; the results confirmed a positive relationship exists between weather and crime. This evidence enhances the probability that weather affects crime is true because the location is in another country with different cultural aspects and yet the weather still seems to affect the levels of crime.

Jacob, Lefgren and Moretti (2007) recently worked on the dynamics of criminal behaviour in relation to evidence from weather shocks. The focus of their study was the correlation between weather and crime in order to examine the short-run dynamics of criminal behaviour. Their methodology consisted of gathering data from the FBI's Uniform Crime Reports. They analysed weekly crime data from 116 jurisdictions around the USA. Their quantitative data showed a 10 per cent increase in violent crime in one week and a reduction of crime by 2.6 per cent the following week. The weather between these two weeks did not change (Jacob et al., 2007). The remaining study results showed a negative relationship between crime and weather. The overall findings of this research suggest the long-run impact of weather on crime is less correlated than the short-term impact of weather on crime. This study shows that short-term weather changes impact weekly or daily rates of criminal activity but, in the long run, the correlation is not linear (Jacob et al., 2007).

2   STUDY AREA

Ifako-Ijaiye is located at a latitude of 6° 52'0″ N and longitude of 2° 53'60″ E in the northern part of Lagos (Figure 1). This location covers a total area of 43 square kilometres. It has a tropical wet and dry climate with precipitation in the form of rain, as well as relatively high temperatures and humidity. Annual rainfall ranges from 203 millimetres to 1,524 millimetres. Temperature levels are high, with a mean annual maximum of about 30° Celsius and a mean annual minimum of around 23.8° Celsius.

Figure 1: Map of the study area
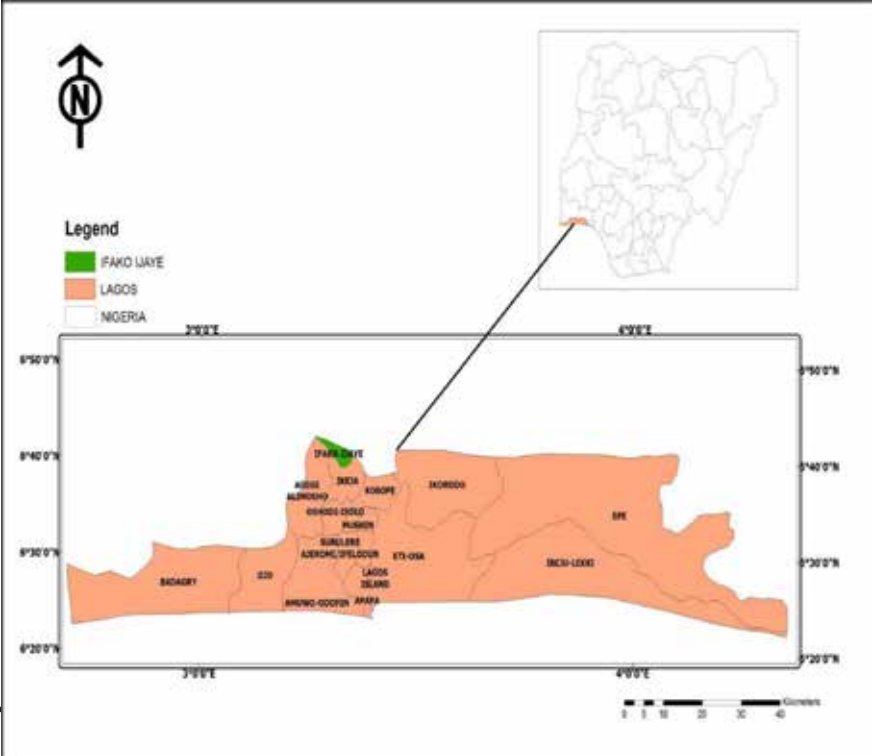
A substantial part of its landmass is found in a relatively flat and flood-prone swamp and creek environment. The shallow foundation soils within such geomorphic units are recent sediments composed of soft clays and loose sands that are generally unable to support heavy structures. Ifako-Ijaiye has a river that flows from Ogun State through the Ladoke Olaniyan Area and creates a natural gorge. It flows southward till it finally drains into the Atlantic Ocean (Figure 1).

The coastal plain sands predominantly cover the areas around Ikeja towards Agege, Alagbado, Magodo and Iju. It is situated on a series of stratified sedimentary rocks in the Dahomey Miogeosynclinal Basin of Southwestern Nigeria. Ifako-Ijaiye is a fast-growing area of Lagos State with a population of 427,878 (Nigerian Muse, 2007).

3   LITERATURE REVIEW

Cohn, Rotton, Peterson and Tarr (2004) developed the Social Escape/Avoidance Theory, which is closely related to Routine Activity Theory and the Negative Affect Escape Model. It suggests that people will attempt to avoid conditions that could bring negative effects. Therefore, days with extreme temperatures (both hot and cold) should lead to less social interaction, which produces smaller amounts of violent crime.

Four main theories on violent crime can be applied to the relationship between heat and violence. The Negative Affect Escape Model (Baron, 1972; Baron & Bell, 1976; Bell & Baron, 1976) concluded that negative effects (feelings of irritation, annoyance or discomfort) and violent acts increase as temperature rises up to a certain inflection point. After exceeding this inflection point, the model predicts a drop in violence as the temperature increases because a person's escape motives (to avoid the heat) will override their aggressive motives.

In contrast, Anderson, Deuser and DeNeve (1995) developed the General Affective Aggression Model. This is a complex model that takes many factors into account, including temperature. This model asserts there are input factors, such as personal and situational variables, which determine a person's arousal, state of affect, and cognitions. Unlike the Negative Affect Escape model, this model predicts a steady linear relationship between temperature and violence without any inflection point (Rotton & Cohn, 2001). Cohen and Felson (1979) developed the Routine Activity Theory to explain why crimes occur.

This theory postulates that for a crime to take place a suitable target must be available, there must be a lack of a suitable guardian to prevent the crime from happening, and a motivated offender must be present. When the weather is warmer, people are more likely to travel away from their homes to public places; this increase in social contact leads to more people being victimised, and thus predicts that an increase in violence is a linear function of the increase in temperature (Rotton & Cohn, 2001).

A large number of studies have evaluated the heat–aggression relationship statistically using state- and national-level data. Rotton and Cohn (2003) compared U.S. annual national totals for assaults with the mean temperature from 1950 to 1999, along with annual state totals from 1960 to 1999. At both levels, assaults are significantly correlated with temperature.

A previous study (Anderson, Bushman, & Groom, 1997) concluded that "serious and deadly assaults" (i.e. assaults and homicide) are correlated with temperature. This conclusion was reached by using average annual temperature and crime data for the 50 largest U.S. Standard Metropolitan Statistical Areas (SMSAs) from 1950 to 1995. They concluded that with every increase in temperature by18°C, serious and deadly assaults rise by 6.6 per 100,000 people.

Several other studies sought to aggregate these results to correlate a location's climate with violent behaviour. Anderson (1989) looked at violent and nonviolent crimes annually across the entire U.S.A. from 1971 to 1980 and concluded that a year with 10 more "hot days" (maximum temperature $\geq 32^0$C) than in an average year would result in 7% more violent crimes. A second study used 260 SMSAs across the U.S.A. for 1980 using the number of "hot days" and the number of "cold days" (maximum temperature $\leq 0^0$C) to see whether hotter cities had higher violent crime rates. Hot days positively correlated with violent crime, while cold days had the opposite relation with violent crime. He postulated that one could use the difference in temperature between U.S. cities to predict the most violent crimes.

However, although one can evaluate the relationship between weather and crime via numerous variables, DeFronzo (1984) suggested that the "inhabitants of an SMSA 'adapt' to their city's particular climatic milieu such that their annual level of criminal behaviour is relatively unaffected by the fact that their SMSA is subject to more or less cold or hot weather or days of precipitation than other American cities".

On the smaller scale, the relationship between assaults and temperature across a particular city has been studied. Many researchers such as Anderson and Anderson (1984), Harries, Stadler and Zdorkowski (1984), Harries and Stadler (1988), Perry and Simpson (1987), Anderson et al. (1997), Cohn and Rotton (1997) conducted various analyses using temporal and spatial characteristics that led to differing conclusions, although nearly all research shows that, as the temperature increases, the number of assaults generally go up as well.

In the U.S.A., Cotton (1986) used daily violent and nonviolent crime aggregates for Des Moines, Iowa, during the summer of 1979 and Indianapolis, Indiana, for the summers of 1978–80. Both cities showed a significant correlation between violent crimes and both maximum daily temperature and average daily temperature. Similar results were found by Anderson and Anderson (1984) who analysed daily aggregates of aggressive and nonaggressive crimes in Houston, Texas, from 1980 to 1982. In both studies, nonviolent crime was also analysed, and it had no significant relationship with temperature.

In more recent times, maximum temperature and sunshine hours were shown to be statistically significant predictors of sexual assaults in Manchester, U.K. (McLean, 2007); sunny days were associated with increases in murder and hit-and-run deaths in Tokyo, Japan (Ikegaya & Suganami, 2008); and monthly temperatures positively correlate with murder and attempted murders across several cities in Pakistan (Simister & Van de Vliert, 2005). Cohn and Rotton (1997) thoroughly researched sub-daily-level crime in several separate studies. They analysed the relationship between assaults and temperature aggregated into 3-h

intervals in Minneapolis, Minnesota, for 1987–88 and in Dallas, Texas, for 1994–95. They observed an inflection point (24°C in Minneapolis and 30°C in Dallas) where aggravated assaults decrease as temperatures rise when using 3-h time intervals. When using 24-h aggregates of assaults and temperature in Dallas, this inflection point was not present.

Harries et al. (1984) chose Dallas as a case study during the summer of 1980 (March–October). They divided Dallas into 12 regions or "neighbourhoods" based on measures of residents' economic well-being. They found there is an interaction between socioeconomic status and assault rates. Assaults were higher in low-status neighbourhoods compared to medium- and high-status neighbourhoods (defined using an urban pathology index). Harries and Stadler (1988) replicated this study using daily assault data for Dallas from 1980 to 1981.

4   MATERIALS AND METHODS

This study employed secondary data that include both climatic parameters and reported cases of criminal activities within the study area. A sample of data covering the period 2005 and 2015 was selected and obtained from the Nigeria Meteorological Agency and Nigeria Police Force, respectively. The periods under consideration fall within the period of the return of civil rule in Nigeria. At this time, it is believed that crimes are at an alarming level due to reduced military intervention and insufficient police mobilisation in the country. Second, the periods suggest when most developing countries, including Nigeria, begin to be aware of the major impact of climate in general. Finally, data availability and accessibility prompted the choice of the period for collecting data. Both descriptive and inferential statistics were employed for data analysis. The descriptive statistics include Mean and Standard Deviation, and coefficient of variation, while regression analysis, Correlation Analysis, Student T-test, and time series analysis form the inferential statistics used. Tables and graphs were generally used to present the data.

5   RESULTS
5.1 Weather Parameter

In Table 1, the minimum temperature recorded over the years shows it is relatively even, with the lowest of 22.8°C recorded in 2013 and the highest of 26°C in 2011. The mean is 24.1°C and its standard deviation from the mean is 0.8°C. The maximum temperature over the years ranges within 2.4°C, showing that temperature changes in the study area are relatively consistent.

Table 1: Weather variables distribution (Source: Nigerian Meteorological Agency, 2016)	Year	Min. T	Max. T	R.H.	Wind	Rainfall
	2005	24.2	31.6	84.3	6.7	135
	2006	24.2	29.7	84.3	6	124.9
	2007	24.1	29.5	83.6	4.9	137.4
	2008	23.9	29.2	82.3	4.9	151.3
	2009	24	29.6	82.1	5.3	116
	2010	23.9	30.7	83.3	5.9	189.4
	2011	26	30.9	77.6	4.6	174.9
	2012	24.2	31.2	78.7	4.8	135.2
	2013	22.8	30.03	82.3	5.2	118.4
	2014	23.6	30.6	83.9	5.2	128.5
	2015	24.03	31.6	81.3	5.4	131.6
	Mean	24.08455	30.42091	82.15455	5.354545	140.2364
	S.D.	0.753145	0.860935	2.216016	0.621874	23.0513
	C.V.	3.127088	2.830077	2.697375	11.61395	16.43746

Relative humidity, which is the amount of water vapour present in air expressed as a percentage, shows the study area is a very humid state with the lowest RH being over 70%, which implies that rainfall occurs almost year-round. The lowest wind speed value of 4.6m/s was recorded in 2011 while the highest value of 6.7m/s was recorded in 2005. The mean wind speed is 5.4m/s with a standard deviation of 0.62; this indicates a deviation from the mean. The lowest rainfall value of 116 mm was recorded in 2009 while the highest value of 189.4 mm was recorded in 2010. The mean rainfall is 140.2 mm with a standard deviation of 23.

5.2 Criminal Activities in Ifako-Ijaiye

As presented in Table 2, there was no reported case of murder in the first two consecutive years (2005–2006), yet the greatest prevalence of murder was reported in 2010 with 6 cases. Cases of assault were rampant in 2010 when 28 cases were reported with fewer cases reported in subsequent years. The lowest incidence of rape was recorded in 2005 and 2013, one case respectively, while the highest incidence of 19 came in 2010. The mean number of rape cases is 4.91, with a standard deviation of 5.11. Cases of theft were prominent and reached their highest level in 2014 with 32 cases, and the lowest level of 10 in 2007. On average, there were 20 cases of theft, with a standard deviation of 6.8.

Armed robbery was at its peak in 2013 with 9 cases reported, and fewer reported cases subsequently. The mean number of armed robbery cases is 5.3 with a standard deviation of 2.15, meaning armed robbery was at a fairly consistent level throughout the period of study. Breach of public peace has a range of 11,

with a mean of 11.5 cases and a standard deviation of 3.1. The lowest recorded number of burglary cases is 3 in 2009, and the highest was in 2015 with 13 cases reported. There were 5 cases of kidnapping reported in 2010 and there were 2 years without any report in 2005 and 2013. The mean kidnapping incidence was 1.7, with a standard deviation of 1.5.

The study also observed there was no case of slave dealing in 2005, although the highest numbers of 9 cases was recorded in 2011. The mean of slave dealing cases is 4.1, with a standard deviation of 2.8. Criminal conspiracy reached its peak in 2010 with 5 cases, with a mean of 1.9 and a standard deviation of 1.6 cases, respectively. The lowest value for cultism was recorded in 2006, 2008 and 2011, respectively, when no cases of cultism were reported while the highest value was seen in 2009 with 4 cases. The mean for cultism is 1.2 with a standard deviation of 1.3. In 2009, there was a drop in a number of cases of false pretence and cheating reported, with the highest value of 31 cases recorded in 2015, while the mean for incidences of false pretence was 15.5 cases reported and a standard deviation of 6.5.

Table 2: Criminal activities in Ifako-Ijaiye (Source: Nigerian Police Force, 2016)

Year	Murder	Assault	Rape/ I.A.	Theft & O.S.	A.R.	B.P.P.	Burglary	KDNPP	S. Dealing	C.C.	Cultism	F.P.C.
2005	0	18	1	19	3	11	10	0	0	1	2	18
2006	0	11	2	14	3	11	7	1	2	0	0	10
2007	1	9	4	10	5	7	4	1	4	2	1	13
2008	3	15	7	18	8	9	5	3	6	4	0	11
2009	2	17	2	13	4	12	3	1	6	1	4	9
2010	6	28	19	21	3	15	4	5	3	5	2	17
2011	1	7	4	18	4	11	9	2	9	3	0	12
2012	2	9	7	25	7	9	6	2	4	1	1	15
2013	0	11	1	21	9	14	5	0	0	2	0	12
2014	3	18	3	32	5	10	7	1	7	0	1	23
2015	1	12	4	29	7	18	13	3	5	2	3	31
Mean	1.727273	14.09091	4.909091	20	5.272727	11.54545	6.636364	1.727273	4.181818	1.909091	1.272727	15.54545
S.D.	1.793929	5.990902	5.107926	6.678323	2.148996	3.110101	3.009077	1.489356	2.821992	1.578261	1.3484	6.547727
C.V.	103.8591	42.51608	104.0503	33.39162	40.75681	26.93788	45.34226	86.22588	67.48241	82.67084	105.9457	42.11988

Key: Rape/ I.A.: Rape/Indecent Assault; Theft & O.S.: Theft and Other Stealing; A.R.: Armed Robbery; B.P.P.: Breach of Public Peace; KDNPP: Kidnapping; Slave Dealing; C.C.: Criminal Conspiracy; F.P.C.: False Pretence and Cheating

5.3 Criminal Activity Patterns in Ifako-Ijaye

Figure 2 shows that 2010 was the year seeing the highest incidence of assault (28 recorded cases) which was then followed by sudden decline over time. Murder was less prevalent due to the relative peace among those living in the area but, in contrast, the number of reported rape cases reached its peak of 19 in 2010. Theft and stealing were the most prevalent and kept on increasing, where this might be due to the inadequacy of the law enforcement agency, the low levels of contentment, the country's poor economic situation, the lack of equity, poor resource management by the leaders and poor weather conditions that hinder high agricultural yields, as well as the low fish catch in the ocean and lagoons.
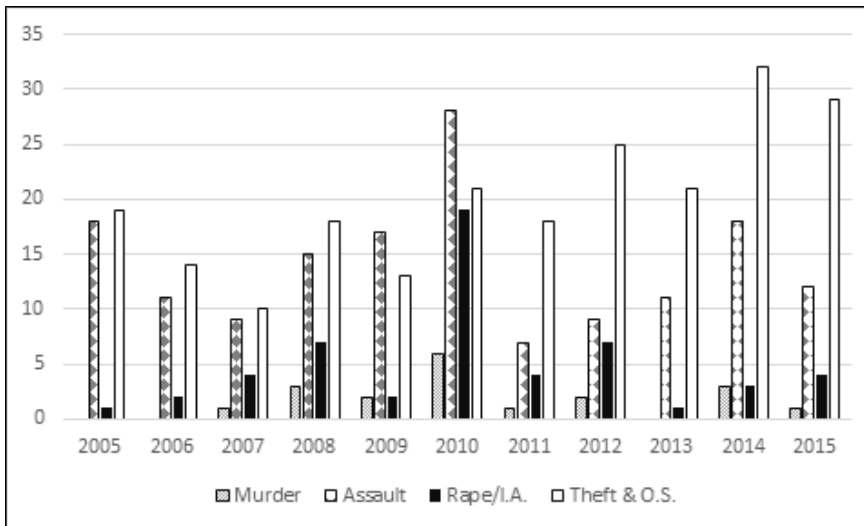

Figure 2: Trend of criminal activities between 2005 and 2015

As shown in Figure 3, several criminal activities had a conical rise and fall pattern. That is, there was an abrupt increase and decrease in certain cases reported. Armed robbery was rampant having had the fewest cases in 2007 with 7 instances reported; this activity mostly dominates at night during the peak of cool weather and in secluded areas probably covered

**Figure 3:
Trend of
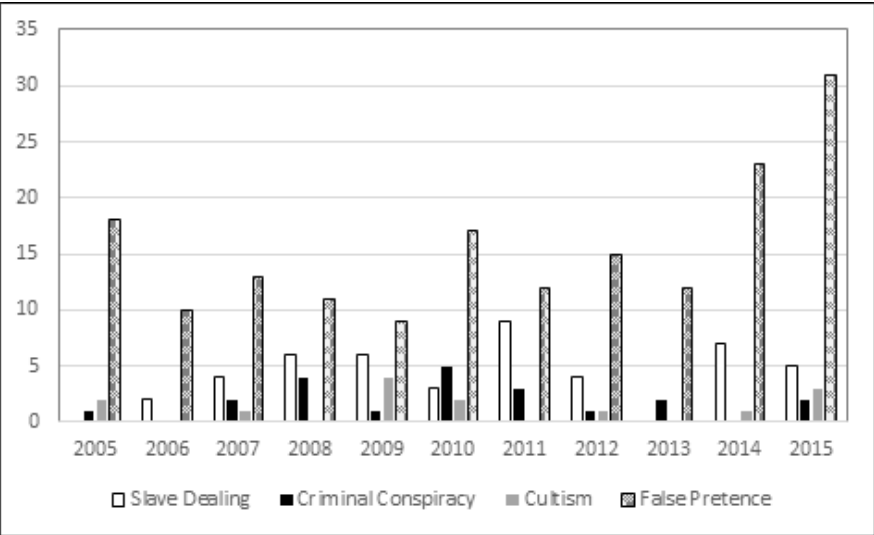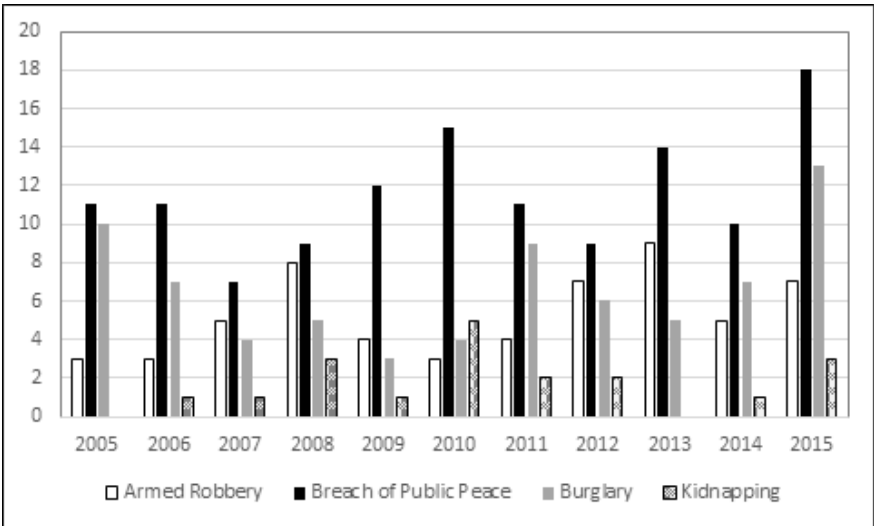other criminal
activities
between 2005
and 2015**

**Figure 4:
Trend
of criminal
activities
between 2005
and 2015**

with vegetation. Kidnapping is the lowest on this trend line, possibly due to people being alert or security conscious. The most incidences of breach of public peace came in 2015 with 18 cases reported due to offenders' high temper.

People expressed their grievances in many ways, leading to the disturbance of peace in the area. Figure 4 shows that low criminal activities, such as "false pretence" and "cheating", which entail people being defrauded of properties and other valuable items, were on the high side.

5.4 Inter-relationship of weather variables and criminality in the study area

Table 3 reveals the result for the degree of relationship between climate and various criminal activities in the area under study. The strength of the relationship varies for each criminal act.

Murder (R = 0.798, R^2 = 0.637, Adjusted R^2 = 0.273 and Standard Error = 1.52915). This implies there is a positive linear relationship of about 80% between murder and climate in the study area. Assault (R = 0.837, R^2 = 0.700, Adjusted R^2 = 0.400 and Standard Error = 4.64021) shows that a relationship at a magnitude of 83% exists between assault and climate. As may be seen, there is a strong positive relationship between the parameters; hence, assault is a more weather-dependent crime. Rape (R = 0.905, R^2 = 0.819, Adjusted R^2 = 0.639 and Standard Error = 3.06903) is only about 10% short of having a perfect relationship with climatic variables. It shows that any slight change in the climate causes rape to fluctuate due to the proportional relationship between climate and rape. For instance, when the weather is hot, there were more cases of rape, meaning that people were more sexually aroused, leading to illegal sexual activity by those who take the law into their own hands.

Theft (R = 0.855, R^2 = 0.732, Adjusted R^2 = 0.464 and Standard Error = 4.89075) indicates a strong positive relationship of 85% with climate. Unlike theft, robbery (R = 0.877, R^2 = 0.769, Adjusted R^2 = 0.538 and Standard Error = 1.46110) is more susceptible to the climate as a relationship of a magnitude of 87% exists between them. Breach of Public Peace (R = 0.639, R^2 = 0.409, Adjusted R^2 = -0.183 and Standard Error = 3.38227) shows there is a positive relationship between Breach of Public Peace and the climate, but it is not strong. It has a 63% chance of occurring with the aid of the climate, unlike rape, for which the figure is 90%. Burglary (R = 0.822, R^2 = 0.676, Adjusted R^2 = 0.352 and Standard Error = 2.42176) shows a strong linear relationship between climate and burglary. Kidnapping (R = 0.805, R^2 = 0.648, Adjusted R^2 = 0.296 and Standard Error = 1.25000); the chances of kidnapping being influence by climate is 80%, 5% less than the relationship between theft and climate.

Table 3: Relationship between climatic variables and crime	Crimes	R	R^2	Adjusted R^2	Standard error of estimate
	Murder	0.798	0.637	0.273	1.52915
	Assault	0.837	0.700	0.400	4.64021
	Rape	0.905	0.819	0.639	3.06903
	Theft	0.855	0.732	0.464	4.89075
	Robbery	0.877	0.769	0.538	1.46110
	BPP	0.639	0.409	-0.183	3.38227
	Burglary	0.822	0.676	0.352	2.42176
	Kidnapping	0.805	0.648	0.296	1.25000
	Slave Dealing	0.841	0.707	0.414	2.15990
	C.C.	0.917	0.842	0.683	0.88847
	Cultism	0.413	0.170	-0.659	1.73699
	False Pretence	0.895	0.802	0.603	4.12515

Predictors: (Constant), Rainfall, Wind Speed, Minimum Temperature, Maximum Temperature, Humidity
Dependent Variables: Criminal Variables

Slave Dealing (R = 0.841, R^2 = 0.707, Adjusted R^2 = 0.414 and Standard Error = 2.15990); slave dealing and climate have a strong positive relationship which is 21% higher than that of breach of public peace. Criminal Conspiracy (R = 0.917, R^2 = 0.843, Adjusted R^2 = 0.683 and Standard Error = 0.88847) is 9% short of having a perfect positive linear relationship with climate. Criminal Conspiracy here depends strongly on climatic variables. Cultism (R = 0.413, R^2 = 0.170, Adjusted R^2 = -0.659 and Standard Error = 1.73699) shows that a weak positive relationship exists between climate and cultism.

Pretence and Cheating (R = 0.895, R^2 = 0.802, Adjusted R^2 = 0.603 and Standard Error = 4.12515) holds a strong positive relationship with climate. The results of analysing the relationship between climate and crime reveal that climate plays a dominant role in criminal activities. Although the strength of the dependence varies with different climatic elements, still other environmental factors influence crime such as human factors and unfavourable government policies that allow some people to take the law into their own hands by perpetrating all sorts of crimes in the area. For instance, Rotton and Cohn (2001) observed that when the weather is warmer people are more likely to travel away from their homes to public places; this increase in social contact leads to more people becoming victimised, and thus predicts an increase in violence has a linear relationship with a temperature increase.

The result of analysis of variance on the climate's impact on criminal activities in Ifako-Ijaiye, Lagos State is shown in Table 4. The computed test statistic for all tests was found to exceed the probability values, i.e. murder (1.7 > 0.2), assault

(2.3 > 0.2), with the exception of cultism (0.2 < 0.9). This means that a significant relationship exists between the climatic conditions and various crimes. During intensive heat, cold weather, windy atmosphere, cloudy skies, among others, unlawful people in the study area tend to take the law into their own hands in order to disrupt the peace and good coexistence of people in the area. They commit all sorts of evil acts to divest people of their property. However, other environmental factors had a small influence on such evil practices where factors like Sunshine hours, Cloud cover, Elevation and Psychological state of mind either directly or indirectly influence criminal acts. This shows that climatic variables are crucial determinants of criminal activities. Criminality in Ifako-Ijaiye is a product of climatic variables.

Crimes	S.S.	D.F.	M.S.	F - calculated	P – value
Murder	32.182	10	4.098	1.753	0.276
Assault	358.909	10	50.250	2.334	0.187
Rape	260.909	10	42.763	4.450	0.061
Theft	446.000	10	65.281	2.729	0.147
Robbery	46.182	10	7.102	3.327	0.107
BPP	96.727	10	7.906	0.691	0.652
Burglary	90.545	10	12.244	2.088	0.219
Kidnapping	22.182	10	2.874	1.839	0.260
Slave Dealing	79.636	10	11.262	2.414	0.178
C.C.	24.909	10	4.192	5.311	0.045
Cultism	18.182	10	0.619	0.205	0.946
False Pretence	428.727	10	68.729	4.039	0.076

Table 4: Impact of climate on criminal activities

Predictors: (Constant), Rainfall, Wind Speed, Minimum Temperature, Maximum Temperature, Relative Humidity
Dependent Variables: Criminal Variables

5.5 Regression Modelling for the Climate-Crimes Relationship

(a) Murder = $9.291 - 1.208_{minT} + 0.98_{maxT} + 0.155_{RH} - 0.770_{wind} + 0.71_{rain}$ (see Table 5)

The regression explains that minimum temperature and wind are inversely proportional to murder. An increase in these two will positively cause a drop in the incidence of murder. Other climatic variables in a certain proportion would enhance murder.

(b) Assault = $24.569 - 3.985_{minT} + 0.129_{maxT} + 0.455_{RH} + 3.626_{wind} + 0.18_{rain}$

All variables are directly proportional to assault, except minimum temperature. Wind has the strongest level, showing that windy days lead to more assaults. This implies that high-temperature days will see greater assaults. Therefore, people need to be more vigilant on such days. As observed in this

study, Rotton and Cohn (2003) compared annual U.S. national totals for assaults with the mean temperature from 1950 to 1999, along with annual state totals from 1960 to 1999. At both levels, assaults are significantly correlated with temperature. In another study, Anderson et al. (1997) concluded that "serious and deadly assaults" (i.e. assaults and homicide) are correlated with temperature. This conclusion was reached by using average annual temperature and crime data for the 50 largest U.S. Standard Metropolitan Statistical Areas (SMSAs) from 1950 to 1995. They concluded that with every increase in temperature by 18°C produces an increase of 6.6 per 100,000 people in serious and deadly assaults.

I Rape = $105.704 - 3.921_{mi-T} - 0.329_{maxT} - 0.410_{RH} + 0.881_{wind} + 0.233_{rain}$

When the relative humidity is very low, the circulation oxygen in the brain is minimal, making space for an unstable psychological state, which might enhance rape. Rape is rampant during a rainy season that is accompanied with wind since there a positive relationship exists between rape and climate.

(d) Theft = $-196.357 - 4.003_{minT} + 8.234_{maxT} + 1.217_{RH} - 7.700_{wind} + 0.025_{rain}$

When the maximum temperature, rain and relative humidity increase, so does theft. For instance, a rainy day facilitates the snatching of property. Since Lagos State is a coastal city with rain occurring nearly all year-round, theft will keep on growing.

(e) Robbery = $107.986 - 2.388_{minT} + 0.136_{maxT} - 0.500_{RH} - 1.397_{wind} - 0.006_{rain}$

Robbery is inversely proportional to minimum temperature, relative humidity, wind and rain, i.e. robbery occurs on days with a higher maximum temperature, low minimum temperature, relative humidity, wind and rainfall. The mean maximum temperature in Ifako-Ijaiye is 30°C, implying that an temperature increase in the area will also cause robbery to rise, thereby putting lives at risk.

(f) BPP = $104.794 - 2.485_{maxT} + 0.694_{maxT} - 0.896_{RH} + 2.813_{wind} + 0.029_{rain}$

When the maximum temperature is high and the day is windy and coupled with positive relative humidity, people tend to express their grievances through protest of a violent nature. Breach of public peace will trigger the forced migration of people to other areas since they no longer enjoy a serene environment.

(g) Burglary = $-158.787 + 1.825_{minT} + 2.977_{maxT} + 0.505_{RH} - 0.886_{wind} - 0.41_{rain}$

The study revealed houses are hardly burgled on rainy days but especially in the dry season when people tend to move out due to the heat. Increases in the maximum and minimum temperatures will ensure this occurs. People must be alert during the dry season as burglary numbers will be high. These findings agree with the work of Field (1992) who observed a positive relationship between higher temperatures and property crime. He posited that when the temperatures increased people spent more time outside their home, and this also led to a higher rate of property crime such as car theft and burglary.

(h) Kidnapping = $21.028 - 0.766_{minT} + 0.016_{maxT} - 0.110_{RH} - 0.074_{wind} + 0.058_{rain}$

This is inversely proportional to minimum temperature, relative humidity and wind. Slightly rainy days with a moderate temperature attract more kidnapping. Kidnapping causes insecurity, meaning people need to move en masse rather than alone.

(i) Slave Dealing = $-110.541 + 2.343_{minT} + 0.721_{maxT} + 0.727_{RH} - 4.448_{wind} + 0.003_{rain}$

Child trafficking is greater in the presence of moderate temperatures, about 70% relative humidity, as well as slight rainfall. Humidity is high year-round in Ifako-Ijaiye, meaning slave dealing will always be reported except when measures are taken to combat this menace.

(j) Criminal Conspiracy = $61.201 - 1.107_{minT} - 0.610_{maxT} - 0.321_{RH} + 0.469_{wind} + 0.070_{rain}$

This will occur when the temperature is negative and it is relatively humid, and slight rainfall and a breezy day encourage this. Criminals tend to conspire and execute their evil plans more on windy days.

(k) Cultism = $-7.480 - 0.055_{minT} + 0.368_{maxT} - 0.28_{RH} + 0.524_{wind} - 0.012_{rain}$

This behaviour occurs when there is no rainfall, a moderate maximum temperature and the day has a gentle breeze. The implication is that cultism is a greater threat to people in the dry season.

(l) False Pretence and Cheating = $-465.884 - 0.421_{minT} + 9.727_{maxT} + 2.987_{RH} - 9.342_{wind} + 0.002_{rain}$

This is directly proportional to maximum temperature, relative humidity and rainfall. More of these variables or an increase in them causes a higher incidence of false pretence. People tend to cheat each other more on hot days.

Table 6 shows that rape ($r = 0.025$) is directly related to minimum temperature, while murder ($r = -0.087$), assault ($r = -0.331$), theft ($r = -0.219$), robbery ($r = -0.463$) and BPP ($r = -0.192$) are inversely related to minimum temperature (significant at $\alpha = 0.5$). It can be said that a rise in minimum temperature causes a rise in the incidence of rape while, at a minimum temperature, the numbers of murder, assault, theft, robbery and BPP increase.

Table 5: Relationship between climatic variables and crime

Crimes	R	R^2	Adjusted R^2	Standard error of estimate
Murder	0.798	0.637	0.273	1.52915
Assault	0.837	0.700	0.400	4.64021
Rape	0.905	0.819	0.639	3.06903
Theft	0.855	0.732	0.464	4.89075
Robbery	0.877	0.769	0.538	1.46110
BPP	0.639	0.409	-0.183	3.38227
Burglary	0.822	0.676	0.352	2.42176
Kidnapping	0.805	0.648	0.296	1.25000
Slave Dealing	0.841	0.707	0.414	2.15990
C.C.	0.917	0.842	0.683	0.88847
Cultism	0.413	0.170	-0.659	1.73699
False Pretence	0.895	0.802	0.603	4.12515

Predictors: (Constant), Rainfall, Wind Speed, Minimum Temperature, Maximum Temperature, Relative Humidity

Dependent Variables: Criminal Variables

Further, assault (r = 0.077), rape (r = 0.077), theft (r = 0.628) and BPP (r = 0.439) are directly related to maximum temperature while murder (r = -0.052) and robbery (r = - 0.132) work inversely to the maximum temperature. This implies robbery and murder will only prevail when the maximum temperature is low or is falling.

However, a rise in RH fosters an increase in murder (r = 0.039) and assault (r = 0.515), meaning they are directly proportional. Rape (r = -0.049), theft (r = -0.155), robbery (r = -0.291) and BPP (r = -0.028) are inversely related to RH. Namely, these activities will be reduced during the Harmattan when the humidity is high and will increase in the rainy season when the humidity is low.

Wind speed works to keep a lid on murder (r = -0.084), theft (r = -0.041) and robbery (r = - 0.544) since high wind turbulence does not enable these crimes to grow. Assault (r = 0.551), rape (r = 0.017) and BPP (r = 0.309) are rampant. Conversely, rainfall is directly proportional to murder (r = 0.623), assault (r = 0.351), rape (r = 0.788) and BPP (r = 0.080), and inversely proportional to theft (r = -0.008) and robbery (r = -0.301). This implies that rainfall has a negative impact on the occurrence of theft and robbery and encourages a higher incidence of murder, assault, rape and BPP.

Table 6: Correlation between climatic variables and criminality

Weather Elements	MinT	MaxT	RH	Wind	Rain	Murder	Assault	Rape	Theft	Robbery	BPP
minT	1										
maxT	0.235	1									
RH	-0.589	-0.303	1								
Wind	-0.219	0.296	0.667	1							
Rain	0.510	0.184	-0.285	-0.078	1						
Murder	-0.087	-0.052	0.039	-0.084	0.623	1					
Assault	-0.331	0.077	0.515	0.551	0.351	0.738	1				
Rape	0.025	0.077	-0.049	0.017	0.788	0.881	0.621	1			
Theft	-0.219	0.628	-0.155	-0.041	-0.008	0.242	0.177	0.111	1		
Robbery	-0.463	-0.132	-0.291	-0.544	-0.301	-0.134	-0.383	-0.161	0.327	1	
BPP	-0.192	0.439	-0.028	0.309	0.080	0.101	0.319	0.205	0.409	0.080	1

Significant at α= 0.50

With respect to the findings in the level of association between climate and crimes, the respondents' opinion shows that rainy seasons recorded higher levels of criminal activities than dry seasons. About 84% of respondents believed that during the rainy season people were harsh, sensitive and aggressive towards each other, especially on highways and streets. They find it difficult to tolerate one another, thereby leading to different incidences of criminal acts, with 24% agreeing that criminal acts prevail in summer and 19% of the respondents agreeing that kidnapping is prevalent in the rainy season.

Minimum temperature is directly proportional to burglary (r = 0.332), kidnapping (r = 0.177), slavery (r = 0.572) and criminal conspiracy (r = 0.133). Increases in minimum temperature cause a rise in burglary, kidnapping, slavery

and criminal conspiracy. Cultism (r = -0.098) and false pretence (r = -0.122) are inversely proportional to minimum temperature (Table 6).

Maximum temperature negatively correlates with slavery (r = -0.081) and criminal conspiracy (r = -0.087), meaning an increase in the maximum temperature causes a decrease in slavery and criminal conspiracy. On the other hand, burglary (r = 0.742), kidnapping (r = 0.177), cultism (r = 0.276) and false pretence (r = 0.699) are directly related to the maximum temperature. A rise in maximum temperature causes an increase in burglary, kidnapping, cultism and false pretence.

	MinT	maxT	RH	Wind	Rain	Burglary	KDNPP	Slavery	C.C.	Cultism	F.P.
minT	1										
maxT	0.235	1									
RH	-0.589	-0.303	1								
Wind	-0.219	0.296	0.667	1							
Rain	0.510	0.184	-0.285	-0.078	1						
Burglary	0.332	0.742	-0.187	0.241	-0.020	1					
KDNPP	0.177	0.177	-0.216	-0.123	0.752	-0.024	1				
Slavery	0.572	-0.081	-0.525	-0.673	0.297	0.044	0.322	1			
C.C.	0.133	-0.087	-0.207	-0.178	0.805	-0.197	0.754	0.139	1		
Cultism	-0.098	0.276	0.118	0.302	-0.176	0.076	0.140	0.038	-0.081	1	
F.P.	-0.122	0.699	0.058	0.176	-0.003	0.076	0.253	0.064	-0.072	0.367	1

Table 7: Correlation between climatic variables and crime

Significant at α= 0.50

A humid environment or season sees more cultism (r = 0.118) and false pretence (r = 0.058) since RH is directly proportional to them. Burglary (r = -0.187), kidnapping (r = -0.216), slavery (r = -0.525) and criminal conspiracy (r = -0.207) will keep decreasing provided that RH keeps rising.

Wind speed has a negative correlation with kidnapping (KDNPP) (r = -0.123), slavery (r = -0.673) and criminal conspiracy (r = -0.178). For instance, on days of very turbulent wind people mostly remain indoors, reducing kidnapping in these periods. Burglary (r = 0.241), cultism (r = 0.302) and false pretence (r = 0.176) go up as the wind speed increases.

All criminal activities are sensitive to rainfall, except burglary (r = -0.020), cultism (r = -0.176) and false pretence (r = -0.003) that are indirectly related to rainfall. A decrease in rainfall will increase incidences of burglary, cultism and false pretence. Conversely, kidnapping (r = 0.752), slavery (r = 0.297) and criminal conspiracy (r = 0.805) rise as rainfall increases since they are directly related (Table 7).

6 CONCLUSIONS

This research examined the impact of climate on criminal activities in Ifako-Ijaiye LGA, Lagos State. The study reveals that rainfall was a major contributor to the occurrence of any criminal activities and that the vegetation cover found in the

environment serves as a hideout for criminals. It was discovered that, although the climate affects all criminal activities, rape and criminal conspiracy are the most susceptible to climate parameters. Although there are variations in climatic parameters over the years, these variations have considerably different impacts on criminal activities. For instance, this study revealed rainfall is the strongest parameter inducing murder and kidnapping, while maximum temperature induces theft, false pretense and cheating. The study suggests further research on other crime-induced factors, such as particular genes, neurological deficits, malnutrition and environmental pollutants as observed by Akers and Sellers (2008). It is equally essential to note that strategic patrols and supplies of new detective gadgets could serve as crime-control measures in this area and other similar environments.

REFERENCES

Akers, R. L., & Sellers, C. S. (2008). *Criminal theories: Introduction, evaluation, and application* (5th ed.). Los Angeles: Roxbury.

Anderson, C. A., (1989). Temperature and aggression: Ubiquitous effects of heat on the occurrence of human violence. *Psychological Bulletin, 106*(1), 74–96.

Anderson, C. A., & Anderson, D. C. (1984). Ambient temperature and violent crime: Tests of the linear and curvilinear hypotheses. *Journal of Personality and Social Psychology, 46*(1), 91–97.

Anderson, C. A., Bushman, B. J., & Groom, R. W. (1997). Hot years and serious and deadly assault: Empirical tests of the heat hypothesis. *Journal of Personality and Social Psychology, 73*(6), 1213–1223.

Anderson D. C., Deuser, W. E., & DeNeve, K. (1995). Hot temperatures, hostile affect, hostile cognition, and arousal: Tests of a general model of affective aggression. *Personality and Social Psychology Bulletin, 21*(5), 434–448.

Ayoade, J. O. (2004). *Introduction to climatology for the tropics*. Ibadan: Spectrum Books.

Baron, R. A. (1972). Aggression as a function of ambient temperature and prior anger arousal. *Journal of Personality and Social Psychology, 21*(2), 183–189.

Baron, R. A., & Bell, P. A. (1976). Aggression and heat: The influence of ambient temperature, negative affect, and a cooling drink on physical aggression. *Journal of Personality and Social Psychology, 33*(3), 245–255.

Bell, P. A., & Baron, R. A. (1976). Aggression and heat: The mediating role of negative affect. *Journal of Applied Social Psychology*, *6*(1), 18–30.

Cohen, L. E., & Felson, M. (1979). Social change and crime rate trends: A routine activity theory approach. *American Sociological Review, 44*(4), 588–608.

Cohn, E. G. (1990). Weather and crime. *British Journal of Criminology, 30*(1), 51–64. Retrieved from http://www.geog.ubc.ca/courses/geob370/students/class07/crime_weather/misc/wather_and_crime.pdf

Cohn, E. G. (1993). The prediction of police calls for service: The influence of weather and temporal variables on rape and domestic violence. *Journal of Environmental Psychology, 13*(1), 71–83.

Cohn, E. G., & Rotton, J. (1997). Assault as a function of time and temperature: A moderator-variable time-series analysis. *Journal of Personality and Social Psychology, 72*(6), 1322–1334.

Cohn, E. G., Rotton, J., Peterson, A. G., & Tarr, D. B. (2004). Temperature, city size, and the southern subculture of violence: Support for Social Escape/Avoidance (SEA) theory. *Journal of Applied Social Psychology, 34*(8), 1652–1674.

Cotton, J. L. (1986). Ambient temperature and violent crime. *Journal of Applied Social Psychology, 16*(9), 786–801.

DeFronzo, J. (1984). Climate and crime: Tests of an FBI assumption. *Environment and Behavior, 16*(2), 185–210.

Field, S. (1992). The effect of temperature on crime. *British Journal of Criminology, 32*(3), 340–351.

Gottfredson, M. R., & Travis, H. A. (1990). *General theory of crime*. Stanford: Stanford University Press.

Harries, K. D., & Stadler, S. J. (1988). Heat and violence: New findings from Dallas field data, 1980–1981. *Journal of Applied Social Psychology, 18*(2), 129–138.

Harries, K. D., Stadler, S. J., & Zdorkowski, R. T. (1984). Seasonality and assault: Explorations in inter-neighborhood variation, Dallas, 1980. *Annals of the Association of American Geographers, 74*(4), 590–604.

Ikegaya, H., & Suganami, H. (2008). Correlation between climate and crime in Eastern Tokyo. *Canadian Journal of Criminology and Criminal Justice, 50*(2), 225–238.

Intergovernmental Panel on Climate Change. (2007). *Climate change 2007: Synthesis report: Summary for policymakers.* Geneva: International Panel of Climate Change. Retrieved from https://www.ipcc.ch/publications_and_data/ar4/syr/en/spm.html

Jacob, B., Lofgren, L., & Moretti, E. (2007). The dynamics of criminal behavior: Evidence from weather shocks. *Journal of Human Resources, 42*(3), 489–527.

Law, J., & Martin, E. A. (2003). *Oxford dictionary of law* (7th ed.). Oxford: Oxford University Press.

McLean, I. A. (2007). Climatic effects on incidence of sexual assault. *Journal of Forensic and Legal Medicine, 14*(1), 16–19.

Nigerian Meteorological Agency. (2016). *Nigeria Climatic Data (NIMET).* Oshodi: NIMET.

Nigerian Muse. (2007). *Nigeria 2006 population census arranged by state*. Retrieved from http://www.nigerianmuse.com/20070820063612zg/sections/important-documents/nigeria-2006-population-census-arranged-by-state-wikipedia/

Nigerian Police Force. (2016). *Crime data were sourced*. Ifako-Ijaiye: Divisional Headquarters.

Perry, J. D., & Simpson, M. E. (1987). Violent crimes in a city: Environmental determinants. *Environment and Behavior, 19*(1), 77–90.

Rotton, J., & Cohn, E. G. (2001). Temperature, routine activities, and domestic violence: A reanalysis. *Violence Victims, 16*(2), 203–215.

Rotton, J., & Cohn, E. G. (2003). Global warming and U.S. crime rates: An application of routine activity theory. *Environment and Behavior, 35*(6), 803–825.

Simister, J., & Van de Vliert, E. (2005). Is there more violence in very hot weather? Tests over time in Pakistan and across countries worldwide. *Pakistan Journal of Meteorology*, 2(4), 55–70.

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