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Public Transport for Urban India – Comparative Policy Paper of Hyderabad and Bogota- Case Study Approach

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Abstract:

Urban India is under high pressure with mobility challenges, with the demand for public transport outpacing the supply, an increased dependence on private vehicles, traffic congestion, pollution, and road accidents. To improve public transport infrastructure, cities in India should compare themselves with cities from developing countries rather than the developed. Indian cities have been shifting to capital-intensive Public Transport systems, mainly the Metro Rail. Most of these cities with operational metro rail systems struggle with underutilization, with a significant gap between projected and actual ridership and financial viability. In a similar context, Bogota, the capital city of Colombia, succeeded with an affordable and integrated public transport approach. This paper compares Hyderabad's metro rail system and Bogota's TransMilenio Bus Rapid Transit system through Qualitative Comparative Analysis by exploring how various causal conditions influenced public transportation outcomes in both cities. This study aims to identify strategies and practices that can contribute to implementing an efficient and sustainable Public Road transport system for Indian cities.

Introduction:

India has experienced a significant surge in urban population growth in recent years. According to the *World Bank's Urbanization Prospects* data, India's urban population accounted for 36% in 2023, up from 31.14% in 2011 (*Ministry of Housing and Urban Affairs*, 2016). The population of the top 10 cities in India constitutes nearly 10% of the total population (see Figure 1).

City	Population		Share (%)	Rank		Change	
	2023	2024		India	World	Population	(%)
Delhi	32,941,309	33,807,403	2.34	1	2	866,094	2.63
Mumbai (Bombay)	21,296,517	21,673,149	1.50	2	9	376,632	1.77
Kolkata (Calcutta)	15,332,793	15,570,786	1.08	3	18	237,993	1.55
Bangalore	13,607,800	14,008,262	0.972	4	23	400,462	2.94
Chennai (Madras)	11,776,147	12,053,697	0.836	5	28	277,550	2.36
Hyderabad	10,801,163	11,068,877	0.768	6	34	267,714	2.48
Ahmadabad	8,650,605	8,854,444	0.614	7	45	203,839	2.36
Surat	8,064,949	8,330,528	0.578	8	50	265,579	3.29
Pune (Poona)	7,166,374	7,345,848	0.510	9	58	179,474	2.50
Jaipur	4,207,084	4,308,510	0.299	10	112	101,426	2.41

Figure 1. Population of Cities in India 2024 - StatisticsTimes.com

This exponential growth in urban population has placed a heavy burden on transportation and mobility infrastructure in cities and towns due to the widening gap between demand and supply of services. However, the lack of adequate transport infrastructure cannot solely be attributed to population growth; it also stems from historical constraints and various state policy priorities in the past. Currently, metropolitan cities in India face severe traffic issues due to an increase in private transportation, inefficiencies in public transport services, rising per capita trips, longer trip lengths, and a lack of long-term state investment in transportation infrastructure. Among these challenges, the increase in private vehicle ownership, driven by the lack of a reliable public transportation system, is the most significant factor.

Public transport systems in Indian cities have not grown at an optimal pace to meet rising demand. For instance, in August 2022, Hyderabad required a minimum of 6,000 buses compared to its fleet of only 3,100 buses, even after the addition of 650 new buses (Jose, 2022). Singh (2015) notes that the inability of public transport systems to meet demand has led urban residents to increasingly rely on private modes of transport, as well as intermediate modes such as auto-rickshaws and taxis. The Regional Transport Authority (RTA) data reveals that the Greater Hyderabad region had over seven million personal vehicles in 2023, including 5.69 million two-wheelers (up from 3.95 million in 2017) and 1.41 million four-wheelers (up from 0.92

million in 2017) (“Personal vehicles cross 70L mark in Greater Hyderabad”, 2023). Over the past decade, 5.7 million new vehicles have been added, contributing to various problems such as increased air pollution from emissions, noise pollution, urban heat islands in congestion-prone areas, and road accidents.

To address these kind of challenges, 21 Indian cities have invested in metro rail systems as of 2024, compared to only five in 2014 (Mishra, 2024). Discussions around urban public transport development often focus on capital-intensive systems such as Mass Rapid Transit Systems (MRTS) or Bus Rapid Transit Systems (BRTS), often modeled on cities in developed countries. While metro rail systems are perceived to reduce congestion, pollution, and road accidents by encouraging a public shift from private vehicles, research by Mohan (2008) indicates that this assumption is not always valid in low- and middle-income countries.

Heavily invested metro projects, often promoted as flagship initiatives by central and state governments, are underutilized compared to their design capacities (see Figure 2). This underutilization frequently leads to the need for operational subsidies. Decisions to approve metro rail projects are typically based on factors such as peak-hour traffic forecasts, congestion levels, urban population density, and trip lengths. However, these decisions often neglect the financial sustainability of such projects. Saxena (2023) notes, "The average cost of building a metro in India is currently around INR 407 crore per km." India presently has an operational metro rail length of 945 kilometers, ranking third globally after China (4,201 kilometers) and the USA (1,408 kilometers) (Subhashini, 2024). In August 2024, the central government approved a combined investment of INR 30,000 crore for metro projects in Bengaluru, Pune, and Thane, scheduled for completion by 2029. This will add to the 1,018 kilometers of metro rail currently

under construction, bringing India's operational metro length to approximately 2,000 kilometers, surpassing the USA (Mishra, 2024).

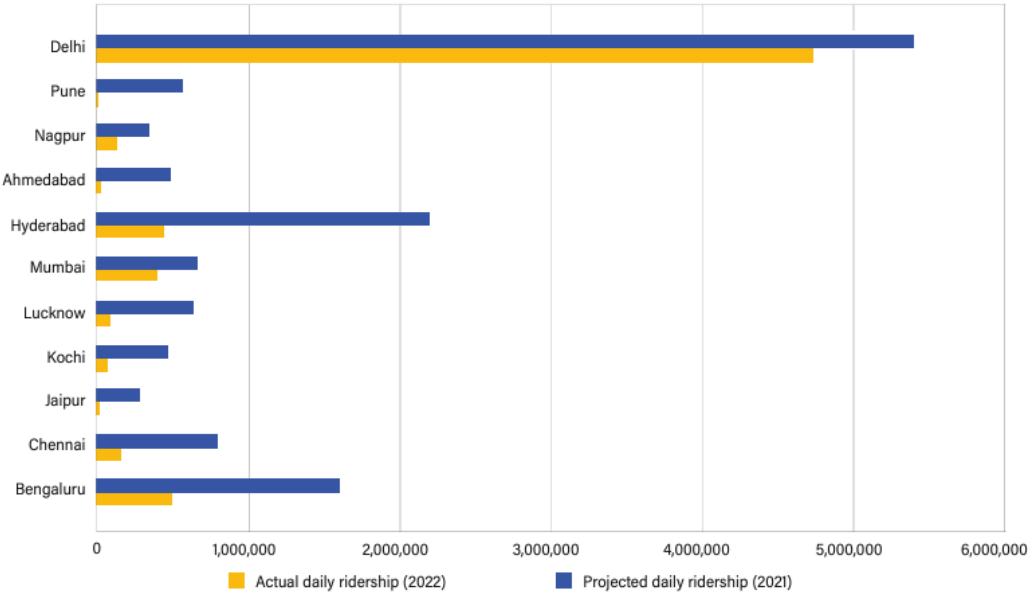

Figure 2 Projected and Actual Ridership in India (WRI India,2023)

For this comparative policy analysis, a case study approach using Qualitative Comparative Analysis (QCA) is employed to evaluate urban transportation policies. Hyderabad's choice of public transport as MRTS is compared with Colombian capital city Bogotá's low-capital model, the TransMilenio Bus Rapid Transit system. This comparison enables a comprehensive examination of factors influencing urban transport policies, such as socio-economic conditions, state financial capabilities, and political dynamics. By analyzing the outcomes of Bogotá's TransMilenio and their applicability to Hyderabad's context, QCA can identify strategies and practices that contribute to positive outcomes for urban public transport systems in Indian cities facing similar challenges.

Case Study Approach:

Hyderabad- Metro Rail Limited (HMRL):

The decision to adopt Metro Rail as a public transportation choice in Hyderabad arose from the city's rapid growth and associated challenges. Hyderabad's population increased from 4.67 million in 1991 to 6.38 million in 2001, accompanied by 1.56 million vehicles in the city. Ramachandran (2011) noted that the then-existing public transport system, primarily operated by the State Road Transport Corporation's buses, had a 45% modal share, while the 148 km of railways carried only 0.5% of commuters—an inadequate provision for the growing population in 2001.

Studies and Proposals

Various studies were conducted from 1983 onward to plan for Hyderabad's growing transportation and mobility needs. The Comprehensive Traffic and Transportation Study conducted in 1983 by Regional Engineering College, Warangal, and commissioned by the Hyderabad Development Authority, Municipal Corporation of Hyderabad, and Andhra Pradesh State Road Transport Corporation (APSRTC), recommended improvements to junctions, developing terminals for intermediate public transport, expanding the road network, enhancing bus services, and constructing a 51.5 km Light Rail Transit System (LRTS) (Ramachandran, 2011).

Subsequently, a feasibility study by Rail India Technical and Economic Services Limited (RITES) in 1988 proposed a 22.5 km LRTS in three phases, but no follow-up action occurred (Ramachandran, 2011). In 1994, the Japan External Trade Organization (JETRO) recommended

two MRTS routes: Line 1 (Balanagar to Afzalganj, 14.9 km) and Line 2 (Afzalganj to Dilsukhnagar, 5.7 km). However, this proposal was not implemented.

A joint study by the Andhra Pradesh Government and Indian Railways proposed a multimodal suburban transport system. In 2003, the government engaged the Delhi Metro Rail Corporation (DMRC) to prepare a detailed project report (DPR) for Phase I of the Hyderabad Metro, which included two corridors: Miyapur–Chaitanya Puri (25.6 km) and Secunderabad–Charminar–Falaknuma (12.6 km) (Ramachandran, 2011).

According to Ramachandran (2011), the Hyderabad Metro was implemented as a Public-Private Partnership (PPP) by L&T Metro Rail (Hyderabad) Limited at an estimated cost of USD 2.8 billion. The Government of India contributed 10% as viability gap funding, while the state government provided USD 400 million for land acquisition, rehabilitation, and utility shifting. The remaining majority stake was held by L&T Metro Rail (Hyderabad) Limited. The actual project cost was ₹18,411 crores.

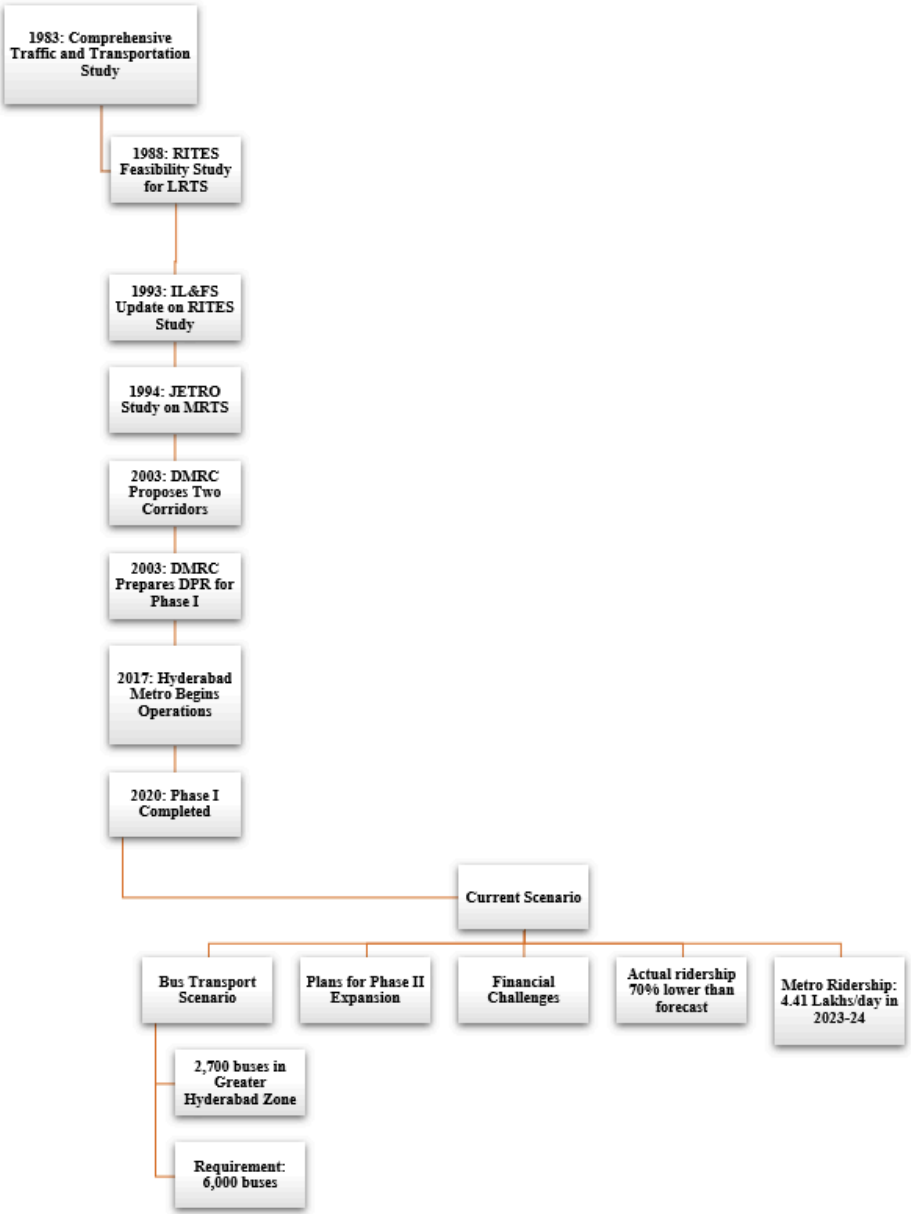

Figure 3 Flow Chart of Hyderabad-MRTS

Current Scenario of Hyderabad Metro

Phase I of the Hyderabad Metro network spans 69.2 kilometers across three lines. Operations of two lines began in November 2017, with the third line operational in February

2020. As of April 2024, the Hyderabad Metro Rail Limited (HMRL) has an average daily ridership of approximately 441,000, which is 70% lower than the forecasted 1.5 million passengers per day during the project's inception. L&T Metro Rail has faced financial challenges, with operational revenues insufficient to meet debt obligations, necessitating fund infusions from L&T to support debt servicing (Paul Oommen, 2022).

Despite its challenges, the Government of Telangana is working on the Detailed Project Reports for Phase II, which involves an additional 116.2 km, including metro expansion to Hyderabad International Airport and other regions, with an estimated cost of ₹32,237 crores (Kaushik, 2024).

State Road Transport Corporation

In 2001, APSRTC operated 2,605 buses in the Hyderabad Development Authority area on 874 routes. Currently, the Telangana State Road Transport Corporation (TSRTC) operates approximately 3,000 buses in the Greater Hyderabad Municipal Corporation (GHMC) area, whereas the city requires about 6,000 buses to meet transportation needs (Jose, 2022). The insufficient bus fleet has led residents to increasingly rely on private vehicles.

Bogotá – TransMilenio

Bogotá, the capital city of Colombia, experienced rapid population growth in the 1980s due to migration from other parts of the country. The study on Bogotá's urban transportation policy by Bocarejo et al. (2013) begins with a special mention of the spatial characteristics of the city, which informed policy considerations, such as the spatial segregation of the population, with low-income groups settling on the city's outer periphery. Bogotá's lower-income groups

faced mobility challenges, including a high percentage of income spent on transportation and longer travel times due to their peripheral location.

In the 1980s, to address the challenges of increasing private vehicle usage, Bogotá started closing roads to car traffic for seven hours on Sundays. According to Nair and Kumar (2005), this practice continued, with 120 km of roads closed to motor vehicles on Sundays by 2005.

In the 1990s, the city faced transportation issues due to neglected road maintenance. Large portions of the city budget were allocated to constructing flyovers and widening roads, which failed to alleviate traffic congestion. Bogotá also faced increasing pollution levels, rising road accident rates, a lack of public space, and an inefficient public transit system. According to Nair and Kumar (2005), the situation became critical around 1997.

In 1998, the Japan International Cooperation Agency (JICA) presented a "Transportation Master Plan" to Bogotá, proposing a metro system, an urban highway, and elevated streets. However, Bogotá rejected the plan as it was capital-intensive. Instead, the city developed a comprehensive approach that focused on implementing a Bus Rapid Transit System (BRT), improving non-motorized vehicular infrastructure, and discouraging private automobile use.

Bus Rapid Transit System (TransMilenio)

TransMilenio S.A., a new authority, was established in October 1999 with the objective of: “Transforming Bogotá's public transport system in order to improve its citizens' quality of life and the city's air quality, increase productivity, and have an updated system with resources in place to provide transport facilities to more than 80 percent of the city's population” (TransMilenio: Renewing Bogotá’s Transport System, 2016).

TransMilenio was implemented in 2000 with segregated busways, improved bus station infrastructure—making them cleaner and more comfortable, with faster boarding and alighting processes and efficient ticketing systems—and a priority given to buses over private vehicles. By 2012, the system had expanded to 112 km of dedicated bus lanes (trunk lines). “Feeder lines that provide access to the trunk lines cover 440 km of routes in the outlying districts” (Hub, 2019).

Hub (2019) adds that “TransMilenio in 2018 had more than 3,500 buses carrying up to 240 passengers per bus, with an average daily ridership of 2.3 million people. It is the first BRT system in the world to reach operational productivity levels equivalent to a metro system. At its peak load, it is the busiest BRT system in the world, carrying more than 250,000 passengers per hour.”

Non-Motorized Vehicular Infrastructure

Bogotá also focused on developing pedestrian and bicycle infrastructure, using pedestrian areas as tourist attractions with safety measures. The pedestrian streets and 300 km of bicycle paths were integrated with TransMilenio, promoting alternatives to motorized private vehicles.

The project also included measures to disincentivize private vehicle use by initially restricting car circulation by 40% during peak hours, implementing annual car-free days, and planning for a future ban on all car circulation during peak hours.

Financing and Impact

The project was a public-private partnership model, with infrastructure managed by the government and operations handled by private partners. The national government of Colombia

pledged USD 990 million for construction over 14 years. TransMilenio was 70% financed by the national government and 30% by the local government. “The capital cost of the infrastructure for Phase I was US$297 million or $9.4 million per mile ($5.4 million per km), not including the cost of land acquisition. The cost for Phase II rose to US$545 million or $13.3 million per km. This higher cost for Phase II was due primarily to increased investment in bridges, interchanges, and associated transportation infrastructure improvements” (Energy Sector Management Assistance Program [ESMAP], 2009).

“9% of passengers used to commute by private car and now commute by bus. In the areas where TransMilenio operates, there was a reduction of 92 percent in deaths, 75 percent in injuries, and 79 percent in collisions” (TransMilenio: Renewing Bogotá’s Transport System, 2016). It also improved air quality, with a “40% reduction in pollutant agents and a 10.3% decrease in gasoline consumption” (Nair & Kumar, 2005). However, as demand grew in later years, TransMilenio faced issues of overcrowding.

Qualitative Comparative Analysis

The Qualitative Comparative Analysis (QCA) is used to assess the factors that influence urban transport system outcomes in Hyderabad and Bogotá. QCA allows for the analysis of different conditions and combinations that determine specific outcomes. By comparing the existing conditions of the two cities, we can understand the role each factor played in the functioning or achievement of objectives, specifically the metro rail system in Hyderabad and the BRT and NMV transport infrastructure development in Bogotá. After identifying the conditions, a truth table is created to narrow down the influencing factors and identify causal pathways that led to the different outcomes in Hyderabad and Bogotá.

Truth Table:

The truth table in QCA is a tool used to explore and analyze how various combinations of conditions relate to a specific outcome. Boolean minimization is typically applied to simplify the results for each condition. Truth tables are helpful in identifying necessary conditions for an outcome that is influenced by several factors.

Conditions:

- **Political Support:**
    - **Hyderabad:** The city's metro rail initiative received political backing, supported by state and central government funding for land acquisition, R&R packages, and viability gap funding. The DPR for an additional 70 km of metro expansion is also being pushed forward.
    - **Bogotá:** Political support in Bogotá focused on implementing an efficient BRT system as part of a broader urban mobility strategy.
- **Financial Constraints:**
    - **Hyderabad:** Due to financial constraints, a PPP model was adopted. The metro system operates at a significant financial loss, but Phase II expansion is still planned.
    - **Bogotá:** Limited financial resources led to the rejection of a metro system and the adoption of the more affordable TransMilenio BRT.
- **Public Opinion:**

  - **Hyderabad:** Public opinion is mixed, with some support for the metro rail but challenges due to operational inefficiencies, peak-hour congestion, and higher costs for shorter rides. Ridership remains below forecasts.
  - **Bogotá:** The TransMilenio system enjoys broad public acceptance, supported by policies to reduce private vehicle use and promote public transport.
- **Environmental Concerns:**
  - **Hyderabad:** Although the metro rail is a sustainable option, its impact on pollution reduction has been limited due to low ridership and persistent traffic congestion.
  - **Bogotá:** TransMilenio has significantly reduced air pollution and gasoline consumption, contributing to environmental sustainability.
- **Perception of Development:**
  - **Hyderabad:** The metro rail is perceived by the public and politicians as a symbol of modernity and development, driving political and social support despite economic and operational challenges.
  - **Bogotá:** Public perception favors a pragmatic and functional approach to development, prioritizing accessibility and sustainability over the symbolic value of high-tech solutions like a metro rail.
- **Equity and Social Inclusion:**
  - **Hyderabad:** The metro system faces accessibility issues for low-income populations due to high costs and limited connectivity to peripheral areas, as highlighted by Hyderabad Urban Lab.

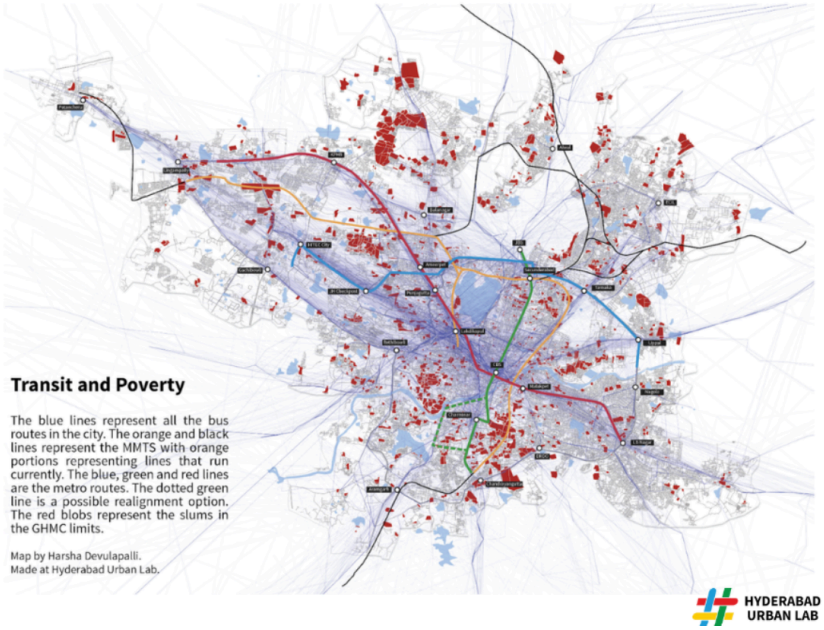

Figure 4 Transit and Poverty Maping of Hyderabad, Hyderabad Urban Lab

- **Bogotá:** TransMilenio was explicitly designed to improve access for low-income groups living on the city's periphery, reducing the cost and time burden of transportation.

- **Integration with Other Modes of Transport:**
  - **Hyderabad:** The metro rail system suffers from limited integration with other public transport modes, especially last-mile connectivity, leading to underutilization.
  - **Bogotá:** TransMilenio is well-integrated with pedestrian infrastructure and bicycle networks, enabling efficient multimodal transport.

Outcome:

- **Hyderabad:** A capital-intensive metro rail system with low ridership and financial challenges.

- **Bogotá:** A cost-effective BRT system integrated with non-motorized vehicle (NMV) transport infrastructure, leading to widespread public use and environmental benefits.

Truth Table for Public transportation system of Hyderabad and Bogota:

- Truth table lists the conditions and outcomes for each case study and binary values (0 or 1) will be assigned to indicate whether a condition is present or absent in each city's case.

Case	Political Support	Financial Constraints	Public Opinion	Environmental Concerns	Perception of Development	Equity and Social Inclusion	Integration with Other Modes of Transport	Outcome
Hyderabad	1	1	0	1	1	0	0	Metro System
Bogotá	1	0	1	1	0	1	1	BRT System

- Bogota's success can be attributed to its lesser financial constraints, strong public support during implementation, and emphasis on equity and social inclusion. The focus on integrating other transport modes and connectivity also helped in widespread adoption.
- Hyderabad, though with financial constraints, has chosen and is still in plans of expansions due to its perception that metro rail is a symbol of development and modernity. The lower ridership and increasing debt burdens have been due to less regard for integrating other transport means for last mile connectivity, public opinion due to operational routes, peak hour traffic due to limited coaches and costs for shorter rides being higher and the average ridership being lower than the forecasted.

Discussion and Conclusion:

Hyderabad and Bogotá faced similar challenges in the late 1990s. However, the choices they made to address these challenges shaped their respective trajectories. Hyderabad's decision to adopt a metro rail system fell short of addressing the growing population's needs, and the city continues to face similar issues. In contrast, Bogotá's adoption of the Bus Rapid Transit (BRT) system transformed its urban mobility landscape.

The TransMilenio system in Bogotá was implemented as an innovative and cost-effective alternative to the capital-intensive metro rail system. It was integrated with a vision for sustainable mobility. On the other hand, Hyderabad's metro rail has not delivered a transformative impact in addressing mobility challenges and has incurred severe financial losses. The continued focus on metro expansion risks leading to similar outcomes if alternative, more effective solutions are not considered.

The success of TransMilenio and its integration with non-motorized transport infrastructure in Bogotá demonstrates that simpler, financially feasible solutions can be more effective than expensive metro projects. For its future expansion, Hyderabad could explore cost-effective, road-based transport options that are incrementally scalable. Better coordination between different modes of transportation—buses, non-motorized vehicles, private motorized vehicles, etc.—similar to Bogotá's approach, could significantly improve overall system efficiency.

Bogotá's approach of enhancing access for low-income groups living on the city's periphery and aligning transportation policies with population needs offers valuable lessons.

Indian cities like Hyderabad could adopt a similar strategy by involving the public in the decision-making process, thereby ensuring that transportation systems benefit all social groups, particularly those in less accessible areas.

Urban transportation policies in Indian cities must be tailored to the unique context of each city. While the analysis highlights the success of Bogotá's BRT system over Hyderabad's metro rail, this does not imply that a BRT system should be universally recommended for Hyderabad or other Indian cities. The emphasis should be on achieving cost-effectiveness, public acceptance, and an integrated approach. Transportation solutions should align with local conditions, including public perceptions, socioeconomic factors, and state capacity, rather than prioritizing the symbolism of heavy infrastructure projects.

While metro systems may symbolize modernity and development, practical and scalable solutions that meet the needs of the population can create a balanced and effective public transportation framework for Indian cities.

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