A Biplot Analysis of Crime Victimizations in the Rural Areas of Dutsin-Ma/Kurfi Federal Constituency, Katsina State, Nigeria

Yusuf Bello

Department of Statistics, Federal University, Dutsin-Ma, P.M.B. 5001, Dutsin-Ma, Katsina State, Nigeria

Abstract

Victimization from criminal activities is an inevitable phenomenon at all ages of human existence. However, the growing sophisticated violent and organized criminal activities in Nigeria have resulted in leveling the country with a soaring crime rates. Many manageable crimes from rural areas were metamorphosing to sophisticated crimes because little is known about them as the result of under-reporting to the police. To complement the Nigeria crime statistics, this work conducted crime victimization survey in the rural areas of Dutsin-Ma/Kurfi Federal Constituency during the last quarter of 2023. The crimes were banditry, rape, murder, theft, burglary, robbery, fraud and assault. A biplot method of principal component analysis was used to simultaneously display the crimes and the relative position of the wards and villages. The results show a significant correlation between banditry, rape and murder that indicates the activities of banditry transcends to occasional murder and raping. The eastern part of the constituency enjoys relative peace and security because of lower crime concentrations, while the western part that neighbour forest reserves suffers from high crime concentrations and in particular the widespread of banditry. The most vulnerable areas are Sanawa, Kuki B and Dabawa wards in Dutsin-Ma local government area, and Wurma A and B, Kurfi A, Bambadawa and Danmarke wards in Kurfi local government area. It was also observed that the prevalence of theft and burglary is related to urbanization. The government should consider urban and socio-economic related problems and the impact of forest reserves in controlling urban related crimes and in fighting banditry in the North-western part of Nigeria, respectively.

Keywords : Biplot, Principal component analysis, Crime victimization survey, Rural areas, Banditry

1   Introduction

Crime statistics provides the estimates of the level and change in one aspect of the well-being of a nation, state, or locality (United Nations Office on Drugs and Crime, 2023). There is no universal definition of crime (Danbazau, 2007). However, in a strict legal definition, a crime is a

*a** Corresponding author. Tel.:+2348134983581
Email address : ybello@fudutsinma.edu.ng

violation of criminal law which in most societies can be defined broadly as any 'act or omission forbidden by law on pain of punishment' (Carvell and Swinfen, 1970). Traditionally, statements about levels of and trends in crime are based on administrative statistics of courts or police forces concerning crimes recorded by these institutions. However, such official crime figures fail to reflect crimes which have not been detected and recorded, unreported or reported but not recorded by police forces or the courts (United Nations Office on Drugs and Crime, 2023). The self-report measures of criminal victimization have been an alternative to the administrative statistics in proper explanation of the dynamic of crimes in especially the rural areas where police where often not available or the victims often exercise some fear or reluctance in reporting of crimes.

Victimization is the process of being victimized, either from a physical or a psychological or a moral or a sexual point of view (Muratore, 2014). Sample surveys are used to measure the extent and patterns of victimization from crime, the perception of safety of citizens, as well as the trust in the performance of law enforcement and criminal justice agencies. Victimization surveys produce crime measures independently of police activities and free from legal, political or administrative influences by interviewing a representative sample of individuals about their experiences and perception of crime (United Nations Statistical Commission, 2020; United Nations Office on Drugs and Crime, Undated). Crime victimization surveys (CVS) help researchers in establishing crime victimization theories, and the governments in understanding the sociodemographic dynamics of crimes and victims for effective crime control and prevention in the establishment of peace and stability. There are many national and international resources of CVS that include CLEEN Foundation from Nigeria, Crime Survey for England and Wales, Latin America and Caribbean Crime Victimization Survey Initiative, International Crime Victimization Survey and the United Nations Office on Drugs and Crime (United Nations Office on Drugs and Crime, Undated).

0

Nigeria as one of the African continent s largest and most influential nations suffers from a high crime rate that poses significant security challenges to the country similar to the other African countries (Michael, 2023). Over the past two decades, organized crime in Nigeria has evolved structurally, grown more sophisticated and become both more violent and better organized (National Institute for Security Studies, 2022). The aggregated crimes resulting in ranking Nigeria high in African crime rates, posing serious challenges to the safety of the citizens and the economy of the country are human trafficking, kidnapping, banditry, arms trafficking, cybercrimes, oil bunkering and other financial crimes. Furthermore, the impact of the high crime rate has affected the citizens physically, mentally, emotionally and financially. The factors responsible for the prevalence of the criminal activities include corruption, poor governance, malfunctioned judicial system, rising macroeconomic problems of unemployment, inflation and poverty in the country (Global Initiative against Transnational Organised Crime, 2023; Toochukwu, 2023, Aderounmu, 2021).

FJoRAE

In the effort to study the distribution and the factors responsible of the soaring crime rate in Nigeria, many researchers utilized the administrative statistics in the course of the analysis (Atanu, 2019; Oguntunde et al., 2018; Adiele, 2013). Bello et al., (2012a) have applied different algorithms on different interval measures for better classification of crime data in Nigeria. Similarly, many researchers have downward the scope of the crime analysis to the levels of states and local government areas for the better understanding the dynamics of crimes. Focusing on Katsina State located in the Northwestern Nigeria; the state has suffered the menace of banditry and kidnapping for many years (Umar, 2023; Sobowale, 2023; Ibrahim, 2023). Banditry is a composite crime that includes kidnapping, massacre, rape, cattle rustling, and the illegal possession of firearms. The impact of their actions has been devastating, with a staggering 1,087,875 individuals in rural communities displaced as of December 2022. Furthermore, between 2010 and May 2023, approximately 13,485 deaths have been attributed to banditry (The Global Observatory, 2024).

There are some researches that studied the distributions and the effects of crimes in Katsina State by mostly comparing the local government areas or areas within the metropolitan city of Katsina using the administrative statistics (Ladan and Danjuma, 2023; Bello et al., 2012b; Yelwa and Bello, 2012) However, no study was available to classify the crime distribution of rural areas because of the non availability of such official statistics. The only CVS available was the work of Bello et al., (2014) that classify the local government areas in Katsina Senatorial Zone, however the study did not exclusively consider the classification of the rural areas.

Although crime is not just an urban problem, there is little attention to rural crime. Perhaps, this can be related to the underreporting to the Police (Ceccato, 2016; Abraham and Ceccato, 2022). The under-reporting of crime victimization from rural areas in Nigeria is attributed to two factors. Firstly, traditionally individuals in rural communities may be reluctant to report crime or abuse in fear they will not be taken seriously, their confidentiality will not be maintained, their reputation may be damaged, or the outcome will lead to continued and more severe abuse (Rural Health Information Hub, 2021). Secondly, there is uneven distribution of police between urban and rural areas where more police are concentrated in the urban areas, and therefore making it difficult for the police to detect the crimes or the victims to report the crimes (Arisukwu, 2020; Chinwokwu, 2017).

The peculiarity of this work is that the data in this CVS was collected from the remote areas where there are no presence of Police Outpost resulting from the current phase of banditry. This work utilizes the CVS data and biplot method of principal component analysis to study distribution of crime victimization in the rural areas of Dutsin-Ma/Kurfi Federal Constituency, Katsina State, Nigeria.

2   The Concept and Method of Principal Component Analysis

A principal component analysis is concerned with explaining the variance-covariance structure of a set of variables through a few linear combinations of these variables. Its general objectives are (1) data reduction and (2)

interpretation. The central idea of principal component analysis is to reduce the dimensionality of a data set in which there are a large number of interrelated variables, while retaining as much as possible of the variation present in the data set. This reduction is achieved by transforming to a new set of variables, the principal components, which are uncorrelated, and which are ordered so that the first few retain most of the variation present in all of the original variables (Jolliffe, 2002).

Let the random vector $\mathbf{X} = [X_1, X_2, \cdots, X_p]$ have the covariance matrix $\mathbf{\Sigma}$ with eigenvalues $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_p \geq 0$. Consider the linear combinations

$$Y_1 = \mathbf{a_1 X} = a_{11}X_1 + a_{12}X_2 + \cdots + a_{1p}X_p$$

$$Y_2 = \mathbf{a_2 X} = a_{21}X_1 + a_{22}X_2 + \cdots + a_{2p}X_p$$

$$\cdots \tag{1}$$

$$Y_p = \mathbf{a_p X} = a_{p1}X_1 + a_{p2}X_2 + \cdots + a_{pp}X_p$$

Given the covariance matrix $\mathbf{\Sigma}$ of the Xs, we know

$$\mathrm{Var}(Y_i) = a_i' \Sigma a_i \qquad i = 1, 2, \cdots, p \tag{2}$$

$$\mathrm{Cov}(Y_i, Y_k) = a_i' \Sigma a_k \quad i, k = 1, 2, \cdots, p \tag{3}$$

The principal components are those uncorrelated linear combinations $Y_1, Y_2, \cdots, Y_p$ whose variances in Equation (2) are as large as possible (Johnson and Wichern, 2007). While Equation

(1) contains an arbitrary scale factor, the $a_i' = a_{i1} + a_{i2} + \cdots + a_{ip}$ is a vector of constant, and therefore a condition is imposed such that

$$a_i' a_i = \sum_{k=1}^{p} a_{ki} = 1.$$

This condition is to eliminate a situation were variance in Equation (2) can be increase by multiplying any a_i by some constant (egyankosh, undated).

First PC = Y_1 with the largest variance obtained by finding $a_1 \supset$

$$\text{Var}(Y_1) = a_1' \Sigma a_1 = \max(a' \Sigma a)$$

Second PC = $Y_2 \perp Y_1$ with the second largest variance obtained by finding $a_2 \supset$

$$\text{Var}(Y_2) = a_2' \Sigma a_2 = \max(a' \Sigma a) \text{ and } a_1' \Sigma a_2 = 0$$

$$(4)$$

At step i

ith PC = $Y_i \perp Y_k$ with the ith largest variance obtained by finding $a_i \supset$

$$\text{Var}(Y_i) = a_i' \Sigma a_i = \max(a' \Sigma a) \text{ and } a_k' \Sigma a_{i=} 0 \quad \text{for} \quad k < i$$

To find the first principal component, we choose a_1 so as to maximize the variance of Y_1 subject to the normalization constraint that $a_1' a = 1$. Since

$$\text{Var}(Y_1) = \text{Var}(a_1' X) = a_1' \Sigma a_1 \tag{5}$$

then $a_1' \Sigma a_1$ is taken as the objective function which is be maximize using the method of Lagrange multipliers. By this method, consider a stationary points of a differentiable function of p variables, $f(X_1, X_2, \cdots, X_p)$, subject to a constraint $g(X_1, X_2, \cdots, X_p) = c$, such that there exists a number λ, called the Lagrange multiplier, so that

$$\frac{\delta f}{\delta X_i} - \lambda \frac{\delta g}{\delta X_i} = 0 \qquad i = 1, 2, \cdots, p \tag{6}$$

at the stationary points. The above p equations and the constraint are sufficient to determine the coordinates of the stationary points. By forming a new function, $L(\mathbf{X})$, such that

$$L(\mathbf{X}) = f(\mathbf{X}) - \lambda[g(\mathbf{X}) - c]$$

where $[g(\mathbf{X}) - c] = 0$. Since $[g(\mathbf{X}) - c] = 0$, then the set of Equations (6) may be written simply as

$$\frac{\delta L}{\delta X} = 0$$

By applying the method of Lagrange multiplier in the maximization of $a_1'\Sigma a_1$, such that

$$L(a_1) = a_1'\Sigma a_1 - \lambda(a_1'a_1 - 1)_{,\text{then}}$$

$$\frac{\delta l(a_1)}{\delta a_1} = 2\Sigma a_1 - 2\lambda a_1 \qquad (7)$$

Setting Equation (7) to zero

$$\mathbf{\Sigma} a_1 - \lambda a_1 = 0$$

or

$$(\mathbf{\Sigma} - \lambda\mathbf{I}_p)a_1 = 0 \qquad (8)$$

where $\mathbf{I}_p$ is the ($p{\times}p$ identity matrix). Thus, λ is an eigenvalue of $\mathbf{\Sigma}$ and a_1 is the corresponding eigenvector. If Equation (8) is to have a non trivial solution for a_1, then $(\mathbf{\Sigma} - \lambda\mathbf{I}_p)$ must be a singular matrix. Thus λ must be chosen that

$$|\mathbf{\Sigma} - \lambda\mathbf{I}_p| = 0$$

Given that $\mathbf{\Sigma}$ have p non-negative eigenvalues, $\lambda_1, \lambda_2, \cdots, \lambda_p$, and assuming for the moment that they are distinct such that $\lambda_1 > \lambda_2, > \cdots, > \lambda_p$, to decide which of the p eigenvectors gives $a_1'X$ with maximum variance so that λ must be as large as possible, then we maximize

$$\text{Var}(a_1'\mathbf{X}) = a_1'\Sigma a_1 = a_1'\lambda a_1 = \lambda a_1'a_1 = \lambda$$

Since we are interested in maximization of this variance, then, a_1 is the eigenvector corresponding to the largest eigenvalue of $\mathbf{\Sigma}$, and $\text{Var}(a_1'X) = a_1'\Sigma a_1 = \lambda_1$, the largest eigenvalue.

In general, the kth PC of X is $a_k X$ and $\text{Var}(a_k X) = \lambda_k$, where λ_k is the kth largest eigenvalue of $\mathbf{\Sigma}$, and a_k is the corresponding eigenvector. Continuing as above up to p PCs could be found, but the process is stop after the qth stage ($q \leq p$) when most of the variation in X have been accounted for by q PCs (egyankosh, undated).

2.1 Variance Accounted for by the Principal Components

The Proportion of total variance due to the kth PC is

$$\frac{\lambda_k}{\text{trace}\Sigma} = \frac{\lambda k}{\lambda_1 + \lambda_2 + \cdots + \lambda_p} = \frac{\lambda k}{\sum_{i=1}^{p} \lambda_i} \qquad\qquad\qquad\qquad k = 1,2,\cdots ,p \qquad (9)$$

The Proportion of Variance accounted for by the first q PCs is

$$\frac{\sum_{i=1}^{p} \lambda_k}{\text{trace}\Sigma} \qquad (10)$$

2.2 Biplot in Principal Component Analysis

A biplot is a graphical representation of a PCA that combines both the scores and loadings into a single plot. The scores represent the data points projected onto the principal components, while the loadings indicate the contribution of each original variable to the principal components. By plotting both, we can see how variables and data points relate to each other in a single chart, making it easier to interpret and analyze the PCA results (Sanderson, 2023).

2.3 Some Properties from the Principal Component Analysis

Below are some properties or results from the Principal Component Analysis (Johnson and Wichern, 2007):

Property 1: Let Σ be the covariance matrix with the random vector $\mathbf{X}^0 = [X_1, X_2, \cdots , X_p]$. Let Σ have the eigenvalue-eigenvector pairs $(\lambda_1, e_1), (\lambda_2, e_2), \cdots , (\lambda_p, e_p)$ where $\lambda_1 \geq \lambda_2, \geq \cdots , \geq \lambda_p \geq 0$. Then the *ith* principal component is given by

$$Y_i = \mathbf{e_i}'\mathbf{X} = e_{i1}X_1 + e_{i2}X_2 + \cdots + e_{ip}X_p \qquad\qquad i = 1,2,\cdots ,p \qquad (11)$$

With these choices,

$$\text{Var}(Y_i) = e_i'\Sigma e_i \qquad\qquad i = 1,2,\cdots ,p \qquad\qquad (12)$$

$$\text{Cov}(Y_i, Y_k) = e_i'\Sigma e_k = 0 \qquad\qquad i \neq k \qquad\qquad (13)$$

If some λ_i are equal, the choices of the corresponding vectors, e_i, and hence Y_i, are not unique.

Property 2: Let $\mathbf{X}^0 = [X_1, X_2, \cdots , X_p]$ have covariance matrix Σ, with eigenvalueeigenvector pairs $(\lambda_1, e_1), (\lambda_2, e_2), \cdots , (\lambda_p, e_p)$ where $\lambda_1 \geq \lambda_2, \geq \cdots , \geq \lambda_p \geq 0$. Let $Y_1 = \mathbf{e_1}'\mathbf{X}, Y_2 = \mathbf{e_2}'\mathbf{X}, \cdots , Y_p = \mathbf{e_p}'\mathbf{X}$ be the principal components. Then

$$p \qquad\qquad\qquad\qquad\qquad\qquad p$$

https://fjorae.fudutsinma.edu.ng

7

$$\sigma_{11} + \sigma_{22} + \cdots + \sigma_{pp} = {}^X Var(X_i) = \lambda_1 + \lambda_2 + \cdots + \lambda_p = {}^X Var(Y_i)$$
$$i=1 \qquad\qquad\qquad i=1$$

$$Y_1 = \mathbf{e'_1 X}, Y_2 = \mathbf{e'_2 X}, \cdots, Y_p = \qquad\qquad 0$$

Property 2: If $\mathbf{e_p X}$ are the principal components obtained from the covariance matrix $\mathbf{\Sigma}$, with eigenvalue-eigenvector pairs $(\lambda_1, e_1), (\lambda_2, e_2), \cdots, (\lambda_p, e_p)$, then

$$\rho_{Y_i, X_k} = \frac{e_{ik} \sqrt{\lambda_i}}{\sqrt{\sigma_{kk}}} \qquad i, k = 1, 2, \cdots, p \qquad\qquad (14)$$

are the correlation coefficients between the components Y_i and the variables X_k.

The proving to these properties can be found in the Johnson and Wichern (2007).

3 Methods and Analysis

The data for this research work was obtained from a crime victimization survey in DusinMa/Kurfi Federal Constituency in the last quarter of 2023. The constituency consists of Dutsin-Ma and Kurfi local government areas (LGAs), and each of the LGAs has eleven and ten wards respectively. A ward is a geographical division in a LGA (Nigeria, 2019). The wards in Dutsin-Ma LGA are Dutsin-Ma A (DTM A), Dutsin-Ma B (DTM B), Bagagadi, Kutawa, Makera, Kuki A, Kuki _B, Karofi A, Karofi _B, Shema and Dabawa wards. The wards in Kurfi LGA are Kurfi A, Kurfi B, Tsauri A, Tsauri B, Birchi, Rawayau A, Rawayau _B, Barkiya, Wurma A and Wurma B wards. There is a Katsina-Kankara road that partitioned the constituency into the East and the West. The western part is neighbouring forest reserves or other LGAs neighbouring the forest reserves. In the locations where enumerators can not visit because of security challenges, the target respondents were identified at their new destinations.

The process of data collection entails random selection and administration of questionnaires on twenty respondents cutting across all age and gender groups in every ward. For an in depth analysis of the crime victimizations, each ward was further divided in to at least two rural communities with at least five respondents from a community. The data consists of victims[0] experience to criminal victimizations over the past three years which was converted to percentages. The data was subjected to normality transformation to attain equal weights of the varying magnitude of responses. The analysis begin with the descriptive analysis of the data set, and in terms of coverage the extension of the analysis to the rural areas that suffer from non or few presence of security personnel.

3.1   Descriptive Analysis

The summary statistics of the crimes among the twenty one wards is presented in Table 1. These crimee were categorized in to crimes against person that include banditry, murder, rape and assault, and crimes against property that include theft, burglary, robbery and fraud. Among the listed crimes, banditry, rape, murder and burglary have relatively higher percentages of occurrences with lower variability. Although theft has the highest average percentage of occurrence, the average percentage of banditry is equally high and with the least coefficient of variability. This means that banditry is the most worrisome crime covering most of the areas in the constituency. Fraud has the least occurrence with the highest relative variability, and this indicates that fraud is a least pronounce crime in the constituency.

Table 1: Summary of Crime Victimization among Ward Areas

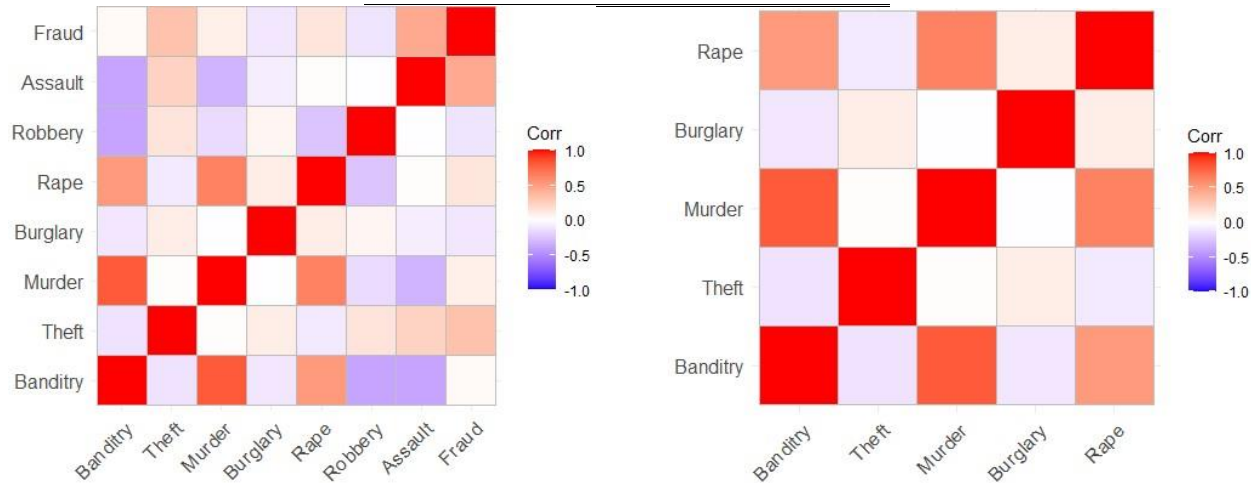| Crime	Mean	STD.DEV	CV
Banditry	64.29	24.96	38.33
Theft	47.62	22.62	47.50
Murder	23.81	23.45	98.48
Burglary	12.86	10.67	83.02
Rape	7.86	14.19	180.63
Robbery	4.05	5.62	138.77
Assault	3.57	5.73	160.50
Fraud	0.95	2.56	268.68

Figure 1: Correlation Matrix of the Crime Victimizations

The correlations between the variables are displayed in Figure 1. It appear from the figure that while there exist mutual correlations between banditry, rape and murder, on the other side banditry and murder are negatively correlated with assault and robbery. We therefore deduce from this relationship that the activities of banditry leads to rape and murder, and that in the areas where banditry is at stake, any encroachment on property and personality are being perpetrated by the bandits. This is because no robber outside the gang of the bandit has viable atmosphere for operations in the area, and furthermore the inhabitants of the areas were being subjugated to object poverty and humiliations leading to loose of potentiality of any sort encroachment between themselves.

Unlike banditry and murder as part of the trio associated crimes (banditry, rape and murder) that shows negative correlations with assault, rape shows insignificant positive correlation with the assault. This may mean that there is element of association between rape and assault at all situations even in the areas where banditry is predominant. The occurrence of property crimes that include theft and robbery are not associated with murder, and this may mean that the perpetrators were mere petty criminals in the locality. Theft shows a mild correlation with fraud, and this may mean that the perpetrators commits the either of the crimes depending on the easiest available opportunity.

3.2 Biplot Analysis of Crime Victimizations

The analysis begins with the trio crimes; banditry murder and rape, that shows significant positive correlations between themselves. The biplot analysis of the crime victimization utilizes the loadings of the principal component. Table 2 presents the loadings and summary of the importance of the components.

Table 2: Principal Components and Summary of their Importance

Crime	PC1	PC2	PC3
Banditry	0.5853	0.5219	-0.6201
Murder	0.6138	0.2149	0.7596
Rape	0.5299	-0.8255	-0.1945
Standard deviation	0.3012	0.1167	0

https://fjorae.fudutsinma.edu.ng

Proportion of variance	0.8697	0.1304	0
Cummulative proportion	0.8695	1.0000	1

All the values of the first principal component are positive and this signifies that the first principal component is the overall crime rate and the corresponding wards in that direction are the crime spot areas. The second component partition the wards between those that tend toward rape and those that tend toward banditry and murder. The importance of the components provided by Table 2 and Figure 2 shows that the first component consist of 87 percent of the variations in the data set which is enough to represent the original data set. The first two components covers all the variances in the data set leaving the third component with no variation to explain.
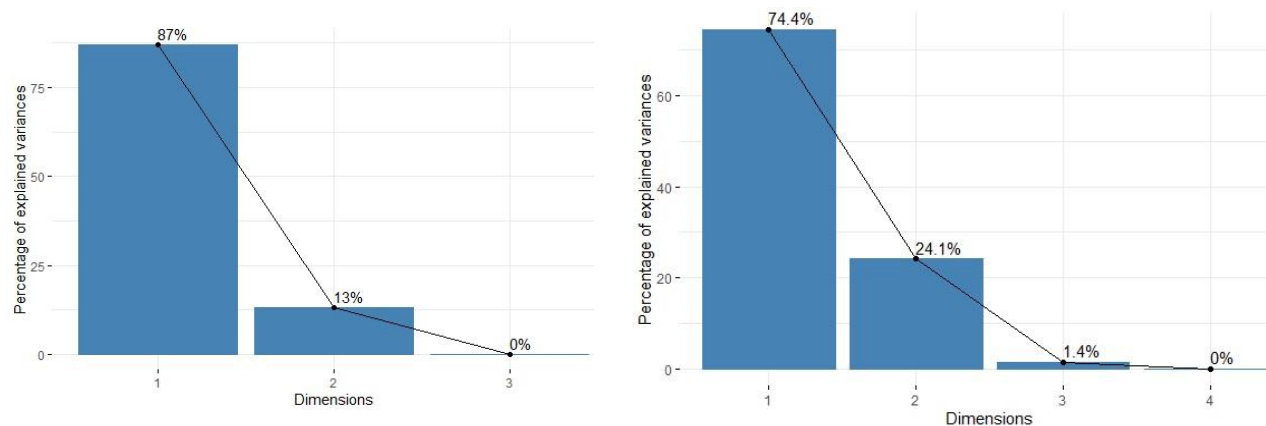
(a) PCs of the most Correlated Crime

(b) PCs of the most Prevalent Crimes

Figure 2: Scree plot of Crime victimization

The biplot of the first two components is presented in Figure 3. As appeared in the plot, the wards with the most positive correlation with the first principal component have the higher crime concentrations, while those with the most negative correlation with the component are the wards the lowest crime concentrations. The crime hot spot areas in order of intensity in terms of banditry, rape and murder are Makera, Wurma B, Tsauri _A, Wurma A and Kuki B. All these wards are located at the western part of the constituency except Kuki B which is located at the southern part of Dutsin-Ma LGA. On the account of second principal component with respect to banditry, it shows that Makera and Wurma B tend towards rape, while Tsauri A, Wurma A and Kuki _B tend towards murder. Another area with high rape cases is Kurfi _A. The wards with the lowest crime concerntrations are Shema, Bagagadi, Rawayau _A, Karofi B and Tsauri B, and they all located at the eastern side of the constituency except Tsauri B.

https://fjorae.fudutsinma.edu.ng

Banditry, theft, murder and burglary as presented in Table 1 are the most prevalent and widespread crimes constituting about 91 percent of the crime victimization in the constituency. The biplot representing the four crime victimizations is presented in Figure 4. The loadings plot shows that the first principal component has high positive values for both banditry and murder. However, the values for burglary and theft are relatively negative. This suggests that Makera, Wurma _B, Tsauri _A and Wurma A wards with the higher victimizations of banditry and murder are the most unsafe areas, while Bagagadi, Shema, Tsauri B and Karofi B wards with the lower victimizations of banditry and murder are relatively safer.
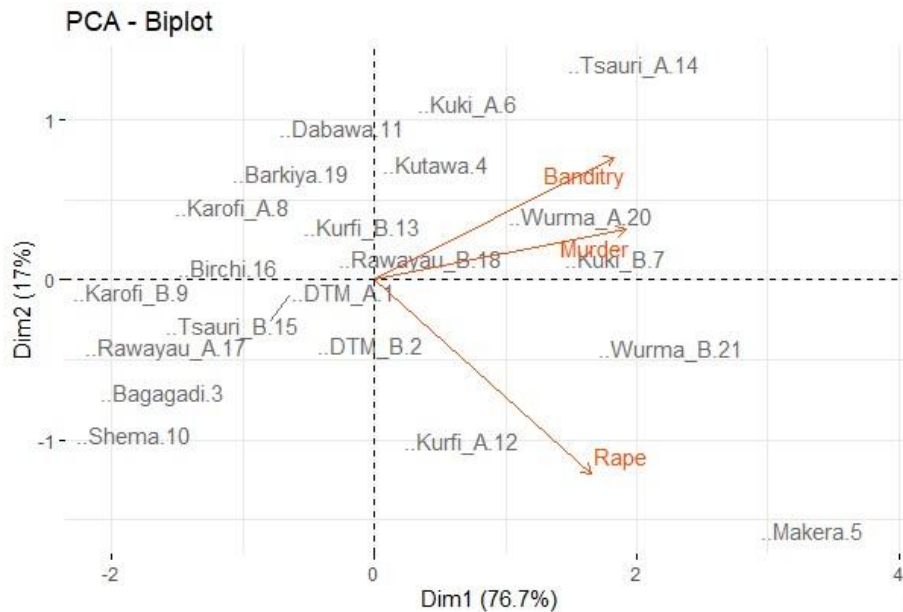
Figure 3: Biplot of the positively correlated crime victimizations

Considering the second component, DTM _A and Kurfi A show higher tendency toward burglary and theft. This can be attributed to the effect of urbanization because these wards are located on the respective Headquarters of Dutsin-Ma and Kurfi LGAs on the Katsina-Kankara road linking Katsina State with other states. This indicates that property crime is more pronounce in the urban centers. Another ward that show tendency towards banditry, murder, burglary and theft is KukiB. The areas that are most safer in terms of the burglary and theft are Rawayau A, RawayauB, Kurfi B, Birehi and Barkiya wards, and these wards are located in the eastern part of Kurfi LGA. Furthermore, Rawayau A, Kurfi _B and Birchi wards are most safer wards in terms of the banditry, murder, rape, burglary and theft in the whole constituency.
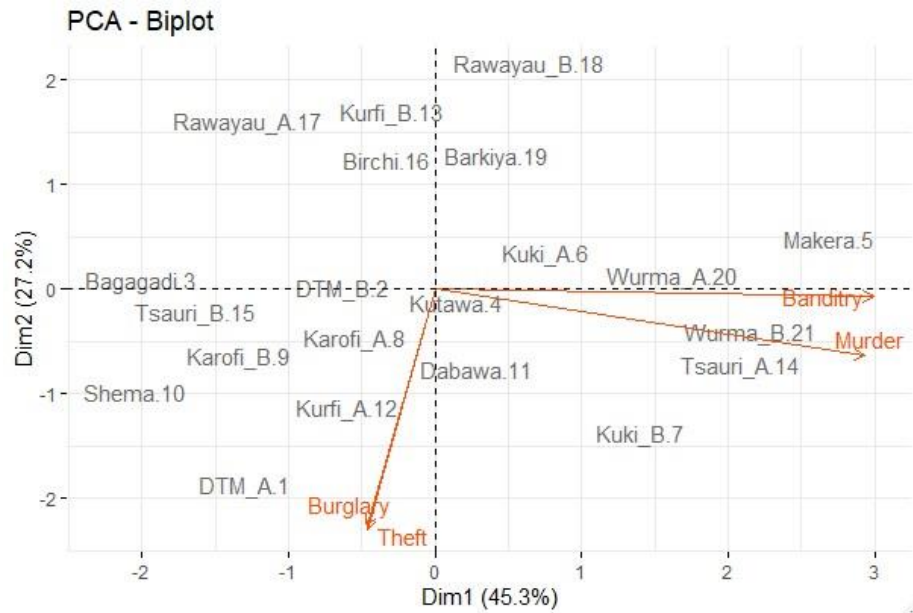
https://fjorae.fudutsinma.edu.ng

Figure 4: Biplot of the most prevalent crime victimizations
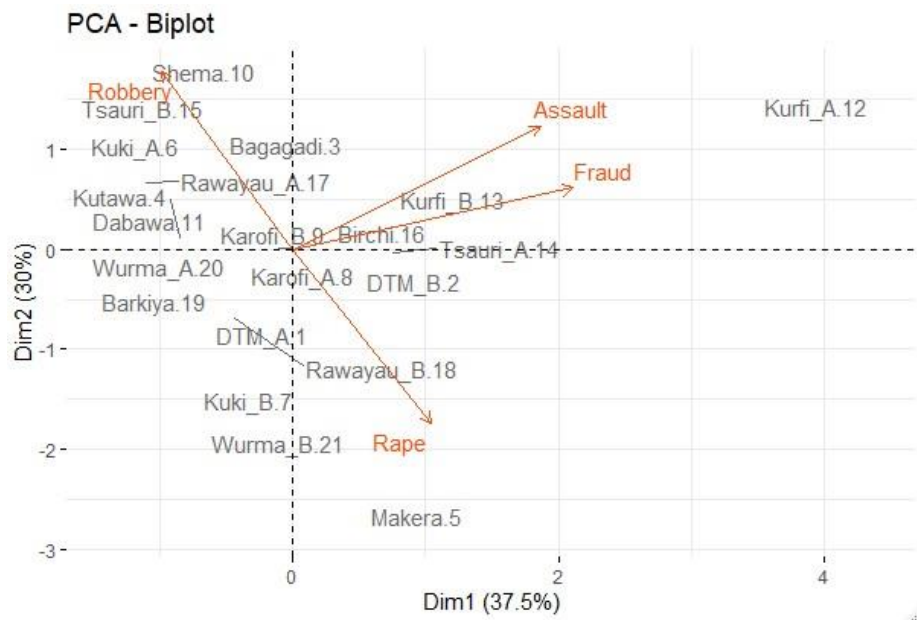
https://fjorae.fudutsinma.edu.ng

Figure 5: Biplot of the least prevalent crime victimizations The biplot in Figure 5 partitioned the areas in to wards inclined to robbery and the wards inclined to assault, fraud and rape. The first quadrant particularly shows that while assault and fraud are the predominant victimizations in Kurfi A, assault in particular is most prevalent in Kurfi B. The fourth quadrant shows that Makera and Wurma B are more inclined to rape while noting that rape is highly associated with banditry. This suggest that as in Figure 2 the menace of banditry is accompanied by rape and murder.

The amplitude of the analysis is further extended to the remote villages to reveal the crime spot areas in rural settlements. The summary statistics of the crimes among the forty two villages is presented in Table 2.

Table 3: Summary of Crime Victimizations among Villages

Crime	Dutsin-Ma LGA			Kurfi LGA		
	Mean	STD.DEV	CV	Mean	STD.DEV	CV
Banditry	61.79	37.71	61.03	63.89	30.59	47.88
Theft	52.26	28.23	54.01	33.26	25.77	77.49
Murder	21.90	30.62	139.80	19.18	25.25	131.65
Burglary	17.90	21.16	118.21	8.30	11.50	138.52
Rape	8.69	20.87	240.12	7.59	11.80	166.38
Robbery	3.57	7.59	212.63	5.86	11.45	195.22
Assault	3.49	7.99	228.72	4.49	9.25	206.47
Fraud	0.00	0.00	0.00	1.98	5.51	278.90

As in Table 1, banditry, theft, murder and burglary have relatively higher percentages of occurrences with banditry and theft have relatively lower variability in both the LGAs. The variability of crime victimization among the villages is relatively higher than in the wards. This is buttressed by the appearance of many zero outcomes in all the crimes with the exceptions of banditry and theft. This indicates that banditry and theft are the widespread crimes bedeviling the lives and property of the people in the constituency. The response on fraud has not been recorded in Dutsin-Ma LGA, while assault is highly insignificant in the remote areas of the constituency. The levels of crimes against property is relatively higher in Dutsin-Ma LGA than in Kurfi LGA. The magnitude, dispersions and the correlation of the crimes would be used to form the composition of the variables in the biplot analysis.

The biplot of the significantly correlated crimes is presented in Figure 6. These crimes are banditry, rape and murder. The first principal component has positive values for all the crimes that maintains it as the overall crime victimizations. The villages at the positive side of the components have higher banditry victimizations that are

associated with rape and murder. The most vulnerable villages are U/Zakara. Sanawa and Turare all in Makera ward. Other vulnerable villages are Dantakiri, Tareshi and Gobirawa in Kuki _B ward, Tabobi in Kutawa and Dabawa G and Maitsani in Dabawa ward. Most of these rural villages are located at the western site of Katsina-Kankara road that are not very far from forest reserve. However, the villages at the negative side have lower banditry, murder anf rape victimizations and hence they constitute the safer areas in the LGA.
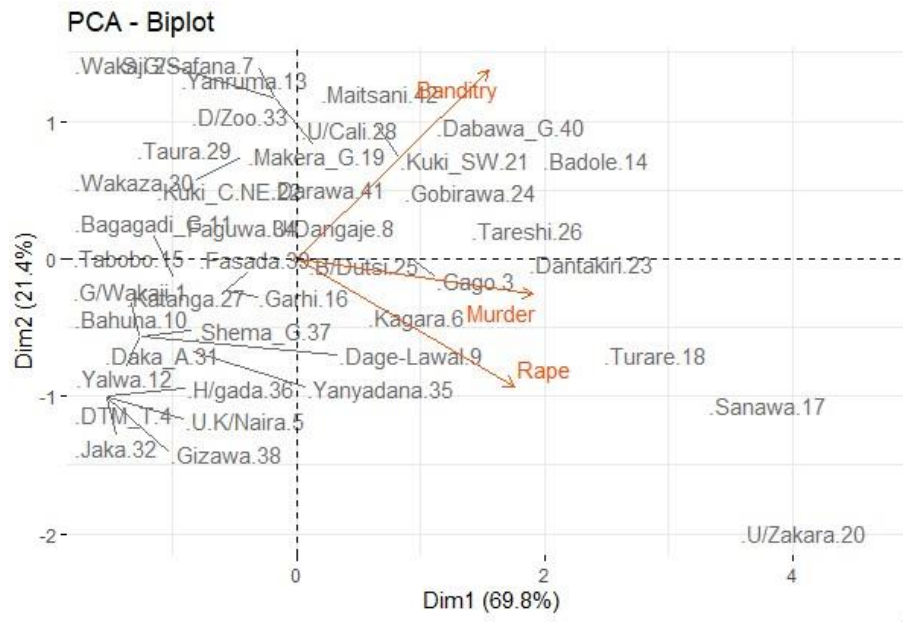
Figure 6: Biplot of the correlated crimes in the remote villages of Dutsin-Ma LGA

Figure 7 shows the biplot of the correlated crimes in Kurfi LGA. The loadings of the first principal component are positive and is interpreted as the overall crime victimizations of banditry, rape and murder. Beside the banditry, the first quadrant consisting of KUF AR, WB NW and WB _C.SE is more inclined to rape, while the fourth quadrant consisting of WA NW, WA C.SE, Bambadawa and Danmarke is more inclined to murder. The areas with lower crime concerntration are Rawayau _A, Rawayau B and Barkiya villages. It is clear that the extreme areas of the first components signify a division between the villages from west and east of the KatsinaKankara road.
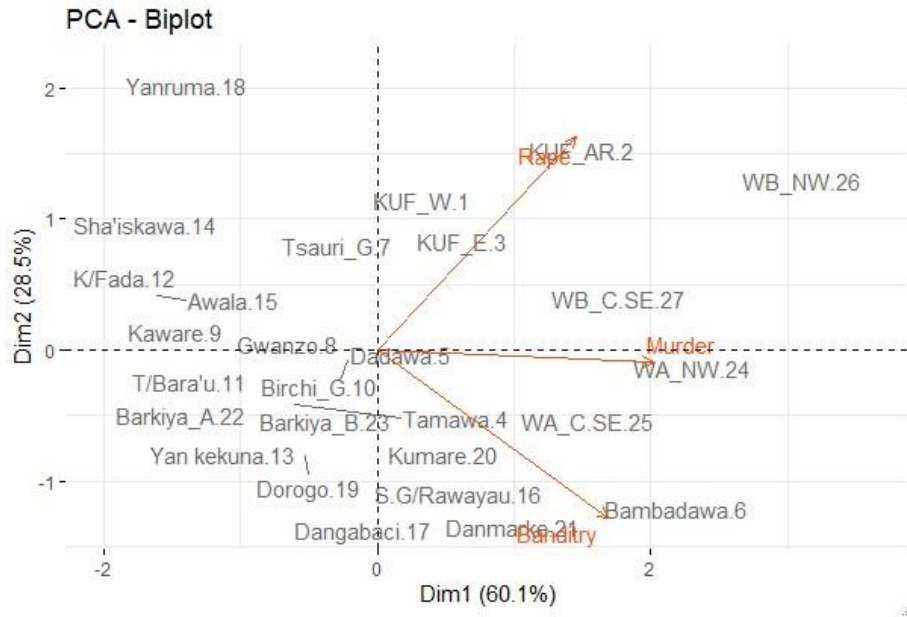
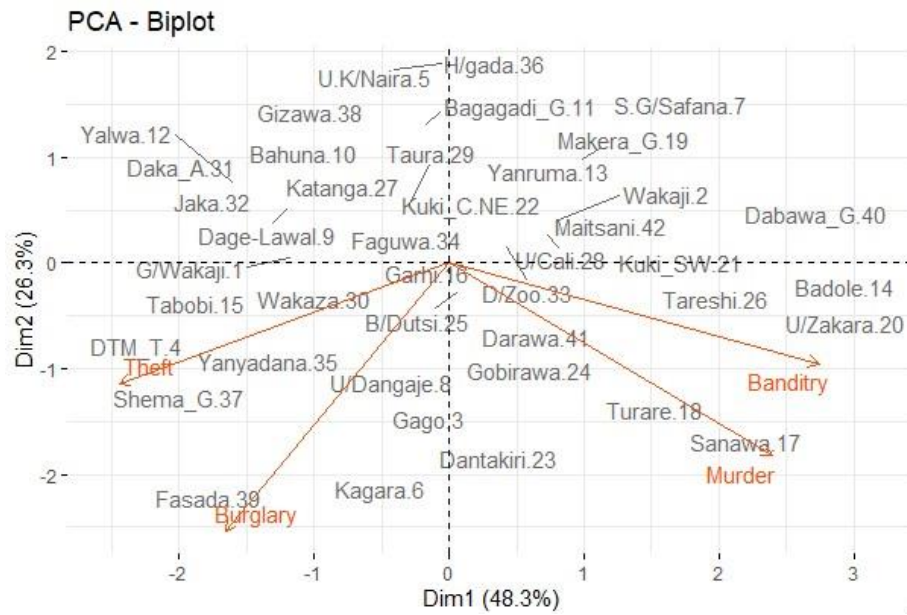Figure 7: Biplot of the correlated crimes in the remote villages of Kurfi LGA

Figure 8: Biplot of the prevalent crimes in the remote villages of Dutsin-Ma LGA The biplot in Figure 8 shows the distribution of four most common crimes in Dutsin-Ma LGA. The positive part of the first component

presents the villages were banditry and murder are prominent. The fourth quadrant shows the villages that are affected by both the banditry and murder, while the first quadrant shows the villages that are affected by either of the crimes. The villages in the second quadrant there is rare cases of theft and burglary, while the menace of banditry rarely transcend to murder.
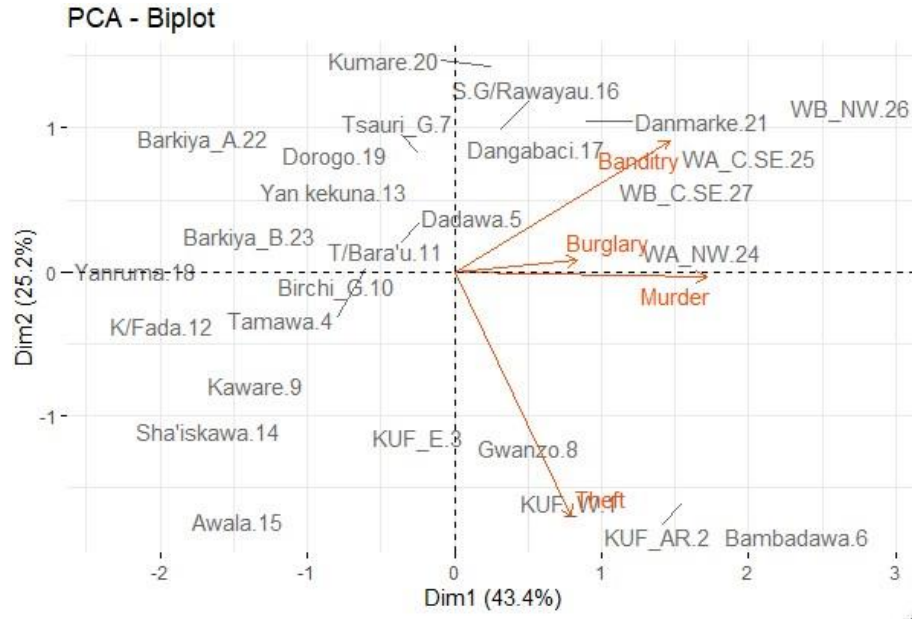

Figure 9: Biplot of the prevalent crimes in the remote villages of Kurfi LGA

The first principal component from Figure 9 has positive values for all the loadings, and hence is described as overall crime victimization. The areas with the overall crime proportions and have beside banditry the prevalence of murder and burglary victimizations are WB NW, WA _NW, WA C.SE, WB C.SE and Danmarke. S.G.Rawayau and Dangabaci also have prevalence of banditry and burglary victimizations. The areas with lower crime victimzations are

0

Birch G, T/Bara BarkiyaA & B, Tamawa, Kaware all the areas in Rawayau A ward (Yan

0 kekuna, Awala, K/Fada, Sha iskawa). The larger proportions of the villages with very crime victimizations are located in the eastern part of Katsina-Kankara road.

4   Conclusion

The paper used biplot loadings of the principal components to analyze crime victimizations in Dutsin-Ma/Kurfi Federal constituency of Katsina State, Nigeria. The constituency comprised of Dutsin-Ma and Kurfi LGAs. The results show that banditry and theft are the prevalent crimes in the constituency. Theft and burglary are the common crimes victimizations in the urban centers of the constituency principally in Dutsin-Ma and Kurfi LGA headquarters. Other villages with the moderate proportions of theft and burglary are either due to their proximity with the urban centers or due to their strategic importance by their locations. These villages are Shema, Karofi, Bagagadi and Tsauri. Assault and fraud are not common in the constituency and occur mostly in the urban centers. This is attributed to the traditional cohesion couple with inclinations to customs and religious in solving disputes in rural areas.

Banditry is significantly correlated with murder and rape. This indicates that the menace of banditry is resulting to occasional murder and raping of girls and women. The areas of banditry dominance to a lesser extend is the southern part of Dutsin-Ma LGA, and to the greater and troubling extend is the western part of the constituency. The most vulnerable areas to banditry, rape and murder in Kurfi LGA are Wurma _A & B, Kurfi A, Bambadawa and Danmarke wards, while the vulnerable areas in Dutsin-Ma LGA are U/Zakara, Sanawa and Turare all in Makera ward. Other vulnerable villages are Dantakiri, Tareshi and Gobirawa in Kuki B ward, Tabobi in Kutawa and Dabawa _G and Maitsani in Dabawa ward.

In conclusion, the eastern part of the constituency has lower crime concentrations and therefore it constitutes the secured area in the constituency. The prevalence of theft and burglary is associated to the level of urbanization of an area. Banditry is widespread in the constituency and its intensity is associated to the proximity of an area to the forest reserves located in the neighbouring LGAs at the western part of the constituency. Therefore, government and stakeholders should consider urban socio-economic related problems in controlling urban related crimes, and the impact of forest reserves in the fight against banditry in the North-western part of Nigeria.

References

Adiele, D.F. (2013), Serious Crime in Nigeria: An Empirical Analysis using Time Series Data (Between 2000-2010), *Global Journal of Mathematical Sciences*, 12: 25-29

Aderounmu, B. (2021), Factors responsible for increasing crime rate in Nigeria, Business Day, Published December 16, 2021, Available at https://businessday.ng/opinion/article/factorsresponsible-for-increasing-crime-rate-in-nigeria/

Arisukwu, O., Igbolekwu, C., Oye, J., Oyeyipo, E., Asamu, F., Rasak, B. and Oyekola, I. (2020), Community participation in crime prevention and control in rural Nigeria, *Heliyon*, 6(9):e05015, 1 - 7. doi: 10.1016/j.heliyon.2020.e05015

Atanu, E. Y. (2019), Analysis of Nigerias Crime Data: A Principal Component Approach using correlation matrix, *International Journal of Scientific and Research Publications*, 9(1): 10 - 16

Bello, Y., Gulumbe, S.U. and Yelwa, S.A. (2012a), Simultaneous Application of Agglomerative Algorithms on Interval Measures for Better Classification of Crime Data across the States in Nigeria. *Research Journal of Applied Science*, 7(1): 41 - 47.

Bello, Y., Gulumbe, S. U., Yelwa, S. A and Badamasi, M. M. (2012b), Monitoring Crime Rates with Control Charts using GIS Classification. *Journal of Engineering and Applied Sciences*, 7(2): 207 214.

Carvell, I. G. and Swinfen, G. E. (1970), Criminal law and Procedure. London: Sweet and Maxwell.

Ceccato, V. (2016), Rural Crime and Community Safety, Taylor & Francis Group

Chinwokwu, E.C. (2017), Managing police personnel for effective crime control in Nigeria, International Journal of Police Science & Management, 19(1): 1122. DOI: 10.1177/1461355716677877

Danbazau, A.B.(2007), Criminology and Criminal Justice. 2nd edition. Ibadan: Spectrum Books Limited.

egyankosh (undated), UNIT 24 Principal Component Analysis,Available at https://egyankosh.ac.in/bitstream/123456789/12628/1/unit-24.pdf

Global Initiative against Transnational Organised Crime (2023), Africa Organised Crime Index 2023, Nigeia, Global Initiative against Transnational Organised Crime, Available at https://ocindex.enactafrica.org/assets/downloads/2023/english/ocindex summary nigeria.pdf Ibrahim, T. (2023), Katsina: Rising Bandits Attacks Worry Residents, Daily Trust, Published August, 28, 2023, Available at https://dailytrust.com/katsina-rising-bandits-attacksworry-residents/

Johnson, R.A. and Wichern, D.W. (2007), Applied Multivariate Statistical Analysis, 6th edition, Pearson Education, Inc.

Ladan, S.I. and Danjuma, K. (2023), Analysis of the Insecurity Facing Katsina Metropolitan, Katsina State, *Direct Research Journal of Social Science and Educational Studies*, 11(3): 13 - 21

Muratore, M.G. (2014), Victimization. In: Michalos, A.C. (eds) Encyclopedia of Quality of Life and Well-Being Research. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-07535 _3156

Michael, C. (2023), KNigeria ranks high in African crime rates, see top 10 list, BUSINESS DAY. Published October, 5, 2023, Available at https://businessday.ng/news/article/768810nigeria/

National Institute for Security Studies (2022), Organized Crime in Nigeria: A Thread Assessment, United Nations Office on Drugs and Crime (UNODC) and National Institute for Security Studies (NISS), Available at https://www.unodc.org/conig/uploads/documents/NOCTA Web Version 25.09.2023.pdf

Nigeria (2019), The Local Government System in Nigeria, Available at http://www.clgf.org.uk/default/assets/File/Country profiles/Nigeria.pdf

Oguntunde, P.E., Ojo, O.O., Okagbue, H.I. and Oguntunde, O.A. (2018), Analysis of selected crime data in Nigeria, *Data in Brief*, 19: 1242 - 1249.

Otu, A.J. and Apeh, I.I. (2022), A Critical Analysis on Regional Policing and Crime Prevention in Nigeria, *Journal of Public Administration, Finance and Law*, 24: 62 - 86.

Rural Health Information Hub (2021), Violence and Abuse in Rural America. Received on May 11th, 2021 https://www.ruralhealthinfo.org/topics/violence-and-abuse.

Sanderson, S.P. (2023), Exploring Multivariate Data with Principal Component Analysis (PCA) Biplot in R, Steves Data Tips and Tricks, Published September, 6, 2023, Available at https://www.spsanderson.com/steveondata/posts/2023-09-06/index.html

Sobowale, A. (2023), Katsina gov condemns killings, vows to end banditry, Punch, Published November, 9, 2023, Available at https://punchng.com/katsina-gov-condemns-killingsvows-to-end-banditry/

The Global Observatory (2024), Northwest Nigeria Has a Banditry Problem. Whats Driving It?, International Peace Institute, Available at
https://theglobalobservatory.org/2024/05/northwest-nigeria-has-a-banditry-problemwhats-driving-it#:˜:text=Banditry%20is%20a%20composite%20crime,displaced%20as%20of %20December%202022.

Toochukwu, O.W. (2023), Rising crime rate in Nigeria, Business Day, Published May, 10, 2023, Available at https://businessday.ng/opinion/article/rising-crime-rate-in-nigeria/

Umar, A. (2023), Bandits Kill Five, Abduct Seven in Fresh Attack in Katsina Community, LiveTV, Published November 7, 2023, Available at
https://www.channelstv.com/2023/11/07/bandits-kill-five-abduct-seven-in-fresh-attackon-katsina-community/

United Nations Office on Drugs and Crime (Undated), The role and importance of crime victimization surveys in a system of crime statistics and their role
in reporting on SDG 16. Available at https://www.unodc.org/documents/data-andanalysis/statistics/ICCS/Korea Module _8 victimization _surveys.pdf

United Nations Office on Drugs and Crime (2023), Results of a victimization survey among the general public in the Fergana Valley, Republic of Uzbekistan. Available at https://www.unodc.org/centralasia/en/publications.html

United Nations Statistical Commission (2020), Handbook on Governance and Statistics, Praia City Group under UN Statistical Commission. Availale at https://www.sdg16hub.org/system/files/202112/PRAIA%20Handbook%20final%20WEB.pdf.

Yelwa, S.A. and Bello, Y. (2012), Complementing GIS with Cluster Analysis in Assessing Property Crime in Katsina State, Nigeria. *American International Journal of Contemporary Research*, 2(7): 190 - 198.

Abbreviation

STD.DEN = Standard deviation	H/gada = Hayin Gada
CV = Coefficient of variation	U/Cali = Unguwar Cali
DTM = Dutsin-Ma	D/Zoo = Dogon Zoo
G/Wakaji = Gangaren Wakaji	U/Zakara = Unguwar Zakara
U.K/Naira = Unguwar Kashe Naira	U/Dangaje = Unguwar Dangaje
KUF = Kurfi	B/Dutsi = Bayan Dutsi
W = West	0

https://fjorae.fudutsinma.edu.ng

FJoRAE

E = East

AR = Along the road

SW = Southwest

C.NE = Central & northeast

G = Gari (Ward Headquarters)

T/Bara'u = Tashar Bara u

K/Fada = Kofar fada

S.G/Rawayau = Sabon Garin Rawayau

WA _NW = Wurma A Northwest

WB NW = Wurma B Northwest

C.SE = Central & southeast

https://fjorae.fudutsinma.edu.ng