

# Detection and Mapping of Violent Crime Hotspots in Southwestern Nigeria

Michael Ajide Oyinloye<sup>1\*</sup>, Suleiman Abdul-Azeez Adegboyega<sup>2</sup>, Francis Omowonuola Akinluyi<sup>2</sup>, Akinola Adesuji Komolafe<sup>2</sup>, Joseph Olusola Akinyede<sup>2</sup>, Olabanji Odunayo Aladejana<sup>2</sup>, Samuel Olumide Akande<sup>3</sup>

<sup>1</sup>Department of Urban and Regional Planning, Federal University of Technology, Akure, Nigeria

<sup>2</sup>Department of Remote Sensing and Geoinformatics, Federal University of Technology, Akure, Nigeria

<sup>3</sup>Centre for Space Research and Applications, Federal University of Technology, Akure, Nigeria

Email: \*maoyinloye@futa.edu.ng, \*micnicjide@yahoo.com, saadegboyega@futa.edu.ng, foakinluyi@futa.edu.ng, foakinluyi@futa.edu.ng, aakomolafe@futa.edu.ng, joakinyede@futa.edu.ng, oodunayo@futa.edu.ng, soakande@futa.edu.ng

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## Abstract

The increasing rate of insecurity in Nigeria, especially the southwest requires a paradigm shift from popular approach to crime hotspots detection. This study employed geospatial technologies to integrate spatio-temporal crime, social media and field observation data from the communities in all the six states in the southwest to develop crime hotspots that can serve as preliminary information to assist in allocating resources for crime control and prevention. Historical crime data from January 1972 to April, 2021 were compiled and updated with rigorous field survey in September, 2021. The field data were encoded, input to the SPSS 17 and analyzed using descriptive statistics and multivariate analysis. A total 936 crime locations data were geolocated and exported to ArcGIS 10.5 for spatial mapping using point map operation and further imported to e-Spatial web-based and QGIS for the generation of hotspot map using heatmap tool. The results revealed that armed robbery, assassination and cultism were more pronounced in Lagos and Ogun States. Similarly, high incidences of farmers/herdsmen conflicts are observed in Oyo and Osun States. Increasing incidences of kidnapping are common in all the south-western states but very prominent in Ondo, Lagos and Oyo States. Most of the violent crime incidents took place along the highways, with forests being their hideouts. Violent crimes are dominantly caused by high rate of unemployment while farmer/herdsmen conflicts were majorly triggered by the scarcity of grazing fields and destruction of arable crops. The conflicts have resulted in the increasing cases of rape and disruption of social group, intake of hard drugs, cult-related activities, low income and revenue generation, and displacement of farmers and infrastructural damages. The study advocates regular retraining and equipping of security

agents, establishment of cattle ranch, and installation of sophisticated IP Camera at the crime hotspots to assist in real-time crime monitoring and management.

### **Keywords**

Violent Crimes, Crime Hotspots Detection, Geospatial Technologies, Temporal Crime Data, Real-Time Crime Information

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## **1. Introduction**

Crime may be better understood as a complex, multi-dimensional event that occurs when the law, offender and target (refers to a person in personal crimes and an object in property crimes) converge in time and place (such as a street corner, address, building or street segment). Crime is regarded as an infraction of both the basic principles of law and norms of civilized and acceptable conduct [1] [2] [3]. Thus, it could be seen as a violation of societal rules as accepted and interpreted by operational criminal code. Crime may be categorized into three, namely crimes against persons or personal crimes, property crimes and crimes against public order [4].

Given the high level of insecurity in the country generally and southwest in particular where spate of kidnapping, organized crimes, armed robberies and cybercrimes have been occurring at alarming rate, this research work focuses on property crimes which comprise organized crimes, armed robbery, kidnapping and ritual killings, among others. Detection and mapping of areas where all or some of these crimes are concentrated, otherwise known as crime hotspots, are very important in the context of technique/approach usually adopted. For instance, the law enforcement agencies usually carry out geographical analysis for establishing crime hotspots through the use of crime pin maps of reported crime events over a given period. Prior to recent advances in geospatial technology, law enforcement agencies typically placed coloured pushpins in wall maps to visualize individual crime events and examine the spatial distribution of crime locations. There is a paradigm shift away from this popular approach to crime hotspots detection. The advent of geospatial techniques and its applications to crime control and management has provided greater opportunities for not only mapping of crime but also allowing the analysis of hotspots over a period of time and shift in the location of hotspots over different periods.

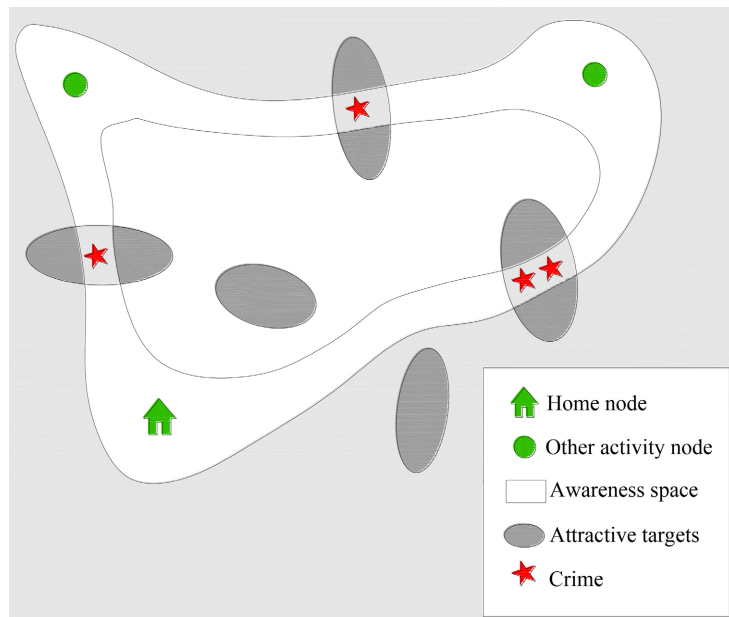
In view of the above, it is important to stress that crime and criminalities have assumed different dimensions such that dealing with it demands a lot with respect to ethical dilemmas and decisions in criminal justice [5]. Thus, effective gathering of crime data, its analysis and taking informed decision in planning and policy formulation requires a careful application of technological and scientific approach that integrates hard and software with traditional intelligence gathering (see for example, [6] [7] [8]). The need for the deployment of geospatial

technologies is informed by the sophisticated manner in which crimes are executed. Thus, the need for efficient and effective application of geospatial technology crime control and management cannot be over-emphasized. [9] noted that “with the population of Nigeria growing at an alarming rate according to statistics, the ability of the existing law enforcement agencies to provide the needed security and the ultimate safety of lives and property in these fast growing commercial cities has become a major source of concern for Nigerian government”. This has earlier been observed by [10] [11]. This to a large extent necessitates the integration of geoinformatics as an added approach in probing into crime and criminalities. [12] emphasizes the capability of GIS in crime mapping that it allows integration and analysis of data to identify, apprehend, and prosecute suspects; it aids more proactive behaviour through effective allocation of resources and better policy setting. This study however, not only adopts geospatial technologies as tools for integrating crime data from different sources for detecting, mapping and analyzing violent crime hotspots but also implements installation of IP Cameras at some detected and mapped crime hotspots for real-time crime information acquisition and dissemination to the law enforcement agents to enhancing quick emergency response. The study further investigates the causes, social and economic consequences of the violent crimes in the specific locations. In addition, the research of this kind adopting geospatial technologies to detect, map and analyze violent crime hotspots is rare in the study area where the level of insecurity has become worrisome.

The study therefore utilizes geospatial technologies to integrate temporal crime data from varying sources which include web based global crime data, field based and, Police and other sources, and generate crime hotspots to assist the law enforcement agencies in allocating resources for crime control and prevention activities

## 2. Conceptual Framework

The concept of spatial dimensions of crime is premised on the fact that human behaviour is person and place-specific; implying that the location of crime must be one of the dimensions of crime analysis [13]. This is alluded to by the Crime Pattern theory which has three main concepts namely, nodes, paths, and edges (Figure 1). A node is a term from transportation, refers to where people travel to and from, such places not only can generate crime within but also nearby. It also conveys a sense of movement and hence carries extra meaning about crime opportunities [14]. Paths is the linkage or the string that attaches routes between nodes, while, edge refers to the boundaries of areas where people live, work, shop or seek entertainment. Crime pattern theory underscores the fact that people and events involved in crime move about in space and time. This is further clarified by [15] that a place could be a point or an area. The routine activity theory identifies the convergence of motivated offender, suitable target, and the absence of a capable guardians in space and time as they are engaged in their



**Figure 1.** Crime pattern theory on diagram.

daily activities as the core elements necessary for a crime to occur. The theory suggests that neighbourhood activity patterns may increase the probability that motivates offenders to converge in time and space at suitable targets and in the absence of a capable guardian; opportunities for crime increase when neighbourhood land-use patterns are conducive to crime activity. Routine activity theorists suggest that criminogenic land-uses influence crime in two ways: 1) by inhabiting an area's social control capacity, and 2) by attracting particular types of routine activities.

Other relevant theoretical frameworks that are used as background in this research are: Place theory, Routine activity theory, Street theory and neighborhood theory. Place theories, according to [16] (1995), explain why crime events occur at specific locations. They deal with crimes that occur at the lowest level of analysis-specific places. They involve looking at specific incidents and asking such questions as, "At what places are burglaries occurring and at what places are they not occurring?". Crime phenomena at this level occur as points, so the appropriate units of analysis are addresses, street corners, and other very small places, which are typically represented on maps as dots. Police action, such as warrants, which specify exact addresses (not blocks or neighbourhoods), is very precise at this level.

Street theories deal with crimes that occur at a slightly higher level than specific places; that is, over small, stretched areas such as streets or blocks. The appropriate units of analysis can be street segments, paths, and sections of highways, which would be represented on maps as straight, bent, or curved lines. Police action is still relatively precise, although not as precise as that of place level. Concentrated patrolling occurs at this level, for example, as well as efforts to change traffic and street patterns [17].

### 3. Materials and Method

#### 3.1. Research Locale

Southwestern Nigeria is one of the six geopolitical zones in Nigeria. It comprises six states, namely Ekiti, Lagos, Ogun, Ondo, Osun and Oyo (Figure 2). It is majorly a Yoruba speaking area, although there are different dialects even within the same state. It offers a wide range of geographic features and tourist potentials, from the Atlantic coast and beaches of Lagos to the natural springs/waterfalls in Osun state, Olumo rocks in Ogun, the scenic views of the historic and ancient city of Ibadan and the rolling topographies, dotted by hills/inselbergs, of Ekiti and Ondo states. The area is also characterized majorly by the guinea savannah which encroached from the north and thick vegetation or forest reserves in all the southern states apart from Lagos which is mostly swampy. The weather conditions vary between the two distinct seasons in Nigeria: the rainy season (March–November) and the dry season (November–February). The rainy season is usually marked by high water table and flooding, while dry season is characterized by the Harmattan dust and cold dry winds that blow from the northern deserts to the southern regions. The strategic location of the southwest, its fertile land, occupation which is significantly farming, landmass of about 80,116km<sup>2</sup> and a population of 38,257,260 [18] makes the policing of the area complex. It has international boundaries with Benin Republic in Oyo and Ogun States, and with the Atlantic Ocean in Lagos, Ogun and Ondo States. The region shares boundary with Kwara State in Osun and Oyo States, and with Edo state in Ondo State.

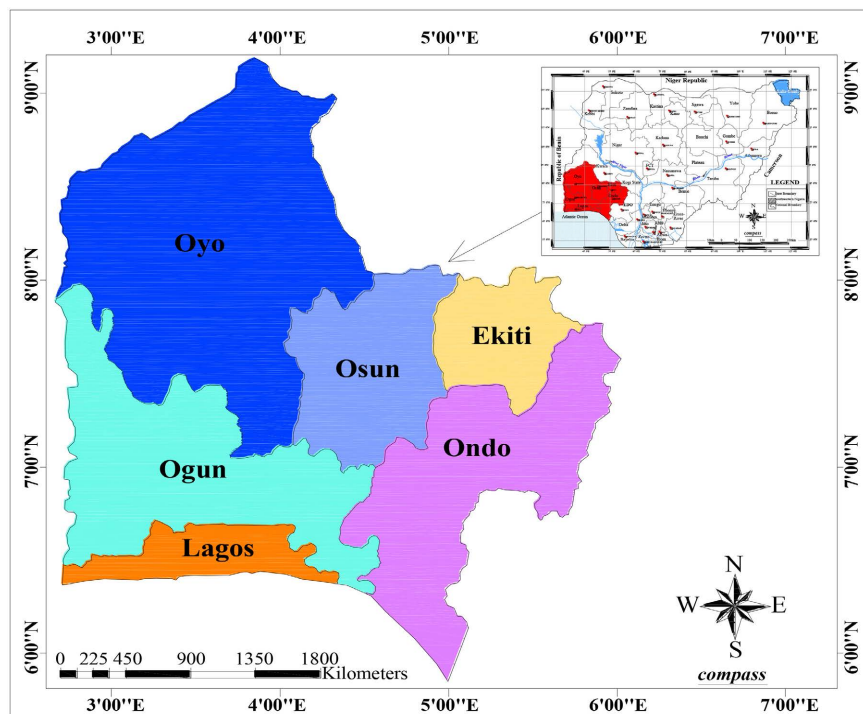


Figure 2. Southwestern Nigeria and its six states.

Most of the land cover types have been deployed for criminal activities by the people of criminal tendencies. For instance, vegetation of the Southwest is characterized by dense vegetation canopy, which is usually exploited as hideouts by Kidnappers. Ondo State for example has over 5000 Km<sup>2</sup> of dense forest reserves. This characteristic is similar for all states in the Southwest of Nigeria except Lagos State. In addition, southwest is highly urbanized and regarded as the commercial hubs of the country. However, the scale of havoc through kidnapping for money/rituals, organized crimes and armed robbery in the South West is particularly worrisome; the present internal insecurity in the region is posing great threats to the socio-economic development of the SW zone and the corporate existence of Nigeria. There is no gainsaying the fact that South Western Nigeria remains the economic hub of the nation, making a huge contribution to the national GDP. But the security situation in the region has reached an alarming state to the extent that the population in the area now lives in obscurity, fear, anxiety and danger, and this is impairing freedom to conduct businesses and derive means of livelihood, with severe consequences on the nation's overall security and economic growth. It is therefore the thrust of this study to deploy geospatial based technologies to carry out a detection and mapping of crime hotspots in the area with a view to generating digital crime hotspot maps that will assist law enforcement agencies in allocating resources for crime prevention activities.

### **3.2. Data Sources and Input**

The study utilized historical crime data sourced from open source Global mapping platform, Nigeria Police, Customs and Civil Defence Corps. Crime data were also obtained from National dailies and Social Media. The study further sourced crime data from a comprehensive field study which involved administration of questionnaire in some selected communities in all the six states of south western Nigeria. In the designing of the questionnaire, the study adopted mixed techniques (qualitative and quantitative methods). The use of multiple techniques in research design affords the investigator the opportunity of taking advantage of both numeric and non-numeric data, which enhances more all-inclusive analysis and hence improves the data results [19]. The designed questionnaire was validated through and during an organized security stakeholder meeting.

Based on the review of existing crime hotspot studies and Daily Newspaper crime reports in relation to the objectives of the research, four categories of respondents were identified. These are Police officers/Civil Defense officers in charge of armed robbery and Kidnapping, members of vigilante groups, Arable farmers/herdsmen and members of National Union of Road Transport Workers (NURTW) in the six states of Southwestern Nigeria. To determine the sample population, multi-stage sampling and snowball sampling techniques were adopted in the determination of sample population. Multi-stage sampling technique was found to be suitable for selecting samples that are concentrated in a few geo-

graphical regions [20] as it may be the case regarding crimes hotspots in the Southwestern part of Nigeria. Snowball sampling was considered alongside with multi-stage sampling technique for selecting samples from the security agencies due to their closed nature [21].

Therefore, Senatorial Districts were considered for the determination of the sample population. In a state, 3 senatorial districts are in existence. 2 Local Government Areas (LGAs) were selected for each senatorial district, amounting to 6 LGAs per state. Followed by selection of 3 communities in each LGA, making a total of 18 communities per state. For the whole study area, 108 communities were randomly selected. 3168 copies of questionnaire (**Table 1**) were eventually administered on the respondents to elicit information on socio-economic characteristics, crime experience, pattern and trend of violent crimes such as armed robbery, kidnapping, ritual killings, cultism and farmers-herdsmen conflicts, security challenges and impacts of the insecurity on the socio-economic development of the communities, among others. The administration of the questionnaire involved the use of KoBo ToolBox based on open data kit in real time and offline modes to security agents, the traditional rulers and community leaders in all the southwestern states in Nigeria.

### 3.3. Data Analysis

Data obtained from questionnaire administration were encoded and input to the SPSS 17 Version software. Descriptive statistics such as simple percentage analysis was used. Multiple regression analysis was carried out to understand the causes, social and economic implications of insecurity with special reference to the notorious farmers/herdsmen conflicts in the southwest Nigeria.

### 3.4. Hotspot Mapping in GIS

Firstly, vector map representing the geometry of the Southwestern Nigeria was generated using ArcGIS; other spatial data such as roads, rivers, elevation and names of various locations were derived from open data sources (e.g. open street map).

The aggregated data (from January 1972 to April, 2021) obtained from the from historical (global) crime, the field-based and the social-media data were classified into seven (7) crime incident types: Armed Robbery, Assassination, Cultism, Farmers/Herdsmen, Kidnapping, Rape, and Assault; these were assigned a unique identification key (ID) and attributes such as the city of the incidents, the coordinates of the crimes as referenced by the World Geodetic System 1984 (WGS84), the time of the crime, the classification and the place of the crime, the date and time when the incident was recorded (**Table 2**). Data were edited for unusable entries and prepared for input into ArcGIS for hotspot mapping and analysis. The data were geolocated by their WGS84 X- and Y-coordinates, while those incidents' coordinates lying outside the place of study were ortho-rectified (**Table 2**).

**Table 1.** Determination of respondents.

State	Senatorial districts	Selected LGAs	Selected Communities	Respondents				
				Security Personnel (1 per comm.)	Arable Farmers (20 per comm.)	Herdsmen (6 per LGA)	Vigilante Group (3 Per comm.)	NURTW (10 per LGA)
Lagos	3	6	18	18	360	36	54	60
Ogun	3	6	18	18	360	36	54	60
Osun	3	6	18	18	360	36	54	60
Oyo	3	6	18	18	360	36	54	60
Ondo	3	6	18	18	360	36	54	60
Ekiti	3	6	18	18	360	36	54	60
<b>Sub Total</b>				<b>108</b>	<b>2160</b>	<b>216</b>	<b>324</b>	<b>360</b>
<b>Grand Total</b>						<b>3168</b>		

**Table 2.** Crime data information and resources.

DATA	INFORMATION	RESOURCE
<b>Incident Data</b>	Incident type	
	Address of the incident location	Field Survey
	Place of incident	Historical
	Date of incident	Media sources
	Time of incident	Security agents
	X,Y coordinates of the incident	
<b>Land use Data</b>	Land use type	Administrative Map
	Size of the land use area	Landsat image
	Landmark type	Landsat image
	Road class	Spatial Attributes(Roads etc)

Database was created for all the point data in ArcGIS environmental; this consists of some collection of crime incidence data from which mapping and hot-spot analysis were carried out using point map operation. However, in the creation of database in the context of geo-informatics, the concept of time, space and location of crime incidence were well considered. Space concept addresses the world around us and our immediate environment. We further imported to e-Spatial web-based and QGIS for the generation of hotspot map for the southwestern Nigeria using heatmap tool. The results of the analyses are in form of report, tables, graphics, static and dynamic maps, which could be sharable concurrently by many users, possess optimized storage, has integrity and should be queried optimally.

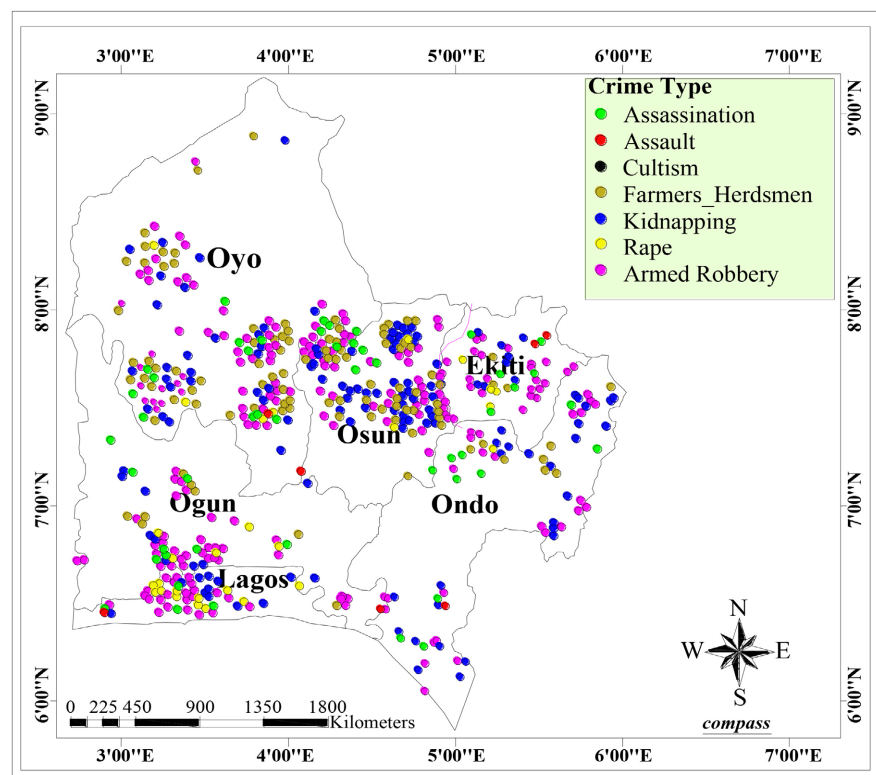
## 4. Results and Discussion

### 4.1. Crime Distribution and Frequency across the Southwestern Nigeria

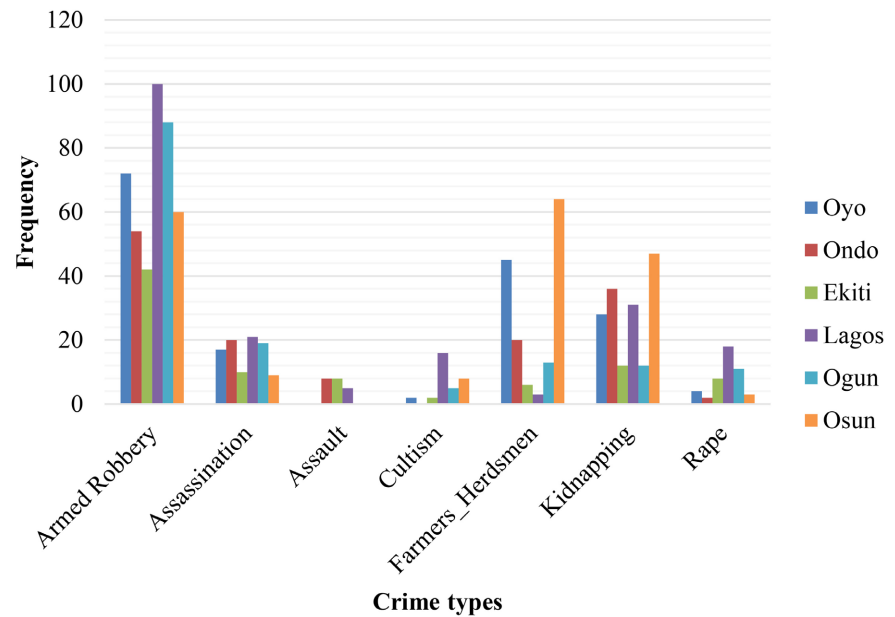
The spatial distribution of violent crimes in southwestern Nigeria is shown in

**Figure 3.** From the figure, the violent crimes include armed robbery, assassination, cultism, farmers/herdsmen, kidnapping, rape and armed assault. The figure reveals that all these crimes are present in the six states of the southwestern Nigeria. This is in agreement with [22] posits that armed robbery, rape, kidnapping, cultism, land dispute, etc. are the types of crime that exist in the southwestern Nigeria. It could be observed that armed robbery, assassination and cultism are more pronounced in Lagos and Ogun States (**Figure 4**). High incidences of these crimes may be anchored on the fact that Lagos is the commercial hubs as well as the former administrative capital of Nigeria where high transport network, population density, level of industrialization, proximity to the Ocean that harbours Apapa, Tin Can and the newly constructed Lekki Deep Sea Ports, easy access to the neighbouring countries by road and water constitute the catalyst for the prevailing socio-economic opportunities. Given this situation, Lagos tends to be conceived as the dream land for most of the people searching for better economic opportunities in Nigeria resulting into in-migration of high influx of migrants of people different socio-cultural backgrounds. Ogun State, as a neighbouring state, provides geographic space for the emerging rapid urbanization from the Lagos side with its associated challenges.

**Figure 4** further reveals that armed robbery is the most predominant violent crime in the southwestern Nigeria. Less occurrence of armed assault is noticed in Osun, Ogun and Oyo States. The figure also shows high incidences of farmers/herdsmen conflicts in Osun and Oyo states. It further reveals increasing incidences



**Figure 3.** Violent crime distribution in southwest Nigeria.



**Figure 4.** Frequency of occurrences of crime in Southwest Nigeria.

of kidnapping in all the states while high incidences of kidnapping are common in Ondo, Lagos and Oyo States. High level of insecurity of lives and properties is therefore becoming worrisome due to the fact that the existing security apparatus seems to have been overwhelmed, and this may adversely retard the socio-economic development of the region and the country at large [23].

For detailed examination of the frequency of crimes in the six states of the south western Nigeria, further discussion on state basis is carried out as follows.

#### 4.1.1. Ekiti State

Ekiti State is one of the less populated states in the southwest with potential risk and vulnerability to various crime activities. Armed robbery and kidnapping are very prominent in the state (Figure 5). In case of robbery attack, highway robbery, banks and house burgling are very common. In most recent times, kidnapping on the highway, which are most times attributed to herdsmen and have continuously created fear for the travelers along Ekiti roads. The kidnapers often make use of the thick forest to perpetrate their evil acts. The recent waves of kidnapping in the state have however taken a new dimension to the extent of killing and taking hostage the Kings and prominent people in Towns and villages with impunity. Though the study reveals very low occulted activities but it is known that occulted activities are present in most places in Ekiti land, suggesting that the initiated individuals are bowing out of such activities in recent times.

#### 4.1.2. Ondo

Similar to the happenings in Ekiti, armed robbery and kidnapping are significantly high in Ondo state (Figure 6); this corroborates the field work findings. Kidnapping activities in Ondo are very frequent along Akure—Owo-Ose roads, Akoko area, and boundary towns.

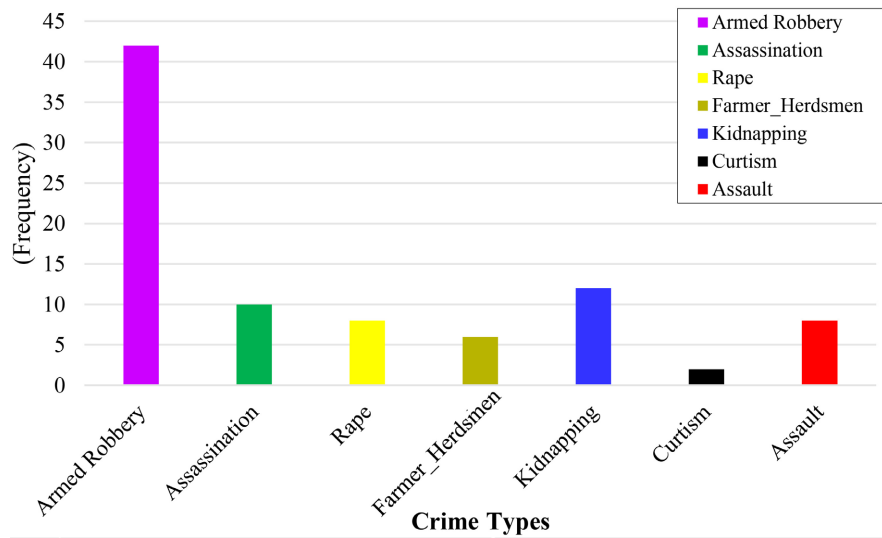


Figure 5. Crime frequency chart in Ekiti State.

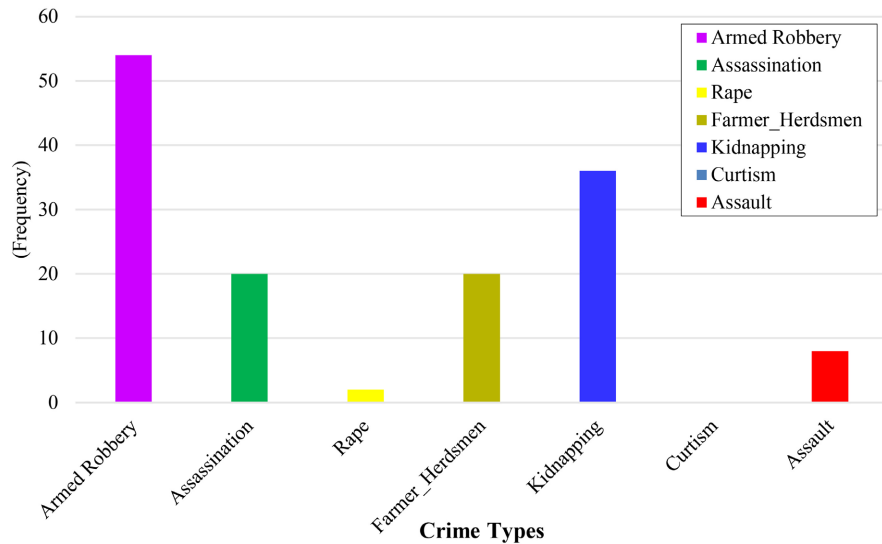
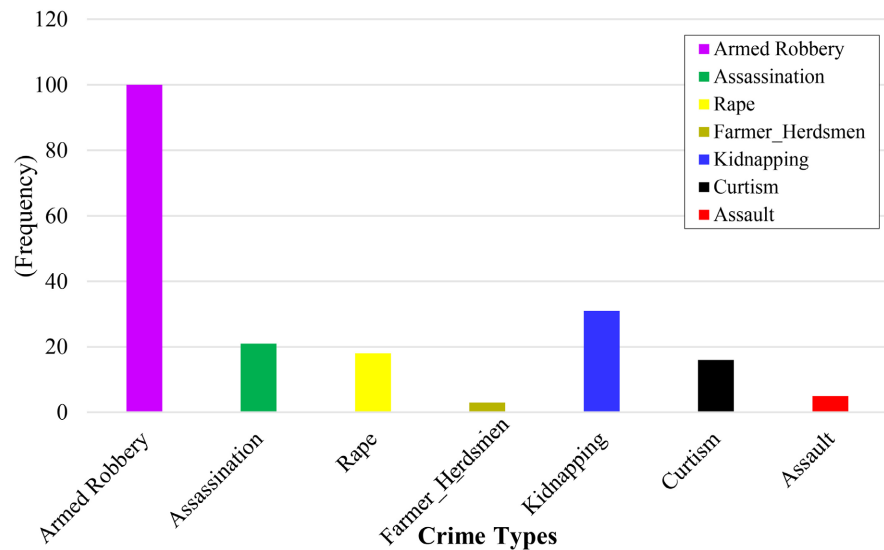


Figure 6. Crime frequency chart in Ondo State.

#### 4.1.3. Lagos State

In Lagos state as shown in **Figure 7**, armed robbery was predominant over other violent crimes. 80% of the crime incidents reported and surveyed were armed robbery cases that occurred along the highways and suburb Local Government Areas such as Ikorodu, Alimosho, Ibeju-Lekki and Ojo. This is followed by kidnapping (26%) and assassination case was put at 20% while rape and cultism (19%) were reported to have been rearing its ugly heads in Ikorodu and environs, particularly, Bayeku and Ofin-Ile; Ojo LGA that hosts the Lagos State University; abandoned School of Nursing building at Lafiaji in Lagos Island as well as Ilubinrin where the proposed Lagos State House of Assembly Housing Complex is sited. Other crimes include assault (3%) and farmers-herdsmen clashes (1%). The farmers-herdsmen clashes were reported at Imota town in Ikorodu LGA.



**Figure 7.** Crime frequency chart in Lagos State.

#### 4.1.4. Ogun State

**Figure 8** shows the crime incidents in Ogun State. Armed robbery incidents predominated over other crime types in the State. This could be explained by the fact the State shares boundary with Lagos State and Republic of Benin. Assassination was also reported to be on the high side. Several cases of farmers-herdsmen were reported at Opeji Odo town in Abeokuta North, Iwoye and Ilaro town. Cases of Kidnapping and rape were also alarming as gathered from the field survey and depicted in **Figure 5**. Cultism, though, records the lowest percentage but for the fact human lives are endangered during clashes between two opposing cults particularly in Iberekodo, Ado-Odo and Igbesa towns is an indication that the operation of the cults runs contrary to norms and values of the residents in the affected communities.

#### 4.1.5. Osun State

According to **Figure 9**, farmers-herdsmen, armed robbery and kidnapping recorded 94%, 90% and 67% respectively. It was gathered during the field survey affirmed by the recent cases of these crime incidents along Ilesa-Akure expressway, Ilesa-Osogbo road and Ilesa-Ile-Ife-Ibadan expressway. Cases of assassination and cultism particularly in Wasinmi in Irewole LGA, Osogbo in Osogbo LGA and Iragbiji in Boripe LGA are 9% and 8% respectively. Rape is also on the increase with 4% incidents in the major towns in the State.

#### 4.1.6. Oyo State

**Figure 10** showed the predominance of armed robbery (92%) over other crime types in the State. Farmers-herdsmen clashes have become worrisome in places like Iganna, Tapa, Otu, Eruwa and Otu towns with 65% incidents. Recent violent clashes in those areas have claimed human lives and destruction of properties. Kidnapping and assassination also recorded 38% and 28% incidents. Whilst rape and cultism recorded less than 10%. It is observed that all the States in the Southwestern

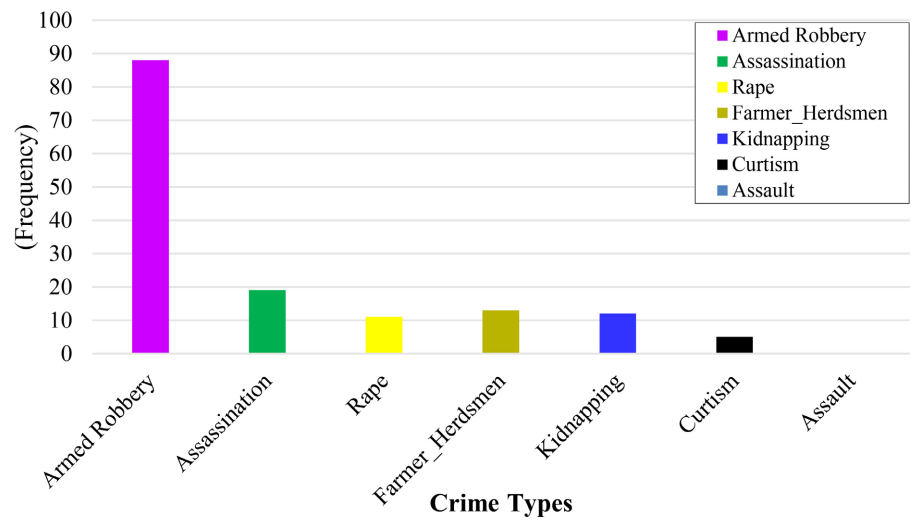


Figure 8. Crime frequency chart in Ogun State.

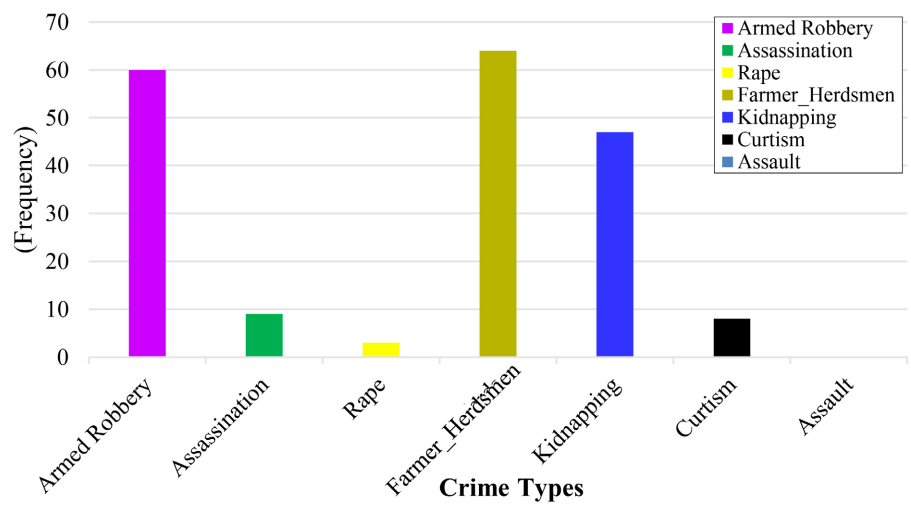


Figure 9. Crime frequency chart in Osun State.

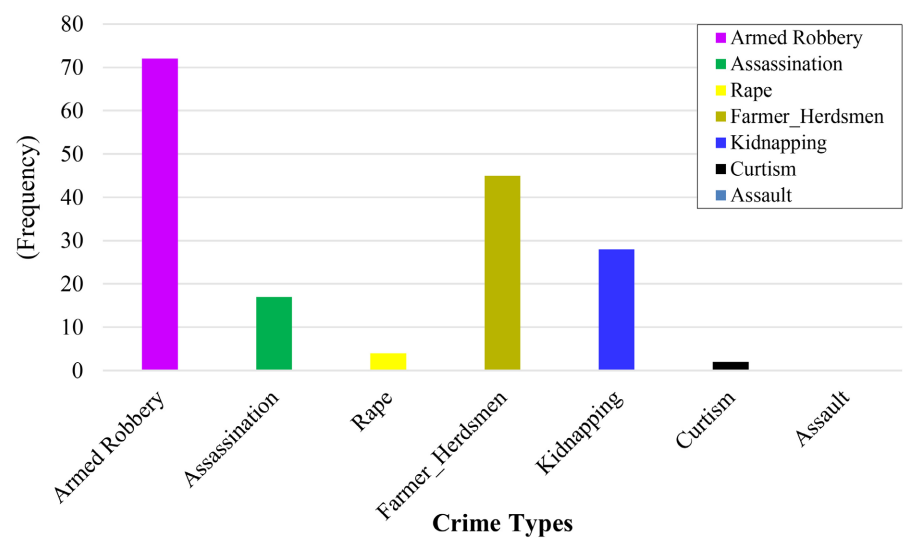
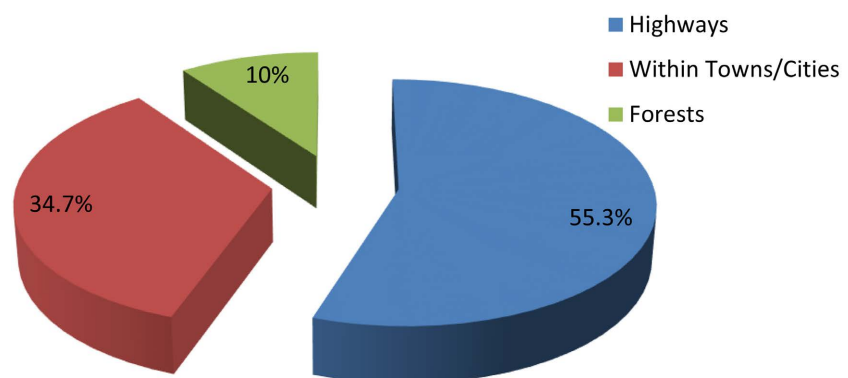


Figure 10. Crime frequency chart in Oyo State.

Nigeria recorded high cases of armed robbery except in Osun State where farmers-herdsmen clashes predominate.

#### 4.2. Crime Incident Pattern in the Southwestern Nigeria

**Figure 11** shows the preponderance of crime incidents particularly armed robbery and kidnapping along highways (55.3%) in the study area. The affected highways include Lagos-Ibadan, Akure-Ilesa-Ibadan, Ore-Ijebu Ode-Lagos, Akure-Owo-Abuja, Owo-Benin and Ibadan-Iseyin-Saki. These highways are noticed to have traversed forested and guinea savanna areas over a long distance. People of criminal tendencies seem to have leveraged on this to perpetuate inhumanly attack on the innocent citizens while on transit and escape to the vast forest. This is alluded to by the crime pattern theory that Lagos, Ibadan, Akure and other towns connected to one another by highways are capable of generating violent crimes and also the edges of highways often times are seen as crime hide-outs occasioned by absence of Police patrols along the highways. The figure also reveals that 34.7% of the violent crimes under consideration takes place within the towns and cities in the study area. Pockets of these incidents are reported at abandoned School of Nursing building at Obalende, new Lagos State Assembly Housing Complex, Ilubinrin in Lagos Island, Iberekodo in Abeokuta, bank area at Iragbiji in Osun State, Owo in Ondo State among others. This is substantiated by place theory that crime behaviour is place-specific and hence, to prevent crime occurrence may require real-time monitoring. The figure further shows that 10% of the crime incidents take place in the forest where farmlands are being destroyed by the herdsmen, culminating in incessant farmers/herdsmen conflicts. In addition to this, it is also observed that the kidnapers have turned the forests particularly forest reserves to their hide-outs where kidnapping victims are temporarily held in captivity for ransom settlement. This is alluded to by routine activity theory that explains lack of adequate security guards around the forests in the southwestern Nigeria and hence, the kidnapers and armed robbers operate with little or no hindrance. Going by the level of sophistication of weapons being deployed by the criminals, suggesting that the existing security architecture desires conscious overhauling. 86.4% of the respondents lend credence



**Figure 11.** Crime incident pattern of occurrence.

to this by affirming that the existing security measures and equipment in place are overstretched (Figure 12).

### 4.3. Causes of High Violent Crime Incidents

The results of analysis on the causes of high violent crime incidents in the southwestern Nigeria are shown in Figure 13. A large proportion (30.77%) of the respondents posit that high rate of unemployment is the dominant cause of the increasing violent crimes. [24] reports similar finding that unemployment is one of the causes of crime in any society. Unemployment statistics released by National Bureau of Statistics in the first Quarter of 2022 lend credence to this as National unemployment rate is (33.3%), under-employment stands at 22.8%, youth unemployment (42.5%) and youth under-employment (21.0%) with the attendant annual average inflation rate of 16.9% and unstable foreign exchange rate. It is evident that there is a large army of unemployed people of active age in Nigeria. This largely explains the increasing crime incidents in the southwestern

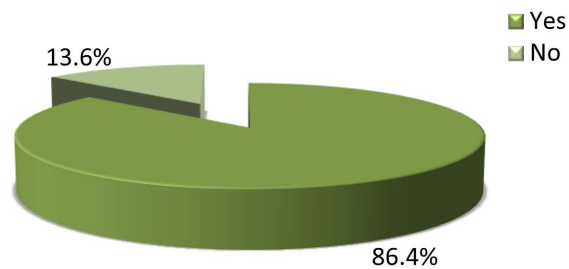


Figure 12. Security measures and equipment overstretched.

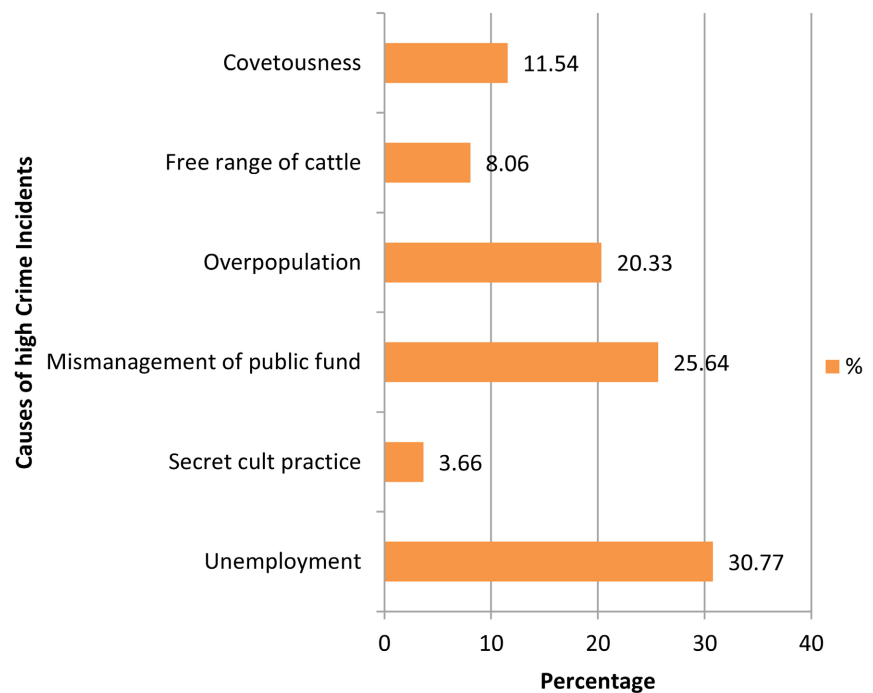
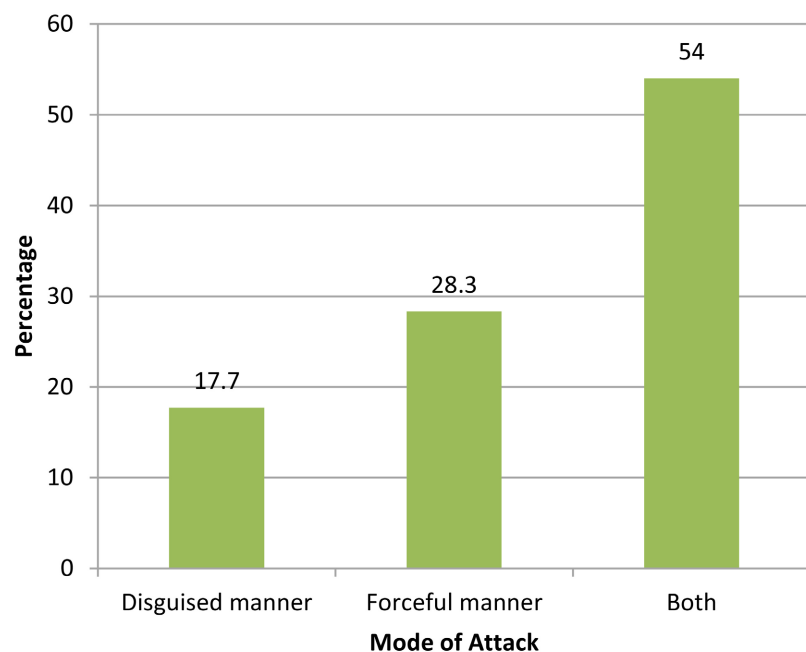


Figure 13. Causes of high crime incidents.

States. The figure further shows other identified causes as mismanagement of public funds (25.64%), overpopulation (20.33%), covetousness (11.54%), free range of cattle rearing (8.05%) and secret cult practice by the youths (3.66%). Mismanagement of public fund has become a cankerworm that tends to have been inhibiting good governance in Nigeria. It partly contributes to the low performance of national economy that fails to create opportunities for the young unemployed graduates. The issue of overpopulation as identified as one of the causes of high crime incidents is subjective but its applicability to places like Lagos and Ibadan may be considered appropriate. This is due to the fact social amenities and economic opportunities in existence in Lagos and Ibadan have been overstretched by increasing demands arising from high influx of migrants on daily basis. Covetousness could be explained as lust for wealth among the youths has become unprecedented with associated crimes such as ritual killings, yahoo plus and yahoo-yahoo in cities and towns of southwestern states. The practice of free range cattle rearing has triggered unprecedented clashes between herdsmen and arable farmers. Many lives and properties have been severely affected by this practice. Secret cult practice by the youths has given rise to some deadly groups such as “One Million Boys”, Badoos and others in Ogun and Lagos States. The scale of operation of these youths in secret cult varies from one state to the other in Southwestern Nigeria.

#### 4.4. Mode of Attack and Time Operation

**Figure 14** shows the mode of attack as explained by the victims during field survey. The figure reveals that the people of criminal tendencies adopt disguised and forceful mode of operation in day or night time. Hours of operation of the



**Figure 14.** Mode of attack.

armed robbers and kidnapers on those highways vary from 12.30 am to 7.50 am, from 12.00 noon to 3.00 pm, and 8.00 pm to 10.00 pm throughout the working days but more severe from Friday to early Monday morning. It is claimed the hoodlums use sophisticated weapons, cutlass and charm during criminal attacks to instill fear in the victims and take that advantage to rob the victims of their valuable belongings such as personal effects, money, lives and farm products. Further, it is reported that 56.5% of the hoodlums are non-indigenes while 43.5% are indigenes (Figure 15). It indicates that the criminals could escape to their places of origin after a successful operation and indigenous hoodlums could also leverage on that to perpetrate their ungodly acts.

#### 4.5. Potential Causes of Farmers/Herdsman Clashes in Southwestern Nigeria

The menace of farmers/herdsman conflicts southwestern Nigeria tends to have been taken a dangerous dimension with regard to potent threat to the national unity, development and food security. In view of this, the causes of this conflict deserve a special treatment in this kind of study. The study therefore assessed the causes of farmers/herdsman clashes in six states of southwestern Nigeria. The results of multivariate analyses on the potential causes of farmers and herdsman conflicts in the southwestern Nigeria are summarized in Table 3(a) and Table 3(b). The regression coefficient calculated (0.760) showed a strong relationship between the causes of farmers/herdsman and the frequency of conflict in the sampled communities in Ekiti State. The causes of the clashes include destruction of arable crops, bush burning, impact of climate change, sexual harassment of women, overgrazing, harassment of nomads, disregard for traditional authority, scarcity of grazing fields, cattle defecation, contamination of stream by cattle, theft of cattle, stray cattle and poor land use planning. The standardized beta coefficient, 0.791,  $p < 0.000$  indicates that a unit change in the variable (destruction of crops) is capable of increasing existing farmers/herdsman crises. This is further strengthened by the big t-value and small (p); 3.250 and 0.005 respectively, which indicates a good contribution of the destruction of crops by the herdsman to increasing farmers/herdsman clashes. The adjusted  $R^2 = 0.230$ ;  $F = 1.662$ ,  $P < 0.05$  indicates that destruction of arable crops by the herdsman as a variable is a significant predictor of farmers/herdsman clashes in Ekiti State. It

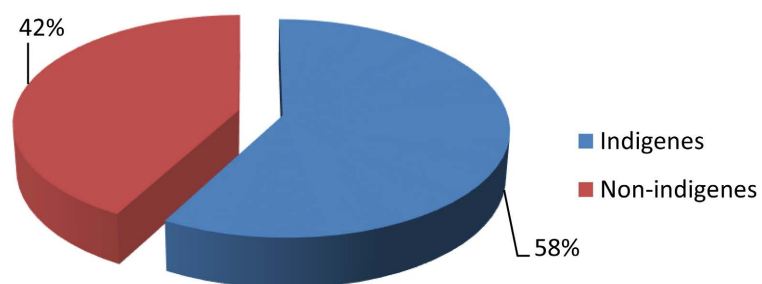


Figure 15. Nativity of hoodlums.

**Table 3.** (a) Model summary; (b) Standardized beta coefficients of stepwise regression.

(a)																		
State	R	Adjusted R <sup>2</sup>	F	t	P-value													
Ekiti	0.760	0.230	1.662	3.250	<0.05													
Ondo	0.531	0.199	11.606	3.356	<0.05													
Lagos	0.838	0.676	26.730	5.667	<0.05													
Ogun	0.925	0.923	655.775	21.699	<0.05													
Osun	0.614	0.344	11.606	4.766	<0.000													
Oyo	0.580	0.308	11.781	5.586	<0.000													

(b)																		
Predictor Variables	Ekiti State			Ondo State			Lagos State			Ogun State			Osun State			Oyo State		
	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T
Destruction of crops	0.791	0.005	3.250	0.388	0.001	3.356	0.730	0.000	5.667	-	-	-	0.294	0.003	3.026	0.626	0.000	5.586
Scarcity of grazing fields	-0.672	0.116	-1.658	-0.134	0.340	-0.957	-	-	-	0.962	0.000	21.699	0.389	0.000	4.766	-0.108	0.172	-1.370
Impact of climate change	0.401	0.380	0.902	0.0317	0.009	2.656	-0.253	0.229	-1.225	0.273	0.000	7.982	-0.086	0.359	-0.919	0.068	0.423	0.802
Sexual harassment of women	0.327	0.357	0.947	0.098	0.698	0.389	0.376	0.088	1.758	0.326	0.040	12.505	0.002	0.979	0.026	-0.098	0.278	-1.086
Overgrazing	0.623	0.452	0.770	-0.051	0.545	-606	-0.459	0.006	-2.802	0.278	0.001	3.453	0.031	0.712	0.369	0.031	0.712	0.369
Bush Burning	0.049	0.892	0.138	-	-	-	-	-	-	0.321	0.337	1.008	-0.028	0.716	-0.364	-0.028	0.716	-0.364
Harassment of nomads	-0.349	0.752	0.770	0.191	0.003	2.959	0.396	0.002	3.214	-0.257	0.005	-2.851	0.163	0.008	2.669	0.163	0.008	2.669
Disregard for traditional authority	-0.403	0.609	-0.520	-	-	-	0.089	0.424	0.802	0.444	0.000	5.520	0.051	0.601	0.524	0.051	0.601	0.524
Cattle defecation	0.031	0.951	0.062	-0.025	0.894	-0.133	0.161	0.290	1.061	-	-	-	0.250	0.003	3.008	0.250	0.003	3.008
Contamination of stream by cattle	0.097	0.887	0.144	-0.303	0.225	-1.219	-0.216	0.052	-1.959	-	-	-	-0.092	0.353	-0.931	-0.246	0.006	-2.763
Theft of Cattle	0.527	0.525	0.649	-0.045	0.517	-0.649	0.429	0.001	3.374	0.685	0.444	0.797	0.336	0.000	5.405	0.336	0.000	5.405
Stray cattle	-0.511	0.297	-1.076	0.224	0.005	2.807	0.304	0.069	1.831	0.485	0.007	3.421	-0.043	0.599	-0.526	-0.043	0.599	-0.526
Poor land use planning	0.016	0.980	0.026	-0.277	0.061	-1.892	0.305	0.017	2.410	-	-	-	0.049	0.546	0.605	-0.091	0.313	-1.010

implies that a unit change in the predictor variable (destruction of arable crops) is capable of triggering upward increase in the rate of farmers/herdsmen clashes in Ekiti State. It suggests that an upward change in the destruction of arable crops has strong tendency to provoke further farmers/herdsmen crises in Ekiti State. This may culminate into loss of lives and properties, displacement of farmers, a threat to food security, insecurity and loss of revenue.

From the **Table 3(a)** and **Table 3(b)**, the results further show (0.531) a strong relationship between the causes of farmers/herdsmen clashes and frequency of conflict variable in the sampled communities under consideration in Ondo State. The standardized beta coefficient, 0.388,  $p < 0.05$  suggests that a unit change in the rate at which crops are being destroyed by the herdsmen's cattle could trig-

ger increasing farmers/herdsmen clashes. This is further strengthened by the big t-value and small (p), 3.356 and 0.001 respectively, which suggests a good contribution of destruction of crops by cattle to increasing farmers/herdsmen clashes. The adjusted  $R^2 = 0.199$ ;  $F = 11.606$ ,  $P < 0.05$  using stepwise regression revealed that destruction of crops by cattle as a variable was a significant predictor of farmers/herdsmen clashes in the sampled communities in Ondo State. It suggests that a unit increase in the predictor variable; destruction of arable crops could bring about corresponding increase in the rate of farmers/herdsmen clashes in Ondo State. It indicates that increasing destruction of crops by the activities of herdsmen could aggravate monumental clashes between the farmers and herdsmen. This may result in poor harvest, shortage of agricultural produce, displacement of farmers, insecurity of lives, cattle and properties.

According to the **Table 3(a)** and **Table 3(b)**, a strong relationship (0.838) was established between the causes of farmers/herdsmen clashes and frequency of conflict variables particularly in Imota community in Ikorodu LGA and Iba community in Ojo LGA. Also, the adjusted R square value of 0.676 showed that the model accounted for 67.6% of the variance in the factors causing farmers/herdsmen conflicts. The standardized beta coefficient, 0.730,  $p < 0.05$  indicates that a unit change in the rate crops are being destroyed by the cattle is capable of triggering further farmers/herdsmen conflicts. This is further strengthened by the big t-value and small (p), 5.667 and 0.000 respectively, which suggests a huge contribution of destruction of crops by cattle to increasing farmers/herdsmen clashes. In essence, adjusted  $R^2 = 0.676$ ;  $F = 26.730$ ,  $P < 0.05$  showed that destruction of crops by cattle as a variable was a significant predictor of farmers/herdsmen clashes in Lagos State. It indicates that a unit increase in the destruction of crops variable is capable of triggering farmers/herdsmen clashes in Lagos State. This may result to avoidable serious injuries, loss of lives and properties.

From **Table 3(a)** and **Table 3(b)**, a strong relationship (0.925) was observed between factors responsible for the farmers/herdsmen clashes and the frequency of the conflict in the sampled communities (Opeji-Odo, Ajegunle-Odo and Iberekodo in Abeokuta North LGA, Abalabi in Ewekoro LGA and Iwoye in Yewa South LGA in Ogun State Ogun State. From **Table 3(b)**, this is further affirmed by the big t-value and small (p), 21.699 and 0.000 respectively, which suggests a large contribution of the scarcity of grazing fields to the farmers/herdsmen clashes. The adjusted  $R^2 = 0.923$ ;  $F = 655.775$ ,  $P < 0.05$  using stepwise regression revealed that scarcity of grazing fields was a significant predictor of farmers/herdsmen clashes in the sampled communities in Ogun State. It implies that a further increase in the scarcity of grazing fields has a strong tendency to precipitate monumental clashes, arising from wanton destruction of arable croplands, between the farmers and herdsmen in the sampled communities in Ogun State.

In Osun State (see **Table 3(a)** and **Table 3(b)**), the regression coefficient cal-

culated (0.614) showed that there was a strong relationship between the causes and frequency of farmers/herdsmen clashes in the sampled communities (Iragbiji, Iree, Inisa, Okuku, Ada, Ajebamidele, Aiyetoro, Bolorunduro, Iloko-Ijesa, Ipetu-Ijesa, Isundurin, Akiriboto, Gbongan, Ode-Omu, Olla and Ilawo). The standardized beta coefficients, 0.389 and 0.336,  $p < 0.000$  indicate that a unit change in the predictor variables (scarcity of grazing fields and theft of cattle) is capable of escalating the existing farmers/herdsmen crises in the sampled communities. The adjusted  $R^2 = 0.344$ ;  $F = 11.606$ ,  $P < 0.000$  showed that scarcity of grazing fields was a significant predictor of farmers/herdsmen crises in the sampled communities in Osun State. It indicates that a unit increase in the predictor variable; scarcity of grazing fields could trigger further destruction of arable crops that has tendency to escalate the existing farmers/herdsmen clashes in the sampled communities in Osun State.

**Table 3(a)** and **Table 3(b)** also showed (0.580) strong relationship between the causes and frequency of farmers/herdsmen clashes in the sampled communities (Tapa town in Ibarapa North, Otu town in Itesiwaju LGA, Elekokan town in Iwajowa LGA, Boroboro town in Atiba LGA and Eruwa town in Ibarapa East LGA) of Oyo State. The standardized beta coefficient, 0.626,  $p < 0.005$  shows that a unit change in the variable (destruction of arable crops) has a strong tendency to escalate the existing farmers/herdsmen crises in Oyo State. This is further reinforced by the big t-value and small (p); 5.586 and 0.000 respectively, indicating that the predictor variable contributes immensely to the menace of farmers/herdsmen crises in the sampled communities. Most essentially, adjusted  $R^2 = 0.308$ ;  $F = 11.781$ ,  $P < 0.000$  showed that destruction of arable by the herdsmen was a significant predictor of farmers/herdsmen clashes in the sampled communities. It suggests a unit change in the predictor variable; destruction of arable crops, could trigger an increasing farmers/herdsmen conflict in Oyo State. In other words, any increase in the destruction of arable crops by the herdsmen could lead to a corresponding increase in the rate of farmers/herdsmen clashes in Oyo State.

From the results of the multivariate analyses, it could be deduced that destruction of arable crops by the herdsmen is the most determinant factor that trigger farmers/herdsmen conflicts in Oyo, Ondo, Lagos and Ekiti States while scarcity of grazing fields as a factor is observed to have responsible for the conflicts in Osun and Ogun States. It implies that destruction of arable crops by herdsmen and scarcity of grazing fields are the main causes of farmers/herdsmen conflicts in the southwestern Nigeria. It could be observed that scarcity of grazing fields has tendency to make arable farmlands vulnerable to herds destruction engendered by free range/open grazing. It implies that continual destruction of arable crops has strong tendency to provoke further farmers/herdsmen crises. This may culminate into loss of lives and properties, displacement of farmers, a threat to food security, insecurity and loss of income/revenue to private individuals, the State and Federal Government.

## 4.6. Socio-Economic Implications of Farmers/Herdsman Clashes in Southwestern Nigeria

### 4.6.1. Social Effects of Farmers/Herdsman Conflicts

The incessant farmers/herdsman conflicts tend to have enormous adverse social effects which the study attempts to assess, bearing in mind the ethno-cultural affiliations of the people involved. **Table 4(a)** and **Table 4(b)** show the results of the analyses on social effects of farmers/herdsman conflicts in Ekiti State, southwestern Nigeria. The regression coefficient calculated (0.655) showed a strong relationship between the predictor variables (reduction in quality of social relationship, reduction of social support, high intake of hard drugs, disruption of social group, reduction in social activities, acquiring weapons/arms, increase in cult-related activities, high cases of rape and loss of human life) and criterion variable (frequency of farmers/herdsman conflict). The standardized beta coefficients, 0.747  $p < 0.000$ , indicates that a unit change in the frequency of farmers/herdsman clashes could further worsen the high cases of rape and disruption of social group in the sampled communities. This is further strengthened by the big t-values and small (p); 4.456 and 4.281  $p < 0.000$  respectively, suggesting a worsening social impact arising from increasing farmers/herdsman clashes in Ekiti State. The adjusted  $R^2 = 0.403$ ;  $F = 16.314$ ,  $P < 0.000$  using step-wise regression showed that the predictor variables; high cases of rape was significant social effects of farmers/herdsman in the sampled communities.

In Ondo State, the **Table 4(a)** reveals a strong relationship (0.936) between the predictor variables (social effects) and the frequency of farmers/herdsman conflict. From **Table 4(a)** and **Table 4(b)**, the standardized beta coefficient, 1.000,  $p < 0.05$  indicates that a unit change in the frequency of farmers/herdsman conflict could trigger corresponding increase in hard drug intakes in the sampled communities. This is further strengthened by the large t-value and small (p); 4.318 and 0.002 respectively, suggesting a huge effect of farmers/herdsman clashes on the social life of the residents of the State. In essence, adjusted  $R^2 = 0.771$ ;  $F = 8.415$ ,  $P < 0.001$  showed that high intake of hard drugs was a significant social effect of farmers/herdsman clashes in Ondo State. This implies that a unit change in farmers/herdsman conflict could result in corresponding increase in the hard drugs consumption in the sampled communities. Consequential upon this, increase in the cases of kidnapping, rape, armed robbery, cultism and other social vices may be engendered.

In Lagos State (see **Table 4(a)** and **Table 4(b)**), it was established that there was a strong relationship (0.598) between farmers/herdsman clashes social effects under investigation in the State. The standardized beta coefficient, 0.424,  $p < 0.05$  suggests that an increase in farmers/herdsman clashes could lead to an increase in cult-related activities in the sampled communities. This is further strengthened by the large t-value and small (p); 2.442 and 0.016 respectively, suggesting that increasing farmers/herdsman clashes could aggravate cult-related activities in the sample communities. In specific term, adjusted  $R^2 = 0.327$ ;  $F = 11.685$ ,  $P < 0.05$  indicates that increase in cult-related activities is a significant

**Table 4.** (a) Model summary; (b) Standardized beta coefficients of stepwise regression.

(a)																	
State	R	Adjusted R <sup>2</sup>	F	t	P-value												
Ekiti	0.655	0.403	16.314	4.456	0.000												
Ondo	0.936	0.771	8.415	4.318	0.001												
Lagos	0.598	0.327	11.685	2.442	0.05												
Ogun	0.995	0.756	8.415	7.479	0.000												
Osun	0.625	0.222	5.518	1.689	0.000												
Oyo	0.721	0.206	2.328	3.481	0.000												

(b)																		
Predictor Variables	Ekiti State			Ondo State			Lagos State			Ogun State			Osun State			Oyo State		
	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T
Reduction in quality of social relationship	-0.072	0.564	-0.578	-2.282	0.004	-3.684	0.290	0.011	2.564	0.369	0.000	9.780	0.476	0.053	2.005	-0.190	0.385	-0.882
Reduction of social support	-0.075	0.640	-0.468	0.075	0.801	0.259	-0.110	0.348	-0.942	-0.346	0.023	-5.275	-0.279	0.320	-1.008	-0.076	0.759	-0.310
High intake of hard drugs	-0.054	0.593	-0.535	1.000	0.002	4.318	-0.238	0.201	-1.282	0.626	0.000	7.479	0.514	0.000	1.689	-0.496	0.129	-1.563
Disruption of social group	0.637	0.000	4.281	0.088	0.718	0.365	-	-	-	-0.146	0.064	-2.038	0.094	0.590	0.543	-0.246	0.423	-0.813
Reduction in social activities	0.227	0.075	1.790	-0.109	0.760	-0.309	-	-	-	0.384	0.128	1.636	0.089	0.661	0.443	-0.178	0.358	-0.935
Acquiring weapons/arms	0.380	0.002	3.142	0.604	0.059	1.972	-	-	-	0.287	0.072	1.971	0.003	0.990	0.013	0.020	0.951	0.061
Increase in cult-related activities	-0.009	0.940	-0.075	-0.492	0.117	-1.621	0.424	0.016	2.442	-0.074	0.170	-1.459	-0.546	0.042	-2.112	0.893	0.002	3.481
High cases of rape	0.747	0.000	4.456	-0.459	0.036	-2.421	-	-	-	0.372	0.060	2.073	0.163	0.474	0.724	-0.316	0.229	-1.229
Loss of human life	-0.027	0.827	-0.218	-0.972	0.000	-10.230	-0.094	0.384	-0.872	0.434	0.000	1.761	-0.386	0.060	-1.939	0.053	0.843	0.200

social effect of farmers/herdsmen clashes in Lagos State. This implies that a unit change in farmers/herdsmen clash variable has tendency to bring about further increase in the cult-related activities that are ravaging the suburbs of Lagos State particularly in Ikorodu and Ojo LGAs where farmers/herdsmen clashes are frequently reported. This is in agreement with previous studies that cult groups engage in nefarious activities such as extortion, armed robbery, maiming, rape, murder and use of drugs [25] [26] [27].

From **Table 4(a)** and **Table 4(b)**, the regression coefficient calculated (0.995) showed a strong relationship between the social effects and farmers/herdsmen clashes in the sampled communities in Ogun State. The standardized beta coefficient, 0.626,  $p < 0.000$  indicates that a unit change in the farmers/herdsmen clashes could result in increasing high intake of hard drugs. This is further strengthened by the big t-value and small (p), 7.479 and 0.000 respectively,

which suggests a large impact of farmers/herdsmen clashes on social component of the inhabitants of the sampled communities. The adjusted  $R^2 = 0.756$ ;  $F = 8.415$ ,  $P < 0.000$  further revealed that high intake of hard drugs was a significant social effect of farmers/herdsmen clashes in the State. It suggests that a unit change in farmers/herdsmen conflict is capable of giving rise to a corresponding increase in high intake of hard drugs in the sampled communities. This possible change may engender increasing cases of armed robbery, rape, cultism, kidnapping and other social vices in the area.

In Osun State, a strong relationship (0.625) was established between the social effects and frequency of farmers/herdsmen clashes (**Table 4(a)**). Also from **Table 4(a)** and **Table 4(b)**, the standardized beta coefficient, 0.514,  $p < 0.000$  suggests a unit change in the frequency of farmers/herdsmen crises could further trigger the consumption of already high intake of hard drugs in the sampled communities. This is further established by the large t-value and small (p); 1.689 and 0.000 respectively, indicating a large effect of farmers/herdsmen clashes on the social component of human life in the sampled communities. The adjusted  $R^2 = 0.222$ ;  $F = 5.518$ ,  $P < 0.000$  showed that high intake of hard drugs was a significant social effect of farmers/herdsmen clashes in the sampled communities. It implies that a unit change in the frequency of farmers/herdsmen conflict is capable of aggravating upward consumption of hard drugs in the sampled communities. This has tendency to escalate social disorderliness and possible breakdown of laws in the State.

In case of Oyo State, a strong relationship (0.721) is observed between the social variables and farmers/herdsmen conflict variable (**Table 4(a)**). Based on **Table 4(a)** and **Table 4(b)**, the standardized beta coefficient, 0.893,  $p < 0.002$  suggests that a unit change in the frequency of farmers/herdsmen crises is capable of accelerating Increase in cult-related activities. More light is further shed on this by the large t-value and small (p); 3.481 and 0.002 respectively, indicating that huge social effects are capable of being precipitated by the increasing farmers/herdsmen clashes in Oyo State. Most importantly, adjusted  $R^2 = 0.206$ ;  $F = 2.328$ ,  $P < 0.002$  revealed that Increase in cult-related activities was a significant social effect of farmers/herdsmen clashes in the State. It implies that a unit change in frequency of farmers/herdsmen conflict could trigger an increase in cult-related activities such as kidnapping, armed robbery, banditry and ritual killings in Oyo State.

In view of these, the main social implications of the farmers/herdsmen conflicts in the southwestern states increasing cases of rape and disruption of social group in Ekiti State, increasing intake of hard drugs in Ogun, Osun and Ondo States, and increasing cult-related activities in Lagos and Oyo States.

#### **4.6.2. Economic Consequences of Farmers/Herdsman Conflicts**

From the results of economic impact analyses of farmers/herdsmen clashes as shown in **Table 5(a)** and **Table 5(b)**, The regression coefficient calculated (0.644) showed a strong relationship between the economic effect variables (low national

**Table 5.** (a) Model summary; (b) Standardized beta coefficients of stepwise regression.

(a)																		
State	R	Adjusted R <sup>2</sup>	F	t	P-value													
Ekiti	0.644	0.385	13.751	3.911	0.000													
Ondo	0.729	0.313	122.065	12.550	0.000													
Lagos	0.687	0.472	16.813	4.779	0.000													
Ogun	0.621	0.340	8.427	1.770	0.000													
Osun	0.493	0.215	8.766	2.636	0.000													
Oyo	0.553	0.123	1.672	2.229	0.000													

(b)																		
Predictor Variables	Ekiti State			Ondo State			Lagos State			Ogun State			Osun State			Oyo State		
	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T	Beta	P-value	T
Low National GDP	0.249	0.101	1.650	0.093	0.559	0.586	0.065	0.660	0.441	0.037	0.931	0.087	0.011	0.934	0.083	-0.316	0.229	-1.229
Reduction in household resources	-0.076	0.751	-0.317	-0.045	0.908	-0.116	0.465	0.000	4.028	-0.136	0.678	-0.416	0.133	0.381	0.877	0.010	0.956	0.056
Loss of house and other properties	-0.092	0.589	-0.541	0.028	0.896	0.131	-0.159	0.125	-1.245	0.021	0.883	0.147	0.135	0.290	1.061	0.031	0.830	0.215
Displacement of farmers	0.395	0.014	2.469	-0.035	0.880	-0.151	0.985	0.000	4.779	0.185	0.425	0.801	-0.023	0.865	-0.171	-0.212	0.136	-1.493
Infrastructural damages	0.119	0.413	0.821	0.023	0.919	0.102	-1.035	0.000	-5.566	0.305	0.049	1.988	0.799	0.005	2.636	-0.026	0.848	-0.191
Scarcity of Agric. Produce	0.373	0.017	2.401	-0.416	0.163	-1.403	-1.420	0.000	-4.492	-0.090	0.685	-0.406	-0.132	0.387	-0.867	-0.080	0.535	-0.621
Low revenue generation from agriculture by individual farmers and state government	0.445	0.000	3.911	0.911	0.000	12.550	0.434	0.027	2.239	0.235	0.467	0.730	0.078	0.638	0.471	0.078	0.638	0.471
Reduction in output and income	0.200	0.288	1.066	1.047	0.073	2.001	0.126	0.591	0.539	0.625	0.000	1.770	0.365	0.022	2.299	0.565	0.002	2.299
Diversion of national income to fight the menace	-0.184	0.226	-3.641	-2.393	0.000	-13.56	0.068	0.676	0.418	-0.110	0.632	-0.480	0.175	0.222	1.225	0.175	0.222	1.225
Loss of produce in storage	-	-	-	-	-	-	-0.471	0.000	-3.679	-	-	-	-	-	-	-	-	-

gross domestic product, reduction in household resources, loss of house and other properties, displacement of farmers, infrastructural damages, scarcity of agricultural produce, low revenue generation from agriculture by individual farmers and State Government, reduction in output and income and diversion of national income to fight the menace) and the frequency of farmers/herdsmen clashes in the sampled communities in Ekiti State. The standardized beta coefficient, 0.445,  $p < 0.000$  indicates that a unit change in the predictor variable (low revenue generation from agriculture by individual farmers and State Government occasioned by destruction of arable crops through the activities of herdsmen) has tendency to trigger farmers/herdsmen crises in Ekiti State. This is

further strengthened by the big t-value and small (p), 3.911 and 0.000 respectively, giving an indication of a huge effect of dwindling income/revenue generation by individual farmers and the State government. The adjusted  $R^2 = 0.385$ ;  $F = 13.751$ ,  $P < 0.000$  revealed that low income/revenue generation from agriculture by individual farmers and the state government was a significant predictor variable of economic implication of farmers/herdsmen crises in the sampled communities in Ekiti State. It implies that a unit change in the predictor variable; low income/revenue generation from agriculture by individual farmers and state government, is capable of triggering farmers/herdsmen conflict in the sampled communities in Ekiti State. Wanton destruction of arable farmlands by the herdsmen could result in poor harvest. By implication, the farmers may experience a dwindling income from agricultural produce and by extension the revenue accruable to the state government may be affected.

The study further carried out an investigation on the possible economic effects arising from farmers/herdsmen clashes in the sampled communities in Ondo State (see **Table 5(a)** and **Table 5(b)**). The regression coefficient calculated (0.729) was an indication of strong relationship between the economic effect variables and frequency of farmers/herdsmen conflict variable in the sampled communities in Ondo State. The standardized beta coefficient, 0.911,  $p < 0.000$  suggests that a unit change in the predictor variable (Low revenue generation from agriculture by individual farmers and state government arising from destruction of arable crops by herdsmen) has a strong tendency to trigger farmers/herdsmen crisis in the State. This is further strengthened by the big t-value and small (p), 12.550 and 0.000 respectively, which suggests a huge impact of farmers/herdsmen clashes on the economic activities of the people of the sampled communities. The adjusted  $R^2 = 0.313$ ;  $F = 122.065$ ,  $P < 0.000$  showed that low revenue generation from agriculture by individual farmers and state government was a significant predictor variable of economic impact of farmers/herdsmen clashes in the sampled communities. It indicates that a unit change in the predictor variable; Low revenue generation from agriculture by individual farmers and state government, is capable of generating farmers/herdsmen clashes in the sampled communities in Ondo State. This may be attributed to indiscriminate and wanton destruction of arable farmlands in the course of cattle rearing by the herdsmen. The farmers, in turn, may be provoked to attack the herdsmen arising from the wanton destruction of their means of livelihood.

From **Table 5(a)** also, a strong relationship (0.687) was established between the economic effect variables and the frequency of farmers/herdsmen conflict in Lagos State. Also from **Table 5(a)** and **Table 5(b)**, the standardized beta coefficient, 0.985,  $p < 0.000$  indicates that unit change in displacement of farmers could further aggravate farmers/herdsmen clashes in the State. This is further reinforced by the big t-value and small (p), 4.779 and 0.000 respectively, which suggests that a large impact of the influence of the predictor variable (displacement of farmers) on the farmers/herdsmen clashes. The adjusted  $R^2 = 0.472$ ;  $F =$

16.813,  $P < 0.000$  revealed that the predictor variable (displacement of farmers) was a significant predictor of farmers/herdsmen clashes in Imota community in Ikorodu LGA and Iba community in Ojo LGA of Lagos State. It suggests a unit change in the predictor variable (displacement of farmers) is capable of increasing economic effects of farmers/herdsmen clashes in Imota and Iba communities in Lagos State. Consequently, this could result in scarcity of agricultural produce, which may necessitate upward increase in the prices of agricultural products in the area.

**Table 5(a)** and **Table 5(b)** further showed a strong relationship (0.621) between the economic effect variables and the frequency of farmers/herdsmen clashes in Ogun State. The standardized beta coefficient, 0.625,  $p < 0.000$  indicates that a unit change in the predictor variable (reduction in output and income arising from the destruction of arable crops) could trigger farmers/herdsmen clashes in the area. This is further strengthened by the big t-value and small (p), 1.770 and 0.000 respectively, which suggests a large impact of farmers/herdsmen clashes on the economic activities of the inhabitants of the sampled communities. The adjusted  $R^2 = 0.340$ ;  $F = 8.427$ ,  $P < 0.000$  revealed that reduction in output and income was a significant predictor variable of economic effect of farmers/herdsmen clashes in the sampled communities. It indicates that a unit change in the reduction of output and income is capable of generating increasing farmers/herdsmen clashes in the sampled communities in Ogun State. The possible change in the reduction of output and income could be attributed to further destruction of farmlands by the herdsmen's cattle. In terms of quantity, the agricultural crops may be badly affected by the cattle attacks and the quantity of crops available for sales during harvest period may be low. This may bring about a dwindling income to the farmers.

In Osun State, the regression coefficient calculated (0.493) suggests a positive relationship between the economic effect variables and the criterion variable (**Table 5(a)**). The standardized beta coefficient, 0.799,  $p < 0.005$  (**Table 5(b)**) indicates that a unit change in the infrastructural damages as a variable, could trigger increasing farmers/herdsmen crises in the sampled communities. This is further elucidated by the big t-value and small (p) value, 2.636 and 0.005 respectively, which indicates that a large economic impacts arising from the farmers/herdsmen clashes in Osun State. From **Table 5(b)**, the adjusted  $R^2 = 0.215$ ;  $F = 8.766$ ,  $P < 0.000$  showed that infrastructural damages was a significant predictor variable of economic effects of farmers/herdsmen clashes in Osun State. Indicating that a unit change in the predictor variable; infrastructural damages could escalate increasing farmers/herdsmen crises in the sampled communities in Osun State. Infrastructural damages could be worsened through deliberate bush burning which is capable of endangering school buildings in the rural areas, water pipes are often destroyed in a bid to get water for their herds, destruction of electric poles etc.

In Oyo State (see **Table 5(a)** and **Table 5(b)**), the regression coefficient cal-

culated (0.553) suggests a positive relationship between the economic effect variables and the criterion variable. The standardized beta coefficient, 0.565,  $p < 0.005$  suggests that a declining reduction in output and income could be an economic consequence of farmers/herdsmen clashes in the sampled communities. This is further reinforced by the big t-value and small (p) value, 2.229 and 0.002 respectively, which suggests that a large economic impacts from the farmers/herdsmen clashes in Oyo State.

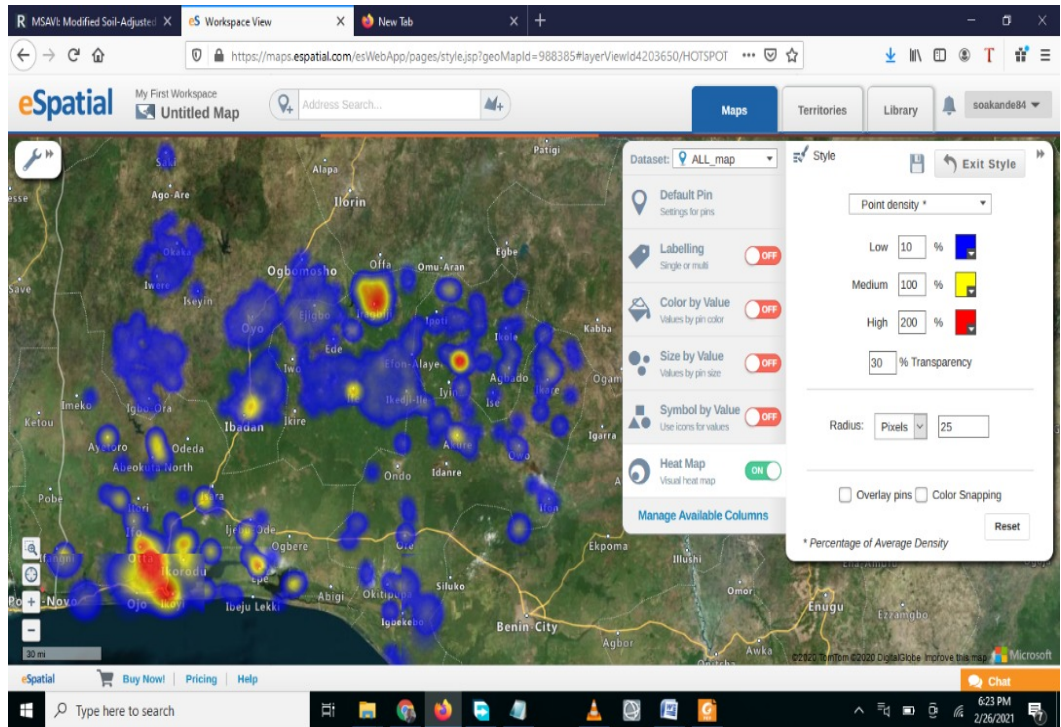
In essence, adjusted  $R^2 = 0.123$ ;  $F = 1.672$ ,  $P < 0.00$  using stepwise regression revealed that reduction in output and income was a significant predictor variable of economic effects of farmers/herdsmen clashes in Oyo State. It implies that a unit change in the predictor variable; reduction in output and income could trigger increasing farmers/herdsmen crises in the sampled communities in Oyo State. Reduction in output and income could be worsened through continual destruction of arable crops. This may culminate in poor harvest and consequent low income to the farmers. The reprisal attack from the farmers may in turn lead to the killing of herds and eventual loss of revenue to the herdsmen. It could at times result into death of some farmers and herdsmen.

Based on the above, the economic effects of farmers/herdsmen conflicts include low income and revenue generation in Ekiti, Ondo, Ogun and Oyo States while displacement of farmers and infrastructural damages constitute the economic consequences of the conflicts in Lagos and Osun States respectively.

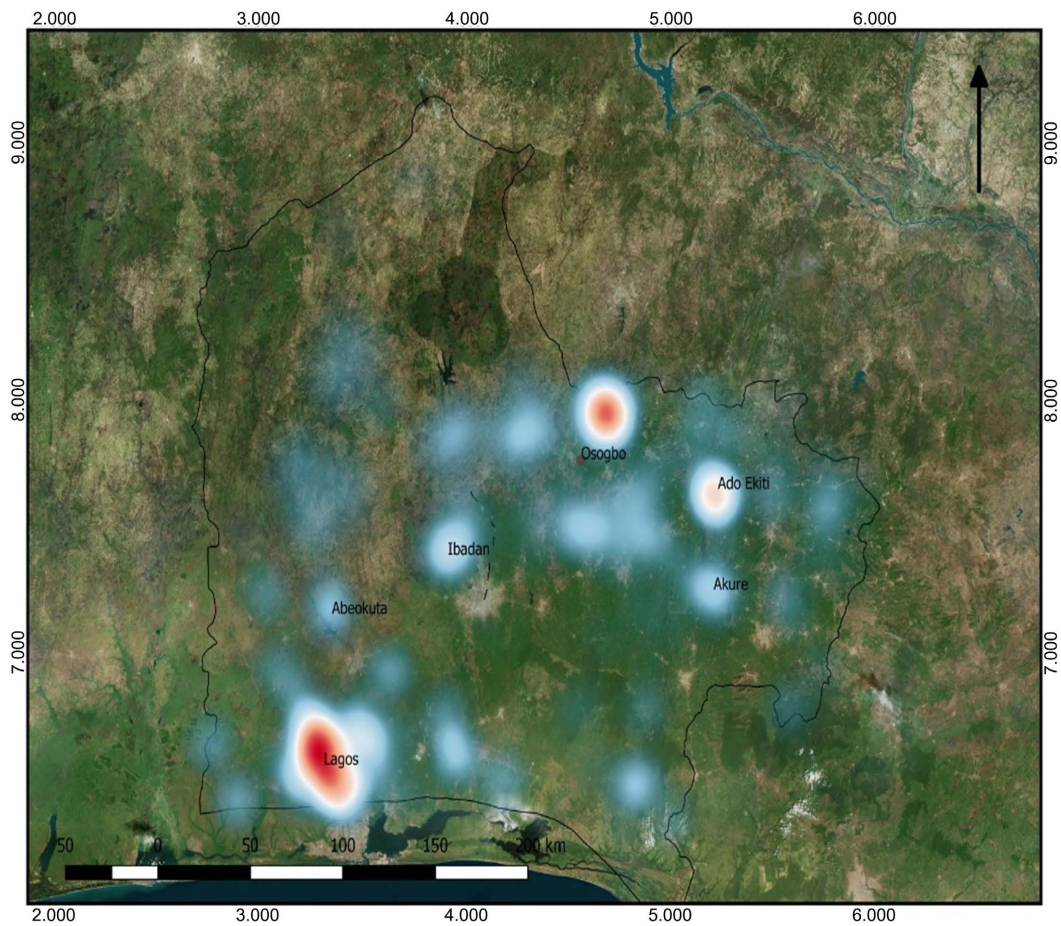
#### 4.7. Crime Hotspot Map

**Figures 16(a)-(c)** show the crime hotspots detected and mapped in the southwestern Nigeria. The detected and mapped crime hotspots in Lagos State include Idasho town (Kidnapping and armed robbery along Highways), Ibeju/Lekki LGA, Bayeku, Imota and Ofin Ile towns (Cultism, Farmers-Herdsmen conflicts and Sea Pirates respectively), Ikorodu LGA, Ebute Sangotedo (Kidnapping, Cultism and armed robbery), Eti-Osa LGA, Lafiaji (Kidnapping, raping and armed robbery around the abandoned school of nursing building). Also, Ilubirin that hosts the proposed Lagos State House of Assembly Housing Complex (kidnapping and armed robbery); Oko Faji (burglary and pickpocketing), Lagos Island LGA, Ijeododo (kidnapping, oil pipe vandalization, land grabbing and armed robbery) in Alimosho and Egan, Akesan and Iba towns (cultism, raping, armed robbery and kidnapping), Ojo LGA.

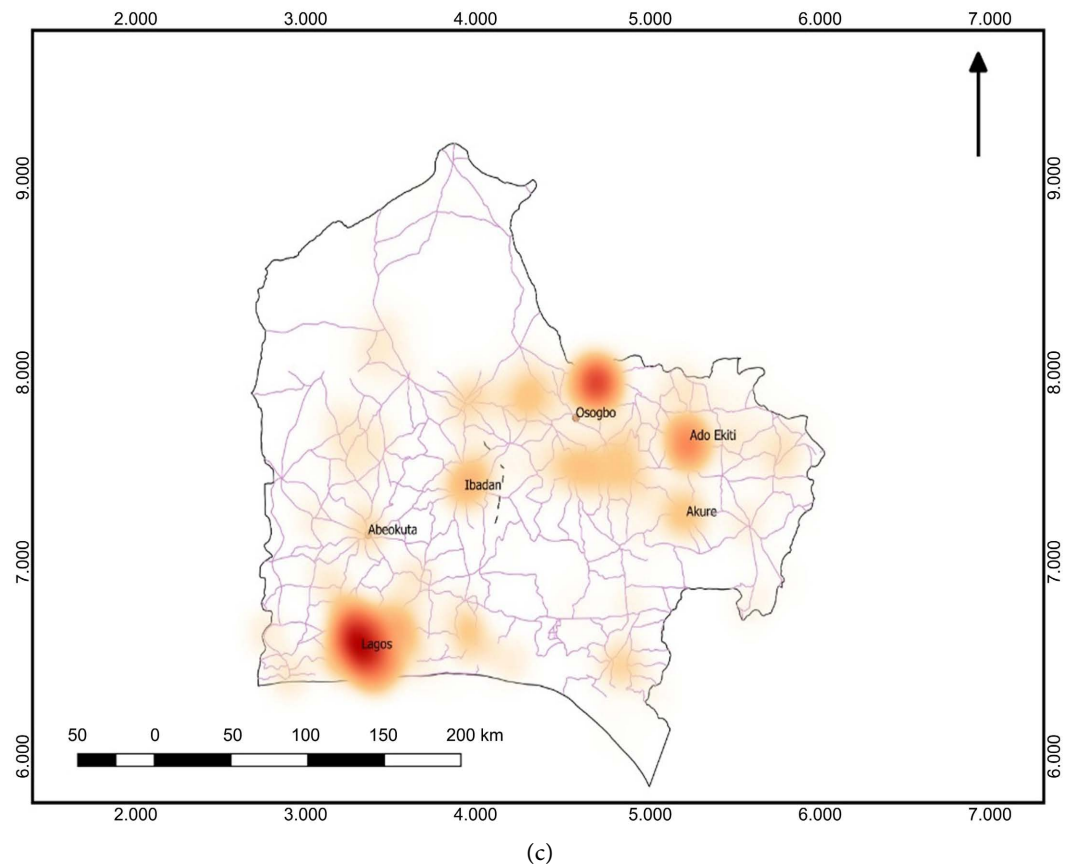
Notable crime hotspots in Ogun State Include Iberekodo (Cultism and armed robbery) in Abeokuta North, Alabata (farmers-herdsmen clashes around Opeji town) Abeokuta North, Arigbajo (Kidnapping and armed robbery along Lagos—Abeokuta Expressway, between Arigbajo and Abule Oko) Ewekoro Local Government Area (LGA), Joju School III and Temidire reservoir in Sango-Ota (kidnapping and armed robbery), Ado-Odo LGA, Igbesa (armed robbery, land grabbing and cultism), Ado-Odo LGA, Ado-Odo town (farmers-herdsmen), Ado-Odo LGA and Ogijo Likosi (cultism, armed robbery and kidnapping), Sagamu LGA.



(a)



(b)



**Figure 16.** (a) Web based-crime hotspot map generated for Southwestern Nigeria; (b) ArcMap Desktop crime hotspot map generated for Southwestern Nigeria; (c) QGIS desktop crime hotspot map generated for Southwestern Nigeria.

In Ekiti State, detected crime hotspots include Ijesha Isu and Oke Ayedun (farmers-herdsmen clashes), Ikole LGA, Agbado and Ode (farmers-herdsmen clashes), Gbonyin LGA, Araromi and Omuo-Oke (kidnapping and farmers-herdsmen clashes), Ekiti East and Alagba-Mesan (kidnapping and farmers-herdsmen clashes), Efon LGA.

Ondo State also has some notable crime hotspots which include Oke Agbe (farmers-herdsmen clashes), Akoko Northwest LGA, Ido-Ani and Ifon (kidnapping), Ose LGA, Akotogbo (kidnapping), Irele LGA and Igbara-Oke (farmers-herdsmen clashes), Ifedore LGA.

Prominent crime hotspots in Osun State include Gbongan town (armed robbery, farmers-Herdsmen clashes and Kidnapping), Ayedade LGA, Okuku town (armed robbery, kidnapping, cultism and farmers-herdsmen clashes), Odo-Otin LGA, Iloko-Ijesa along Ilesa-Akure highway (Kidnapping, armed robbery and farmers-herdsmen clashes), Oriade LGA, Iragbiji town (Cultism, Kidnapping, Armed robbery and farmers-herdsmen clashes), Boripe LGA and Obokun town (Kidnapping, armed robbery and farmers-herdsmen clashes), Obokun LGA.

In Oyo State, the detected crime hotspots are Tapa town (Farmers-herdsmen clashes, kidnapping and armed robbery), Ibarapa North LGA, Otu town (Far-

mers-herdsmen clashes, armed robbery and kidnapping), Itesiwaju LGA, Eleko-kan town (farmers-herdsmen clashes, kidnapping and armed robbery), Iwajowa LGA, Boroboro town (farmers-herdsmen clashes, kidnapping and armed robbery), Atiba LGA and Eruwa town (farmers-herdsmen clashes, kidnapping and armed robbery), Ibarapa East LGA

Based on the above detected and mapped crime hotspots, the study proposes and implements installation of IP Camera at some selected hotspots to detect and transmit crime information to a control room already established at Federal University of Technology, Akure and six computer nodes domiciled at the Headquarters of Nigeria Civil Defence Security Corps in the six State capitals in southwestern States. This will facilitate access to real-time crime information and engender quick emergence response of the security apparatus to the crime scenes thereby making arrest of people of criminal tendency an easy task for the law enforcement agencies.

## 5. Conclusion

The study has demonstrated the capability of geospatial technologies in integrating field based, global and Daily Newspapers' reported crime data to generate violent crime hotspots maps for effective crime control and management in the southwestern Nigeria. It is noticed that armed robbery, assassination and cultism are more pronounced in Lagos and Ogun States. It is further established that armed robbery is the most violent crime in the southwestern Nigeria. Similarly, high incidences of farmers/herdsmen conflicts are observed in Oyo and Osun States. It is also observed that increasing incidences of kidnapping are common in all the southwestern states while high incidences of kidnapping are prominent in Ondo, Lagos and Oyo States. The study unfolds most of the violent crime incidents take place along the highways particularly Lagos-Ibadan, Akure-Ilesa-Ibadan, Ore-Ijebu Ode-Lagos, Akure-Owo-Abuja, Owo-Benin and Ibadan-Iseyin-Saki and use forests as hideouts. Generally, high rate of unemployment is the dominant cause of the increasing violent crimes in the southwestern Nigeria. Destruction of arable crops by the herdsmen is the most determinant factor that trigger farmers/herdsmen conflicts in Oyo, Ondo, Lagos and Ekiti States while scarcity of grazing fields as a factor is observed to have responsible for the conflicts in Osun and Ogun States. The main social implications of the farmers/herdsmen conflicts in the southwestern states include increasing cases of rape and disruption of social group in Ekiti State, increasing intake of hard drugs in Ogun, Osun and Ondo States, and increasing cult-related activities in Lagos and Oyo States. The economic effects of farmers/herdsmen conflicts include low income and revenue generation in Ekiti, Ondo, Ogun and Oyo States while displacement of farmers and infrastructural damages constitute the economic consequences of the conflicts in Lagos and Osun States respectively. The study advocates for increase funding for the acquisition and installation of more IP Camera at the already established crime hotspots in the southwestern Nigeria.

The security agents should be retrained and equipped to meet the current security challenges of the southwestern states. In addition, cattle ranching should be encouraged to forestall further conflicts between the farmers and herdsmen. The research should be replicated in other parts of the country.

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### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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