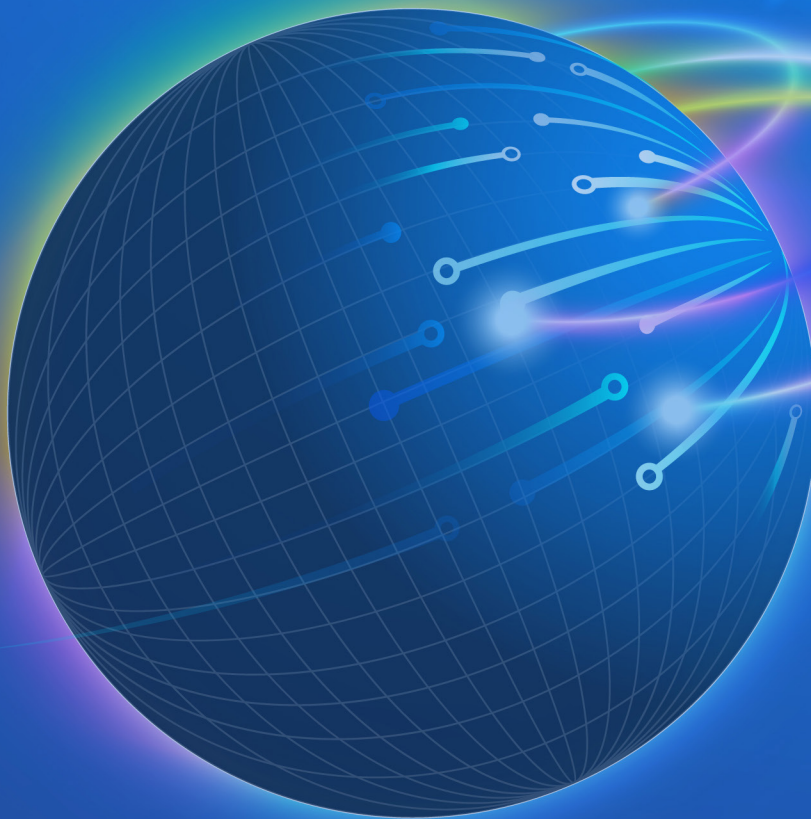




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Assessment of the Distribution of Crimes and Factors Influencing Crime in the Temeke Municipality, Tanzania Using Geospatial Technology

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ABSTRACT

This article assesses the distribution of Crimes at Temeke municipality Dar es Salaam, using quantitative approaches. Both probability and non-probability sampling were applied to get the study area and participants in this study. Data collection was done through participatory mapping, remote sensing, document review, GPS survey, and observation, two sorts of crimes, robbery and burglary were studied in this research. ArcGIS software was used to create hotspot maps, crime patterns, and visualization. Results indicated areas with a high risk of crime, and it increased over time from 2005 to 2022, and spatial factors for crime occurrence, Both family status of people along the study area, economic status, education, poor infrastructure, low living standard and more seen to be factors for crime occurrence. Hence, the spatial distribution of crimes in Temeke municipality is associated with both spatial and spatial factors that lead people to not succeed in their daily life

INTRODUCTION

Across the globe, official reports and data on police-recorded crimes have consistently shown a rise in violent crimes, property crimes, and drug-related offenses from 2003 to 2012, with a notable increase in murders in the Americas (UNODC, 2014). In the 2010s alone, nearly half a million murders occurred worldwide, with 5% in Europe, 31% in Africa, and 36% in the Americas (UNODC, 2013).

The application of geospatial technology in analyzing crime distribution and the factors influencing crime is still in its early stages globally. Only a few countries have begun to integrate Geographical Information Systems (GIS) into law enforcement practices (Ahmed & Salihu, 2013; Yelwa & Bello, 2012). For instance, a study by Schmitz *et al.* (1999) on the use of GIS in policing in Southern Africa showed how law enforcement agencies could improve their operations through crime mapping. Crime mapping helped the South African Police Service (SAPS) solve serial murder cases, such as the Brixton murder and the Dquad robbery, by analyzing cellular data and crime hotspots (Stylianides, 2000). Additionally, Mswela (2019) highlighted that Malawi took a significant step in fighting violent crimes against people with albinism by deploying GPS technology. People in crime hotspots were given GPS devices to assist in tracking and preventing crimes against them. According to Mswela (2019), the integration of automatic monitoring systems has significantly reduced violent attacks against people with albinism in Tanzania.

The application of Global Positioning System (GPS) technology has become essential in both the private and public sectors.

Commercially, GPS technology plays a crucial role in daily activities by providing accurate location information. For over 30 years, organizations like the Tanzania Forest Service (TFS) and Tanzania National Parks (TANAPA) have leveraged GPS technology in efforts to protect endangered species such as elephants and rhinos (TANAPA & TFS, 2018; Tomkiewicz, 1996; TCP, 1998). The national blueprint for 2050 envisions that Geographic Information Systems (GIS) will play a key role in enhancing peace and security operations across the country. In particular, police officers are equipped with GPS-linked devices, allowing them to quickly respond to service calls and efficiently carry out their duties. As noted by Okeyo (2021), technological advancements have opened new doors in the security sector. These innovations are now seen as driving factors behind the distribution of criminal activities and their spatial patterns in Tanzania. GPS and GIS have significantly enhanced the capacity of law enforcement agencies to combat crime and maintain public order. For instance, the installation of closed-circuit television (CCTV) cameras in strategic locations across Dar es Salaam has greatly improved security. CCTV reports have enabled the police to recover stolen goods within three days of the crime. Moreover, real-time crime mapping has become an indispensable tool for police officers. These maps allow law enforcement agencies to plan and execute more effective crime prevention strategies. In light of these developments, a research study was conducted to assess the impact of these technologies on crime reduction, security enhancement and the spatial distribution of crime and factors influencing crime in Temeke municipality, Tanzania using Geospatial technology.

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MATERIALS AND METHODS

Area of the Study

The study was conducted in Kurasini Ward, Dar es Salaam, which was selected due to its higher incidence of offenses compared to other areas in Temeke Municipality, as noted in the Police Report (2019/2020). Kurasini Ward is strategically located near unofficial beaches, marine ports, and dry ports, as indicated by the National Bureau of Statistics (2020). Among the 23 wards in Temeke,

including Mbagala, Chamazi, Charambe, Toangoma, Miburani, Tandika, Keko, Mtoni, Minazini, Mjimwema, and Kijichi, Kurasini was deliberately chosen for its prominence in crime occurrence. Temeke Municipality itself is situated in the southern part of Dar es Salaam, bordered by the Pwani region to the south, Ilala to the west and north, and the Indian Ocean to the east. Geographically, the area lies between 39°12' - 39°33' East and 6°48' - 7°33' South.

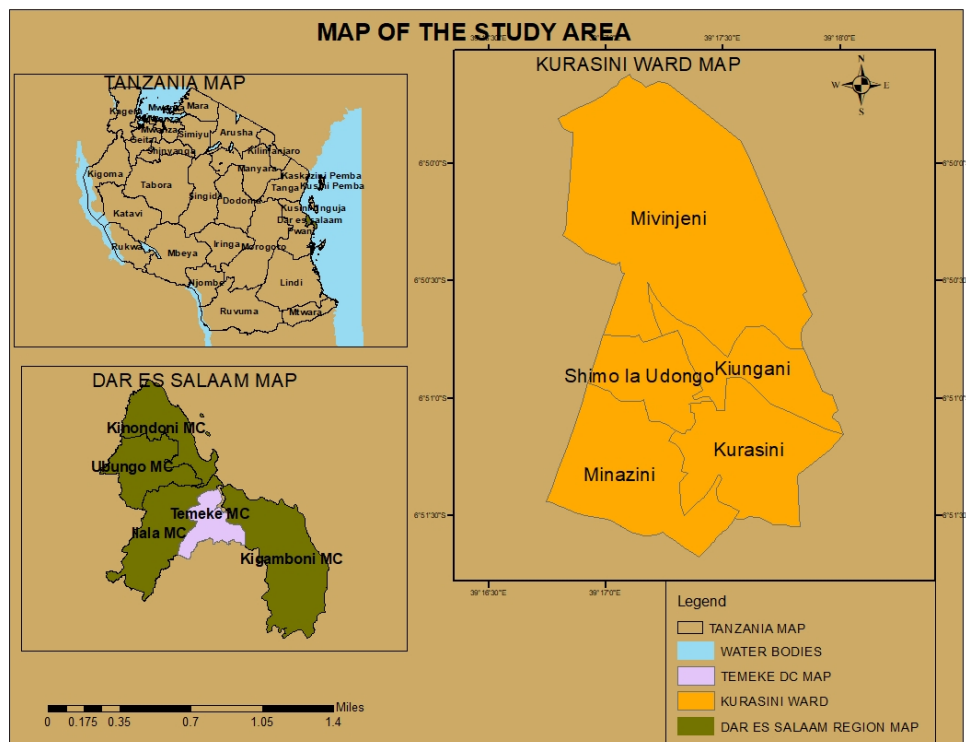


Figure 1: Location of Temeke Municipality and Kurasini ward

Research Design and Sampling

The study utilized a quantitative research design to collect numerical data, enabling a detailed analysis of crime distribution in Kurasini Ward, Temeke Municipality, Dar es Salaam. The specific focus of the study allowed the researcher to target crime-prone areas, offering valuable insights into the relationship between geospatial technology and crime patterns. To gather the quantitative data, GPS and GIS software such as QGIS and ArcGIS were used to analyze spatial data related to crime incidents. The main objective of the quantitative approach was to understand how crimes are distributed within Kurasini Ward. Purposive sampling was employed to select Kurasini Ward, given its reputation as an area with a high frequency of crimes. The target population included detectives from Kurasini, the Ward Executive Officer (WEO), and Street Chairpersons, as they were key stakeholders with access to crime-related data in the area. For quantitative data collection, probability sampling was used to select 84 detectives from the detective unit. The process involved listing the detectives' names, placing them on separate pieces of paper, and drawing 73 pieces

randomly from the basket. This method ensured that 87% of the population was included in the sample, and every detective had an equal opportunity to be selected (Welman, 2001).

Collection of Data

This study utilized both primary and secondary data sources. Primary data sources included community mapping, in-depth interviews, and field observations, while secondary sources encompassed remote sensing, raster data, digitization, and crime-related documents such as investigative journals, reports, and books from the detective department. The diverse collection methods ensured a comprehensive dataset, incorporating all facets of the study, which would have been challenging to achieve with just one method. In community mapping, participants shared their personal experiences and knowledge about the distribution and extent of offenses in the study area, forming the basis for creating crime distribution and hotspot maps. A base map, derived from satellite imagery with appropriate resolution, was used for participatory mapping to

delineate various levels of offenses. A total of sixteen respondents, including detectives, street chairpersons, and a ward executive officer (all with 6-8 years of experience in crime-related matters), were involved in the process. These participants contributed valuable insights on the historical and current occurrences of crimes. During the second phase, participants took part in the mapping activity by marking locations on the map where offenses had occurred and denoting the severity of these crimes using differently colored pebbles, guided

by predetermined questions. The third phase involved analyzing the marked areas as offense hotspots to assess the distance relationships between the marked points. The mapping process utilized a high-resolution 12m × 12m picture with a 1:4000 scale, covering features such as Kurasini roads, the Indian Ocean, schools, churches, and universities to help orient participants. The information gathered from the community mapping was then converted into a vector format and visualized using ArcGIS 10.7 Pro software.



Figure 2: Participatory Mapping with research participants

This study incorporated GPS, surveying, and field observation techniques to validate the crime data gathered from respondents via community mapping and interviews. These methods ensured the accuracy of crime hotspots identified by participants. A transect walk was also conducted, combining GPS, surveys, and field observations to further confirm the data collected during community mapping and interviews with key respondents. Significant locations, such as Kilwa Road, Mafuta Road, and Mandela Road, were identified as major contributors to crime, with GPS marking these sites to a precision of 0-2 meters. The GPS point data was then overlaid on satellite imagery, which helped verify the participants' identification of crime locations and allowed for an in-depth analysis of the spatial distribution of crime incidents, ensuring a thorough and precise understanding of crime patterns in the area.

Data Analysis

Hotspot analysis was carried out across the study area to identify regions prone to crime by evaluating both spatial and socio-economic factors influencing crime occurrences. The objective was to generate maps that illustrate crime patterns and pinpoint specific locations where criminal activities concentrate. The analysis used ArcMap software to detect and visualize crime patterns. The first step involved creating a polygon grid (fishnet) with a 220-meter cell size, covering the entire study area. This was done through ArcGIS by navigating: Data Management Tools > Sampling > Create Fishnet. Once the grid was established, point data layers representing crime incidents were linked to the polygon grid based on their spatial locations. Subsequently, crime hotspot

areas were identified using the spatial statistics tool. The results were visualized to highlight hotspot patterns. The significance of these hotspots was assessed at a 99% confidence level (z-score). A high z-score with a small p-value indicates a significant hotspot, while a low negative z-score with a small p-value signals a significant cold spot. The z-score's magnitude reflects clustering intensity, with a z-score of zero indicating no clustering. The statistical significance of the z-scores was then compared against a predefined confidence level. At a significance level of 0.05 (95% confidence), a z-score below -1.96 is considered statistically insignificant, while a z-score of 1.96 or higher indicates statistical significance. To further validate the findings, GPS data points were overlaid onto the hotspot maps, allowing cross-verification of the identified crime locations. This combined approach provided a comprehensive understanding of crime distribution within the study area.

The sub-ward shapefiles were initially imported into Excel and saved as a comma-delimited text file (CSV format). This CSV file was subsequently uploaded into ArcGIS, where it was overlaid with the sub-ward shape files to verify the responses from the community mapping exercise. This step enabled the spatial validation of the crime locations marked by community participants, ensuring the accuracy of the identified crime hotspots within the defined sub-ward boundaries.

RESULTS AND DISCUSSION

Extent (ranks) of Factors for Occurrence of Crime

Table shows the extent of the factors for crime occurrence, such as family structure, occupation status, and income status and education level.

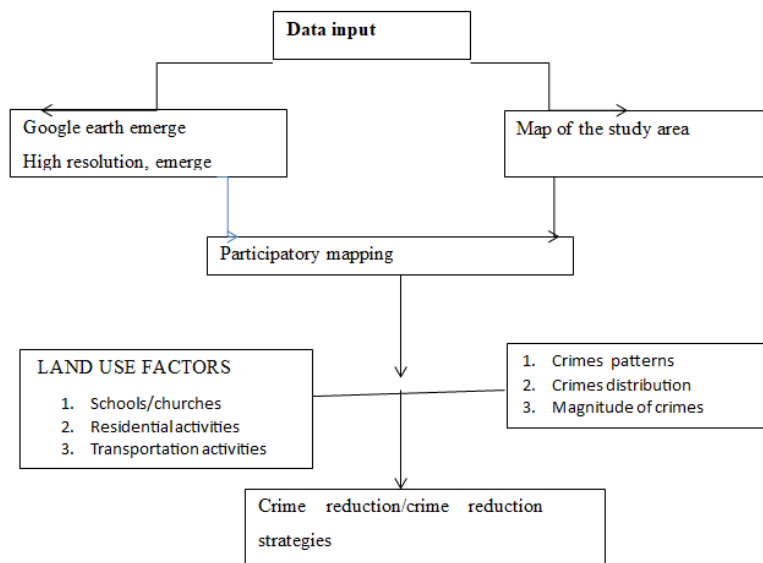


Figure 3: The Model of factors influencing crime

Table 1: Responses on Ranks of factors for crime occurrence

	variable	Kind of crime picked by respondents	factors for	Number of criminals	Criminals in %
1	occupation status	Robbery	Unemployment	11197/15549	72%
		Burglary	Unemployment	6583/9678	68%
2	Income	Robbery	low-income level	12631/15549	81.2%
		Burglary	low-income level	6499/9678	67.2%
3	family status	Robbery	separated/divorced	7605/15549	78.1%
		Burglary	separated/divorced	3507/9678	80.8%
4	Education	Robbery	primary education/no education	9874/15549	63.5%
		Burglary	primary education/no education	5870/9678	60.7%

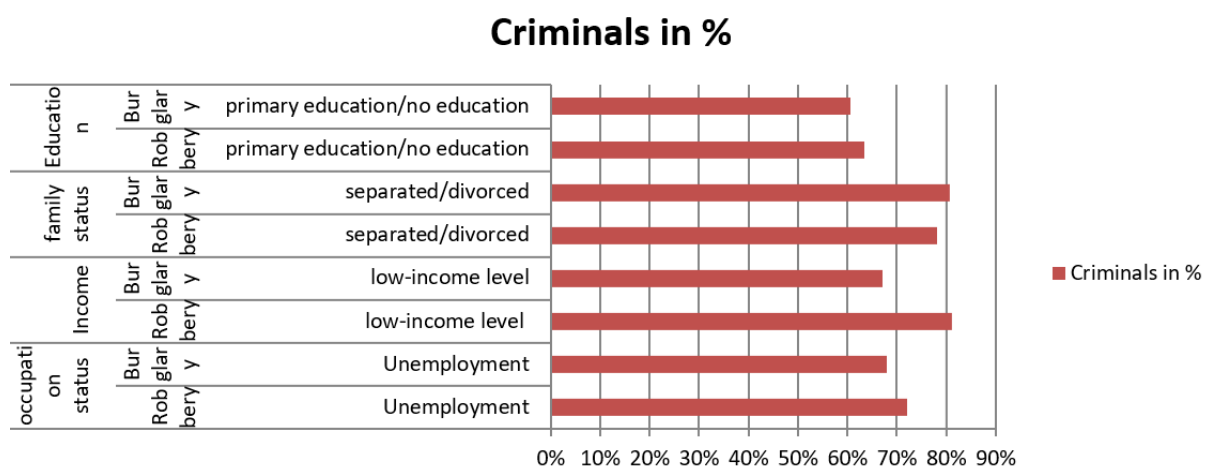


Figure 4: Extent factors for crime occurrences around the study area from 2005-2022

This study identifies several factors that contribute to crime occurrence in urban areas, with income level standing out as the most influential. The research found that income level had a more significant impact on criminal behavior than other variables such as occupational status, family status, and education level.

Family-related issues, especially family breakdowns, were also found to play a critical role in criminal involvement. A lack of parental care, guidance, and counseling from both parents was recognized as a major driver for individuals engaging in criminal activities. Furthermore, family status was identified as the second most influential

factor in criminal behavior, particularly in Kurasini, when compared to education and occupational status. Field respondents highlighted the crucial role of family dynamics, emphasizing how family structure significantly shapes decisions to engage in criminal behavior within urban settings.

Participatory Mapping of Criminal Incidents in Kurasini Ward

The study in Kurasini Ward focused on criminal activities across five streets: Kurasini, Minazini, Mivinjeni, Kiungani,

and Shimo la Udongo. The research utilized a community mapping technique to gather data on crime hotspots. Participants anonymously marked locations on a map where they believed crimes had occurred. Each individual was asked to privately identify the type of crime linked to the marked areas. The results provided critical insights into the area's most prone to criminal activity within the ward, highlighting specific streets and locations identified by the community. These findings emphasize areas where targeted interventions and preventive measures are most needed to combat crime.



Figure 5: Robbery crime incidents in the study area from 2005-2022

The study further categorized the types of offenses and their distribution across Kurasi Ward, with a focus on robbery incidents. Figure 5 illustrates the distribution of robbery crimes, marked in red on the map. Robbery incidents were notably concentrated around certain locations such as Wimo Maasai Bar, Liquid Bar, and Red Kilwa Bar. These crime hotspots were linked to the proximity of major roads like Kilwa and Mandela Road, which provided easy escape routes for robbers, especially during nighttime (Floyd, 2018).

Additionally, robbery cases were prevalent around bus stops such as Mivinjeni, Kurasini, Ufundi, Bandari, and Uhasibu. The streets surrounding these bus stops—particularly Minazini, Shimo la Udongo, and Kurasini—were also prone to robberies. The presence of unstructured housing in these areas contributed to the ease with which criminals could operate. Poor visibility in these neighborhoods allowed robbers to commit crimes and escape without being easily detected (Taylor & Hochuli, 2016).



Figure 6: Burglary crime incidents in the study area from 2005-2022

Figure 6 shows burglary incidents, represented by blue points, which are primarily concentrated along streets such as Shimo la Udongo, Kurasini, and Mivinjeni. These areas are characterized by unplanned housing developments and unauthorized beachfront zones (particularly Kurasini), offering offender's opportunities

for quick escape (Taylor & Hochuli, 2016). The majority of burglary incidents were observed in locations within 12 meters of major roads, especially along Kilwa Road, and more specifically on Mivinjeni Street, Shimo la Udongo Street, and Minazini Street.

Table 2: Summary of Distribution of Crime Incidents around The study area

boundary	Crime type	Crime distribution	Predominant crime
kurasini	Robbery	around Star fuel, around trans cargo, around metoro retot,	Burglary
	Burglary	Kurasini near KCD, near Matero, near metrics, around Metl sudeco	
Mivinjeni	Robbery	Bandari bus stop, Mivinjeni bus stop, peal t lulu modern BNR, around Mafuta road, around Benedictine guest house, around Ufundi bus stand, around Kurasini bizarre food, around Kurasini secondary around ALKhalee j TZ cosmetics	
	Burglary	Near Mafuta road, around a mission to sea farers, Camel Wheat near Avante technology, around Gapco depot Cafritea coffee, around Mivinjeni.	
Minazini	Robbery	around Wimo Maasai Pub, around Berra pork, around Uhamihaji secondary,, around Tiktok chips , around Ommy food, around Masjid and around njia ya reli	
	Burglary	around Kwa Boko, around Continental Cargo, near Yanga place, near mtaa wa kwa Mjumbe nyumba 10, near Tiktok and Snak point	

Shio laudongo	Robbery	around Red Kilwa pub	
	Burglary	Near Ruta pub	
Kiungan	Robbery	around Dicl, around THR empty container deport	
	Burglary	-	

Hotspot Mapping

Robbery and Burglary offenses hotspot maps were created on the study area

Crime Hotspots Mapping around Kurasini Ward

Respondents identified hotspot areas and provided data that were used to generate maps illustrating the spatial patterns of crime incidents in the region. These maps

effectively depicted the distribution of crime across different locations, allowing for a clearer understanding of areas with high concentrations of criminal activity. The spatial analysis helped to highlight trends, identify risk zones, and inform strategies for crime prevention and resource allocation.

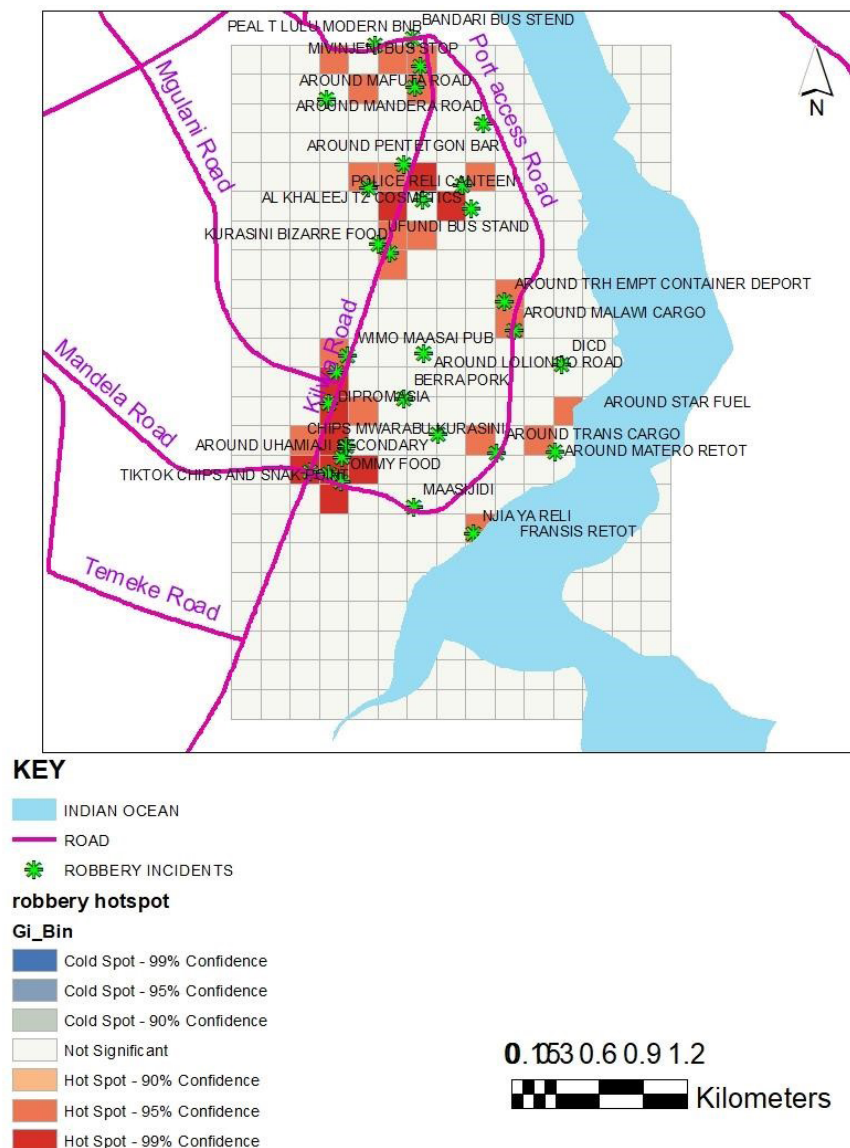


Figure 7: Robbery crime hotspot map in the study area from 2005-2022

Robbery hotspots were classified by intensity and represented using different colors on the map: high-intensity hotspots appeared in red, medium-intensity in light red, and moderate-intensity in dark salmon. High-intensity robbery locations were identified near Diplomasia Secondary School, Uhamiaji Secondary School, Ommy

Food, Chipsi Mwarabu, Al Khaleej Tanzania Cosmetics, and the Police Canteen. Medium-intensity hotspots were observed in areas such as Njia ya Reli, Star Fuel, TRH Empty Container Yard, Malawi Cargo, Wimo Maasai Pub, Mvinjenji Bus Stop, Mafuta Road, Ufundi Bus Stop, Kurasini Bizarre Food, Tiktok Chipsi and Snack,

and along Mandela Road. Based on field observations in Kurasini Ward, the study found that robbery hotspots commonly occurred near luxury-oriented locations, particularly food establishments and pubs located along

accessible roadways. For example, notable hotspots were concentrated along Mandela Road and Mafuta Road, especially near Wimo Maasai Pub, Ommy Food, the Police Canteen, and Chipsi kwa Tiktok Chips and Snack.

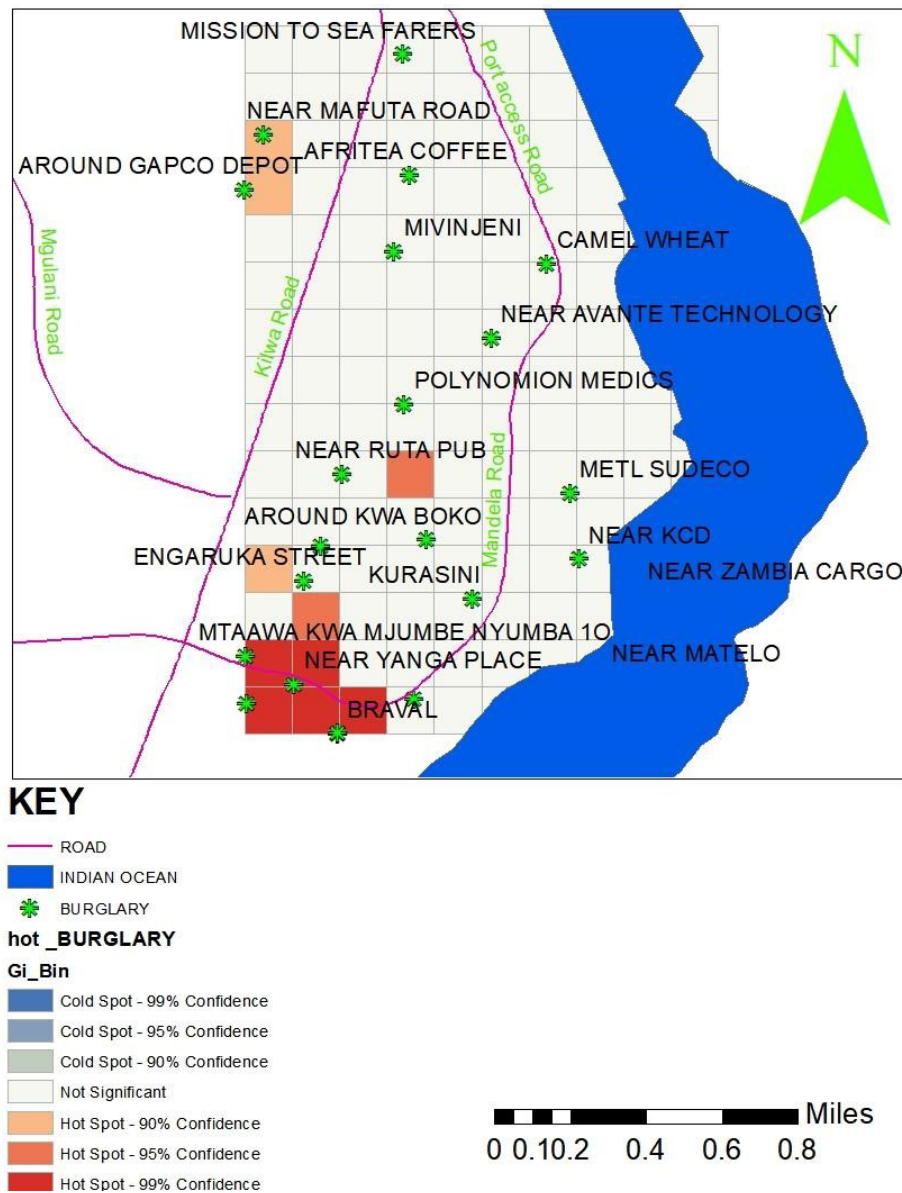


Figure 8: Burglary crime hotspot map in the study area from 2005 -2022

Areas with high burglary activity were indicated in light red on the map, while medium-intensity hotspots appeared in coral, and moderate hotspots were marked in dark salmon. High-intensity burglary zones were identified in locations such as Braval, the vicinity of Yanga Place, and Mtaa wa Kwa Mjumbe Nyumba Kumi. Medium-intensity hotspots were observed near Ruta Pub, whereas moderate ones were found around Engaruka, close to GAP Co. Limited, and near Mafuta Road Street. The crime hotspot map further revealed that Minazini Street—surrounded by bus stops and bordered by major roads like Mander and Kilwa—had a high concentration of unplanned buildings, which contributed to criminal behavior (Masese, 2007).

CONCLUSION

Crime locations within the study area were systematically mapped, leading to the identification of several crime hotspot zones. These included road corridors, bars, schools, catering establishments, bus stops, cash depot areas, pubs, and churches. Furthermore, the analysis revealed that socioeconomic factors such as unemployment, low levels of education, income disparity, and family breakdown played a significant role in driving individuals toward criminal activities as a means of survival.

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REFERENCES

- Ahmed, M., & Salihu, R. (2013). Spatiotemporal pattern of crime using Geographic Information System (GIS) approach in Dala L.G.A of Kano State, Nigeria. *American Journal of Engineering Research (AJER)*, 2(3), 51–58.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative and mixed methods approaches* (4th ed.). Sage.
- Creswell, J. W., Fetters, M. D., & Ivankova, N. V. (2004). Designing a mixed methods study in primary care. *The Annals of Family Medicine*, 2(1), 7–12. <https://doi.org/10.1370/afm.104>
- Mswela, M. (2019). Tagging and tracking of persons with albinism: A reflection of some critical human rights and ethical issues arising from the use of the Global Positioning System (GPS) as part of a solution to cracking down on violent crimes against persons with albinism. *Potchefstroom Electronic Law Journal*, 22(1). <https://doi.org/10.17159/1727-3781/2019/v22i0a6462>
- Okeyo, G. (2021). Advancing crime prevention, criminal justice and the rule of law: Towards achievement of the 2030 agenda. *Country Statement of the Republic of Kenya at the Fourteenth United Nations Congress on Crime Prevention and Criminal Justice, Kyoto, Japan*.
- Silverman, D. (2000). *Doing qualitative research: A practical handbook*. Sage Publications Ltd.
- Stylianides, T. (2000). *Crime analysis and decision support in the South African Police Service: Enhancing capability with the aim of preventing and solving crime*. DACST Innovation Fund Project.
- Taylor, R. B., & Gottfredson, S. (1986). Environmental design, crime and prevention: An examination of community dynamics. In A. J. Reiss & M. Tonry (Eds.), *University Press Southern Africa*.
- United Nations Office on Drugs and Crime, & The World Bank. (2003). *Crime and criminal justice statistics*. <https://www.unodc.org/unodc/en/data-and-analysis/statistics/crime.html>
- United Nations Office on Drugs and Crime. (2009). *Victimization survey*. <https://www.unodc.org/unodc/en/data-and-analysis/statistics/crime.html>
- United Nations. (2014). *World crime index by country: World crime report for the period of 2014–2015*.
- UNODC. (2013). *UNODC homicide statistics*. <https://www.unodc.org/unodc/en/data-and-analysis/homicide.html>
- Welman, C., Kruger, F., & Mitchell, B. (2011). *Research methodology* (3rd ed.). Oxford University Press.
- Yelwa, S., & Bello, Y. (2012). Complementing GIS with cluster analysis in assessing property crime in Katsina State, Nigeria. *American International Journal of Contemporary Research*, 2(7).