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URBAN LAND USE AND THE SPATIAL TARGETS OF TERRORIST ATTACKS IN MAIDUGURI CITY, NORTHEAST NIGERIA

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This research investigates the relationship between urban land use and terrorist attacks in target locations of Maiduguri, Northeast Nigeria – a city significantly affected by insurgency and urban vulnerabilities. Analysing 402 terrorist incidents recorded between 2010 and 2020, the research identifies critical correlations between land use and attack types. The results revealed that tertiary institutions, motor parks, and Jumaat mosques were the highest risk facilities for bomb attacks, increasing their likelihood by 265%, 205%, and 218%, respectively, due to their capacity to attract large crowds and influence routine activities. Markets and schools were found to be key predictors of armed assaults. At the same time, facilities such as public offices, hotels, and recreation areas demonstrated resilience to bomb attacks, reducing their likelihood by 63%, 90%, and 79%, respectively, due to their controlled access and security measures. Notably, certain land uses, including markets and IDP camps, exhibited no significant correlation with bomb attacks, contrary to expectations. These findings highlight the critical role of urban planning in mitigating vulnerabilities by strategically integrating high-risk and resilient land uses. The study emphasizes the need for urban planners and policymakers to incorporate counterterrorism measures into land-use planning, in order to foster safer and more resilient cities in conflict-prone regions.

Keywords: **land use, Maiduguri city, measures, terrorist attacks, vulnerabilities.**

INTRODUCTION

Urban centres, especially in developing countries, are increasingly vulnerable to the impacts of terrorism, which disrupts economic growth, social cohesion, and security (Beall, 2007; Graham, 2010). Maiduguri, the capital of Borno State in north-eastern Nigeria and the birthplace of Boko Haram, epitomises this challenge (Tar and Ayegba, 2021). Over the past decade, Maiduguri has become a critical battleground between terrorists and state forces, with its urban fabric both a target and a tool for terrorist manoeuvres (Onuoha, 2014; Ezeugo, 2016). The protracted terrorist attacks have claimed thousands of lives, displaced millions, and disrupted livelihoods and urban development (Iweze, 2020; Tar and Ayegba, 2021).

Land uses are the skin coat that defines the activity function of the urban area, as well as the distributing factor of activities (Lynch and Rodwin, 2007). The functions of land use in urban areas include providing identity and image (Silke, 2011), determining population concentration (Medina *et al*., 2011) and determining the routine activities of dwellers (Vilalta and Fondevila, 2021). Land use, defined as the way urban space is utilised for residential, commercial, industrial, institutional, and recreational purposes, plays a pivotal role in shaping urban vulnerabilities and resilience to terrorist attacks (Tillyer and Walter, 2019). Certain land use types, such as densely populated residential areas (Alasdair *et al*., 2020; Kim *et al*., 2022), informal settlements (Pakoz

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and Gun, 2016), crowded marketplaces (Sohn *et al*., 2018), and transportation hubs (Loukaitou-Sideris *et al*., 2002), are often targeted by terrorists due to their high population density, economic importance, and limited surveillance infrastructure. In contrast, well-planned institutional zones, military installations, and controlled-access areas are more resistant to attacks because of enhanced security and restricted entry (O'Brien *et al.*, 2022).

In Maiduguri, rapid urbanisation and weak planning frameworks have resulted in informal settlements that lack essential infrastructure and are challenging to the police (Gusau and Dauda, 2010). These areas often serve as recruitment grounds or operational bases for terrorists. Similarly, bustling marketplaces like Monday Market and Gamboru Market (two of the major markets in the city) have frequently been targeted due to their crowded and chaotic nature, which maximises casualties and economic disruption. For example, 20% of bomb attacks in Maiduguri between 2013 and 2017 occurred in Monday Market, and 27% occurred at the University of Maiduguri (Institute for Economics & Peace, 2019), highlighting their vulnerability due to their status as a major commercial hub and major tertiary institution respectively, with both located on an important transport node. This raises an important question – if attacks occur at these places, what is the motive for such actions since attack targets are symbols embodying land users?

The relationship between land use and terrorist activity is particularly significant in the context of developing countries like Nigeria, where urban planning challenges intersect with poverty, unemployment, and political instability. Poorly planned urban areas often become hotbeds for violence and insecurity, emphasising the need for integrated urban governance and counterterrorism strategies (Drake, 1998). Studies suggest that understanding the urban structure and spatial distribution of attacks can contribute to creating safer and more resilient cities (Sharifi, 2018, 2019). For instance, Boko Haram does not choose its targets randomly; rather, its target selection involves careful consideration of spatial factors to maximise impact (Torres-Soriano, 2019).

This study investigates how different urban land-use types influence the spatial distribution of terrorist attacks in Maiduguri, with the aim of identifying patterns of vulnerability and informing land-use planning strategies that enhance urban safety and resilience in a conflict-prone setting. The findings provide critical insights for urban planners, policymakers, and security agencies to develop strategies that balance development and security priorities in conflict-prone regions. Additionally, this research underscores the importance of integrating land-use planning into counterterrorism frameworks, particularly in fragile urban environments, in order to foster sustainable urban development and resilience.

LITERATURE REVIEW

Concept of terrorist attacks

Terrorism is a persistent urban threat involving politically motivated violence by sub-state actors, such as the Provincial Irish Republican Army (PIRA) in Northern Ireland, the Spanish Euskadi ta Askatasuna (ETA), Basque Homeland and Freedom, Liberation Tiger of Tamil Eelam (LTTE) in Sri Lanka, Alqaeda, and Boko Haram in North-eastern Nigeria (Lafree *et al*., 2012; Chuku *et al*., 2017). These attacks vary in form, including shootings, bombings, assassinations, arson, and kidnapping, and later, tactics like suicide bombings and vehicle-borne attacks. Targets are broadly categorised as iconic, symbolic, or arbitrary, and the choice of place and time is shaped by the attack type and desired psychological impact (Marchment, 2019). In Nigeria, the Terrorism (prevention and prohibition) Act (2022) defines terrorist attacks as intentional and malicious actions aimed at intimidating the population, coercing government or international organisations, or seriously destabilising political, economic, or social structures (Okoye, 2021). The law emphasises both the intent and consequences of such acts, particularly when they endanger human life or result in significant economic or social disruption. The responsibility for fighting terrorism is shared among key security agencies, with the Department of State Services (DSS) and the Nigeria Police Force playing central roles in intelligence, investigation, and enforcement (Olalere and Tunde, 2024). The Nigerian Armed Forces support counterterrorism operations in high-risk areas, while the Office of the National Security Adviser oversees national counterterrorism strategy.

The concept of place

The concept of "place" is complex, shaped by activities, characteristics, and spatial contexts. Cities are exemplified by their layered nature, with transportation networks playing a vital role in defining their structure, connectivity, and identity (Kronkvist, 2022). Kevin Lynch's framework emphasises the importance of transportation corridors in shaping urban environments. The design of streets and networks can influence a city's development trajectory, leading to positive or negative outcomes (Sharifi, 2018). Places within cities are often defined by land use and social dynamics, with slums being characterised by deterioration, social isolation, and high crime rates (Amoako, 2021). Land use patterns influence the spatial distribution of activities and associated risks, including terrorism and social disorganisation. Public places, shaped by socioeconomic factors and security concerns, often form homogeneity or exclusion, creating "islands" of different social groups (Favarin, 2018).

Target locations delineation

Bombs are the most devastating weapons of destruction, both in warfare and terrorism. Improvised explosive devices (IEDs) are widely used by terrorists rather than factory-manufactured bombs due to restrictions on purchasing type, clearance, and transportation. IEDs require expert bombmakers and materials to assemble, and most terrorist bomb attacks involve IEDs like planted bombs, suicide vests, and bomb-laden vehicles (Silke, 2011). The National Counterterrorism Centre and the US Department of Homeland Security have established a template for public safety during a terrorist bomb attack, which covers a mandatory evacuation zone (red zone) accessible only to armed military personnel, and a preferred safe zone for humanitarian workers and the press (National

Counterterrorism Centre, 2007). Bomb attacks are the most studied terrorist attack typology due to their uniqueness and because they make headlines.

Armed assault, assassination, and hostage-taking are similar attacks, due to sporadic shootings. Armed assault involves engaging security personnel at checkpoints, bases, or patrols. Assassination involves capturing symbolic figures through sporadic shooting, while hostage-taking is similar to assassination. These attacks require rigorous intelligence networks and surveillance to track and engage targets. Graham (2010) suggests that sporadic shooting-related assaults should be enclosed in a buffer to prevent free-fire areas. Young's (2016) analysis of officer deaths from 1885-2014 and 2005-2014 found high numbers of officer victims at distances less than 21 feet, and fewer victims at more than 50 feet. Safe zones for armed personnel are tagged at 50 feet.

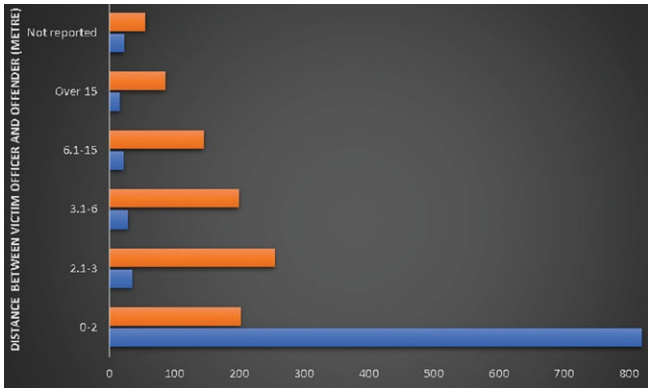

Figure 1. Safe distance for officers in a shoot-out (Source: Young (2016) – modified by the Authors)

Arson attacks involve terrorists setting a target ablaze, often aiming to raze them to the ground or impede their operations. The target area is usually secured by the terrorists to ensure a successful attack. There is no known or documented delineation for areas under arson attacks, but the maximum expected situation can suffice. Arson attacks can be equalised to bomb attacks due to their maximum impact and the use of other methods such as assassination, armed assault, IEDs, hostage barricading, building takeover, and kidnapping (Pfeifer, 2013). Terrorists have found arson attacks advantageous over other tactics due to their potential for mass casualties, economic destruction, and depletion of emergency service resources.

Urban dynamics and terrorist attacks

City development and management require professional skills and rely heavily on standards for urban areas (Coaffee and Rogers, 2008). However, the dynamic nature of urban areas presents challenges, such as terrorism. The human-inclined nature of cities can undermine counterterrorism operations, and environmental features remain major factors aiding terrorist attacks. Therefore, urban planners must adapt to these dynamic challenges to ensure the safety and security of urban areas.

Protecting the city as a whole, therefore, appears unachievable because the "… size of a major city makes it difficult to protect all possible targets, particularly if the range of targets is broad. As long as a terrorist group is operating effectively, it is simply impossible to provide absolute physical protection to the entire transport and commercial structure of a major city. Attempts to do so over the long term would be prohibitively costly and would deplete the resources available to protect specific potential targets" (Drake, 1998, p. 107).

As asserted by Cozens (2011), the urban planner should remain at the forefront of securing the city from terrorist attacks by employing professional expertise and input from security operatives. Since the urban form tends to directly influence city safety or otherwise, it becomes pertinent for urban planners to deploy the right techniques for ensuring city-wide resilience. This can be achieved because "the very design of an urban area may be affected by the desire to hamper terrorists' operations. Such considerations are not new to town planning. The broad, straight Parisian boulevards […] allow charges by the police, infantry, and cavalry to be more effective, and to make it difficult for rebels to erect barricades successfully" (Drake, 1998, p. 109).

Cities face both internal and external threats that need to be managed to ensure their success. Safety is crucial for social and economic progress. Terrorist attack threats can cause panic, damage the social order, and negatively impact economic activities (Li and Wu, 2017). To mitigate these factors, techniques like Crime Prevention Through Environmental Design (CPTED), gated communities, surveillance systems, and architecture of fear can be used. However, creating safer cities may also hinder free flow and public rights. Surveillance systems can be the most inclusive strategy for evading attacks if well incorporated in cities.

Land use and terrorist attacks

Several environmental features have been identified and demonstrated in studies as tending to attract, generate, mar or aid attacks (Kinney *et al*., 2008). These features exist and are tangible in space, and their number is easily estimated. Therefore, the number of available features is collected, no matter how many. The utilisation of geospatial techniques happens to simplify the process of data collection as long as the geolocation of features is ascertained.

Land uses are not always categorised based on their functions, as different features have different influences. Jumaat mosques, which perform the same function as other mosques but have a greater significance for Friday congregational prayer services, are at a higher risk of attack due to their special functional service. Studies have shown that having a few Jumaat mosques concentrated in a place can create more crowds on Friday afternoons and make them a suitable terrorist target (Onat, 2016; Onat and Gul, 2018). Commercial facilities such as pubs, grocery stores, bakeries, shopping malls, clubs, markets, and restaurants are also considered risky. Studies have found that grocery stores, restaurants, offices, and shopping centres have a greater concentration of burglaries (Steinman *et al*., 2020). In San Antonio, Texas, businesses located in block groups, with many commercial uses and high vehicular traffic experience more crime. However, the interaction between busy locations and businesses does not increase crime at business zones outside their major effect as commercial activities (Tillyer and Walter, 2019).

Cities are complex systems that can protect themselves based on the arrangement of land uses. Studies have shown

that schools, bus stops, and police stations can deter burglary in Milan, Italy. In Los Angeles, areas with derelict establishments, empty parking lots, and public storage buildings can foster crime. In Philadelphia, areas exposed to bars and subway stations are positively associated with violence, property and disorder crime types at 400, 800 and 1200 ft thresholds, respectively. Miller *et al.* (2016) found that crime-prone housing is a significant determinant for offenders' rearrest and revocation. Klakla *et al.* (2021) found that crime is highest within an average of 50 meters from monitoring systems. Yusof and Fauzi (2019) found that crime incidences are concentrated close to residential commercial and recreational areas. Kim *et al.* (2022) found that night-time lights, single-person households, disadvantaged neighbourhoods, many companies, and mixed land uses are likely to aggravate theft and sexual assault in South Korea.

THE STUDY AREA

Maiduguri stands as one of the most important cities in North-Eastern Nigeria, with a rich history rooted in the Kanem Borno Empire. The city's establishment at its present location on January 7, 1907, was influenced by the advice of the British, leading to the arrival of Shehu Abubakar Garbai El-Kanemi (Haribarren, 2017). However, smaller settlements, including one called Maiduguri, existed in the area as early as the 17th century. Maiduguri has a vast land-use distribution, with 60% of the developed area being residential. Amidst the residential development, the rest of the support uses include corner shops and other smaller retail activities. A total of 40% of the built-up area is for public use (government offices, schools, recreation centres, among others), as well as commercial and industrial areas. Located between longitude 11°40'N, 11°54'N and latitude 13°4'E, 13°14'E, Maiduguri lies within the Sudan-Sahel transition zone and covers an area approximately 15–18 km long and 11–15 km wide (Waziri, 2009) (see Figure 2). Recent population estimates for 2021, provided by Action Against Hunger in collaboration with the National Emergency Management Agency (NEMA), the International Organization for Migration (IOM), and the Nigerian Bureau of Statistics (NBS), place the population at 1,217,432 (International Office of Migration, 2021).

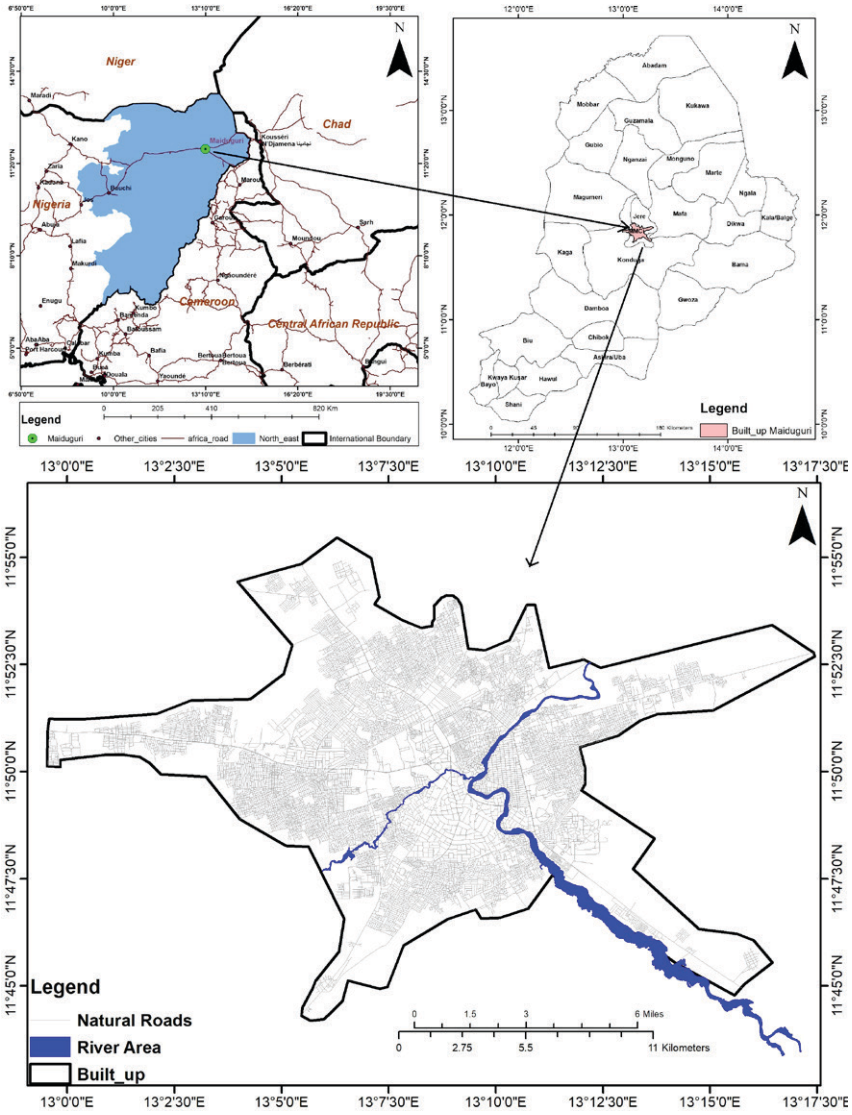

Figure 2. Location and extent of Maiduguri
(Source: OSGOF Admin Boundary data 2020 and direct digitisation by the authors based on Google Satellite Imagery, 2021)

METHOD

Data requirement

Terrorist attack data

Terrorist attack (point) data were obtained from the open-source repository called Global Terrorism Database (GTD, 2025). GTD database provides the point of attack (in longitude and latitude) and its corresponding characteristics like time of attack, casualties, assailants, type of weapon used, type of attack, and attack description, amongst others. After plotting the data, it was discovered that some of the registered coordinates of the locations were inaccurate. Helpfully, the attack description was much more accurate based on sources extracted from electronic and print media (such as all local media houses of Nigeria, the BBC, CNN, and CFI, amongst others) that GTD relied on; and the authors' familiarisation with the study area was also employed. Ground truthing was utilised to ascertain the correct locations since the attack description was found to be correct. A total of 573 attack locations were obtained at first from GTD descriptions. After the correction exercise, only 402 (80%) attacks were found to be authentic and were included in the study. Of these data, 247 were bomb attacks, 100 were armed assaults, 14 were assassination attacks, 28 were arson attacks, and 13 were hostage-taking, making up the 402 cases of terrorist attacks (see Figures 3 and 4). Security personnel were consulted for terrorist attack data to corroborate the GTD data but were unsuccessful.

Figure 4. Road network and attack type distribution in Maiduguri

Administrative boundary and road network data

The administrative boundary of Maiduguri is not distinctively defined. The built-up area of the city was utilised as the basis for delineation. In this regard, two factors were considered for demarcating the extent of the city. Firstly, the trench dug by the military around the city due to the Boko Haram crisis. Even though the basis for the trench is not disclosed, some important fringe settlements were excluded. Secondly, the major factors that determine the extent of an urban area

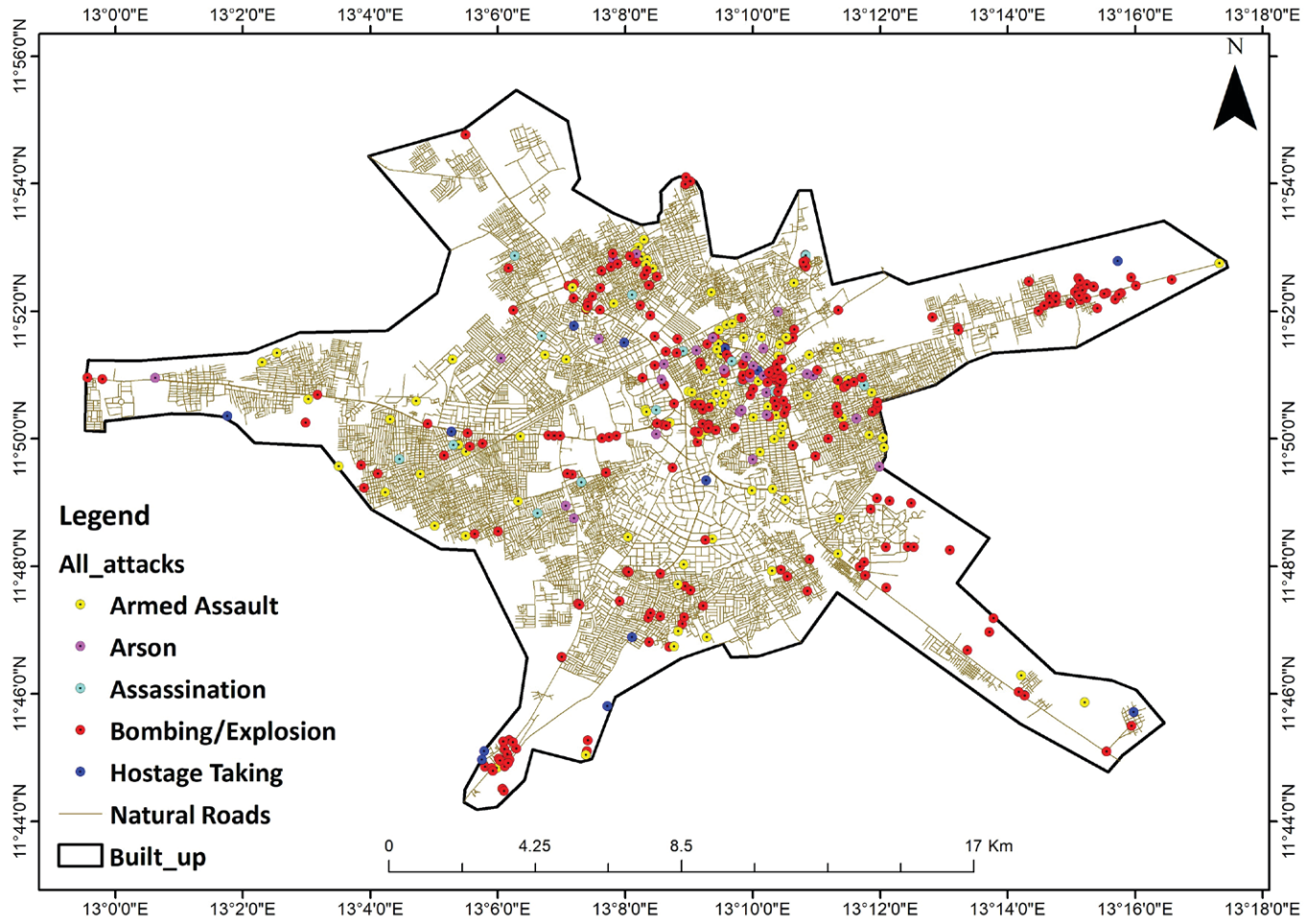

Figure 3. Road network and attack type distribution in Maiduguri

were considered. These are Population, urbanisation, and agglomeration (Mboup, 2019; Hendrigan, 2020). Both the extent and road network of the town were digitised from a high-resolution 0.3 m pixel satellite imagery of the city and environs obtained from the Google Earth repository. The streets were further processed using Axwoman 6.3 (an extension for ArcGIS desktop 10.3.1) to acquire natural roads after removing all isolated streets (Guo, 2019). A total of 7,374 natural streets were obtained. Only 219 (3%) streets in the study area had seen attacks, and these were the ones utilised for the study. Natural streets (roads) are a collection of connected street segments based on the principle of self-best fit, best fit, and every best fit. They are based on the level of connectedness of segments regarding linearity and a small deflection angle. Jiang *et al*. (2008) posited that a deflection angle of 45 degrees is the best. The self-best fit principle was adopted because segments were considered at a small deflection angle (Pung *et al.*, 2022).

Land uses data

Point shapefiles for facilities or spatial correlates were obtained from GRID3 Nigeria. Land uses not provided or partly captured by GRID3 Nigeria were marked and obtained from 0.3 m pixel high-resolution satellite imagery from the Google repository. This was possible because of the researchers' familiarisation with the study area. Unidentifiable features from satellite imagery were captured directly with a GPS-supported Nokia 5.1 plus smartphone. The application Mobile Topographer for Android smartphones, with its high accuracy (as low as 0.1 m), was utilised to acquire the geolocation of features. The application has enhanced inbuilt data collection, storage, collation, retrieval and analysis capabilities (see Table 1).

Data analysis

The locations of land uses were collected with GPS directly through mapping and remote sensing techniques. They were collated by type in individual Excel sheets (.csv format) with their respective coordinates, and converted to shapefiles. We ensured all the shapefiles were in the same coordinate reference system (CRS) for easy merging and plotting. Centroids of the polygons obtained from GRID3 Nigeria were also computed. All the operations were done in ArcGIS 10.3.1 to ensure that shapefiles of all land uses were utilised as points for easy interpolation and display.

Locations targeted by terrorists are established based on the affected area to the line of the safe distance for the press. The safe distance is described as the area around or outside the lethality of the attack that can accommodate non-combatants like press or humanitarian activities during an attack or hostile situation (National Counterterrorism Centre, 2007; Young, 2016). It also refers to areas not impacted by the attack. Bomb attacks (IEDs in Maiduguri) were the most catastrophic attack type, and safe distances based on the National Counterterrorism Centre (2007) standards were established according to the bomb type utilised in the attack. There were a total of 82 planted bomb attacks, 148 suicide bomb attacks and 17 vehicle bomb attacks, respectively, from 2010 to 2020 in Maiduguri. In this regard, buffers were created for the different attack typologies based on the safe distances or zones with the

Table 1. Counts of land uses in Maiduguri

S/N	Facilities	Number	Source
1	Churches	32	GRID3 and Remote sensing
2	IDP camps	125	GRID3 and Remote sensing
3	Other mosques	113	GRID3 and Remote sensing
4	Primary and secondary schools	129	GRID3 and Remote sensing
5	Symbolic targets (traditional chief, top political and religious cleric's residence)	37	Direct collection
6	Private offices	101	Direct collection
7	Hotels	20	Direct collection
8	Shopping outfits/areas	274	Direct collection
9	Jumaat mosques	67	GRID3, Direct collection and Remote sensing
10	Motor parks	14	Direct collection
11	Tertiary institutions	8	Direct collection and Remote sensing
12	Military Barracks	6	Direct collection and Remote sensing
13	Markets	21	Direct collection and Remote sensing
14	Public offices	40	Direct collection
15	Recreational areas	5	Direct collection
16	Banks	19	Direct collection and Remote sensing
17	Paramilitary outfits	22	Direct collection and Remote sensing
18	Derelict buildings	9	Direct collection
19	Uncompleted buildings	562	Direct collection
20	Depression areas/points	10	Direct collection
	Total	1614	

buffer tool. Overlapping buffers were merged as one attack place based on attack typologies. After merging bombs and armed assaults, attacks returned 38 and 97 attack places, respectively. Arson, Hostage-taking, and assassination attacks maintained 28, 13 and 14 attack places, respectively. The latter had attack places equal to the number of attacks because they had small buffer areas. Planted bombs, which can be in bags, briefcases, or projected, among others, were designated for a safe distance of 564 m. Suicide vests carry fewer explosives than planted bombs and were designated a safe distance of 518 m. Vehicle bombs in Maiduguri were in sport utility vehicles (SUVs) and station wagons only. They have the greatest impact because apart from the massive amount they can carry, gas cylinders are also utilised.

Armed assaults and Arson attacks were designated to have a safe distance of 45 m. This is because they have a similar modus operandi. However, Pfeifer (2013) equated arson to bomb attacks because it registers a massive impact and also utilises other attack types. Regarding armed assault, Young (2016) asserted that for armed assault, armed personnel should engage at a distance of 15 m while unarmed personnel should be more than 15 m away. Hostage-taking and assassination also have similar operational strategies. Graham (2010) proposed an enclosed buffer to serve as a safe zone for shootings. For this analysis, 20 m was utilised for the two attack types.

The spatial join tool of ArcGIS 10.3.1 was utilised to count the number of attacks by type and the number of land-use features in each buffer. Attack types were employed as the dependent variable, while land uses were the explanatory variable. By virtue of the nature of the dependent variable being an incident (count) data, descriptive statistics were first run for all attack types to understand the best-fit model for the analysis. This revealed that with the exception of bomb attacks being over-dispersed (variance exceeding the mean), all other attack-type data were under-dispersed (mean exceeding the variance). Negative Binomial regression models were returned as best fit for bomb attacks. Harris *et al.* (2012) suggested a Poisson regression model for under-dispersed and equi-dispersed distributions if the data obeys the rule of thumb (being more than 30 datasets); otherwise, truncated negative binomial regression was utilised. In this case, the other attack-type data were under-dispersed but possessed few datasets, and truncated negative binomial regression is the best fit for them (see Table 2). These models were preferred as a result of their skewed distribution, and they showed the tendency to test countable datasets (Favarin, 2018; Harris *et al.*, 2012; Yue and Zhu, 2019). The best-fit model for each attack dataset is shown in Table 2.

RESULTS AND FINDINGS

This section presents how different land-use types influence the likelihood of terrorist attacks in Maiduguri, by applying regression models to assess the relationship between land use and specific attack types. Table 3 presents the results of a Negative Binomial Regression model used for bomb attacks, while Table 4 displays findings from a Generalised Poisson Regression model for armed assaults. The tables include the regression coefficients, significance values and incidence rate ratios (IRR) to highlight which land-use types are statistically associated with increased or reduced risk.

Table 2. Presentation of best-fit model for analysis

Variable	Arson places	Armed assault places	Assassination places	Bomb attack places	Hostage-taking places
Nature	Under dispersed	Under dispersed	Under dispersed	Over dispersed	Under dispersed
Best fit model	Truncated Negative Binomial Regression	Generalised Poisson Regression	Truncated Negative Binomial Regression	Negative Binomial Regression	Truncated Negative Binomial Regression

Table 3. Negative Binomial Regression model for bomb attacks and land uses in attack places

Land use	Bomb Attacks		
	β	Incident Rate Ratio (IRR)	Sig.
Tertiary institutions	1.2945	3.6492	0.050
Symbolic targets	-0.1111	0.8948	0.772
Military	-0.1822	0.8334	0.795
Mosques	-0.1541	0.8572	0.024
Motor parks	1.1135	3.0451	0.010
Paramilitary	-0.8813	0.4143	0.133
Private offices	0.3752	1.4553	0.044
Primary and secondary schools	0.6522	1.9197	0.050
Public offices	-1.0071	0.3653	0.002
Recreation	-1.5694	0.2082	0.050
Shopping	-0.1197	0.8872	0.169
Banks	-0.1646	0.8482	0.072

Land use	Bomb Attacks		
	β	Incident Rate Ratio (IRR)	Sig.
Churches	-0.4367	0.6462	0.433
Hotels	-2.3057	0.0997	0.029
IDP camps	0.0085	1.0084	0.857
Jumaat mosques	1.1584	3.1849	0.000
Markets	-0.1524	0.8587	0.649
Derelict buildings	1.8594	6.4198	0.126
Uncompleted buildings	-0.0023	0.9974	0.904
Depression areas/points	-0.0003	1.0000	0.471

The likelihood ratio test of α=0 (see Table 3) signifies that the Negative Binomial Regression model is fit for the bomb attack.

As presented in Table 3, tertiary institutions, Mosques, Motor parks, Private offices, Primary and Secondary Schools and Jumaat Mosques were positively correlated with bomb attacks. This result signifies that an increase in the presence of tertiary institutions, Mosques, Motor parks, Private offices, Primary and Secondary Schools and Jumaat Mosques (at α=0) was found to be associated with an increase in bomb attacks. Tertiary institutions, motor parks and Jumaat mosques were returned as the riskiest facilities in bomb attack places. In these places, bomb attacks are more likely by 265% (IRR=3.6492), 205% (IRR=3.0451) and 218% (IRR=3.1849), respectively. There is the likelihood of experiencing 3.64-times, 3.04-times and 3.18-times bomb attacks in such places. These are facilities with global and/or local influences that affect the routine activities of commuters (Brantingham and Brantingham, 1995; Curman *et al.*, 2015). Tertiary institutions and motor parks, apart from their major function, were established as perfect spots for commercial activities, since they are always crowded. Jumaat mosques are similar, except that they are crowded for shorter times on a weekly basis (Friday afternoons). Private offices and primary and secondary schools were returned as lower-risk facilities in terms of their potential for a bomb attack. In these places, bomb attacks are more likely by 45.53% (IRR=1.4553) and 91.97% (IRR=1.9197), respectively. There is a 1.45-time and 1.91-time likelihood of experiencing bomb attacks. Unlike primary and secondary schools, private offices can be single or combined in a complex with few or large employee bases. Private offices have more of a global influence compared to primary and secondary schools. It is not surprising that they are at a lower risk regarding bomb attacks because they keep fewer crowds, have less routine activity, and less time for maintaining crowds at once. The coefficients for Markets, Churches and IDP camps were not significant.

Mosques, public offices, recreation areas and hotels were negatively correlated with bomb attacks. This indicated that a decrease in the presence of Mosques, public offices, recreation areas and hotels (at α=0) was found to be associated with a decrease in bomb attacks. Mosques, public offices and recreation areas were returned as the greatest mitigators of bomb attacks. in these places bomb attacks are less likely by approximately 14.3% (IRR=0.8572), 63.47% (IRR=0.3653), 79.18% (IRR=0.2082) and 90.03% (IRR=0.0997). Being in areas with public offices and hotels have a less likelihood for bomb attacks by 63.48% and 90.03%, respectively.

The likelihood ratio test of δ=0 (see Table 4) signifies that the Generalised Poisson Regression model is fit for armed assaults.

Markets and primary and secondary schools returned a positive correlation with armed assaults. An increase in the presence of markets, primary and secondary schools (at δ=0) was found to be associated with an increase in armed assaults. Markets and primary and secondary schools are more likely to experience armed assaults by 97.8% (IRR=1.9780) and 86.91% (IRR=1.8691), respectively (see Table 4).

Table 4. Generalised Poisson model for armed assaults and land uses in attack places

Land uses	Armed assault		
	β	Incident Rate Ratio (IRR)	Sig.
Mosques	-0.1085	0.8972	0.856
Jumaat mosques	-0.1886	0.8281	0.805
Markets	0.6821	1.978	0.048
Churches	0.0951	1.0998	0.852
Primary and secondary schools	0.6254	1.8691	0.050
Military	0.2195	1.2454	0.709
Public offices	-0.0066	0.9934	0.993
Symbolic targets	0.4428	1.5571	0.158
Uncompleted building	0.1222	1.1076	0.803

DISCUSSION AND CONCLUSIONS

Places have been known to encompass certain activities in space that give them the identity to be recognised (Lynch, 1960; Lynch and Rodwin, 2007). All inhabitants of the city are entitled to this place as it contributes to shaping and determining their routine activities. This study demonstrated the extent to which land uses or facilities within locations targeted by terrorists can predict terrorist attacks. The study findings showed that tertiary institutions, motor parks and Jumaat Mosques are the greatest predictors of bomb attacks in attack places. Given the fact that bomb attacks are perpetrated either by planting, suicide or the use of vehicles (National Counterterrorism Centre, 2007), with the intention of massive damage, these facilities are attractive for such action. Jumaat mosques, unlike other smaller mosques, encourage massive gatherings on a weekly basis. Motor parks and tertiary institutions, apart from pulling crowds, encourage ambient populations. This result supported the findings of Kliot and Charney (2006), which demonstrated that suicide bomb attacks take advantage of agglomerations.

Conversely, markets, IDP camps and Churches were not significantly correlated despite being places of large populations and crime attractors, as shown in studies (Favarin, 2018; Onat and Gul, 2018). Indeed, the number of markets in Maiduguri is considerably lower than that of Jumaat mosques. There are few IDP camps and churches in Maiduguri. Movement in and out of camps is heavily restricted, and mitigating routine activities take place around them. The same applies to churches, except for a single crowded day in the week. Also, selecting them as targets can be exhausted after a small number of attacks. This is not surprising, because a study by Onat (2016) in Spain found bakeries to be stronger predictors compared to shopping areas and public offices, which would have been expected to be number one on the terrorist target list. This is because bakeries define pedestrian routine activities and are the source of bread, which is a major staple food in Spain.

Another significant finding in this study is that mosques, public offices, recreation areas and hotels were found to be mitigators of bomb attacks. This can be attributed to the level of defensiveness created around the facilities. On the one hand, public offices and hotels, including their vicinities, are well-guarded. On the other hand, there are restricted entrances and exits into them. They are enveloped in routine security checks throughout. Hence, public offices and hotels appear to be good mitigating factors for bomb attacks. Kliot and Charney (2006) asserted that access is crucial for aspiring terrorists. In this regard, the presence of encumbrances to targets is a discouragement as it costs more to remove them and overall leads to failed attacks or reduced impacts.

Additionally, mosques were found to be negatively correlated with bomb attacks, while Jumaat mosques are positive. Other Mosques (also called Kamsu Salawat mosques) are utilised only for five daily prayers. They are greater in number, serving and influencing local neighbourhoods. The majority of them hold smaller crowds at prayer times, influencing local routine activities. Jumaat mosques hold much larger crowds and have a global influence. At the same time, they perform the functions of other mosques. It is obvious, therefore, that Jumaat mosques will appear more attractive as a target for terrorist bomb attacks than other mosques.

With regard to armed assaults, markets and primary and secondary schools were shown to be positive crime predictors. It is expected that markets, and primary and secondary schools are very risky areas in a terrorist situation. Apart from defining routine pedestrian and vehicular activities, they also have large crowds. Markets maintain commercial activities throughout the day, giving an extended timeframe for terrorists to attack. At the same time, the large population makes it an attractive target that is liable to bring about mass casualties, as asserted by Medina *et al*. (2011). Primary and secondary school activities take place from morning to the afternoon. They involve a smaller number of people compared to markets, and are therefore expected to have less influence.

None of the facilities were significant for arson, hostage-taking or assassination attacks. From the data utilised for this study's analysis, arson, hostage-taking and assassination attacks were registered for telecommunication facilities and primary/secondary schools. Arson attacks, which are used less frequently than bombings or armed assaults, are often accompanied by shootings to deter or suppress immediate resistance (Pfeifer, 2013). Li *et al.* (2014) asserted that arson attacks are carried out on facilities contrary to a terrorist group ideology or are an impediment to their course. This is an indication that arson attacks are expensive to embark on. In this vein, it is possible to embark on another strategy of attack or replace the typology since cost consideration is an important aspect verified before attacks (Drake, 1998; Gill *et al*., 2018).

Counterterrorism measures should, in this case, go beyond conventional policing with regard to mounting rhythmic checkpoints, barricades, target hardening or frequent patrols to get the job done. Governments have viewed this strategy as a magic wand that has eventually produced unsatisfactory results. New grounds should be explored which will serve as a significant corroborator of the existing strategy. From the findings in this study, land use tends to have a significant influence on terrorist attacks. As a result, urban planners need to go beyond conventional crime prevention (Cozens, 2011) and tackle terrorism in urban at all planning stages (Vogelbacher *et al.*, 2016). Given the nature of cities in developing countries – that are mostly spontaneous and undergoing replanning – the siting and distribution of land uses should occupy the central stage of setting out the structure of the city. Urban planners should not totally rely on standards alone but rather consider the level to which a certain land use can influence attacks. Tertiary institutions and Jumaat mosques for instance, are the riskiest facilities and should be treated as such. Additionally, a combination of land uses should be fundamental factor for distribution in urban space. Land uses that tend to have a repelling tendency for attacks should be sited close to aggravating land uses to create not just harmony but a balance for achieving resilience.

This study has demonstrated how land uses or environmental features influence terrorist attacks in Maiduguri. It is evident that several studies have attempted similar approaches, yielding tremendous results. To the best of our knowledge, studies attempting a qualitative approach to this subject matter appear to be missing in the literature. It would be worthwhile for such an attempt to provide in-depth results for a greater understanding of spatial systems in cities.

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