Multidimensional SDG Integration into Urban Transport and Mobility: A Systematic Review with Policy Implications for Tamil Nadu

[1]Alagappan Ramanathan

[1]Development Goals Specialist- Sustainable Transport & Mobility
[1] United Nations Development Programme India, Chennai, India

Abstract: This study examines the integration of urban transport planning with Sustainable Development Goals (SDGs), emphasizing a shift from mobility-focused approaches to accessibility, sustainability, and inclusion. Using a systematic review and cross-case analysis, it identifies how transport interventions contribute to multiple SDGs, including health, equity, climate action, and economic growth. Findings highlight co-benefits and trade-offs across metro systems, BRT, cycling, and electric mobility. The study underscores the need for integrated, data-driven, and equity-focused transport policies, offering actionable insights for advancing sustainable urban mobility in Tamil Nadu.

Index Terms **- Urban Transport Policy, SDGs, Multidimensional Integration, Public Transport, Tamil Nadu, Sustainability Transitions**

I. INTRODUCTION

Urban transport policy has evolved from a focus on mobility and infrastructure provision to broader concerns of accessibility, sustainability, and inclusion. The SDG framework reinforces this shift by emphasizing interlinkages across sectors (Le Blanc, 2015). However, policy design often remains fragmented, limiting the realization of co-benefits across SDGs (UN-Habitat, 2020). Tamil Nadu, as one of India's most urbanized states, provides a relevant policy context with ongoing investments in metro rail, bus system reforms, and electric mobility initiatives (Government of Tamil Nadu, 2023). This paper addresses the gap between sectoral transport planning and integrated SDG-based policy frameworks.

Figure-1 presents a systems-based framework illustrating how urban transport interventions influence multiple SDGs simultaneously. The framework maps transport dimensions (infrastructure, services, governance, technology) against SDG outcomes (health, equity, climate, economic growth), highlighting feedback loops, co-benefits, and trade-offs

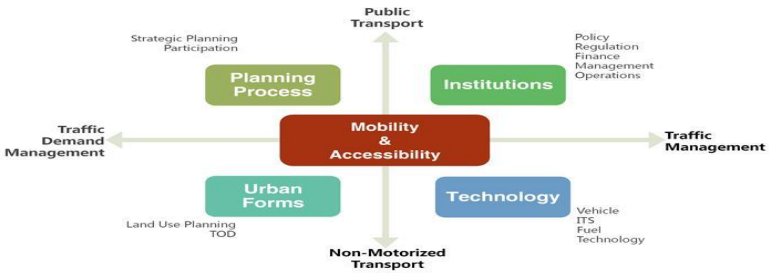

Figure 1. Multidimensional SDG–Urban Transport Integration Framework

This review analysis is derived from three interrelated research dimensions that collectively frame its analytical scope and policy orientation. First, the review investigates how urban mobility systems interact with multiple Sustainable Development Goals simultaneously and interconnectedly identifying that sustainable transport is not a single topic for development in the mobility but needs to be considered as a connection with goals related to health, climate action, economic inclusion, gender equity, and sustainable cities, among others. Second, this assessment checks what patterns emerge across interventions implemented in diverse geographies, through literatures. Third, and most critically for applied policy, the review explores how Tamil Nadu can leverage integrated SDG frameworks to strengthen its urban mobility planning with the background of the state's rapidly urbanizing cities, considering the states march towards sustainability agenda of 2030. Together, these questions orient the review towards both theoretical synthesis and actionable policy insight, bridging the gap between global SDG commitments and the regional imperatives of mobility governance in Tamil Nadu.

II. LITERATURE REVIEW

2.1 Transport Policy and SDG Integration

Urban transport policies are increasingly evaluated through sustainability lenses, linking mobility systems to broader development outcomes (Banister, 2019). According to Özaydın, Ö. Et.al (2025), integrating transport policies with the Sustainable Development Goals (SDGs) is crucial for achieving global sustainability targets, particularly given the extensive influence of transportation on economic, social, and environmental dimensions. The UN's 2030 Agenda emphasizes this integration, recognizing

transportation's pivotal role in improving road safety (SDG 3.6), developing resilient infrastructure (SDG 9.1), and ensuring inclusive urban mobility (SDG 11.2) (Abouelela, M., et.al. 2025).

Transportation significantly impacts several SDGs directly and indirectly. Public transport systems, non-motorized mobility, and electrification play a central role in achieving SDG targets. For instance, sustainable transport directly contributes to SDG 11 (Sustainable Cities and Communities) by promoting accessible, safe, affordable, and sustainable transport systems for all, improving road safety, and expanding public transport. (Yang, L. 2023)

2.2 Systems Thinking and Policy Integration

For this study secondary data has been collected. From the website of KSE the monthly stock prices for the sample firms are obtained from Jan 2010 to Dec 2014. And from the website of SBP the data for the macroeconomic variables are collected for the period of five years. The time series monthly data is collected on stock prices for sample firmsand relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE - 100 Index is taken from yahoo finance.

2.3 Emerging Policy Paradigms

Emerging policy paradigms in transportation are increasingly focusing on shifting away from traditional mobility-centric approaches to prioritize accessibility, equity, climate responsiveness, and data-driven governance. These new approaches are crucial for aligning transportation systems with Sustainable Development Goals (SDGs) and integrating systems thinking principles.

2.4 Recent approaches emphasize

Accessibility over mobility: The shift from "mobility over accessibility" signifies a fundamental change in how transportation systems are conceived and developed. Historically, transportation planning emphasized increasing the speed and volume of vehicle movement (mobility), often through road expansion projects. However, emerging paradigms prioritize accessibility, which focuses on people's ability to reach destinations, goods, and services, regardless of the travel mode. (Elder, M. 2024). This aligns strongly with SDG 11 (Sustainable Cities and Communities) by fostering inclusive, safe, resilient, and sustainable human settlements. By improving accessibility, policy makers can reduce car dependency, lower carbon emissions, and improve public health outcomes, thereby contributing to SDGs like SDG 3 (Good Health and Well-being) and SDG 13 (Climate Action). (Issa, L., Mezher, T., & El Fadel, M. 2024).

Equity-focused planning: Equity-focused planning is gaining prominence, addressing historical disparities in access to transportation and the unequal distribution of transportation's negative impacts. This paradigm ensures that transportation policies and investments benefit all segments of society, particularly marginalized and low-income communities. It involves designing systems that are affordable, reliable, and safe for everyone, ensuring equitable access to jobs, education, healthcare, and other essential services. For example, ensuring that public transit networks effectively serve underserved areas contributes to SDG 10 (Reduced Inequalities) and SDG 1 (No Poverty). (Erzurumlu, S. et.al.2023).

According to Grover, C. & Singh, N. (2023), by adopting a systems thinking approach, planners can identify how transportation policies might inadvertently perpetuate or exacerbate social inequities through feedback loops, such as insufficient public transport leading to job inaccessibility for low-income populations, further entrenching poverty. Policy integration is essential here, requiring collaboration between transportation departments, social services, and urban planning to develop comprehensive solutions that address the root causes of inequity.(Saguin, K., & Howlett, M. 2022)

Climate-responsive transport systems: Climate-responsive transport systems are a direct response to the urgent need to mitigate climate change and adapt to its impacts, aligning directly with SDG 13 (Climate Action) and SDG 7 (Affordable and Clean Energy). This paradigm emphasizes decarbonization through the promotion of electric vehicles, the development of sustainable fuels, and significant investments in public transportation, cycling, and walking infrastructure. (Erzurumlu, S. S., et.al. 2023). A systems thinking perspective highlights the intricate linkages between transportation emissions, air quality, public health, and broader ecological systems. (Xiao, H., Liu, Y., & Ren, J. 2022). Policy integration here means coordinating efforts across energy, environment, and urban development sectors to create a coherent strategy for a low-carbon transport future.

Data-driven governance: The emergence of data-driven governance in transportation involves leveraging advanced analytics, real-time data, and intelligent systems to inform policy decisions, optimize network performance, and enhance user experience. This paradigm allows for more precise identification of problem areas, more effective allocation of resources, and dynamic adjustments to policies based on empirical evidence. (Song, J., & Jang, C. 2023). This approach supports multiple SDGs by improving efficiency (SDG 9: Industry, Innovation, and Infrastructure), fostering sustainable urban development (SDG 11), and potentially reducing resource consumption.

III. METHODOLOGY

A systematic review methodology was adopted, consistent with Transport Policy standards for evidence-based policy research. Database Sources used Scopus, Web of Science, and institutional reports from the Government and other stakeholders. The methodology focused a case study analysis. A total of twenty-five case studies initially considered from that relevancy based final matrix of selected five which are globally recognized. From the selected case studies, using analytical methods such as matrix mapping, Heat mapping and cross case comparative analysis the results were derived. These methods are used to derive patterns, relationships, and thematic intensities across diverse case studies and 17 SDGs. This systematic arrangement facilitates the identification of co-occurrences, gaps, and relationships within the data.

3.1 Results- Cross Case Analysis

The following Table-1 summarizes the multidimensional connections between urban transport interventions and specific SDGs. It highlights how mobility systems contribute simultaneously to health, energy, infrastructure, equity, sustainability, climate, and partnerships.

Table 1. SDG–Urban Transport Linkages

SDG	Transport Dimension	Key Contribution
SDG 3 (Health)	Air quality, road safety	Reduced accidents, improved respiratory health
SDG 7 (Energy)	Efficiency, renewables	EV adoption, metro energy savings
SDG9 (Infrastructure)	Innovation, resilience	Smart transport systems, MaaS
SDG 10 (Equity)	Accessibility, affordability	Inclusive design, subsidies
SDG 11 (Cities)	Sustainable mobility	Integrated public transport
SDG 12–13 (Climate)	Resource use, emissions	Modal shift, lifecycle efficiency
SDG17 (Partnerships)	Governance, collaboration	PPPs, citizen engagement

The following Table 2. Case Study Matrix presents selected case studies across diverse geographies, mapping transport interventions against SDG impacts. It illustrates how metro systems, bus rapid transit, cycling infrastructure, and electric mobility generate overlapping environmental, social, and economic outcomes.

Table 2. Case Study Matrix

Case	Geography	Intervention	SDGs Impacted	Key Outcomes
Chennai Metro	India	Metro rail	3, 7, 9, 10, 11, 13	Reduced congestion, improved access, lower emissions
Bogotá BRT	Colombia	Bus rapid transit	3, 10, 11, 13	Affordable mobility, emission reductions
Copenhagen Cycling	Denmark	Non-motorized transport	3, 11, 13	Health benefits, climate mitigation
Shenzhen EV Fleet	China	Electric buses	7, 9, 13	Energy efficiency, innovation

The following table 3 SDG Contribution Heatmap provides a comparative visualization of the intensity of SDG contributions across different transport interventions. The gradation (low, medium, high) demonstrates co-benefits and trade-offs, offering a multidimensional lens for policy analysis.

Table 3. SDG Contribution Heatmap

Intervention	SDG 3	SDG 7	SDG 9	SDG 10	SDG 11	SDG 12	SDG 13	SDG 17
Metro Rail	●●	●●	●●	●	●●●	●	●●	●
BRT	●●	●	●	●●●	●●	●	●●	●●

Cycling Infrastructure	●●●	●	●	●●	●●●	●●	●●●	●
EV Adoption	●	●●●	●●	●	●	●●	●●●	●●

Legend: ● = low contribution, ●● = medium, ●●● = high contribution.

IV. DISCUSSION

Patterns show that public transport consistently supports multiple SDGs, while EV adoption creates trade-offs between climate benefits and equity concerns. Developed cities emphasize climate outcomes; developing cities prioritize equity and access (UN-Habitat, 2020).For Tamil Nadu, integrated planning is essential. Metro expansion, bus reforms, and e-mobility must align with SDG co-benefits, ensuring affordability, inclusion, and resilience (Government of Tamil Nadu, 2023).

V. POLICY IMPLICATIONS FOR TAMIL NADU

Aligned with Transport Policy's emphasis on actionable insights:

a. Integrated Mobility Planning-Adopt SDG based planning frameworks that integrate environmental, social, and economic objectives.
b. Institutional Coordination-Strengthen between various GoTN agencies such as Transport Department, Municipal Administration and Water Supply Department, Department of Home, Prohibition and exercise and Housing & Urban Development etc.
c. Inclusive Mobility Strategies-Prioritizing gender responsive mobility, universal accessibility and affordable transport.
d. Climate Aligned Investments- More focus towards climate aligned investments such as public transport systems across the state, better non-motorized infrastructure and clean mobility technologies.

VI. CONCLUSION

Urban transport is a multidimensional enabler of SDGs. This study demonstrates that interventions simultaneously affect environmental, social, and economic outcomes. By filling the research gap with integrated SDG assessments, the paper contributes to both academic literature and policy practice. For Tamil Nadu, the transition toward sustainable mobility requires a shift from sectoral planning to integrated, SDG-aligned transport policy frameworks. Future research should explore quantitative modeling, participatory governance, and India-specific SDG mobility indices.

REFERENCES

[1] Abouelela, M., Stamos, I., Chaniotakis, M. (Emmanouil), & Antoniou, C. (2025). Disentangling the relationships between the SDGs and transportation. *Research in Transportation Business & Management*, *62*, 101447. https://doi.org/10.1016/j.rtbm.2025.101447.
[2] Banister, D. (2019). *Transport for sustainable development*. Transport Reviews, 39(5), 565–578.
[3] Elder, M. (2024). Integration versus prioritization in the Sustainable Development Goals: An argument to prioritize environmental sustainability and a just transition. *Sustainable Development*, *33*(1), 465–477. https://doi.org/10.1002/sd.3130.

[4] Erzurumlu, S. S., Deets, S., Nersessian, D., & Rodgers, V. L. (2023). Strategic engagement of business with Sustainable Development Goals: A systems thinking approach. *Business Strategy and the Environment*, *32*(7), 4954–4969. https://doi.org/10.1002/bse.3402.
[5] Government of Tamil Nadu. (2023). *Tamil Nadu Sustainable Transport Policy*. Chennai: Department of Transport.
Grover, C., & Singh, N. (2023). A Systems Thinking Approach to Navigate Interlinkages to Achieve SDGS In India. Journal Of Sustainability Science and Management, 18(2), 179–196. Https://Doi.Org/10.46754/Jssm.2023.02.013.
[6] Issa, L., Mezher, T., & El Fadel, M. (2024). Can network analysis ascertain SDGs interlinkages towards evidence-based policy planning? A systematic critical assessment. *Environmental Impact Assessment Review*, *104*, 107295. https://doi.org/10.1016/j.eiar.2023.107295.
[7] Issa, L., Mezher, T., & El Fadel, M. (2024). Can network analysis ascertain SDGs interlinkages towards evidence-based policy planning? A systematic critical assessment. *Environmental Impact Assessment Review*, *104*, 107295. https://doi.org/10.1016/j.eiar.2023.107295.
[8] Le Blanc, D. (2015). *Towards integration at last? The sustainable development goals as a network of targets*. Sustainable Development, 23(3), 176–187.
[9] Özaydın, Ö., Kabak, Ö., Topcu, Y. I., Ülengin, F., & Önsel Ekici, Ş. (2025). Analysis of direct and indirect relations among sustainable development goals and transportation targets. *Transport Policy*, *171*, 270–281. https://doi.org/10.1016/j.tranpol.2025.06.007.

[10] Pojani, D., & Stead, D. (2017). *Sustainable urban transport in the developing world: Beyond megacities*. Sustainability, 9(4), 600.
[11] Saguin, K., & Howlett, M. (2022). Enhancing Policy Capacity for Better Policy Integration: Achieving the Sustainable Development Goals in a Post COVID-19 World. *Sustainability*, *14*(18), 11600. https://doi.org/10.3390/su141811600.
[12]Sanneh, E. S. (2018). *Systems Thinking for Sustainable Development*. Springer International Publishing. https://doi.org/10.1007/978-3-319-70585-9.
[13] Song, J., & Jang, C. (2023). Unpacking the sustainable development goals (<scp>SDGs</scp>) interlinkages: A semantic network analysis of the <scp>SDGs</scp> targets. *Sustainable Development*, *31*(4), 2784–2796. https://doi.org/10.1002/sd.2547.
[14] UN-Habitat. (2020). *World Cities Report 2020: The Value of Sustainable Urbanization*. Nairobi: United Nations.
[15] World Bank. (2021). *Transforming Urban Transport: Pathways to Sustainable Cities*. Washington, DC.
[16] Xiao, H., Liu, Y., & Ren, J. (2022). Synergies and trade-offs across sustainable development goals: A novel method incorporating indirect interactions analysis. *Sustainable Development*, *31*(2), 1135–1148. https://doi.org/10.1002/sd.2446.
[17] Yang, L. (2023). Sustainable City Planning and Development: Transport and Land Use. *Sustainability*, *15*(22), 15804. https://doi.org/10.3390/su152215804.