Gangireddy Shravani

Location of logistics facilities, a spatial analysis of critical location factors

May 2024

Location of logistics facilities, a spatial analysis of critical location factors

Master of Planning

(Transport Planning and Logistics Management)

Gangireddy Shravani

[Sch. No. 2022MTPLM017]

SCHOOL OF PLANNING AND ARCHITECTURE, BHOPAL

NEELBAD ROAD, BHAURI, BHOPAL (MP)-462030

May 2024

Location of logistics facilities, a spatial analysis of critical Location factors

Thesis submitted in partial fulfillment of the requirements for
the award of the degree of

Transport planning and Logistics management

By
Gangireddy Shravani
Scholar No. 2022MTPLM017

SCHOOL OF PLANNING AND ARCHITECTURE, BHOPAL
NEELBAD ROAD, BHAURI BHOPAL (MP)-462030

May 2024

Declaration

I **Gangireddy Shravani**, Scholar No. **2022MTPLM017** hereby declare that the thesis titled “Location of Logistics Facilities, a Spatial Analysis of Critical Location Factors”, submitted by me in partial fulfilment for the award of degree, at the School of Planning and Architecture, Bhopal, India is a record of bonafide work carried out by me. The matter/result embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

Signature of the Student

Date: _____

Certificate

This is to certify that the declaration of Gangireddy Shravani is true to the best of my knowledge and that the student has worked under my guidance in preparing this thesis.

RECOMMENDED

_____

Signature of the Guide

ACCEPTED

_____

Prof. Saurav Popli

Head, Department of Transport Planning

May 2024, Bhopal

Acknowledgments

I want to express my warm gratitude to everyone who has supported me throughout my post-graduate thesis journey. Their encouragement has been crucial for the successful completion of this study. I'd like to thank

Firstly, my family. especially my parents, **G Vijaya Shanker Reddy**, and **Jagadeeshwari**, as well as my sister, **Navya Reddy** my cousin brothers **Vamsi Krishna Reddy** and **Jayanth Reddy** for Their unwavering love, understanding, and encouragement have given me the strength and motivation to overcome obstacles, and pursue my academic dreams.

A big shoutout to my mentor, **Dr. Mayank Dubey**. His guidance, expertise, and continuous encouragement have been invaluable at every step of this thesis. His consistent validation has shaped my work significantly, enhancing its quality throughout the process.

I'd also like to thank **Dr. Mohit Dev** for their valuable input during review discussions.

My friends and classmates deserve a special mention for their companionship and daily inspiration. Our daily conversations have enlightened me in academic and motivational ways, and their support has been crucial in overcoming challenges.

I'm grateful to individuals like **Justin Andrews, Vimal V, Bharath Reddy, and Shreya Nalla** for their moral support amidst the challenges.

This thesis would not have been possible without the immense support of warehouse operators, truck drivers, and warehouse consultancy services for their cooperation in data collection. Special thanks to **Mr. Vishwanath Sista** from the Hyderabad Metropolitan Development Authority, and **Mr. Srinivas Reddy** from the Police Department Hyderabad for providing data, FCI, CCI, and CWC Offices for providing me data.

In conclusion, I extend my sincere gratitude to all those mentioned above and to everyone else who has significantly contributed to my academic journey. I appreciate all your help, inspiration, and hard work. It's been an honour to team up with such amazing individuals and organizations.

Abstract

This study aims to evaluate the spatial correlation between influential factors and warehouse location decisions to identify potential patterns. The objectives include identifying key parameters and analyzing the spatial distribution of existing warehouses. Additionally, the study seeks to examine the correlation between these influential factors and the locations of warehouses. By identifying the desirable spatial distribution of warehouse locations for future planning purposes. Through a comprehensive analysis of these factors and their spatial relationships, the study aims for an approach to developing a multi-decision-making model leveraging Geographic Information System (GIS) technology to identify optimal warehouse locations in Hyderabad, India. This locates the spatial correlations between influential parameters and warehouse positioning decisions while presenting potential patterns in the process.

The objectives of the study include the identification and analysis of various factors influencing warehouse location decisions. These factors include transportation infrastructure, rental values, land availability, proximity to the city center, freight terminals, airport approachability, and connectivity to major highways such as the national highway, state highway, and state outer ring road, freight route proximity to commercial land use, distance from proposed truck terminals, and travel time contours are considered as parameters influencing warehouse location decisions. By addressing these objectives, the study attempts to identify a desirable spatial distribution for warehouses within Hyderabad. The optimal locations are determined using the weighted overlay method, which integrates multiple influential factors to identify strategic warehouse sites in 3 scenarios.

Furthermore, the research assesses the alignment of truck terminal sites with the strategic positioning of warehouses. This evaluation enhances the efficiency of the urban logistics ecosystem and contributes to the optimization of transportation logistics. By combining several crucial aspects, the research provides policymakers, urban planners, and stakeholders in logistics and supply chain management with insights and potential trends.

Policymakers involved in land use preservation and urban planning can leverage the findings of this research to strategically allocate space and maintain optimal land usage. By utilizing insights from the identified ideal warehouse locations, policymakers can facilitate the provision of common utilities such as common railway siding, parking facilities, and driver amenities. This proactive approach not only enhances logistical operations but also fosters sustainable urban development and supports the seamless functioning of the supply chain

Keywords: Logistic facilities, Warehouse location selection, multi-criteria decision making, Freight planning, Logistics facilities, Warehouse planning, Land use.

सारांश

इस अध्ययन का उद्देश्य संभावित पैटर्न की पहचान करने के लिए प्रभावशाली कारकों और गोदाम स्थान निर्णयों के बीच स्थानिक सहसंबंध का मूल्यांकन करना है। उद्देश्यों में प्रमुख मापदंडों की पहचान करना और मौजूदा गोदामों के स्थानिक वितरण का विश्लेषण करना शामिल है। इसके अतिरिक्त, अध्ययन इन प्रभावशाली कारकों और गोदामों के स्थानों के बीच संबंध की जांच करना चाहता है। भविष्य के नियोजन उद्देश्यों के लिए गोदाम स्थानों के वांछनीय स्थानिक वितरण की पहचान करके। इन कारकों और उनके स्थानिक संबंधों के व्यापक विश्लेषण के माध्यम से, अध्ययन का लक्ष्य हैदराबाद, भारत में इष्टतम गोदाम स्थानों की पहचान करने के लिए भौगोलिक सूचना प्रणाली (जीआईएस) तकनीक का लाभ उठाने वाले बहु-निर्णय लेने वाले मॉडल को विकसित करने के दृष्टिकोण को विकसित करना है। यह प्रक्रिया में संभावित पैटर्न प्रस्तुत करते हुए प्रभावशाली मापदंडों और गोदाम स्थिति निर्णयों के बीच स्थानिक सहसंबंधों का पता लगाता है।

अध्ययन के उद्देश्यों में गोदाम स्थान निर्णयों को प्रभावित करने वाले विभिन्न कारकों की पहचान और विश्लेषण शामिल है। इन कारकों में परिवहन अवसंरचना, किराये के मूल्य, भूमि की उपलब्धता, शहर के केंद्र से निकटता, माल ढुलाई टर्मिनल, हवाई अड्डे की पहुंच क्षमता, और राष्ट्रीय राजमार्ग, राज्य राजमार्ग और राज्य बाहरी रिंग रोड जैसे प्रमुख राजमार्गों से कनेक्टिविटी, वाणिज्यिक भूमि से माल ढुलाई मार्ग की निकटता शामिल है। उपयोग, प्रस्तावित ट्रक टर्मिनलों से दूरी और यात्रा समय की रूपरेखा को गोदाम स्थान निर्णयों को प्रभावित करने वाले पैरामीटर के रूप में माना जाता है। इन उद्देश्यों को संबोधित करके, अध्ययन हैदराबाद के भीतर गोदामों के लिए वांछनीय स्थानिक वितरण की पहचान करने का प्रयास करता है। इष्टतम स्थान भारित ओवरले पद्धति का उपयोग करके निर्धारित किए जाते हैं, जो 3 परिदृश्यों में रणनीतिक गोदाम साइटों की पहचान करने के लिए कई प्रभावशाली कारकों को एकीकृत करता है।

इसके अलावा, अनुसंधान गोदामों की रणनीतिक स्थिति के साथ ट्रक टर्मिनल साइटों के संरेखण का आकलन करता है। यह मूल्यांकन शहरी लॉजिस्टिक्स पारिस्थितिकी तंत्र की दक्षता को बढ़ाता है और परिवहन लॉजिस्टिक्स के अनुकूलन में योगदान देता है। कई महत्वपूर्ण पहलुओं को जोड़कर, अनुसंधान नीति निर्माताओं, शहरी योजनाकारों और रसद और आपूर्ति श्रृंखला प्रबंधन में हितधारकों को अंतर्दृष्टि और संभावित रुझान प्रदान करता है।

भूमि उपयोग संरक्षण और शहरी नियोजन में शामिल नीति निर्माता रणनीतिक रूप से स्थान आवंटित करने और इष्टतम भूमि उपयोग बनाए रखने के लिए इस शोध के निष्कर्षों का लाभ उठा सकते हैं। पहचाने गए आदर्श गोदाम स्थानों से अंतर्दृष्टि का उपयोग करके, नीति निर्माता आम रेलवे साइडिंग, पार्किंग सुविधाओं और ड्राइवर सुविधाओं जैसी सामान्य उपयोगिताओं के प्रावधान की सुविधा प्रदान कर सकते हैं। यह सक्रिय दृष्टिकोण न केवल लॉजिस्टिक संचालन को बढ़ाता है बल्कि टिकाऊ शहरी विकास को भी बढ़ावा देता है और आपूर्ति श्रृंखला के निर्बाध कामकाज का समर्थन करता है।

कीवर्ड: लॉजिस्टिक सुविधाएं, गोदाम स्थान चयन, बहु-मापदंड निर्णय लेना, माल ढुलाई योजना, रसद सुविधाएं, गोदाम योजना, भूमि उपयोग।

Table Of Contents

LIST OF FIGURES

LIST OF ABBREVIATIONS

GIS	Geographic Information System
LEEP	Logistics Efficiency Enhancement Program
FCI	Food Corporation of India
CCI	Cotton Corporation of India
CWC	Central Warehouse Corporation
VKT	vehicle kilometers traveled
IT	information technology
PPP	public-private partnership
TS-iPASS	Telangana state industrial project approval and self-certification system
NH	National Highway
SH	State highway
DOG	Distance optimality gap
GVDT	goods vehicle distance traveled
TMA	Tokyo Metropolitan area
HMDA	Hyderabad Metropolitan Development Authority
GHMC	Greater Hyderabad Municipal Corporation
PLI	Production Linked Incentive
IDW	Inverse Distance Weighting
ORR	Outer Ring Road
URDPFI	Urban and Regional Development Plans Formulation and Implementation
CBD	Central business district
TTC	travel time contour
MDCM	Multi-Criteria Decision Making

CHAPTER 1: INTRODUCTION

1.1 Background

Over the past five years, India has emerged as the world's fastest-growing major economy, primarily driven by a surge in demand for goods and services. This economic expansion has opened up significant opportunities for Indian citizens, with over 22 million people finding employment in various sectors. Recognizing the pivotal role of logistics in sustaining economic growth, the Government of India is actively pursuing measures to enhance the sector's performance.(Sinha, 2021). This endeavor encompasses the development of dedicated rail-based freight corridors and logistics and economic corridors, aimed at strengthening capacity and connectivity across the nation.

Furthermore, efforts are on track(Sinha, 2021). These initiatives are integral to supporting the logistics sector by facilitating the smoother movement of goods and fostering greater integration within the economy.

India aims to address the challenges plaguing its logistics sector by optimizing freight transport systems and enhancing infrastructure networks. These endeavors are essential for sustaining economic growth development a favourable environment for businesses to thrive and maximizing the benefits of India's budding economy.

The Logistics Efficiency Enhancement Program (LEEP) is a government initiative aimed at enhancing logistics efficiency through a combination of infrastructure development and technological advancements(Sinha, 2021). These parks are equipped with modern mechanized warehousing facilities tailored to meet the specific needs of various commodity groups.

the logistics parks will offer cold storage facilities to accommodate perishable goods, as well as racked warehousing space suitable for storing palletized cargo such as parcels and apparel. By incorporating a higher proportion of mechanized material handling processes, these logistics parks aim to minimize storing and handling losses, thereby improving overall efficiency in the supply chain.

Additionally, LEEP incorporates the adoption of technological and digital solutions to further optimize logistics operations. These solutions include goods tracking systems, which enable real-time monitoring and management of cargo movement.

By leveraging both infrastructure enhancements and technological innovations, LEEP seeks to drive significant improvements in logistics efficiency, ultimately benefiting businesses and consumers.

1.1.1 Freight transportation in India

Since 1951, the share of freight transportation handled by rail in India has experienced a continuous decline, standing at a mere 18 percent in 2020, while road transport dominates with a share of 71 percent (Sinha, 2021). This decline can be attributed to insufficient rail capacity, particularly on high-density routes. However, various factors suggest that rail transport could offer a cost-effective and efficient alternative for a significant portion of India's freight needs. Firstly, the country's commodity mix predominantly consists of bulk goods, which align well with rail's capabilities for bulk handling. Additionally, considering that freight often travels over long distances in India, rail transport can capitalize on economies of scale compared to road transport. Moreover, India's geographical configuration, characterized by a low coast-to-landmass ratio, favours rail and coastal transport modes over road transport in many regions of the country. Furthermore, the role of rail extends beyond bulk freight; through intermodal transportation, which combines rail and road transport for containerized goods, rail can compete for a market share in higher-value, non-bulk goods. Thus, despite its declining share, rail transportation presents significant potential to cater to India's diverse freight requirements, offering both cost-effective solutions for bulk goods and competitive options for higher-value commodities through innovative intermodal practices(Sinha, 2021)

1.1.2 Significance of warehouse location

The strategic selection of warehouse positions plays a crucial role in the competence and effectiveness of supply chain operations. In the realm of logistics and distribution, understanding the spatial correlation between influential factors and warehouse location decisions is crucial for optimizing network design, minimizing costs, and enhancing overall operational performance. By exploring this complex relationship, organizations can uncover valuable insights that can lead to more informed decision-making processes and identify potential patterns that can desire competitive advantage. This study aims to explore the spatial dynamics that

underpin warehouse location decisions, shedding light on the interplay between key factors and geographical considerations to provide a comprehensive understanding of how businesses can strategically position their facilities for maximum impact. Through a systematic analysis of these correlations, this research seeks to offer actionable recommendations for organizations looking to enhance their supply chain capabilities and achieve sustainable growth in an increasingly complex and interconnected global marketplace.

In the Indian scenario, with its vast geographical expanse and diverse market demands, the spatial correlation between influential factors and warehouse location decisions holds significant importance. Understanding these correlations can unveil patterns that can guide businesses in making informed decisions to enhance their supply chain performance.

India's rapid economic growth, escalating population, and evolving consumer preferences have led to a surge in demand for efficient logistics and warehousing solutions. Factors such as proximity to transportation networks, access to key markets, availability of skilled labor, land costs, infrastructure development, and government policies all influence the strategic placement of warehouses across the country. Analyzing the spatial relationships between these factors and warehouse locations can provide valuable insights into the underlying patterns that drive decision-making processes.

By leveraging advanced analytical techniques such as spatial data analysis, geographic information systems (GIS), and machine learning algorithms, industries can discover hidden correlations and trends within their warehouse location data. This deeper understanding can help organizations optimize their distribution networks, reduce transportation costs, minimize delivery times, and ultimately enhance customer satisfaction.

this study aims to explore the spatial correlation between influential factors and warehouse location decisions in the Indian. By identifying potential patterns and relationships, this research seeks to provide actionable insights for businesses looking to strategically position their warehouses for maximum operational efficiency and competitive advantage in India's rapidly evolving market landscape.

1.2 Aim:

To assess the spatial correlation between influential factors and warehouse location decisions to identify potential patterns.

1.3 Objectives:

1. Identify key parameters and analyse their spatial distribution of existing warehouses.
2. Evaluate factors influencing warehouse location decisions (transportation infrastructure, land costs, tariff, rental value land availability, etc.)
3. Examine the correlation between influential factors and warehouse locations.
4. Identify the desirable spatial distribution of warehouse locations for future planning.

1.4 Need:

It explores the spatial dynamics of logistics facility placement by analyzing critical factors and uncovering patterns influencing warehouse location to reserve land for future development

1.5 Scope:

The study's scope is confined to identifying the key parameters influencing warehouse location decisions, and factors influencing these choices to identify patterns

1.6 Limitations:

The study limits major parameters due to constraints in time and data availability.

1.7 Research question:

- What is the ideal location in a city to establish warehouse facilities?
- Can we predict which location is suitable to propose a future logistics warehouse while considering parameters like land value, land use, transportation facilities (nearby highway, freight corridor bypass, etc.), and driver requirements?
- Can reserve land for warehouses for further years in the master plan?

1.8 Utility of research:

- The research on spatial analysis of warehouse locations offers practical and innovative advancement.
- Implications for policy and future research directions.
- These findings will have the potential to contribute significantly to the improvement of more efficient and effective logistics management practices.

1.9 Methodology:

The research commences with an in-depth review of background literature, focusing on the location of logistics facility centers. These centers serve multiple functions, including transportation, loading, and unloading, as well as parking facilities and other essential amenities. The initial phase involves framing the aim and objectives of the study, followed by an examination of case studies from various countries to understand best practices in locating logistic centers. Successively, the literature on global best practices is reviewed to inform the research process.

Primary data is collected through surveys, while secondary data is gathered from diverse sources, including the Central Warehouse Corporation, Food Corporation of India, and Cotton Corporation of India. The study area is comprehensively understood through an analysis of existing logistics facilities, identification of influencing factors, and consideration of land use factors. Key parameters are identified and their spatial distribution within existing warehouses is analyzed. Moreover, the correlation between factors affecting warehouse location is explored, employing techniques such as the superposition of geographic factor layers to identify patterns and spatial correlations.

Detailed information regarding private and government warehouses, encompassing their capacities, commodities, and origin of commodities, is obtained from truck drivers, warehouse owners, operators/managers, and other key players in the warehouse sector.

The research methodology is guided by insights from the literature, particularly focusing on data analysis techniques and methods. These include various approaches to conduct weighted overlay methods, considering parameters such as city center proximity, major road networks, and accessibility to airport and freight terminals.

A comprehensive research methodology, outlined in seven steps (shown in Figure 1)ranging from background study to result analysis and documentation, is derived from the literature review. This structured approach ensures a rigorous and systematic investigation into the location determinants of logistics facilities, facilitating informed decision-making in this critical aspect of supply chain management.

METHODOLOGY

BACKGROUND STUDY

The aim, objectives, the scope of the study, and limitations

LITERATURE STUDY

Related studies and practices, methodology understanding, GIS analysis

NEED OF THE STUDY

It explores the spatial dynamics of logistics facility placement by analyzing critical factors and uncovering patterns influencing warehouse location to reserve land for future development

DATA COLLECTION

PRIMARY DATA

1. Warehouse questionnaire
2. Cluster observation
3. Truck drivers
4. Clients and stakeholders
5. Consultancy service

SECONDARY DATA

1. Locations of FCI, CCI, and CWC warehouses and details
2. Proposed logistics park and truck terminals in and around Hyderabad-HMDA
3. City freight-restricted routes -Cyberabad police commissioner office
4. Empty warehouse location warehouse capacity, rental value, circle rate, land value
5. India Warehousing Market Report 2023

OBJECTIVE - 1

Identify key parameters and analyze their spatial distribution of existing warehouses.

Understanding the study area
Locations of existing logistics facilities ,Influencing factors ,Land use factors

Identify key parameters and analyze their spatial distribution of existing warehouses.

OBJECTIVE - 2

Evaluate factors influencing warehouse location decisions

ANALYSIS AND EVALUATION

Correlation between the factors affecting the warehouse location
• Superposition of geographic factor layers, patterns, and spatial correlations

Analysis
• Most preferred MCDM -multi-criteria decision-making

OBJECTIVE - 3

Examine the correlation between influential factors and warehouse locations

RESULTS AND RECOMMENDATIONS

Identification of most suitable location for logistic facilities for future demand

OBJECTIVE - 4

Identify the desirable spatial distribution warehouse locations.

Figure 1 Research Methodology

CHAPTER 2. LITERATURE:

Logistics Center Definitions

1. A Logistics center is a center in a defined area within which all activities related to transport, logistics, and the distribution of goods. (EUROPLATFORMS EEIG. (2023, March 7). Definition - EUROPLATFORMS EEIG. https://www.europlatforms.eu/definition/)

2. The logistics center is a special intermodal hub in the transportation system, including different logistics facilities, where separate operators provide several services, connected to transportation, logistics, and distribution in established geographical coverage(Yazdani & Mu, n.d.)

Logistics centers, which encompass specialized warehouses and buildings, are fundamental components within the logistics and freight transportation sectors. These facilities are strategically positioned to ensure streamlined access to vital transportation infrastructure, primarily road networks, and are located to fulfill the specific requirements of logistics operations. Various factors, including proximity to transportation hubs, land accessibility, and monitoring involvement, shape logistics facilities' establishment. Particularly within urban settings, logistics facilities exhibit diverse characteristics in terms of size, types, and positioning, with present-day facilities increasingly integrating features such as technology, sustainable practices, and proximity to consumer hubs to effectively address the dynamic needs of the logistics industry(Buldeo Rai et al., 2022). Consequently, the location of logistics facilities emerges as a pivotal consideration, necessitating a delicate balance between factors such as consumer proximity, land availability, and logistical intricacies to optimize operational efficacy and meet market demands.

2.1 Logistics Sprawl

Logistics sprawl refers to the phenomenon where warehouses and distribution centers move from urban areas to suburban or exurban locations. This trend is driven by the need for more space, proximity to transportation networks like highways and airports, and the availability of cheaper land in suburban areas.

Logistics sprawl can have implications for transportation infrastructure, environmental factors like emissions and congestion, and the overall organization of supply chains in metropolitan areas like

- Logistic sprawl contributes to increased truck travel distances, impacting vehicle kilometers traveled (VKT) and subsequently escalating pollution levels, also disrupting employee settlement patterns and travel routines.
- Centralized and clustered land settings demand shorter trips and fewer stops for product delivery compared to decentralized and dispersed land use, thereby affecting the efficiency and quality of logistics operations.

2.2 Case study of the Tokyo metropolitan area

The transformation in logistics practices has brought significant changes in the spatial distribution of logistics facilities, a phenomenon observed globally, particularly in the past couple of decades. There has been a notable shift toward the decentralization of logistics facilities, often referred to as "logistics sprawl" observed in numerous urban centers (Sakai et al., 2018)This decentralization is argued to result from various factors, including limited available land, soaring land prices, and congestion issues near urban cores, alongside evolving functional and physical requirements for logistics facilities(Sakai et al., 2018). Despite widespread concerns regarding the impacts of logistics sprawl, discussions on public policies aiming to situate logistics facilities in socially beneficial locations are notably scarce. This gap in discourse can, in part, be attributed to the dearth of detailed shipment data essential for conducting comprehensive evaluations of the impacts of logistics facility locations on urban freight traffic.

This study aims to examine the performance of logistics systems concerning the locations of logistics facilities, with a distinct focus on the influence of the types of commodities handled by these facilities. this research studies the impacts of commodity types on logistics system performance. The analysis utilizes the concept of the "distance optimality gap" (DOG), which serves as a measure for evaluating the efficacy of logistics facility locations. This measure is determined by assessing the disparity between actual travel distances and the optimal travel distances for shipments to and from a facility. The optimal travel distance, refers to the total distance traveled by goods vehicles (GVDT) achievable at an ideal, though hypothetical, location.

In the study (Sakai et al., 2018)examining the correlation between commodity types, spatial characteristics, and the optimal distance of logistics facilities in the Tokyo Metropolitan area (TMA), approximately 23 square kilometers, and accommodating a population of 42 million, data was drawn from the Tokyo Metropolitan Freight Survey. This survey provided detailed establishment-level records about distribution centers, top terminals, residential areas, intermodal facilities, and oil terminals. The dataset encompassed information gathered from various stakeholders including manufacturers, wholesalers, retailers, and transport service providers. A total of 2147 samples were collected, encompassing data on factors such as floor area, commodity type, number of vehicles, trip details, and origin and destination points.

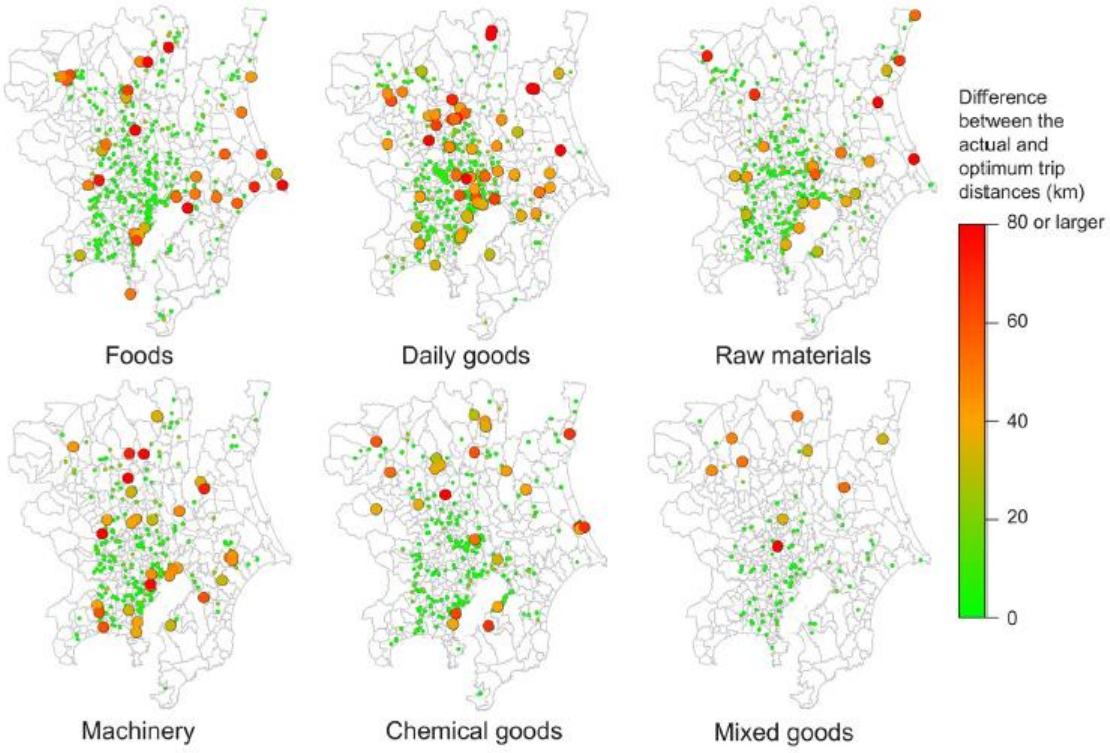


Figure 2 Facility-specific distance optimality gap (DOG) depicted at actual locations

The objective "The relationship between commodity types, spatial characteristics, and distance optimality of logistics facilities" (Sakai et al., 2018)The study categorizes logistics facilities based on the type of commodity they handle and explores the concept of "distance optimality gap," which is defined as the gap between the minimum travel distance possible and the actual distance traveled by goods vehicles. The research aims to find the complex relationship between the location of logistics facilities and the distance optimality gap, highlighting how factors like commodity types and spatial characteristics influence the efficiency of logistics operations. Additionally, it provides insights into the impact of urban freight

distribution, land use, city logistics, and logistics sprawl, emphasizing the importance of detailed data on logistics facilities and shipments for formulating effective approaches to improve the distance optimality of logistics land use.

The finding is certain facilities near urban centers exhibit large DOGs, optimal locations vary by commodity. Despite challenges in determining the social benefits of locating logistics facilities in outer edge areas, data highlights the necessity of flexible land use regulations and detailed analysis of shipment data for effective policy formulation.

2.3 Case study of the Paris metropolitan area

A comprehensive investigation into logistics terminal optimization within the Paris metropolitan area centers on the operational dynamics of a prominent parcel delivery enterprise, DB Schenker. The study endeavors to determine the most advantageous terminal locales based on two pivotal criteria: the minimization of total Euclidean distances between terminals and pick-up/delivery points, and the pragmatic constraint of limiting the number of terminals to mitigate logistical sprawl consequences.

DB Schenker's terminal placements closely align with the optimal sites deduced by the model, suggesting a strategic alignment with operational optimization. Employing a polycentric operational model, DB Schenker operates multiple terminals, each strategically serving its designated territory. This decentralized approach enables proximity to customers, although constrained by the financial considerations associated with terminal proliferation.

Refinement in delivery and pick-up allocation to existing terminals could yield a noteworthy reduction of 2 km in average Euclidean distance. Furthermore, terminal relocation presents an opportunity for an additional 1.6 km reduction. The segregation of deliveries and pick-ups in analysis yields minimal variance in optimal terminal placement, reinforcing the efficiency of the overarching strategy.

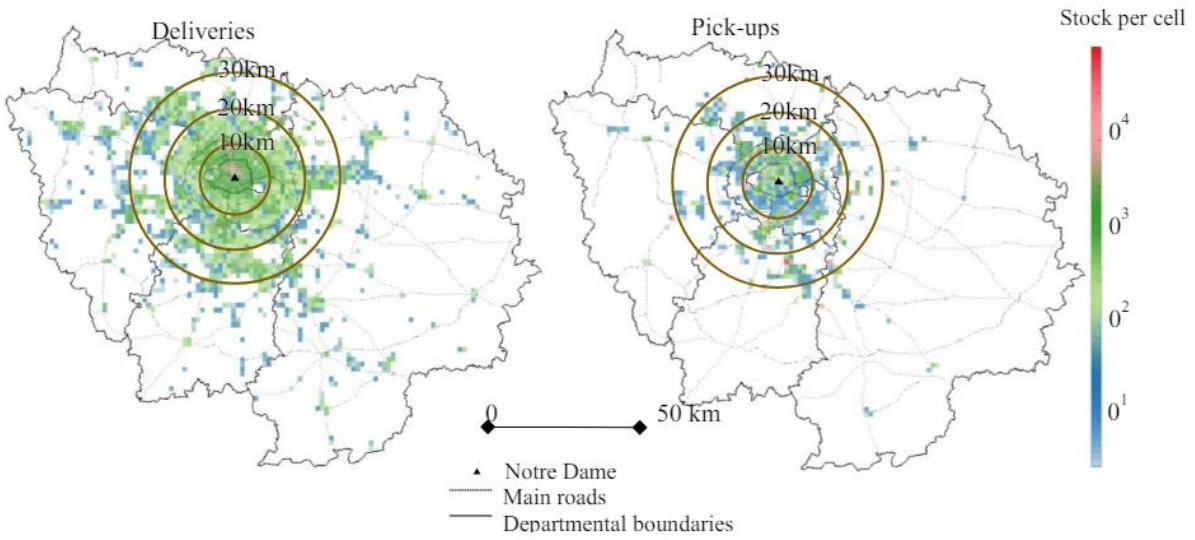


Figure 3 Density of deliveries (left) and pick-ups (right) for two months, 2.5 km2 grid

Optimal terminal positioning, prioritizing distance minimization, invariably situates terminals beyond the city center. This strategic placement not only enhances operational efficiency but also aligns with environmental imperatives by curbing pollution through the facilitation of a polycentric organizational framework. (Shown in Figure 4Figure 4 the current locations of terminal and the optimal locations of the terminals

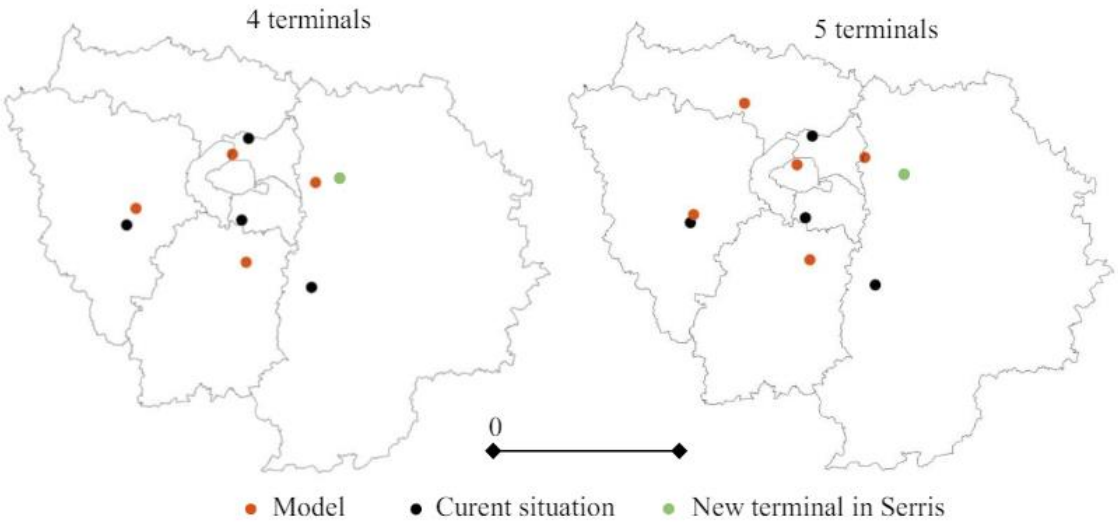


Figure 4 Current location of terminals (black) and optimization results (orange) for 4 and 5 terminals

The organizational configuration closely approximates the theoretical outcomes, with a notable diminishment in the total distance between customers and terminals. For DB Schenker, this organizational proximity translates to a reduced carbon footprint

by minimizing access distances to clientele—a testament to the efficacy of the polycentric operational model.

2.4 Telangana State Logistics Policy 2021-26 Overview

The Telangana State Logistics Policy 2021-26 is a strategic initiative designed to transform the logistics landscape in Telangana. Aligned with national goals, it aims to enhance efficiency, reduce costs, and attract private investments in the logistics sector. The policy encompasses various initiatives to bolster infrastructure, improve service quality, integrate modern technologies, and enhance skill development within the industry.

2.4.1 Sector Transformation and Economic Impact

The logistics sector in Telangana is undergoing significant transformation driven by the Telangana State Logistics Guidelines 2021-2026. This proactive approach by the Government of Telangana aims to enhance the state's economy and create employment opportunities. By streamlining infrastructure, improving service quality, and integrating modern technologies, the state aims to catalyse growth in the logistics industry.

2.4.2 National Context and Challenges

India's logistics sector, valued at USD 215 billion in 2020, is expanding rapidly. However, logistics expenses in India remain higher than the global average due to underdeveloped infrastructure, fragmented warehousing systems, and regulatory complexities. Enhancing the logistics sector can boost exports and drive economic growth, with a 10% reduction in logistics costs potentially increasing exports by 5-8%.

2.4.3 Policy Focus Areas

Government Initiatives: The Government of Telangana is committed to boosting the logistics sector through strategic initiatives and the establishment of logistics-focused industrial zones such as Hyderabad Pharma City and NMIZ in Zaheerabad. These initiatives aim to augment manufacturing capacities and streamline distribution domestically and internationally.

2.4.4 Policy Purpose and Vision:

The policy aims to enhance the ease of logistics, reduce costs, and attract private investments. It focuses on developing robust infrastructure, improving service quality, increasing technology penetration, and enhancing skilled manpower availability.

2.4.5 Policy Tenure:

Spanning five years from the date of notification, the policy is designed to facilitate effective execution through private sector participation, skill development, and technological advancements.

2.4.6 Implementation Framework:

The framework includes building logistics infrastructure, strengthening transportation networks, developing skills, and supporting technology and quality standards. It incentivizes the development of Multi-Modal Logistics Parks and Integrated Logistics Parks and promotes the use of high-capacity commercial fleets.

2.4.7 Infrastructure Development:

Telangana aims to become a cost-effective logistics hub by developing infrastructure, enhancing service quality, and integrating modern technologies. The policy includes initiatives like the allocation of land for common logistics infrastructure and support for technology upgradation.

2.4.8 Strategic Location and Industrial Policies

Telangana's strategic location and robust industrial policies like TS-iPASS position the state as a key player in the logistics domain. By identifying logistics as a thrust sector, the state aims to leverage economic growth to enhance manufacturing, agriculture, and food processing industries. Projects like Kaleshwaram and Mission Kakatiya have boosted paddy cultivation, positioning Telangana as a significant rice producer.

2.4.9 Expected Outcomes and Benefits

The policy is expected to attract investments of Rs. 10,000 Crores into the state's logistics infrastructure and create over 100,000 direct employment opportunities, with additional indirect employment prospects. By fostering innovation and incentivizing private sector participation, Telangana aims to enhance its competitiveness in the global market.

2.4.10 Conclusion

The Telangana State Logistics Policy 2021-26 represents a comprehensive strategy aimed at optimizing logistics operations, enhancing infrastructure, and fostering economic growth. By aligning with the National Logistics Policy, it ensures coherence

and uniformity across regional and national operations, promoting a robust, resilient, and sustainable logistics ecosystem in India.

2.5 Introduction to the National Logistics Policy (NLP)

Introduced on September 17, 2022, the National Logistics Policy (NLP) aims to revolutionize India's logistics sector by reducing costs and enhancing efficiency. By lowering logistics costs, which currently stand at 13-14% of GDP, to align with those of developed countries, the policy seeks to increase the competitiveness of Indian products both domestically and internationally. It provides a comprehensive framework to address logistical challenges and promote the seamless movement of goods across the country.

2.5.1 Development and Objectives

The development of the NLP has been a meticulous process, taking eight years to formulate. This reflects India's commitment to thorough groundwork before implementing policies to ensure their successful execution. The policy aims to tackle last-mile delivery issues, improve transportation efficiency, save time and money for manufacturers, and prevent wastage of agricultural products. By enhancing coordination and streamlining processes, the NLP seeks to accelerate sectoral growth, foster value addition, and stimulate entrepreneurship.

2.5.2 Core Framework

At its core, the NLP lays down an interdisciplinary, cross-sectoral, and multi-jurisdictional framework to develop the entire logistics ecosystem. It aims to make the logistics industry more efficient and cost-effective, boosting economic growth, creating employment opportunities, and enhancing the competitiveness of Indian industries in the global market.

2.5.3 Infrastructure and Stakeholder Engagement

One of the key objectives of the NLP is to create modern infrastructure of world-class standards by engaging all relevant stakeholders in a holistic planning and implementation process. This collaborative approach is expected to enhance efficiency and synergy, particularly in alignment with initiatives like PM Gati Shakti, which focuses on multi-modal connectivity.

2.5.4 Enhancing International Trade

Recognizing logistics as the backbone of India's international trade, the policy aims to promote seamless movement of goods to diversify exports and enhance the competitiveness of Indian industries. By reducing logistics costs from 16% of GDP to the global average of 8% by 2030, the NLP aims to unlock significant growth potential in the sector. The Indian logistics market is projected to reach $215 billion in the next two years, with a CAGR of 10.5% through 2025.

2.5.5 Key Steps for Implementation

To achieve its objectives, the NLP outlines four significant steps:

- Integration of Digital Systems (IDS): Digital integration of various systems across seven departments to streamline processes and improve efficiency.
- Unified Logistics Interface Platform (ULIP): Facilitates shorter and smoother cargo movement by enabling real-time exchange of information in a confidential manner.
- Ease of Logistics (ELOG): Enhances the ease of doing business in the logistics sector through transparency and accessibility.
- System Improvement Group: Monitors all logistics-related projects regularly to ensure effective implementation.

2.5.6 Expected Outcomes and Benefits

The NLP is expected to minimize logistical challenges, boost exports, and benefit small businesses and individuals engaged in the sector. It is anticipated to stimulate economic growth through employment generation, inter-state and international trade, and overall enhancement of the logistics ecosystem.

2.5.7 Synergy with Other Initiatives

The transformative potential of the NLP is amplified when combined with other connectivity and infrastructure improvement programs such as Gati Shakti, Sagarmala, and Bharatmala. These initiatives aim to create a single-window e-marketplace, streamline logistics facilitation, and harness the potential of waterways for cost-effective transportation alternatives.

2.5.8 Recent Improvements and Future Developments

Notable improvements have already been observed in Indian ports, with increased capacity and reduced turnaround times for cargo ships. Additionally, the development of air cargo ports, cold storage facilities, and multi-modal hubs nationwide is expected to further enhance freight movement efficiency.

2.5.9 Complementary Actions

India's Comprehensive Logistics Action Plan (CLAP) complements the objectives of the NLP by focusing on reducing logistics costs to global benchmarks by 2030. Through the adoption of advanced technology, such as paperless trade operations and unified tax systems like GST, the logistics sector is poised for significant transformation.

2.5.10 Conclusion

The National Logistics Policy is a transformative initiative aimed at revolutionizing the logistics sector in India. By reducing costs, enhancing efficiency, and promoting seamless movement of goods, the policy is expected to drive economic growth, create employment opportunities, and bolster the competitiveness of Indian industries in the global market. With a comprehensive framework and collaborative approach, the NLP lays the foundation for a modern and efficient logistics ecosystem, propelling India towards its goal of becoming a $5 trillion economy by 2024-25.

2.6 Major factors

A comprehensive review of various papers relevant to my study has been shown, focusing on the techniques, tools, and parameters employed in different case studies. Among the diverse methodologies examined, the use of multi-criteria decision-making (MCDM) techniques stands out as particularly significant. A total of 14 articles were analyzed to identify the key parameters and methods utilized in these studies.

The reviewed literature highlights the importance of MCDM in addressing complex decision-making scenarios involving multiple conflicting criteria. Various techniques under the MCDM umbrella, such as the Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and others, are frequently employed. These methods facilitate a structured and objective

evaluation process, aiding in the prioritization and selection of optimal alternatives based on predefined criteria.

Key factors include proximity to transportation infrastructure (highways, railways, airports, seaports), industrial zones, and production centers, as well as population density and available land for expansion. Economic considerations such as land costs, construction expenses, and operational expenditures are critical. Environmental and social factors, including environmental impact, traffic implications, and local employment, play significant roles. Infrastructure connectivity and the ability to integrate intermodal transport systems are essential for efficient logistics operations. Additionally, strategic considerations such as land availability for redevelopment and specific constraints of the area are important. These parameters collectively facilitate informed decision-making, aiming to optimize logistics efficiency, cost-effectiveness, and sustainable development.

1. (Uyanik et al., 2018)
2. (Fraile et al., 2016)
3. (Sakai et al., 2018)
4. (Jakubicek & Woudsma, 2011)
5. (Rikalovic et al., 2018)
6. (Taniguchi et al., 1999)
7. (Özceylan et al., 2016)
8. (Peker et al., 2016)
9. (Önden et al., 2018)
10. (Uysal, 2014)
11. (Jacyna-gołda & Izdebski, 2017)
12. (Durmuş & Turk, 2014)
13. (Kang, 2018)
14. (Singh et al., 2018)

CHAPTER 3. STUDY AREA

3.1 Site Selection Criteria

In recent years, the warehouse industry has experienced significant growth, sustained by increased government investment, enhanced infrastructure, and expanded access to global markets. This growth trajectory is estimated to continue over the next 3–5 years, signaling a structural shift towards a more organized and consolidated logistics sector (Logistics – Invest Telangana. (n.d.). https://invest.telangana.gov.in/logistics/.).

Establishing dedicated freight corridors, coupled with advancements in containerization, inland waterways, and expanded air and rail connectivity, has catalyzed a surge in activity within the logistics sector.

Hyderabad has emerged as a prominent investment destination, strategically situated to connect several industrial corridors across the country. Notably, the award-winning Hyderabad Airport serves numerous international destinations, further enhancing the city's attraction for investors and businesses.

According to the United Nations World Cities Report of 2016, Hyderabad's population is projected to exceed 10 million by 2030. This population growth is driven by various factors, including the city's thriving information technology (IT) sector, renowned educational institutions, and ongoing infrastructural developments. Hyderabad's robust economy and favorable living conditions also contribute to its magnetism, attracting individuals and families seeking enhanced career prospects and quality of life.

The existing projects like Mangalapally Logistics Park, a world-class facility spanning 22 acres, stands as India's first integrated logistics park developed under a public-private partnership (PPP) model. Additionally, the state government is leading the development of a radical logistics park at Batasingaram in Hyderabad, spread across 40 acres and investments worth Rs 50 crores. This initiative, featuring warehousing, parking, and retail facilities, aligns with the state's ambition to establish 10-12 more logistics parks within the next two to three years, envisioning Hyderabad as a global logistics hub.

Furthermore, Telangana's logistics policy, complemented by initiatives such as ease of doing business, the proposed Pharma City, and TS-iPASS, positions the state to

scale up its presence in the sector significantly. With the potential for fivefold growth within three years, Telangana is composed of substantial expansion in the logistics industry. (Logistics – Invest Telangana. (n.d.). https://invest.telangana.gov.in/logistics/)

Upcoming projects The Indore-Hyderabad Economic Corridor, spanning 713 kilometers, serves as a crucial expressway linking Indore in Madhya Pradesh to Hyderabad. Connecting through the patancheru cluster of NH-161 in Telangana, spanning 40 kilometers, is a pivotal component of this corridor. Scheduled for inauguration in March 2024, this corridor is anticipated to boost inter-state connectivity, stimulating economic growth and fostering regional integration, while concurrently diminishing logistics travel time and costs.

Hyderabad's expanding logistics industry, backed by strong infrastructure, government support, and strategic location, positions the city as a major player in India's logistics sector. With ongoing expansion plans and connectivity projects, Hyderabad promises sustained growth, making it an ideal study area for the thesis.

3.2 City Profile

Hyderabad, the capital of the Indian state of Telangana, holds a crucial position in Southern India. Beyond its demographic significance, Hyderabad has transformed into a prominent investment hub, strategically connecting various industrial corridors across the nation. Its geographical stretch, administered by the Hyderabad Metropolitan Development Authority (HMDA), spans over 7257 square kilometers, accommodating a population of 97 lakhs (shown in Figure 5). Within this vast region, the Greater Hyderabad Municipal Corporation (GHMC) governs an area of 625 square kilometers (Census, 2011), hosting a population of 69 lakhs. it ranks as the fourth-most populous city in India These administrative boundaries delineate the study area, offering a comprehensive focus on the socio-economic dynamics within Hyderabad and its immediate surroundings. As a blooming metropolis, Hyderabad embodies a confluence of tradition and modernity, attracting businesses, investors, and a diverse populace seeking opportunities and prosperity. Its strategic location, rising population, and infrastructural development emphasize its significance as a key player in India's economic landscape, composed for further growth and advancement in the years to come.

In Hyderabad, warehousing activities primarily gravitate towards three key clusters: Medchal, Patancheru, and Shamshabad. During the financial year 2023, the manufacturing sector led the highest volume of transactions. This surge can be attributed to government initiatives like Make in India and the implementation of Production Linked Incentive (PLI) schemes, aimed at boosting manufacturing. Remarkably, occupiers in the manufacturing realm largely from pharmaceuticals, paints, electricals, and equipment manufacturing industries. The demand from these sectors has witnessed significant growth, experiencing a year-on-year increase of 98% in absolute volumes, reaching 0.18 million square meters (2.0 million square feet) during the financial year. This robust growth highlights the resistance of Hyderabad's warehousing market, fuelled by supportive policies and the dynamic needs of the manufacturing landscape (Frank, 2023)

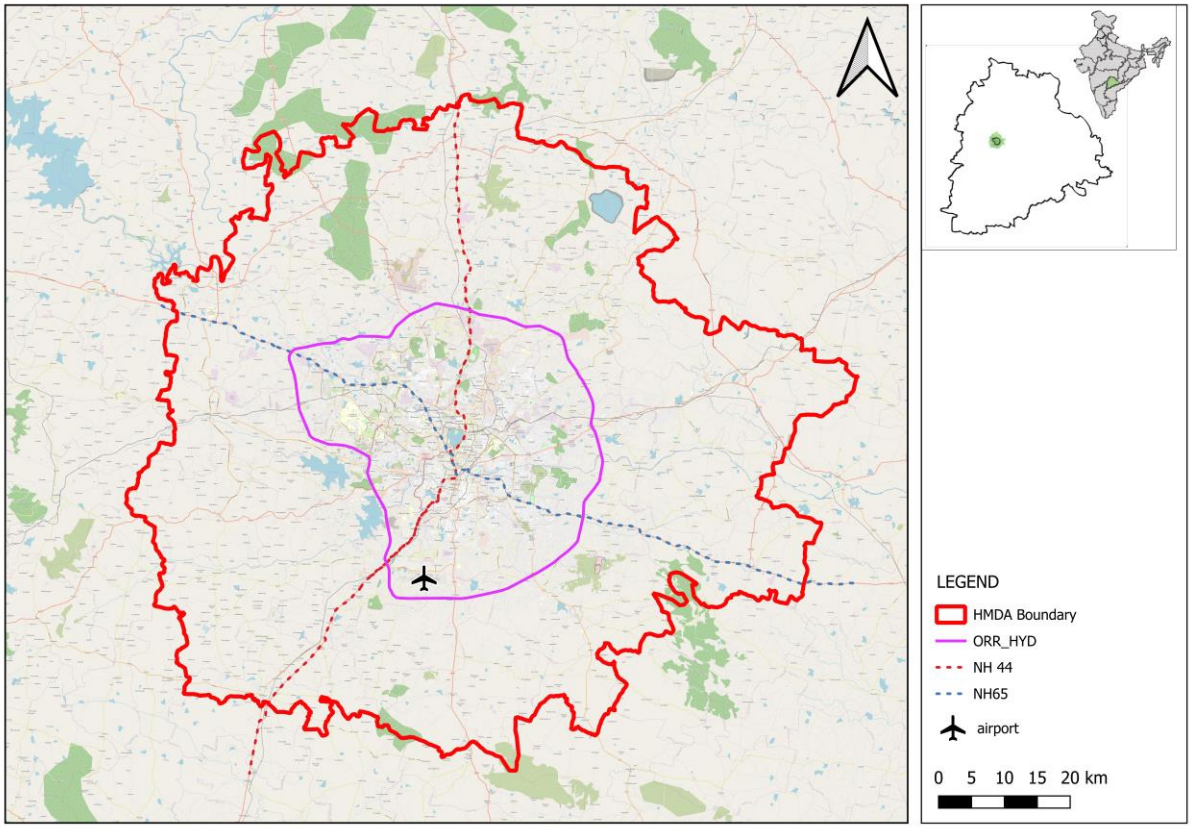


Figure 5 Map of HMDA boundary

CHAPTER 4- DATA COLLECTION

The primary survey focused on three major warehouse clusters around Hyderabad: the Medchal cluster in the north along the Hyderabad-Nagpur highway (NH-44), the Patancheru cluster in the west on the Mumbai-Hyderabad highway (NH-65), and the Shamshabad cluster in the south along the Bangalore-Hyderabad highway (NH-44) (shown in Figure 6). The survey included a detailed questionnaire, cluster observations, interviews with truck drivers, engagement with clients and stakeholders, and consultation services. the primary survey focused on on-the-ground assessments and interactions.

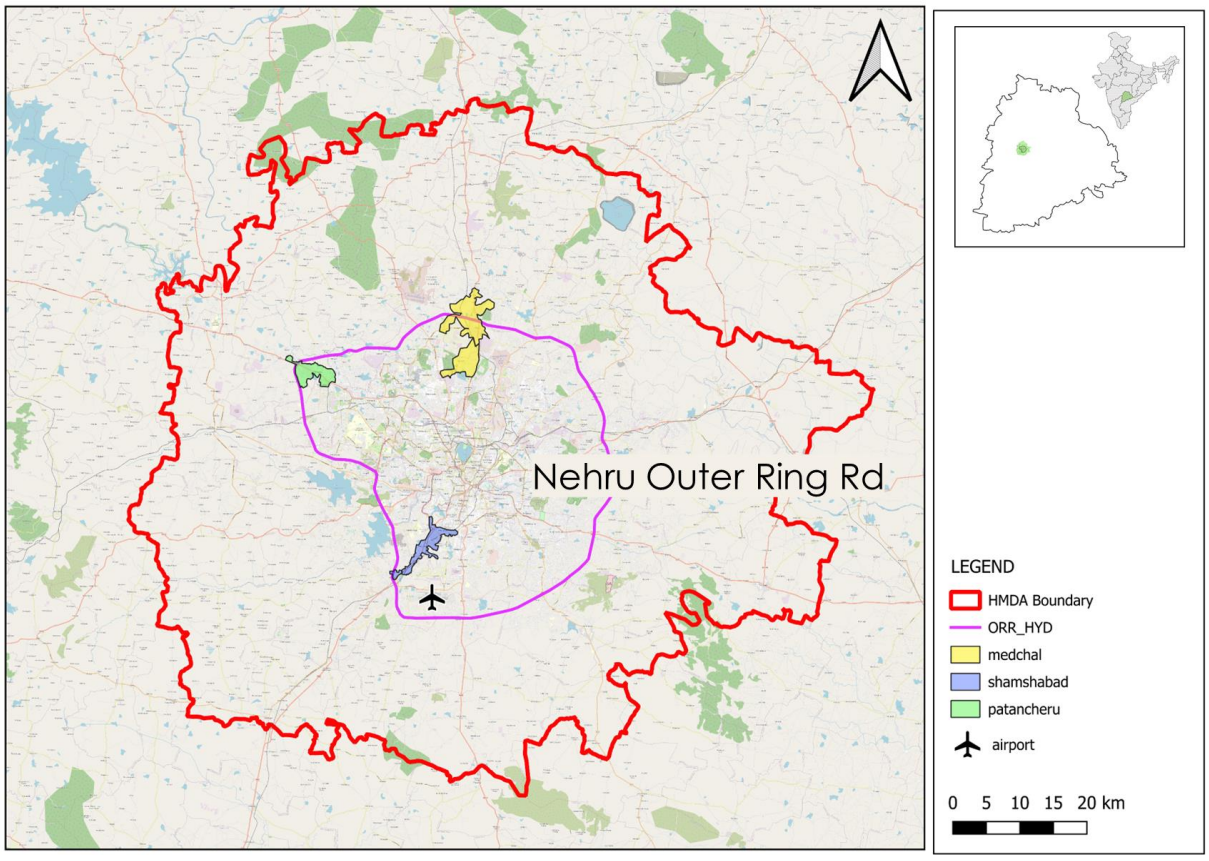


Figure 6 Warehouse Clusters in Hyderabad

Additionally, the survey gathered secondary data on the locations, capacities, and details of Food Corporation of India (FCI), Central Warehousing Corporation (CCI), and Central Warehousing Corporation (CWC) warehouses, including their offices in Sanath Nagar and Nampally, Hyderabad.

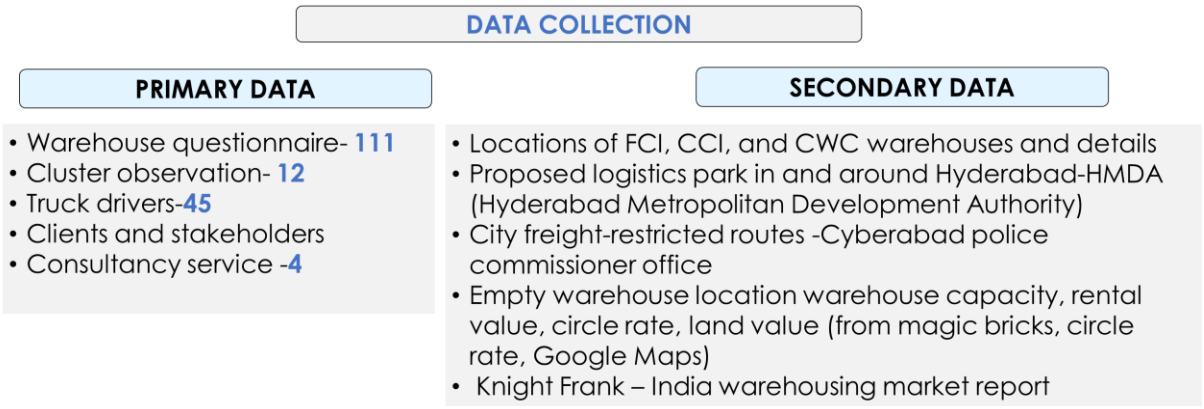


Figure 7 Data Collected

Also, layouts of proposed logistics parks in and around Hyderabad, under the Hyderabad Metropolitan Development Authority (HMDA). It also identified city freight-restricted routes enforced by the Cyberabad and Hyderabad police, with specific mention of the Cyberabad police commissioner's office, Gachibowli police station, and the absence of information for the Rachakonda zone. Additionally, the survey examined empty warehouse locations, their capacities, rental values, circle rates, and land values using sources like Magic Bricks, circle rate data, and Google Maps. Furthermore, insights from Knight Frank's India Warehousing Market Report were incorporated to provide a comprehensive understanding of the overall warehouse market dynamics. The secondary survey utilized existing data sources and market reports to supplement and validate the findings. This combined approach ensured a holistic understanding of warehouse clusters, logistics parks, city regulations, and market trends in and around Hyderabad.

The data collected from the three major warehouse clusters around Hyderabad Provides valuable insights into their respective characteristics. In the Medchal cluster, encompassing an extensive area of 39.1 square kilometers with a perimeter of 35.6 kilometers, the survey comprised 38 warehouse questionnaires, 3 cluster observations, and interactions with 18 truck drivers. This extensive data collection process paints a comprehensive picture of the warehouse landscape, offering a detailed understanding of the operations and logistics in the northern region along the Hyderabad-Nagpur highway.

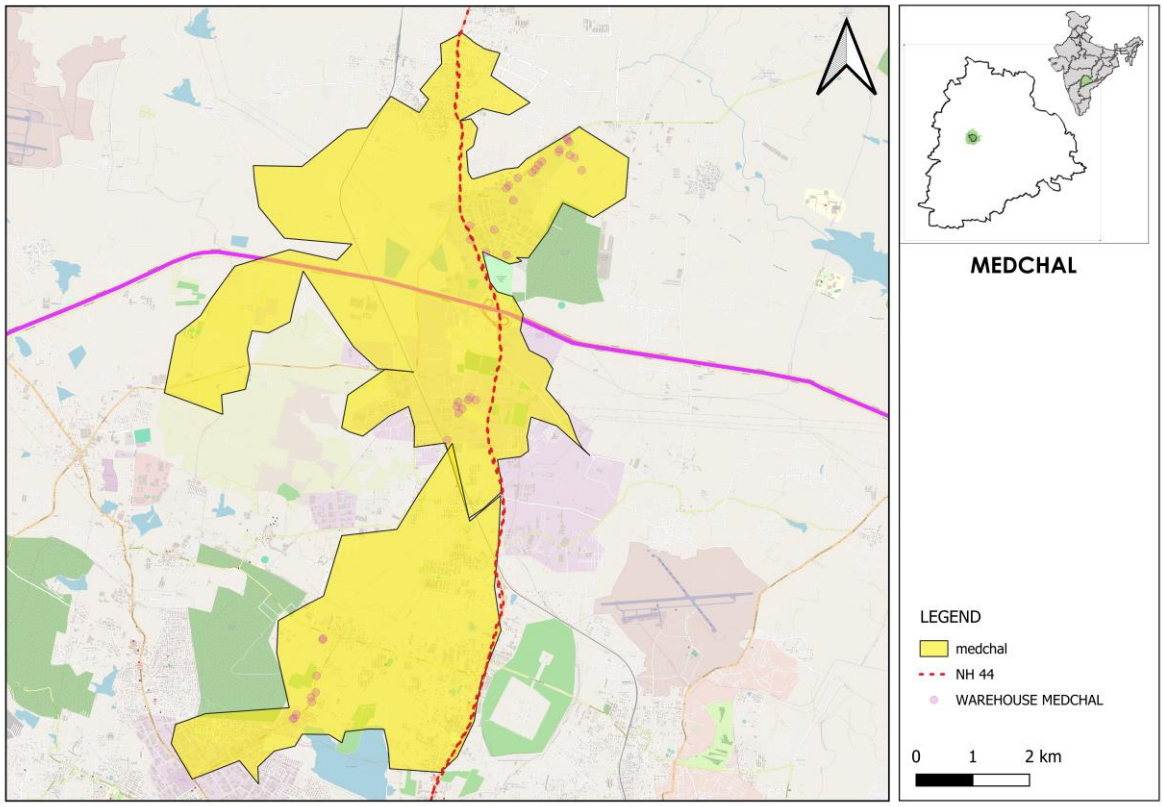


Figure 8 Medchal cluster

The Patancheru cluster in the west, covering 9.73 square kilometers with a perimeter of 29.4 kilometers, the survey included 32 warehouse questionnaires, 5 cluster observations, and engagement with 15 truck drivers.

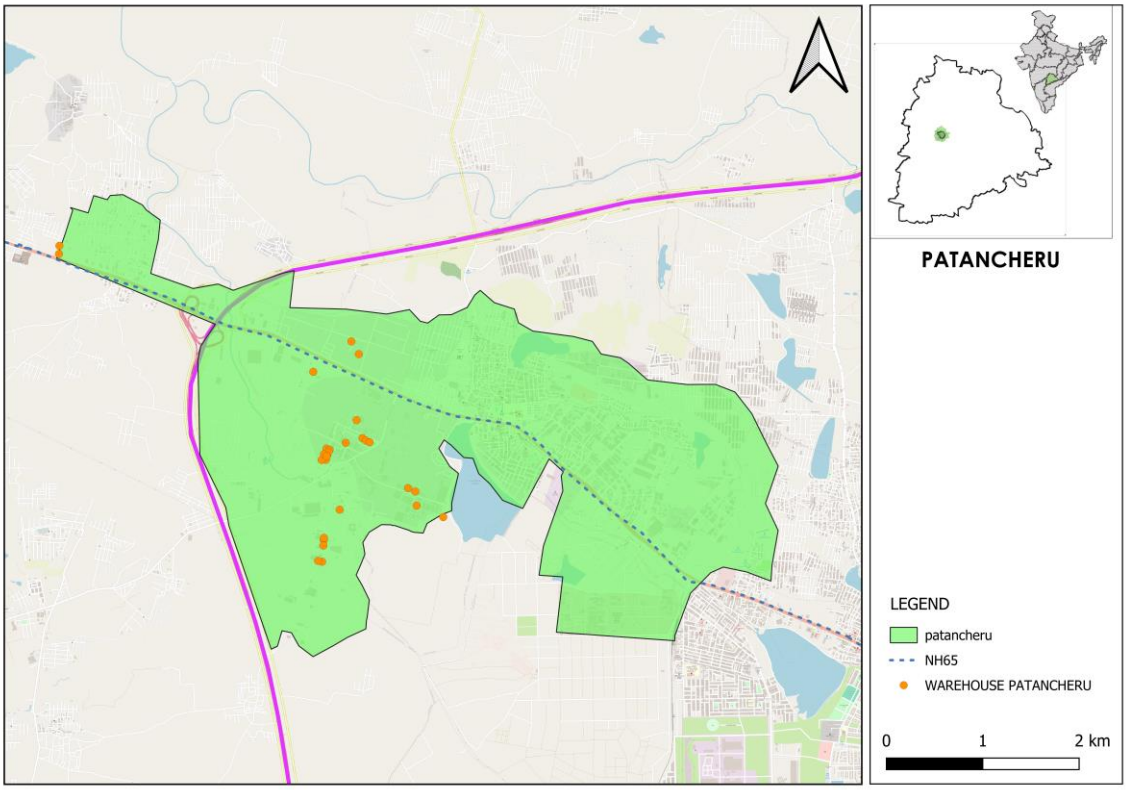


Figure 9 Patancheru cluster

The gathered information sheds light on the distinctive characteristics of this cluster on the Mumbai-Hyderabad highway, providing a perspective on its warehouse infrastructure and operational dynamics.

Lastly, in the Shamshabad cluster in the southern region along the Bangalore-Hyderabad highway, the survey covered an expansive area of 27.55 square kilometers with a perimeter of 42.9 kilometers. The data collection process involved 39 warehouse questionnaires, 4 cluster observations, and interactions with 12 truck drivers. This thorough examination of the southern warehouse cluster offers insights into the logistical intricacies and operational patterns in the vicinity of Shamshabad.

Overall, the data collected from these clusters not only quantifies the physical dimensions of each area but also explores into the specifics of warehouse operations, cluster dynamics, and the experiences of truck drivers, contributing to a comprehensive understanding of the warehouse landscape in and around Hyderabad.

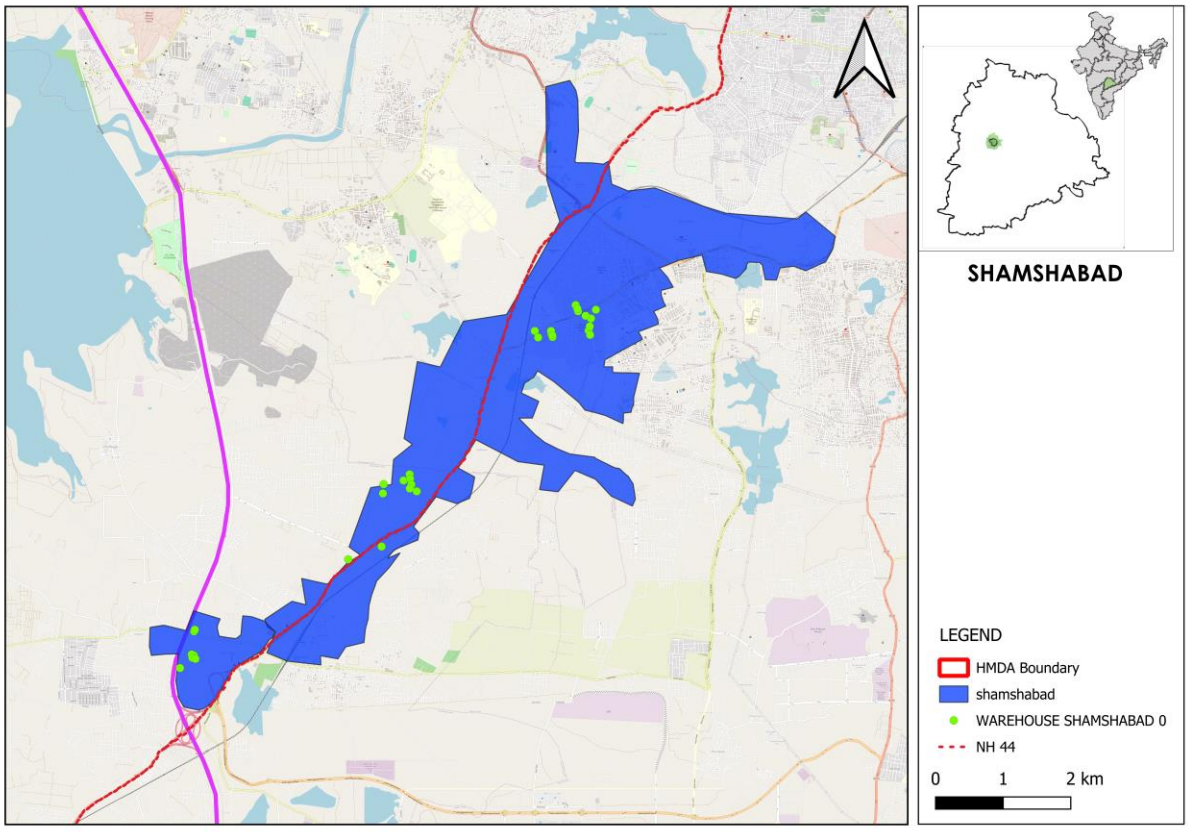


Figure 10 Shamshabad cluster

CHAPTER 5- ANALYSIS

The Multi-Criteria Decision Making (MCDM) method stands as the preferred approach for assessing land suitability, particularly in the context of determining ideal locations for warehouses. This method employs a Weighted Overlay technique, which integrates various factors to evaluate and prioritize potential sites. In this particular study, a comprehensive selection of 10 parameters has been identified through primary surveys and interviews with warehouse consultancy services, coupled with direct observations.

The chosen parameters encompass a wide spectrum of considerations crucial for determining land suitability for warehouse establishments. Firstly, the rental value serves as a fundamental aspect, reflecting the economic viability and potential return on investment for warehouse developers. A higher rental value indicates areas of greater demand or strategic significance within the market. proximity to the city center emerges as a pivotal criterion. Warehouses situated closer to urban centres often benefit from enhanced accessibility, facilitating efficient transportation and distribution networks. This proximity not only reduces transit times but also potentially minimizes operational costs associated with logistics and supply chain management.

Additionally, proximity to key transportation hubs such as airports, railway stations, and major road connections is essential. These factors directly impact the efficiency and effectiveness of distribution channels, enabling seamless connectivity to broader markets and facilitating timely deliveries.

The consideration of freight-restricted routes further refines the assessment, ensuring that selected sites offer unconstrained access for vehicles, thereby avoiding potential logistical monitoring constraints.

proximity to commercial spaces assumes significance, as it can influence synergistic opportunities for businesses operating within the same vicinity. This proximity may adopt collaborative ventures, optimize resource sharing, and potentially attract secondary industries or services, thereby enhancing the overall business ecosystem

The availability of land parcels is a critical determinant, particularly in regions characterized by high demand and limited supply. Assessing the accessibility and availability of suitable land for warehouse development is essential for ensuring feasibility and avoiding potential land use conflicts or zoning restrictions.

Finally, evaluating travel time to the city center provides valuable insights into the overall accessibility and convenience of a chosen location. Minimizing travel distances not only reduces transportation costs but also enhances operational efficiency and responsiveness to market demands.

The Weighted Overlay method synthesizes these diverse criteria by assigning weights to each parameter based on their relative importance and impact on land suitability. By incorporating stakeholder preferences and expert insights gathered through surveys and consultations, this approach facilitates a comprehensive and systematic evaluation of potential warehouse sites.

5.1 Primary Survey Analysis

5.1.1 Types of Commodities

In the diverse landscape of warehouse commodities, Patancheru, Shamshabad, and Medchal clusters in Hyderabad showcase distinctive specialization across six categories. In Patancheru, the warehouses predominantly house grains, flour mills, groceries, and dairy products. This cluster emerges as a hub for essential food items, emphasizing its role in supporting the local and regional supply chain for daily sustenance.

Shamshabad, on the other hand, assumes a different profile, focusing on the storage and distribution of raw materials, construction materials, and plywood. This specialization underscores Shamshabad's significance in catering to the construction and manufacturing sectors, playing a pivotal role in supplying the foundational elements for various industries.

Group	Commodity Type included
Foods	Dairy products,Agriculture,fish and stock farm and packed food products
Daily goods	Furniture, household products, light industrial products
Raw materials	woods, minerals, metals, chemicals, construction material
Engineering and machinery	general machineries, electronics goods, transport equipment , precision instruments and apparatus
Mixed goods	goods from more than one shipper, including parcels
empty	No goods

Figure 11 Types of Commodities

Meanwhile, the Medchal cluster is a storage of packed food and agricultural needs. With a focus on processed and ready-to-consume items, Medchal contributes to the efficient distribution of packaged foods and agricultural essentials, serving the evolving demands of the market.

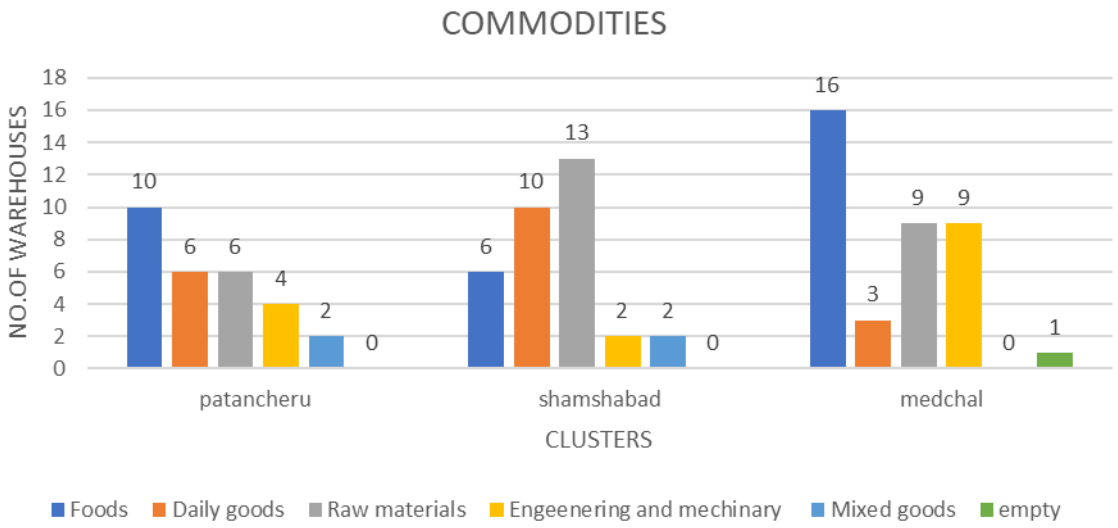


Figure 12 Number of warehouses in each Clusters

These specific commodity distributions within each cluster showcase a strategic alignment with the unique economic activities and demands prevalent in the respective regions. The specialization not only enhances the operational efficiency of warehouses but also reflects the adaptability of these clusters to cater to the diverse needs of their surrounding communities and industries. This understanding of commodities within each cluster contributes to a more targeted and efficient logistical network, fostering the growth and resilience of Hyderabad's warehouse ecosystem.

5.1.2Storage Area

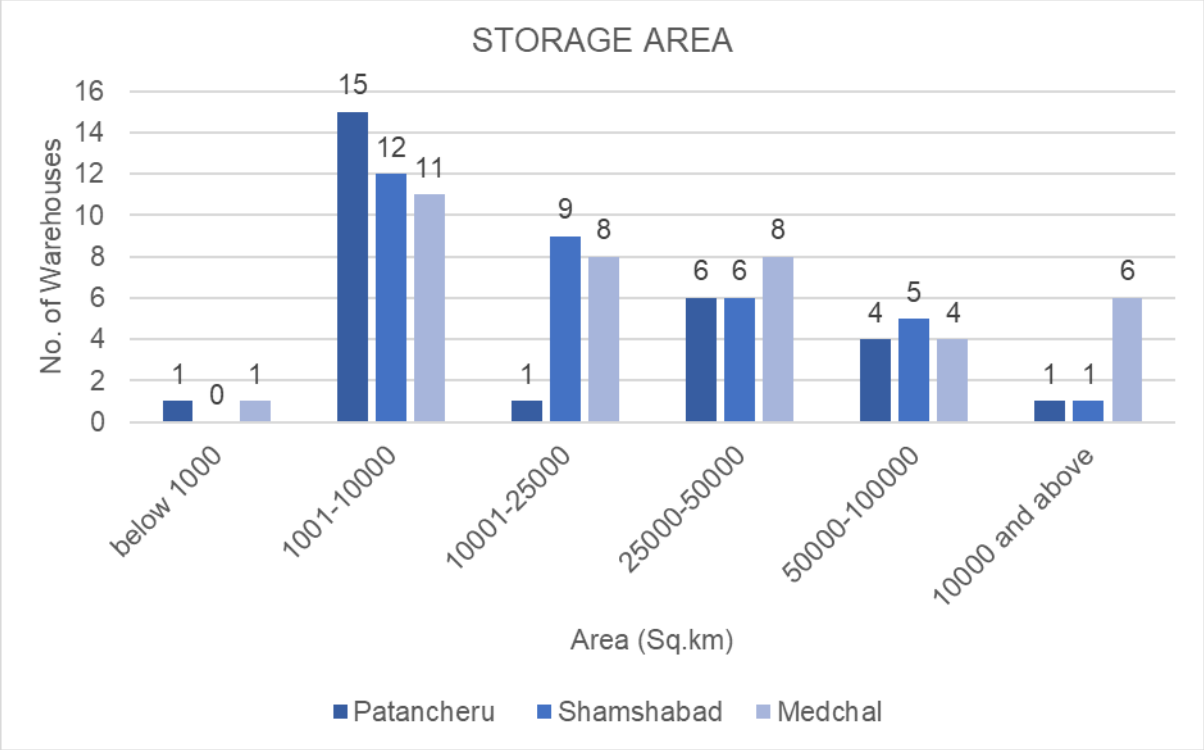


Figure 13 Storage Capacity of each cluster

There are 38 warehouses with floor areas spanning from 1000 to 10000 square feet and Patancheru has the most warehouses ranging from 1000-10000 (shown in figure13)

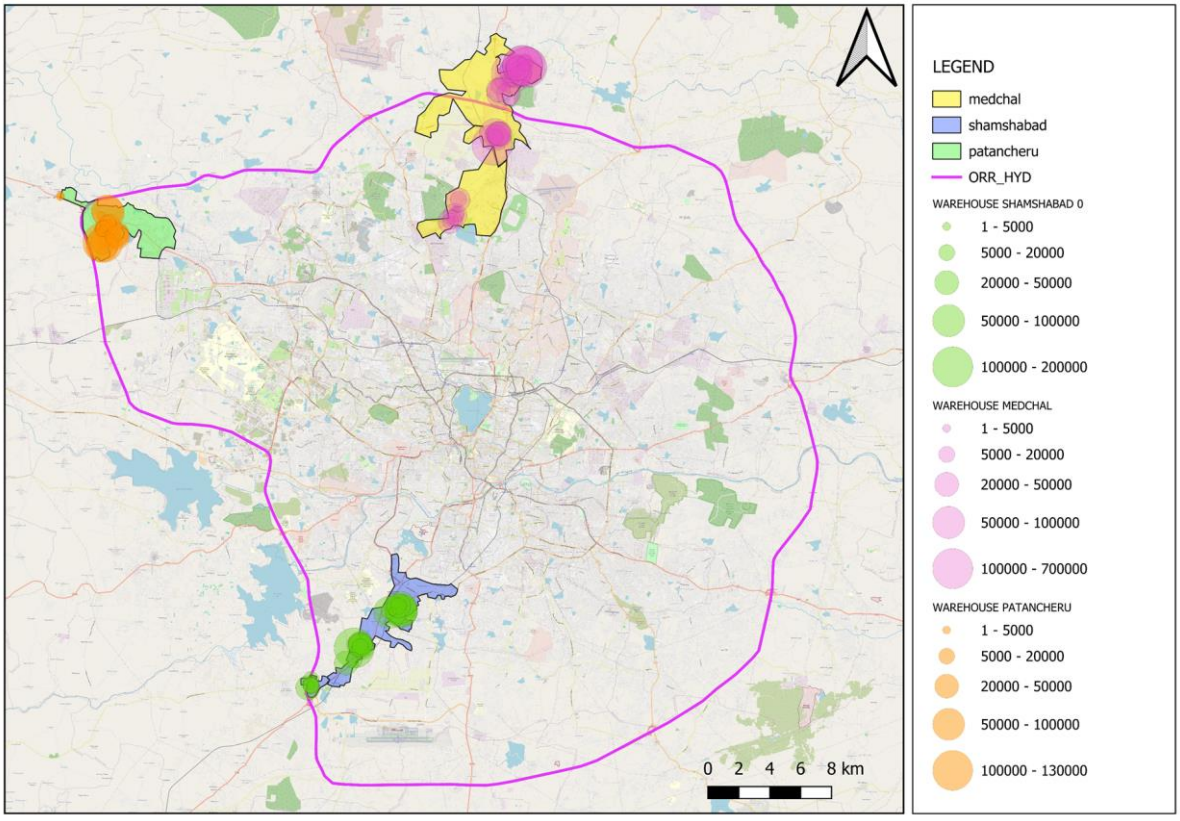


Figure 14 Map Depicting size of warehouses

5.1.3 Rental Value

Among the three clusters, Shamshabad stands out with the highest observed rental value, commanding an average cost of 21.7 rupees per square foot. Following closely is the Medchal cluster, where the rental value is slightly lower but still significant at 19.5 rupees per square foot (shown in Figure 15). Patancheru, while maintaining a competitive position, records a comparatively lower average rental cost of 19.2 rupees per square foot. This rental value hierarchy reflects the varying economic dynamics and demands in each cluster, with Shamshabad leading in terms of real estate expenses, closely trailed by Medchal, and Patancheru securing a position with a slightly more affordable average per square foot cost.

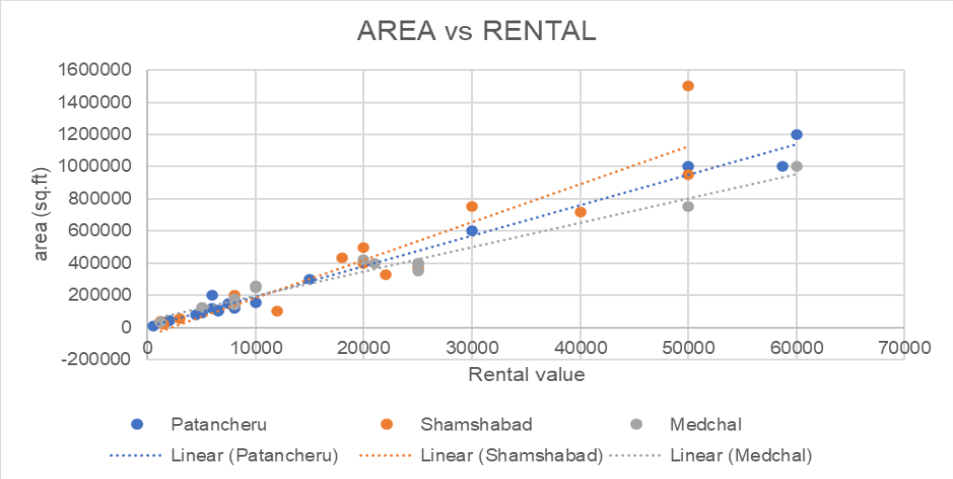


Figure 15 Scatter plot illustrating the corelation between Area vs Rental

Out of a total of 89 warehouses, the majority, specifically 50 warehouses, are under lease agreements.(shown in figure 16.)

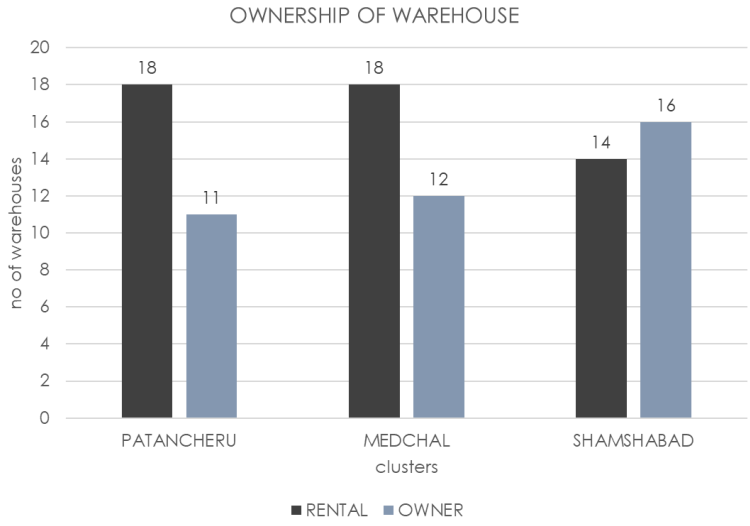


Figure 16 Ownership of warehouses in each cluster

5.2 Parameters

5.2.1 Rental Value

One challenge is that our method might not fully grasp intricate spatial patterns or trends. To determine the rental prices of warehouses across the city, we employ a technique called IDW (Inverse Distance Weighting) Interpolation. This method entails collecting around 150 data points from sources like Magic bricks and 99acres. These samples are spread out across the city, noting rental values at different locations (X, Y coordinates). This approach helps us estimate rental prices in areas where we don't have direct data by considering the values of nearby locations. However, it's important to recognize that this technique may not capture all the complexities of how rental prices vary across different parts of the city.

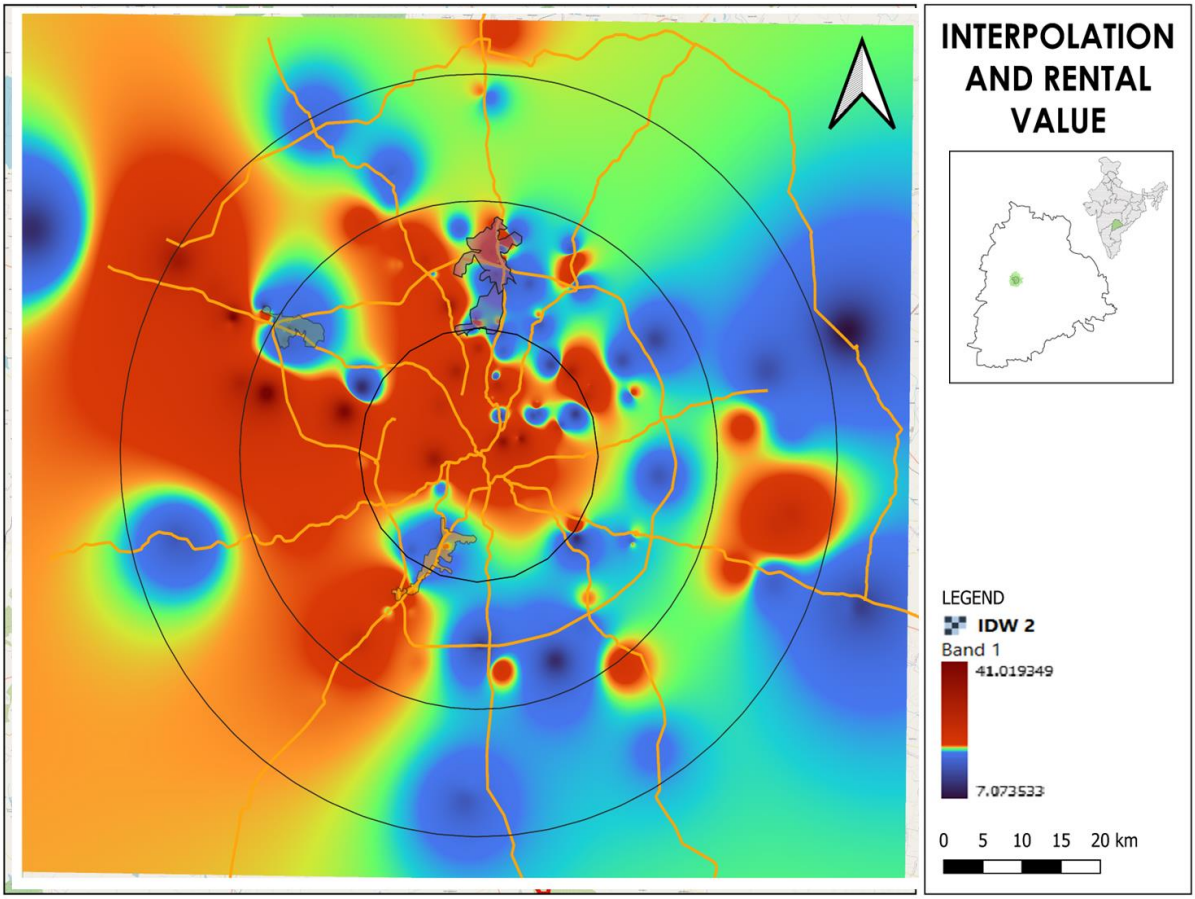


Figure 17 Rental Value

By calculating weights based on distances, an interpolated surface is generated. it's important to acknowledge that this technique has limitations, as it may not fully capture complex spatial patterns or trends.

5.2.2 Freight-restricted routes

Hyderabad, a budding metropolis, strategically divides its expanse into three distinctive police zones - Rachakonda, Cyberabad, and Hyderabad. The city's intricate traffic management system incorporates specific regulations for the mobility of heavy commercial vehicles, imposing restrictions on Interdistrict and National Permits on all roads. However, these restrictions do not extend to the Outer Ring Road (ORR) and its service roads, providing a dedicated corridor for seamless vehicular movement. The ORR emerges as a crucial lifeline for unconstrained logistics and transportation activities, avoiding the restrictions imposed on other city roads. (shown in Figure 18)

In an attempt to optimize traffic flow and reduce congestion, the city enforces strict measures on freight vehicles during peak hours. From 7:30 am to 11:30 am and 4:00 pm to 10:30 pm, heavy commercial vehicles, including those with interdistrict and national permits, face restrictions within the city limits. This time-sensitive approach aims to balance the influx of traffic, ensuring smoother commuting experiences for residents and maintaining efficient logistics operations.

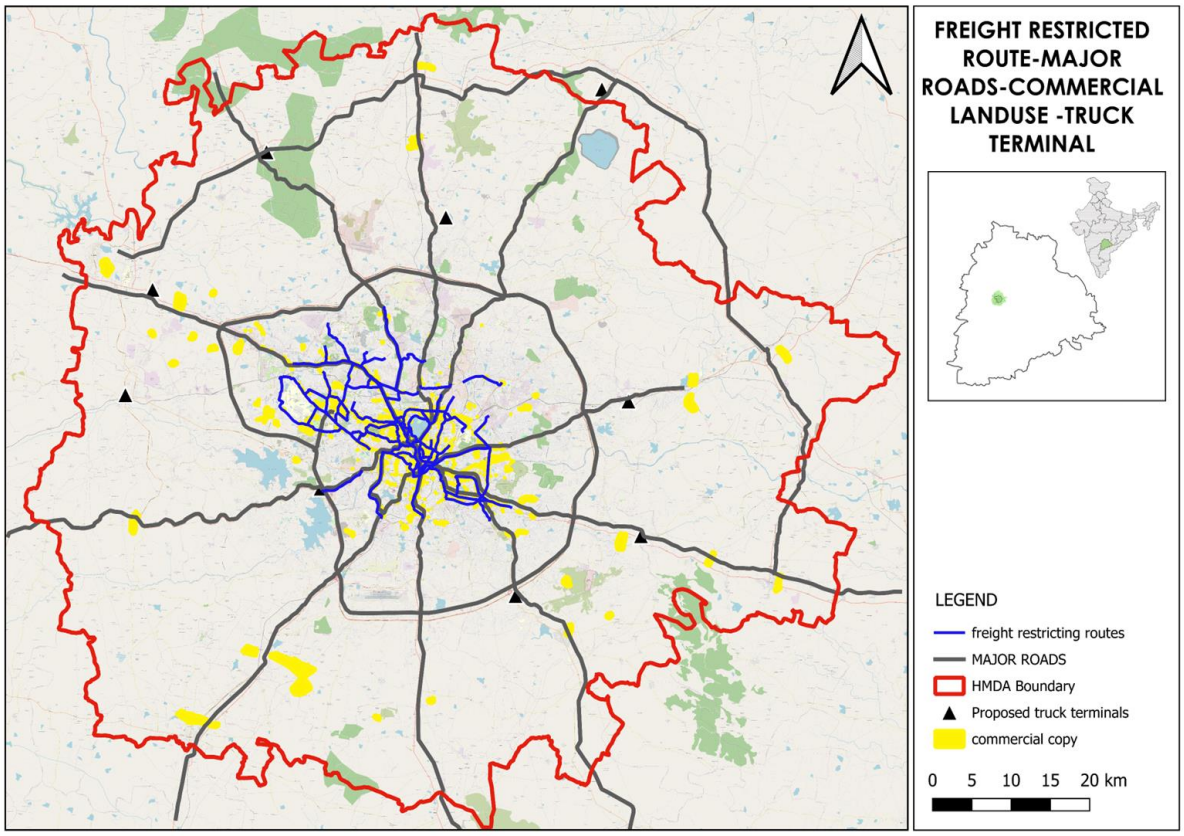


Figure 18 Freight Restricted Routes

5.2.3 Commercial land-use

Freight transportation tends to gravitate towards the commercial hubs within the city, while warehouses are positioned on the outskirts, at the peri-urban edges. These trips typically originate from the outermost areas of the city and move towards its center. The flow of freight aligns with the bustling activity of commercial zones(shown in Figure 18), drawing goods towards areas of high economic activity. Meanwhile, warehouses strategically situate themselves on the periphery, providing convenient access to transportation routes while still being relatively close to urban markets. As goods move from the outskirts towards the city, they serve to replenish stocks, fulfill orders, and meet the demands of businesses and consumers within the urban core. This spatial arrangement optimizes the logistics of freight movement, ensuring efficient supply chain operations while supporting the dynamic needs of urban commerce.

5.2.4 Major Roads

One of the crucial aspects influencing the choice of warehouse locations is the presence of major roads, with existing clusters often found along National Highways 44 and 65. These major roads encompass State Highways, National Highways, and the outer ring road surrounding the city. Warehouses situated closer to these main roads tend to command higher rental prices. This is because easy access to transportation routes facilitates smoother movement of goods in and out of the warehouses. Being near major roads reduces transportation costs and enhances efficiency in supply chain operations. As a result, warehouses strategically position themselves along these vital transportation arteries to capitalize on the logistical advantages they offer. This proximity to major roads not only ensures convenient connectivity but also reflects the premium placed on accessibility and logistical convenience in determining warehouse rental values.

5.2.5 Proposed Truck Terminals

The significance and effectiveness of transport terminals focus on two primary attributes: location and accessibility. Location plays a pivotal role as it determines a terminal's ability to cater to a large population concentration or industrial activity, essentially defining its market area. Equally critical is the terminal's accessibility to other terminals, both locally and regionally, as well as its integration into the broader regional transport system.

A proposed network of nine truck terminals has been meticulously designed to fulfill these objectives, considering estimated tonnage demand and factors such as population growth, economic activities, and URDPFI guidelines. Among these, two terminals are recommended for immediate development by 2021: one on NH-65 at Batasingaram, heading towards Vijayawada, and another on Sagar Road at Mangalapally. Terminals at Shamshabad on NH-44 and Khandi on NH-65, directed towards Pune, are estimated necessary for development between 2021 and 2026. Pragnapur on SH-1 and Bhuvangiri on NH-163 are slated for development between 2026 and 2031. The remaining terminals are earmarked for development between 2031 and 2041 (Logistics – Invest Telangana. (n.d.). https://invest.telangana.gov.in/logistics/).

Although the Batasingaram terminal is initially proposed to cover 40 acres of land, long-term plans anticipate an expansion requiring approximately 100 hectares. Each major and minor truck terminal is projected to occupy approximately 100 and 20 hectares

5.2.6 Travel Time Contour

The travel time contour within Hyderabad is intricately linked to the proximity of key industrial clusters to the central business district (CBD). Shamshabad emerges as the closest to the CBD, offering an advantageous location for businesses and warehouses operating in the southern region. Following Shamshabad, the Medchal cluster takes its place, strategically positioned along the Hyderabad-Nagpur highway. Meanwhile, Patancheru, situated on the Mumbai-Hyderabad highway, falls third in line concerning proximity to the CBD. This spatial arrangement not only influences the travel time dynamics for freight vehicles but also plays a pivotal role in shaping the economic and logistical landscape of each cluster. As Hyderabad continues to evolve, the harmonization of traffic regulations, strategic location planning, and a comprehensive understanding of travel time contours become integral components for the city's sustainable growth and efficient urban logistics. The travel time contour map is generated using real-time data, updated at 30-minute intervals, depicting the accessibility from the city center. It illustrates that Shamshabad can be reached within a 30-minute timeframe.

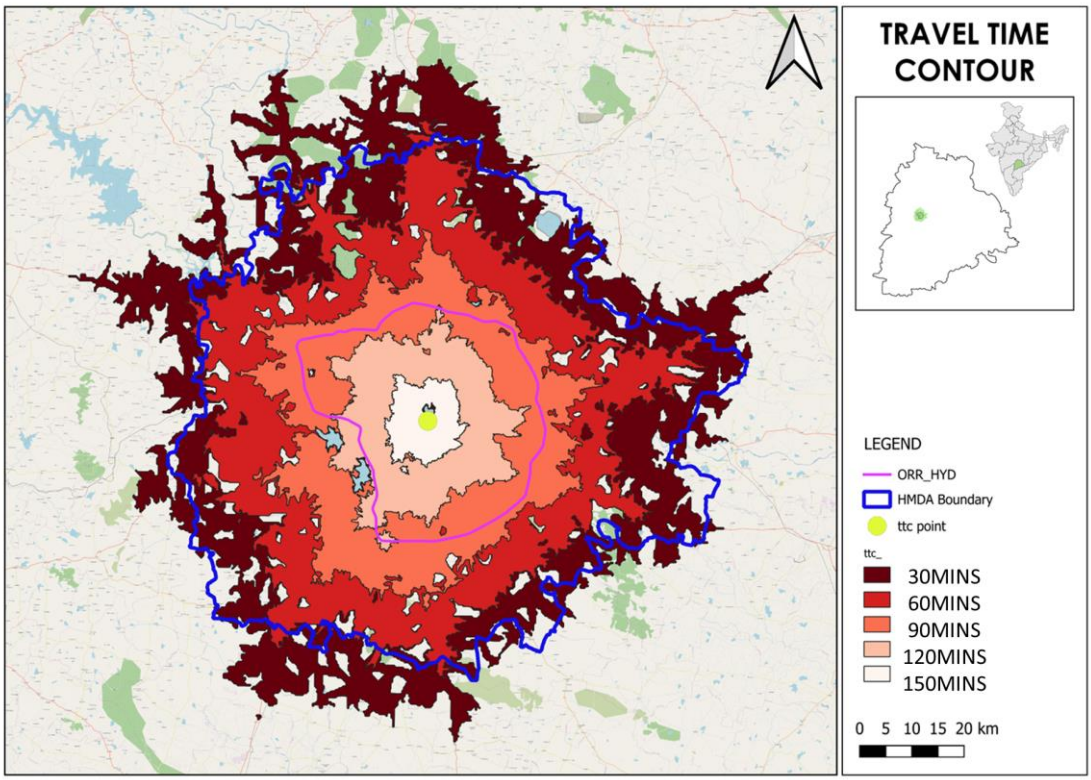


Figure 19 Travel Time Contour

5.2.7 Proximity to the Airport

Being close to the airport in Shamshabad, located south of the city, is a big advantage. The closer a warehouse is to the airport, the better it is for cutting down travel costs.

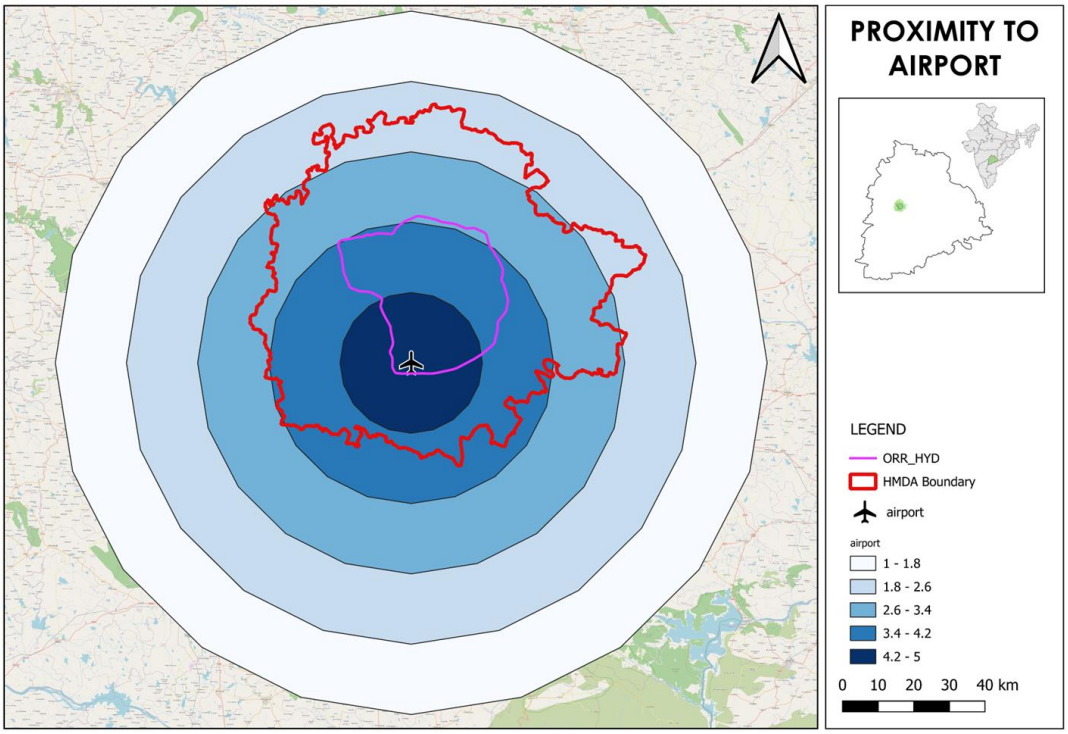


Figure 20 Proximity to Airport

5.2.8 Proximity to City Center

In this scenario, the heart of the city acts as a magnet for freight, drawing it toward the center within a 15-kilometer radius (figure 17). Given this, the outskirts of the city emerge as the prime choice for warehouses. This is because there's more land available, and it comes at a lower cost compared to central areas. Warehouses strategically positioned on the outer edges benefit from ample space to store goods while keeping land expenses in check. Moreover, being on the outskirts doesn't hinder access to the city center since freight naturally moves towards it. Therefore, locating warehouses on the outer periphery proves advantageous both in terms of land availability and cost-effectiveness, while still maintaining convenient proximity to the city's focal point for freight movement.

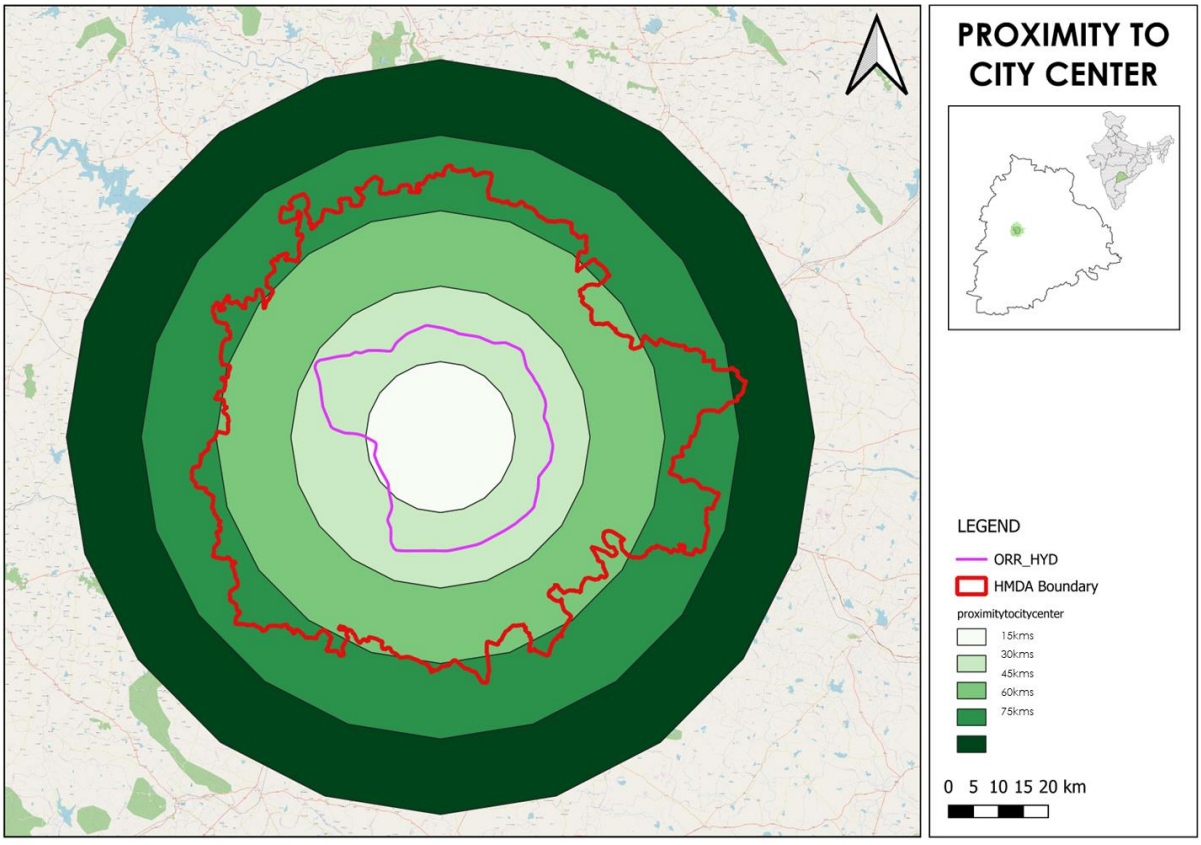


Figure 21 Proximity to City centre

5.2.9 Freight Terminal

In Telangana, there's a network of freight terminals designed to streamline logistics. With 102 loading locations and 97 unloading locations, along with 5 container rail terminals and 6 private freight terminals, these hubs play a vital role. The study focuses on fourteen freight terminals (shown in Figure 22) encircling the city, recognizing their significance in reducing logistics costs and travel time for goods.

By strategically distributing goods among these terminals, companies can optimize their supply chain operations. These terminals serve as pivotal points for the efficient transfer of goods, minimizing the distance traveled and the time spent in transit. Ultimately, this leads to cost savings for businesses and faster delivery times for customers. Thus, the integration of freight terminals into the transportation network enhances the overall efficiency and effectiveness of the logistics ecosystem in Telangana.

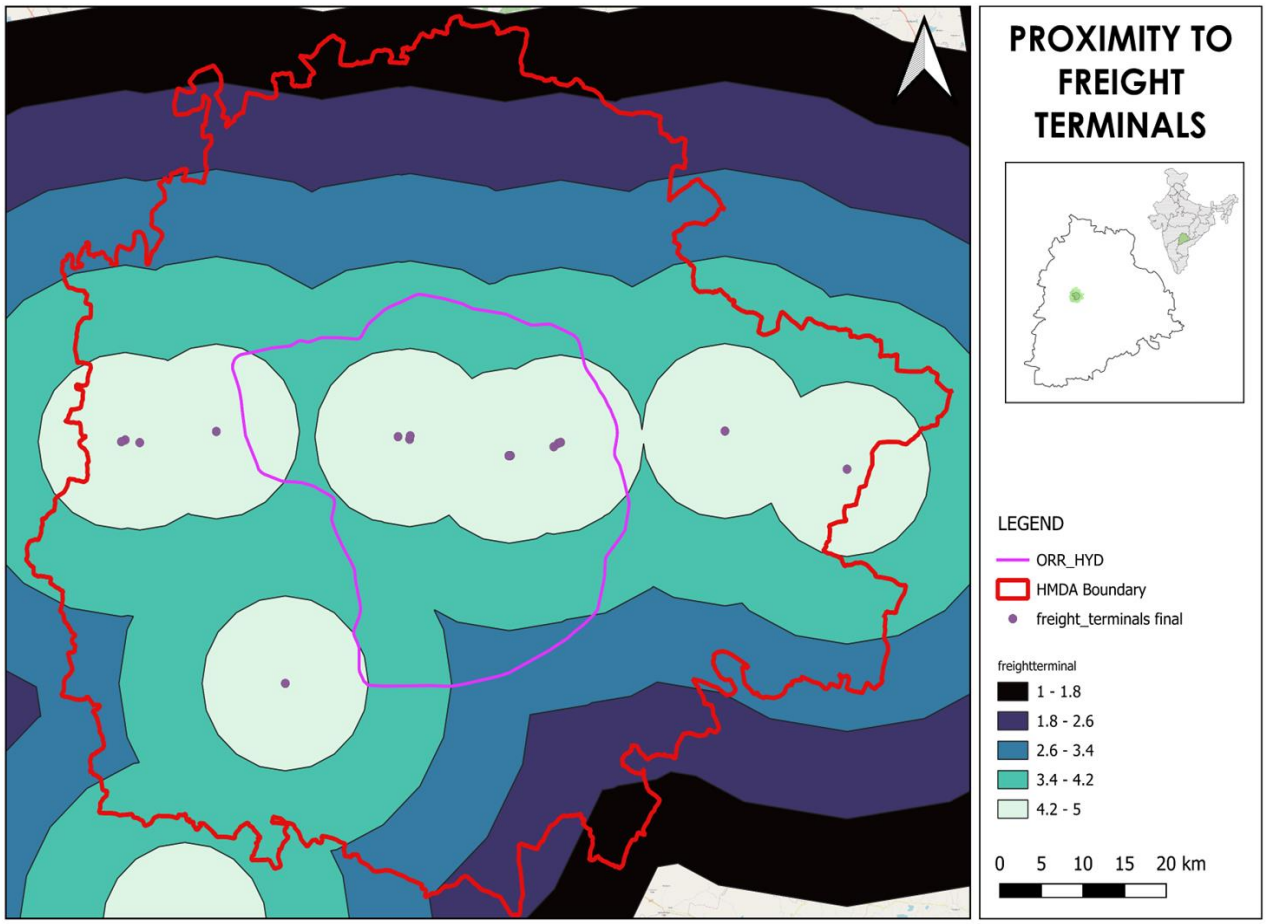


Figure 22 Proximity to Freight Terminals

5.2.10 Rasterization of Layers

These 10 layers are into raster layers with pixels sized at 10 meters by 10 meters each. This means we'll represent each layer as a grid of squares, with each square measuring 10 meters on each side. Each layer captures different aspects related to land parcel availability, rental values per square foot, distances from various key points like the city center, airport, and freight terminals, as well as travel time contours and proximity to commercial land use.

By converting them into raster layers, we can analyze and visualize these factors spatially, helping us understand how they vary across the area of interest. This raster data will provide valuable insights for decision-making in urban planning, transportation logistics, and real estate development, among other fields.

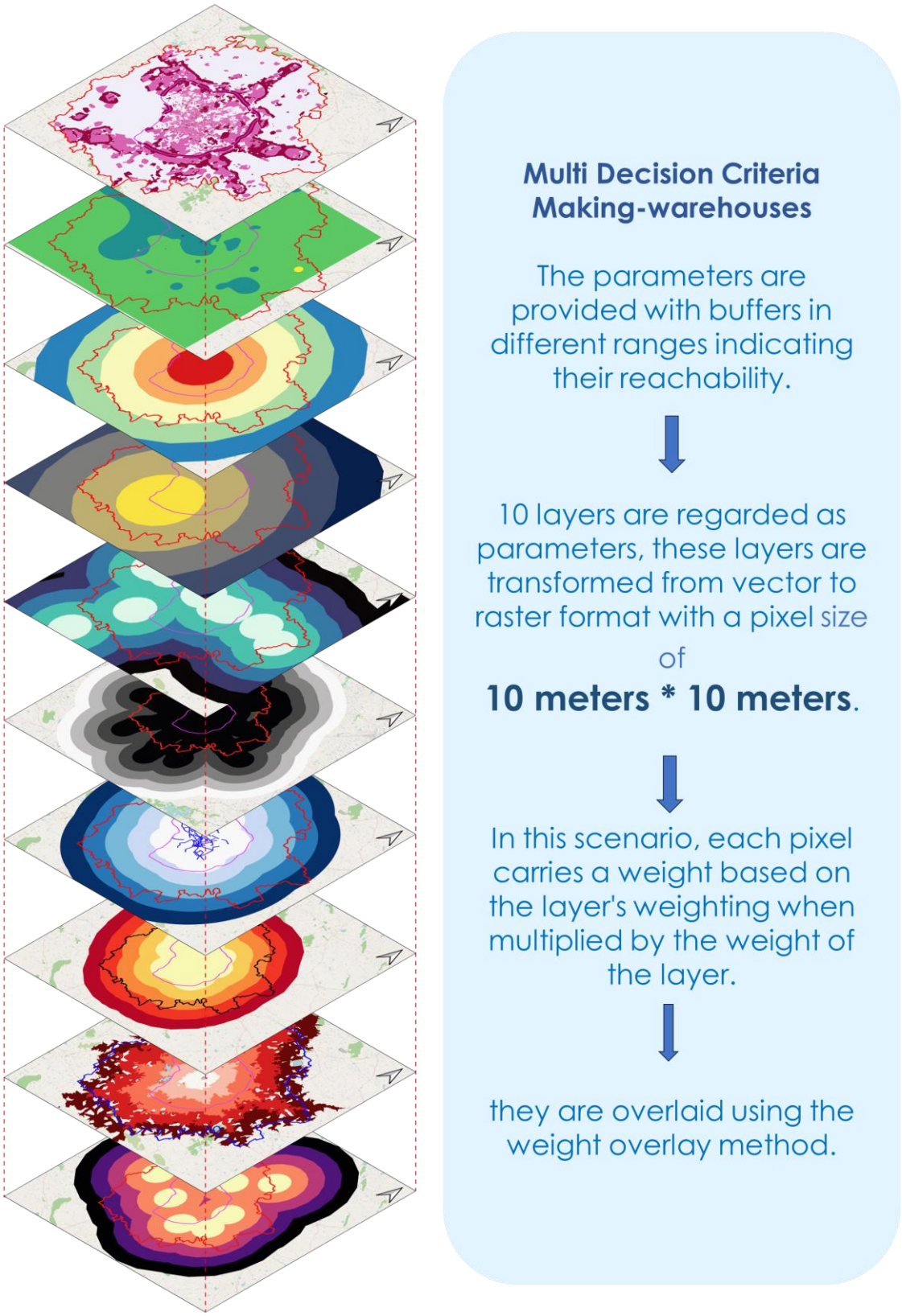


Figure 23 Multi- Decision Criteria Overlay

multi decision criteria making-warehouses

s.no	Parameter	Range Sub categories	Suitability	Weight(%)			Reasoning
				observation	literature	truck terminals	
1	RENTAL VALUE(per sq.ft)	0-10	5	15	12	12	The warehouse with the lowest rental value is the most preferred option for reducing logistic costs.
		10-20	4				
		20-30	3				
		30-40	2				
		>40	1				
2	PROXIMITY TO CITY CENTER (km)	0-5	1	8	12	5	The outer periphery of the city is the most desirable location due to maximum land availability and minimum land costs.
		5-10	2				
		10-20	3				
		20-30	4				
		30-40	5				
3	PROXIMITY TO AIRPORT (km)	0-20	5	5	13	5	The closest proximity to the airport is the most favorable for minimizing travel expenses.
		20-40	4				
		40-60	3				
		60-80	2				
		>80	1				
4	PROXIMITY TO FREIGHT TERMINAL (km)	0-20	5	5	12	5	Opting for the nearest distance to the freight terminal is highly advantageous in reducing travel expenses.
		20-40	4				
		40-60	3				
		60-80	2				
		>80	1				
5	DISTANCE FROM NH,SH,ORR (km)	0-10	5	18	14	12	Enhancing connectivity, the location is strategically positioned near the city's major roads, facilitating ease of transportation.
		10-20	4				
		20-30	3				
		30-40	2				
		>40	1				
6	FREIGHT RESTRICTED ROUTES (Km)	0-10	1	12	6	12	Warehouses tend to avoid freight-restricted routes as they do not facilitate transportation efficiently.
		10-20	2				
		20-30	3				
		30-40	4				
		>40	5				
7	PROXIMITY TO COMMERCIAL LANDUSE	0-10	5	8	7	5	As that trips from the warehouse are drawn towards commercial areas, proximity to commercial land use is highly preferable.
		10-20	4				
		20-30	3				
		30-40	2				
		40-50	1				
8	DISTRANCE FROM PROPOSED TRUCK TERMINALS (Kms)	0-15	5	10	6	30	Proximity to truck terminals makes areas highly suitable.
		15-30	4				
		30-45	3				
		45-60	2				
		>60	1				
9	LAND PARCEL AVAILABILITY	0-15	5	14	13	10	Access to land parcels is essential for development purposes or for allocating space in a master plan.
		15-30	4				
		30-45	3				
		45-60	2				
		>60	1				
10	TTC	>60	5	5	5	4	In travel time contour , the most preferred areas are those requiring the least amount of time for travel.
		60mins	4				
		45mins	3				
		30mins	2				
		15mins	1				

Figure 24 MDCM Weightage

5.3 Scenario – 1

OBSERVATION, PRIMARY SURVEY, AND CONSULTANCY SERVICES OPINION

The importance of various decision criteria is determined based on observations, primary surveys, and opinions from consultancy services. Major roads carry the most weight, making up 18% of the overall decision-making process. Rental value comes next, accounting for 15% of the total weightage. Using the weighted overlay method, it's found that the core area and intermediate ring are the most balanced locations for setting up warehouse clusters. This means these areas are neither significantly advantageous nor disadvantageous when considering all the factors involved. By giving more weight to factors like major roads and rental value, decision-makers aim to find optimal locations for warehouse clusters that offer good accessibility and reasonable rental costs, leading to more efficient distribution and logistics operations.

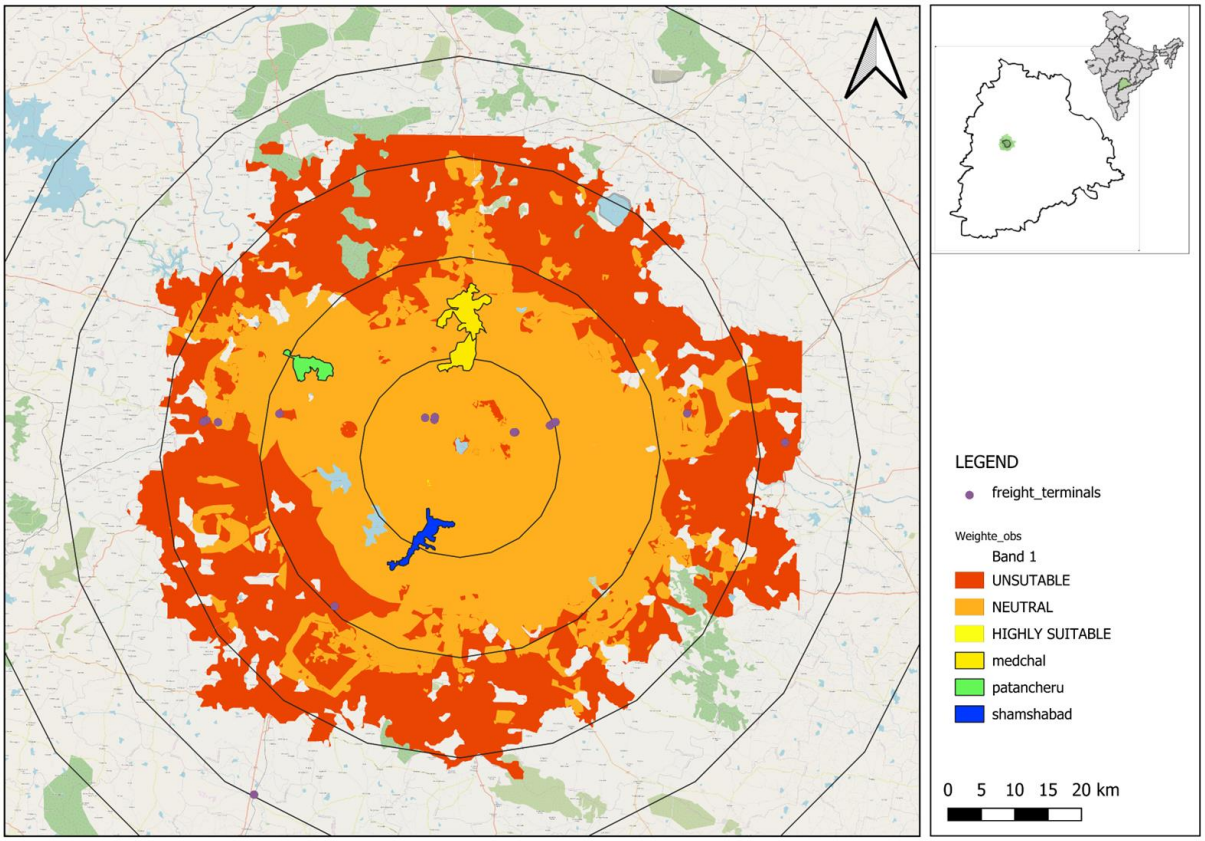


Figure 25 Scenario 1

5.4 Scenario -2

LITERATURE REVIEW

Based on findings from the literature review, the importance of various decision criteria is determined. Major roads are given the highest weightage, accounting for 14% of the overall consideration. Proximity to the airport and land parcel availability carry equal weight, each at 13%. Using the weighted overlay method, it's concluded that the core area and intermediate ring emerge as the most suitable location for establishing warehouse clusters. This means these areas are deemed optimal when considering all the factors analyzed. By prioritizing factors like major roads and proximity to key facilities, decision-makers aim to identify locations that offer favorable conditions for warehouse operations, such as good accessibility and ample space availability. This approach ensures that warehouses are strategically positioned to facilitate efficient logistics and distribution activities.

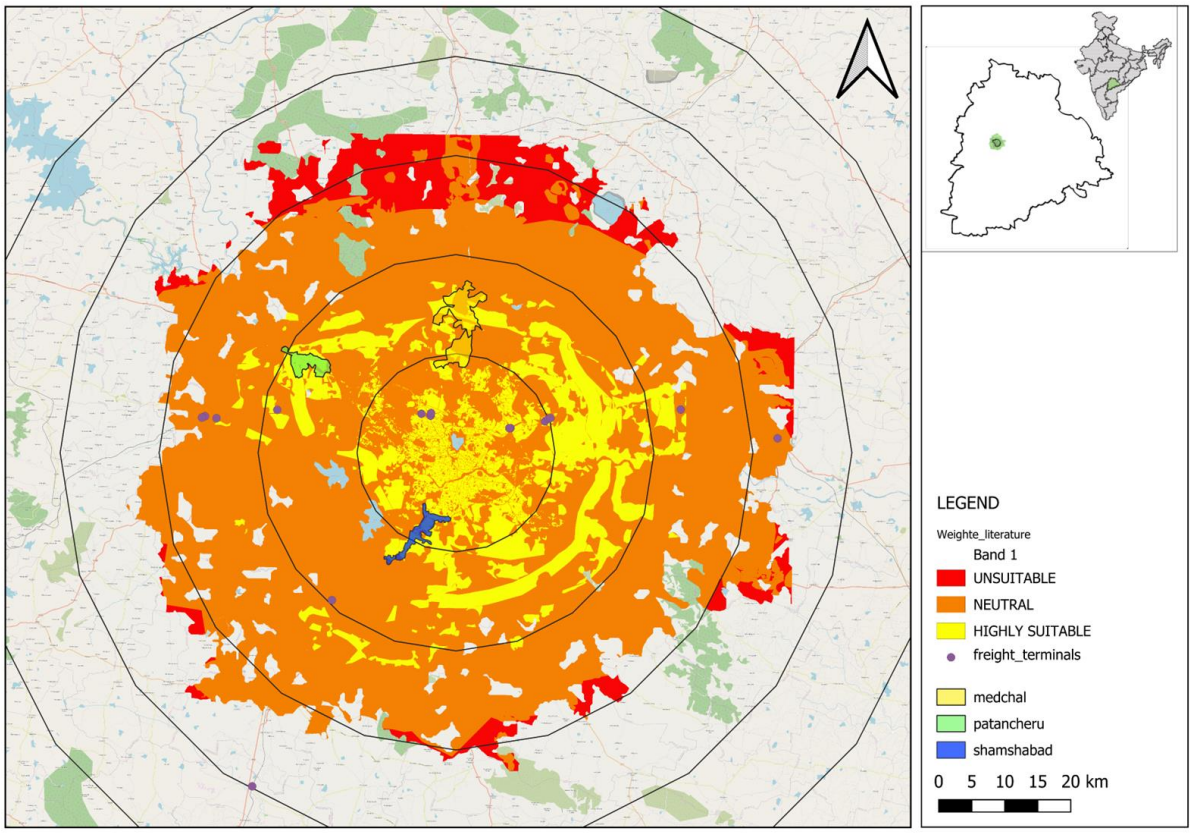


Figure 26 Scenario 2

5.5 Scenario -3

PROPOSED TRUCK TERMINALS ARE THE MOST PRIORITY

The importance of various decision criteria is determined by prioritizing proposed truck terminals, which carry the highest weightage at 30%. Using the weighted overlay method, it's found that the intermediate ring emerges as the prime choice for establishing warehouse clusters. These locations are considered the most suitable. Notably, the truck terminals are positioned on the outer edge of the city. This strategic placement aims to optimize logistics operations, as it allows for easy access to transportation routes while minimizing congestion within the city center. By giving priority to the placement of truck terminals, decision-makers aim to enhance the efficiency and effectiveness of the supply chain network, ultimately benefiting businesses and consumers alike.

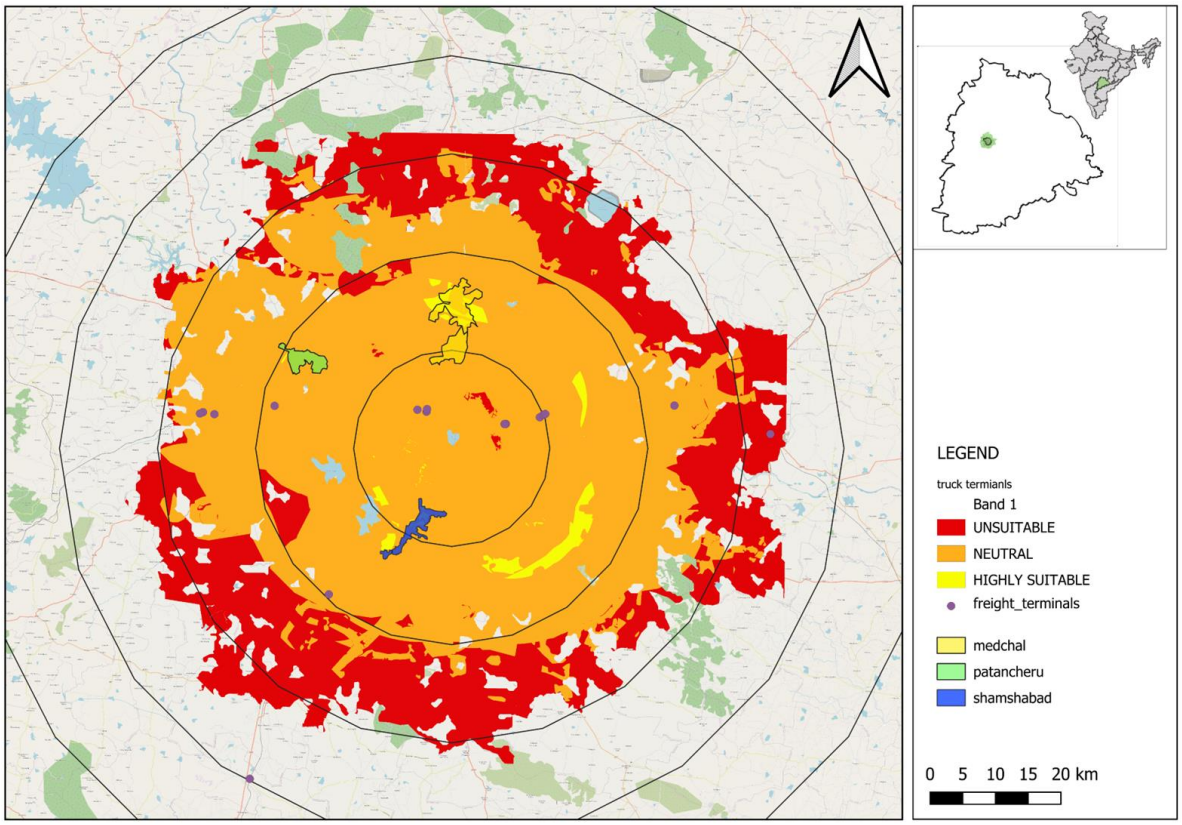


Figure 27 Scenario 3

The current distribution of warehouse clusters aligns closely with the findings of the weighted overlay method outlined in the existing literature. This indicates that the chosen locations are highly favorable for establishing warehouse clusters. Additionally, the validation process further confirms the suitability of assigning weightage based on the literature review. By comparing the actual locations of warehouses with the results obtained from the literature review, we strengthen our confidence in the decision-making process. This validation underscores the robustness of the methodology employed, as it demonstrates a consistent alignment between theoretical findings and real-world applications. As a result, decision-makers can have increased assurance in the reliability and effectiveness of the weighted overlay method for determining optimal warehouse locations. This alignment between theory and practice enhances the overall credibility and trustworthiness of the decision-making process, ultimately leading to more informed and successful outcomes in warehouse management and logistics planning.

5.6 Optimal location

The most suitable scenario, as identified through the literature review which is scenario-2, combines land availability, freight terminals, and appropriateness of the location. By superimposing these parameters, the highlighted areas represent the most ideal locations. These areas are not only near a freight terminal but also possess ample land availability and are deemed highly suitable according to the literature review. This integrated approach ensures that the selected sites optimize both logistical efficiency and land utilization, making them prime locations for establishing warehouse facilities and supporting streamlined supply chain operations.

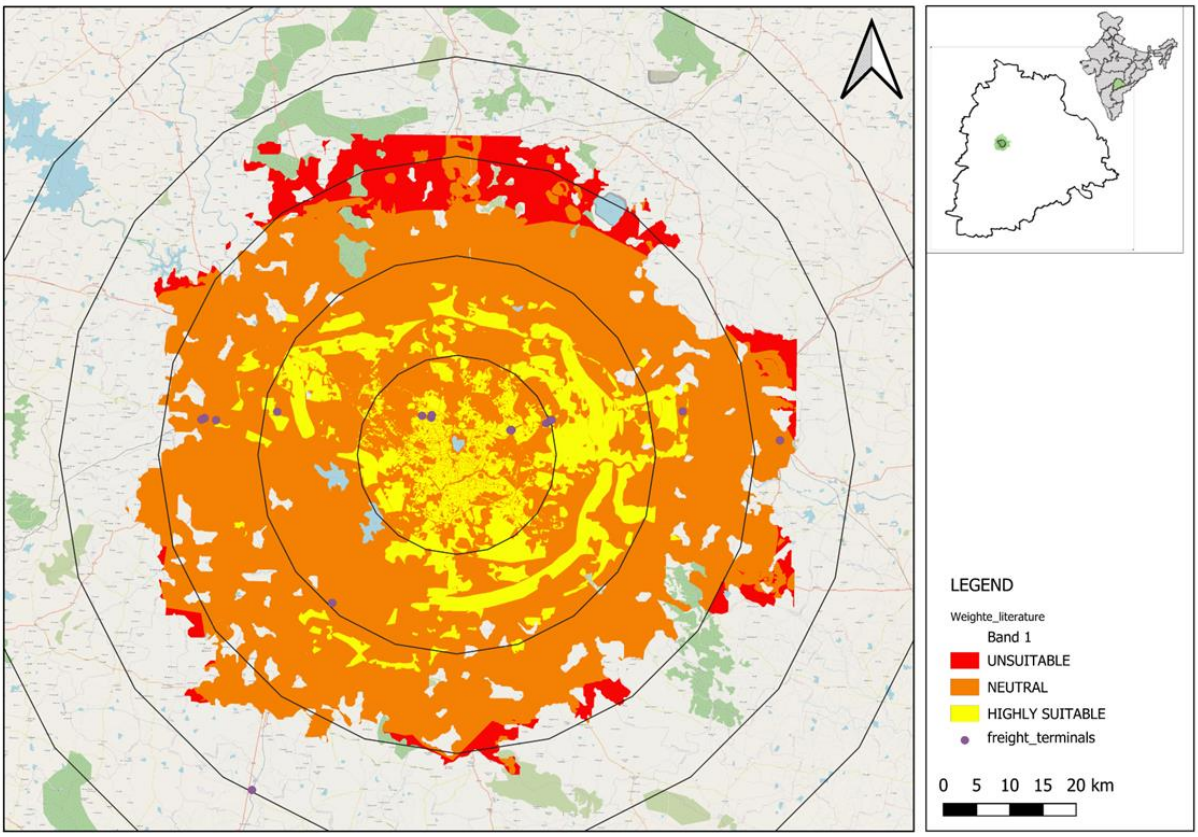


Figure 28 Scenario 2

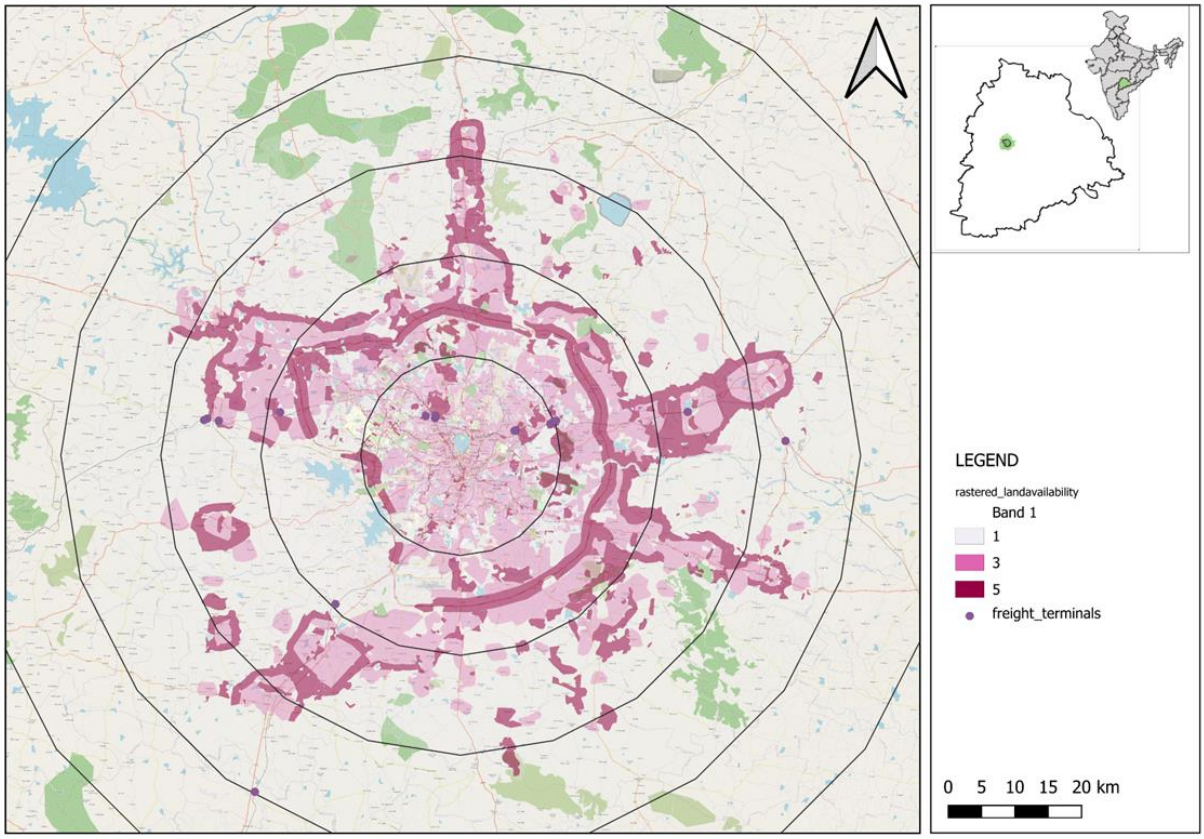


Figure 29 Land-use

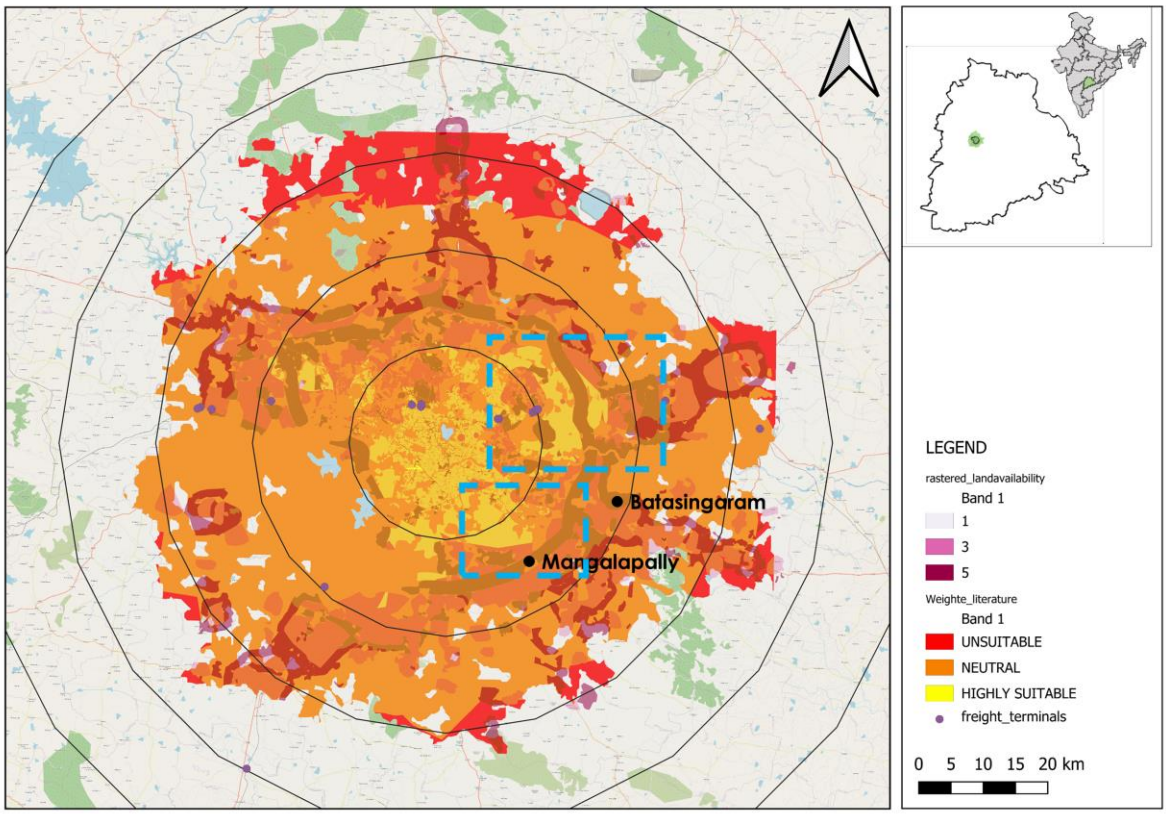


Figure 30 Optimal Location For Forthcoming Warehouses

The most favorable sites for future development are situated along National Highway 163 and National Highway 65, linking Warangal and Vijayawada, respectively. The proposed Batasingaram and Mangalapally logistic parks are situated in highly suitable locations.

CHAPTER 6. PROPOSALS & RECOMMENDATIONS

6.1 Proposals

1. Preserving and securing highly suitable land in the master plan is crucial for accommodating clusters and preventing unplanned organic clustering throughout the city. By conserving these areas, urban planners can strategically manage development to optimize space usage and promote efficient infrastructure utilization.

One approach to conserving these clusters involves providing shared amenities to enhance their functionality and sustainability. These shared amenities can include various facilities custom-made to support the needs of businesses and logistics operations within the cluster.

2. Railway sidings and freight terminals are essential components of a logistics park, facilitating seamless transportation of goods via rail. Integrating these facilities into the cluster conserves valuable land and enhances connectivity, allowing businesses to efficiently transport goods to and from the park.

Common parking facilities address the parking needs of employees, visitors, and delivery vehicles within the cluster. Centralized parking areas optimize land usage and reduce congestion, ensuring smooth traffic flow and enhancing the overall accessibility of the cluster. Loading and unloading points are vital for the efficient movement of goods within the logistics park.

Efficient space utilization for heavy and light goods is essential for maximizing the productivity of businesses within the cluster. Designing flexible warehouse spaces that accommodate a range of storage and distribution needs ensures that businesses can operate efficiently while optimizing the use of available land.

Additionally, other amenities such as green spaces, recreational areas, and communal facilities can contribute to creating a vibrant and sustainable cluster environment. These amenities enhance the quality of life for employees and residents within the cluster while promoting social interaction and community cohesion, preserving highly suitable land for clusters in the master plan and providing shared amenities are essential strategies for promoting sustainable urban development and preventing haphazard growth. By integrating these amenities into

the cluster, urban planners can create vibrant and efficient logistics parks that support economic growth and enhance the overall livelihood of the city.

6.2 Recommendations

Facilitating the transportation of goods via railways for import and export purposes offers numerous benefits to logistics operations. Rail transportation provides a cost-effective and environmentally friendly alternative for moving goods, especially over long distances. By utilizing railways, businesses can transport a wide range of goods, from small-scale items to heavy cargo, efficiently and reliably.

Moreover, integrating railways into logistics operations enhances overall efficiency by reducing transportation time and costs. Railways offer faster transit times compared to road transport for long-distance shipments, helping businesses meet tight deadlines and customer demands. Additionally, railways often have lower operating costs per ton-mile compared to other modes of transportation, resulting in cost savings for businesses.

Overall, leveraging railways for transportation within logistics operations not only facilitates import and export activities but also boosts efficiency, reduces costs, and contributes to sustainable logistics practices.

Bibliography

Buldeo Rai, H., Kang, S., Sakai, T., Tejada, C., Yuan, Q. (Jack), Conway, A., & Dablanc, L. (2022). ‘Proximity logistics’: Characterizing the development of logistics facilities in dense, mixed-use urban areas around the world. *Transportation Research Part A: Policy and Practice*, *166*, 41–61. https://doi.org/10.1016/j.tra.2022.10.007

Durmuş, A., & Turk, S. S. (2014). Factors Influencing Location Selection of Warehouses at the Intra-Urban Level: Istanbul Case. *European Planning Studies*, *22*(2), 268–292. https://doi.org/10.1080/09654313.2012.731038

Fraile, A., Larrodé, E., Alberto Magreñán, & Sicilia, J. A. (2016). Decision model for siting transport and logistic facilities in urban environments: A methodological approach. *Journal of Computational and Applied Mathematics*, *291*, 478–487. https://doi.org/10.1016/j.cam.2014.12.012

Frank, K. (2023). *India warehousing report*. *5*.

Jacyna-gołda, I., & Izdebski, M. (2017). The Multi-criteria Decision Support in Choosing the Efficient Location of Warehouses in the Logistic Network. *Procedia Engineering*, *187*, 635–640. https://doi.org/10.1016/j.proeng.2017.04.424

Jakubicek, P., & Woudsma, C. (2011). Proximity, land, labor and planning? Logistics industry perspectives on facility location. *Transportation Letters*, *3*(3), 161–173. https://doi.org/10.3328/TL.2011.03.03.161-173

Kang, S. (2018). Warehouse location choice : A case study in Los Angeles , CA. *Journal of Transport Geography*, *August*, 1–11. https://doi.org/10.1016/j.jtrangeo.2018.08.007

Önden, İ., Acar, A. Z., & Eldemir, F. (2018). Evaluation of the logistics center locations using a multi-criteria spatial approach. *Transport*, *33*(2), 322–334. https://doi.org/10.3846/16484142.2016.1186113

Özceylan, E., Erbaş, M., Tolon, M., Kabak, M., & Durʉut, T. (2016). Evaluation of freight villages: A GIS-based multi-criteria decision analysis. *Computers in Industry*, *76*, 38–52. https://doi.org/10.1016/j.compind.2015.12.003

Peker, I., Baki, B., Tanyas, M., & Murat Ar, I. (2016). Logistics center site selection by ANP/BOCR analysis: A case study of Turkey. *Journal of Intelligent and Fuzzy Systems*, *30*(4), 2383–2396. https://doi.org/10.3233/IFS-152007

Rikalovic, A., Soares, G. A., & Ignjatic, J. (2018). Spatial analysis of logistics center location: A comprehensive approach. *Decision Making: Applications in Management and Engineering*, *1*(1), 38–50. https://doi.org/10.31181/dmame180138r

Sakai, T., Hyodo, T., & Kawamura, K. (2018). The relationship between commodity types, spatial characteristics, and distance optimality of logistics facilities. *Journal of Transport and Land Use*, *11*(1), 575–591. https://doi.org/10.5198/jtlu.2018.1363

Singh, R. K., Chaudhary, N., & Saxena, N. (2018). Selection of warehouse location for a global supply chain: A case study Rajesh. *IIMB Management Review*. https://doi.org/10.1016/j.iimb.2018.08.009

Sinha. (2021). Fast Tracking Freight in India: a roadmap for clean and cost effective goods transport. *Niti Aayog, Rmi, and Rmi India*, *June*, 140. https://www.niti.gov.in/sites/default/files/2021-06/FreightReportNationalLevel.pdf

Taniguchi, E., Noritake, M., Yamada, T., & Izumitani, T. (1999). Optimal size and location planning of public logistics terminals. *Transportation Research Part E: Logistics and Transportation Review*, *35*(3), 207–222. https://doi.org/10.1016/S1366-5545(99)00009-5

Telangana logistics policy. (2021). *Industies and Commererce Depatment*.

Uyanik, C., Tuzkaya, G., & Oğuztimur, S. (2018). A LITERATURE SURVEY ON LOGISTICS CENTERS’ LOCATION SELECTION PROBLEM. In *Nat Sci* (Vol. 36, Issue 1). www.europlatforms.eu/definition/,

Uysal, H. T. (2014). Selection of Logistics Centre Location via ELECTRE Method: A Case Study in Turkey / Electre Yöntemiyle Lojistik Merkezi Kuruluş Yeri Seçimi Selection of Logistics Centre Location via ELECTRE Method: A Case Study in Turkey. *International Journal of Business and Social Science*, *5*(9). www.ijbssnet.com

Yazdani, M., & Mu, Y. (n.d.). *Logistics Center Location Decision Using a Multi-Attribute Analysis Structure*.

Logistics – Invest Telangana. (n.d.). https://invest.telangana.gov.in/logistics/

EUROPLATFORMS EEIG. (2023, March 7). Definition - EUROPLATFORMS EEIG. https://www.europlatforms.eu/definition/

National Logistics policy in India. (n.d.). Invest India. https://www.investindia.gov.in/team-india-blogs/national-logistics-policy-india

ANNEXURES

Annexure A- Survey Format

WAREHOUSE QUESTIONNAIRE

Disclaimer: This survey is for educational purposes only and is a part of the academics of Master of Planning at the School of Architecture, Bhauri (Bhopal- M.P.). This survey aims to study the location of logistics facilities.

अस्वीकरण: यह सर्वेक्षण केवल शैक्षिक उद्देश्य के लिए है और स्कूल ऑफ आर्किटेक्चर, भौरी (भोपाल-म.प्र.) के मास्टर ऑफ प्लानिंग के क्लास असाइनमेंट का एक हिस्सा है। इस सर्वेक्षण का उद्देश्य शहर के सड़क यातायात और परिवहन परिदृश्य का अध्ययन करना है।

Location (Google coordinates):	Established year:
Owner details:	Operational timings:
Dedicated Parking for Warehouse (yes/no)	If yes, number:

What are the primary commodities stored in your warehouse (commodities and current volume/size)

How would you describe the nature of your commodities	Perishable	Durable

Shelf life of commodity: ☐1-3 days ☐One week ☐One month ☐6 months ☐1 year ☐More than a year

Services and infrastructure available	Water supply, Source of water supply?
	Electricity (max voltage required)
	Nearest Fire station
	Nearest Hospital
	Local Transport availability.

What is the total storage capacity of your warehouse:

Rental value of warehouse (sq. ft/ month):

Do different commodity prices influence the rental value? The reason, why?

commodity	origin

Modes of transportation:

Abutting land descriptions:	EAST	
	WEST	

	NORTH	
	SOUTH	
Recent tenants/depositors of the warehouse commodity (last 3 years)?		
Observation What type of warehouse is it: ☐ Cold storage ☐bulk storage ☐dry storage ☐ E-commerce ☐Railside		
Approach Road details (road width and road condition):		
Built condition:	Clear Height (in m):	
Proximity to rail side/ railway station	proximity to airport	proximity to highway
Current land Price as per sq. ft (in INR):	1) Market Rate	2) Ready reckoner rate (Circle rate)

Nearest warehouse (km)	☐Government warehouse	☐Nearest warehouse (km)	
Other:			

योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India

CLUSTER OBSERVATION

Disclaimer: This survey is for educational purposes only and is a part of the academics of Master of Planning at the School of Architecture, Bhauri (Bhopal- M.P.). This survey aims to study the location of logistics facilities.
अस्वीकरण: यह सर्वेक्षण केवल शैक्षिक उद्देश्य के लिए है और स्कूल ऑफ आर्किटेक्चर, भौरी (भोपाल-म.प्र.) के मास्टर ऑफ प्लानिंग के क्लास असाइनमेंट का एक हिस्सा है। इस सर्वेक्षण का उद्देश्य शहर के सड़क यातायात और परिवहन परिदृश्य का अध्ययन करना है।

Cluster name/villages under cluster	
What kind of warehouses are predominant in the cluster?	
How accessible is the cluster in terms of road infrastructure/ links?	
What is the total area/total number of the warehouse cluster?	
Is there room for expansion of the cluster/abutting land use?	
How skilled is the workforce within the cluster?	
Are there training programs for employees to enhance their skills, if any mention?	
common facilities	
facilities	details
1) Toilets/ refreshments	
2) Canteen/ dining spaces	
3) Loading and unloading spaces	
4) Dedicated Parking	

other details:

योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India

TRUCK DRIVERS

Disclaimer: This survey is for educational purposes only and is a part of the academics of Master of Planning at the School of Architecture, Bhauri (Bhopal- M.P.). This survey aims to study the location of logistics facilities.
अस्वीकरण: यह सर्वेक्षण केवल शैक्षिक उद्देश्य के लिए है और स्कूल ऑफ आर्किटेक्चर, भौरी (भोपाल-म.प्र.) के मास्टर ऑफ प्लानिंग के क्लास असाइनमेंट का एक हिस्सा है। इस सर्वेक्षण का उद्देश्य शहर के सड़क यातायात और परिवहन परिदृश्य का अध्ययन करना है।

Survey location	
Driver age:	
Origin:	
Destination:	
Journey time:	
Operation hours:	
Waiting time to load and unload:	
Are there designated areas with amenities such as restrooms and break rooms for drivers?	
Are there designated parking and staging areas for trucks?	
Are there designated areas for drivers to wait during loading and unloading?	
Is there secure parking for trucks during stops?	
Who decides the Route Planning and Navigation?	
Are you aware of restricted routes in the city?	
How is communication handled between the warehouse and drivers?	
Are the tariff structures and fees transparent (tariff per day)? How are additional charges communicated to drivers?	
What amenities do you desire during the journey break?	
☐Toilets ☐parking ☐dormitory ☐Dhaba/ canteens ☐fuel station ☐ mechanic stations ☐charging stations	
Are there provisions for mandatory rest breaks as regulations, if yes how long?	
1) Less than 2hrs	3) 5-10hrs
2) 2-5 hrs	4) More than 10hrs
other details:	

CLIENTS AND STAKEHOLDERS

Disclaimer: This survey is for educational purposes only and is a part of the academics of Master of Planning at the School of Architecture, Bhauri (Bhopal- M.P.). This survey aims to study the location of logistics facilities.
अस्वीकरण: यह सर्वेक्षण केवल शैक्षिक उद्देश्य के लिए है और स्कूल ऑफ आर्किटेक्चर, भौरी (भोपाल-म.प्र.) के मास्टर ऑफ प्लानिंग के क्लास असाइनमेंट का एक हिस्सा है। इस सर्वेक्षण का उद्देश्य शहर के सड़क यातायात और परिवहन परिदृश्य का अध्ययन करना है।

survey location	
Client details/company name:	
Proximity to Company:	
Awareness about restricted routes:	
Origin (of goods):	
Destination (of goods):	
Route usually preferred	
How do you contact a warehouse of storage?	
☐Advertisement ☐consultancy services ☐ known warehouse ☐own warehouse	
other:	
Desired rental value (sq. ft/month):	
How crucial are transportation links (roads, highways, ports) for your logistical needs?	
Are there specific transportation requirements that the warehouse must meet?	
Desired Storage Capacity:	
Are there seasonal fluctuations that impact your storage requirements?	
What security measures are necessary for the goods stored in the warehouse?	
Are there specific industries or businesses you prefer to be near?	
What insurance is essential for your goods stored in the warehouse?	
Major needs of a warehouse/ how important is the parameter on a scale of 10:	
Nearest to manufacturing unit:	Near to Delivery location; if any mention the place:
Low rental value	Transportation availability
Low land value	Commodity specific
Parking facility	storage required
Warehouse type	Safety and Security
Pest control	Insurance
Operational timings	
Other details:	

योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India

CONSULTANCY SERVICE

Disclaimer: This survey is for educational purposes only and is a part of the academics of Master of Planning at the School of Architecture, Bhauri (Bhopal- M.P.). This survey aims to study the location of logistics facilities.
अस्वीकरण: यह सर्वेक्षण केवल शैक्षिक उद्देश्य के लिए है और स्कूल ऑफ आर्किटेक्चर, भौरी (भोपाल-म.प्र.) के मास्टर ऑफ प्लानिंग के क्लास असाइनमेंट का एक हिस्सा है। इस सर्वेक्षण का उद्देश्य शहर के सड़क यातायात और परिवहन परिदृश्य का अध्ययन करना है।

consultancy name/location:	
no.of clients in a year :	
platform for advertising	
What is the minimum and maximum storage capacity requested for:	
does storage needs fluctuate seasonally or over time?	
what security and safety cautions clients require	
what are the major commodities, among your client's age	
What is the average rental cost?	
do you have collaborative partnerships with other businesses?	
how do you reach out to transport operates	
do you provide insurance?	
other details:	

Annexure – B Rasterised Layers

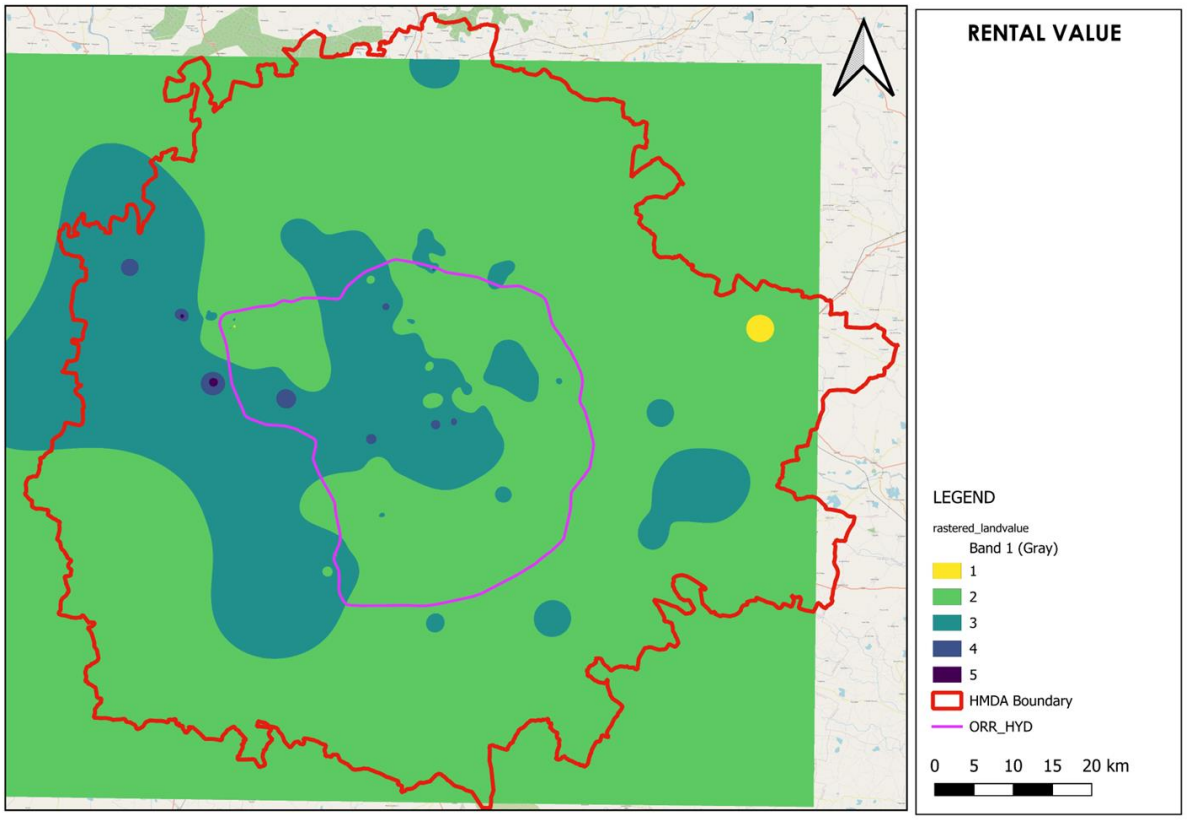


Figure 31 Rasterized Layer of Rental Value

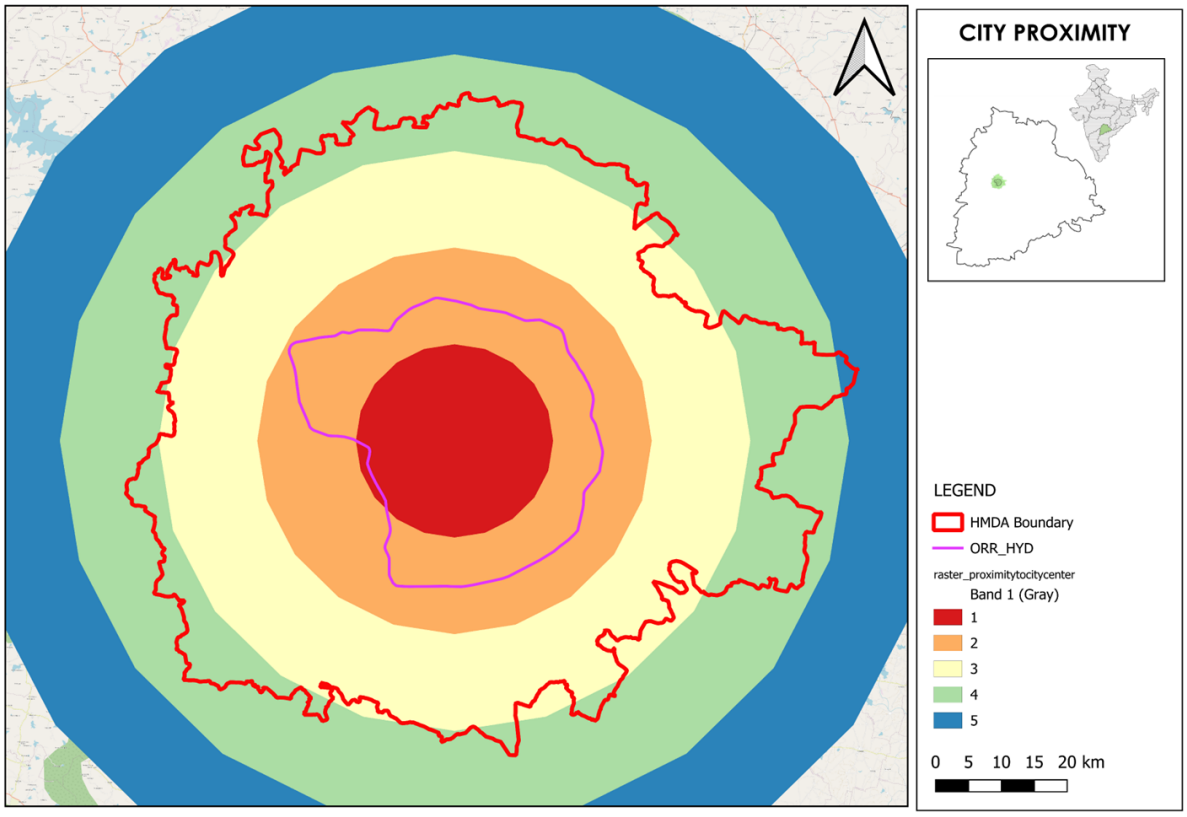


Figure 32 Rasterized layer of City Proximity

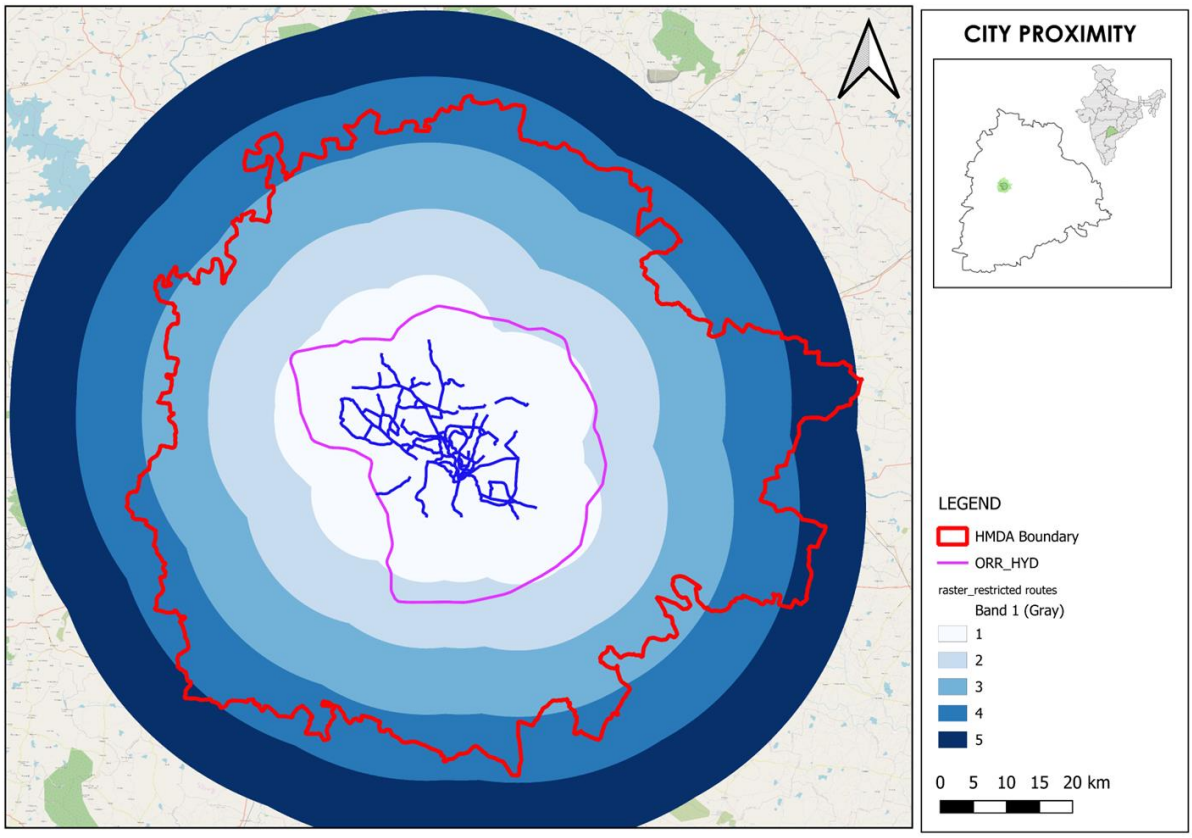


Figure 33 Rasterized layer of city Proximity

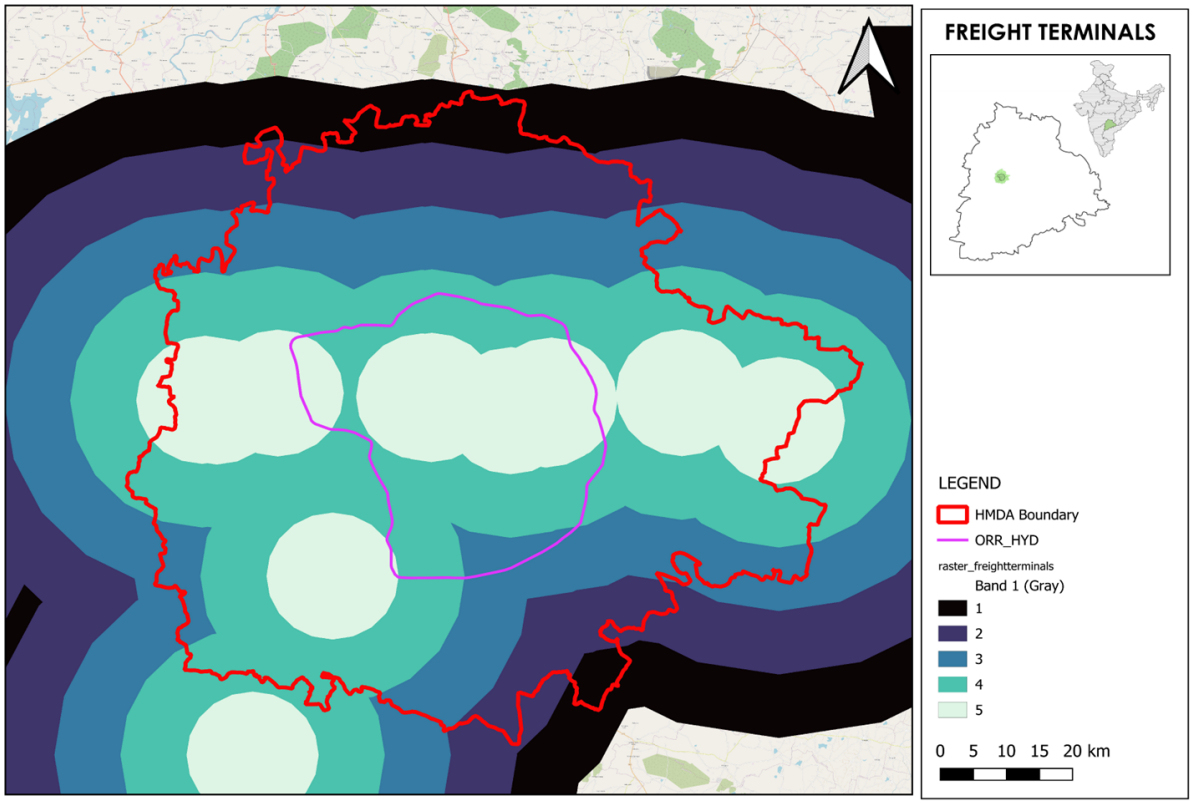


Figure 34 Rasterized layer of Freight Terminals

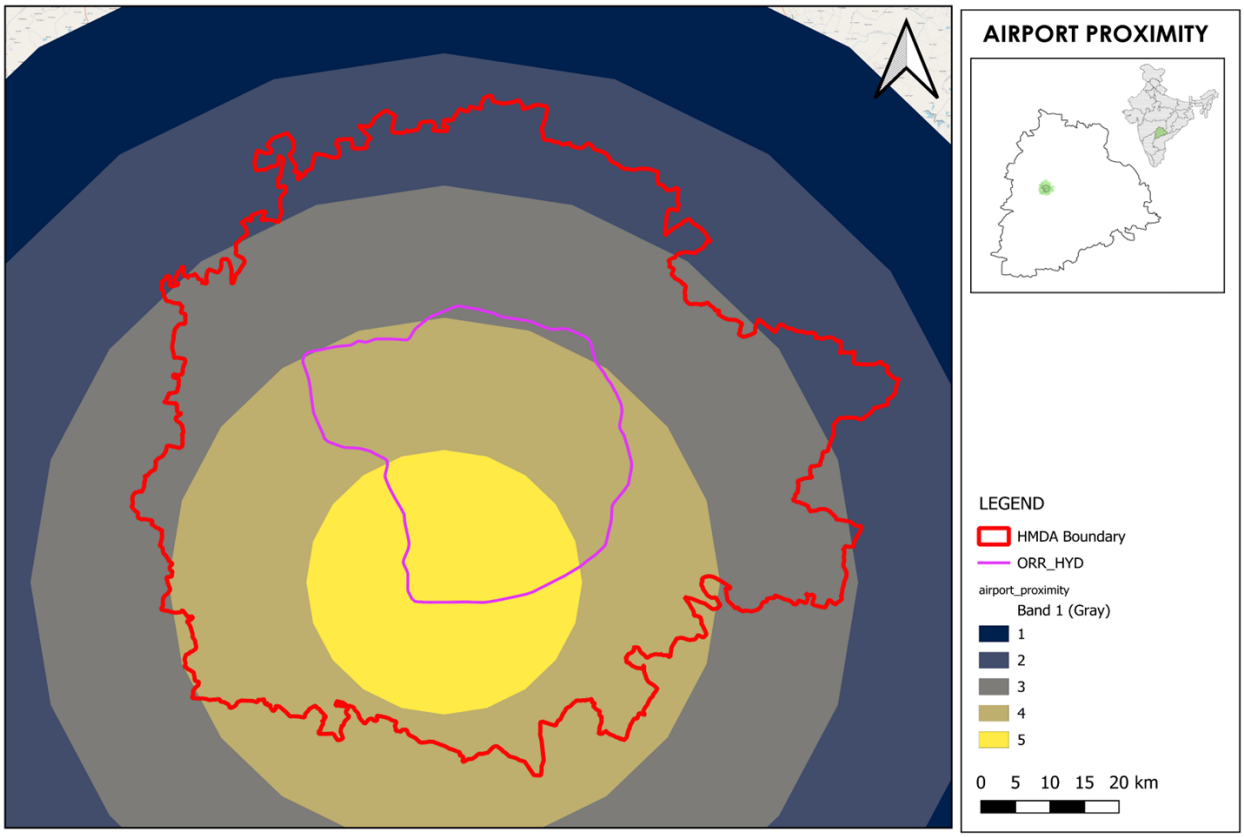


Figure 35 Rasterized layer of Airport Proximity

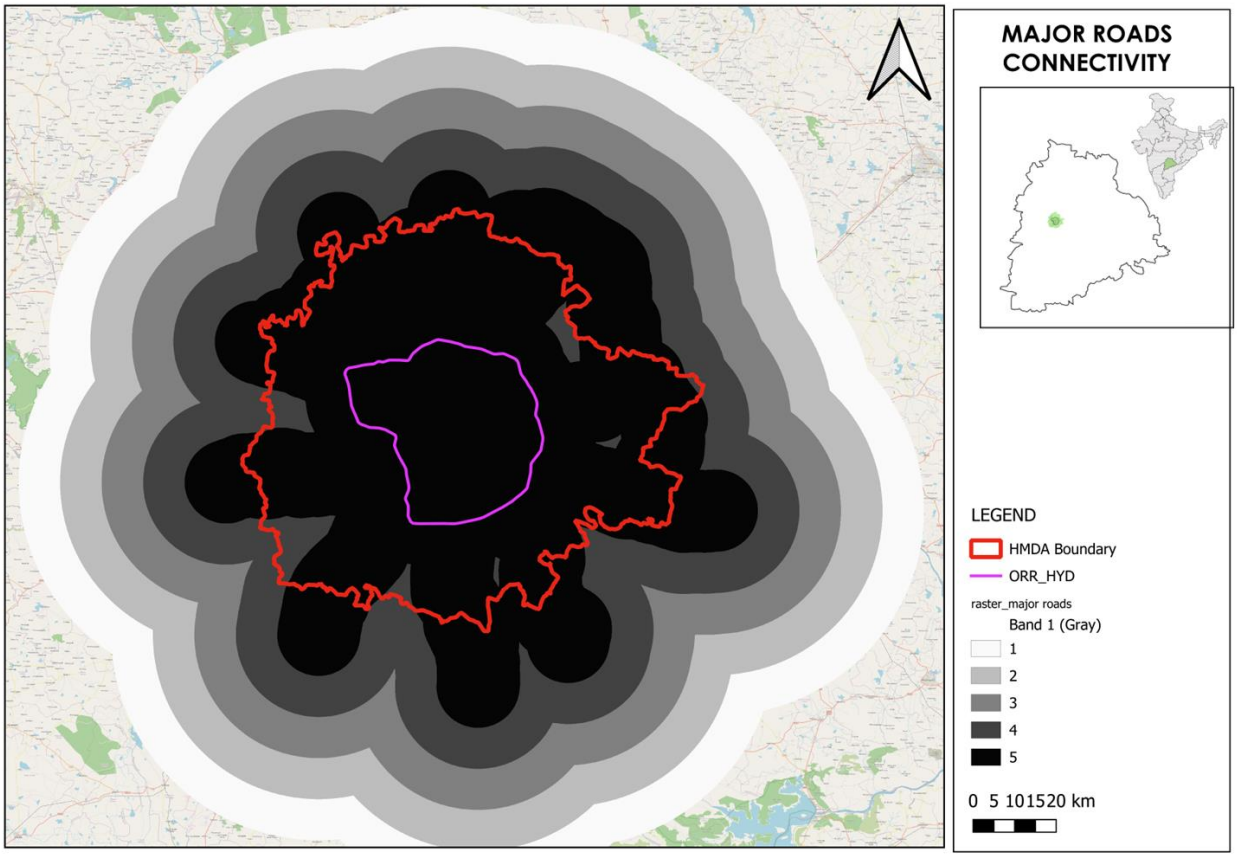


Figure 36 Rasterized layer of Major roads Connectivity

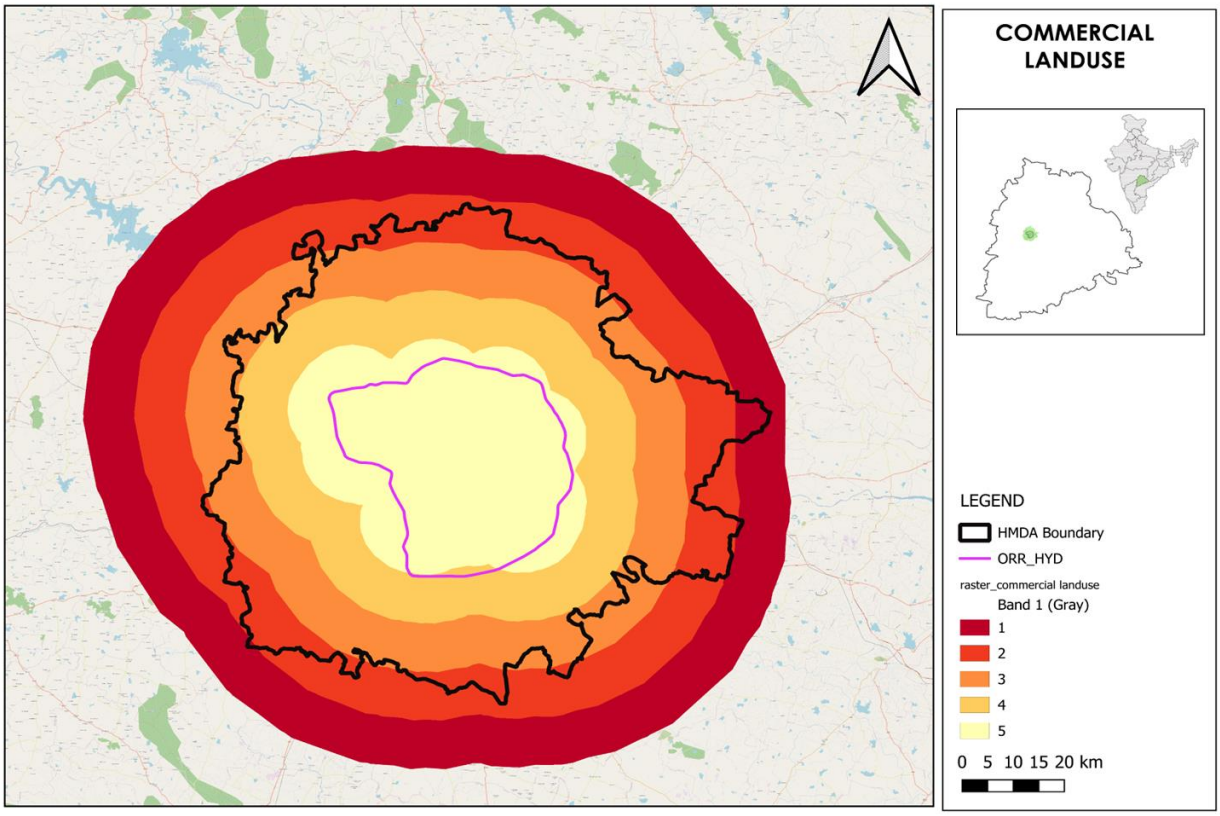


Figure 37 Rasterized layer of Commercial Landuse

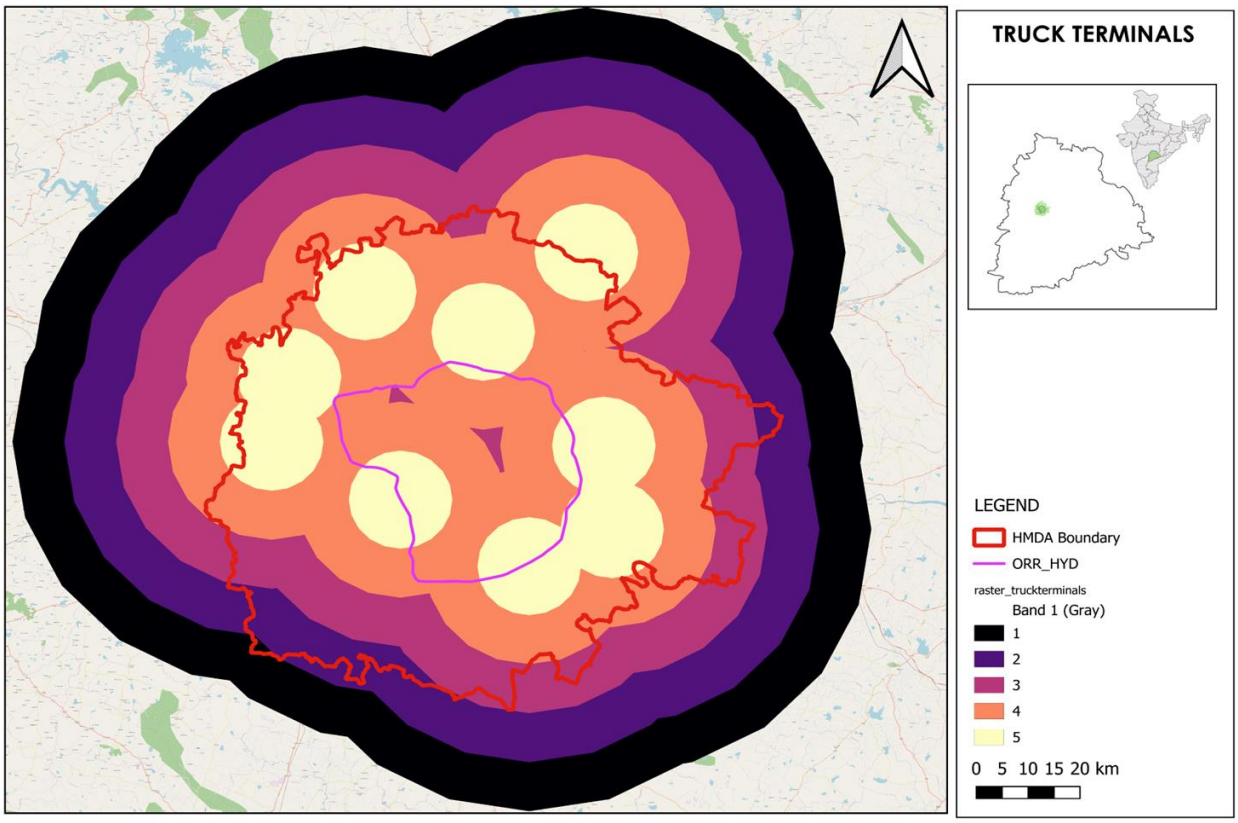


Figure 38 Rasterized Layer of truck Terminals

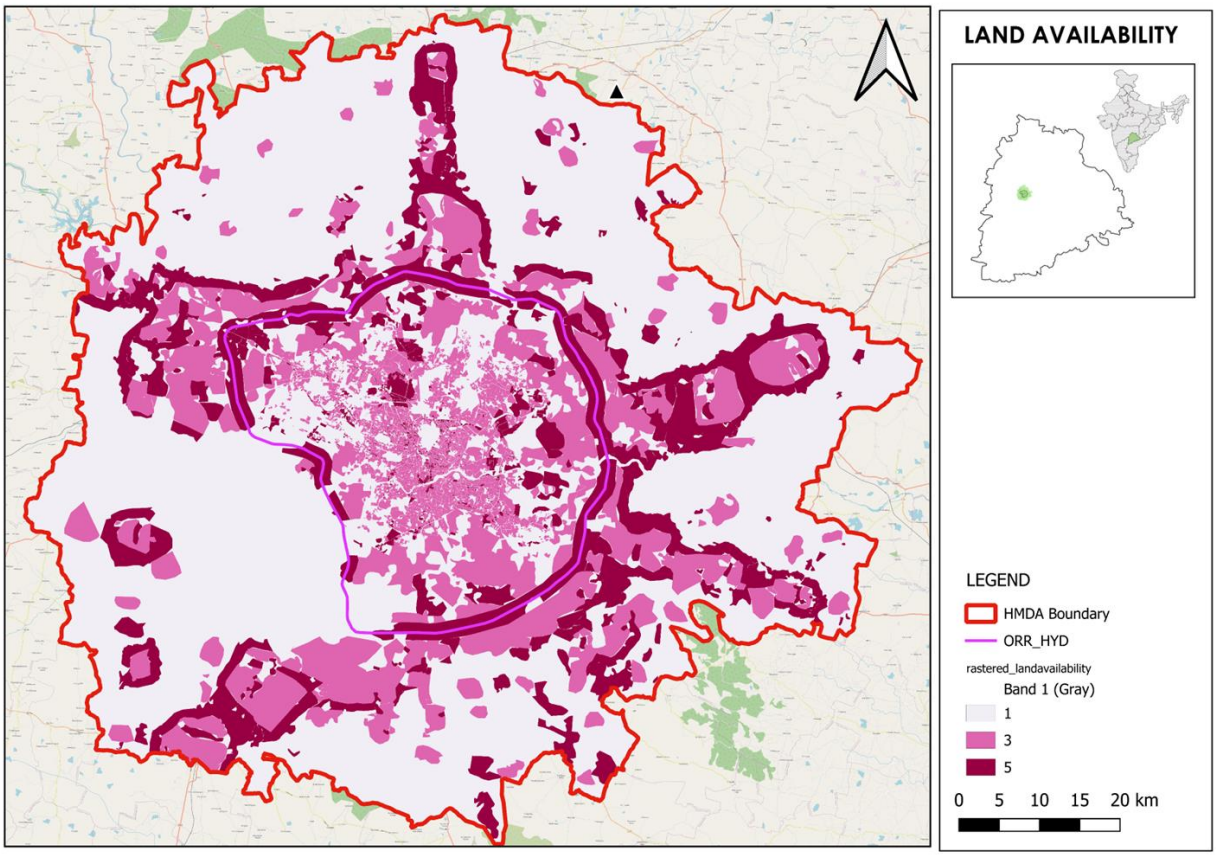


Figure 39 Rasterized layer of Land Availability

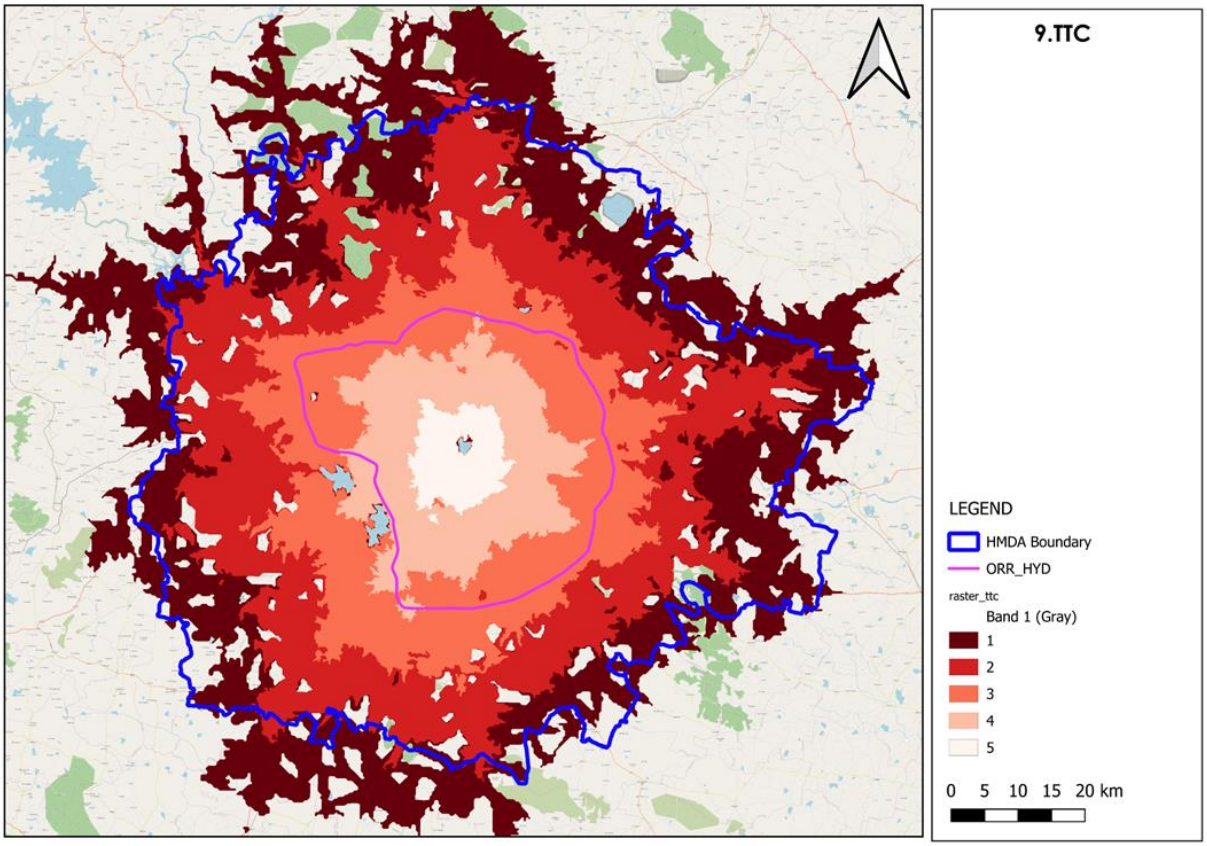


Figure 40 Rasterized layer of Travel Time Contour

Annexure C - Sheets

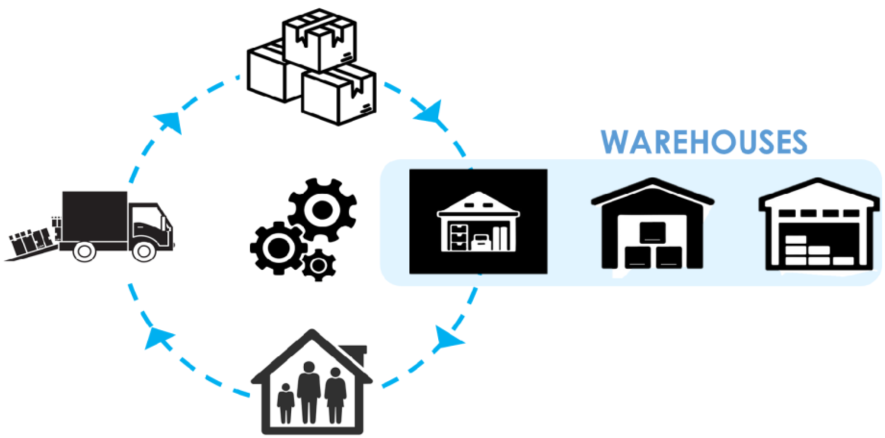
LOCATION OF LOGISTICS FACILITIES A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS

BACKGROUND

Logistics facilities are buildings or warehouses that house all activities related to logistics and freight transportation. They include storage and distribution facilities, such as warehouses, loading and unloading facilities, and logistics services

logistics can be defined as "**the process of strategically managing the procurement, movement, and storage of materials, parts, and finished inventory (and the related information flows) through the organization and its marketing channels**"

- NLP - India aims to elevate its position in the Logistics Performance Index (LPI) to be within the top 25 countries by 2030, considering its current ranking of 44th.
- (India) logistics costs represent an estimated **13-14% of GDP**, while the global average is **9-10%.**



TELANGANA STATE LOGISTICS POLICY- 2021-2026

The policy aims to encourage the growth of the logistics sector in the state and to attract private sector investments in the logistics sector to optimize the overall cost and time involved in logistics

- Hyderabad has emerged as a major investment destination connecting several industrial corridors in the country
- **Mangalapally** Logistics Park is a world-class facility spread over 22 acres (proposed)
- logistics park at **Batasingaram** 40 acres with an investment of Rs 50 crores with warehousing, parking, and retail facilities.(proposed)

INTRODUCTION

Aim :
To assess the spatial correlation between influential factors and warehouse location decisions to identify potential patterns.

Objectives:
1. Identify key parameters and analyze their spatial distribution of existing warehouses.
2. Evaluate factors influencing warehouse location decisions (transportation infrastructure, land costs, tariff, rental value land availability, etc.)
3. Examine the correlation between influential factors and warehouse locations.
4. Identify the desirable spatial distribution of warehouse locations for future planning.

Research question :
- What is the ideal location in a city to establish warehouse facilities?
- Can we predict the location suitable to propose future warehouse facilities while considering parameters that give a pattern?

Scope: The study's scope is confined to identifying the key parameters influencing warehouse location decisions, and factors influencing these choices to identify patterns.

Limitations:
The study limits major parameters due to constraints in time and data availability.

Expected outcome:
To identify suitable locations for future warehouse clusters.

01	GANGIREDDY SHRAVANI 2022MTPLM017 MTPLM 2022-24	LOCATION OF LOGISTICS FACILITIES A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS	Seal and Signature	DEPARTMENT OF TRANSPORT PLANNING	योजना एवं वास्तुकला विद्यालय, भोपाल School of Planning and Architecture, Bhopal An Institute of National Importance, Ministry of Education, Government of India

METHODOLOGY

BACKGROUND STUDY

The aim, objectives, the scope of the study, and limitations

LITERATURE STUDY

Related studies and practices, methodology understanding, GIS analysis

NEED OF THE STUDY

It explores the spatial dynamics of logistics facility placement by analyzing critical factors and uncovering patterns influencing warehouse location to reserve land for future development

DATA COLLECTION

PRIMARY DATA
1. Warehouse questionnaire
2. Cluster observation
3. Truck drivers
4. Clients and stakeholders
5. Consultancy service

SECONDARY DATA
1. Locations of FCI, CCI, and CWC warehouses and details
2. Proposed logistics park and truck terminals in and around Hyderabad-HMDA
3. City freight-restricted routes -Cyberabad police commissioner office
4. Empty warehouse location warehouse capacity, rental value, circle rate, land value
5. India Warehousing Market Report 2023

ANALYSIS AND EVALUATION

Understanding the study area
Locations of existing logistics facilities ,Influencing factors ,Land use factors

Identify key parameters and analyze their spatial distribution of existing warehouses.

Correlation between the factors affecting the warehouse location
- Superposition of geographic factor layers, patterns, and spatial correlations

Analysis
- Most preferred MCDM -multi-criteria decision-making

RESULTS AND RECOMMENDATIONS

Identification of most suitable location for logistic facilities for future demand

OBJECTIVE - 1

Identify key parameters and analyze their spatial distribution of existing warehouses.

OBJECTIVE - 2

Evaluate factors influencing warehouse location decisions

OBJECTIVE - 3

Examine the correlation between influential factors and warehouse locations

OBJECTIVE - 4

Identify the desirable spatial distribution warehouse locations.

02 GANGIREDDY SHRAVANI
2022MTPLM017
MTPLM 2022-24

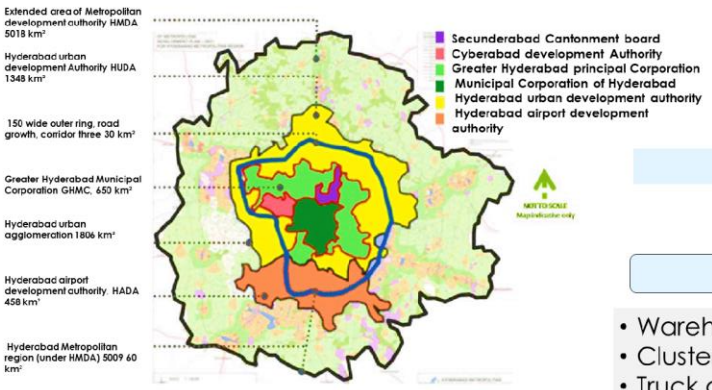
LOCATION OF LOGISTICS FACILITIES
A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS

Seal and Signature

DEPARTMENT OF TRANSPORT PLANNING

योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India

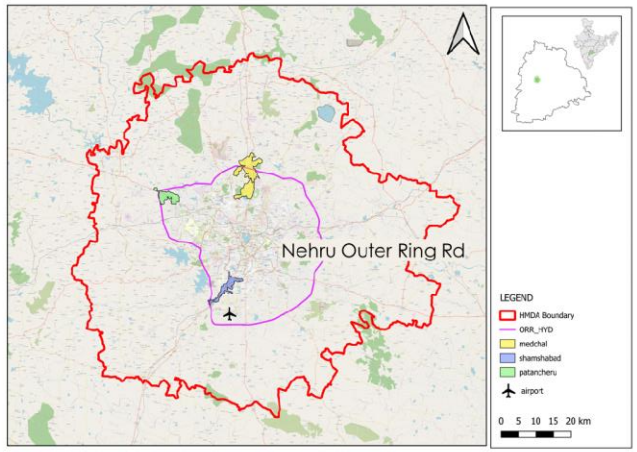
STUDY AREA



	HMDA	GHMC
	97 lakhs	69 lakhs
	7257 sq.km	625 sq.km

Source : censes 2011

Hyderabad is major investment destination connecting several industrial corridors in the country



PRIMARY SURVEY CLUSTERS-DATA COLLECTION

Warehouse are largely concentrated in three major Clusters:

- **MEDCHAL** cluster in the north located along the Hyderabad- Nagpur highway (NH-44)
- **PATANCHERU** cluster in the west on the Mumbai-Hyderabad highway(NH-65)
- **SHAMSHABAD** cluster in the south located along Bangalore-Hyderabad highway(NH-44)

The survey was conducted from January 29th to February 12th.

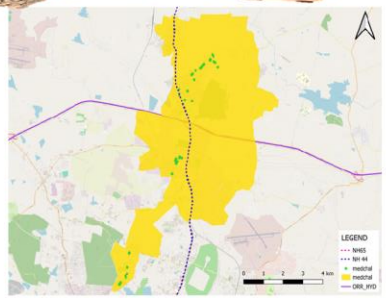
DATA COLLECTION

PRIMARY DATA

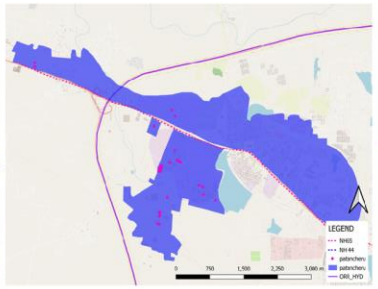
- Warehouse questionnaire- **111**
- Cluster observation- **12**
- Truck drivers-**45**
- Clients and stakeholders
- Consultancy service -**4**

SECONDARY DATA

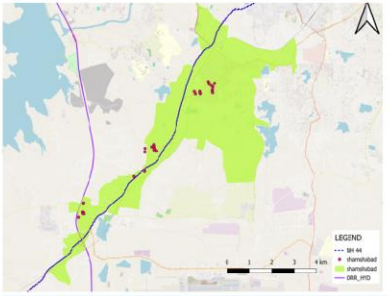
- Locations of FCI, CCI, and CWC warehouses and details
- Proposed logistics park in and around Hyderabad-HMDA (Hyderabad Metropolitan Development Authority)
- City freight-restricted routes -Cyberabad police commissioner office
- Empty warehouse location warehouse capacity, rental value, circle rate, land value (from magic bricks, circle rate, Google Maps)
- Knight Frank – India warehousing market report



WAREHOUSE QUESTIONNAIRE- 38
CLUSTER OBSERVATION-3
TRUCK DRIVERS -18
AREA -39.1 sq km
PERIMETER-35.6 km



PRIMARY SURVEY
WAREHOUSE QUESTIONNAIRE- 32
CLUSTER OBSERVATION-5
TRUCK DRIVERS -15
AREA -9.73 sq km
PERIMETER-29.4 km



PRIMARY SURVEY
WAREHOUSE QUESTIONNAIRE- 39
CLUSTER OBSERVATION-4
TRUCK DRIVERS -12
AREA -27.55 sq km
PERIMETER-42.9 km

03 GANGIREDDY SHRAVANI
2022MTPLM017
MTPLM 2022-24

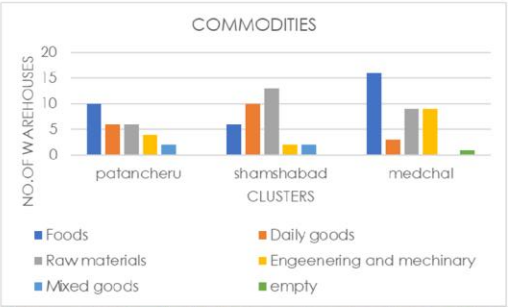
LOCATION OF LOGISTICS FACILITIES
A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS

Seal and Signature

DEPARTMENT OF TRANSPORT PLANNING

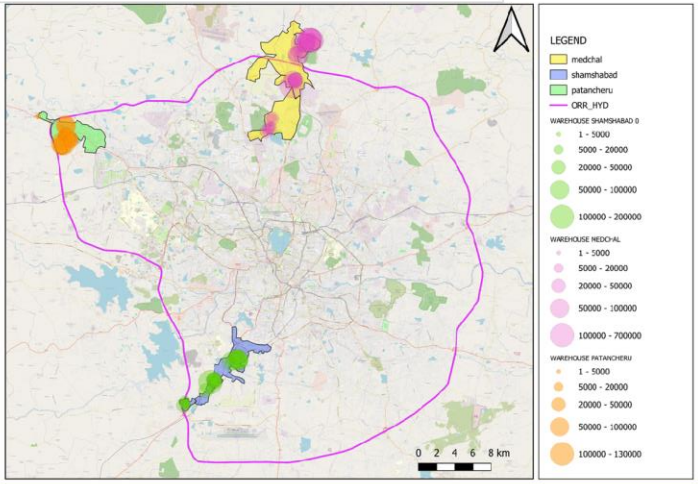
योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India

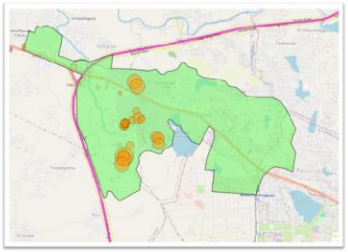
Group	Commodity Type included	Code
Foods	Dairy products,Agriculture,fish and stock farm and packed food products	F
Daily goods	Furniture, household products, light industrial products	D
Raw materials	woods, minerals, metals, chemicals, construction material	R
Engineering and machinery	general machineries, electronics goods, transport equipment , precision instruments and apparatus	E
Mixed goods	goods from more than one shipper, including parcels	M
empty	No goods	0

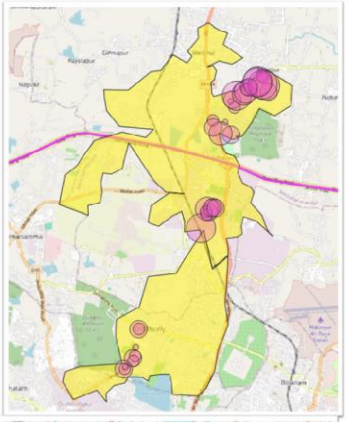


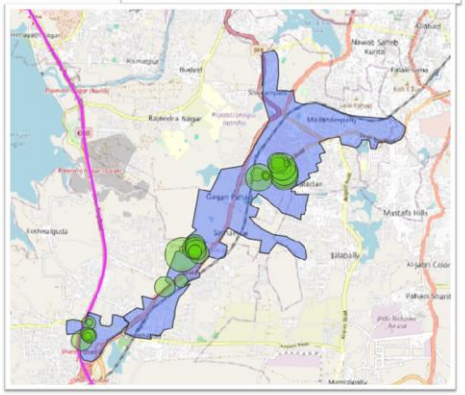
Major commodities

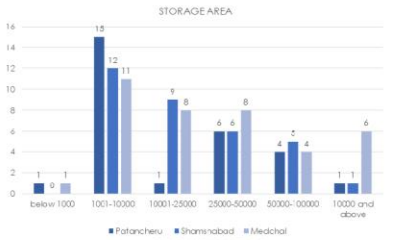
- Patancheru – grains, flour mills, groceries, and dairy products
- Shamshabad - raw material, construction material and plywood
- Medchal- packed food and agricultural needs

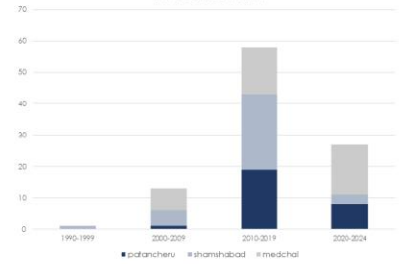


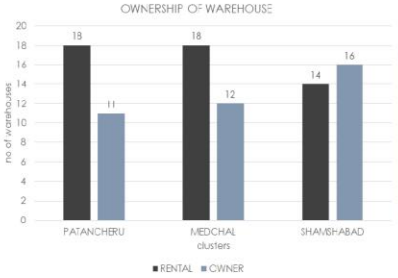












- 38 of the warehouses have an area ranging from 1000 to 10000 square foot.
- Out of 99 samples, the majority of warehouses, 58 in total, were established between 2010 and 2019.
- Among these, the highest number of warehouses established in a specific location was 24 in Shamshabad.
- Most of the warehouses are rented, with 52 out of them being rented.
- Among the 3 patches' a higher rental value is observed in Shamshab-ad followed by Medchal

- On average per square foot, it cost ,**21.7 rupees in Shamshabad ,19.5 rupees in Medchal and 19.2 rupees in Patancheru**

04

GANGIREDDY SHRAVANI
2022MTPLM017
MTPLM 2022-24

LOCATION OF LOGISTICS FACILITIES
A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS

Seal and Signature

DEPARTMENT OF TRANSPORT PLANNING

योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India

PRIMARY SURVEY CLUSTERS-DATA COLLECTION

PARAMETERS

S.NO	ARTICLE	RENTAL VALUE	PROXIMITY TO CITY CENTER	PROXIMITY TO AIRPORT	PROXIMITY TO FREIGHT TERMINALS	DISTANCE FROM MAJOR ROADS	FREIGHT RESTRICTED ROUTES	PROXIMITY TO COMMERCIAL LANDUSE	PROPOSED TRUCK TERMINALS	LAND AVAILABILITY	TRAVEL TIME CONTOUR	TAKE AWAYS
1	A literature survey on logistics centers location selection problem											This article outlines the prevalent decision-making tools employed for the selection of logistics centers. Various sectors as parameters **-Location, cost, environment , cargo capacity ,social factors** etc
2	Decision model for siting transport and logistic facilities in urban environments: a methodological approach -Alberto Frailea, Emilio Larrode´a, A´ . Alberto Magren´a´nb,, Juan Antonio Siciliab											Superposition of various GIS layers to find optimal locations of logistic facilities Factors:**Accessibility , population density , public transport , average daily traffic, industrial parks, land for development Decision factors:high ADT, accessibility, population density public transport,shopping area, industrial parks, land for building development**
3	The relationship between commodity types, spatial characteristics, and distance optimality of logistics facilities											The link between logistics facility placement and the distance optimality gap(DOG) between potential and actual travel distance for goods vehicles. the gap between the actual and optimum travel distances for the shipments to/from a facility urban freight establishment survey that collected data from the six commodity type-based groups: foods, daily goods, raw materials, machinery, chemical goods, and mixed goods Factors: **the relationship between commodity types, spatial characteristics, and distance optimality of logistics facilities**
4	Proximity, land, labor and planning? Logistics industry perspectives on facility locaton Paul Jakubicek &Clarence Woudsma											Canadian municipalities have significant impacts on surrounding land uses and on nearby transportation infrastructure factors which negatively influence location (push factors) were **land costs and tax rates, and a lack of land available for expansion site ability to operate 24/7 ,proximity to highways**
5	SPATIAL ANALYSIS OF LOGISTICS CENTER LOCATION: A COMPREHENSIVE APPROACH Aleksandar Rikalović*, Gerson Antunes Soare, Jolana Ignjatić											logistic center location analysis include:**1. Spatial position2. Intermodal connections (road, water, air, and rail transport) 3. Size of the available location 4. Topography 5. Local traffic connections 6. Environment and ecological aspects 7. Ownership structure 8. Equipment of communal infrastructure 9. Constraints in the area**
6	Optimal size and location planning of public logistics terminals Eiichi Taniguchi a,* , Michihiko Noritake b, Tadashi Yamada b, Toru Izumitani c											optimal location of logistics terminals were generally at **junctions of expressways**
7	Evaluation of freight villages: A GIS-based multi-criteria decision analysis -Özceylan, E.,Erbaş, M., Toon, M., Kabak, M., Durğut, T., (2016)											Proximity to **railroad system**, Proximity to **highway system**, Proximity to **airport**, Proximity **to industrial zone**, **Population density**, possible expansion of **land, Slope of land, Cost of land, Distance to forest zone, Distance to rivers, Distance to lakes**, Distance to earthquake epicenter, Height difference to **railway line**
8	Logistics center ste selection by ANP/BOCR analysis: A case study of Turkey											Socio-economic factors (Environmental effect, **Traffic effect, Impact of economic life, Impact of disaster logistics), Location (Distance to production, Distance to city center, Distance to airport, Distance to highway, Distance to port**), Facility cost (Building facility cost, Transport connection cost), **Railway transportation, Highway Transportation**, Land cost (Land Acquisition cost, padding cost), Operation cost (Shipping cost), Physical characteristic of land (Land size, Expansion opportunity, Ground structure, Slope of land), Structure and **ownership of land** (Ownership status of land, Availability of land for reconstruction plan) (and 7 specific Highway Transportation and Railway Transportation sub-criteria)
9	EVALUATION OF THE LOGISTICS CENTER LOCATIONS USING A MULTI-CRITERIA SPATIAL APPROACH											Proximity to **highways**, Proximity **railway**, Proximity **airports**, Proximity **seaports**, **Volume of international trade, Population, Handling capabilities of the ports**
10	Selection of Logistics Centre Location via ELECTRE Method: A Case Study in Turkey											Technical (Highway Infrastructure, **Railway** Infrastructure, **Airway** Infrastructure, **Seaway infrastructure, Passenger capacity**, Freight capacity), **Economic** (Land cost), **Social** (Employment), Logistics potential (Development Level), **Environment** (Weather condition, Hydrological condition, Topological cond., Geographical condition),
11	Comparative analysis of multi-criteria decision making methodologies and implementation of a warehouse location selection problem											The paper discusses various multi-criteria decision-making methodologies like AHP, TOPSIS, and ELECTRE, comparing their core processes, necessity to quantify criteria, determining weights, consistency checks, problem structures, and final results Parameters : **Unit price, Stock holding capacity, Average distance to shops , Average distance to main suppliers , Movement flexibility**
12	Factors Influencing Location Selection of Warehouses at the Intra-Urban Level: Istanbul Case											Critical Factors in Warehouse Location Selection within Istanbul: • Evaluating transport accessibility via major routes such as TEM, and proximity to vital **transportation hubs** like Tuzla, Ambarlı, and Zeytinburnu **ports**, alongside Atatürk **Airport**, is pivotal. • **Considering market size as indicated by district GDP, clustering with production facilities, and proximity to CBDs**
13	WAREHOUSE LOCATION PROBLEM IN SUPPLY CHAIN DESIGNING: A SIMULATION ANALYSIS											warehouse location optimization methods, considering factors like costs, time, and decision-maker preferences Parameters:**Fixed costs, variable costs, and cost-correcting functions , Supply, demand, and flow balancing constraints , Facility capacity limits and profitability threshold**
14	Selection of warehouse location for a global supply chain: A case study											Warehouse location selection in a global supply chain hinges on optimizing **transportation costs** and improving operational resilience, including factors like **labor availability and regulatory compliance.**
		12	12	13	12	14	6	7	6	13	5	100

05

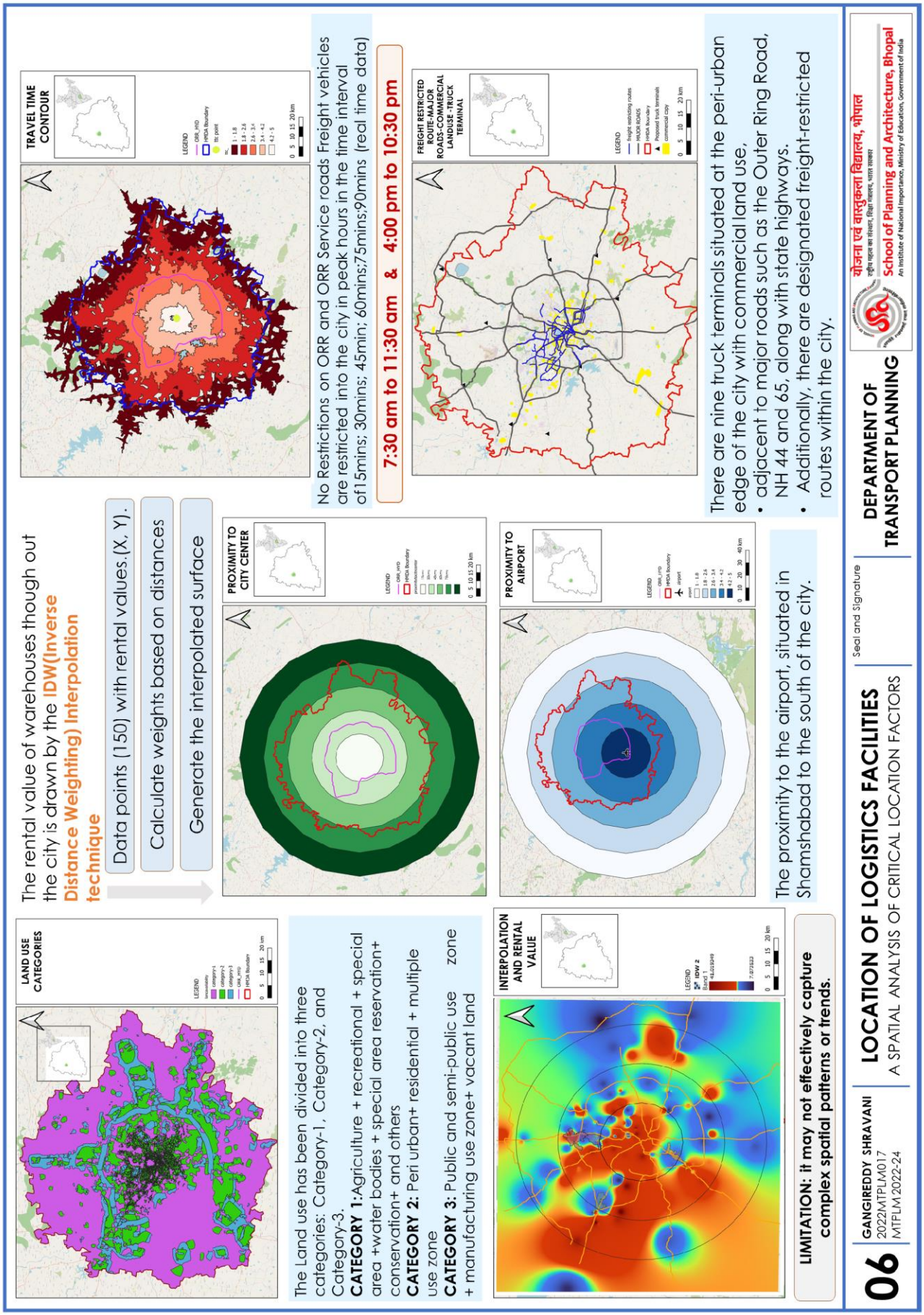
GANGIREDDY SHRAVANI
2022MTPLM017
MTPLM 2022-24

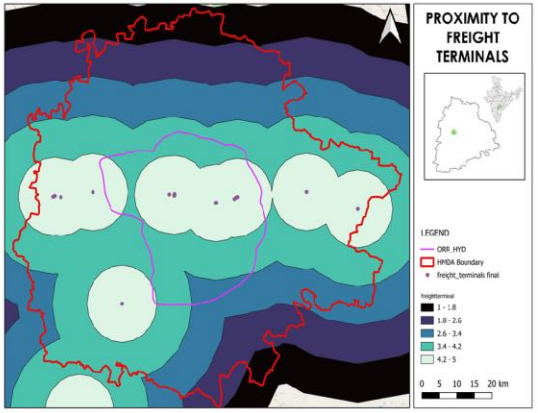
LOCATION OF LOGISTICS FACILITIES
A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS

Seal and Signature

DEPARTMENT OF TRANSPORT PLANNING

योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India


LAND USE CATEGORIES
The Land use has been divided into three categories: Category-1, Category-2, and Category-3.
CATEGORY 1:Agriculture + recreational + special area +water bodies + special area reservation+ conservation+ and others
CATEGORY 2: Peri urban+ residential + multiple use zone
CATEGORY 3: Public and semi-public use zone + manufacturing use zone+ vacant land
INTERPOLATION AND RENTAL VALUE
LIMITATION: it may not effectively capture complex spatial patterns or trends.
The rental value of warehouses though out the city is drawn by the IDW(Inverse Distance Weighting) Interpolation technique
Data points (150) with rental values.(X, Y).
Calculate weights based on distances
Generate the interpolated surface
PROXIMITY TO CITY CENTER
PROXIMITY TO AIRPORT
The proximity to the airport, situated in Shamshabad to the south of the city.
TRAVEL TIME CONTOUR
No Restrictions on ORR and ORR Service roads Freight vehicles are restricted into the city in peak hours in the time interval of15mins; 30mins; 45min; 60mins;75mins;90mins (real time data)
7:30 am to 11:30 am & 4:00 pm to 10:30 pm
FREIGHT RESTRICTED ROUTE-MAJOR ROADS-COMMERCIAL LANDUSE-TRUCK TERMINAL
There are nine truck terminals situated at the peri-urban edge of the city with commercial land use,
adjacent to major roads such as the Outer Ring Road, NH 44 and 65, along with state highways.
Additionally, there are designated freight-restricted routes within the city.
06
GANGIREDDY SHRAVANI
2022MTPLM017
MTPLM 2022-24
LOCATION OF LOGISTICS FACILITIES
A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS
Seal and Signature
DEPARTMENT OF TRANSPORT PLANNING
योजना एवं वास्तुकला विद्यालय, भोपाल
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India

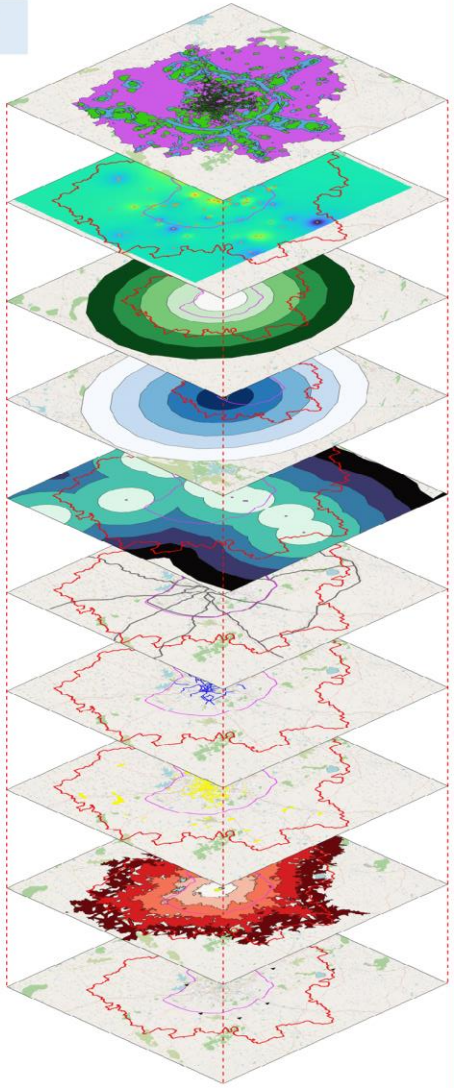


Freight terminals in Telangana
Loading locations-102
Unloading locations -97
Container rail terminals -5
Private freight terminals- 6
There are fourteen(14) freight terminals surrounding the city.

Interactions with Truck drivers

LAYERS OVERLAY

1. LAND PARCEL AVAILABILITY
2. RENTAL VALUE (per sq.ft)
3. PROXIMITY TO CITY CENTER (km)
4. PROXIMITY TO AIRPORT (km)
5. PROXIMITY TO FREIGHT TERMINALS (km)
6. DISTANCE FROM NH,SH,ORR (km)
7. FREIGHT RESTRICTED ROUTES (Km)
8. PROXIMITY TO COMMERCIAL LANDUSE
9. TRAVEL TIME CONTOUR (15MINS)
10. DISTRANCE FROM PROPOSED TRUCK TERMINALS (Kms)



07

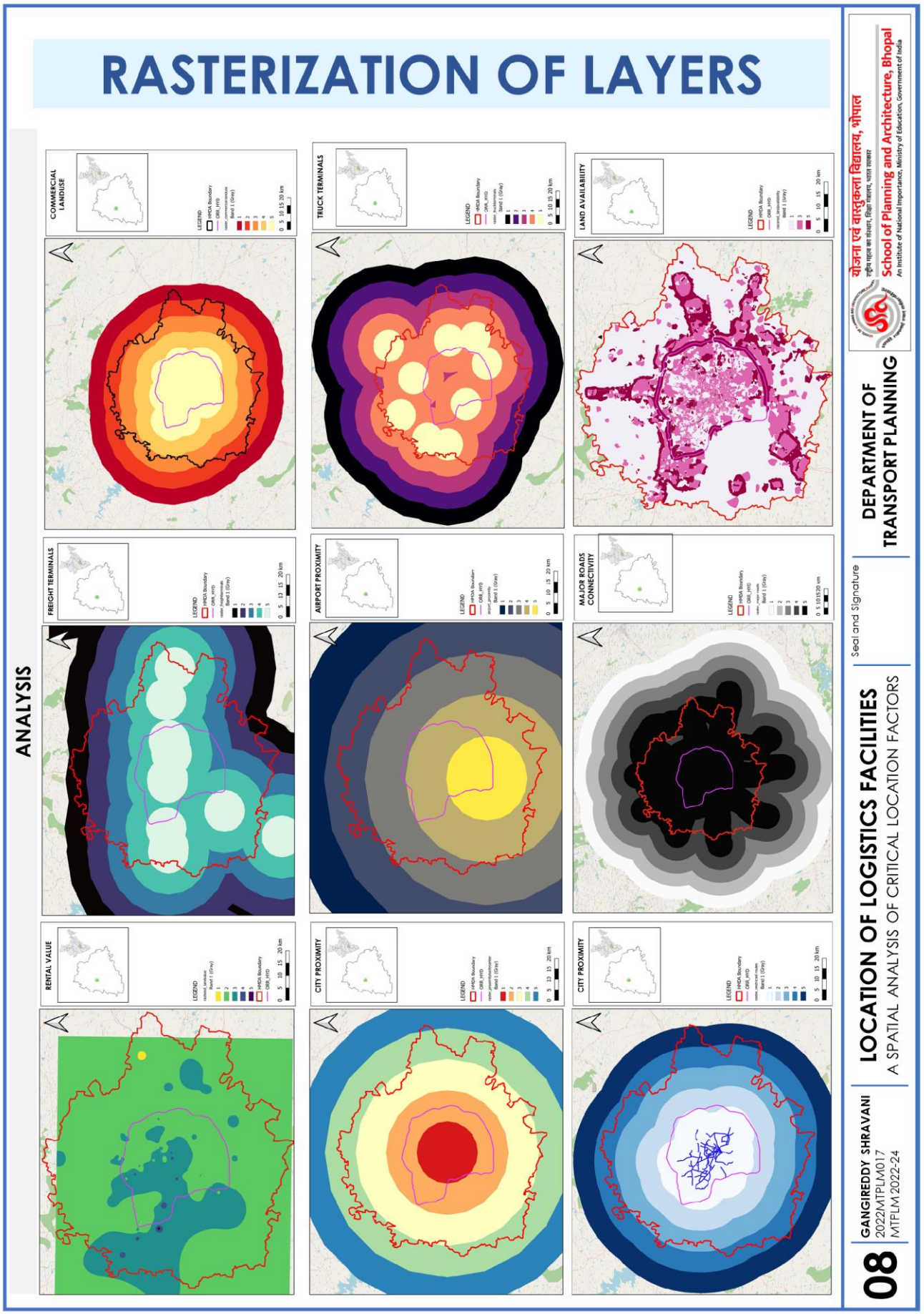
GANGIREDDY SHRAVANI
2022MTPLM017
MTPLM 2022-24

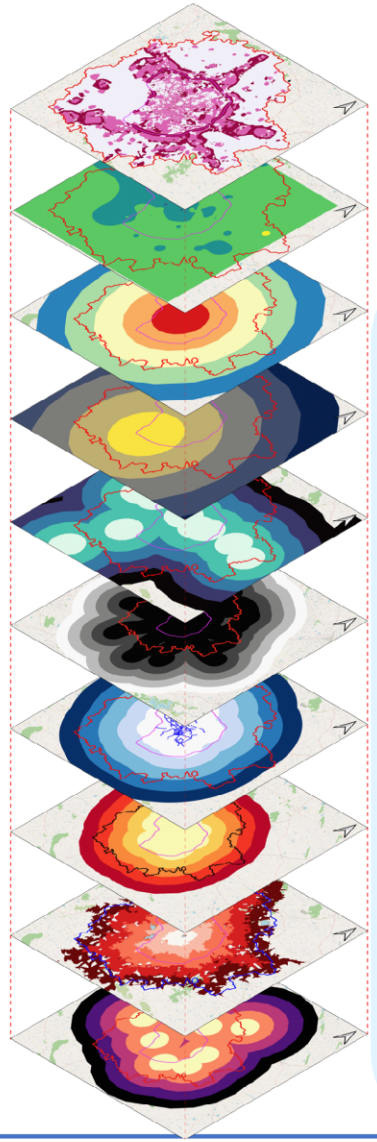
LOCATION OF LOGISTICS FACILITIES
A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS

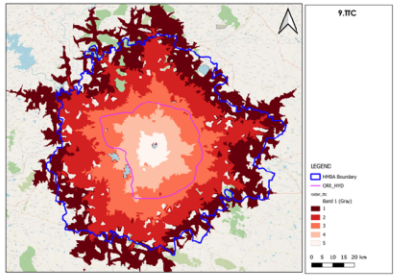
Seal and Signature

DEPARTMENT OF TRANSPORT PLANNING

योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India


RASTERIZATION OF LAYERS
ANALYSIS
COMMERCIAL LANDUSE
TRUCK TERMINALS
LAND AVAILABILITY
FREIGHT TERMINALS
AIRPORT PROXIMITY
MAJOR ROADS CONNECTIVITY
RENTAL VALUE
CITY PROXIMITY
CITY PROXIMITY
योजना एवं वास्तुकला विद्यालय, भोपाल
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India
DEPARTMENT OF TRANSPORT PLANNING
Seal and Signature
LOCATION OF LOGISTICS FACILITIES
A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS
08
GANGIREDDY SHRAVANI
2022MTPLM017
MTPLM2022-24





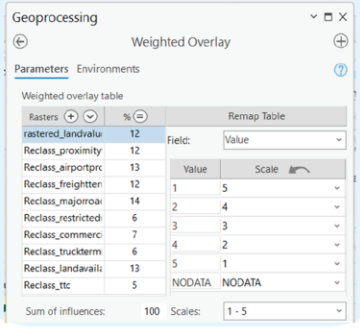
Multi Decision Criteria Making-warehouses

The parameters are provided with buffers in different ranges indicating their reachability

10 layers are regarded as parameters, these layers are transformed from vector to raster format with a pixel size of **10 meters * 10 meters.**

In this scenario, each pixel carries a weight based on the layer's weighting when multiplied by the weight of the layer.

they are overlaid using the weight



multi decision criteria making-warehouses

s.no	Parameter	Range Sub categories	Suitability	Weight(%) observation	Weight(%) literature	Weight(%) truck terminals	Reasoning
1	RENTAL VALUE(per sq.ft)	0-10	5	15	12	12	The warehouse with the lowest rental value is the most preferred option for reducing logistic costs.
		10-20	4				
		20-30	3				
		30-40	2				
		>40	1				
2	PROXIMITY TO CITY CENTER (km)	0-5	1	8	12	5	The outer periphery of the city is the most desirable location due to maximum land availability and minimum land costs.
		5-10	2				
		10-20	3				
		20-30	4				
		30-40	5				
3	PROXIMITY TO AIRPORT (km)	0-20	5	5	13	5	The closest proximity to the airport is the most favorable for minimizing travel expenses.
		20-40	4				
		40-60	3				
		60-80	2				
		>80	1				
4	PROXIMITY TO FREIGHT TERMINAL (km)	0-20	5	5	12	5	Opting for the nearest distance to the freight terminal is highly advantageous in reducing travel expenses.
		20-40	4				
		40-60	3				
		60-80	2				
		>80	1				
5	DISTANCE FROM NH,SH,ORR (km)	0-10	5	18	14	12	Enhancing connectivity, the location is strategically positioned near the city's major roads, facilitating ease of transportation.
		10-20	4				
		20-30	3				
		30-40	2				
		>40	1				
6	FREIGHT RESTRICTED ROUTES (Km)	0-10	1	12	6	12	Warehouses tend to avoid freight-restricted routes as they do not facilitate transportation efficiently.
		10-20	2				
		20-30	3				
		30-40	4				
		>40	5				
7	PROXIMITY TO COMMERCIAL LANDUSE	0-10	5	8	7	5	As that trips from the warehouse are drawn towards commercial areas, proximity to commercial land use is highly preferable.
		10-20	4				
		20-30	3				
		30-40	2				
		40-50	1				
8	DISTRANCE FROM PROPOSED TRUCK TERMINALS (Kms)	0-15	5	10	6	30	Proximity to truck terminals makes areas highly suitable.
		15-30	4				
		30-45	3				
		45-60	2				
		>60	1				
9	LAND PARCEL AVAILABILITY	0-15	5	14	13	10	Access to land parcels is essential for development purposes or for allocating space in a master plan.
		15-30	4				
		30-45	3				
		45-60	2				
		>60	1				
10	TTC	>60	5	5	5	4	In travel time contour , the most preferred areas are those requiring the least amount of time for travel.
		60mins	4				
		45mins	3				
		30mins	2				
		15mins	1				

09 GANGIREDDY SHRAVANI
2022MTPLM017
MTPLM 2022-24

LOCATION OF LOGISTICS FACILITIES
A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS

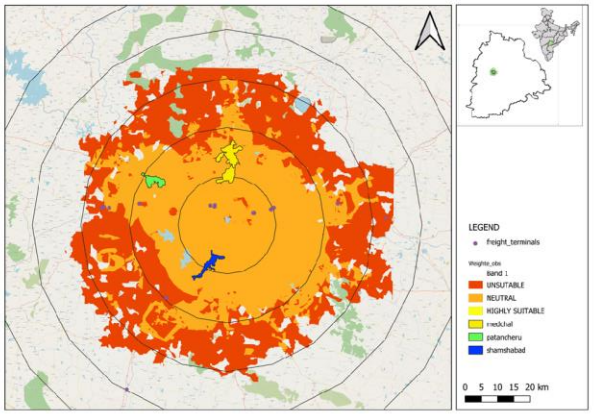
Seal and Signature

DEPARTMENT OF TRANSPORT PLANNING

योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India

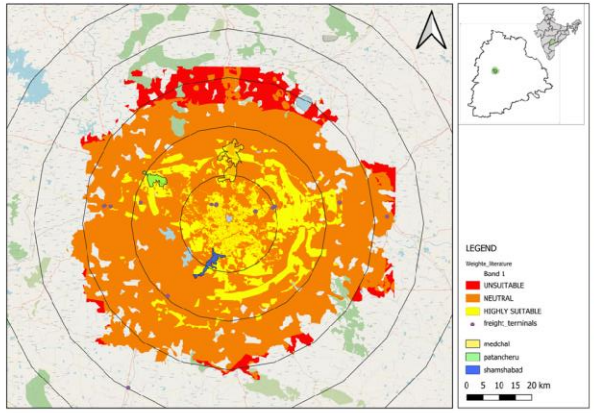
SCENARIOS

OBSERVATION, PRIMARY SURVEY AND CONSULTANCY SERVICES OPINION



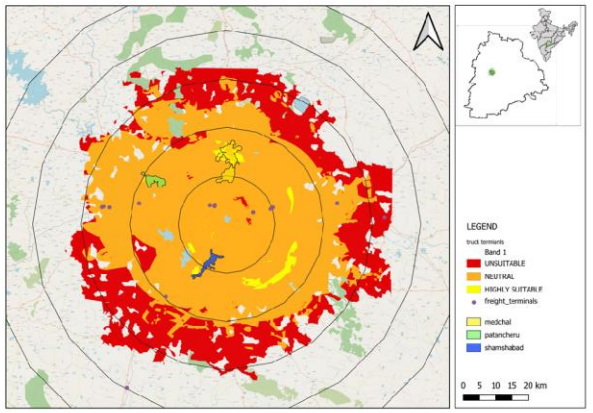
- The highest weight is assigned to **major roads**, accounting for **18%.**
- **Rental value** follows closely, with a weight of **15%.**
- According to the weighted overlay method, the **core area and intermediate** ring emerge as the **neutral locations** for establishing warehouse clusters.

LITERATURE REVIEW



- **Major roads** receive the highest weightage at **14%.**
- Proximity to the **airport and land parcel** availability both have a weight of **13%.**
- The weighted overlay method indicates that the **core area and intermediate** is the most suitable location for establishing warehouse clusters.

PROPOSED TRUCK TERMINALS ARE THE MOST PRIORITY



- Proposed **truck terminals** are assigned the highest weightage, constituting **30%.**
- According to the weighted overlay method, the **intermediate ring** emerge as the most suitable locations for establishing warehouse clusters.
- The truck terminals are situated on the outer edge of the city.

1. The current warehouse clusters are situated in locations **highly favorable** according to the weighted overlay method of **literature review**.

2. The validation of **existing locations reinforces the appropriateness** of assigning weightage based on the literature review.

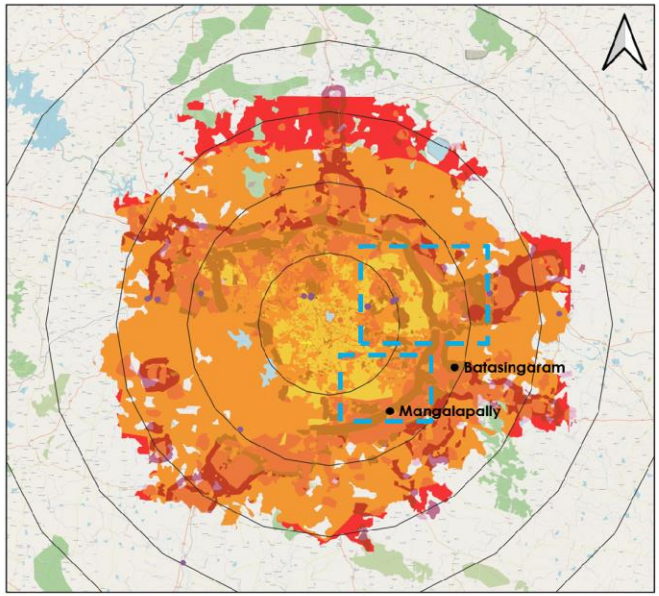
10 | GANGIREDDY SHRAVANI
2022MTPLM017
MTPLM 2022-24

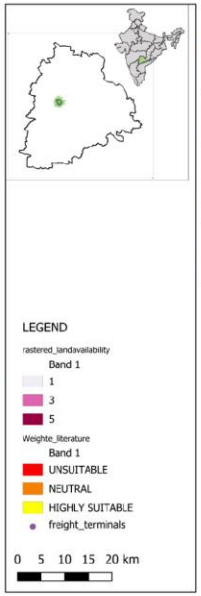
LOCATION OF LOGISTICS FACILITIES
A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS

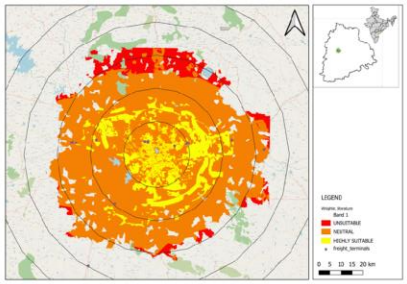
Seal and Signature

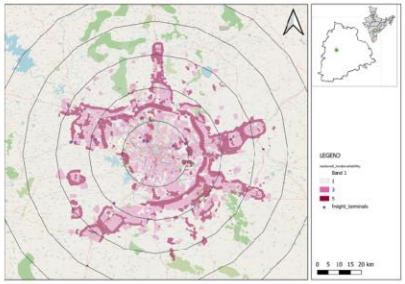
DEPARTMENT OF TRANSPORT PLANNING

योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India









Most appropriate scenario
(Literature review)
+
Land availability
+
Freight terminals

The 3 parameters are super imposed and the highly suitable land is near to a freight terminal with land availability and highly suitable land

Highlighted areas are most suitable

PROPOSALS & RECOMENDATIONS

1. Highly suitable land needs to be preserved and **secured in the master plan** to accommodate clusters to prevent organic clustering throughout the city.

2. The cluster conserved can be provided with **shared amenities** like:
   - Railway sidings and freight terminals
   - Common parking facilities
   - Loading and unloading points
   - Minimize space efficiency for heavy and light goods,

among other amenities.

- **This facilitates the transportation of goods, ranging from small-scale to heavy, via railways for import and export purposes.**
- **Also, enhances logistics efficiency while concurrently decreasing both the time and cost associated with logistics operations.**

11 | GANGIREDDY SHRAVANI
2022MTPLM017
MTPLM 2022-24

LOCATION OF LOGISTICS FACILITIES
A SPATIAL ANALYSIS OF CRITICAL LOCATION FACTORS

Seal and Signature

DEPARTMENT OF TRANSPORT PLANNING

योजना एवं वास्तुकला विद्यालय, भोपाल
राष्ट्रीय महत्व का संस्थान, शिक्षा मंत्रालय, भारत सरकार
School of Planning and Architecture, Bhopal
An Institute of National Importance, Ministry of Education, Government of India

report for palag.doc

ORIGINALITY REPORT

9%	9%	4%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.jtlu.org Internet Source	2%
2	eds.yildiz.edu.tr Internet Source	1%
3	hal.archives-ouvertes.fr Internet Source	1%
4	dmame.rabek.org Internet Source	<1%
5	www.dhyeyaias.com Internet Source	<1%
6	Submitted to The Robert Gordon University Student Paper	<1%
7	lab.geog.ntu.edu.tw Internet Source	<1%
8	www.researchgate.net Internet Source	<1%
9	Submitted to Middle East Technical University Student Paper	<1%

10	environmentportal.in Internet Source	<1 %
11	Submitted to Swinburne University of Technology Student Paper	<1 %
12	www.semanticscholar.org Internet Source	<1 %
13	shodh.inflibnet.ac.in:8080 Internet Source	<1 %
14	www.mdpi.com Internet Source	<1 %
15	Submitted to American Public University System Student Paper	<1 %
16	digitalcommons.georgiasouthern.edu Internet Source	<1 %
17	www.push.gov.uk Internet Source	<1 %
18	Antoine Robichet, Patrick Nierat. "Consequences of logistics sprawl: Order or chaos? - the case of a parcel service company in Paris metropolitan area", Journal of Transport Geography, 2021 Publication	<1 %
19	Submitted to University of Adelaide Student Paper	

		<1 %
20	www.tandfonline.com Internet Source	<1 %
21	www.tailieudaihoc.com Internet Source	<1 %
22	dergipark.org.tr Internet Source	<1 %
23	saarj.com Internet Source	<1 %
24	timesofindia.indiatimes.com Internet Source	<1 %
25	Beatriz Alves De Senna, Lílian Dos Santos Fontes Pereira Bracarense, Leise Kelli De Oliveira, Renata Lúcia Magalh&#xFFFD;ã et al. "Freight villages and urban goods distribution: perspectives of freight transport operators, experts, and policymakers from multi-criteria decision analysis", World Review of Intermodal Transportation Research, 2021 Publication	<1 %
26	Clarence Woudsma, Paul Jakubicek, Laetitia Dablanc. "Logistics Sprawl in North America: Methodological Issues and a Case Study in Toronto", Transportation Research Procedia, 2016	<1 %

	Publication	
27	doaj.org Internet Source	<1 %
28	www.diva-portal.se Internet Source	<1 %
29	www.idfcinstitute.org Internet Source	<1 %
30	arxiv.org Internet Source	<1 %
31	oresta.org Internet Source	<1 %
32	qspace.qu.edu.qa Internet Source	<1 %
33	www.financialexpress.com Internet Source	<1 %
34	www.indiaglobalbusiness.com Internet Source	<1 %
35	Kailai Wang, Zhenhua Chen, Long Cheng, Pengyu Zhu, Jian Shi, Zheyong Bian. "Integrating spatial statistics and machine learning to identify relationships between e-commerce and distribution facilities in Texas, US", Transportation Research Part A: Policy and Practice, 2023 Publication	<1 %

36	Submitted to Vietnam Maritime University Student Paper	<1 %
37	library.acadlore.com Internet Source	<1 %
38	oacis.repo.nii.ac.jp Internet Source	<1 %
39	suryaa.com Internet Source	<1 %
40	www.grossarchive.com Internet Source	<1 %

Exclude quotes	On	Exclude matches	< 7 words
Exclude bibliography	On		