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GIS BASED SPATIAL ANALYSIS OF LAND USE ACCESSIBILITY USING SPEEDO BUS SERVICE ON SELECTED ROUTES IN LAHORE

Faryal Khalid
Department of City & Regional Planning,
Lahore College for Women University, Lahore, Pakistan
Email: fariyalkhalid@gmail.com
Arwa Tariq
Department of City & Regional Planning,
Lahore College for Women University, Lahore, Pakistan
Email: arwaplanner@gmail.com
Iqra Ismail
Department of City & Regional Planning,
Lahore College for Women University, Lahore, Pakistan
Email: iqra.ismail94@yahoo.com
Kashmala Tahir
Department of City & Regional Planning,
Lahore College for Women University, Lahore, Pakistan
Email: Kashmalacrp@gmail.com
Ali Asghar
Department of City & Regional Planning, University of Engineering and Technology Lahore, Pakistan
Email: 2021crp25@student.uet.edu.pk
*Corresponding Author: ****Faryal Khalid***

Abstract
Accessibility is considered important for an urban public transport system in the world. The mobility to the different land uses can be improved by the providing an efficient transport system within a city. Accessibility and connectivity of public transport stations are considered as important aspects in provision of user friendly public transport. The intent of this research is to analyze the accessibility pattern of different land uses through public transport facility in Lahore. This study develops a Geographical Information System (GIS) based spatial framework of access of land use from the public transport using LUPTAI Index. Initially, LUPTAI accessibility measures are developed to consider personal trip making in terms of walking from a public transit stops to destination land uses on the basis of standard walking distances. Walking distances from the public transit stop to different land use are categorized in the different distance based categories: high, medium, low and poor. Secondary, the spatial analysis techniques are used to develop the accessibility measures and to carry out the spatial analysis of land use access from the different public transport stations. Lastly, thematic maps are generated to exhibit the accessibility level of selected case study routes. Based on the findings, this dissertation also suggests recommendations to solve the problems faced by the users of the public transport facility.

Keywords: *LUPTAI, GIS, Local Transport Network, Public Transport*

1. Introduction

The most important outcome of an urban transport system is accessibility. The accessibility of public transport has attained a fundamental significance in the design of the public transport system in terms of mobility. To provide equal access opportunities to different income groups the public transportation development systems are focusing on the sustainability and

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enhancement of public transport. So, the main purpose of public transport accessibility assessment is to provide the better understanding of relationship between people and land uses. Therefore, the connectivity of public transport to enhance the accessibility to different land uses is considered as major aspects for the provision of the user-friendly public transport system. Different types of economic activities are bounded the major cities of any nations. These economic activities supported different infrastructure facilities including the public transport system. So, different studies on accessibility have evolved in parallel with geographic information systems (GIS) to map the level of access to different social services, and it also helps in identifying the underserved areas.

2. Problem Statement

One of the key problems in land use and transport planning in cities is accessibility. It is crucial to provide the public transport network which enhances the accessibility of people to their destination land uses. Lacks of adequate transport transit; mostly in developing countries are creating the barriers to access the land use destinations within a minimum time. These barriers also create social execution among the people which enhance the call for addressing the needs of transit –dependent populations. Moreover, the population centers of urban areas became more dispersed due to sprawl of metropolitan cities which as the resultant increases the travel cost. The lack of public transport and poor location of the transit stops also affects the productivity of urban systems. One of the most vital aspects of an urban public transport system in the world is its accessibility. The middle and the lower class group of cities use an urban public transport to access their destination land uses. The lack of accessibility to urban public transport in addition to failure issues to existing mobility issues also limit the accessibility of people to different areas of cities. LUPTAI helps to analyze the accessibility level of people to their destination land uses. The findings of this research would be beneficial for identifying the accessibility to different land uses through public transport. This study will also help the authorities of government concerning this public transport to identify the root cause in the failure of the accessibility and mitigate that causes to improve the transport in Lahore.

3. Research Objectives

1. Review the literature on the significance and the best practice of land use accessibility through the public transport in both developing and developed country.
2. To determine the land uses distribution and stops of selected public transport facility.
3. To examine the land use and public transport accessibility of selected facility by using LUPTAI Model.
4. To draw major conclusions and recommendations to take measures for improvement of the selected transport facility of Lahore.

5. Literature Review

This chapter includes the review of basic concepts of accessibility in relation to the public transport and its importance in daily life. It further describes the different types of models used to attain better accessibility to destination land uses using the public transport facility. It also includes the review of different approaches and accessibility strategies taken for the improvement of the public transport system. Geographic Information Systems (GIS) also play a very important role in land use and public transport accessibility and identifying the data related to the existing local transport network, and identifies the particular accessibility problems using the information of services with information related to disadvantaged areas and demographic groups. It further exemplifies different approaches and guidelines adopted in developed and under developed countries in the context of land use and public transport accessibility. It also describes a brief review of current legislative provision and policy guidelines adopted in Pakistan for land use and public transport accessibility.

6. Research Methodology

The research methodology of this study included detailed physical surveys of the selected public transport routes. The attributes of the spatial data was converted into digital form using different query operations, and the existing individual and aggregate problems were showed through digital mapping. The opinion of the public was also recorded through a questionnaire. The derived outcomes of this

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research used efficiency of the collected data and its interpretation using directive analysis. This research used spatial analysis, and the collected data was analyzed and assembled using different geo-spatial tools in ArcGIS. The buffer of 1200 meter was applied around the selected station, and the land uses including Commercial, Educational, Health, Financial and postal areas were initially marked.

6.1 LUPTAI Accessibility Measures

The personal trip making choices were developed to consider the LUPTAI accessibility measures. These measures used the approach of walking distances from public transit stops to different destination land uses. The standard walking distance from different pubic transit stops extended using the LUPTAI approach, and these walking distances have been categorized different distance based categories: high, medium, low and poor level of accessibility.

Table 1: LUPTAI Accessibility Measures

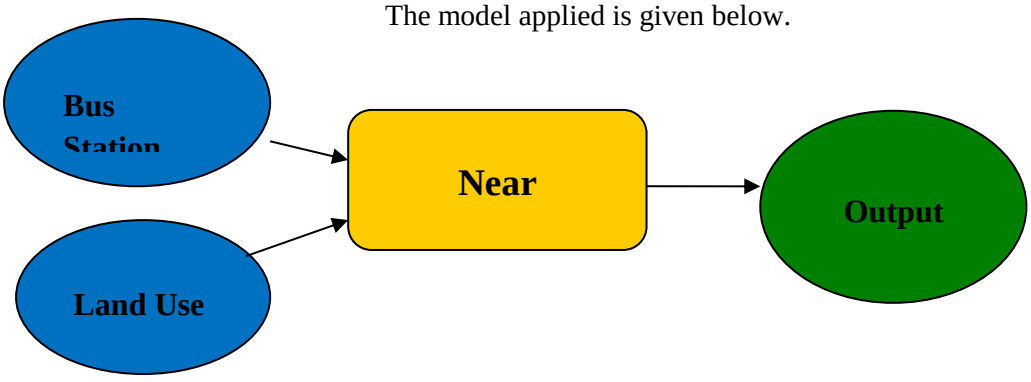
DISTANCE	MODE	LAND USE			
		Commercial	Health	Education	Financial & Postal
Upto 300 m	WALKING				
400 m					
500 m					
600 m					
700 m					
800 m					
900 m					
1000 m					
1100 m					
1200 m					
1300 m					
1400 m					
1500 m					
1600 m					
Above 1600 m					
Accessibility Level: High Medium Low Poor None					

6.2 Modelling Land Use and Public Transport Accessibility Index

Land Use and Public Transport Accessibility Index considered the bus stop to access different destinations via walking. The destination based approach was used to quantify the level of accessibility of the selected land use destinations using public transport network. The following logical steps were used for the selected destination based accessibility approach.

- The land uses within a specified walking distance was selected from each public transport stop using the buffer technique in Arc GIS.
- The accessibility level of destination land uses was quantified using the Near Tool in ArcGIS.

The model applied is given below.



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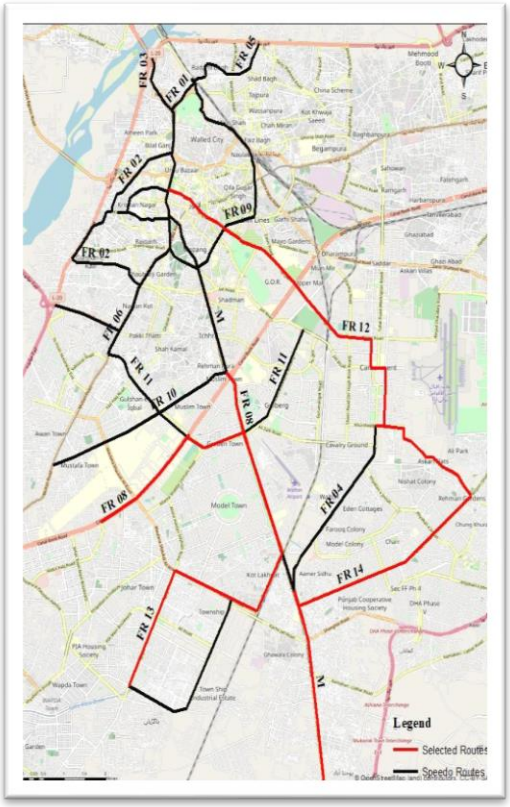
6.3. Selection of Case Study

Speedo Bus service was selected as the case study for the following research, which covers 14 predestined routes in Lahore. The routes selected for the research were FR-08 (Doctor Hospital to Canal), FR-12 (R.A Bazar to Civil Secretariat), FR-13 (Baggrian to Kalma Chowk) and FR-14 (R.A Bazar to Chungi Amar Sidhu). The route map and buffer map around the selected public transport facility is given below in Figure 2 & 3.



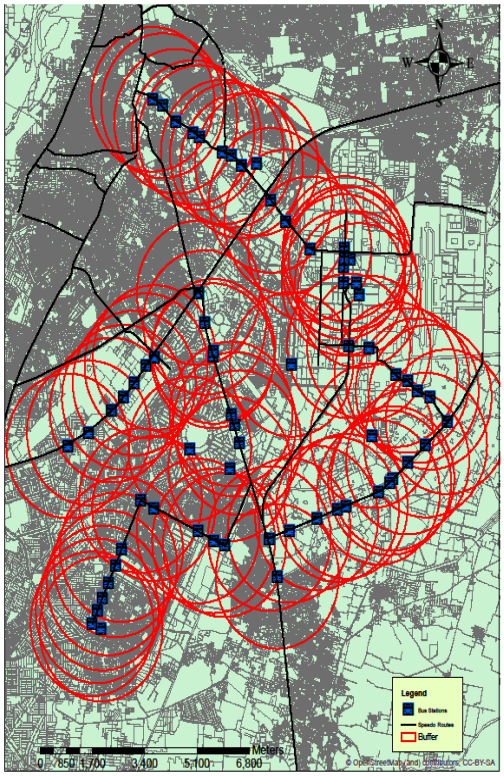


Figure 1: Route Map of Speedo Bus Service
Figure 3: Buffers showing the Analysis Area

7. Results

The thematic maps and general description was used to carry out the results related to GIS. Point data of different land uses was divided as high, medium, low, poor, and no accessibility using LUPTAI measures. The accessibility maps of commercial, financial & postal, health and education land uses are given below.

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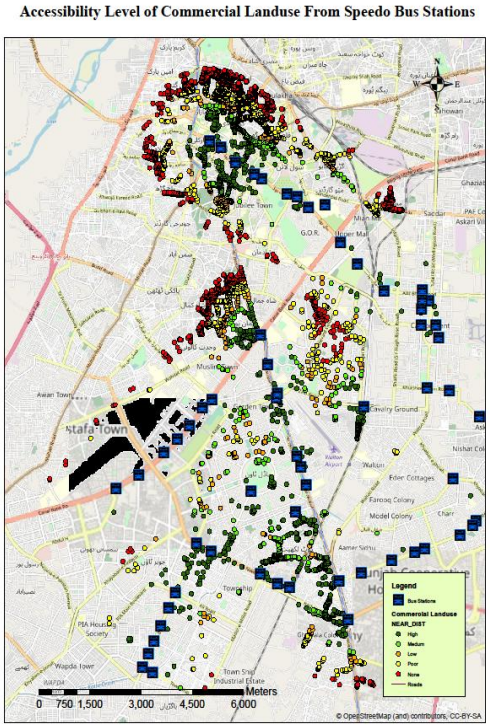

Figure 4: Accessibility Level of Commercial Land Use

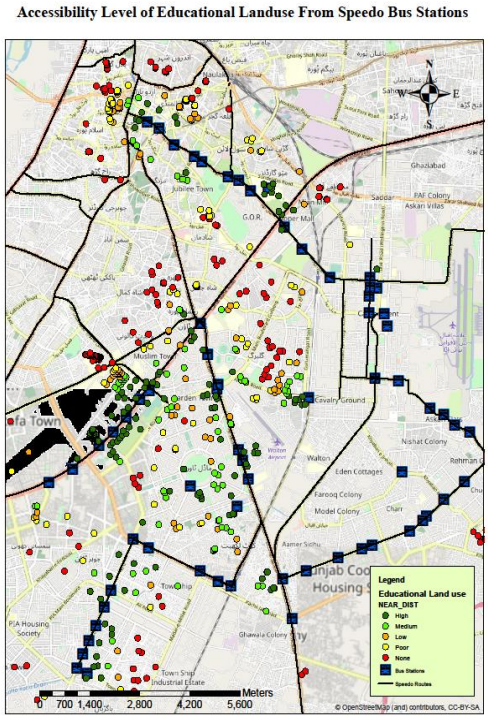

Figure 5: Accessibility Level of Educational Land Use

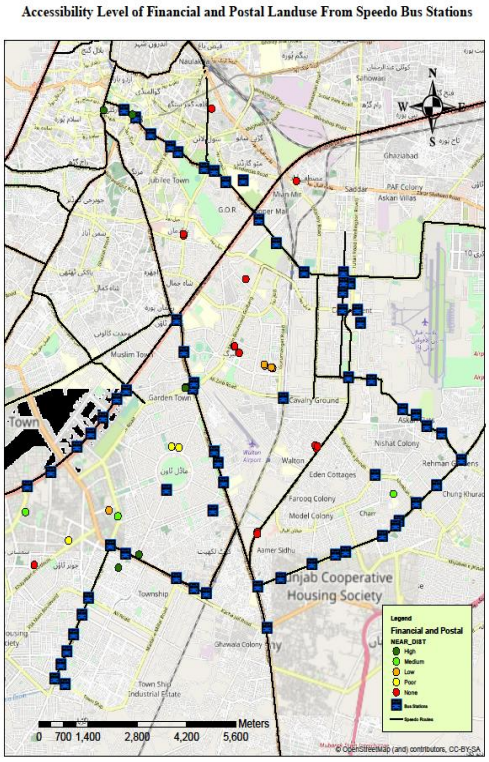

Figure 6: Accessibility Level of Health Land

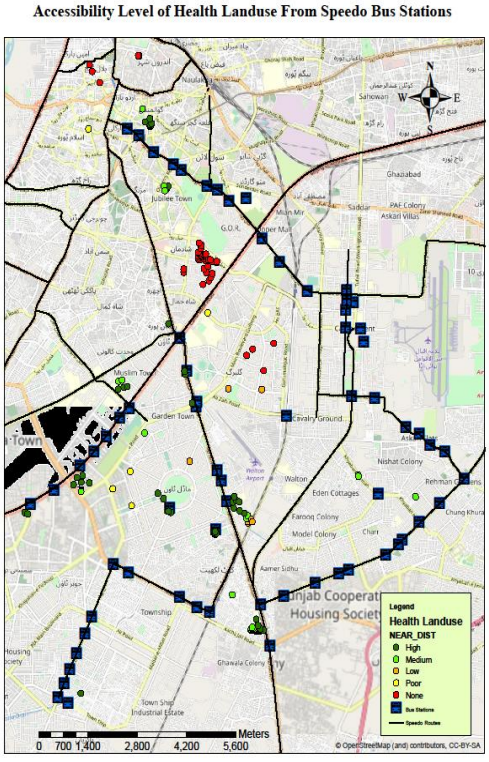

Figure 7: Accessibility Level of Financial &Postal

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The map given in Figure 4 shows the accessibility of commercial buildings through thematic maps. Most of the commercial buildings are at the high and poor level of accessibility. However, some buildings have medium and low accessibility as well. The route FR-08 provides the high accessibility of commercial buildings near Campus Pull, Barket Market and Kalma Chowk. Most of the commercial buildings are at poor accessibility level from route FR-12. However, some buildings have high and low level of accessibility from the route. The route FR-12 provides the high accessibility of commercial buildings near Punjab University Old Campus to Afshan Chowk. Most of commercial buildings are at high accessibility level from at route FR-13 and FR-14. The route FR-13 provides the high accessibility to commercial buildings near the bank stop to Phatak. However, route FR-14 provides the high accessibility of commercial buildings near Chungi Amar Sidhu, and Ghazi Chowk in Lahore.

The map given in Figure 5 shows, the accessibility of educational buildings from different Speedo Routes .The route FR-08 provides the high accessibility of educational buildings near Campus Pull to Jinnah Hospital. The accessibility of educational buildings from the route FR-12 provides the high accessibility to educational buildings near PU Old Campus to Canal Bridge. The route FR-13 provides the high accessibility to educational buildings near Muslim Chowk to the Sabzi Mandi area in Lahore. Few educational institutes are present at route, FR-14. The route FR-14 provides the high accessibility to educational buildings near Ghazi Chowk.

The map given in Figure 6 shows the accessibility of health care buildings. Few health care buildings are at high accessibility level from the route FR-08. The route FR-08 provides the high accessibility of health care buildings near Doctor Hospital, Jinnah Hospital, Hailey College, Campus Pull, and Kalma Chowk. Few health care buildings are at high accessibility level from route FR-12. The route FR-12 provides the high accessibility to health care buildings near Governor House and Anarkali stop. The route FR-13 provides the high accessibility to health care buildings near Bhabra Chowk, Gulab Devi Hospital and Sabzi Mandi.

The map given in Figure 7 shows the accessibility of banks through thematic mapping. The route FR-08 provides the poor accessibility of financial buildings near Kalma Chowk and IBA. Some banks have high accessibility level from route FR-12. The route FR-12 provides the high accessibility to banks near PU Old to Governor House. The route FR-13 provides the high accessibility of financial buildings near Model Town Link Road and Bhabra Stop.

8. Conclusions

The use of LUPTAI model is one of the inventive tools, and it can be used in urban planning as the support model. The future and existing projects of public transport can be sequenced and relocated using this model. The outcomes of the model can be used for better land use planning to achieve integrated transport system and to reduce the need and length of the trip. The sustainable travel modes and different travel choice can be used to promote social equity and support different activity centers and local business. The accessibility and connectivity of public transport stations are considered as important aspects in provision of user friendly public transport. It is crucial to provide the public transport network which enhances the accessibility of people to their destination land uses. The result of the following research demonstrates the accessibility to different land uses of an urban area using public transport. LUPTAI model is considered as the valuable tool to access the relationship between transport and land uses, and to map and identify the areas with the high and low level of accessibility to different land uses using the Speedo Bus Service in Lahore

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