AN INVESTIGATION OF THE RELATIONSHIP BETWEEN ROAD TYPES AND SPATIAL PATTERNS IN THE DISTRIBUTION OF COMMERCIAL ACTIVITIES IN KOTTAWA, SRI LANKA

Hiruni Siriwardana[1], Susantha A.L. Amarawickrama[2]
[1,2]Department of Town & Country Planning,
University of Moratuwa, Sri Lanka
[1]siriwardanahher.19@uom.lk
[2]susanthaa116@uom.lk

ABSTRACT -The transportation network profoundly influences the location of commercial activities. The study aims to identify the spatial distribution of commercial activities in the Sri Lankan context. This study examines which road types (A, B, C, D & E class) correlate with specific commercial activities and how commercial activities are distributed in Sri Lanka. Kottawa, a Sri Lankan transportation hub, was the case study. Point of interest (POI) (Big Data) and road network data were analyzed using the Pearson correlation coefficient. The results show that A class roads show significant correlations with auto services (0.810), food and catering (0.707), medicine and healthcare (0.814), textile (0.226), and recreation activities (0.715). B class roads are correlated with finance (0.266) and retail activities (0.281). Recreation activities correlate positively with C class roads but negatively with auto services. Food and catering correlate positively with D and E class roads but negatively with recreation. Urban planners and policymakers can use these findings to guide the organic growth of commercial hubs.

Keywords: Road types; Commercial types; Points of interest; Correlation

1. INTRODUCTION

Commercial activity outlets are the main object of study of commercial geographic spaces to identify the characteristics of commercial distribution [1]. With rapid urbanization, transportation networks become a crucial factor in deciding the location of commercial activities [2][3]. Previous studies have identified a relationship between commercial activities and transportation networks mainly based on street centrality characteristics. Various kinds of transportation routes are linked to different speeds and capacities, affecting commuter journeys, and subsequently influencing the demand for various types of commercial activities. However, existing literature does not specifically address the relationship between commercial activities and transportation infrastructure, such as road types. This study examines the spatial distribution of commercial activities in terms of road types, addressing the gap in the existing literature.

2. MATERIALS AND METHODS

2.1. Case study area

Kottawa, situated within the Colombo Metropolitan area in the Western Province of Sri Lanka, holds significance as a third-order city in the urban hierarchy of the region. Kottawa is positioned along the High-Level Corridor, one of the seven transport corridors in the Western Province, it is part of the 3K township development. The study focuses on a 3 km buffer zone, examining variations in the distribution of commercial activities from high density to low density.

Sri Lanka Society of
Transport and Logistics

2.2. Data Collection

Two main variables are the (dependent variable) commercial activities and the (independent variable) road network to explore the impact of types of roads on various commercial establishments. The independent variables under consideration include road classes (Geometric Design Standards of Roads (RDA, 1998)); A class, B class, C class, D class, and E class, and distance to the city center (m). The dependent variables encompass the commercial densities (counts/km^2) using Point of Interest (POI, Big data)of eight categorical commercial types identified from the literature [4][5] and ground verification; Retail, Auto service, Food and catering, Finance, Recreation, Textile, Medicine & health care, Hardware & Household appliances.

3. RESULTS AND DISCUSSION

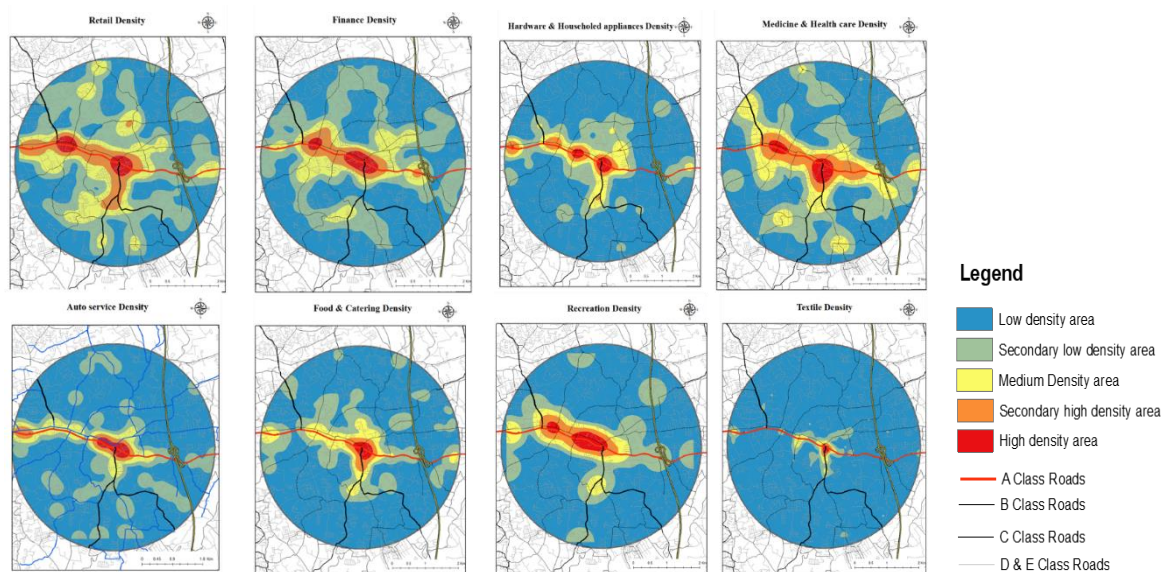### 3.1. Relationships between road types and commercial activities

Figure 1:Spatial distribution of commercial activity densities

	Distance to the city center	A Road density	B Road density	C Road density	D & (E) Road density
Retail	-.535**	.067	.281**	.058	.058
Finance	-.765**	.077	.266**	-.063	.074
Auto service	-.654**	0.810**	.324**	-.239**	.044
Food & Catering	-.169*	.707**	.110	-.031	.998**
Medicine &Healthcare	-.210*	.814**	.138	-.015	-.015
Hardware	-.408**	.062	.015	-.061	.065
Textile	-.030	.226**	-.042	-.112	-.042
Recreation	-.706**	.715**	-.162	.445*	-.401*

Table 1: Pearson correlation coefficients results of road types density and commercial activity density

Commercial activities are notably higher along A and B-class roads. A class road, being primary connectors between major cities, naturally attract a significant commuter population. For instance, retail and medicine activities have higher densities on A and B class roads, highlighting the importance of accessibility for these sectors. Retail activities benefit from the heavy traffic, providing convenience to

commuters. B class roads, which connect residential areas, manufacturing zones, and town centers, also play a critical role in the distribution of commercial activities.

Financial activities are concentrated at intersections of A and B-class roads. This concentration can be attributed to the need for financial institutions to be accessible to a broad customer base.

Auto service activities exhibit a linear concentration along A class roads, with multiple density centers along both A and B roads. This pattern is driven by the need for high visibility and easy access for customers requiring vehicle maintenance services. The negative correlation with C class roads indicates that these services prefer locations with higher traffic volumes to attract more customers.

Food and catering activities are centered around the city, show a strong correlation with A and D class roads. This distribution reflects the necessity for these establishments to be in highly accessible areas to cater to both residents and commuters.

The spatial distribution of hardware activities, despite having multiple density centers, does not show a significant correlation with any specific road type. This lack of correlation suggests that hardware stores might prioritize factors other than road types, such as land availability and cost, over proximity to major roads. Recreation activities, correlating with A and C roads, favor locations that can attract larger customer bases. Textile activities are predominantly aligned with A roads, particularly in the city center. This concentration can be linked to the higher foot traffic and accessibility of central locations, which are crucial for textile businesses relying on walk-in customers.

4. CONCLUSION

The research highlights how commercial activities peak in density at the city center and gradually decrease outward. The findings emphasize that A and B roads significantly influence commercial locations which serve as primary connections and attract high commuter populations., driving high-density focal points at key intersections. This spatial analysis provides critical insights for urban planners and policy makers, enabling them to upgrade the road network, guide zoning regulations, and strategically plan for balanced commercial growth in cities. By understanding these patterns, planners can foster organic growth of commercial hubs, and enhance regional connectivity.

A limitation of using Pearson correlation in this research is its inability to infer causation and the potential influence of confounding variables. Future research should incorporate population characteristics and the scale of commercial activities to enhance understanding of their distribution dynamics, aiding more informed urban planning and development decisions.

REFERENCES

[1]   T. Zheng, "Relationship between Urban Retail Commercial Space Distribution and the Road Network & Population Distribution: Comparison of Mobility and Non-Current Factors," *Journal of Business and Management*, vol. 21, no. 2, pp. 42–48, 2019, doi: 10.9790/487X-2102024248.

[2]   K. W. Tsou and H. T. Cheng, "The effect of multiple urban network structures on retail patterns - A case study in Taipei, Taiwan," *Cities*, vol. 32, pp. 13–23, 2013, doi: 10.1016/j.cities.2013.02.003.

[3]   G. Lin, X. Chen, and Y. Liang, "The location of retail stores and street centrality in Guangzhou, China," *Applied Geography*, vol. 100, pp. 12–20, Nov. 2018, doi: 10.1016/j.apgeog.2018.08.007.

[4]   D. Zheng and C. Li, "Research on Spatial Pattern and Its Industrial Distribution of Commercial Space in Mianyang Based on POI Data," *Journal of Data Analysis and Information Processing*, vol. 08, no. 01, pp. 20–40, 2020, doi: 10.4236/jdaip.2020.81002.

[5]   Z. Ma, C. Li, P. Zhang, J. Zhang, D. Liu, and M. Xie, "The impact of transportation on commercial activities: The stories of various transport routes in Changchun, China," *Cities*, vol.132, Jan. 2023, doi: 10.1016/j.cities.2022.103979.

Sri Lanka Society of **Transport and Logistics**