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RESEARCH ARTICLE

Analyzing Burglary Dynamics through Land Use in Selangor, Kuala Lumpur, and Putrajaya: A Space-Time EHSA Approach

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Abstract. In response to the escalating incidence of burglary incidents in rapidly urbanizing metropolitan regions, this study innovatively integrates Emerging Hot Spot Analysis (EHSA) with Space-Time Pattern Mining (STPM) to examine the spatio-temporal dynamics of burglary across Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT) between 2015 and 2020. The primary objective is to delineate the intricate interplay between urban land use configurations and the evolving patterns of burglary, thereby addressing critical research gaps in crime mapping and predictive resource allocation. Employing a robust methodological framework within the ArcGIS Pro 3.1 environment, the research stratifies crime data into four distinct temporal intervals to construct space-time netCDF cubes, applies the Getis-Ord Gi* statistic with False Discovery Rate (FDR) correction to identify statistically significant clusters, and utilizes the Mann-Kendall trend test to classify hotspots into eight categories (new, consecutive, intensifying, persistent, diminishing, sporadic, oscillating, and historical). The results reveal a nuanced spatial clustering of burglary incidents that is significantly influenced by varied land use types—ranging from residential and industrial zones to open spaces—thereby enhancing the granularity of hotspot detection and offering empirical insights into the temporal evolution of crime patterns. Consequently, the study concludes that the integration of advanced geospatial analyses not only clarifies the complex dynamics between urban morphology and burglary occurrences but also provides a solid empirical basis for informed law enforcement and urban planning strategies Moreover, these findings underscore the need for ongoing longitudinal investigations and the development of adaptive, data-driven models to further refine predictive capabilities and foster sustainable urban safety initiatives.

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1. Introduction

The advent of Emerging Hotspot Analysis (EHSA) marks a significant advancement in the field of crime risk assessment, introducing a comprehensive approach for identifying areas at increased risk for criminal activities, specifically commercial burglaries (Bowers, 2004). This methodological innovation enables a detailed examination of both contemporary and historical crime data, enabling the identification of regions where commercial burglary incidents are on the rise or likely to increase in the near future (Cheng & Williams, 2012). Furthermore, spatio-temporal analysis has become an indispensable tool for decoding the complex dynamics of burglary patterns, providing valuable insights into both the temporal and spatial aspects of these criminal activities. Utilizing EHSA, this investigation aims to pinpoint the specific areas within Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT) that have experienced notable shifts in commercial burglary rates, particularly

during the COVID-19 lockdown period (Campedelli et al., 2020). The The study also examines the critical role of land use patterns in shaping the trajectory and spatial distribution of burglaries, building on existing research that highlights a significant link between land use composition and burglary incidence. Notably, research by Felson et al. (2022) in Detroit demonstrates that urban blocks with mixed land use are more vulnerable to burglary incidents than those predominantly residential in nature (Chen et al., 2017).

The primary objective of this study is to comprehensively elucidate the complex interplay between urban land use configurations and the evolving spatio-temporal patterns of burglary across Selangor, Kuala Lumpur, and Putrajaya, employing advanced geospatial techniques—namely Emerging Hot Spot Analysis (EHSA) and Space-Time Pattern Mining (STPM)—within an ArcGIS Pro framework. This integrative approach aims to bridge critical gaps in the existing crime mapping literature by systematically stratifying burglary data over distinct temporal intervals, thereby uncovering statistically significant clusters and trends that inform predictive resource allocation and strategic urban planning. Ultimately, the study seeks to provide robust empirical insights that can underpin targeted law enforcement interventions and sustainable urban safety initiatives, while also addressing the underexplored nexus between diverse land use types and property crime dynamics as highlighted by previous works (e.g., Bowers, 2004; Cheng & Williams, 2012).

Although there is a growing academic interest in hotspot analysis for understanding crime patterns, detailed investigations into the specific spatial distribution of crimes within these hotspots remain relatively scarce. This gap in the literature is addressed by the seminal work of Wang & Zhang (2019), which reveals that the majority of criminal incidents within hotspots tend to cluster in a narrowly defined area, away from the core of the hotspot. This study expands on these findings by performing a detailed micro-level analysis of crime distribution within hotspots, introducing the concept of a 'gyration radius' to identify areas with the highest concentration of criminal activity. It highlights the tendency for criminal incidents to cluster in the peripheral areas of hotspots. Additionally, this research employs the STKDE2 method, which uses univariate kernel functions to provide a more nuanced delineation of hotspots compared to traditional approaches (Hu et al., 2018; Wang & Zhang, 2019). This innovative research paves the way for advancements in crime prediction modeling and the development of tailored policing strategies that address the unique spatial characteristics of hotspots. By identifying hotspots as voxel cells with statistically significant density estimates, this study provides a solid foundation for more targeted law enforcement efforts (Koper et al., 2021; Moews et al., 2021).

The comprehensive study by Bunting et al. (2018) investigates the complex spatial and temporal dynamics of aggravated assault and larceny within Miami-Dade County from 2007 to 2015. Utilizing EHSA, the research categorizes various types of hotspots - emerging, persistent, continuous, and sporadic - and examines their spatial distribution. The study identifies significant spatial clusters of aggravated assaults in specific areas and examines the sociodemographic factors on these incidents. The findings suggest a nuanced approach to crime prevention and law enforcement, underscoring the importance of sophisticated geospatial analyses. Dewinter et al. (2022) explore the spatiotemporal dynamics of calls for service (CFS) in Antwerp, Belgium, focusing on urgency levels and police priority codes. Their analysis, which employs various statistical methods, highlights the relationship between priority codes and the allocation of police resources. The study advocates for integrating priority codes into patrol routing solutions, proposes adjustments to resource allocation and patrol strategies based on the spatiotemporal distribution of CFS. To understand the complex spatial patterns of various crime types, researchers have leveraged a range of techniques, including hotspot analysis, spatial regression, and crime mapping (Chainey et al., 2008; Short et al., 2010).

The primary objective of Hashim et al. (2019) is to intricately map and understand the complex patterns of crime across urban areas. Their research delves into the various factors influencing these patterns, including but not limited to population size, density, and the rate of urbanization. Leveraging the advanced analytical capabilities of ArcGIS Pro 2.4, the study employs innovative tools such as Emerging Hot Spot Analysis (Space Time) and Ordinary Least Squares (OLS) Regression to conduct an in-depth examination of urban crime patterns and their underlying causes. The findings reveal a troubling scenario: of the 102 neighborhoods analyzed, 54 were identified as significant crime hot spots, indicating disturbingly high crime rates. Moreover, the regression analysis highlights the critical impact of urbanization rates and population size, which together account for a significant 56% of the variation in crime rates, while population density having a minimal impact. Hashim et al. (2019) and advocate for the development of a novel fractal model to enhance the spatial mapping of crime hot spots, a crucial step toward effectively addressing urban crime. Their approach emphasizes the importance of accurately delineating the precise boundaries of high-crime areas, which is essential for the efficient deployment of law enforcement resources and the implementation of targeted crime prevention strategies.

Hashim et al. (2019) research covers an extensive analysis of 43 urban areas over an 84-month period (2011-2017), encompassing all 13 categories of crime, from violent offenses to property-related crimes, thus providing a comprehensive overview of the crime landscape. The study strongly advocates for future research to explore the specifics of various crime types, aiming to uncover nuanced patterns and the complex interplay of influencing factors. It emphasizes the need to incorporate economic and lifestyle factors in subsequent studies to better understand the causal relationships and broader impacts of crime on society. In terms of actionable outcomes, the study identifies specific neighborhoods as major contributors to the overall crime rate and recommends targeted crime prevention measures, including Crime Prevention Through Environmental Design (CPTED), Safe City Programs, and the Omnipresence Initiative, tailored to these high-risk areas. By integrating advanced hot spot analysis and correlation techniques, Hashim et al. (2019) also provide crucial insights that can significantly inform and enhance policing strategies and policy formulation aimed at reducing crime.

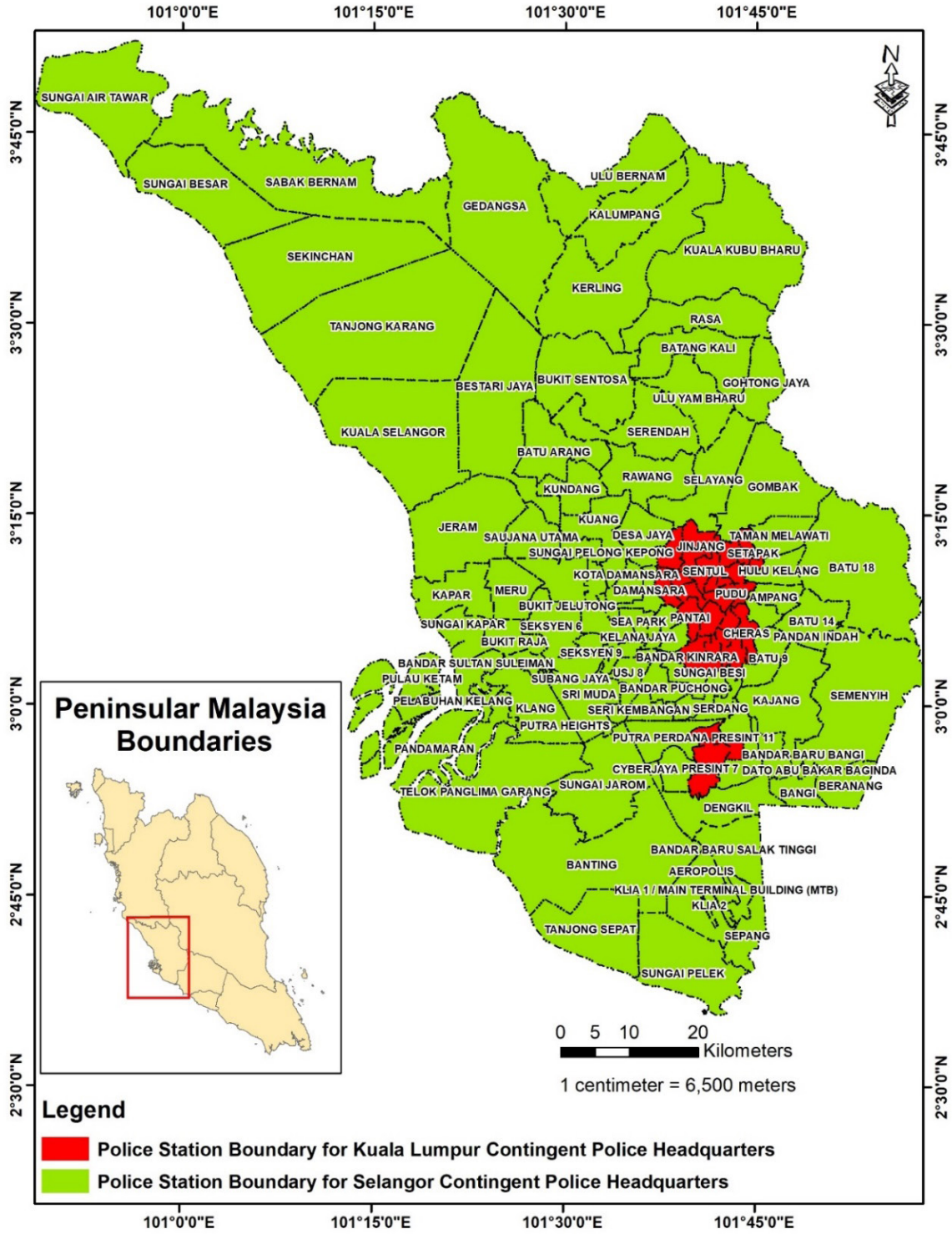
Hashim et al. (2019) study not only offers a detailed account of the current urban crime situation but also sets a clear direction for future research and practical interventions. Through its detailed analysis and insightful findings, this research serves as a crucial resource for government entities and law enforcement agencies seeking effective strategies to improve urban safety and combat crime. It marks a significant

step forward in the pursuit of more secure and resilient urban communities. Additionally, the study by Herrmann (2015) and He et al. (2023) provides valuable insights into the micro-level dynamics of crime distribution within these hot spot areas, revealing that the majority of crimes are concentrated within a small, distinct region within the broader hot spot. These findings have profound implications for policymakers, law enforcement agencies, and urban planners, as they highlight the need for a comprehensive and data-driven approach to tackling the complex issue of urban crime.

2. Methods

Study Area

This research casts its analytical gaze over the contiguous regions of Selangor, Kuala Lumpur Federal Territory (KLFT), and Putrajaya Federal Territory (KLFT), which collectively form a pivotal socio-economic axis within Malaysia. Selangor stands as a beacon of urban progress, encircling Kuala Lumpur Federal Territory (KLFT), the heart of Malaysia's economic vitality, propelling the country's industrial and service sectors forward. Covering an area of 7,950.91 square



Source: Data Collection/Analysis Division, Crime Prevention and Community Safety Department (CPCSD), Royal Malaysia Police Headquarters, Bukit Aman.

Figure 1. Police Stations Boundary for Selangor and Kuala Lumpur Contingent Police Headquarters (KLCPH)

kilometers, Selangor is home to a diverse population of 6,994,423, resulting in a population density of 880 individuals per square kilometer (Jabatan Perangkaan Malaysia, 2022a). The demographic composition in Selangor showcases a slight male dominance, with a gender ratio of 113 males for every 100 females, reflecting the nuanced social fabric of the region. Adjacent to Selangor, the Federal Territory of Kuala Lumpur (KLFT) epitomizes urban sophistication and cultural diversity, sprawling over 243 square kilometers. As Malaysia's melting pot, it houses 1,982,112 inhabitants, translating to a staggering population density of 8,157 people per square kilometer (Jabatan Perangkaan Malaysia, 2022a, 2022b). The demographic dynamics in Kuala Lumpur Federal Territory (KLFT) reflect a similar male predominance as in Selangor, with 115 males for every 100 females, further highlighting the region's vibrant societal structure.

In contrast, the Federal Territory of Putrajaya (PFT), established in 1999 as Malaysia's administrative heartland, covers just 49.3 square kilometers. Despite its smaller geographical footprint, Putrajaya is home to 109,202 residents, and boasts a population density of 2,215 individuals per square kilometer (Jabatan Perangkaan Malaysia, 2022b). This compact yet densely populated territory adds another layer of diversity to the study's geographic canvas. The confluence of these regions—Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT)—offers a rich demographic and socio-economic tapestry for academic exploration. The diversity and dynamism inherent in these areas provide fertile ground for investigating urban development, socio-economic trends, and governance practices. This study leverages the unique characteristics of each region to delve into the complex patterns of urbanization and development, aiming to contribute valuable insights to policy-making and strategic planning for sustainable urban growth and socio-economic prosperity (Ahmad et al., 2024; Jubit et al., 2024).

Spatial and Non Spatial Data

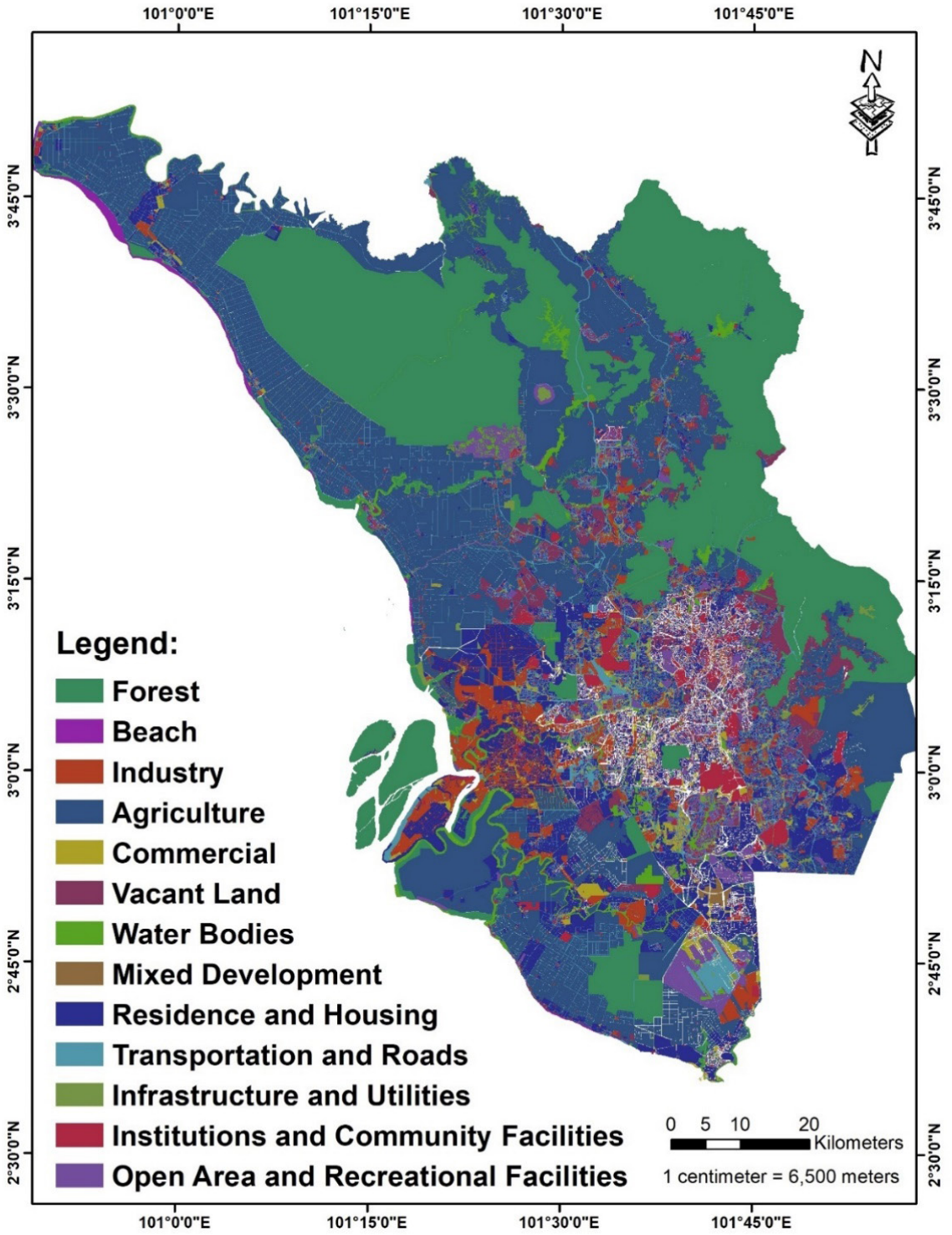
This study represents a significant foray into quantitative analysis, leveraging an extensive collection of secondary data meticulously compiled from 2015 to 2020. This data, sourced from the esteemed Intelligence/Operations/Records Division of the Royal Malaysia Police Headquarters, forms the foundation of our research. Focusing on the vibrant urban settings of Selangor, Kuala Lumpur Federal Territory (KLFT), and Putrajaya Federal Territory (PFT), we conduct an in-depth investigation into the relationship between property and violent crimes (Masron et al., 2024). This endeavor involves a detailed analysis of crime incidents, including their geographic locations, timing, and specific types of offenses, aiming to illuminate the underlying patterns and trends in urban crime (Ahmad et al., 2024). The geographical scope of this research is defined by the administrative boundaries of the police stations within the Selangor Contingent Police Headquarters (SCPH), encompassing 87 stations, and the Kuala Lumpur Contingent Police Headquarters (KLCPH), with its 24 stations. Utilizing the powerful capabilities of ArcGIS software, we have spatially organized and analyzed the collected data at the level of individual police station boundaries (Jamru et al., 2024; Masron et al., 2019, 2025; Mohd Ali et al., 2025; Zakaria et al., 2025). This meticulous spatial mapping enables a granular analysis of crime distribution across these urban areas, providing fresh perspectives on the spatial dynamics of crime and other studies (Adewuyi et al., 2017; Ahmad et al., 2024; Trisnawati & Khoirunurrofik, 2019).

A pivotal aspect of our analysis is the exploration of the intricate links between crime patterns and land use. The study examines a broad range of land use categories, including Water Bodies, Forests, Industrial Zones, Infrastructure and Utilities, Community Institutions and Facilities, Open Spaces and Recreational Areas, Residential and Housing Zones, Beachfronts, Mixed Development Areas, Transport Networks and Roads, Trade and Commercial Centers, Agricultural Lands, and Vacant Plots (Figure 2). This comprehensive survey is further enriched by incorporating 2018 land use data from the MyGDI Program, supported by the Malaysia Geospatial Data Infrastructure and the National Geospatial Center (Ahmad et al., 2024). This collaboration exemplifies the depth of our analysis, aiming to unravel the multifaceted relationships between various land uses and crime occurrences. By integrating sophisticated analytical tools with a diverse dataset, this research seeks to shed light on the complex dynamics of urban crime. The goal is to provide a robust empirical basis for policy development and strategic planning, ultimately contributing to the creation of safer and more secure urban environments.

Emerging Hot Spot Analysis (EHSA)

The integration of Emerging Hot Spot Analysis (EHSA) with Space Time Pattern Mining (STPM) stands at the forefront of contemporary analytical methodologies, enabling the exploration of dynamic changes in spatial point density or attribute values across space-time cubes. Utilizing the advanced capabilities of ArcMap (Parry & Locke, 2022), this approach is crucial for uncovering evolving trends and patterns within aggregated point data or raster layers. EHSA is particularly noteworthy for its capacity to classify spatial trends into eight distinct classifications: new, consecutive, intensifying, persistent, diminishing, sporadic, oscillating, and historical hot and cold spots. This classification provides a comprehensive overview of temporal patterns, enhancing our understanding of spatial phenomena over time (Parry & Locke, 2022). By generating space-time netCDF cubes through various STPM tools, EHSA employs the Spatial Relationship Concept to calculate the Getis-Ord Gi* statistics. This step is critical in identifying significant hotspots through Hot Spot Analysis, with the False Discovery Rate (FDR) correction enhancing the accuracy of hotspot detection. The completion of spatio-temporal hotspot analysis imbues each cube with essential statistical metrics, including z-scores, p-values, and specific hotspot classifications, thereby providing a granular view of the spatial distribution of phenomena under study (Parry & Locke, 2022).

The analysis extends further to explore the temporal evolution of these hot and cold spots through the application of the Mann-Kendall trend test. This examination reveals both the direction and magnitude of changes in spatial anomalies over time, providing a deeper insight into the underlying dynamics. EHSA's robust framework allows researchers to identify, categorize, and analyze crime hotspots and cold spots across different temporal scales effectively. Equipped with analytical outcomes such as z-scores and p-values for each location, along with comprehensive hotspot statistics for each cube, EHSA facilitates a sophisticated classification of the study area's locations. This enables a nuanced understanding of



Source: MyGDI Program [Malaysia Geospatial Data Infrastructure

Figure 2. Land Use 2018 for Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT)

the spatial-temporal dynamics within the regions of interest, providing invaluable insights for strategic planning and policy formulation aimed at addressing and mitigating the identified spatial phenomena.

3. Result and Discussion

The analysis is intricately designed to dovetail with the underlying spatio-temporal burglary data by first organizing incident records into space-time netCDF cubes, which encapsulate both the spatial distribution and the temporal evolution of events, and then applying Emerging Hot Spot Analysis (EHSA) to discern statistically significant clusters. This process inherently involves rigorous statistical computations: the Getis-Ord Gi* statistic is calculated to evaluate the degree of spatial clustering within the data, while the False Discovery Rate (FDR) correction is employed to control for multiple testing errors, thereby ensuring that the identified hotspots—categorized into new, consecutive, intensifying, persistent, diminishing, sporadic, oscillating, and historical—are not artifacts of random variation. Furthermore, the incorporation of the Mann-Kendall trend test quantitatively assesses the direction and magnitude of temporal trends in these hotspots,

producing vital metrics such as z-scores and p-values that provide a granular view of the evolving crime dynamics. In essence, the methodology seamlessly integrates advanced geospatial analysis with robust statistical calculations, ensuring that the analytical framework not only fits the complex nature of the data but also substantiates its findings through systematic, quantitative evaluation (Parry & Locke, 2022).

Midnight Burglary (12am-6.59am)

The utilization of Emerging Hot Spot Analysis (EHSA) within the midnight timeframe (12am-6.59am) across Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT) has revealed intricate insights into the spatial distribution of land use, underscoring the dynamic urban and environmental landscape of the study area. This detailed exploration, illustrated through Figures 3, 4, & 5, illuminates the evolving nature of land use across diverse temporal frames, identifying patterns such as Sporadic, Persistent, Oscillating, New Hot Spot, Intensifying, Historical, Diminishing, and Consecutive land use percentages. These findings reveal significant shifts in the landscape, highlighting the continuous transformation within the study region. For the Sporadic Percentage Area (km²) (%), the three lowest percentages are Mixed Development (0.00%), Beach (1.30%) and Water Bodies (2.35%) and the three highest percentages are Agriculture (11.93%), Industry (12.30%) and Residence and Housing (31.06%). For the Persistent Percentage Area (km²) (%), the three lowest percentages are Beach (0.005%), Mixed Development (0.24%) and Vacant Land (3.04%) and the three highest percentages are Transport and Roads (13.37%), Industry (17.87%) and Residence and Housing (30.95%). For the Oscillating Percentage Area (km²) (%), the three lowest percentages are Mixed Development (0.00%), Beach (0.24%) and Water Bodies (1.46%) and the three highest percentages are Transport and Roads (10.54%), Agriculture (25.79%) and Residence and Housing (27.57%).

As for the Intensifying Percentage Area (km²) (%), the three lowest percentages are Beach (0.00%), Mixed Development (0.50%), Agriculture (2.17%) and the three highest percentages are Industry (11.37%), Transport and Roads (11.99%) and Residence and Housing (31.18%). For the Historical Percentage Area (km²) (%), the five lowest percentage is Beach (0.00%), Mixed Development (0.00%), Agriculture (0.00%), Forest (0.00%) Vacant Land (0.00%) and Water Bodies (0.33%) and the three highest percentages are Industry (16.28%), Residence and Housing (28.24%) and Transport and Roads (28.90%). For the Diminishing Percentage Area (km²) (%), the three lowest percentages are Beach (0.00%), Mixed Development (0.00%), Agriculture (0.00%) and Infrastructure and Utilities (1.35%) and the three highest percentages are Forest (17.85%), Industry (28.73%) and Residence and Housing (29.92%). For the Consecutive Percentage Area (km²) (%), the three lowest percentages are Mixed Development (0.00%), Beach (0.63%) and Water Bodies (0.90%) and the three highest percentages are Industry (12.79%), Agriculture (19.84%) and Residence and Housing (26.65%).

The midnight analysis reveals that the lowest percentages of Sporadic land use areas encompass Beaches, Mixed Development, and Trade and Commercial zones, with higher percentages observed in Transportation and Roads, Agriculture, Industry, and notably, Residence and Housing sectors. This pattern suggests a concentration of midnight burglary activities in more populated and industrially active areas. Conversely, Persistent and Oscillating land use patterns exhibits a similar trend, with Residential and Housing, along with Industry and Agriculture, showing the highest percentages. This indicates areas of continual burglary risk. Notably, the New Hot Spot analysis reveals a significant prevalence of Residential and Housing (64.92%), followed by Agriculture and Industry. This underscores the emergence of new burglary hotspots primarily in residential areas. This

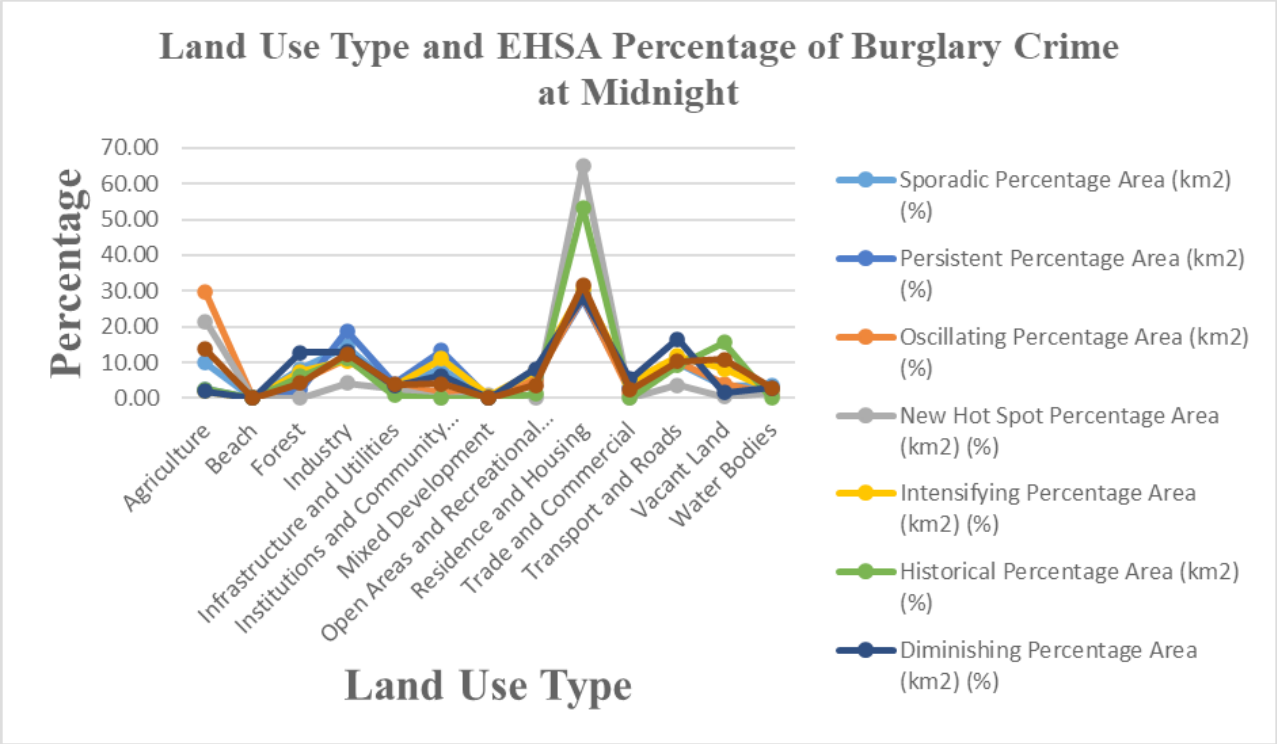


Figure 3: Land Use Type and EHSA Percentage of Burglary Crime at Midnight (12am-6.59am)

trend is mirrored in the Intensifying and Historical land use categories, where Residential and Housing once again dominate, highlighting a sustained vulnerability of these areas to burglary incidents.

The Diminishing and Consecutive categories further elucidate areas where burglary risks are either reducing or persistently high, respectively, with Residence and Housing remaining a consistent focus across different temporal analyses. These variations in land use patterns underscore the critical need for strategic urban planning and environmental management to address the challenges posed by the spatial distribution of burglary incidents. These EHSA findings are instrumental for urban planners, environmental managers, and policymakers, providing a comprehensive overview of land use dynamics in relation to burglary risks. The pronounced emphasis on Residential and Housing areas across multiple temporal frames calls for targeted infrastructural and community service enhancements to support growing populations while mitigating burglary risks. Meanwhile, industrial and commercial zones require vigilant environmental compliance and impact mitigation strategies to ensure sustainable urban development and secutiry.

Furthermore, the identification of areas with low or diminishing land use percentages presents unique opportunities for conservation or redevelopment, aiming to balance urban growth with environmental sustainability.

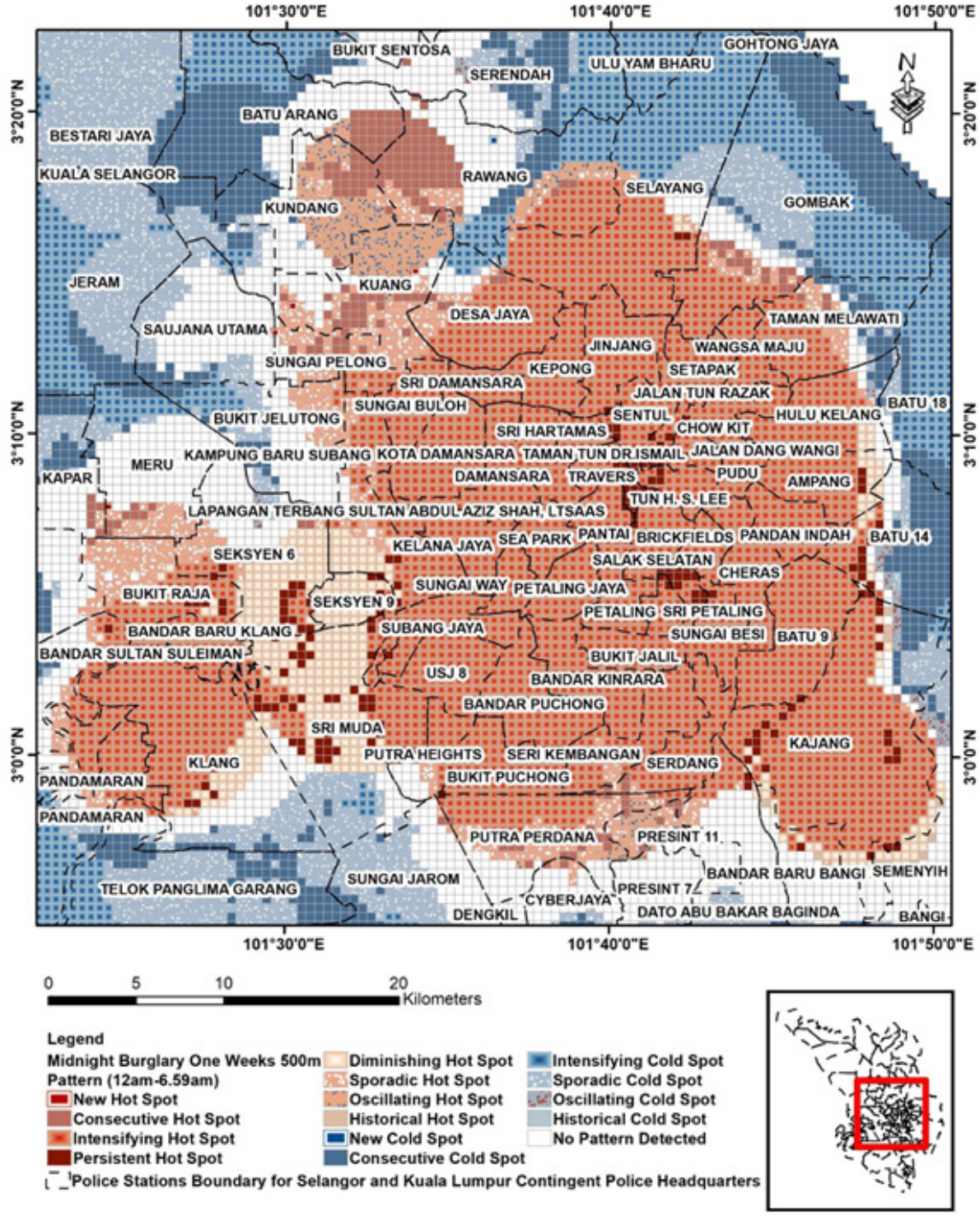


Figure 4: Midnight (12am-6.59am) Burglary EHSA by 1 weeks and 500 m

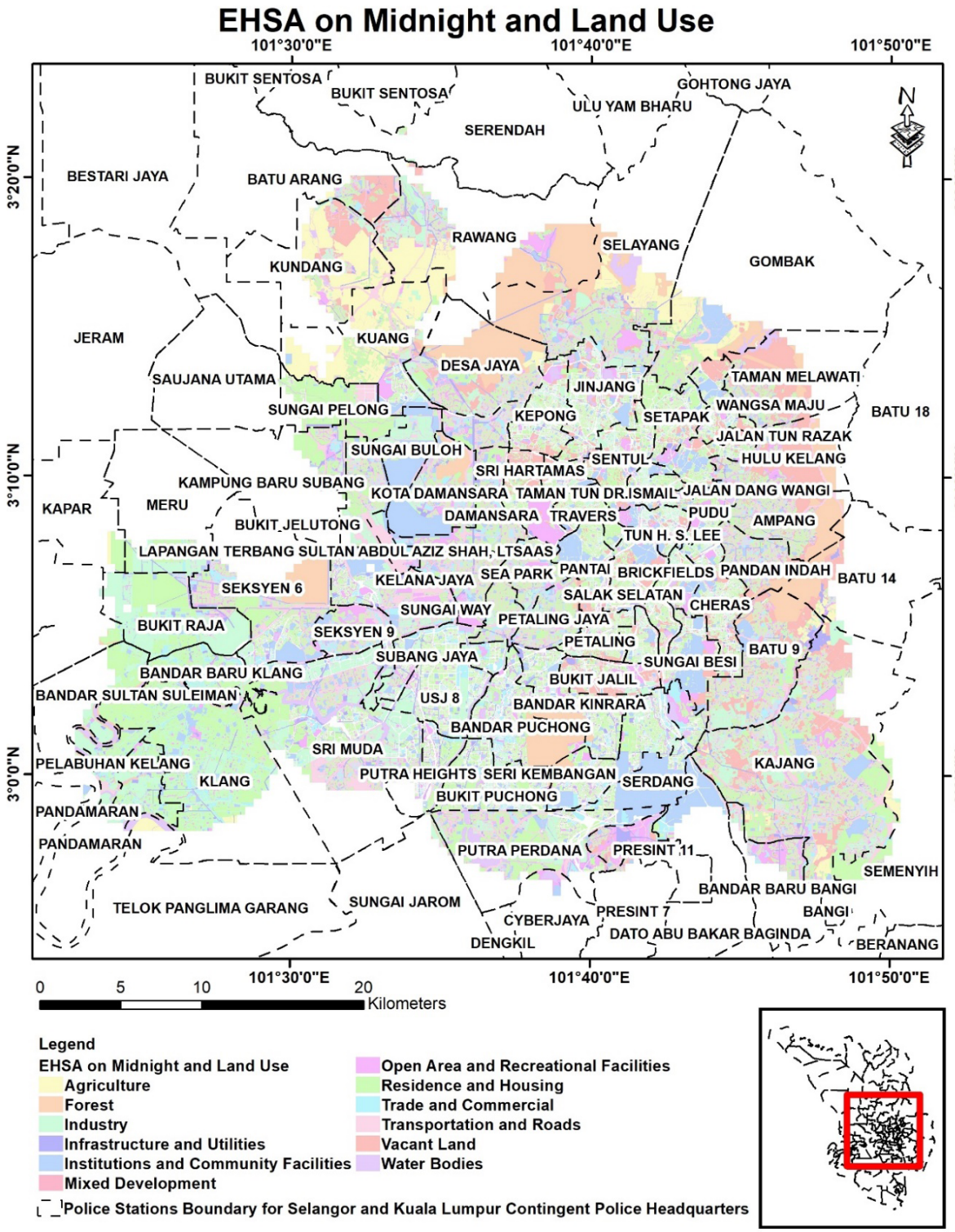


Figure 5: Midnight (12am-6.59am) Burglary EHSA by 1 weeks and 500 m with Land Use

Conversely, areas marked by high transportation and road percentages highlight the imperative for adept transportation planning to meet infrastructure demands effectively. The EHSA results furnish pivotal insights into the nuanced spatial distribution of land use categories during the midnight timeframe, laying a solid foundation for informed urban and environmental policymaking within Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT). A detailed understanding of land use distribution and its implications for burglary risks is essential for crafting comprehensive strategies that promote sustainable urban development, environmental preservation, and enhanced livability. Future research should continue to monitor these patterns over time, enabling adaptive planning strategies that address the evolving urban and environmental landscape of the region.

Morning Burglary (7am-11.59am)

The analysis conducted through Emerging Hot Spot Analysis (EHSA) for the morning timeframe (7am-11.59am) in Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT) reveals detailed insights into the spatial distribution and dynamics of land use categories across these regions. The findings, illustrated in

Figures 6, 7, & 8, provide a comprehensive view of the urban and environmental characteristics prevalent within the study area during the morning hours. The EHSA outcomes for the morning period reveal significant patterns in land use distribution. Notably, the lowest percentages of Sporadic land use areas were observed in Mixed Development (0.00%), Beaches (1.30%), and Water Bodies (2.35%). In contrast, the highest percentages were found in Agriculture (11.93%), Industry (12.30%), and Residence and Housing (31.06%). This suggests a dispersed occurrence of morning burglaries, predominantly in residential areas, followed by industrial and agricultural zones. The analysis of Persistent Percentage Area reveals the Beaches (0.005%), Mixed Development (0.24%), and Vacant Land (3.04%) as having the lowest percentages. In contrast, Transport and Roads (13.37%), Industry (17.87%), and Residence and Housing (30.95%) emerged as areas with a consistent presence of burglaries, underscoring ongoing security challenges in these sectors.

The Oscillating Percentage Area analysis identified the lowest percentages in Mixed Development (0.00%), Beaches (0.24%), and Water Bodies (1.46%). Conversely, Transport and Roads (10.54%), Agriculture (25.79%), and Residence and Housing (27.57%) recorded the highest percentages, indicating fluctuating burglary trends in these areas. In the Intensifying Percentage Area category, the lowest percentages were found in Beaches (0.00%), Mixed Development (0.50%),

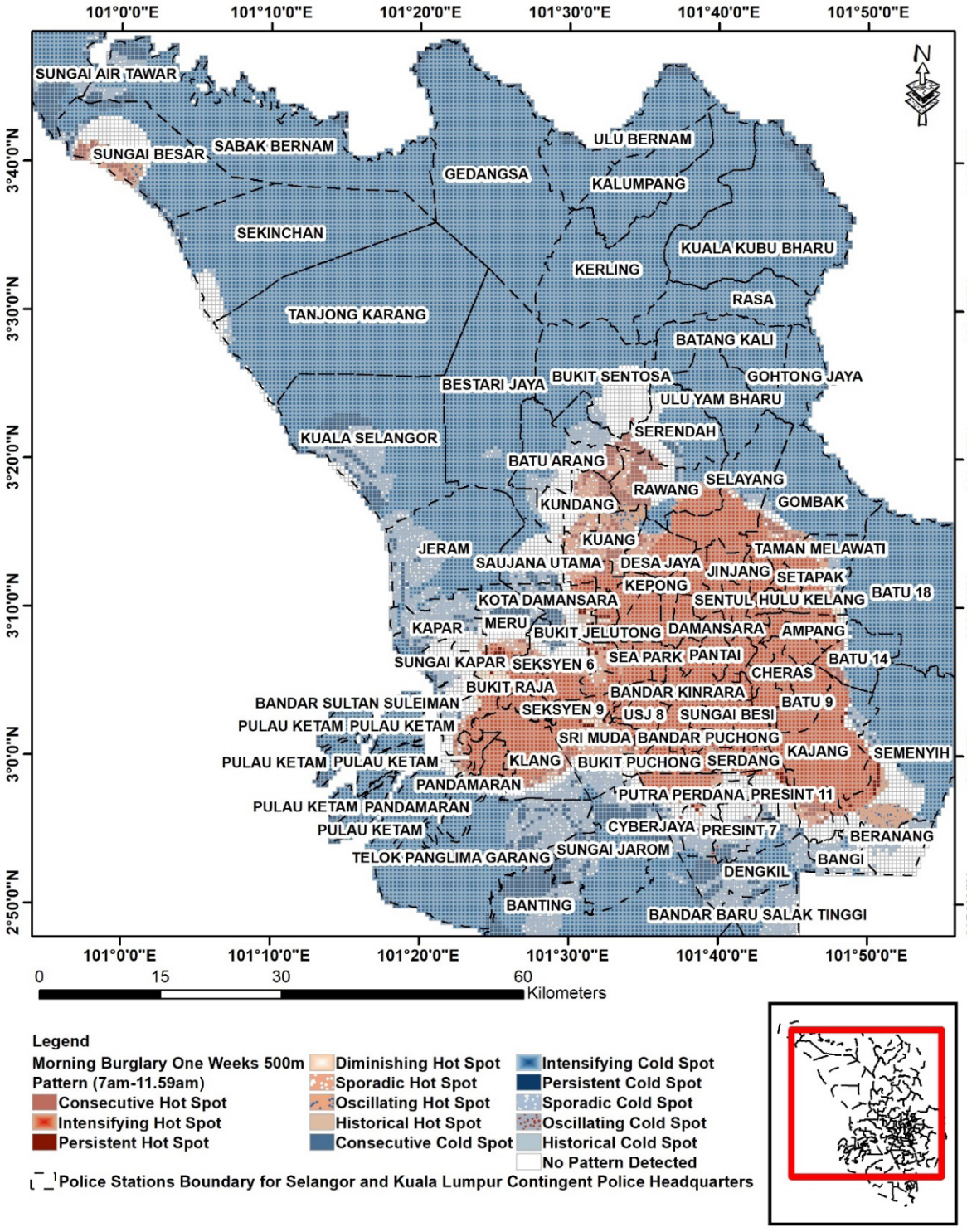


Figure 6. EHSA for Burglary Crimes in the Morning (7am-11.59am) by 1 weeks and 500 m.

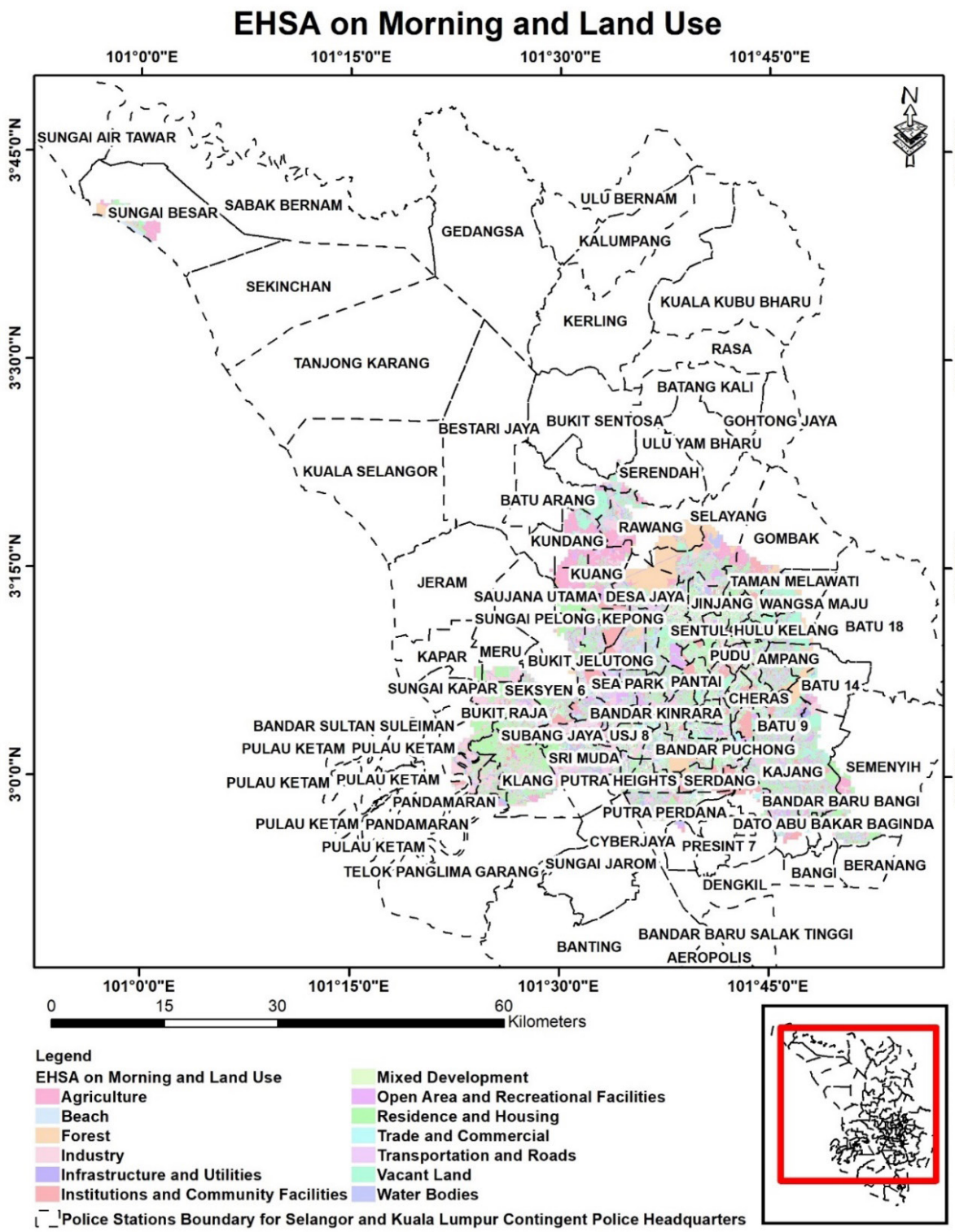


Figure 7. Morning (7am-11.59am) Burglary EHSA by 1 weeks and 500 m with Land Use

and Agriculture (2.17%), while the highest were in Industry (11.37%), Transport and Roads (11.99%), and Residence and Housing (31.18%). These highlights areas experiencing an increase in burglary incidents. The Historical Percentage Area analysis pointed out minimal activity in Beaches, Mixed Development, Agriculture, Forests, Vacant Land, and Water Bodies. In contrast, Industry (16.28%), Residence and Housing (28.24%), and Transport and Roads (28.90%) had the highest percentages, suggesting longstanding hotspots for burglaries. For the Diminishing Percentage Area land uses such as Beaches, Mixed Development, Agriculture, and Infrastructure and Utilities showed the lowest percentages, while Forests (17.85%), Industry (28.73%), and Residence and Housing (29.92%) recorded the highest, indicating a decline in burglary rates in these sectors. The Consecutive Percentage Area analysis reveals the lowest percentages in Mixed Development, Beaches, and Water Bodies, while the highest percentages are in Industry (12.79%), Agriculture (19.84%), and Residence and Housing (26.65%). This pattern suggests areas where burglaries have been consistently reported over time.

The EHSA results from the morning period underscore significant land use patterns, highlighting the pronounced vulnerability of residential areas to burglary incidents, followed by industrial, transport, and agricultural zones.

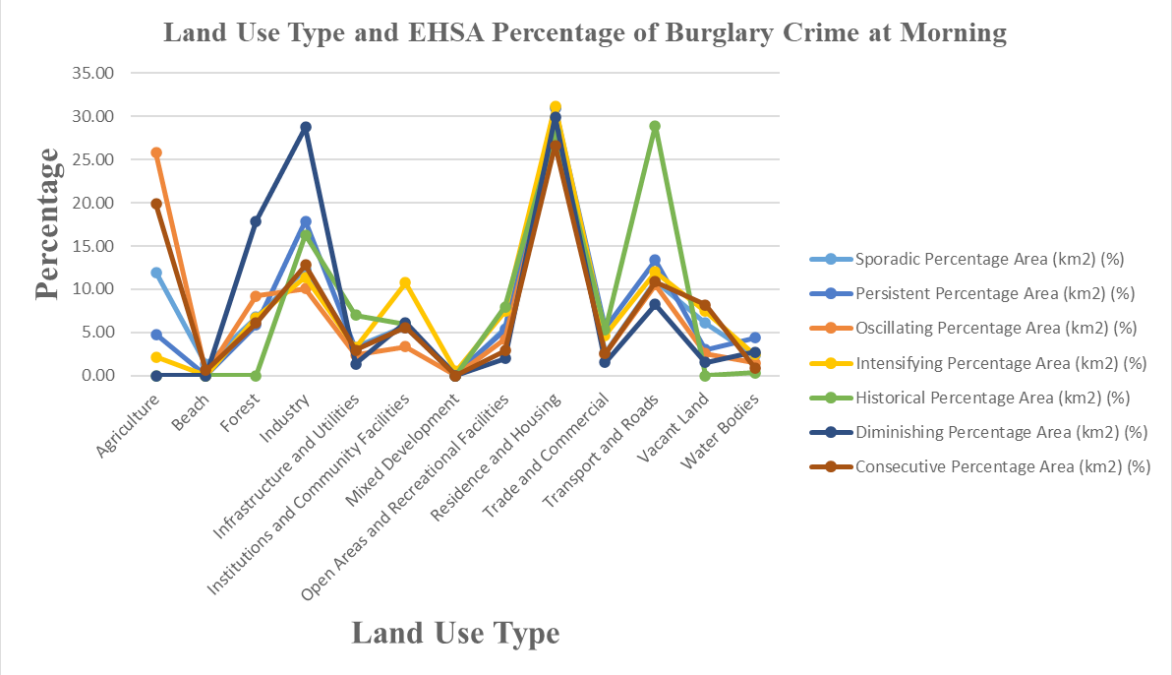


Figure 8. Land Use Type and EHSA Percentage of Burglary Crime at Morning (7am-11.59am)

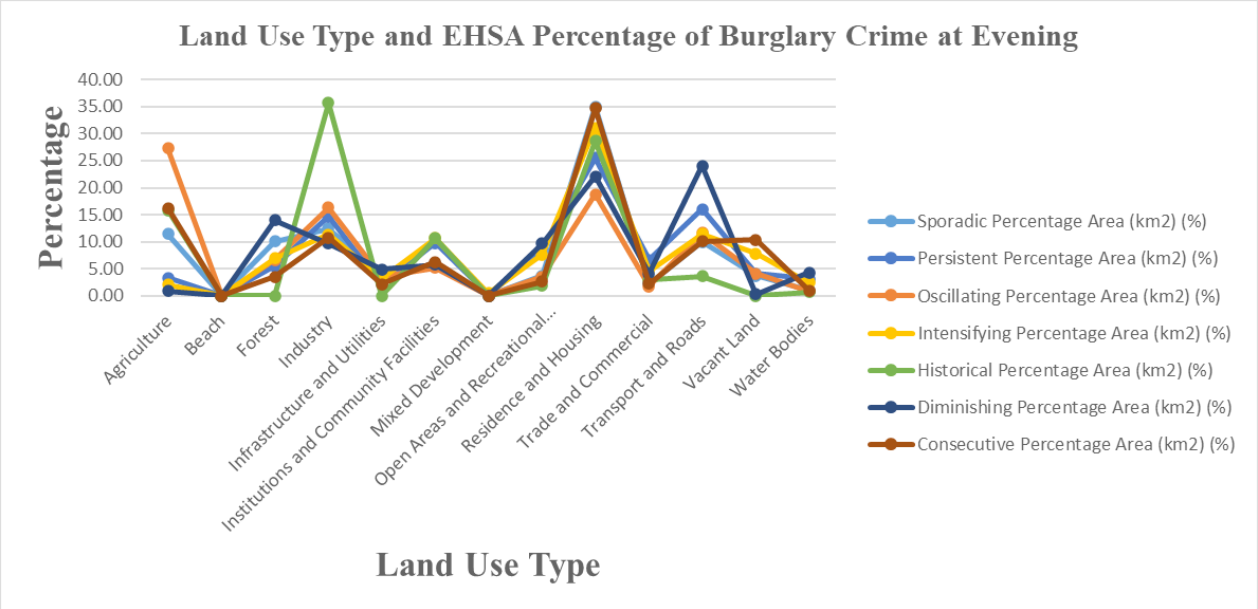


Figure 9. Land Use Type and EHSA Percentage of Burglary Crime at Evening (12pm-6.59pm)

These spatial distributions necessitate targeted interventions in urban planning and environmental management to mitigate burglary risks effectively. The data emphasizes the importance of developing strategic measures for infrastructure development, environmental compliance, and community services, tailored to the specific needs and challenges of different land use categories. The morning burglary analysis provides critical insights into the spatial dynamics of land use categories in Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT), offering a solid foundation for informed urban development and crime prevention strategies. Future research should continue to track these patterns over time, enabling the development of adaptive and proactive responses to urban and environmental challenges, thereby fostering a safer and more sustainable living environment for the residents of these regions.

Evening Burglary (12pm-6.59pm)

The Emerging Hot Spot Analysis (EHSA) conducted for the evening timeframe (12pm-6.59pm) across Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT) unveils significant insights into the spatial distribution of land use categories. Figures 9, 10, & 11 graphically illustrate these distributions, providing a comprehensive overview of urban development and environmental characteristics within these areas. The analysis identifies distinct patterns in land use, highlighting areas of sporadic, persistent, oscillating, intensifying, historical, diminishing, and consecutive land use trends. These patterns collectively offer a nuanced understanding of the region's evolving landscape, essential for strategic urban planning and policymaking. For the Sporadic Percentage Area (km^2) (%), the three lowest percentages are Mixed Development

(0.00%), Beach (0.09%) and Water Bodies (1.04%), while the three highest percentages are Agriculture (11.45%), Industry (12.47%) and Residence and Housing (35.01%). Meanwhile, the Persistent Percentage Area (km^2) (%), indicated that the three lowest percentages are Beach (0.00%), Mixed Development (0.21%) and Infrastructure and Utilities (2.12%), while the three highest percentages are Industry (14.71%), Transport and Roads (16.04%) and Residence and Housing (25.55%).

For the Oscillating Percentage Area (km^2) (%), the three lowest percentages are Beach (0.00%), Mixed Development (0.00%) and Water Bodies (0.94%) and the three highest percentages are Industry (16.39%), Residence and Housing (18.76%) and Agriculture (27.32%). Meanwhile, the Intensifying Percentage Area (km^2) (%), revealed the three lowest percentages are Beach (0.00%), Mixed Development (0.55%) and Agriculture (2.06%) and the three highest percentages are Industry (11.36%), Transport and Roads (11.49%) and Residence and Housing (31.10%). The Historical Percentage Area (km^2) (%), indicated that the six lowest percentages are Beach (0.00%) Mixed Development (0.00%), Infrastructure and Utilities (0.00%), Forest (0.00%), Vacant Land (0.00%) and Water Bodies (0.74%), while the three highest percentages are Agriculture (15.81%), Residence and Housing (28.68%) and Industry (35.66%). On the other hand, the Diminishing Percentage Area (km^2) (%) indicated that the three lowest percentages are Beach (0.00%), Mixed

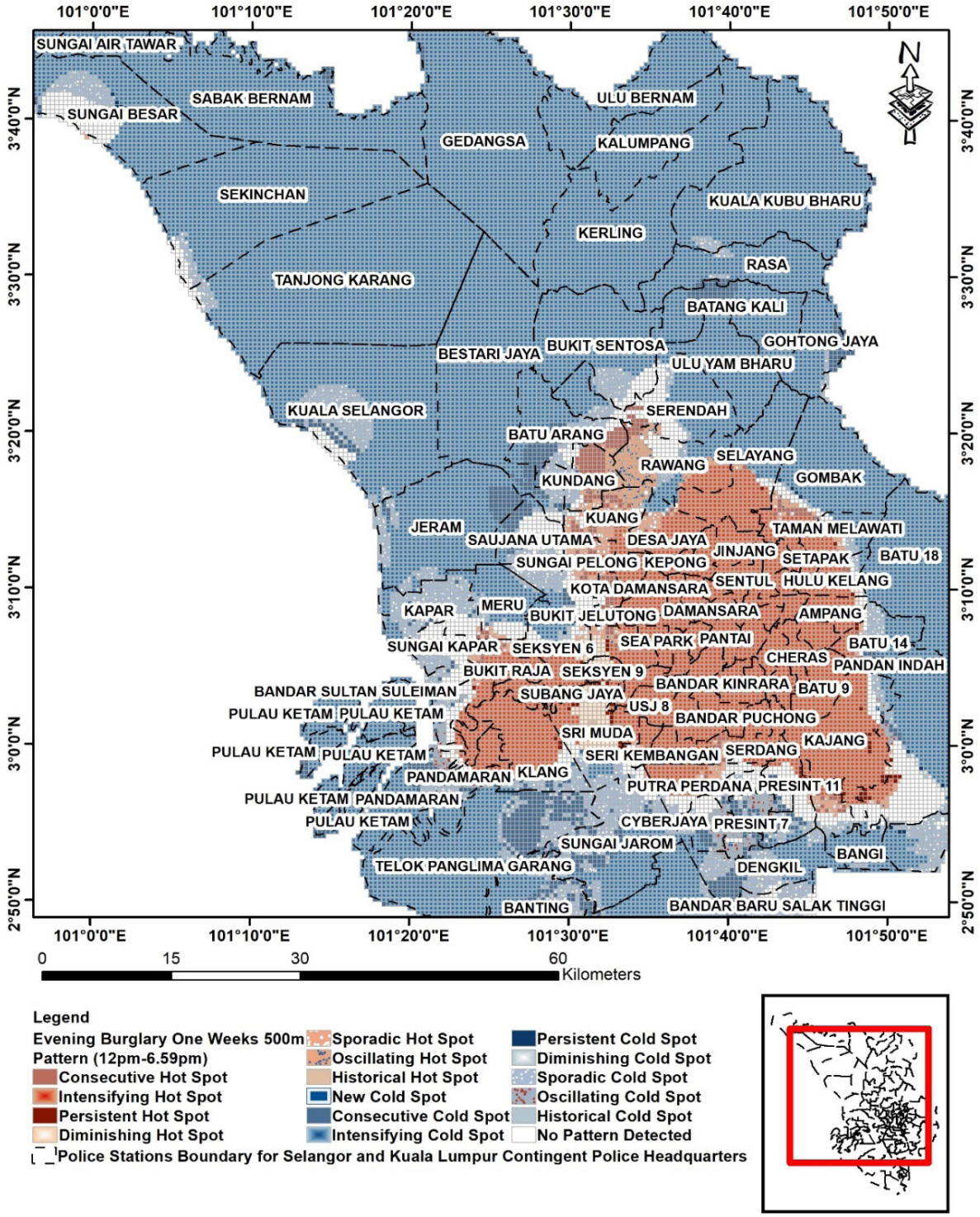


Figure 10. EHSA for Burglary Crimes in the Evening (12pm-6.59pm) by 1 weeks and 500 m.

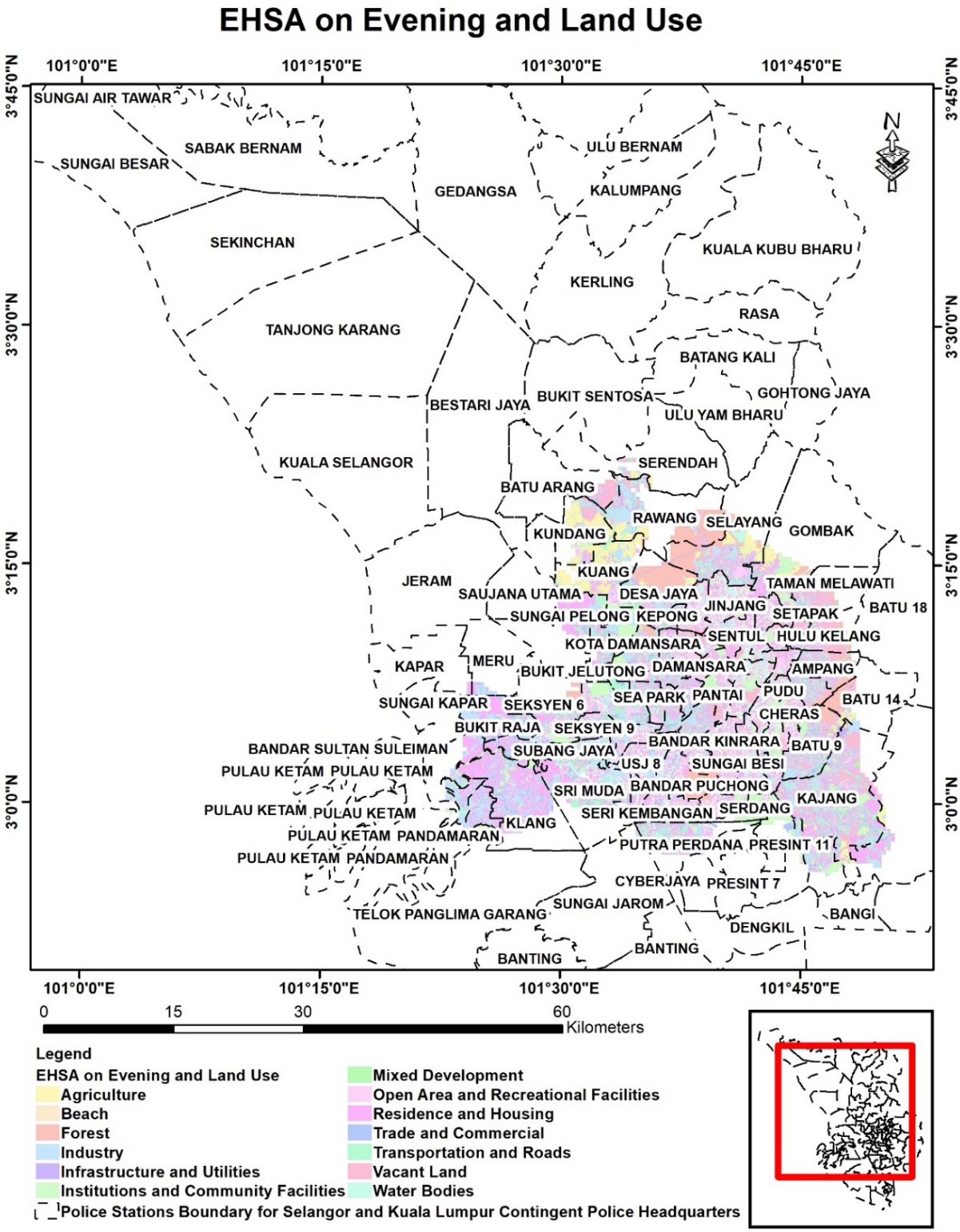


Figure 11. Evening (12pm-6.59pm) Burglary EHSA by 1 weeks and 500 m with Land Use

Development (0.00%) and Vacant Land (0.32%), while the three highest percentages are Forest (14.05%), Residence and Housing (22.08%) and Transport and Roads (24.05%). For the Consecutive Percentage Area (km^2) (%), the three lowest percentages are Beach (0.00%), Mixed Development (0.00%) and Water Bodies (0.99%) and the three highest percentages are Industry (10.73%), Agriculture (16.23%) and Residence and Housing (34.70%).

Examining the Sporadic Percentage Area (km^2) (%), the three land use categories with the lowest percentages are Mixed Development (0.00%), Beach (0.09%), and Water Bodies (1.04%). Conversely, the categories with the highest percentages are Agriculture (11.45%), Industry (12.47%), and Residence and Housing (35.01%). Similarly, the analysis of Persistent Percentage Area (km^2) (%) reveals notable disparities, with Industry (14.71%), Transport and Roads (16.04%), and Residence and Housing (25.55%) occupying the top percentages, while Beach (0.00%), Mixed Development (0.21%), and Infrastructure and Utilities (2.12%) occupying the lowest percentages. The Oscillating Percentage Area (km^2) (%) follows a similar trend, highlighting Industry (16.39%), Residence and Housing (18.76%), and Agriculture (27.32%) as the dominant categories. The Intensifying Percentage Area (km^2) (%) showcases the rising prominence

of Industry (11.36%), Transport and Roads (11.49%), and Residence and Housing (31.10%). On the other hand, the Historical Percentage Area (km²) (%) underscores the persistent dominance of Agriculture (15.81%), Residence and Housing (28.68%), and Industry (35.66%). The Diminishing Percentage Area (km²) (%) reflects shifts in land use, with Forest (14.05%), Residence and Housing (22.08%), and Transport and Roads (24.05%) exhibiting increasing presence. Lastly, the Consecutive Percentage Area (km²) (%) highlights the consistent prevalence of Industry (10.73%), Agriculture (16.23%), and Residence and Housing (34.70%).

Sporadic trends reveal a concentration of burglary activities in agricultural, industrial, and residential areas, with the highest percentage in Residence and Housing (35.01%). This suggests a dispersed pattern of burglaries across these sectors during the evening. Persistent trends further underscore the significance of residential areas (25.55%), followed closely by Transport and Roads, and Industrial Zones, indicating ongoing burglary risks in these areas. Oscillating trends point to a fluctuation in burglary incidents, with Agriculture, Residence and Housing, and Industry facing the highest variability. This fluctuation could reflect changing patterns of activity in these areas during the evening. Intensifying trends highlight a growing concern in Residential Areas (31.10%), alongside Industry and Transport and Roads, suggesting an increase in burglary activities in these sectors. Historical trends emphasize the enduring presence of burglaries in Industrial (35.66%), Residential (28.68%), and Agricultural Areas, indicating long-standing hotspots. Diminishing trends, on the other hand, show a decline in burglary incidents, particularly in Forests, Residential Areas, and Transport and Roads, suggesting effective mitigation efforts or shifts in burglar focus. Consecutive trends reveal a consistent pattern of burglaries in Residential Areas (34.70%), Agriculture, and Industry, underscoring the need for ongoing vigilance and preventive measures in these sectors.

The EHSA outcomes are crucial for urban planning, environmental management, and sustainable development, providing a detailed landscape of land use dynamics within the study region. The analysis highlights the critical need for targeted interventions in areas with high residential, industrial, and agricultural land use to mitigate burglary risks. It also suggests opportunities for conservation or redevelopment in areas with low percentages of specific land use categories, while emphasizing the importance of efficient transportation planning to meet infrastructure demands. The evening burglary analysis via EHSA offers vital insights for informed decision-making in urban and environmental policy formulation. Understanding the complex distribution of land use categories and their implications for burglary patterns is essential for developing comprehensive strategies that promote sustainable urban growth, environmental preservation, and enhanced community safety. Continued research and monitoring are necessary to track temporal trends and shifts in land use patterns, enabling adaptive planning strategies that effectively address the evolving challenges faced by Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT).

Night Burglary (7pm-11.59pm)

The Emerging Hot Spot Analysis (EHSA) performed for the night timeframe (7pm-11.59pm) across Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT) offers enlightening insights into the spatial arrangement of land use categories and their respective percentages within these regions. Illustrated through Figures 12, 13, & 14, these findings highlight the complex urban development and environmental characteristics prevalent within the study area during the night. The Sporadic Percentage Area (km²) (%) the three lowest percentages are Beach (0.00%), Mixed Development (0.00%) and Trade and Commercial (1.91%). The three with the highest percentages are Forest (10.23%), Industry (14.65%) and Residence and Housing (33.80%). The Persistent Percentage Area (km²) (%) shows that the three lowest percentages are Beach (0.00%), Mixed Development (0.00%) and Agriculture (1.86%). The three highest percentages are Institutions and Community Facilities (12.71%), Transport and Roads (16.50%) and Residence and Housing (33.36%). The Oscillating Percentage Area (km²) (%) reveals that the three lowest percentages are Beach (0.00%), Mixed Development (0.00%) and Water Bodies (0.86%). The three highest percentages are Industry (11.17%), Residence and Housing (25.14%) and Agriculture (30.89%). The Intensifying Percentage Area (km²) (%) indicates that the three lowest

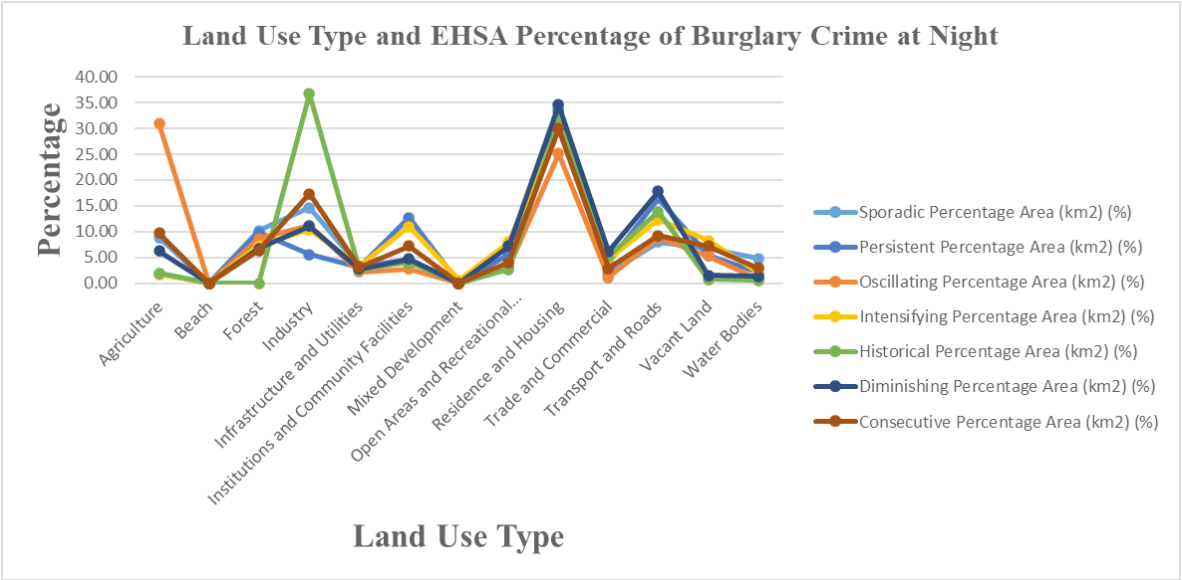


Figure 12. Land Use Type and EHSA Percentage of Burglary Crime at Night (7pm-11.59pm)

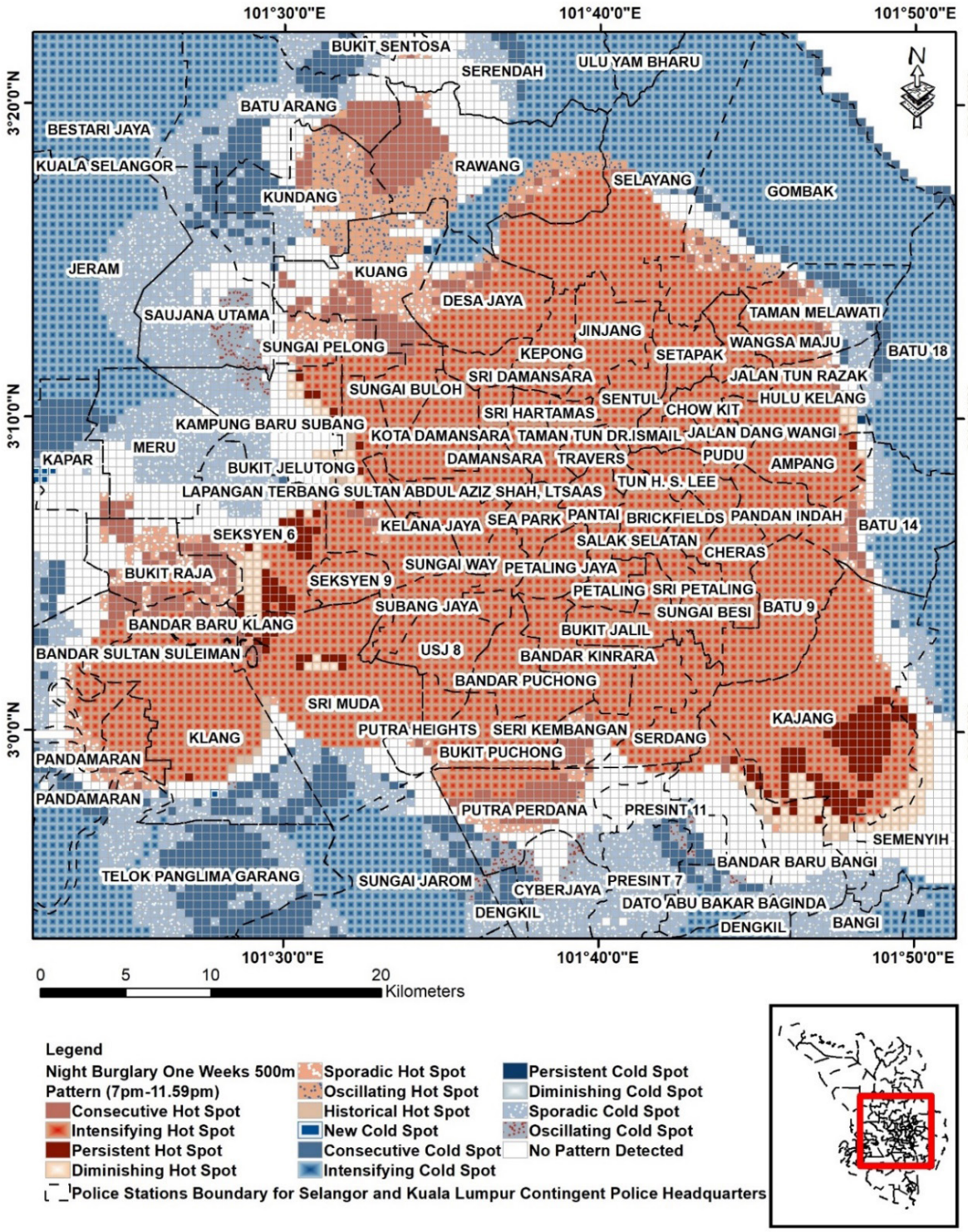


Figure 13. EHSA for Burglary at Night (7pm-11.59pm) by 1 weeks and 500 m.

percentages are Beach (0.00%), Mixed Development (0.59%), and Agriculture (1.75%). The three highest percentages are Institutions and Community Facilities (10.95%), Transport and Roads (12.33%) and Residence and Housing (30.29%). The Historical Percentage Area (km^2) (%) lists the four lowest percentages as Beach (0.00%), Mixed Development (0.00%), Forest (0.00%) and Water Bodies (0.58%). The three highest percentages are Transport and Roads (13.90%), Residence and Housing (31.47%) and Industry (36.68%). The Diminishing Percentage Area (km^2) (%) shows that the three lowest percentages are Beach (0.00%), Mixed Development (0.00%), Water Bodies (1.30%) and the three highest percentages are Industry (11.03%), Transport and Roads (17.84%) and Residence and Housing (34.63%). The Consecutive Percentage Area (km^2) (%) indicates that the three lowest percentages are Beach (0.00%), Mixed Development (0.00%) and Trade and Commercial (2.88%). The three highest percentages are Agriculture (9.76%), Industry (17.34%) and Residence and Housing (30.00%).

The discussion about the Distribution Patterns such as Sporadic Percentage Area shows the least presence in Beaches and Mixed Development, both at 0.00%, and Trade and Commercial areas at 1.91%. Conversely, Forests (10.23%), Industry (14.65%), and Residence and Housing (33.80%)

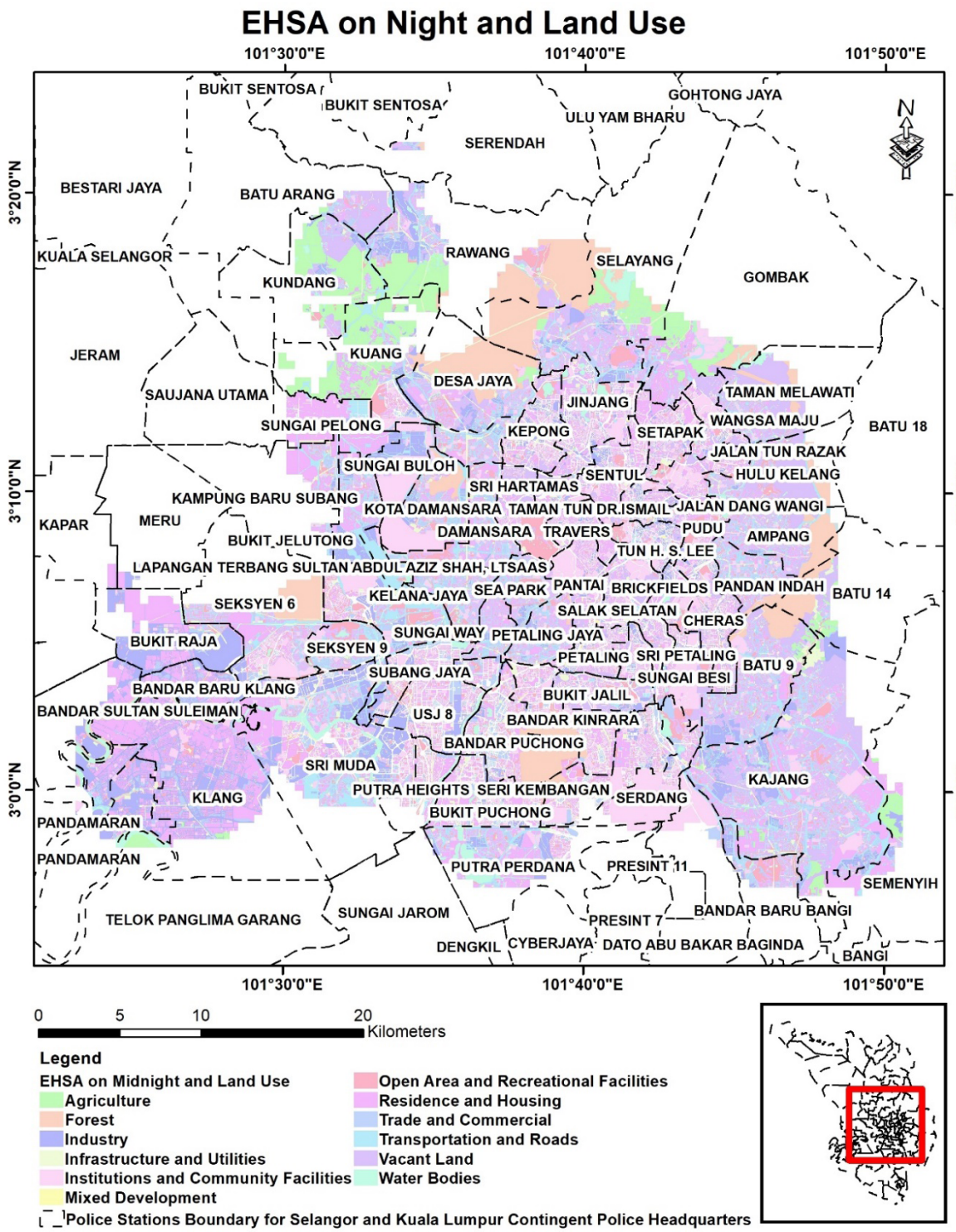


Figure 14. Night (7pm-11.59pm) Burglary EHSA by 1 weeks and 500 m with Land Use

exhibit the highest sporadic percentages. This suggests a varied distribution of night-time burglary incidents, with a notable concentration in residential areas. In the Persistent Percentage Area, the lowest percentages were found in Beaches and Mixed Development (both at 0.00%), and Agriculture at 1.86%. The highest percentages were in Institutions and Community Facilities (12.71%), Transport and Roads (16.50%), and Residence and Housing (33.36%), indicating a consistent pattern of burglaries in these areas. Oscillating Percentage Area with no occurrences in Beaches and Mixed Development and minimal in Water Bodies (0.86%). The oscillating trends are most pronounced in Industry (11.17%), Residence and Housing (25.14%), and Agriculture (30.89%), highlighting fluctuating burglary risks. Intensifying Percentage Area analysis points to minimal intensification in Beaches and Mixed Development, with Agriculture at 1.75%. The most intensification is seen in Institutions and Community Facilities (10.95%), Transport and Roads (12.33%), and Residence and Housing (30.29%), suggesting growing burglary concerns in these areas. The Historical Percentage Area trends show negligible occurrences in Beaches, Mixed Development, and Forests, with the highest in Transport and Roads (13.90%), Residence and Housing (31.47%), and Industry (36.68%), underscoring longstanding hotspots. The Diminishing Percentage Area category reflects a reduction in burglary activities in Beaches and Mixed Development, with a significant presence in Industry

(11.03%), Transport and Roads (17.84%), and Residence and Housing (34.63%), indicating areas where burglary risks are declining. The Consecutive Percentage Area demonstrates consistent burglary patterns, with the lowest in Beaches and Mixed Development and the highest in Agriculture (9.76%), Industry (17.34%), and Residence and Housing (30.00%).

The spatial distribution identified through EHSA during the night highlights the critical need for targeted urban planning and environmental management efforts. Areas with high residential, industrial, and agricultural percentages require strategic attention to mitigate burglary risks, enhance infrastructure, and ensure community safety. Conversely, areas with low percentages in certain land use categories may present opportunities for redevelopment or conservation efforts. The consistent emphasis on residential areas across various temporal frames necessitates improved infrastructure and community services to support population growth. Similarly, industrial and commercial zones demand strict environmental monitoring and compliance measures. The EHSA results for the night period provide a foundational understanding of land use distribution within Selangor, Kuala Lumpur Federal Territory (KLFT) and Putrajaya Federal Territory (PFT), essential for informed urban development and crime prevention strategies. These insights are crucial for fostering sustainable urban growth, preserving environmental quality, and enhancing livability. Ongoing research and monitoring are essential to capture temporal trends and shifts in land use patterns, enabling adaptive planning strategies to effectively address the evolving urban and environmental challenges effectively.

4. Conclusion

The integrative EHSA framework applied across Selangor, Kuala Lumpur FT, and Putrajaya FT reveals a complex interplay between land use dynamics and burglary incidents, with residential, industrial, and agricultural zones emerging as critical vulnerability areas. This refined analysis underscores the need for targeted urban planning and robust environmental monitoring, while simultaneously providing a solid empirical basis for data-driven interventions aimed at mitigating crime risks in rapidly urbanizing settings. Moreover, the study highlights significant research gaps that warrant further investigation. Notably, there is a pressing need for longitudinal studies to capture the evolving influence of socio-economic factors, technological advancements, and policy shifts on burglary dynamics. Future research integrating qualitative insights from community engagement and advanced predictive models, such as machine learning algorithms, will be pivotal in developing sustainable crime prevention strategies and fostering resilient urban environments.

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