# GEOSPATIAL ASSESSMENT OF POLICE INSTALLATION LOCATIONS IN OYO TOWN, OYO STATE, NIGERIA

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## Abstract

*Evaluation of the locations of security agency installations in relation to the areas they cover is a critical aspect of enhancing national security integrity. This study employed Geographic Information System (GIS) methods to assess the distribution of police divisions/stations in Oyo Town, Oyo State, Nigeria. Data on the locations of these police divisions/stations were acquired using Global Positioning System (GPS) technology. An administrative map of the research area was provided by the Ministry of Land and Survey, Oyo State, serving as the base map for analysis. Descriptive statistics, including frequency and percentage, were utilized to analyze the data. To determine the distribution pattern of police divisions/stations and assess their coverage area, Nearest Neighbour Analysis (NNA) and buffer operations conducted, respectively. The findings revealed a total of 11 police divisions/stations, with Afijio Local Government Area (LGA) housing five police installations accounting for 45.45% while Oyo West LGA had only one police division (9.09%). Settlements such as Akinmorin, Atiba, Ojogbodu, Durbar, Ilora, Iyabode, Awe, and Jobele received adequate police coverage. However, the majority of settlements in the extreme northern regions of the study area lacked sufficient police infrastructure. Additionally, a significant dispersion of police divisions/stations was observed, with a Nearest Neighbour Ratio of 1.61 at a significance level below 0.01%. Consequently, this study recommends that police authorities increase the number of police stations in the underserved northern parts of the study area to enhance security provision.*

**Keywords**: *Security, Police Installations, Buffer Operation, Nearest Neighbour Analysis and Oyo Town.*

## Introduction

The rapid expansion of urban areas has significantly increased the demand for security personnel and police facilities to secure various neighbourhoods (Cheng & Chen, 2021; Khaliji & Jafarpour Ghalehteimouri, 2024; UN-Habitat, 2011). This demand has led to the establishment of more police stations in Nigerian urban centers, aiming to improve socioeconomic growth and attract investors. As Nigeria experiences rapid economic development and population growth, the need for public services in cities has intensified (Ojo & Ojewale, 2019; Ukwayi et al., 2017). However, insecurity has become a major obstacle to urban development, with public resources increasingly directed toward enhancing security in both urban and rural areas (Akinyetun et al., 2023; Ikechukwu, 2018; Momoh et al., 2018). The police force plays a crucial role in maintaining internal security in Nigeria and is considered one of the Federal Government's essential services.

Numerous studies emphasize the importance of strategically placing police stations to ensure public safety and social stability (Boivin & de Melo, 2023; Ndakotsu, 2023). Police stations are fundamental to Nigeria's public security framework, tasked with preventing and managing incidents related to public safety (Adegoke, 2014; Iheriohanma et al., 2020; Mangai et al., 2022). The effective location of police installations in relation to population growth is crucial for enhancing law enforcement and community safety (Elsheikh, 2022). Geographic inequities in the distribution of police stations can lead to inadequate public security, thereby jeopardizing the safety of residents and their property. The current landscape of policing in Nigeria reveals significant challenges, including the lack of accessible geo-location data for many police stations (Daukere et al., 2020). This absence hinders effective security analysis and limits citizens' access to essential services. Moreover, there is often a mismatch between areas with high rates of violent incidents and the number of police stations available, resulting in either an over-concentration of police facilities in safer areas or a scarcity in high-crime zones. Regions such as Oke-Ogun in Oyo State exhibit a disproportionate number of police stations relative to their  crime incident rates (Olaniyi, 2020). This discrepancy raises questions about the allocation of police resources and suggests that the presence of police facilities may not be effectively aligned with actual security needs in this and other areas across the country.

According to a recent report, 60% of urban dwellers in developing countries have experienced criminal activity, with victimization rates reaching 70% in some cities (Cheng & Chen, 2021). In Nigeria, over 134,000 criminal offenses were reported to the Nigeria Police Force (National Bureau of Statistics, 2018), with Lagos State accounting for the highest percentage of these cases at 50,975 (37.9%). Recently, Nigeria has faced a historically high rise in crime rates affecting all parts of the nation, including Oyo State, where incidents of violence have been reported, such as the recent arrests of alleged assassins linked to an Oyo State hotelier (Feyisipo, 2022). Afolabi (2019) noted that despite various security measures implemented by the government, insecurity and criminal activities continue to escalate alarmingly. Addressing these rising crime concerns necessitates an understanding of the relationship between police facilities and population growth, as well as the individual characteristics of those engaging in illegal activities.

Research indicates that rising criminal activity is a significant social issue in modern society, particularly in developing countries, where factors such as poor infrastructure, inadequate police facilities, and low police staff-to-population ratios exacerbate the problem (Adeolu, 2019; Ahmed et al., 2013; Ajala & Owabumoye, 2018; Blessing & Braimoh, 2019; Canter & Youngs, 2016; Stassen & Ceccato, 2019).  For example, Adeolu (2019) employed Geographic Information Science (GIS) to analyze police station locations and crime hotspots in Ikeja, Lagos, revealing that many residents had to travel over 2 kilometers for police services despite most crime hotspots being within 1 kilometer. This study concluded that simply situating police stations near crime scenes is insufficient; effective crime reduction also requires adequate policing equipment. Supporting this view, Ahmed et al. (2013), found disparities in police service coverage in Kano, highlighting the need to consider population distribution when planning police station placements to enhance security.

In another study, Ajala & Owabumoye (2018) utilized GIS to analyze the impact of police station placement on crime rates in Akure, southwestern Nigeria. Findings indicated a significant relationship between crime rates and distance from police stations, showing that crime rates tended to increase as the distance from these stations increased. Additionally, the study revealed a clustered pattern of crimes concentrated around central areas where police stations were located; suggesting that proximity to law enforcement may influence crime distribution. However, the study's reliance on secondary crime data raises concerns about potential inconsistencies. If the data used were outdated or inaccurately reported, this could skew the results and lead to misleading conclusions about crime patterns. Similarly, Rahmani et al. (2014) examined optimal police station placement in

Qazvin, Iran. Their analysis also faced limitations in accounting for the dynamic nature of crime, particularly its relationship with urban development and population changes over time. This suggests a need for more comprehensive methodologies that include detailed geographic coordinates for police facilities and a systematic approach to data collection. Such improvements are essential for conducting significant analyses of spatial patterns that could inform better policing strategies and enhance public safety.

In Nigeria and other developing African nations, overlapping police facilities and services result in wasted resources (Ahmed et al., 2013). A deeper understanding of the spatial optimization of police stations is essential for reducing criminal incidents (Jiang et al., 2022). Urban regions face increasingly complex challenges due to rapid population growth and changing land use patterns (Ukwayi et al., 2017). Evaluating the relationship between police presence and population growth in Oyo Town is necessary to address insecurity arising from urban expansion and traffic conditions that complicate access to police services. Despite this need, no study has systematically examined strategies for selecting police station locations relative to different types of settlements in the area. As a result, this study is aimed to assess the location of police stations in Oyo Town, Oyo State, Nigeria, using GIS methods. The specific objectives were to locate and map the existing police stations within the study area, determine the buffer zones around these stations and analyze the spatial patterns of police facilities within the study area.

**Description of the Study Area**

The study area is Oyo Town in Nigeria's Oyo State. The study area is one of the state's largest towns and has a long history that stretches back to the 12$^{th}$ century, when it served as the capital of the Oyo kingdom (Jiboye & Ogunshakin, 2010; Oluwatoyin & Oludare, 2021). The research area is situated between Latitudes 7$^{o}$ 38′N and 8$^{o}$37′N of the Equator and Longitudes 3$^{o}$40′E to 4$^{o}$9′E of the Greenwich Meridian (Figure 1). The four Local Governments Areas (LGAs) that make up Oyo Town are: Afijio, Atiba, Oyo West, and Oyo East (Jimoh et al., 2018). There are two distinct seasons in the region: the wet season and the dry season. The rainy season, which runs from April to October, is known as the "wet season," while the "dry season," which runs from November to March, is known for its hot weather. With a combination of forest and savannah vegetation, the study area is situated in the derived savannah zone of Oyo State (Ufoegbune et al., 2011).

The population dynamics of Oyo Town and its surrounding local government areas (LGAs) reveal significant demographic characteristics. According to the 2006 National Population Census, Afijio has a population of 134,173, Oyo East LGA has 124,095, Oyo West LGA has 136,457, and Atiba LGA has 168,246. The total area of the study region is approximately 3,149 km², and based on projections from the 2006 census to 2023, the population of the area is estimated to be 997,596 (Table 1). The predominant ethnic group in this region is the Yoruba, with Oduduwa, a member of the Oyos subgroup, recognized as their common ancestor (Jiboye & Ogunshakin, 2010; Oluwatoyin & Oludare, 2021). Historically, the Oyos have been the principal ethnic group within the Oyo Empire. Oyo Town is also home to several higher education institutions, which contribute to its educational landscape. Notable institutions include the Government Technical College, Emmanuel Alayande College of Education, Federal College of Education (Special), Federal School of Surveying, and Ajayi Crowther University. These educational facilities play a crucial role in shaping the community and addressing various social issues, including crime and public safety. Understanding the relationship between population distribution and police facilities is essential for enhancing security measures in Oyo Town.
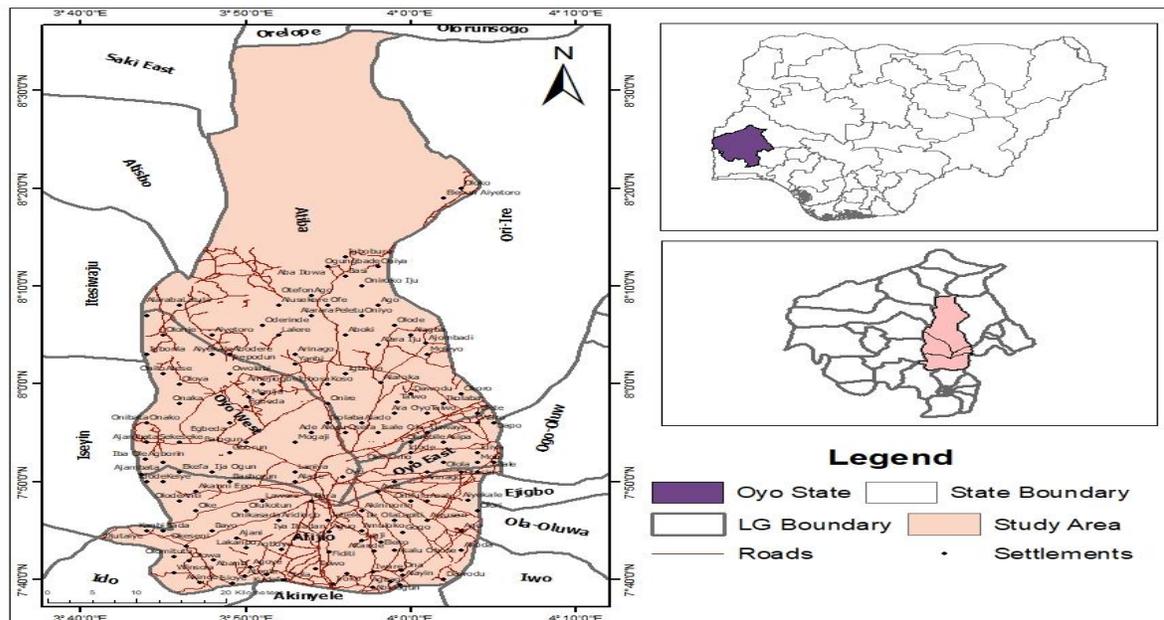
**Figure 1: The Study Area**
**Source: Adapted from the Administrative Map of Oyo State**

## Materials and Methods

For this study, both primary and secondary data were utilized, categorized into attribute data (characteristics of spatial features) and spatial or geometric data (the geographical locations of features). A Global Positioning System (GPS) device (Mreno 120, Garmin) was used to acquire the geographic coordinates of police facilities in the study area. This point data was stored as CSV (comma-delimited) files in Microsoft Excel before being used to illustrate the spatial distribution and patterns of the police installations. The files were subsequently imported into ESRI's ArcGIS 10.8 software for geospatial analysis and overlaid on a geo-referenced map of the study area. Secondary data included an administrative map of the research area obtained from the Ministry of Land and Survey, Oyo State, which guided the field survey, while the names of the police installations were collected during the survey. To extract local road networks, imagery from Google Earth and Bbbike was downloaded. A geo database was utilized to organize both the spatial and attribute data. The analysis focused on the geographic distribution and organization of police facilities across the study area's four LGAs: Afijio, Oyo West, Oyo East, and Atiba.

The geographic coordinates of police facilities were utilized to create a map illustrating their distribution across the study area. To assess the coverage area of each police installation, buffer operation tool in ESRI's ArcGIS 10.8 was used to determine the distances between the stations and other locations, as well as to identify the settlements they serve. Although Nigerian police stations do not have a defined citation distance, a 2 km buffer was established to indicate areas that are fully served versus those that are not. For example, Emengini et al. (2017) employed buffer zone analysis with distances of 1 km and 2 km to show that certain areas in Bauchi Metropolis are adequately served by police facilities. Similarly, Fondevila et al. (2021) used buffer zone analysis to examine crime distribution within 100 m of the nearest police station in Buenos Aires, Argentina.

To examine the spatial patterns of police installations in the research area, the Nearest Neighbour Analysis (NNA) method was employed. This approach helps determine whether the distribution of police facilities is dispersed or clustered. The Mean Nearest Neighbour distance is divided by the Expected Nearest Neighbour distance to derive the index. Specifically, if the index is less than 1.0, it indicates a geographically concentrated pattern, whereas an index greater than 1.0 suggests a dispersed pattern (Philo & Philo, 2021). The analysis utilized both the nearest neighbour index (I) and the standard normal variate (Z-Score) to assess the average distance between the randomly generated data and the actual data. The nearest neighbour index is calculated using the following formula:

$$I = \frac{D_r}{D_h} - - - - - - - - - - 1$$

Where:

$D_r$ = the calculated average distance of the real (observed) data

$D_h$ = the average distance of the imaginary (expected) data

The $D_r$ and $D_h$ are compared using the Z-Score. The null hypothesis states that the distribution of police stations in the research area is randomly distributed rather than clustered or dispersed. The Z-Score is a statistical significance measure whose value is crucial in determining whether to accept or reject this claim (Bajjali, 2019). If the Z-Score is less than the value of the stated confidence level, which is 95% (-1.96), the null hypothesis will be rejected and the alternative hypothesis will be accepted, suggesting that there is either a clustered or dispersed pattern. Moreover, a negative Z score indicates clustering, while a positive one indicates dispersion or evenness.

For the four LGAs of Oyo town, the figures of the 2006 population census were utilized, and projections were made through to 2023. The projection was based on the Newman's (2001) formula thus:

$$P_n = Po + (\frac{1 + R}{100} \times Po)\, n - - - - - - - - - - 2$$

Where: $P_n$ = recent year population, $Po$ = base year population, $R$ = annual growth rate of Oyo State (3.55% in 2023) and n = figure of intermediate years (2023-2006 = 17).

**Results and Discussions**

**Spatial Distribution of Police Divisions/Stations in Oyo Town**

The distribution of police divisions and stations in Oyo Town reflects a significant variance across its LGAs, as illustrated in Table 1. The findings indicate that there are a total of eleven (11) police installations, which include six police divisions, two police stations, one police post, one area command and a monitoring police unit within the study area. Notably, Afijio LGA stands out with the highest concentration of police facilities, accounting for five installations, or 45.45% of the total. These include three police divisions, one police station, and one police post. This is particularly significant given its projected population of 237,956 in 2023, highlighting an increasing demand for security as the population grows with increasing influential people. Despite having one of the smallest populations among the LGAs, second only to Oyo East, Afijio is characterized by several developed neighbourhoods where these police installations are strategically located. This historical context can be traced back to the establishment of colonial administration offices and native authority structures in the area, which might have influenced the current distribution of police installations.

In contrast, Oyo West LGA has only one police facility (9.09%), despite a substantial population of 241,615.  This disparity raises concerns regarding the adequacy of police resources to meet the security needs of its residents. Similarly, LGAs such as Atiba and Oyo East have experienced notable population increases, with populations of 298,384 and 219,641, respectively, yet they maintain only two and three police facilities, respectively. This limited police installations may contribute to rising crime rates if these resources do not expand in line with population growth. These findings are in line with those of Adewale & Kehinde (2023), who discovered that there is an urgent need for improved policing strategies in response to urbanization and demographic shifts because the police-to-population ratio falls short of the UN-recommended threshold of 1:450.

The area sizes of the LGAs in Oyo town vary significantly. For example, Atiba covers a substantial 1,757 km², while Oyo East spans only 144 km². This discrepancy in size indicates that larger areas may require more police facilities to manage crime and ensure public safety effectively. The distribution of police stations in relation to area size further underscores potential gaps in coverage. For example, while Afijio LGA encompasses an area of 722 km² and hosts five police facilities, Oyo West LGA, which covers 526 km²—approximately 72.91% of Afijio's area is served by only one police division. This disparity in police presence relative to area size may impact the effectiveness of law enforcement in Oyo West. The contrast between these two LGAs highlights the importance of considering both population density and geographic coverage in assessing police resource allocation.

**Table 1: Number of Police Installations and Population Distribution in Oyo Town**

| S/No | LGA | No. of Police Divisions/Stations | Percentage | Population 2006 | Population 2023 | Area (km²) |
|------|-----|-----------------------------------|------------|-----------------|-----------------|------------|
| **1.** | Afijio | 5 | 45.45 | 134,173 | 237,956 | 722 |
| **2.** | Atiba | 2 | 18.18 | 168,246 | 298,384 | 1,757 |
| **3.** | Oyo East | 3 | 27.27 | 123,846 | 219,641 | 144 |
| **4.** | Oyo West | 1 | 9.09 | 136,236 | 241,615 | 526 |
| | **Total** | **11** | **100.00** | **562,501** | **997,596** | **3,149** |

**Source: Authors' Analysis (2023)**

Figure 2 illustrates that the majority of police stations are located within the urban neighborhoods of the research area. However, settlements situated outside the city center receive relatively limited police services. Towns such as Atiba, Ojogbodu, Durba, Ilora, Awe, and Jubilee are among those that are well served by police facilities. These findings indicate that the central region of the research area is where most police stations are concentrated. The concentration of police stations in these central areas cannot be fully explained by Christaller's central place theory, which posits that the location of services is determined by factors such as community sense, population density, accessibility, and proximity, while considering threshold and range. Instead, this concentration may be attributed to historical factors, including the presence of former colonial administration offices and the seat of native authority. Additionally, influential individuals and officials, higher education institutions, economic development, and various commercial activities contribute to the establishment of police facilities in these regions. These results align with findings from Daukere et al. (2020), who noted that, the presence of higher education institutions, economic development, and commercial activities significantly influence the locations of police facilities. Such factors underscore the need for a nuanced understanding of how historical and socio-economic contexts shape police service distribution in urban areas.
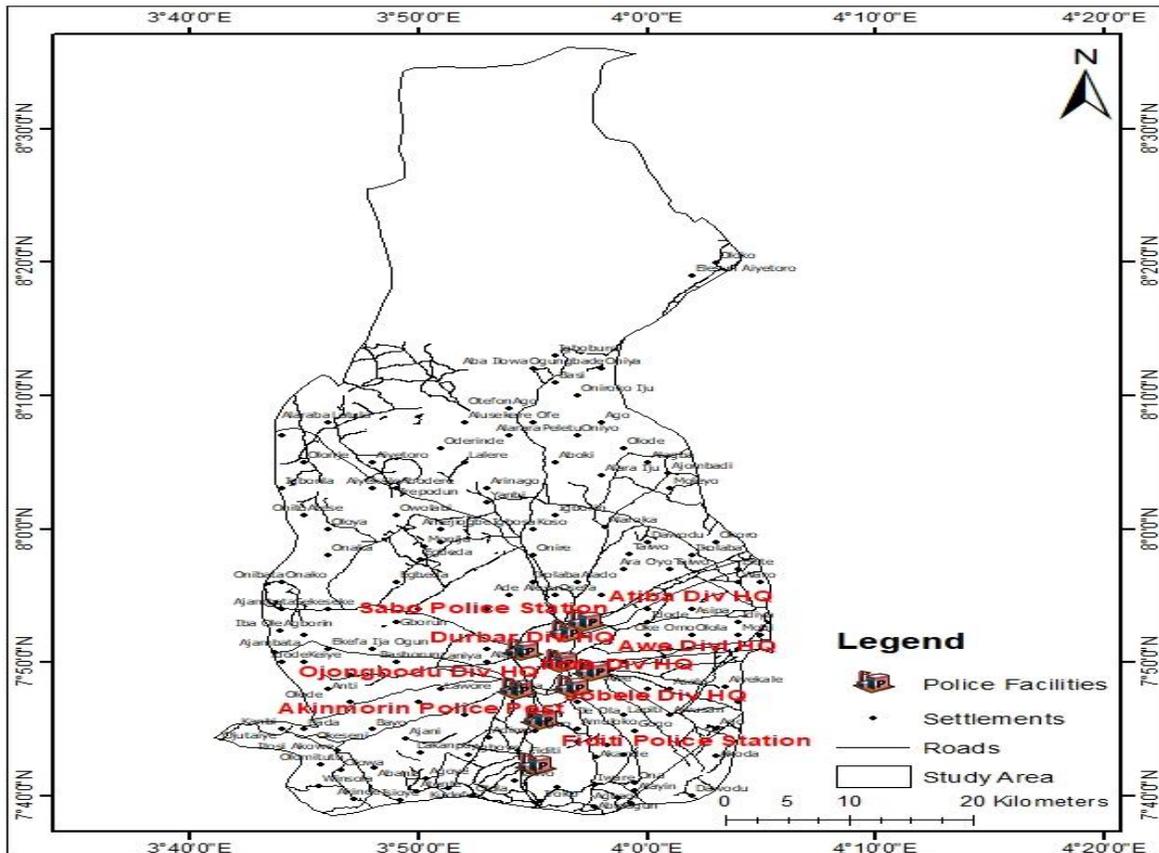
**Figure 2: Distribution of Police Station in Oyo Town**
**Source: Authors' Analysis (2023)**

**Buffer Zones of Police Division/Stations**

The findings illustrated in Figure 3 highlight the establishment of a 2 km buffer zone to categorize locations as either fully or partially served by police facilities. This approach provides a clear visual representation of the areas within the research region that are adequately covered by police stations or divisions, allowing for a better understanding of police accessibility across different neighbourhoods. According to the findings shown in Figure 3, the settlements of Akinmorin, Atiba, Ojogbodu, Durba, Ilora, Iyabode, Awe and Jobele are adequately provided with police facilities. However, most communities in the northernmost part of the study area remain underserved. This lack of attention may negatively impact residents' ability to report crimes effectively. Analysis reveals that many residents must travel an average distance of 2.6 square kilometers to reach the nearest police station, which may discourage them from seeking help or reporting crimes to the police. These findings suggest that the principles outlined in the central location theory, which explains the placement of central service bases based on community needs, accessibility, and population density, may not fully explain the current location of police facilities. Rather, local decisions by police planners may be influenced by historical factors and socio-economic conditions in a particular area. Furthermore, these findings is consistent with those of Ahmed et al. (2013) who reported that some residents in Kano Metropolis had to walk more than two kilometers to reach the nearest police station. This raises broader issues regarding police access in different parts of Nigeria and highlights the need for strategic planning to improve service delivery in underserved areas.
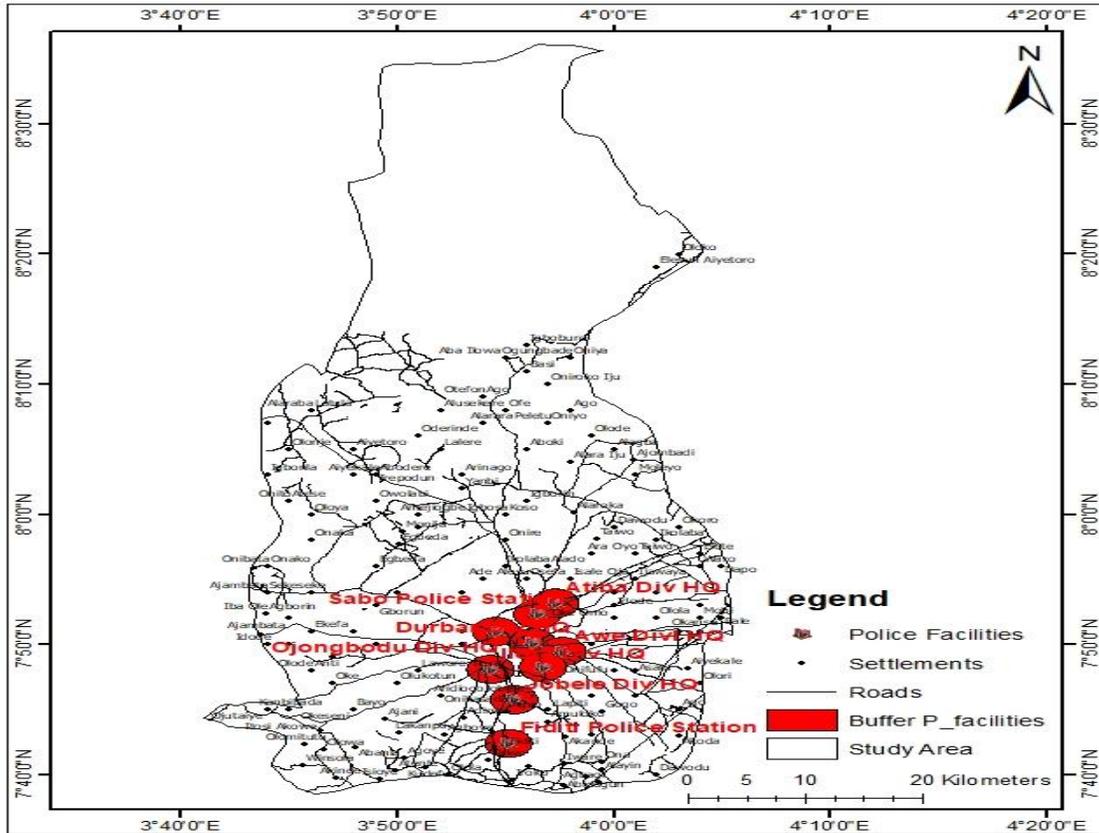
**Figure 3: Buffer Zone Analysis of Police Installations in Oyo town**
**Source: Authors' Analysis (2023)**

## Spatial Pattern of Police Facilities in Oyo Town

The NNA approach was employed with the null hypothesis that the police stations were allocated at random among the study area's 4 LGAs. The NNA output technique generated the Hypertext Markup Language (HTML) file with a graphic summary of the outcomes. The results graphs of Figure 3 showed the Observed Mean Distance, Expected Mean Distance, Nearest Neighbour Index, P-value, and Z-Score. The nearest neighbour statistics in this figure revealed that, as opposed to the expected mean distance of 1640.88 meters, the observed mean distance between the police division is 3627.25 meters. The research findings also showed a distributed dispersion of police facilities. Since the p-value was below the 0.05 stipulated level of confidence, the null hypothesis, which showed a dispersed pattern, was accepted. The study area's dispersed pattern of police station placement could be best explained by human influence, the location of the seat of local authority, presence of important individuals and officials, higher education institutions, economic development, and some commerce and offices of both public and private entities in particular places than others. These results did concur with those of Daukere et al. (2020), who found that the spatial distribution pattern of the police divisions/stations was dispersed (Z -score = 2.76; p-0.05) in the Sagbama LGA of Bayelsa State, Nigeria.
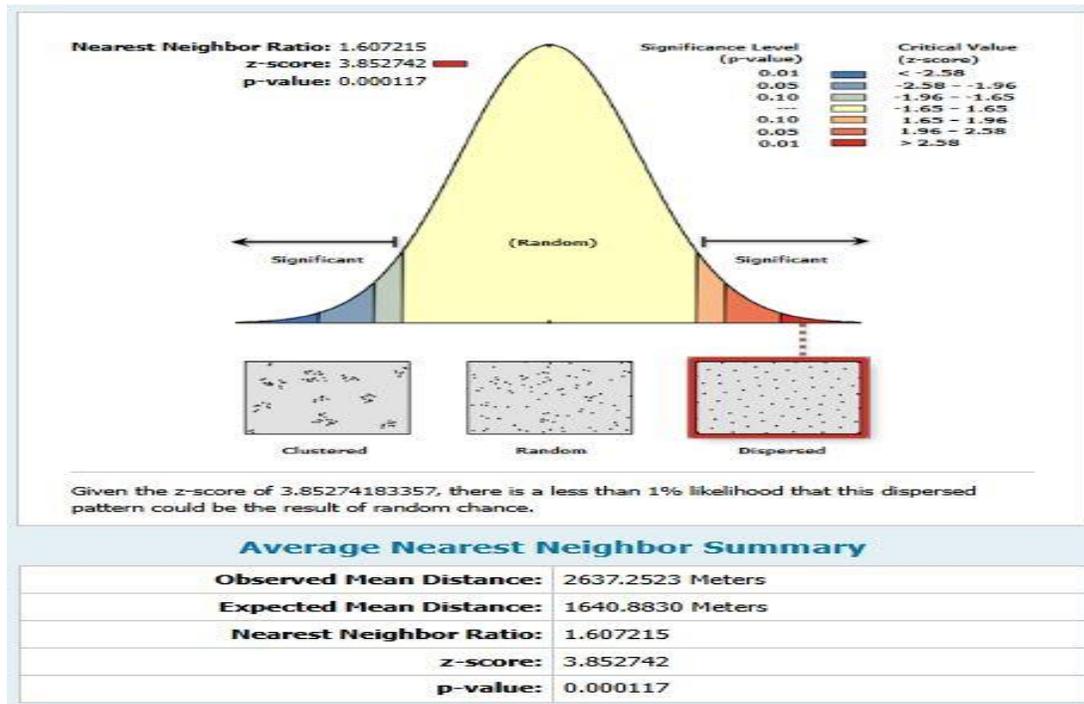
**Figure 4: Spatial Pattern of Police Installations in Oyo Town**
**Source: Authors' Analysis (2023)**

In general, given that the generated nearest neighbour index is greater than 1 and the calculated Z-score is positive (3.85) as shown in Figure 3, there is less than 1% chance that the police stations in the study region displayed a disperse patterns and that is not randomly distributed, which was the null hypothesis. The dispersed pattern of the police facility could be the result of inequalities in population distribution, inequalities in the presence of influential people and politicians, variations in industrial development and the presence of government facilities (schools, health care facilities, etc.) in some neighbourhoods than others. The findings suggest that the police will have little or no influence over the study area in which they operate in terms of preventing crime, which is definitely important to highlight. This is because the majority of villages are not covered by police installations. This may be one of the causes for the involvement of other security agents like Vigilantes, Amotekun, and military base Operation Burst in addition to the police's efforts to combat crime in the area.

**Conclusion and Recommendations**

This study analyses the distribution of police installations and population demographics across the four LGAs in Oyo Town, Oyo State, Nigeria. The findings from this study reveal significant disparities in the distribution of police facilities across the LGAs in Oyo Town, indicating a pressing need for strategic improvements in law enforcement resource allocation. With a total of eleven police installations, Afijio LGA stands out with five facilities, serving a projected population of 237,956, while Oyo West LGA, despite having a larger population of 241,615, and is served by only one police division. This imbalance raises concerns about the adequacy of police resources to meet the security needs of residents, especially in light of increasing populations in other LGAs like Atiba and Oyo East. The analysis also highlights that larger areas may require more police facilities to manage crime effectively, as seen in the limited coverage in Oyo West compared to Afijio. Furthermore, the

concentration of police stations in urban neighbourhoods indicates that rural areas, particularly those in the northern part of the study area, remain underserved, which may hinder residents' access to law enforcement services. The observed dispersion of police installations suggests that human factors, such as traditional historical administrative centers and economic activity, significantly influence their placement. This distribution pattern may hinder law enforcement efficiency in areas where residents are forced to travel considerable distances—averaging 2.6 kilometers—to access police services. Overall, these findings underscore the necessity for enhanced policing strategies that align with population growth and geographic considerations to improve public safety and community trust in law enforcement across Oyo Town.

Based on the findings regarding police facilities and population demographics in Oyo Town, the following recommendations are made to enhance public safety and improve the effectiveness of law enforcement:

1. Given the significant disparities in police facility distribution, particularly in Oyo West, Atiba, and Oyo East LGAs, it is crucial for Oyo State Commissioner of Police should request for establishment of additional police stations or posts in the extreme northern part of the study area. The current limited police presence in this area may contribute to rising crime rates as populations grow. Expanding police infrastructure will help ensure that all communities have adequate access to law enforcement services, thereby enhancing public safety and community trust in the police.

2. Policymakers should adopt a data-driven approach to assess and optimize the allocation of police resources based on population density, crime statistics, and geographic coverage. Utilizing GIS can help identify crime hotspots and areas with inadequate police coverage. This strategic planning will enable law enforcement agencies to deploy personnel and resources more effectively, ensuring that they are positioned where they are most needed.

3. To foster better relationships between the police and the communities they serve, it is essential to enhance community policing initiatives. This includes increasing engagement with local residents, establishing feedback mechanisms for community concerns, and involving community members in safety programs. By building trust and collaboration between law enforcement and citizens, communities can become more proactive in crime prevention efforts, leading to a safer environment for all residents.

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