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SOCIAL BENEFITS EVALUATION OF BENGALURU METRO RAIL TRANSPORT SYSTEM

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Bengaluru Metro Rail Transportation (Namma Metro) has become the lifeline of daily commuters in Bengaluru to travel from one end to other. The transportation and its service play an important role in the development of the country. Due to the fast growth in education, employment, health and accommodation it has become mandatory that the modern commuting system had to take a great turn up. The metro system is the most important transportation system in urban infrastructure. This study explores the perception of 400 commuters regarding the social benefits of Bengaluru metro rail transportation in Karnataka. Employing statistical tools such as KMO and Bartlett's test, principal component analysis and Varimax rotation, the research evaluates the effects of Bengaluru metro rail transportation on its commuters in terms of social benefits. The analysis reveals significant social benefits provided by Bengaluru metro to its commuters such as safer, convenient and affordable means of transport, fast and reliable, improvement in standard of living, improved relatives connectivity mobility of work force, equal social status etc., the study emphasizes the importance of enhancing the social benefits to the daily commuters in Namma Metro. Recommendations include increasing rail service by reducing frequency time in peak hours, social integrity, and economic development of the region and policy makers to support each commuter. By addressing these issues, the study aims to optimize social benefits of Bengaluru metro to its commuters by fostering economic growth. This research provides actionable insights for policy makers to enhance social benefits of Bengaluru metro rail transportation for better socio-economic outcomes.

KEYWORDS: ***Social Benefits, Evaluation, Bengaluru Metro Rail Transportation, Karnataka.***

INTRODUCTION

Transportation plays an important role in the development of a country and it is an indicator of social and cultural life of its citizens. Status of the people in the state with respect to education, employment and Health gets affected by prevailing transportation system. So, it is very important for any city to have an effective public transportation system and the same has to be managed to face upcoming, future challenges and to ensure effectiveness in their operations. Railways are definitely one of the largest and most convenient forms of transportation. Public transport is a system of transport for passengers by group travel systems available for use by the general public unlike private transport, typically managed on a schedule, operated on established routes and that may charge a posted fee for each trip.

Metro rail is more convenient. it is the lifeline of most of the metropolitan cities in India. The introduction of Bengaluru metro needs the identification of the changes bought out by it in the transportation sector of the economy. Most importantly, Bengaluru metro contributes to the diversion of a very high proportion of current passenger traffic from road to Metro and serves part of the growing passenger traffic demand in Bengaluru. As a result, there will be reduction in the number of vehicles on road with the introduction Metro. The Bengaluru metro also brings about a reduction in air pollution because of the substitution of electricity for petrol and diesel and reduced congestion on the roads. The main focus of this study is on the significant social benefits provided by Bengaluru metro to its commuters such as safer, convenient and affordable means of transport, fast and reliable, improvement in standard of living, improved relatives connectivity by use of metro, mobility of work force, equal social status etc.,

Evolution of Metro Rail Transport in India and Social Benefits

Railway system occupies significant place in the realm of transportation. Comparing with other means of transportation

system, this particular mode has grater advantages as it can carry a large number of passenger and large & heavy loads to long distances. Since its launch in the field in transportation, railway underwent tremendous changes in term of shape, speed, mode of running, distance of whatever field human mind can imagine. Among those changes, the most important one is considered to be the emergence and spread of metro rail system.

The word metro actually comes from an abbreviation form of 'Paris Metropolitan'. That was quickly abbreviated into metro, which become common word used to designate all subway network. In some cases, metro is regarded as rapid transits train system.

World's first urban underground railway was Metropolitan railway which began its operation on 10th January 1863. It was built largely in shallow tunnels and is now part of London underground.

The following table indicates the evolution and operational length of metro rail transportation at different cities in India. In India approximately 1000 kilometers of metro network is built and functional.

Table: 1.1 Metro Rail Transport System in India with date of operation and length

Sl. No.	City	Date and Year of First line Operation	Total Operational Length (In kilometers)
1	Kolkata	24 October 1984	60.28
2	Delhi	24 December 2002	395.00
3	Bengaluru	20 October 2011	77.00
4	Gurgaon	14 November 2013	12.85
5	Mumbai	08 June 2014	59.50
6	Jaipur	03 June 2015	11.98
7	Chennai	29 June 2015	54.10
8	Kochi	17 June 2017	28.80
9	Lucknow	05 September 2017	22.88
10	Hyderabad	29 November 2017	69.10
11	Ahmedabad	04 March 2019	60.06
12	Nagpur	08 March 2019	38.20
13	Kanpur	28 December 2019	8.98
14	Pune	06 March 2024	32.97
15	Agra	6 March 2024	29.40
16	Noida	25 January 2019	29.70
17	Indore	31 May 2025	5.90

Source: metronetworkinindia.com

Bengaluru Metro Rail Transportation

Namma Metro (meaning **Our Metro** in Kannada), also known as **Bengaluru Metro**, is a rapid transit system serving the city of Bengaluru, the capital city of the state of Karnataka, India. It is the second longest operational metro network in India with an operational length of 77 kilometers, just behind Delhi Metro. Upon its inauguration, it became the first underground metro system in South India. Namma Metro has a mix of underground, at grade, and elevated stations. Out of the 66 operational metro stations of Namma Metro as of October 2023, there are 57 elevated stations, eight underground stations and one at-grade station. The system runs on standard-gauge tracks.

Bengaluru Metro Rail Corporation Limited (BMRCL), a joint venture of Government of India and the State Government of Karnataka, is the agency for building, operating and expanding the Namma Metro network. Services operate daily between 05:00 and 24:00 running with a headway varying between 5–15 minutes. The trains initially began with three coaches but later grew to six coaches as ridership increased. Power is supplied by750V direct current through third rail. As of March 2024, the metro system had an average daily ridership of about 8,50,000 commuters.

The State Town Planning Department had recommended looking into a mass rapid transit project, i.e. a metro for Bengaluru city way back in 1977. A high-level Committee had also agreed that a metro study was warranted and a team from Southern Railway (SR) was commissioned to do this in 1981. The Southern Railway team recommended a 2-corridor metro, 80 km (50 mi) in length in addition to commuter rail lines and a ring railway.

In 1993, the State of Karnataka established another committee to look into mass rapid transit. This committee had again recommended the same metro project put forward by SR in 1983 and the same circular railway.

The state created Bangalore Mass Rapid Transit Ltd (BMRTL) in 1994, with terms of reference to seek a public private partnership for a mass rapid transit project. The government immediately introduced a special city cess dedicated to the anticipated mass rapid transit project. BMRTL commissioned a feasibility study

which came up with an elevated, LRT-based, 300 km (190 mi) long network on 6 routes. A private consortium led by United Breweries Group undertook further development of the project on BOT basis. However, the project hadn't taken off.

In 2003, the Government of Karnataka commissioned the Delhi Metro Rail Corporation (DMRC), which had successfully developed the Delhi Metro, to carry out a detailed preparation study for a metro in Bengaluru, to be done emulating the technical and financial aspects of the approach used in Delhi. The study recommended a 2-line metro, 60 km (37.3 mi) and 50 km (31 mi) in length, cross shaped. The middle of the cross was to be at the Central Railway Station in Bengaluru, completely underground. The economic rate-of-return was forecast at 22.3%. The financial forecast assumes a government subsidy for interest payments and some depreciation; i.e. fare revenue will cover somewhat more than direct operating costs. The Government accepted this option. BMRTL ceased to exist and was replaced by Bengaluru Metro Rail Corporation Ltd (BMRCL). Finally, Bengaluru Metro Rail Transportation commenced its commercial operation on 20th October 2011 between Baiyappanahalli and Mahatma Gandhi Road with three coaches.

Social Benefits of Bengaluru Metro Rail Transportation

Metro rail projects are meant to cater to cities with more than two million population and the costs in these cases are related to areas which are proposed to serve underground, elevated or at grade alignment. Larger the underground and elevated proposal, larger shall be the cost involved. It is highly advantageous to get funding from the central government or through private – public partnership or from international funding agencies.

The following are the social benefits of metro rail transportation

- Equal social status among metro passengers during travel
- Lower air pollution
- Improved relatives Connectivity by use of Metro rail Transportation
- Reduced passenger density during non-peak hours
- Mobility of work force
- Improvement in Standard of living
- Fast and Reliable means of transport
- Safer, Convenient and affordable means of transport
- Enhanced social integrity
- Reduced road accidents

LITERATURE REVIEW

Preston, J. (2001) presented a research agenda for the integration of transportation and socio-economic activity. The author argues that the traditional approach of treating transport and socio-economic activity as separate entities has led to inefficiencies in transportation planning and policy-making. To address this issue, the article proposes an integrated approach that considers the interrelationships between transport and socio-economic activity. The author identifies several research areas that can help achieve this integration, including the role of transportation in shaping urban form, the impact of transportation on social equity, the influence of information technology on transportation demand, and the evaluation of transportation investments. The proposed research agenda can help guide future research in this area and inform transportation policy-making.

Mukti Advani (2005) conducts the study on the evaluation of Delhi Metro in terms of capacity, travel time and accessibility to the system and evaluation indices reflecting commuter's perspective. The study covered evaluation criteria, initial and maintenance cost of metro, users of metro. The study concluded with high-capacity system does not necessarily generate high demand. Estimation of passenger demand for transit services should consider complete journey of commuters including access time.

Cascajo.R (2005) conducted a research study to assess the economic, social, and environmental impacts of rail urban projects. The study focused on evaluating the effects of the rail urban projects on the development of urban areas and the well-being of the population. The study employed a multi-criteria analysis approach that included quantitative and qualitative methods to analyze the impacts of rail urban projects. The research findings indicate that rail urban projects have positive impacts on the economic, social, and environmental aspects of urban areas. Specifically, rail urban projects were found to enhance the mobility of the population, increase accessibility to different parts of the city, reduce traffic congestion, and improve the overall quality of life of urban dwellers.

Murthy et.al (2006) carried out research study on the social cost-Benefit Analysis of Delhi Metro. It tries to measure all the benefits and costs from Phase I and Phase II projects covering a total distance of 108 kms in Delhi. Estimates of the social benefits and costs of the project are obtained using the recently estimated shadow of price of investments, foreign exchange and unskilled labour as well as the social time preference rate for the Indian economy. The IR on investments in the metro is estimated as 17 percent, while the economic rate of return is 24 percent. The authors opine that benefits from the reduction of urban air pollution due to metro have increased the economic rate of return by 1.4 percent.

Badami (2009) focuses on the importance of pedestrian accessibility in urban transport policy. The article argues that urban transport policy should prioritize the needs of people and the environment, rather than prioritizing motorized transportation. The author suggests that pedestrian accessibility should be the first step in developing a sustainable urban transport policy. By prioritizing pedestrian accessibility, cities can reduce the use of personal automobiles and reduce the negative environmental impacts of transportation. Additionally, pedestrian accessibility improves the quality of life for residents by providing them with safe and accessible options for transportation. In order to achieve pedestrian accessibility, Badami (2009) recommends several policy interventions, such as designing streets for pedestrians, improving public transit

accessibility, and implementing traffic calming measures. These interventions can help to create a more livable and sustainable urban environment.

Tiwari (2013) conducted research on the impact of the metro rail system on public transportation in cities. The study argues that while the introduction of metro rail has been perceived as a positive development, it has actually led to the derailing of public transport in cities. The research highlights that the metro rail system has resulted in the neglect of other modes of public transport, such as buses, which are often left to deteriorate in terms of infrastructure and service quality. This has led to a decline in ridership on these modes, which disproportionately affects the poor and marginalized communities who rely on public transport the most. The study suggests that a more comprehensive approach to public transport planning is needed, one that takes into account the entire system and not just one mode, in order to create a sustainable and equitable public transport system for all.

Kheyroddin and Taghvaee (2014) conducted a study on the influence of metro station development on neighborhood quality in Tehran, Iran. The study aimed to explore the impact of the Tehran Metro Rail System on the quality of life in neighborhoods surrounding its stations. The research was based on a survey of 400 residents living within a 500-meter radius of ten selected metro stations. The study used multiple regression analysis to examine the relationship between metro station development and neighborhood quality. The study found that metro station development had a positive impact on neighborhood quality, including improvements in accessibility, safety, and cleanliness. The results also suggested that proximity to metro stations was a significant factor in residents' perception of their neighborhoods. The study recommended that urban planners and policymakers should consider the potential impact of metro station development on neighborhood quality when designing and implementing public transportation systems.

Duelkar et.al (2015) reviewed that Pune Metro rail project was an ad hoc decision with weak governance and inadequate public engagement. The study identifies shortcomings with methodological errors and over estimation of the benefits from the metro rail which are then used to prove that it has a positive social impact. The study is concluded that there is an urgent need to revisit all proposed metro rail projects and critical review is highly needed.

Bhattacharya and Mahapatra (2017) aimed to examine the urban governance framework for multimodal integrated urban transportation systems in India. The study found that there is a lack of a comprehensive and coordinated approach to urban governance for transportation systems in India. The authors suggested that effective urban governance could be achieved through the integration of policies, stakeholders, and resources for multimodal transportation systems. Furthermore, they emphasized the need for participatory decision-making processes and the involvement of multiple stakeholders, including the public, in the governance framework. In conclusion, the research highlights the importance of effective urban governance in the successful implementation of multimodal integrated urban transportation systems. The study provides insights into the challenges and opportunities for urban governance in transportation systems in India and offers recommendations for improving the current governance framework.

Elangovan et.al (2018) analyzed the effect of Chennai metro rail by limited-routing system and its future growth. The study covers the Chennai Metro Rail Corporation limited causes of concerns, parameters to be considered while planning the metro rail line, integration of transport network, urban styles and coming up with issues. The study suggests that the metro cities are always in a constant mode of transition and the city is looking forward to revitalize its stagnant and rethink its future of transport. As the country is rapidly urbanizing mass public transport will be the mainstay of cities having five million plus population.

Neware et.al (2018) explores "the study on transportation modes in terms of fuel consumption parameter". Transportation is the growing need of developing country as the numbers of private vehicles are increasing in the city day by day which results in heavy congestion on the road of the city. Introduction of metro rail in Nagpur city will result in passenger ridership shift from the road-based transport to metro rail.

Aditya.P. et.al (2019) conducted a study for the analysis of socio-economic impact of Pune Metro rail on Vanaz-Ramwadi corridor. The authors observe that the metro rail in Pune is going to make a socio-economic impact by furnishing multiple advantages to the residents of Pune like reduction in traffic accumulation, fuel saving, weakening accidents, reducing travel time of passengers and reduction in air pollution. It also creates an impact on revenue of the government, passengers, private transporters, general public and unskilled labour.

Agaton et.al (2020) conducted a research study on the socio-economic and environmental analyses of sustainable public transport in the Philippines. The researchers focused on the impacts of implementing sustainable transportation systems in the country, particularly in urban areas. The researchers gathered data through surveys and interviews with key stakeholders in the transportation sector. The findings of the study revealed that sustainable public transport could have positive socio-economic and environmental impacts. The researchers recommended that the government should prioritize the implementation of sustainable transportation policies and invest in public transport infrastructure.

Snehal Misal et.al (2021) conducted and analyzed that, there has been pressure on the public transportation system since ever the industrial and residential development pace accelerated. The study focused on the social-cost benefit analysis of the Pune Metro by providing several benefits like decrease in the travel

time of people using metro, road accidents, and air pollution and will improve the living environment for people. It is concluded that, Pune Metro will benefit society as the social cost of the project is low and temporary as comparing benefits are more and long-lasting.

OBJECTIVES

1. To identify the social benefits of Bengaluru metro rail transportation.
2. To analyse the social benefits of Bengaluru Metro rail transportation.
3. To evaluate the impact of social benefits of Namma Metro.
4. To provide recommendations for improving the social benefits of Bengaluru metro to its commuters.

RESEARCH METHODOLOGY

The study adopts a mixed-method approach to analyse social benefits of Bengaluru metro rail transportation in Karnataka. Data were collected from 400 commuters of Bengaluru metro rail transportation through a structured questionnaire. Quantitative techniques, including KMO and Bartlett's tests were employed to assess sampling adequacy and data reliability. Factor analysis with Varimax rotation was used to identify key components influencing social benefits of Bengaluru metro rail transportation. The study focused on social benefits of Bengaluru metro rail transportation at micro level.

DATA ANALYSIS AND INTERPRETATION

Table 1.2: KMO and Bartlett's Test on Social Benefits of Bengaluru Metro at Micro level – Part A

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.638**
Bartlett's Test of Sphericity	Approx. Chi-Square	**377.384****
	Df	45
	Sig.	**.000**

**** P<0.01**

Over Table 1.2 Kaiser-Meyer-Olkin (KMO) value of 0.638 suggests marginal sampling adequacy for factor analysis of social benefits of Bengaluru metro rail transportation at micro level. Bartlett's Test of Sphericity with a significant chi-square value of 377.384 ($p < 0.01$), confirming data appropriateness.

Table 1. 3: VARIMAX - Rotated Component Factors for Social Benefits of Bengaluru Metro Rail Transportation at Micro level

Sl. No	Factors	Rotated Component Factors				Communalities
		1	2	3	4	
1	Equal social status among metro passengers during travel	.170	.135	**.745**	-.002	**.603**
2	Lower air pollution	.016	-.035	**.798**	-.002	**.638**
3	Improved relatives Connectivity by use of Metro rail Transportation	**.697**	.019	.182	.081	**.526**
4	Increased passenger density during peak hours	-.392	.470	.207	.399	**.577**
5	Reduced passenger density during non-peak hours	.064	-.184	.033	**.707**	**.539**
6	Mobility of work force	.228	.132	-.067	**.677**	**.532**
7	Improvement in Standard of living	**.778**	.148	-.018	.149	**.649**
8	Fast and Reliable means of transport	.301	**.689**	-.053	-.137	**.586**
9	Safer, Convenient and affordable means of transport	.105	**.780**	.087	.008	**.628**
10	Enhanced social integrity	**.545**	.338	.111	.111	**.436**
	Eigen Values	**1.728**	**1.512**	**1.296**	**1.177**	**5.713**
	Percentage of Trace	**17.282**	**15.119**	**12.964**	**11.774**	**57.139**

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

The Table 1.3 highlights four rotated component factors---best means of transport, improvement in standard of living, fast and reliable transport and improved relatives' connectivity----that collectively explain 57.139% of the variance. Key findings include high factor loadings for "lower air pollution" (0.798), "safer, convenient and affordable means of transport" (0.780), "improved standard of living" (0.778) and "reduced passenger density during non-peak hours" (0.707) emphasizes their sensitivity to social benefits of Bengaluru metro at micro level. The results underscore the necessity of addressing the social benefits at micro level to its commuters.

In summary, the data analysis underscores the impact of social benefits of Bengaluru metro rail transport on commuters. While the metro transport system has streamlined its benefits and with enhanced services. Challenges persist regarding mobility of work force, enhanced social integrity and increased passenger density during peak hours. These findings highlight the need for policy intervention to address these issues and optimize social benefits Bengaluru metro to all commuters.

FINDINGS

1. Bengaluru Metro rail Transportation is safer, convenient and affordable means of transport.
2. Namma Metro services are fast and reliable means of transport to daily commuters in Bengaluru.
3. Standard of living has improved through lower air pollution, mobility of work force and equal social status among metro commuters.
4. Journey is very comfortable during reduced passenger density in non-peak hours.
5. Use of Bengaluru Metro rail transportation improves relative's connectivity through commuter friendly services.

SUGGESTIONS

1. Reduced disparity in social integrity is highly recommended to enhance social integrity of Bengaluru Metro commuters.
2. Increase in number of metro rails by reducing frequency of metro rail reduces passenger density during peak-hours.
3. Implement regulatory mechanisms to monitor the services of Bengaluru Metro to enhance social benefits to its commuters.

CONCLUSION

The implementation of Bengaluru Metro Rail Transportation has significantly improved social benefits to the society particularly that within the corridors influence zones. Namma Metro is providing safe public mass rapid transit by reliable, inexpensive and environment sustainable transit system for Bengaluru city. Bengaluru metro results in a higher percentage of public transportation being used to meet the city's mobility demand. This study contributes to understand the Bengaluru metro regional developments through social benefits and offers actionable insights for policy makers and stakeholders.

REFERENCES

1. *Preston, J. (2001). Integrating transport with socio-economic activity – a research agenda for the new millennium. Journal of Transport Geography, 9(1), 3-12.*
2. *Mukti Advani and Geetam Tiwari (2005), "Evaluation of public transport systems: Case study of Delhi Metro", Proceedings in START-2005 Conference held at IIT Kharagpur, India.*
3. *Cascajo, R. (2005). Assessment of economic, social and environmental effects of rail urban projects. In Young Researchers Seminar (4-5). European Transport Research Review.*
4. *Murthy M.N, Kishore Kumar Dhavale, Meenakshi Ghosh and Rashmi Singh (2006), "Social Cost Benefit Analysis of Delhi Metro", The report submitted to Institute of Economic Growth, Delhi University, October, PP 1-29.*
5. *Badami, M. G. (2009). Urban transport policy as if people and the environment mattered: pedestrian accessibility the first step. Economic and Political Weekly, 44(17), 39-48.*
6. *Tiwari, G. (2013). Metro rail and the city: Derailing public transport. Economic and Political Weekly, 48(28), 68-75.*
7. *Kheyroddin, R., Taghvaee, A., & Jafari, M. J. (2014). The influence of metro station development on neighborhood quality: The case of Tehran metro rail system. International review for spatial planning and sustainable development, 2(4), 3-14.*
8. *Deulkar.W.N. and Shaikh.A.F. F (2015), Pune Metro Rail Project: A review", International Journal of Structural and civil Engineering research, Volume 4, Issue 1, February, PP 109-117.*
9. *Bhattacharya, A., & Mahapatra, G. D. (2017). Urban Governance in Multimodal Integrated Urban Transportation. International Journal of Multidisciplinary Studies in Engineering and Research, 3(9), 68-74.*
10. *Elangovan, Senthil Kumar.C.B, and Nallusamy.S (2018), "Study on Effect of Chennai Metro Rail limited routing System and its Future Growth", International Journal of Mechanical and Production Engineering and Development, volume 8, Issue 1, February, PP 1079-1085.*
11. *Neware K.M, Sanghai S.S and Jajulwar (2018), Impact of Nagpur Metro on other Transportation modes in terms of Fuel Consumption", International Journal of Innovations in Engineering and science, Volume 3, No. 4, PP 49-53.*
12. *Aditya.P.Mane. Rahul.A.Sonawane., Avinash.M.Mali. Pranav.S.Talpelwar. Raheja and Amit.G.Kale,(2019), "Analysis of Socio-Economic Impact of Pune Metro Rail on Vanaz-Ramwadi Corridor", Global Journal of Engineering and Researches, May, PP-255-266.*
13. *Agaton, C. B., Collera, A. A., &Guno, C. S. (2020). Socio-economic and environmental analyses of sustainable public transport in the Philippines. Sustainability, 12(15), 6253.*
14. *Snehal Misal, Vanishri Patel, and Deepa Joshi (2021), "Social cost benefit analysis of Pune Metro", International Journal of research in Engineering and Science, Volume 9, issue 8, PP.07-11*