

Urban Spatial Dynamics and Street Surveillance in Juja Settlement, Kenya: Implications for Crime Prevention and Urban Planning

Beatrice Kirongon, Moirongo Otoki, Teckla Muhoro, Mirera Raphael Binyanya

Centre for Urban Studies, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya

Email: beatrice.kirongon@jkuat.ac.ke

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Abstract

Space syntax, specifically, axial analysis as represented by axial lines and observation of the public open spaces, was undertaken to unveil the urban spatial dynamics and street surveillance in Juja settlement, Kenya. The research identifies three primary land uses, namely commercial, residential, and idle land, and explores the presence of various human activities, traffic patterns, surveillance opportunities, and street luminance in the area. The study found that Juja Settlement's land use distribution is as follows: 66% residential, 16.7% commercial, and 17.5% idle land uses, suggesting that the predominant land use is residential. The study also shows that Juja Settlement's streets have moderate mean integration (HH) value of 0.672149208 and a low mean connectivity value of 3.4. Concerning street traffic flows, Juja settlements' streets are principally pedestrian, at above 80% with low motorised transport at slightly above 10%. Therefore, Juja is primarily a residential settlement with poor public open spaces layout, predisposing the settlement to increased incidences of urban crimes such as snatch theft and robberies.

Keywords

Urban Spatial Relations, Street Surveillance, Juja Settlement, Kenya, Crime Prevention, Urban Planning, Public Open Spaces

1. Introduction

Crime occurrence is explained by routine activity theory that focuses on space and time factors as enablers of crime, specifically the ecological contexts in which a suitable target, motivated offender and absence of capable guardian occur (Clarke & Felson, 2004; Song et al., 2017; Weisburd & Amram, 2014). The

occurrence of human social interactions is pegged on the presence of activities that enable both social encounters and social interactions to take place (Weisburd & Amram, 2014), when these activities are predictable in terms of time and place of occurrence routine activities emerge. The routine activities act as magnets for possible offenders but also provide the needed surveillance by the presence of eyes on the street (Jacobs, 1961).

Early scholars studied crime prevalence in urban areas at “micro” levels including city, community, state, region or/and neighbourhood levels (Eck & Weisburd, 2014; Weisburd & Amram, 2014). However recent studies on crime and place relations have focussed on the “micro” level by looking at the specific site where crime occurs within a larger urban context (Eck & Weisburd, 2014; Hurst, 2020; Weisburd & Amram, 2014). On the other hand, (Eck & Weisburd, 2014) places are specific locations or sites where crime occurs and could be as small as an apartment building or business block in line with Weisburd, Groff and Yang’s law of concentration of crime in place. One advantage of ‘Micro’ crime and place studies is the site-specific nature of places unlike macro studies where the obscuring influence of wider or larger geographies is eminent, it has also been found that crime is tightly concentrated at a few micro places in a city Sherman et al. (1989) as cited by (Weisburd & Amram, 2014).

Therefore, the opportunities created by vibrant places in street surveillance for enhanced urban guardianship are discussed by looking at the spatial character of Juja settlement in this paper.

2. An Overview of Juja Settlement

2.1. Historical and Geographical Context

Juja settlement traces its origins to the early white settlers (Aldrick, 2012) who established wild game ranches and agricultural ranches hence leading to establishment of the earliest documented human settlements in the region. Several other factors influenced the growth and expansion of Juja settlement including; the construction of Nairobi-Thika Railway line; expansion and growth of both Nairobi town and Thika town; the establishment of JKUAT (Jomo Kenyatta University of Agriculture and Technology) (see cluster G in **Figure 1**) and finally the expansion of Thika road.

Geographically, the study area is a Settlement (**Figure 1**) in Kiambu County in Kenya, and is located 30 km from Nairobi, Kenya’s Central Business District (CBD). The study area is bound by two rivers, River Ndarugu to North East, and River Thiririka to the South West (**Figure 1**), while the Southern extreme is delineated by the Juja railway line. Cluster G, (highlighted in **Figure 1**), was left out of the study of public open spaces since cluster G’s open spaces are privately controlled and hence ceases to be public.

Unlike urban towns whose urban layouts are planned, streets, and spaces allocated to cater to various urban needs, Juja settlement was not planned. The settlement developed incrementally where private developers acquired land

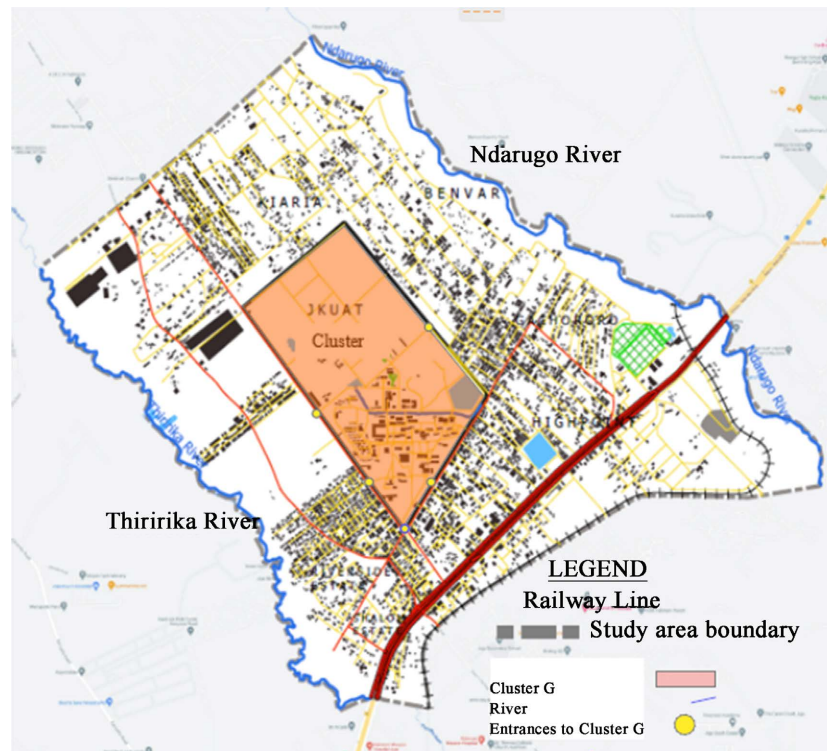


Figure 1. Juja settlement study area map.

around JKUAT for prospecting and later sold off or developed. The informal subdivision of land resulted in the current state of the “town” characterised by poor street hierarchy from the arterial roads to the minor streets ranging from 9 - 6 m street width range except for Thika highway, which is an A2 highway and class C Juja-Gatundu road (Ministry of Transport, Infrastructure, Housing, Urban Development, and Public Works, 2022). Provision of public spaces such as squares, gardens, and parks is inexistent. Hence, public open spaces are the public street networks. Due to this informality, the resultant urban public open spaces layout in the study area is a mixed pattern of deformed grid or cul-de-sac layout (Figure 2).

2.2. Juja Settlement’s Population

Demographically, Juja sub-county has a population of 300,948 in 2019-census (KNBS, 2019) indicating more than 50% increase from 118,793—population census of 2009. However, the study area population out of the 300,948 is only 40,446 persons (County Government of Kiambu, 2020).

2.3. Legal and Institutional Framework Overview

2.3.1. The Constitution of Kenya of 2010

Juja urban settlement derives its main mandate from Article 66 (1) of Kenya Constitution (2010) stating that land use planning, public interest, public safety, public order, public morality, and public health are interests through which a state

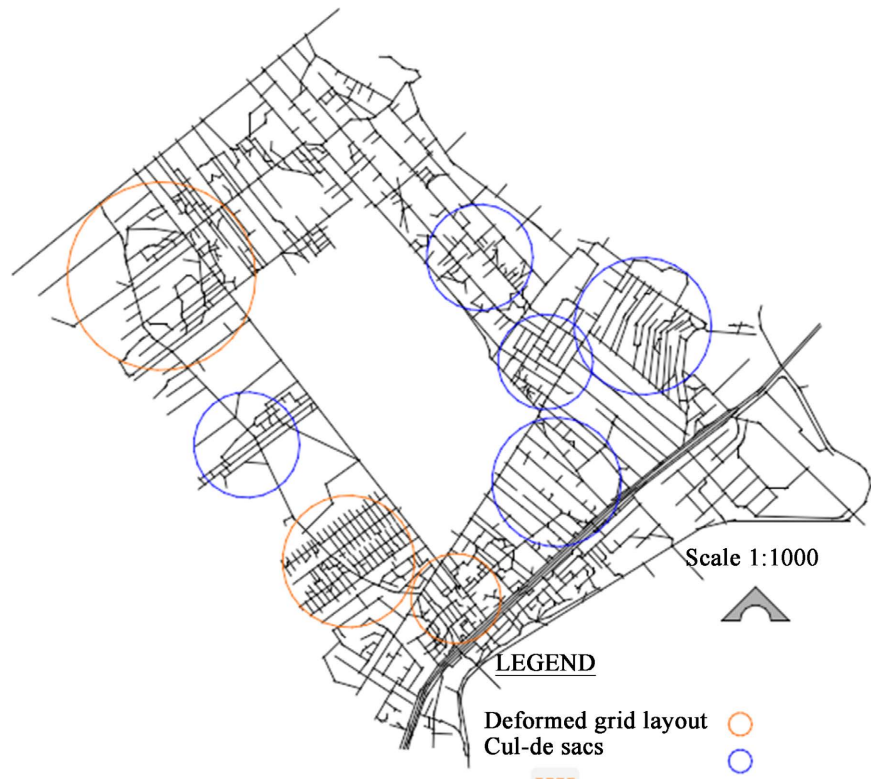


Figure 2. Prevalent street (public open spaces) patterns in Juja settlement.

may regulate the use of land; indirectly implying the important public safety through land use regulations in Kenya. The study is also cognisant of Article 176 (2) and 184 that guide the urban planning activities and the responsibility of county governments in executing functions as indicated in the fourth schedule as outlined in Article 176.

By ensuring human and land rights are upheld, the Constitution creates a legal framework that discourages criminal behavior. Furthermore, far-reaching impact on urban safety and security as envisioned by the devolution of power as envisioned. However, this is not the case, as crime and insecurity continue to ravage urban settlements in the country.

2.3.2. Physical and Land Use Planning Act (No. 13 of 2019)

The Physical and Land Use Planning Act that regulates land development is important in this study. The Act summarises the preparation of physical and land use plans forming the basis for the preparation of other detailed plans like the integrated urban development plan hence guiding the development and use of land. The Physical and Land Use Act provides a good basis for understanding the constitution of streets by buildings and the relationship between the building and the street as informed by regulations.

However, the piecemeal implementation of the Land Use and Planning Act across the country, especially in unplanned settlements has resulted in unsafe urban enclaves, where crime and insecurity thrive. Juja settlement as unplanned

settlements is an example of the constant struggle local governments face in dealing with fast growing urban areas, whose growth rate overtake planning attempts and hence the glaring struggle with crime and insecurity.

2.3.3. National Urban Development Policy (NUDP)

This is a policy framework that seeks to promote sustainable urban development in cities, towns and metropolitan regions that is critical to national development. The NUDP basis of sustainable urban development includes urban economy, national, and county urban planning, land, environment, ecological footprints, and infrastructure development among others that directly influence issues relating to crime and safety in urban areas. The NUDP Policy addresses the underlying social, economic, and environmental factors contributing to urban crime; a rather holistic approach aiming to create safer and sustainable urban environments. Juja settlement however falls behind in the quest to achieve sustainable development as evidenced by the rising crime and insecurity challenges.

2.3.4. The Urban Areas and Cities Act

The Urban Areas and Cities Act provides the legal framework for the planning, development and management of urban areas and cities while including procedures to ensure security and safety. The Urban Areas and Cities Act (UACA) is a crucial legal and policy framework for addressing crime and insecurity in Kenyan urban areas and cities. The Act prioritizes urban planning, law enforcement, community engagement, infrastructure development, data-driven decision-making, and capacity building, hence providing a comprehensive approach to promoting safety and security for all urban residents. However, for effective implementation of the UACA collaboration and coordination among government agencies, community organizations, and other stakeholders is paramount to create safe and livable urban environments.

2.4. Conclusion

Juja settlement is mainly a typical example of unplanned urban settlements, a common phenomenon in African countries, especially in Kenya. The spaces allocated for public usage are scarce and in most instances resulting in conflicting usage and congestion that predispose urban areas to increased crime incidences. The unfavourable characteristics often act as crime attractants that accord possible offenders chances to commit a crime. When the mundane human surveillance of public open spaces as necessitated by human interactions is impeded crime prevalence is bound to increase.

3. Research Methodology

The research methodology adopted in establishing the spatial relations of Juja settlement (both field observations and axial map analysis) is briefly expounded in this section.

The study began, using Juja Figure Ground Map in **Figure 3** as the base map,

with a systematic field reconnaissance survey. The survey aimed to establish the general trend of the spatial pattern of public open spaces as illustrated in **Figure 4**. The published pilot (Kirongon et al., 2022) exposed the problems of the data collection tools and informed suitable refinements.

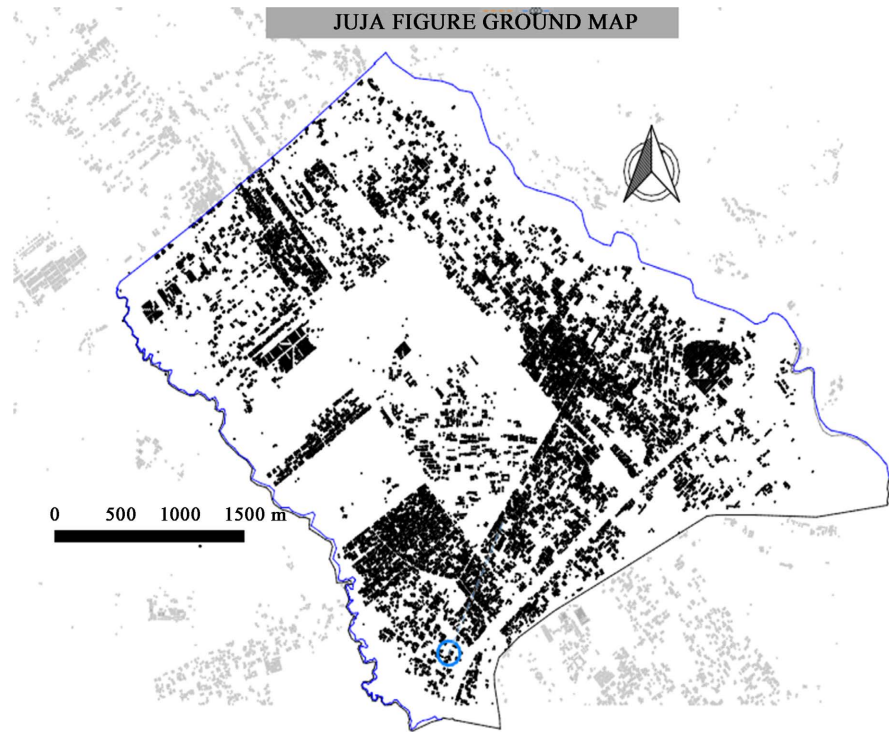


Figure 3. Juja figure ground map (Kirongon, Otoki, & Muhoro 2022).



Figure 4. Juja axial map (Kirongon et al., 2022).

3.1. The Research Design

The research was designed with two distinct data collection methods, first the map analysis using DepthmapX software and secondly, field observation methods.

3.1.1. Map Analysis Method

The axial map was generated by converting Juja's Ground Figure Map (**Figure 3**) consisting of a series of voids and solids representing the urban public open spaces into an axial map using DepthmapX software. DepthmapX software was then used to conduct the "space syntax map analysis" to ascertain the urban spatial structure and the ensuing relations in the area (UCL, 2021). The measures of integration, connectivity, and choice formed the focus of this study to enable the understanding of street surveillance.

3.1.2. Field Observation Method

The field survey method was adopted to observe and record the surveillance levels together with human activities, and traffic flows in the public open spaces of Juja settlement. The observation method applied here for data collection was the observation of the physical environment (Zeisel, 1995) with the aid of field survey instruments and tools.

The data collected from the two methods were thereafter regressed using the SPSS analysis tool.

3.2. Sampling Design

3.2.1. Sampling Frame for the Map Analysis

Axial map analysis was conducted on all the axial lines documented within the study area owing to the ease of software analysis in terms of time and financial resource implications. DepthmapX software is freely available from the University of London College (UCL) website. Therefore, the sample frame of 1380 axial lines was analyzed.

3.2.2. Sampling Frame for the Field Survey

A purposeful sampling of four axial lines was adopted for the field survey (**Figure 5**) because the field survey conducted for this study was time-consuming, compounding the limited financial resources available for the study. Purposive random sampling ensured that errors in sampling a small sample size were limited by selecting representative axial lines where crime had been reported or Google crime drop pins dropped by respondents.

4. Data Analysis and Discussions

4.1. Spatial Character of Juja Settlement's Public Open Spaces

Built-Up Density along Public Open Spaces

The presence of buildings along the street provides permanent and stationary forms of street surveillance (Crowe, 2000). Street surveillance by building inhabitants is enhanced in public open spaces where the buildings fronting (**Figure 6**)

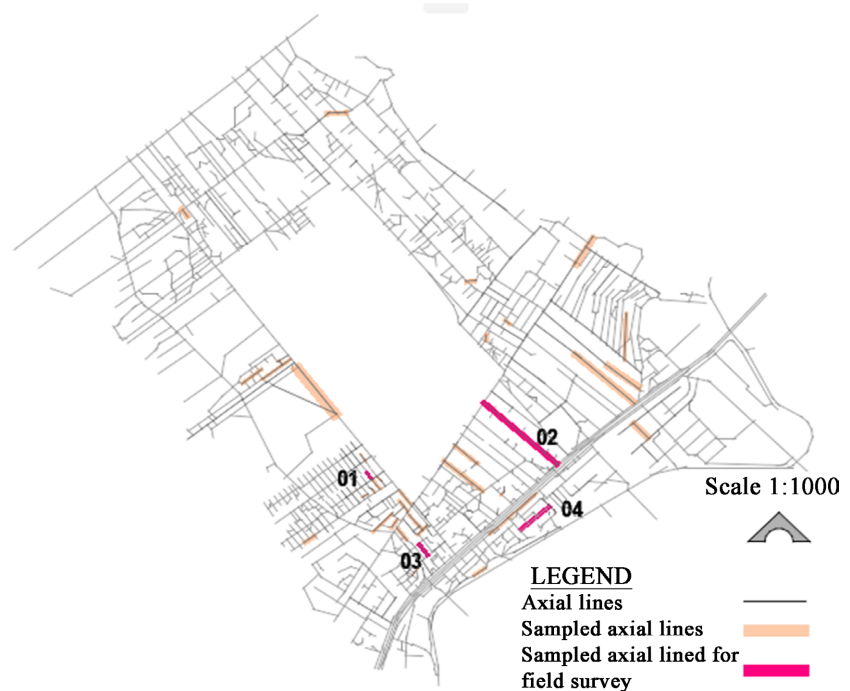


Figure 5. Sampled axial lines for the field survey (Author, 2023).



Figure 6. Images showing sample streets context (Author, 2023).

have more floors and provisions of openings overlooking the street below ultimately boosting the street guardianship. The average number of floors per the three land uses is four for commercial area, three for residential areas, and one for the idle land use areas. The findings also implied that the commercial areas built-up densities were higher followed by the residential areas and finally the idle land use areas.

Distribution of Land Uses along Streets in Juja Settlement

Land use distribution as measured by the area allocated for commercial, residential or idle land uses along streets indicates that 66% of land use is residential, 16.7% is commercial, and 17.5% is idle land use (Figure 7). The findings show that Juja settlement is mainly residential. The streets located at the settlement's CBD harbour commercial-residential land uses, characterised by buildings whose lower floors are designated for commercial activities and upper floors for residential activities. On the other hand, idle land uses are located in

street further away from the university. These findings also paint a picture of the development trends in Juja Settlement where developments mushroom around magnet points such as institutions of learning, and commercial areas.

Integration, Connectivity and Choice

Juja Settlement has a moderate integration (HH) value of 0.672149208. In **Figure 8**, the majority of the axial lines are green to blue indicating very low integration levels in Juja, except for the few orange/red axial lines that indicate high integration at major roads.

Connectivity measures for Juja settlements are very low (**Figure 9**) with a mean connectivity measure of 3.4.

Step depth as a measure of the fewest turns from a selected root line to all other lines in a system in the study was taken from two root spaces, the main stage to Thika and the University main entrance, which are the main traffic

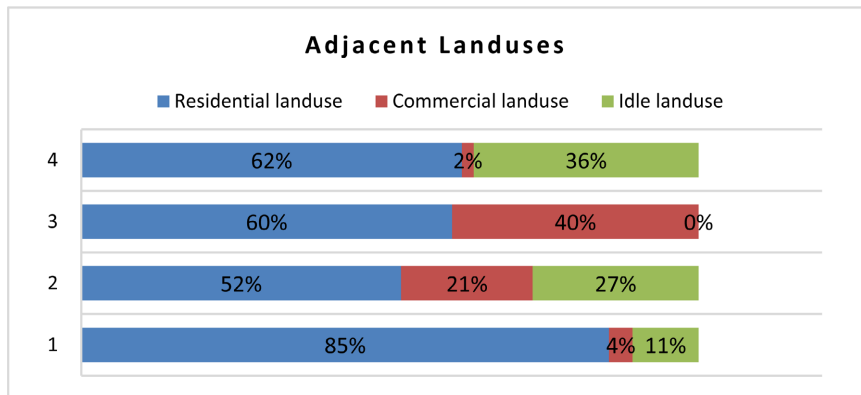


Figure 7. Clustered column chart showing the distribution of land uses along streets in Juja Settlement (Author, 2023).

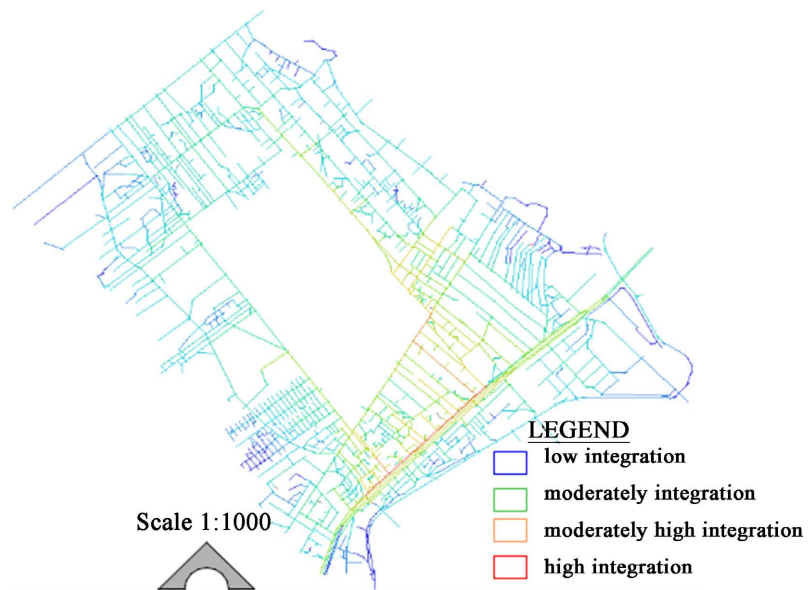


Figure 8. Axial map showing the integration of axial lines in Juja Settlement (Author, 2023).

sources and destinations. The findings indicate that from the university main gate Juja settlement is predominantly shallow, with both step depth averages being 7.8. Step depth increases from the origin line outwards from step 01 to the furthest axial line at step 16 from both root lines highlighted in axial maps in **Figure 10** and **Figure 11**.

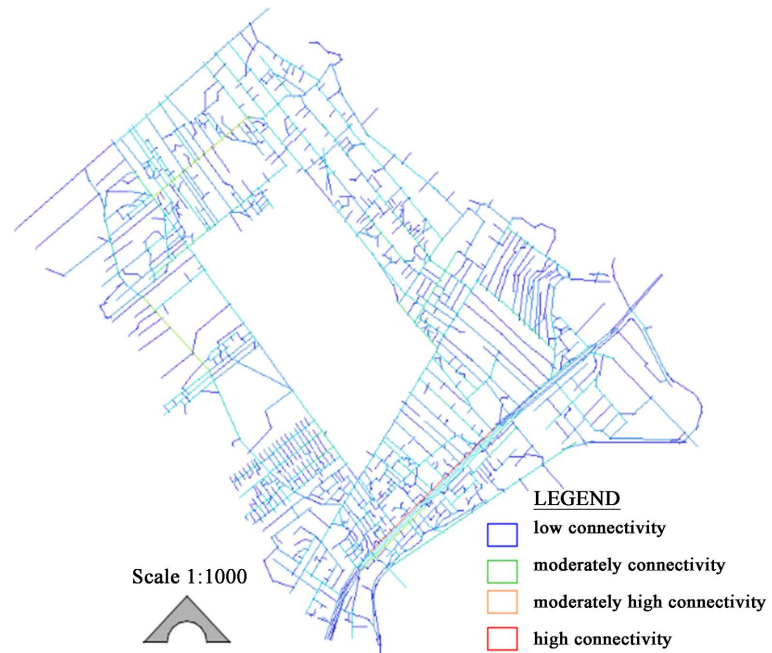


Figure 9. Axial map showing the connectivity of axial lines in Juja Settlement (Author, 2023).

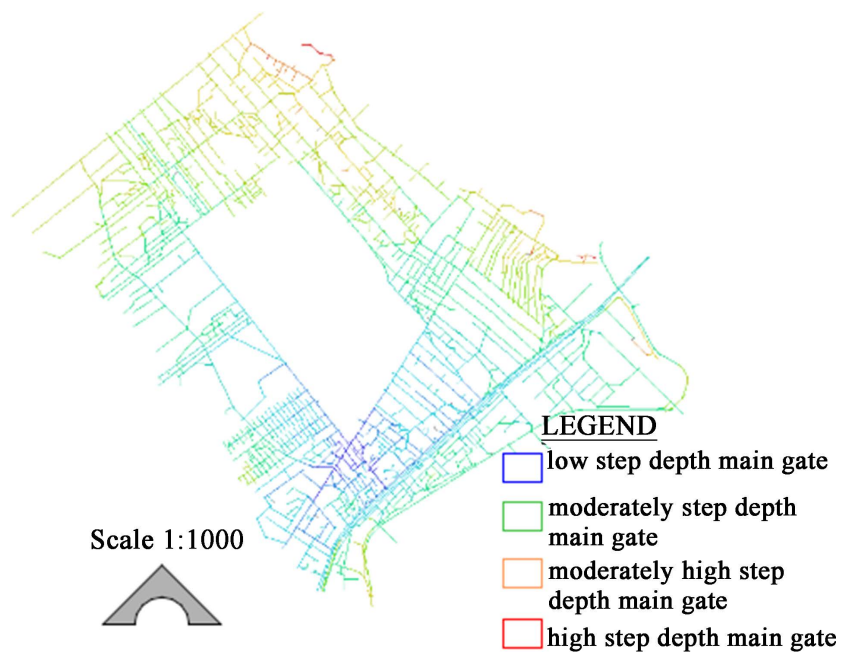


Figure 10. Axial map showing step depth from the main gate of axial lines in Juja Settlement (Author, 2023).

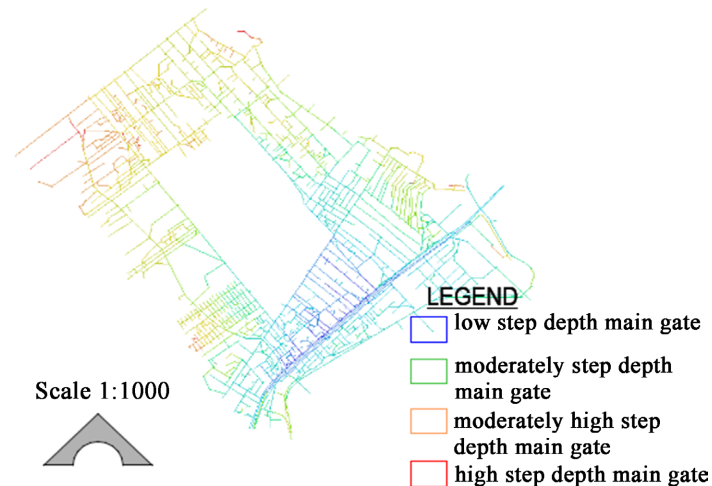


Figure 11. Axial map showing step depth from the main stage of axial lines in Juja Settlement (Author, 2023).

4.2. Street Surveillance in Juja Settlement's Public Open Spaces

Human Activities along Streets

The degree of guardianship of urban spaces, as measured by human activities along the streets (traffic flows, structured and non-structured urban activities), (Cohen & Felson, 1979; Welsh, Mudge, & Farrington, 2009), helps to prevent possible offenders from committing crime(s). This study findings indicate that mobile (un-structured) activities, which happen impromptu without forethoughts and planning such as the casual gathering of friends on the go or conversations across balconies were highest in axial line 01 followed by axial line 03 with the lowest occurrence of mobile activities in axial line 02 and 04. The static (Structured) activities that are planned activities around stalls, and shops frontage selling points also were similarly high for axial line 03 and the lowest in axial 04.

The findings imply that street location influences the frequency of occurrence of structured activities and unstructured activities in Juja Settlement. Hence the streets fronting commercial land uses have more activities compared to the streets fronting idle land parcels.

Traffic Flow Rates in Juja Settlement

The spatial layout of urban areas provides a preview of the Traffic flow (Cozens, Hillier, & Prescott, 2001) while explaining routine activities' magnets and urban densities.

In Juja, pedestrian traffic flow is the highest of all forms of traffic flow with average frequency of 82% (Figure 12). Motorized traffic comes second at a frequency of 13.5% while Non-Motorized traffic is the lowest at 4.25%.

The findings suggest that movement on foot is the predominant mode of transport within the settlement as compared to the low movements using either NMT or Motorized transport. However, traffic flows in relation to predominant land uses indicated that the commercial, and residential land uses register more

foot traffic as compared to idle land uses.

Street Surveillance in Juja Settlement

Vertical street surveillance by the building fronting the street is enhanced due to the higher number of floors per building whose openings and building layouts face the street. This study established that street surveillance per unit length of street increases with increased density and commercial land uses.

The study found that Street 3 has the highest combined surveillance area of 639.72 m² which is 533.1% percent of vertical surveillance area per unit length of street (Figure 13). Street 2 has the lowest value of 288.84 m² at 28.9% surveillance per unit length of street. Street 1 percentage surveillance is 232% while Street 4 is at 183.5% surveillance area per unit length of the street. Therefore, higher building densities whose openings face streets provide more surveillance per unit length.

Street Luminance Levels in Juja Settlement

Street lighting is important for the continuation of street guardianship to the night hours through surveillance in urban areas. The streets in Juja Settlement have very low luminance rates, which are largely provided by land/property

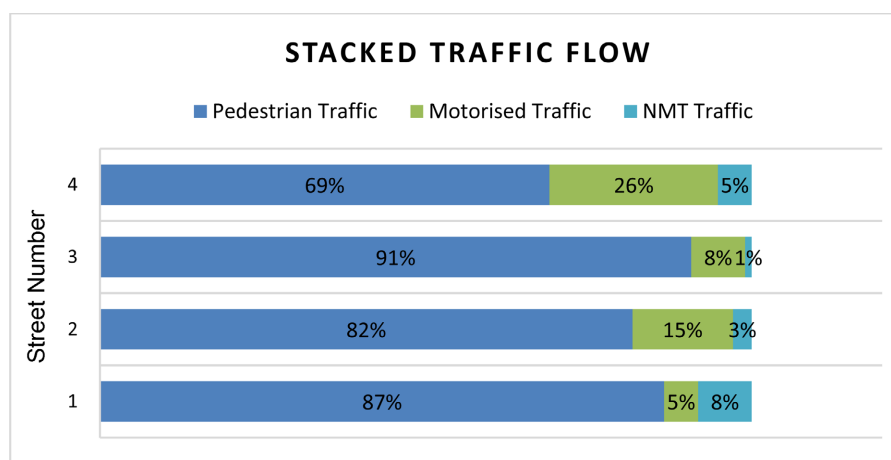


Figure 12. Stacked chart showing traffic percentages rates in Juja (Author, 2023).

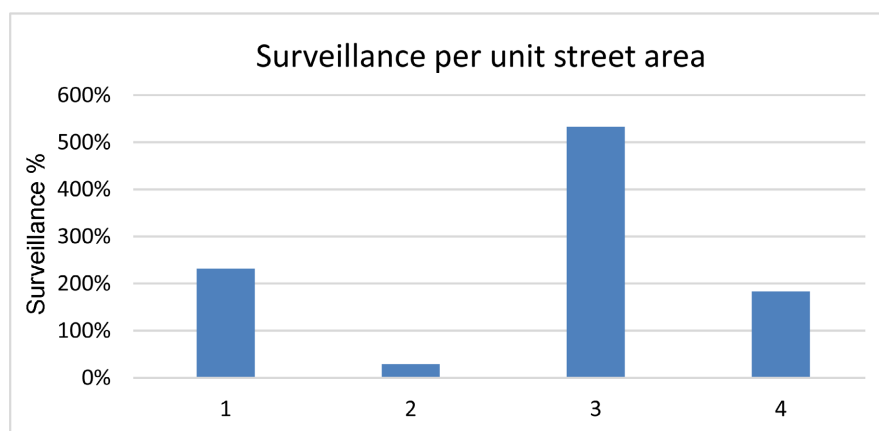


Figure 13. Surveillance degree of each cluster respectively (Authors, 2023).

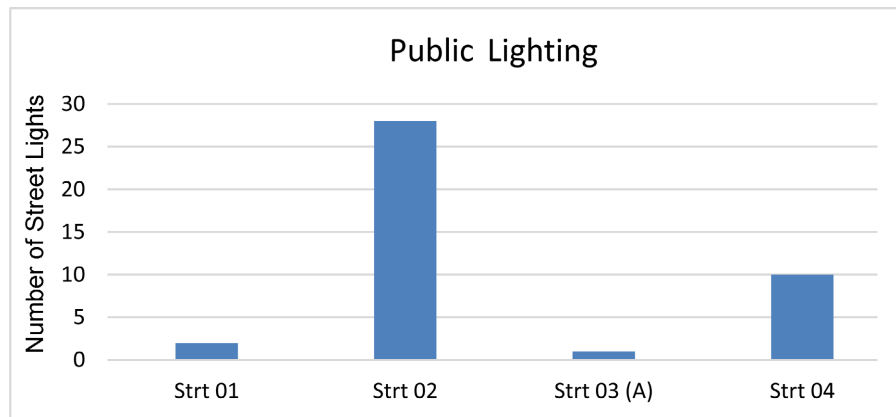


Figure 14. Bar graph showing public lighting frequency per street length (Authors, 2023).

owners. Street 3 has the lowest luminance level of 0.8% (1 streetlight per 100 m street length), while streets 1 luminance is at 2.8% (1 streetlight per 50 m length of street), street 2 & 4 have 2%, and 2.9% luminance levels respectively (Figure 14). The figures indicate that the likelihood of crime occurring at night is high in Juja settlement due to poor surveillance caused by poor street lighting conditions. This implies that possible offenders can easily commit crimes and escape successfully since guardianship of urban spaces has been impeded by the poor public lighting conditions.

5. Study Conclusions and Recommendations

5.1. Street Character and Surveillance of Juja Settlement's Public Open Spaces

The predominant land use in any town drives the economy and highly influences the movement directions and economic rates within the town. Land uses also determines the periods when a town is said to be awake or asleep and hence influencing crime occurrence (Fran & Colleen, 1994; Song et al., 2017) by either extending the presence of targets along the streets, drawing possible targets and offenders to the public or impeding the surveillance by space guardians. Similar to findings by Adel et al. (2016), land uses provide opportunities for criminals to commit crimes by either reducing movements or exaggerating them.

In Juja settlement, commercial and residential land use areas have activities influx featured by increased movements or traffic flows compared to idle land use areas where traffic flow is low. Integration of commercial and residential activities fuels Juja's economy to the night. Pedestrian flows around commercial areas are bound to increase due to the probability of optional and social activities as provided by the commercial spaces or surroundings in addition to the compulsory necessary activities. It is therefore evident that surveillance levels around commercial land uses are high due to increased eyes on the streets. Another feature of commercial land use in Juja settlement is territoriality as businesses seek to define their extents that somewhat increase crime prevention measures.

Idle land uses location further away from the CBD area in Juja indicates that the further away you move from settlement's anchors/magnets the more idle land is. The streets in idle land use areas have poor surveillance, and reduced area of window surveillance, which could lead to increased crime occurrence in the settlement.

Therefore, it is important for a good land use mix to exist in Juja settlements to reap the benefit of all land uses. As residential land uses provide necessary activities for traffic flow, commercial land uses enable and sustain the optional and social activities, all of which are imperative in ensuring constant eyes on the streets. Idle land uses must be elevated in use or value to attract people and to promote space ownership and control that will result in the trimming and clearing of bushes, clearing of litter and demarcation of territories. These features will reduce ambush areas and escape places for possible offenders.

The study also found that the presence of idle land use patterns along public open spaces discourages people from using the street segments hence robbing the street segments of street guardianship. Idle land use areas were also characterized by limited pedestrian traffic throughout the day (morning, noon and evening) increasing the vulnerability of street users to crime due to limited guardianship.

During the day, poorly connected and poorly integrated streets characterized by obstructed sightlines, cul-de-sacs streets and poor lighting at night prevent street surveillance and guardianship in Juja settlement. The lack of static activities that act as magnets to more human activities and presence (Gehl, 1989, 2010) also robs the settlement of the needed constant eyes on the street through human activities. The evidence of limited static activities along streets points to the absence of structured spaces that could attract static activities, such as open street cafés or terraces, along the street in Juja settlement.

Notably, areas with drinking dens (Baum & Klaus, 2005; Brower & Carroll, 2007) in commercial land areas could predispose settlement to crime as supported also by Robinson & Roh (2001) these commercial activities exist in both commercial and residential land use areas in Juja settlement.

In conclusion, Juja settlement is largely segregated, shallow, and poorly connected as shown in the axial map analysis except for the areas lining major roads and areas around the town's CBD. The major land use is residential followed by commercial and finally idle land uses, which greatly influence human interactions in the town and the possibilities of surveillance of both the streets and the buildings contained therein. However, areas in Juja settlement with increased densities, throughway streets, and good connectivity registered low crime incidences as earlier discussed.

5.2. Recommendations

The recommendation for public open spaces (streets) in Juja settlement focuses on the design and usage of the streets to reduce vulnerability to crime within the

premises of street surveillance through interventions that encourage human contact and interactions. The public open spaces in Juja settlement will benefit greatly from increased human surveillance as enhanced by urban spatial relations that augment the vibrancy of public open spaces. Some of the recommendations include:

- Accommodating mixed-use developments throughout the town, especially in the periphery areas enhances economic diversity hence vibrancy along the town's public open spaces. Increased human interactions along public open spaces result in improved space guardianship against crime through constant street surveillance.
- Enhancement of vertical surveillance of public open spaces by densification through multi-storeyed developments, infill, and developments of idle land parcels. However, the design of the multi-storey developments must allow for street surveillance through the adoption of building layouts that face the streets they front.
- Landowners to idle land parcels or walled land parcels to be encouraged to provide land uses that will attract activities to increase human traffic flows. Opening up could mean redesigning the wall for better visibility or incorporating spaces and activities that add to the street activities such as stalls or shops facing the street.
- Opening up of the segregated streets in Juja settlement by the introduction of new streets where possible or by connecting the existing street networks. The enabling of diverse movement choices by improving connectivity helps in reducing the predictability of possible target movements and giving choices for escape during crime events. However, there is a possibility of multiple choices also enabling criminals to escape after committing an offence.
- Ensure the provision of proper public street lighting at correct intervals and suitable luminance levels along all streets. Especially for the streets, further from the settlement CBD and major road networks. Visibility, as enabled by lighting, especially for the dusk and dawn periods of the day, ensures that hiding spots for criminals are eliminated, in essence, street luminance aids surveillance in the absence of natural lighting.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- Adel, H., Salheen, M., & Mahmoud, R. A. (2016). Crime in Relation to Urban Design. Case Study: The Greater Cairo Region. *Ain Shams Engineering Journal*, 7, 925-938. <https://doi.org/10.1016/j.asej.2015.08.009>
- Aldrick, J. (2012). *The Life of William Northrup McMillan*. Old Africa Books.
- Baum, B. K., & Klaus, P. (2005). *Violent Victimization of College Students, 1995-2002*

- (pp. 1-7). US Department of Justice; Office of Justice Programs, NCJ 206836.
- Brower, A. M., & Carroll, L. (2007). Spatial and Temporal Aspects of Alcohol-Related Crime in a College Town. *Journal of American College Health, 55*, 267-275. <https://doi.org/10.3200/JACH.55.5.267-276>
- Clarke, R. V., & Felson, M. (2004). *Routine Activity and Rational Choice* (M. F. R. V. G. Clarke (ed.), 5th ed.). Transaction Publishers.
- Cohen, L. E., & Felson, M. (1979). Social Change and Crime Rate Trends: A Routine Activity Approach. *American Sociological Review, 44*, 588-608. <https://doi.org/10.2307/2094589>
- County Government of Kiambu (2020). *County Government of Kiambu; County Annual Development Plan 2021-2022*. August 2020.
- Cozens, P., Hillier, D., & Prescott, G. (2001). Crime and the Design of Residential Property—Exploring the Perceptions of Planning Professionals, Burglars and Other Users: Part 2. *Property Management, 19*, 222-248. <https://doi.org/10.1108/EUM000000005784>
- Crowe, T. D. (2000). *Crime Prevention through Environmental Design* (L. J. Fennelly (ed.), 3rd ed.). Butterworth-Heinemann.
- Eck, J., & Weisburd, D. (2014). Crime Places in Crime Theory. *American Journal of Sociology, 95*, 3-17.
- Fran, K., & Colleen, L. (1994). Women's Safety in the University Environment. *Journal of Architecture and Planning Research, 11*, 128-136.
- Gehl, J. (1989). *Life between Buildings: Using Public Space* (Vol. 8). Island Press. <https://doi.org/10.3368/lj.8.1.54>
- Gehl, J. (2010). *Cities for People*. Island Press.
- Hurst, J. N. (2020). Stability in Unstable Places: Property Crime in a Campus Environment. *Crime Prevention and Community Safety, 22*, 110-133. <https://doi.org/10.1057/s41300-020-00087-6>
- Jacobs, J. (1961). *The Death and Life of Great American Cities*. Random House, Inc.
- Kenya National Bureau of Statistics (KNBS) (2019). *Kenya Population and Housing Census Volume 1: Population by County and Sub-County* (Vol. 1). Kenya National Bureau of Statistics. <https://www.knbs.or.ke/?wpdmpromo=2019-kenya-population-and-housing-census-volume-i-population-by-county-and-sub-county>
- Kironгон, B., Otoki, M., & Muhoro, T. (2022). The Role of Spatial Relations in Influencing Crime in Public Open Spaces of Settlements around Juja Town. *Current Urban Studies, 10*, 821-839. <https://doi.org/10.4236/cus.2022.104046>
- Ministry of Transport, Infrastructure, Housing, Urban Development, and Public Works (2022). *Street Design Manual for Urban Areas in Kenya*.
- Robinson, M. B., & Roh, S. (2001). Crime on Campus: A Survey of Space Users. *Crime Prevention and Community Safety, 3*, 33-46. <https://doi.org/10.1057/palgrave.cpcs.8140104>
- Sherman, L. W., Gartin, P. R., & Buerger, M. E. (1989). Hot Spots of Predatory Crime: Routine Activities and the Criminology of Place. *Criminology, 27*, 27-56. <https://doi.org/10.1111/j.1745-9125.1989.tb00862.x>
- Song, J., Andresen, M. A., Brantingham, P. L., & Spicer, V. (2017). Crime on the Edges: Patterns of Crime and Land Use Change. *Cartography and Geographic Information Science, 44*, 51-61. <https://doi.org/10.1080/15230406.2015.1089188>

- UCL Space Syntax (2021). *Case Studies Space Syntax. Online Training Platform.*
<http://otp.spacesyntax.net/applying-space-syntax/urban-methods-2/application-template-2/>
- Weisburd, D., & Amram, S. (2014). The Law of Concentrations of Crime at a Place: The Case of Tel Aviv-Jaffa. *Police Practice and Research, 15*, 101-114.
<https://doi.org/10.1080/15614263.2013.874169>
- Welsh, B. C., Mudge, M. E., & Farrington, D. P. (2009). Reconceptualizing Public Area Surveillance and Crime Prevention: Security Guards, Place Managers and Defensible Space. *Security Journal, 23*, 299-319. <https://doi.org/10.1057/sj.2008.22>
- Zeisel, J. (1995). *Inquiry by Design.* Cambridge University Press.