R4TLI
ISSN : 2513-2504

A COMPARATIVE ANALYSIS OF PROXIMITY TO URBAN SERVICES IN MEDIUM TOWNS IN SRI LANKA

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ABSTRACT -This research presents a comparative analysis of service proximity in medium-sized towns in Sri Lanka, addressing urbanization's impact on livability and sustainability. By examining service points of interest (POIs) and their distribution within distance-based isochrones, the study evaluates the adequacy of facilities in meeting daily needs. A novel methodology using a facility-to-population ratio and a gravity indicator is proposed to assess service reachability. Findings highlight deficiencies in facility quantity and irregular population dispersion, suggesting an imbalance in facility-to-population support. This approach aids urban planners in developing strategies for sustainable urban environments.

Keywords: POI data; Proximity; Isochrones 15 min city concept; Proximity; Accessibility; Graph Theory; Gravity Model; Sustainable Urban Planning

1. INTRODUCTION

The significance of attaining a high quality of daily life has grown in prominence with the progress of economies and the ongoing rise in population (Dameri, 2013). According to Tobler's law, the level of interaction between two locations diminishes as the distance separating them increases. This spatial distance introduces obstacles or incurs expenses related to time, finances, and energy, ultimately influencing individuals' overall welfare (Waters, 2017). Such dynamics lead to externalities like longer journeys within the city, increased use of private cars, congestion, and pollution (Glaeser & Kahn, 2004). Various studies have explored the relationship between mobility and urban form, sparking debates on the optimal size and structure of cities (Gordon et al., 1989). Initiatives like the 15-minute City Living Centers aim to address distance-related issues by emphasizing essential services within a walkable distance, tailored to nearby residents' needs (Borghetti et al., 2021). In Sri Lanka, current urban planning practices fall short in effectively addressing and measuring strategies for providing essential services within walkable distances. This gap challenges the creation of sustainable, livable urban environments prioritizing accessibility and convenience. The National Physical Planning Department envisions development corridors by 2050, leading to the selection of key urban centers for this study. Central to this research is applying graph theory to quantify service availability, introducing a gravity-based index for assessing and comparing medium-sized urban areas in Sri Lanka.

2. MATERIALS AND METHODS

The evaluation of service proximity in medium-sized towns in Sri Lanka unfolds in three key phases. Firstly, we examine various city-level services to identify those that are lacking. Secondly, we explore the interplay between services and population to pinpoint underdeveloped regions. Thirdly, we assess city attractiveness by evaluating the availability of categorized services using a gravity indicator. The overall methodological framework follows four basic processes. First, we categorize services into eight categories: Administrative services, Commercial services, Cultural services, Educational services,

Health care services, Recreational services, Shopping services, and Public transport services. This categorization is based on their applicability to Sri Lanka and relevant literature. Second, we extract Point of Interest (POI) data using the Google API and Google My Maps, focusing on services available within a 2km radius of the city's major point of insertion. In the third step, we measure distances and time using the network analyst tool, considering walking speed to create isochrones. These isochrones help determine the service availability within different buffer zones around facilities. The fourth step involves calculating the service availability in each buffer zone by determining the ratio of the number of facilities to the population and measuring distances from POIs to the nearest facility POIs. This ratio helps ascertain the sufficiency of services within a feasible walking distance and identify distant zones that are underdeveloped. Further, proportions are used to identify the need for additional linked services for each category, employing graphical representation.

Finally, the selected cities validate the process and assess serviceability using a developed gravity-based model. The model's formula considers the number of facilities (n), the population served, and the generalized cost (GC) in terms of distance or time:

$$SCORE_{city} = \sum_k \omega_k \sum_i (n_k)^{\alpha} * \exp(-\beta * \mathrm{GC}_i)$$

Figure 1:Adapted the gravity index to measure human attraction to services.

- n_k = number of service points of type ***k*** around the city center.
- $\mathbf{GC}_i$ = generalized travel cost: average distance from city center to service point ***i*** expressed in km.
- α = weight to be calibrated.
- β = weight to be calibrated.
- ω_k = weight based on the relevance of the service of type ***k*** among the other types.

Population data for the cities were sourced from the 2012 Statistical Yearbook published by the Census Department of Sri Lanka. POI data and information from Google API helped ascertain the number of facilities in each category within a 2km radius. The distances were measured using the ORS tool in QGIS to calculate the gravity index. This comprehensive methodology provides a robust framework for assessing and comparing the service proximity and urban livability in medium-sized towns in Sri Lanka.

3. RESULTS AND DISCUSSION

The key findings of the research reveal that over 50% of the residential population in the selected towns is within the 800–1600-meter zone from services, indicating a reliance on motorized transportation. Shopping facilities are the most prevalent within the initial 800-meter range, especially in Kalutara and Kegalle, due to development along main transportation arteries. The Network Analyst tool highlighted that a sufficient number of services exist within the first 800 meters, benefiting the community population more than the residents, with over 80% of POIs located within 1000 meters of the nearest facility POIs. Kurunegala, Kegalle, Kalutara, and Dambulla were identified as the most attractive towns

in terms of service provision, based on the availability and distribution of categorized service

4. CONCLUSION

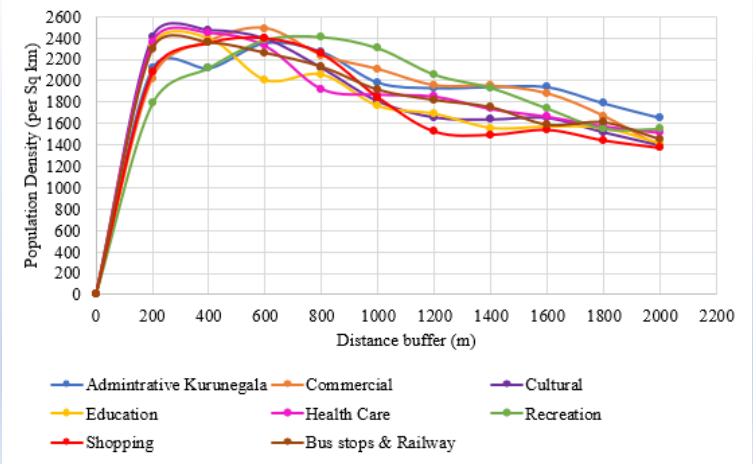

Figure 2:The proximity of residents to various facilities in Kurunegala city (starting from categorized services)

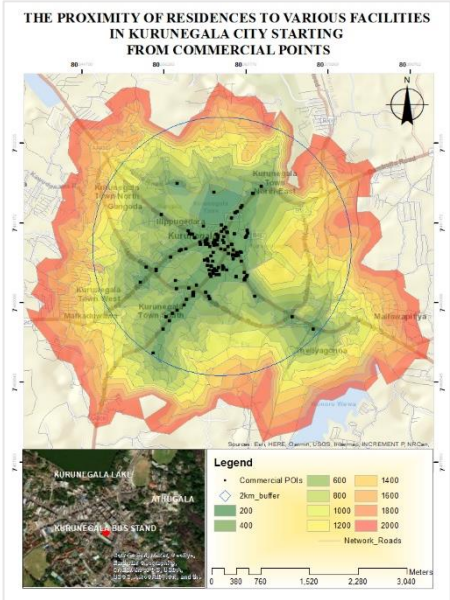

Figure 3: The proximity of residents to various facilities in Kurunegala city (starting from commercial points)

The research concludes that the current spatial arrangement of services in the selected cities is more favorable to the community population (visitors and non-resident users of city services) than to the residing (residential) population. The key insights include that city users can access essential services within 800-1000 meters, aligning with the 15-minute city concept where basic needs are within a 10–15-minute walk. This proximity benefits visitors more than the residents. The findings suggest that urban planners and policymakers need to focus on improving the distribution and reachability of services for the residing population. Enhancing accessibility within closer distances can reduce dependency on motorized transportation, thereby promoting sustainable urban living. To enhance the quality of life for residents, strategic planning should prioritize the redistribution of services to ensure more balanced and equitable access. This includes addressing the deficiencies in the quantity and distribution of facilities to support the residential population effectively. The research highlights the importance of aligning urban development with the National Physical Planning Policy & Plans, aiming for a sustainable and accessible urban environment by 2050. Emphasizing the 15-minute city concept and incorporating gravity-based assessments can guide future urban development strategies. In summary, the research underscores the need for targeted urban planning efforts to improve the spatial distribution of services, ensuring that both residents and community users benefit from accessible and sustainable urban environments.

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