

Application of Average Nearest Neighbour Analysis of Firearm and Crime Management in the Federal Capital Territory, Nigeria

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Abstract

This paper focuses on identifying locations of firearm recovery and examining changes in illegal firearm possession and recovery in Federal Capital Territory (FCT), Abuja. Applying data sourced from the Nigeria Police Force Headquarters, FCT command Abuja, the National Bureau of Statistics (NBS), and reports from Non-Governmental Organizations (NGOs) using Geographic Information Systems (GIS) and Average Nearest Neighbour Analysis (ANNA) methods. The study revealed that 34.0% of illegal firearms were recovered in Abuja Municipal while 19.9% were recovered in Bwari local council. The result also showed that the average nearest neighbour analysis of the four-dataset revealed that illegally possessed firearm and recovered firearm were clustered. While the distribution of firearm recovered that were involved in crime is random and Firearm stolen and recovered is dispersed. The study therefore, recommends that: the average nearest neighbour analysis and GIS methodologies should be integrated in fighting crime, as this will enable the creation of geo data base to reduce ineffectiveness and create automated police field operation and increase the effectiveness of crime fighting generally.

Keywords: Firearm, Crime, Geographic Information Systems (GIS), Cluster, Random, Disperse.

1.0 Introduction

Nigeria, with an estimated population of 98,847,407 (United Nations, 2019), is the most populous country in Africa. With over 250 ethnic groups, it is also the continent's most diverse nation. Because of the social, economic, and political factors, there has been an upsurge in gun-related crimes. This includes ethno-religious tension and militancy. The availability of arms in the northern part of Nigeria because of Boko Haram insurgency, kidnapping, banditry, and militancy in the South–South is frightening and worrisome. The need for self-defense by the citizens has led to the purchase of high caliber of firearms in Nigeria. At this stage, it is pertinent to say without missing a word that there are many illegal firearms in the hands of the citizens, and of course, they may use them indiscriminately. (Ime and Mohammed., 2008).

Despite the effort by our security agencies that man our border like the Nigerian immigration, customs service, and Nigeria police force the security in our borders are still very bad and porous,

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this allow the infiltration of Small Arms and Light Weapon (SALW) and trafficking of illicit arms. Because Nigeria is regarded has the source/origin of illegal arm trafficking, therefore the proliferation of SALW can be linked to local manufacturing. Even the legal acquisition of SALW for various security agencies by the Nigerian government eventually illegally finds their way to militia groups (Yacubu, 2005; Adejo, 2009; Nte, 2011).

It is no surprise that out of the 640 million small arm in circulation in the world, approximately 100 million can be found in Africa out of that about 30 million are found in sub Saharan Africa then an estimate of 8 million can be traced to West Africa. Most of this SALW about 59% are in the hands of civilians, then 38% are owned by government armed forces, 2.8% are in the hand of police and 0.2% are owned by armed groups. Eight million brown new guns are manufactured every year from 1,249 companies in 92 countries in the world, an average of 10 to 14 billion ammunition are also manufactured annually enough to kill every human living in the world twice over. The trade in gun is estimated to worth \$4 billion every year out of this about \$1 billion may be unauthorized or illegal. It is estimated that African Countries spent about 300 billion united states dollars on armed conflicts between 1999 to 2005, this is equal to the sum of international grants to the continent within the same period of time (Ibrahim, 2003; Stohl and Tuttle, 2009; Nte, 2011).

A programmed held on the 11th of August, 2016 at the National Consultation on Physical Security and Stockpile Management (PSSM) in Abuja Nigeria capital organized by United Nation Regional Center for Peace and Disarmament in Africa and the office of the Presidential Committee on Small Arm and Light weapons (PRESCOM), it was revealed that about 70% of the 500 million illegal firearm in west Africa are in Nigeria about 350 million. UNREC's director Mrs. Olatokunbo Ige, gave this data during the meeting, she further said that those Small Arms and Light Weapon (SALW) are in the hand of non-state actors who use the weapons to threaten lives and properties of their compatriots.

Alpers *et al.*, (2014). Revealed that the number of both legal and illegal firearms in the hand of civilians in Nigeria is approximately two million, according to their study the put the arte of private ownership to 1.5 firearm per one hundred Nigerians. They however admitted that it is very difficult to count the number of illegal fire arm in the hand citizens in Nigeria so they approximate it to be at one million. Hence the rate of unlawful held guns in Nigeria is 0.71 illegal firearm per one hundred people.

Ukandu, (2012) explained the proliferation of firearms in Nigeria asserted that rampant cases of interception and seizure of arms and ammunition are indicatives to show the extend Nigerian have

armed themselves. Explaining further without giving dates alleged that an estimated to hundred-million-naira weapon cache was intercepted along the express road to Jos. Ukandu also alleges that missiles similar to the ones being used in Afghanistan were also said to have been seized on their way into Nigeria. At this point one might ask how many weapons of this caliber have made their way into Nigeria. Massive accumulation and acquisition of arms by groups and individuals in Nigeria present a challenging and increasing dangerous obstacle to Nigeria.

Akinosho, (2014) decriing the level of proliferation of firearm in Nigeria, posit that this is the major cause of instability in the country and is motivated by insecurity, poverty and weak governance. Edeko, (2011) quite agree with Akinosho and reveals that “stolen or lost firearm from people that licensed to that carry firearm are playing a major part in escalating crimes and firearm violent in Nigeria, this may threaten our sustained democracy and security of life and properties which are major panacea for development”.

According to a study by Vitus, (2018) on firearm violent in Nigeria, the number of violent deaths in Nigeria increase by 1.4%, human fatalities increase from 10,515 in 2017 to 10,665 in 2018. Some of the major causes of death in Nigeria were political issues, religious violence, land issues, herders and farmers clashes and road accidents. Although there as decline in death toll by Boko Haram from 2,829 in 2017 to 2,135 in 2018. This account to a 28% decrease. Death from cult related activities amounted to 453 in 162 incidents across Nigeria. People were also killed in the hand of kidnappers amounting to 238 from 76 kidnapping case in 2018. A total of 2,331 people were killed in 350 firearm incidents involving security operatives.

Ime and Mohammed (2008), studied the impact of Small Arms and Light Weapons (SALW) in Africa by reviewing the situation in Nigeria and using a small hospital in Kano northern Nigeria as their case studies. The study suggested that several political factors and socio-economic reasons have led the increase in firearm violent in Nigeria. Others include ethno-religious tensions, the response of security forces to criminal activity, and growing economic disparity. Kano is known for high cases of communal riots between the predominant Muslims and the non-indigene Christians; in most of this crisis study revealed that firearms were used.

The Federal Capital Territory of Nigeria (FCT) is a multi-ethnic and religious region in Nigeria. As the capital, people from all part of Nigeria move into FCT for a better living, this have led to alarming rate of crime. The situation of crime generally in Nigeria has taken a different dimension

as crime is increasing in a geometric progression in spite of efforts of law enforcement agencies to address the situation. In fact, the spate of insecurity in Nigeria remain an obstacle to the progress and development of the country (Balogun *et al.*, 2014).

According to United Nations, Abuja is the fastest growing cities in the world as it had grown in term of population by 139.7 percent within the spate of ten years (2000 to 2010). The increase in population brought about satellite towns like Lugbe, Gwagwalada, Kuje, Bwari, Abaji and karu to mention but a few (Olanrewaju, 2009).

Although geographical analysis plays a crucial role in crime research, studies conducted in Nigeria have predominantly concentrated on specific regions. Although these studies are not accomplished by employing spatial analysis methodologies, including Average Nearest Neighbour Analysis (ANNA) and kernel density estimation, which identify spatial concentrations of crime incidents that are statistically significant

Bridging this gap, this paper employed spatial analysis methodology using Average Nearest Neighbour Analysis to identify location of firearm recovery in FCT, and examine changes in illegal firearm possession and recovery between 2020 and 2024 Law enforcement agencies can effectively prioritize resource allocation, strategically deploy patrols, and implement targeted prevention initiatives through the identification of locations.

2.0 Materials and Methods

2.1 Materials

2.1.1 Location and size

The FCT is located in North Centre Nigeria it lies between latitude $8^{\circ} 25' 00''$ N and $9^{\circ} 25' 0''$ N and longitude $6^{\circ} 45' 0''$ E and $7^{\circ} 45' 0''$ E. It shears boundary with the following state. Niger State in West and North, Kaduna State to the North East, Nasarawa State to the East and South, and Kogi State to the Southwest. The FCT is made up of six local council comprising the city of Abuja and five local government areas namely Abaji, Kuje, Bwari, Gwagwalada and Kwali as shown in Figure 1. While the capital city covers about 250 km^2 , the whole geographical area of FCT has a land mass of approximately 8000 km^2 and it is situated in the savannah region

With moderate climatic condition (Federal Capital Development Authority, 2019). This study covered all six local councils.

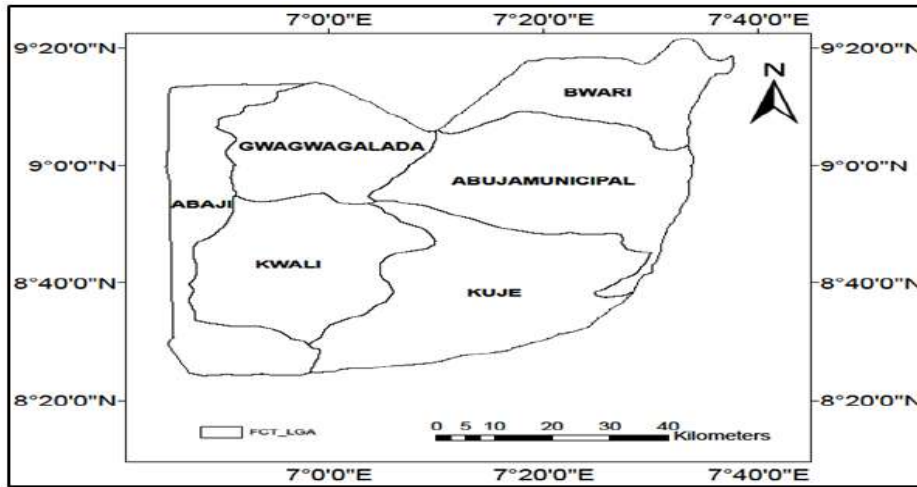


Figure 1: Map of Federal Capital Territory Showing Local Councils
Source: National Space Research and Development Agency (2019).

2.1.2 Population

Abuja is listed as one of the fastest growing cities in the world, with the population presently over 2.5 million since 1980s when the development started. Because of the sole reason of the city’s reputation for welcoming diverse culture, ethnicity, and religion the population will continue to grow. (World Population Review, 2019).

The latest census conducted in FCT was on 2006 when the population was estimated at 776,298. However, this population has grown almost 140% between 2000 and 2010 exceeding 2.4 million. The FCT population is diverse, the official language is English Language, almost all Nigeria languages can be found in FCT but the major ones include Gbagi, Hausa, Fulani, Ibo, Yoruba, to mention a few. The FCT population in 2019 is estimated at 3,095,118 (UN World Urbanization Prospects, 2019).

2.1.3 Reconnaissance survey

A field reconnaissance survey of the study area was carried out. The aim of this is to obtain detailed firearms illegally possessed and recovered with crime records and also identify all the police area commands in the Federal Capital Territory, this survey have also provided names and number of various police station under each area command in the study area. This information was used to draw the crime map of the study area under every police command in FCT. The following are the area commands in Federal Capital Territory:

Area Commander Metro

Lugbe Division, National Assembly Division, Maitama Division, Wuye Division, Garki Division,

Durumi Division, Asokoro Division, Wuse Division, and CPS Division.

Area Commander Karu

Nyanya Division, Karshi Division, Karu Division, Jikwoyi Division, Apo Division, Kabusa Division, Supreme Court Division, Legislative Quarters Division, Galadima Division, and Trade More Division.

Area Commander Kubwa

Kubwa Division Zuba Division Bwari Division Gwagwa Division and Dutse Alhaji Division.

Area Commander Life Camp

Life Camp Division, Karmo Division, Gwarimpa Division, Mabushi Division, and Utako Division.

Area Commander Abaji

Abaji Division, Guau Karya Division, Yaba Division, and Robochi Division.

Area Commander Gwagwalada

Gwagwalada Division, Kwali Division, Kuje Division, and Iddo Division.

2.1.4 Data Used

The data used in this study was collected from the Nigeria Police Force Headquarters, FCT Command Abuja., the National Bureau of Statistics (NBS), and reports from Non-Governmental Organizations (NGOs) i.e. **Conflict Armament Research (CAR) and Centre for Armed Violence Reduction**. The data covered the period from 1st January 2020 to 31st December 2024.

2.2 Methods

In order to achieve the objective of where firearms were recovered at FCT, three points were addressed when processing the data:

- i. the distribution of illegal firearm possession in FCT
- ii. the distribution of firearm recoveries in FCT, and
- iii. the distribution of gang or cult involvement in firearm recoveries.

Maps were created using basic point and choropleth mapping techniques. Maps were generated in this process for: illegal firearm possessed and recovered, firearm recovered, and firearm recoveries by type of firearm. Spatial statistical analysis was conducted on the dataset generated on illegal firearm possession, firearm stolen and recovered, recovered firearm, and firearm recovered that were involved in crime. The Average Nearest Neighbour (ANN) tool was used to determine whether or not each of the four-point distributions were clustered or randomly dispersed.

While changing spatial distribution of firearm possession and recovered between the study periods in FCT was achieved by ANNA. In order to perform this analysis, the data was organized by years. A new layer containing all five datasets for each year was created (firearm possession, firearm recoveries, violent crime, and property crime). Since the time span covers five years and there are five variables being analysed a total of 25 new fields were created within a new shape file. At the end of the process, five maps for each of the five years, each displaying hot and cold spot were

produced. The Average Nearest Neighbour Value (R_n) equation is given by Clark and Evans, (1954). As follow

$$R_n = \frac{D(Obs)}{0.5\sqrt{\frac{a}{n}}} \quad (2.1)$$

where $D(Obs)$ is the mean value of the nearest neighbor distances, a is the area sampled and n is the number of points (in this case retail buildings).

3.0 Results and Discussion

3.1 Results

3.1.1 Descriptive Statistics

Table 1: Descriptive Data for Illegal Firearm Possession, 2020- 2024

Measure	Value
Illegal firearm possession	747
Thefts involving firearm	267
Average number of firearms illegally used per theft	2.80
Total firearm illegally possessed and recovered	514 (68.80%)

As noted above (Table 1), 514 firearms that were illegally possessed in FCT were recovered. Between January 1st, 2020, and December 31st, 2024 there were a total of 747 fire arms illegally possessed and reported to the FCT command. On average more than two firearms were used per theft reported. Finally, more than half of the firearms illegally possessed and reported to the Nigerian police were recovered.

3.1.2 Identifying the Location of Firearm Recovery in FCT

Table 2: Firearm Recovered by Type of Firearm, 2020 - 2024

Types of guns	Total Firearm Recovered	Percentage (%)
AK 47	33	6.42
Locally made Gun	406	79.00
Riffle	25	4.68
English Pistol	50	9.73
Total	514	100

Table 2 above reveals that over 70 percent of the illegally possessed firearms recovered by the Nigeria Police Force were locally made guns. This also comes as no surprise, considering the large number of locally made guns that were illegally possessed and subsequently recovered by the police. These results suggest that locally made guns are more likely to be used in a crime than other guns in the FCT.

The data collected on firearms recovered in FCT greatly differs from the data collected on illegal

firearms possessed in FCT. As shown in Table 2, this is due to the lack of prompt action by the Nigerian Police Force at crime scenes. A total of 514 firearms were recovered by the Nigeria Police Force between January 1st, 2020 and December 31st, 2024. For the reasons mentioned above, there are many uncertainties about the origin of firearms recovered in FCT. Firearm recoveries are shown below in a similar fashion to illegal firearm possession by types of firearm.

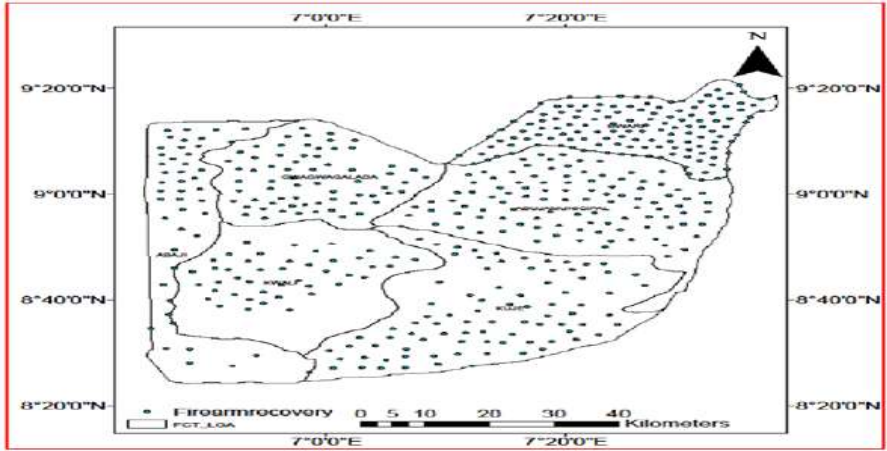


Figure 1: Illegal Firearm Recoveries in FCT, 2020-2024

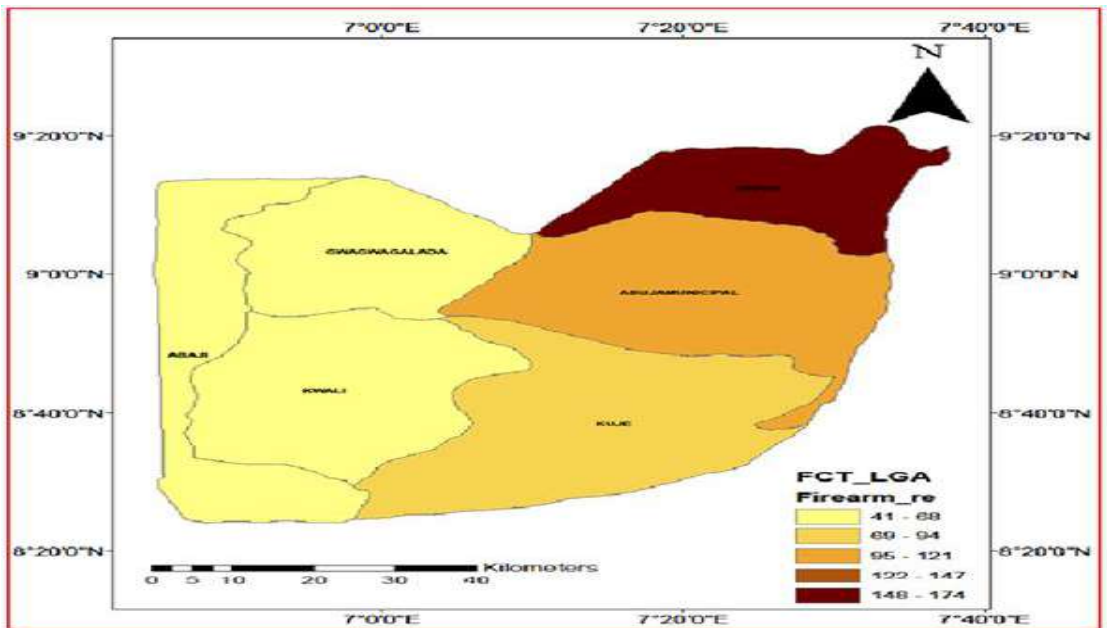


Figure 2: Illegal Firearm Recoveries in FCT, 2020-2024

From Figure 1.1 it can be seen that there are a lot of illegally possessed firearm in Abuja municipal

area council, this trend is not reflected in the recoveries of firearms. It is apparent from a visual analysis that only 103 firearms were recovered out of 254 (40.55%) illegally possessed firearm in Abuja Municipal as compared to the recovery of 149 out of 174 (85.63%) reported cases of illegal possession of firearm in Bwari local council. Once again there are a number of possible reasons for the change in pattern. Property crimes, of which firearm crime is one type, are more characteristic of areas with middle to higher economic status. In FCT, criminals who most likely live in out sketch of the city central for example Bwari may likely come from that area to commit crime in city center and then return home to the satellite town where firearms are more commonly recovered. This trend is supported by Figure 3 which shows the recoveries of firearms in FCT. Note that not all firearms recovered in FC T were involved in crime.

Table 3 Total recoveries of firearms in FCT, 2020- 2024

Local Council	Number Recovered
Abaji	53
Abuja Municipal	103
Kuje	95
Bwari	149
Gwagwalada	3
Kali	51

Table 4 Total Recoveries of Firearm that were involved in Crime, 2020 to 2024

Involved in Crime	Total	Percent
Yes	308	60.00%
Violent	103	20.03%
No	30	5.84%
Suicide	53	10.31%
Attempted Suicide	20	3.89%
All Recoveries	514	100%

Tables 3 and 4 present the statistics on firearm recoveries and their involvement in crimes. Just over half of the 514 firearms recovered by the Nigeria Police Force were actually involved in a crime. These numbers still only reflect the firearms recovered by the Nigeria Police Force and do not account for any of the firearms that were never reported. The Figure 3 showed a strong likelihood that a firearm, after being illegally possessed, will eventually be used in the commission of a crime.

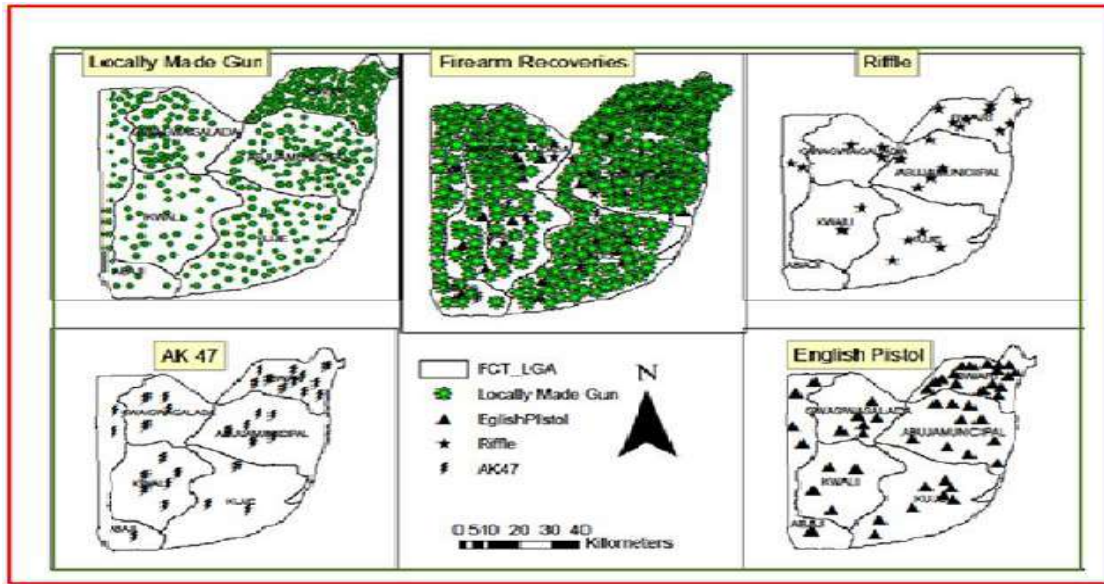


Figure 4: Illegal Firearm Recoveries in FCT by types of firearm, 2020-2024.

Table 2 and Figure 4 show that locally made guns are the most commonly illegally possessed firearm. The rate and distribution of locally made gun recovery both suggest that locally made guns are, by far, used much more in crimes. This is most likely explained by their concealable and light weight nature in addition to having a lower cost.

3.1.3 Average Nearest Neighbour Analysis

Table 5: Average Nearest Neighbour Results

Dependent variable	Observed mean distance	Expected mean distance	ANN Ratio	Z -Score	P- Value	Remark
Illegal possessed firearm	2195.019	2278.008	0.9635	1.4882	0.1366	Clustered
Firearm Stolen and Recovered	8093.950	6696.908	1.2086	2.1858	0.0288	Dispersed
Recovered Firearm	1847.032	2141.591	0.8624	-5.9364	0.0000	Clustered

Firearm Recovered that are involve in crime	2195.019	2278.008	0.9635	-1.4880	0.1366	Random
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The Average Nearest Neighbour (ANN) analysis showed different distribution for all four-point datasets: illegally possessed firearms, firearm stolen and recovered (from the stolen recovered dataset), firearm recoveries (from the recovered firearms dataset), and firearms recoveries that were involved in crime (from the recovered stolen dataset). Conversely, results from the average nearest neighbor analysis of the four-point dataset revealed that illegally possessed firearm and recovered firearm were clustered, as shown in (Figures 5 and 6). While the distribution of firearm recovered that were involved in crime is random (Figure 7) and Firearm stolen and recovered is dispersed (Figure 8)

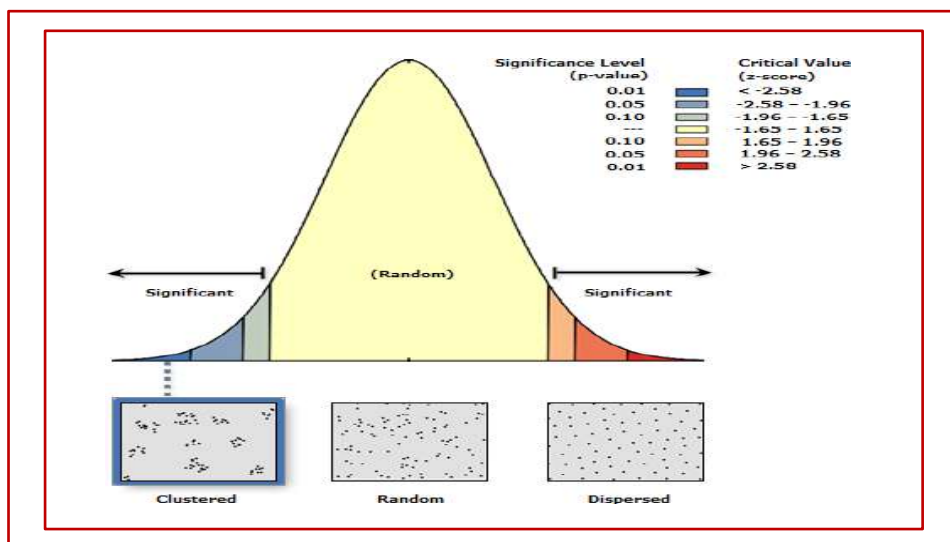


Figure 5: Average Nearest Neighbour Analysis of Illegal Firearm 2020 to 2024

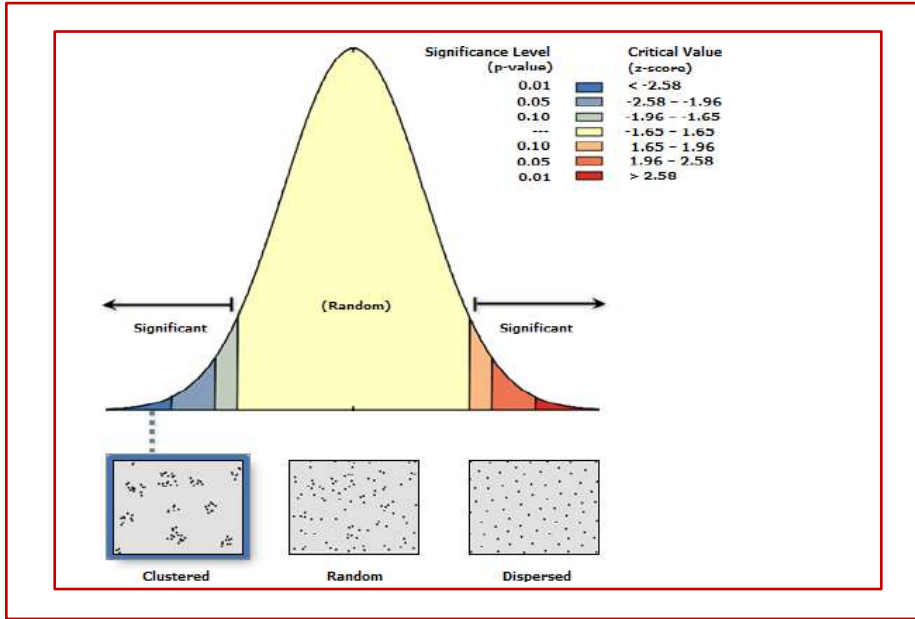


Figure 6: Average Nearest Neighbour Analysis of Recovered Firearm in FCT, 2020 to 2020

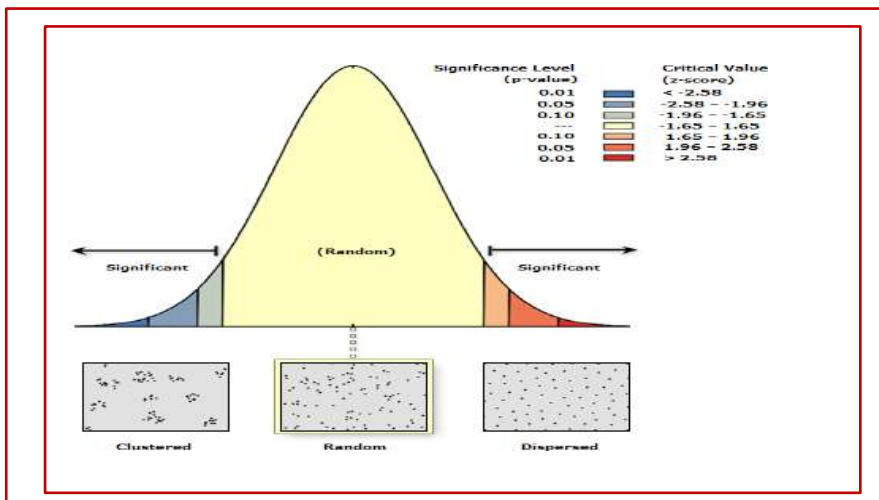


Figure 7: Average Nearest Neighbour Analysis of Recovered Firearm that were Involved in Crime in FCT, 2020 to 2024.

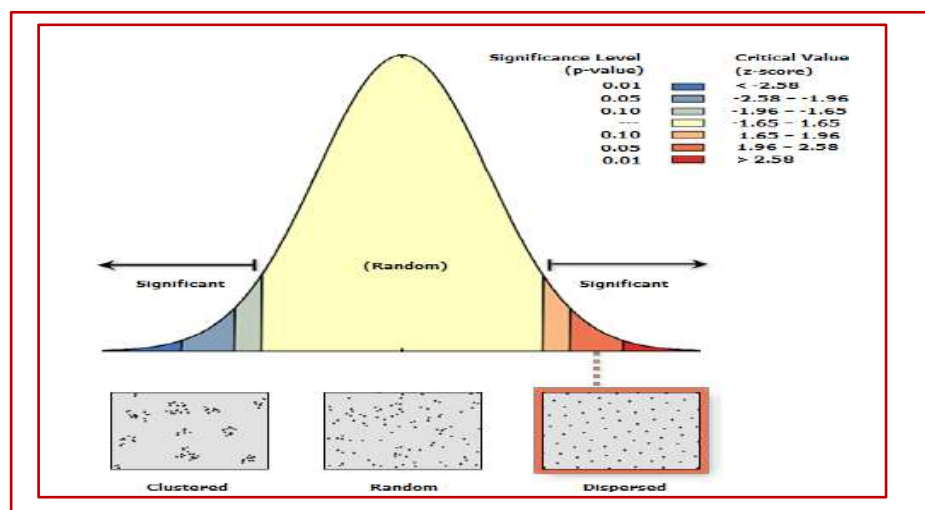


Figure 8: Average Nearest Neighbour Analysis of Firearm Stolen and Recovered in FCT, 2020 to 2024

4.0 Conclusion

The use of Average Nearest Neighbour Analysis in firearm and crime management in FCT has been applied. With right condition and cooperation from relevant authority, average nearest neighbour analysis can be used to solve problems by identifying locations of firearm recovery and examining changes in illegal firearm possession and recovery with the intent to reveal the factors leading to such crimes and how they can be effectively managed. With average nearest neighbour analysis, police and other law enforcement agencies can create maps which shows scenes of crime this could be used to forecast and map out strategies for combating crime. The study therefore, recommends that: the average nearest neighbour analysis and GIS methodologies should be integrated in fighting crime, as this will enable the creation of geo data base to reduce ineffectiveness and create automated police field operation and increase the effectiveness of crime fighting generally.

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