

Spatio -Temporal Analysis of Urban Crime Pattern and its Implication for Abuja Municipal Area Council, Nigeria

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Abstract This study examined the spatio-temporal analysis of urban crime pattern and its implication for Abuja Municipal Area Council of the Federal Capital Territory of Nigeria; it has the aim of using Geographical Information System to improve criminal justice system. The aim was achieved by establishing crime incident spots, types of crime committed, the time it occurred and factors responsible for prevailing crime. The methods for data collection involved Geoinformatics through the use of remote sensing and Global Positioning Systems (GPS) for spatial data. Questionnaires were administered for other attribute information required. The analysis carried out in a Geographic Information System (GIS) environment especially for mapping and the establishment of spatial patterns. The results indicated that the main types of crime committed were theft and house breaking (42.9%), followed by assault (12.4%), mischief (11.3%), forgery (10.5%), car snatching (9.05%), armed robbery (8.5%), trespass (5.2%) and culpable homicide (0.2%). In terms of hot spots the districts recorded the following: Garki (27.62%), Maitama (25.7%), Utako (24.3%), Wuse (20.9%) and Asokoro district (1.4%) respectively with most of the crime committed during the day time. Many attributed the crimes to mainly high rate of unemployment and poverty (79.1%). Consequently to reduce the crime rate, the socio-economic situation of the city must be improved through properly constructed interventions scheme in areas known to quickly generate employment such as agriculture, small and medium scale enterprises, mining and tourism.

Key Words: Crime incident, Crime pattern, Policing, Spatio-temporal analysis, Socio-economy.

Abstrak Studi ini menguji analisis spatio-temporal pola kejahatan perkotaan dan implikasinya terhadap Dewan Kota Abuja Wilayah Ibu Kota Federal Nigeria; ia memiliki tujuan untuk menggunakan Sistem Informasi Geografis untuk memperbaiki sistem peradilan pidana. Tujuannya dicapai dengan mendirikan tempat kejadian kejahatan, jenis kejahatan yang dilakukan, waktu yang terjadi dan faktor-faktor yang bertanggung jawab atas kejahatan yang berlaku. Metode pengumpulan data melibatkan Geoinformatics melalui penggunaan remote sensing dan Global Positioning Systems (GPS) untuk data spasial. Kuesioner diberikan untuk informasi atribut lain yang diperlukan. Analisis dilakukan di lingkungan Sistem Informasi Geografis (SIG) terutama untuk pemetaan dan pembentukan pola spasial. Hasil penelitian menunjukkan bahwa jenis kejahatan utama yang dilakukan adalah pencurian dan pemutusan hubungan kerja (42,9%), diikuti oleh serangan (12,4%), kerusakan (11,3%), pemalsuan (10,5%), penyeragaman mobil (9,05%), perampokan bersenjata 8,5%), pelanggaran (5,2%) dan pembunuhan tersembunyi (0,2%). Dalam hal titik panas, distrik mencatat hal berikut: Garki (27,62%), Maitama (25,7%), Utako (24,3%), Wuse (20,9%) dan Asokoro (1,4%) masing-masing dengan sebagian besar kejahatan yang dilakukan selama siang hari Banyak yang menganggap kejahatan tersebut pada tingkat pengangguran dan kemiskinan yang sangat tinggi (79,1%). Akibatnya untuk mengurangi tingkat kejahatan, situasi sosio-ekonomi kota harus ditingkatkan melalui skema intervensi yang dibangun dengan baik di daerah yang diketahui segera menghasilkan lapangan kerja seperti pertanian, usaha kecil dan menengah, pertambangan dan pariwisata.

Kata kunci: Kejadian Kejahatan, pola Kejahatan, Kepolisian, Analisis Spatio-Temporal, Sosial Ekonomi.

1. Introduction

Different definitions exist for an urban area United Nations [2008], they also vary from one continent to

another and from country to country on the basis of population, size of city, function or extent of built-up areas. It is a place-based characteristic that incorporates elements of population density, social and economic organisation, and the transformation of the natural environment into a built environment Weeks, J.R. [2010].

This transformation makes urban communities to have some unique characteristics among which are size, density of population, family, marriage, occupation, class extremes, social heterogeneity, social distance, system of interaction, mobility, materialism, individualism,

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to mention a few Lederbogen, F., Kirsch, P., Haddad, L., Streit, F., Tost, H., Schuch, P., *et al.* [2011]. This unique characteristic of urban areas has been known to generate so many problems some of which are fiscal problems Knauss, T. [2012], crowding Regoeczi, W. C. [2008], housing Massey, D. S., & Denton, N. A. [1993], homelessness Lee, B. A., Tyler, K. A., & Wright, J. D. [2010], traffic and transportation Rosenthal, E. [2011], air pollution Stylianou, M., & Nicolich, M. J. [2009], mental health problems Lederbogen, *et al.* [2011], public education and crime Lederbogen, *et al.* [2011]. Consequently, cities have been known to have much higher rates of violence and property crime than small towns or rural areas. Several of these problems stem directly from the fact that urban areas involve large numbers of people living in a relatively small amount of space Barkan, S.E [2016].

Crime is one of the major problems that accompany the development of modern society Ackerman W.V., and Murray A.T. [2004]. Crimes undermine the social fabric of society, by first eroding the sense of safety and security Danbazau, A.B. [1999]. Crime analysis, which is aimed at developing effective crime prevention strategies to combat crime, is yet to be fully developed in a developing country like Nigeria. This is in spite of the fact that organizations, especially in the developed countries of the world, are increasingly depending on Geographical Information System (GIS) and other statistical techniques for analytical modelling and real-world representation. This dependency has attracted law enforcement agencies to integrate different data types such as, crime statistics, location of crime and socio- demographic data in order to improve on crime analysis for effective crime prevention and control.

An effective crime analysis study using Geographic Information System (GIS) and other statistical techniques is capable of providing the information required by policy makers and law enforcement officers. This will help analyze and make decisions by understanding areas of high crime rates (crime hot spot) within a law enforcement or Police jurisdiction. The importance of the application of GIS in effective crime management is tied to a map which helps the criminal justice system providers to visualize the location of crime incidents Saddler, D. [1999]. The ability to access and process information spatio-temporally with the aid of a map, also allows law enforcement agents to allocate resources quickly and more efficiently. This point was also underscored given the critical nature of law enforcement, information about the location of crime incident, suspect or victim is often crucial in determining the size and shape of resources to be deployed in a specific location Ratcliffe, J.H. & McCullagh, MJ [1998].

Crime occurrence is influenced by varied factors such as unequal distribution of resources, social class, income level, poverty level, population density, unemployment level, and other demographic factors Ratcliffe, J.H. & McCullagh, MJ (1998). When these social factors and crime data are integrated in a GIS environment, they assist in determining a pattern between crime and location. In a similar manner, conventional statistical information employed by criminologists, can also be made available in map format to show specific crime patterns and geographical relationships among factors associated with criminal events.

The prevailing practice of crime analysis in the country in general and Abuja municipal Area Council (AMAC) Phase I, in particular, is yet to meet global standards, as law enforcement jurisdictions still collect and store crime related information manually. The methods used in collection, analysis, retrieval, storage and dissemination of information crime statistics are still poor, inaccurate and untimely. For instance, crime data is still being collected using police forms and books and are stored in filing cabinets. Compared to the police forces elsewhere, (in most developing countries), the old practices inherited from the colonial authority are still used. This system is prone to errors. The criminal justice system also requires timely and reliable information, so as to be prompt in the discharge of their responsibilities in a modern world with its attendant dynamisms. The development above likely accounts for the rising incidence of crimes due to lack of information on the spatial dimension of crime within the study area and also the reason why most crime are unresolved. To match the current trend in the developed world like the recent incidents in France, Belgium, Germany and United Kingdom, the approach to crime management must change.

Consequently, the aim of this study is to use Geographic Information System (GIS) and Remote Sensing (R.S) technique in Spatio-temporal analysis of urban crime pattern in order to improve police criminal justice delivery. To achieve this aim, the following objectives were adopted: to establish the possible crime incident spots and determine the types of crimes committed; to seek to tie crime occurrences with time (day and night); and to establish the factors responsible for the prevailing crime pattern.

The study covers a period of 2011-2012. Among the crimes that the study sets out to examine include; theft or car snatching; trespass mischief, forgery and culpable homicide. Geospatial analyses were used to; establish crime incident spots and determine the crimes committed; determine the existing police infrastructures in the study area. Find out steps that need to be taken to improve criminal justice service delivery and to tie crime occurrences with time (i.e. day and

night). Questionnaires were also administered to establish the factors responsible for the prevailing crime pattern in the area.

2. The Methods

The Federal Capital Territory is located between latitude $8^{\circ}25'$ to $9^{\circ}25'$ north of the equator and longitude $6^{\circ}45'$ to $7^{\circ}24'$ east of the Greenwich Meridian. The territory covers an area of 8,000sq km. and occupies about 0.8% of Nigeria Adakayi, P.E. [2000]. The territory is situated wholly within the region generally referred to as the Middle Belt (Figure. 1), and is bordered on all sides by four states, namely, Niger, Nasarawa, Kogi and Kaduna (Figure. 2). The Abuja Municipal Area Council (AMAC) Phase 1, which constitutes the study Area, is located on the eastern wing of the Territory with a land mass of 1,200sq km (Figure. 3). The area was subdivided into five districts namely; Asokoro, Garki, Maitama, Wuse and Utako districts respectively.

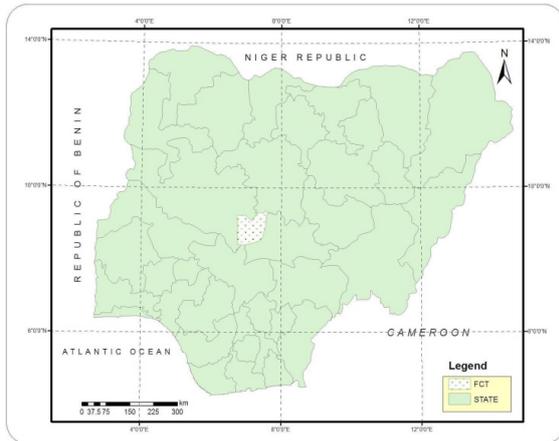


Figure 1. Nigeria showing FCT

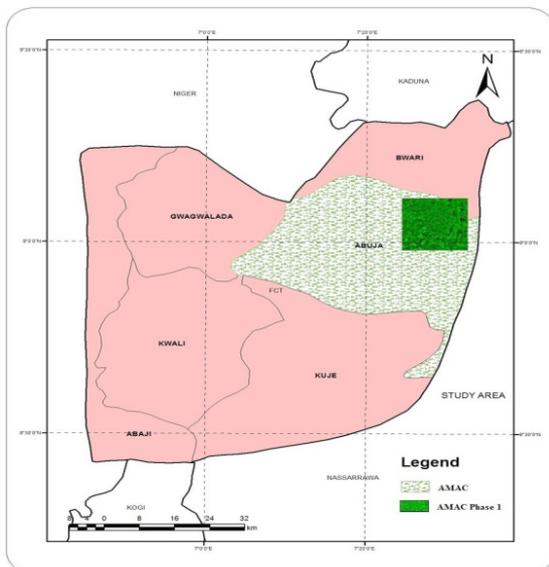


Figure 2. FCT showing AMAC Phase 1

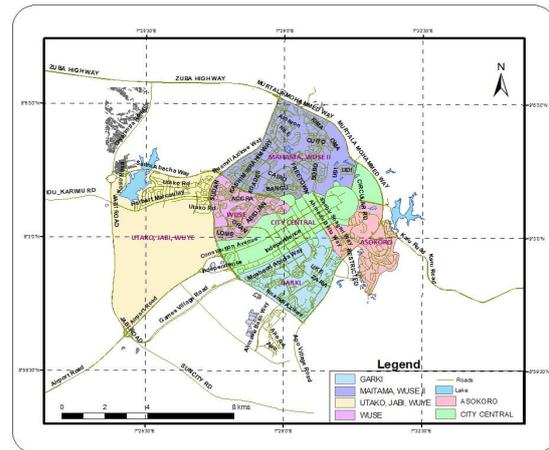


Figure 3. AMAC phase 1 showing the districts

Materials

In determining the data and their sources, cognizance was given to the nature, scope and the methodology adopted Adewuyi, T.O. The data used, include those gathered from both primary and secondary sources. The secondary data include satellite imageries and maps of the area. Primary data includes data obtained through purposive interview, responses from administered questionnaires to members of the public and the police, as well as coordinates of crime incident spots and police stations obtained with the aid of Global Positioning System (GPS) during field work.

Preceding the steps taken to actualize the objectives of the research, reconnaissance survey was embarked upon. This was followed by data acquisition, data processing, georeferencing, digitization, database design and creation, spatial analysis, map production and cartographic visualization. To avoid duplication of effort during field work, a proper feasibility study and site survey of the study area was carried out on a district by district basis, to obtain the coordinates of crime incident spots, and existing police stations with the use of a Global Positioning Systems (GPS) for validation.

Figures 4 and 5 are Nigeria SAT- 2 and IKONOS imageries of the study area. They were clipped out of a mosaic from IKONOS and Nigeria SAT- 2 imageries of the FCT using ArcGIS 9.3 software. Geo-referencing of the imageries was then carried out to bring them to the same ground coordinates. This was used to plot the coordinates of the various crimes committed in the study area and the spatial distribution of police infrastructure in the areas to aid digitization and geospatial analysis.



Figure 4. IKONOS Image of the study area



Figure 5. NigeriaSat -2 Image of the area
Source: NASRDA [2012]

Based on the projected population of the area from 2011 from National Population Census of 2006,

which was given as one million two hundred and ten thousand, nine hundred and fifty eight (1,210,958). The area was divided into five strata and 1500 copies of a questionnaire (representing 0.1% of the total population) were administered. Three hundred copies of the questionnaire were administered per stratum, using a multi-stage sampling technique. A separately designed questionnaire was administered to police officers (150 copies) using purposive sampling. Responses from the administered questionnaires were collated and analyzed to establish the factors responsible for the prevailing crime pattern in the area. It also provided clues on the crime causative factors, thereby providing insight on steps to be taken to improve police service delivery.

Pattern analysis was also carried out with the aid of Crimestat III software to generate the Nearest Neighbour Index (NNI) of the crime distribution pattern. In a bid to tie crime occurrences with time, crime data extracted from police records maintained at the five divisions of the study area were categorized spatio-temporal (i.e. day and night). The data was plotted to establish the spatio-temporal distribution pattern of crimes in the area.

3. Results and Discussion

Types and Rate of Crimes Committed

Having obtained available crime data from the five Police divisions of the study area, it was processed and subjected to in-depth analysis to highlight the rate, distribution, crime types, as well as the spatio-temporal distribution of crimes in the study area are shown in figure 6.

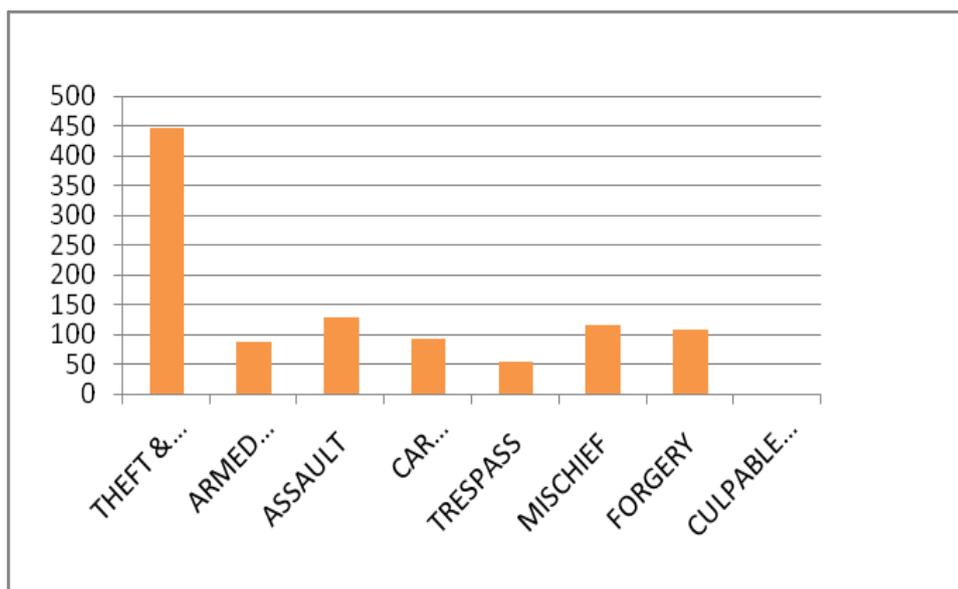


Figure 6. Classification of types of crime
Source: Authors work [2012].

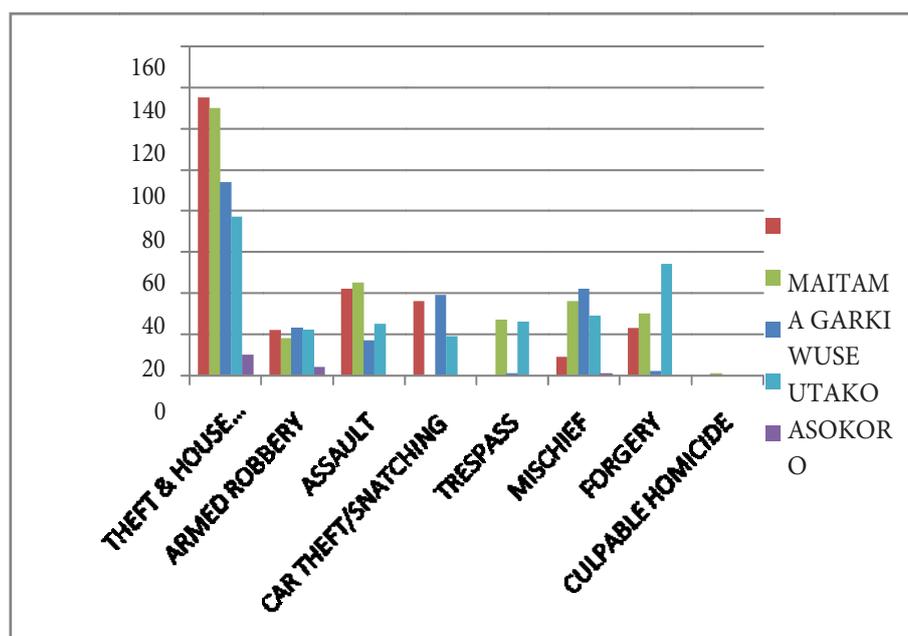


Figure 7. Crime distribution within districts
Source: Author, [2012]

As can be deduced from figure 6, the total crime rate for the study area (as reflected by the crime records obtained from the five districts) is one thousand and thirty nine (1039) crimes of diverse nature, ranging from theft and house breaking to culpable homicide. Out of this number, theft and house breaking recorded the highest crime rate of four hundred and forty six incidents (446), representing 42.9%, followed by assault with one hundred and twenty nine (129) reported incidents, representing 12.4%. This was followed by mischief and forgery which recorded one hundred and seventeen (117) and one hundred and nine (109) incidents representing 11.3% and 10.5% respectively. Car snatching and armed robbery incidents were also reported in the area during the period under review, with car snatching recording ninety four (94) incidents, representing 9.05% and armed robbery with eighty nine (89) incidents, representing 8.5% and trespass recording fifty four (54) incidents, representing 5.2%.

Figure 7 also shows that the crime rate in Maitama police division is closely followed by that of Utako police division which recorded a total of two hundred and fifty two (252) incidents, representing 24.3% of the total crime rate in AMAC phase 1 in 2011. Out of this number, theft and house breaking recorded the highest incidents of seventy seven (77) incidents followed by forgery with fifty four (54) incidents, mischief with twenty nine (29), trespass with twenty six (26), assaults, twenty five (25), armed robbery with twenty two (22), car theft/ snatching with nineteen (19), and culpable homicide, zero (0) respectively. This development is

not unconnected with the high crime rate in Utako districts which is characterized by slum settlement like Dakibiyu, inhabited by low income groups of people; most of whom have no means of daily livelihood. Also, the high rate of armed robbery, car snatching, theft, and mischief among others in the area must have been brought about by the concentration of business activities at the market and motor parks in the area, which undoubtedly attract diverse groups of people to the area in search of opportunities.

Wuse district of the study area, recorded a total crime rate of two hundred and eighteen (218) crime incidents, representing 20.9% of the total crime incidents in the area in 2011. Out of this figure, theft and house breaking recorded ninety four (94) cases, followed by mischief with forty two (42) incidents and car theft/ snatching which recorded thirty nine (39) criminal acts. Others are armed robbery, twenty three (23); assaults seventeen (17); forgery two (2); trespass, one (1); and culpable homicide zero incident.

The crime distribution rate in Wuse district could be attributed to the volume of activities taking place in the district. Wuse, is one of the major commercial hubs of AMAC phase 1 with high concentration of people who visit the area for commercial and allied activities, hence the relatively high concentration of criminal activities as highlighted.

Of the five districts of AMAC Phase 1, Asokoro district, recorded the least crime incident in 2011 with a total crime rate of fifteen (15), representing 1.4% of the total crime rate the in study area. Out of this number theft and house breaking recorded

ten (10) incidents followed by robbery with four (4) incidents and mischief which recorded one incident. The low rate of crime in Asokoro district is generally informed by the secured nature of the neighborhood, which is surrounded by military and other security formations. Also, the location of the neighbourhood (which is serviced by a limited number of major roads that links the numerous interconnectivities within the neighborhood to the entire city), renders the area less vulnerable to acts of criminality, as those roads are under constant police surveillance. This emerging crime distribution pattern for the study area is further displayed in fig 8 using multiple bar charts for easier and faster grasp.

Garki has the highest crime rate followed by Utako and Maitama, while Asokoro has the lowest crime rate in the area. The high crime rate in Garki district of the FCT is not unconnected with high poverty rate / youth unemployment which is prevalent in the area. Garki district of the study area, remain one district that is still inhabited by the original inhabitants of the FCT. The area is largely undeveloped and unplanned with high population of people with no meaningful source of income. The blend of urban and slum settlements in the district could be responsible for the prevailing rate of crime in the district.

Spatio-Temporal Crime Distribution Pattern

In the course of data collection, coordinates of identified crime incident spots and their respective addresses were obtained. The coordinates (Eastings and Northings), types of crime incidents, and their addresses are shown in Figure 4 as the spatial distribution of crime Incident spot in the five districts of the FCT.

District By District Spatio-Temporal Crime Distribution Pattern.

The spatio temporal crime pattern for Wuse district shows that crimes occur in the area both during the day and at night, but with higher frequency in the daytime. Theft and house breaking are the most predominant crime types in the district and are usually carried out during the day, except for mischief which is mostly carried out at night. The high rate of mischief in Wuse district at night could be attributed to the vibrant night-life in the district. Generally, most parts

Figure 10 above shows the district by district spatio-temporal crime pattern. The statistics show that

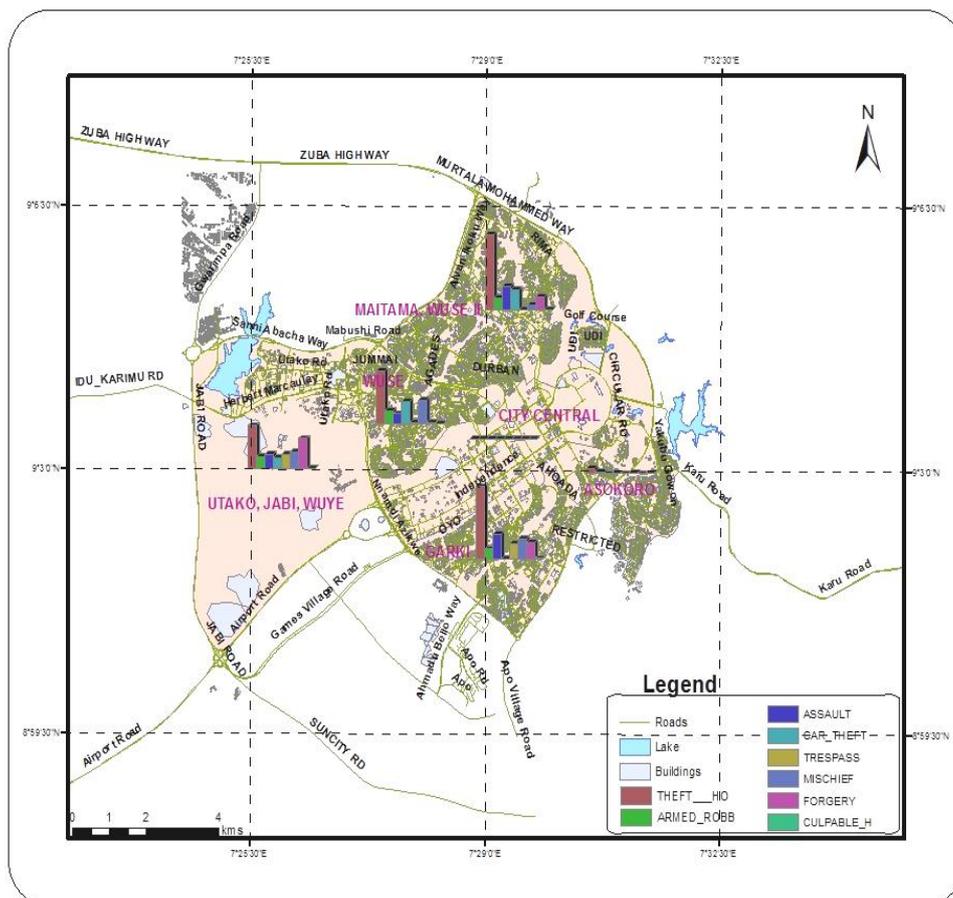


Figure 8. The spatial distribution of crimes in the districts.

Source: Author, [2012].

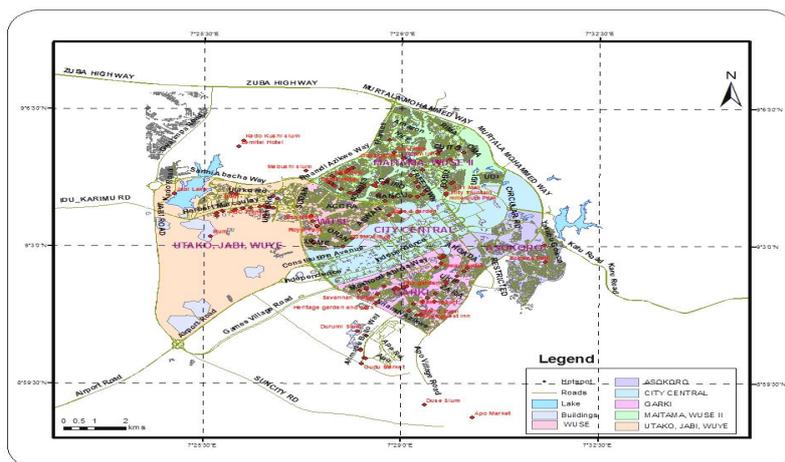


Figure 9. The distribution of crime Incident spots.
Source: Authors work [2012].

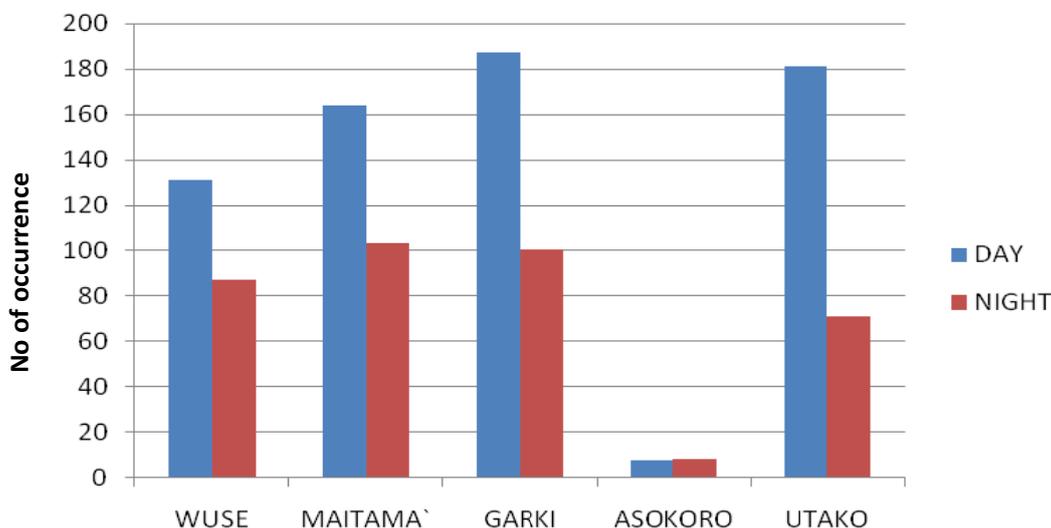


Figure 10. Spatio- temporal crime distribution pattern

of Wuse district experience thriving night activities with clubs and other forms of social interaction, which renders the neighbourhoods vulnerable to acts of mischief by criminal elements at night.

The Spatio-temporal crime statistics for Maitama/Wuse II districts revealed that, crimes take place both in the day and at night, but with higher frequency during the daytime. Theft and house breaking are the most predominant crime types recorded by the districts and are usually carried out during the daytime except for armed robbery which is mostly carried out at night. The proximity of Maitama district to Mpape (which is an unplanned neighborhood inhabited by people of low income class), could be responsible for incidents of armed robbery in the area at night. Moreover, the ease of access into Maitama district which is surrounded by dual carriage ways leading to Kubwa, Asokoro and other parts of the city could be

responsible for night robbery in the area. The highways serve as easy escape routes for the robbers after their heinous crimes.

The Spatio temporal crime trend for the Garki district shows that crimes generally occur during the day and at night, but that the frequency is higher during the daytime. Theft and house breaking are the most predominant crime in the district and are usually carried out during the daytime. As earlier highlighted, Garki remains one of the districts in the study area that still harbors unplanned (slum) settlements within the urban neighborhood. This affords individuals with no meaningful source of livelihood the opportunity to engage in acts of criminality such as theft and house breaking in the day time, as they are bound to use their idle time to break into people’s houses in the afternoon when they must have left home for their places of work.

For Asokoro district the trend shows that crimes are generally perpetrated both during the day and at night. It also shows that Asokoro district has the lowest crime rate in the whole of AMAC phase 1 as only three types of crimes (theft and house breaking, armed robbery and mischief) out of the eight crimes identified in the study area, occur frequently in the districts. The statistics shows that theft and house breaking are usually carried out during the daytime, armed robbery mostly takes place at night, while mischief, on the other hand, occurs mostly in the daytime. Asokoro being a high class residential zone is inhabited by influential members of the public with fewer individuals inhabiting most of the houses. This allows criminals operating in the area, the opportunity to break in and steal from most homes in the area, particularly, homes that are left without security guards during working hours. Mischief takes place in Asokoro in the day time as opposed to night hours

in Wuse district; this is because there is little or no night life in Asokoro. This is in contrast with Wuse district, with its bustling night life and attendant high crime rate.

For Utako district, crimes usually occur in the district both in the day and night but with a higher frequency in the day time. The statistics show that theft and house breaking as well as forgery are the most predominant crimes in the districts and are usually carried out during the daytime. Utako district is renowned for its role as the transportation hub of the study Area, as it serves as the terminal of major inter-State transport companies in the area. Activities at the terminals provide ad-hoc employment for the teeming unemployed youth who serve as motor boys, hawkers, load carriers etc. Activities around the area also attract touts, many of whom engage in the consumption of illicit drugs such as Indian hemp. This is of course,

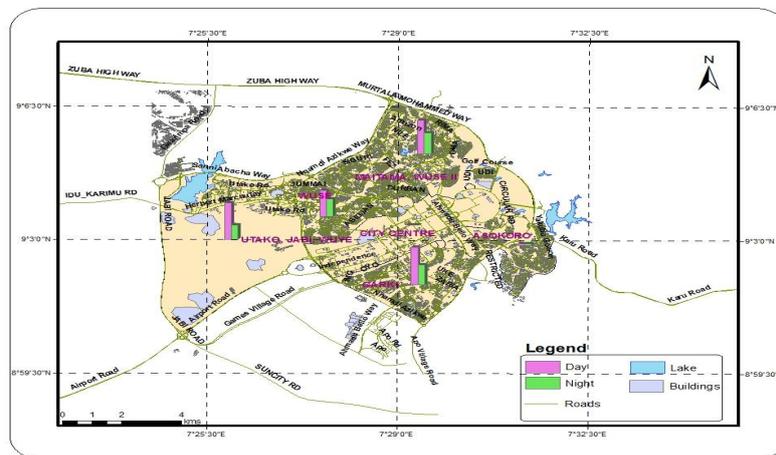


Figure 11. Choropleth map showing the crime distribution pattern in the five districts
Source: Author [2012].

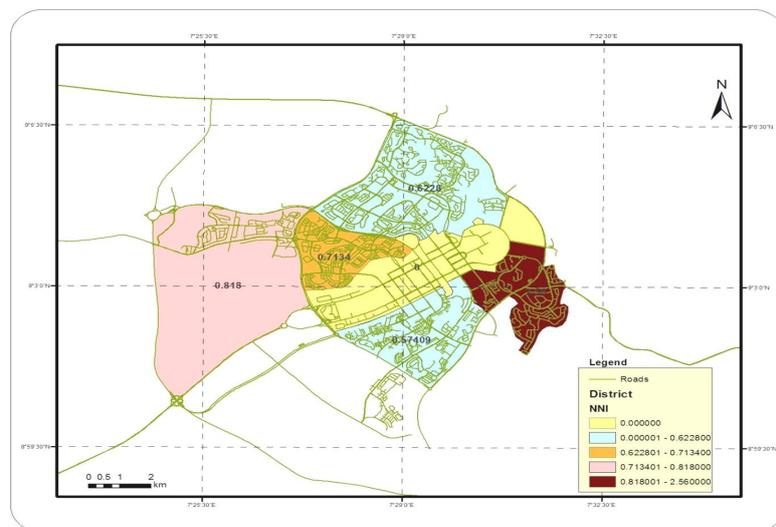


Figure 12. Choropleth map showing the NNI
Source: Author[2012]

closely associated with incidents of theft, house breaking, and forgery which abound in the neighborhood. The emerging spatio temporal crime distribution pattern for the five districts of AMAC phase I, is summarised and presented graphically in figure 11.

Figure 12 displays the value of NNI for the districts. The Nearest Neighbour Index (NNI) for Utako district, is 0.818 which tends towards 1, hence the crime distribution pattern for Utako district is random. On the other hand, the Nearest Neighbour Index (NNI) for Maitama district is 0.622. This indicates that the crime distribution pattern for Maitama district is relatively random as the index value also tends towards 1. Garki and Wuse crime distribution pattern also tends towards random, with Nearest Neighbour Index values of 0.57409 and 0.7154 respectively. Asokoro district on the other hand is however perfectly dispersed with a Nearest Neighbour Index value of 2.56. While the Nearest Neighbour Index (NNI) for the distribution of police station in the area is also dispersed with NNI value of 1.60.

Factors Responsible for the Prevailing Crimes

Results of the questionnaires administered to respondents in the course of the research indicate that a total of nine hundred and eighty nine (989) (respondents representing 79.1%) hold the view that high poverty / youth unemployment is responsible for the general crime rate in the study area in 2011. This is followed by those who blamed income disparity with 8.3% and other demographic factors which recorded 6.9%.

In all, a total of one thousand five hundred questionnaires were administered out of which one thousand two hundred and fifty six (1,256) were retrieved from respondents across the districts. Out of this number, a total of seven hundred and twenty two (722) respondents, representing 57.5% attributed the factors responsible for acts of criminality in the area to urban congestion; sixty nine respondents representing 5.5%, attributed the crime rate to proliferation of drinking spots, three hundred and ten respondents representing 24.7% attributed the rate of crime in the area to inadequate penalty for offenders, while one hundred and three (103) respondents representing 8.2% attributed the prevailing rate of crime in the area to sales of illicit drugs; and fifty two respondents representing 4.1% attributed the crime rate to other factors. The outcome of the result of administered questionnaires highlighted above, are as shown in figure 12.

On police perception of crime rate in the study area, out of one hundred and fifty (150) questionnaires distributed to police officers and men, a total of one hundred (100) questionnaires were retrieved, with a view to knowing their perception on the factors

responsible for crime and criminality in their various jurisdictions. The low rate of return is attributed to irregular mobility of the officers, most of whom are deployed on special duties at short notice. Out of this number, twenty five (25) officers, representing twenty five percent (25%) were of the opinion that unemployment was responsible for the prevailing crime rate in the area, while another twenty five percent (25%) attributes the rate of crime in the area to drug addiction. Fifty respondents (50) representing fifty percent (50%), however, attributed the prevailing crime rate in the area to other unspecified factors.

Buffer analysis was deployed to map the identified crime impacted zones (crime Incident spots) in the study area, where crime prevention strategies need to be strengthened. Distances of 2.5km from each police station were buffered to crime incident spots and the spatial distribution of police stations. The result revealed that most crime Incident spots in the five districts of the study area were not adequately covered by existing police stations serving the area. Consequently, these areas are vulnerable to crime and criminality.

4. Conclusion

This study has carried out the spatio-temporal analysis of urban crime pattern in the Abuja Municipal Area Council of the Federal Capital Territory. The study reveals that the spatial pattern of crime incidence is generally random in nature though when examined district-by- district, the rate varies from one district to another, except for Asokoro district which has a disperser pattern. It was also discovered that the temporal pattern was a little bit more of day time crime occurrence than night time. This was as a result of the criminals taking advantage of occupant departure to work. Consequently, the most common crime carried out in the area is theft and house breaking. The other types of crime are observed to be far behind in terms of level of crime incidence.

On the causes of crime in the study area, the general consensus narrowed down the causes to two reasons. First, the high level of unemployment and second, poverty particularly among the lower classes of people in the society. Amazingly, the two reasons are socio-economic in nature. Consequently, to have a lasting solution to the rate of crime incidence in the area, there must be the political will and concise effort from every stakeholder to reduce the level of unemployment and poverty in the area Lee, B. A., Tyler, K. A., & Wright, J. D. [2010].

This must comprise genuine intentions and properly constructed approaches to poverty alleviation in areas of the economy like agriculture, Small and Medium Scale Enterprises (SMEs), mining and tourism which are known to engage a large numbers of people.

Crime prevention efforts of the police will yield little results until more studies and understanding of the dynamics and consequences of urban land use changes is given more priority in research Adewuyi, T.O. (2007).

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