Journal of Applied Engineering, Technology and Management (JAETM)

Economic Perspectives on Bhutan's Transport Sector: A Review of Growth and Sustainability Challenges

Pema Wangchuk[1*]

[1]*Department of Humanities and Management, Jigme Namgyel Engineering College, Dewathang*

[*]*Corresponding author: Pema Wangchuk, pemawangchuk.jnec@rub.edu.bt*

Published: June 2025

DOI: https://10.54417/jaetm.v5i1.143

Abstract

This review examines the economic outlook on Bhutan's transport sector, with an emphasis on sustainability, growth, and policy implications. Bhutan's geographic challenges as a landlocked country with mountainous terrain have significant implications for its transport infrastructure, which plays a pivotal role in facilitating trade, tourism, and national connectivity. However, high resource consumption, high dependence on imported fossil fuels, and environmental degradation are key challenges in the transport sector, posing sustainability concerns. The objective of the review is to assess how transportation influences Bhutan's economic development while examining the associated environmental challenges. A narrative review methodology was applied, involving a structural selection of peer-reviewed journal articles, government reports, and policy documents. Thematically, literature was synthesized to identify key trends, research gaps, and policy directions, supported by Bhutan's growth policy framework. Key findings reveal that although the transport sector plays a pivotal role in economic development, it multiplies Bhutan's carbon footprint and undermines Bhutan's environmental commitments. It also reflects a tension between rapid infrastructure expansion and the nation's commitment to Gross National Happiness, carbon neutrality and environmental conservation. Existing research lacks integrated policy mechanisms and focuses on low-emission technologies and alternative energy sources. This review suggests the adoption of smart and green transport systems supported by coherent and cross-sectoral policies. For a balance of economic growth with environmental sustainability, the review also recommends investments in renewable energy-based transport, robust coordination among the relevant agencies and improved regulatory frameworks. These insights aim to support Bhutanese policymakers in shaping future strategies for a resilient and eco-friendly transport sector in Bhutan.

Keywords— Bhutan Transport Sector, Growth Trends, Externalities, Sustainability, Sustainable Development, Transport policy

1 Introduction

In the contemporary global context, balancing economic growth with environmental sustainability has become a critical focus of discussion for all governments, particularly in developing nations like Bhutan. In 1974, Bhutan introduced the Gross National Happiness (GNH), a unique balanced approach, which emphasizes holistic well-being over conventional economic indicators. While GNH integrates sustainability as a core pillar, its practical application in sectors such as transportation presents complex development challenges. The transport sector is indispensable to Bhutan's socio-economic development. It facilitates tourism, regional connectivity, and trade, which are key drivers of national growth [1][19]. As acknowledged by the United Nations Development Programme, the sector functions as the pillar of Bhutan's economy [17]. However, it also generates significant environmental externalities, including greenhouse gas emissions, deforestation, and air pollution. Compounding these challenges are issues such as limited technological integration, budgetary constraints, and rural inaccessibility, all of which hamper Bhutan's efforts to achieve its sustainable development objectives [20]. The infrastructural and environmental concerns are identified as the key deficiencies in Bhutan's transport sector [19][20]. The decline of Bhutanese economic development over the past few years was the main consequence of these limitations experienced by Bhutan [1][11][13].

This review aims to critically assess the economic and environmental dimensions of Bhutan's transport sector, focusing on the tensions and synergies between economic growth and sustainability. In particular, it explores three key themes: the transport sector's role in economic development, its environmental impacts and externalities, and the policy implications for building a sustainable transport future. To guide this work, a narrative literature methodology was employed, consistent with the approach recommended by Snyder [21], who emphasizes flexibility and depth in synthesizing diverse sources. The methodology also draws on the guidance of Van Wee and Banister [22], who outline best practices for structuring and evaluating literature in transport research. The review process included the systematic section and thematic synthesis of peer-reviewed articles, national policy reports, and relevant publications by international agencies. The key terms used in this review include:

Growth: The improved infrastructure and connectivity ensure the national productivity and enhancement of economic activity in the country

Sustainability: the capacity to meet current transportation and economic needs without compromising the environment or future generations' well-being.

Externalities: unintended side effects, either positive or negative arising from transport activities, especially environmental impacts. Finally, this review captures the existing literature by identifying key research gaps to provide actionable insights for Bhutanese policymakers, academics and stakeholders, who are looking to harmonize transport development with the nation's GNH principles and climate commitments.

2 Literature Review

This review follows a narrative literature review approach as outlined by Snyder [21], highlighting the breadth of understanding and synthesis over a purely systematic or meta-analytic approach. Moreover, adopting Van Wee and Banister [22], the review identifies and categorizes relevant sources by themes such as growth trends, externalities, and sustainability issues. A mix of peer-reviewed journal articles, national-level policy reports, and international agency publications were included, and selected using keyword combinations such as "Bhutan transport sector"," sustainability", "externalities", and "policy". The synthesis process involved a comparative analysis of thematic patterns, contradictions, and research gaps across the literature.

2.1 Growth Trends

Bhutan's economic growth depends on industrial development, tourism, and electricity exports to India. The transport sector and citizen's mobility needs have been massively influenced by this growth. The country is landlocked and mountainous, the road transport is the primary means of transporting goods and passengers across Bhutan. The figure 1 demonstrates the growth of motor registration in the country between 2011 and 2020 as reported by the former Ministry of Information and Communication. It grew to 6.7% in the last decade between 2011-2020.

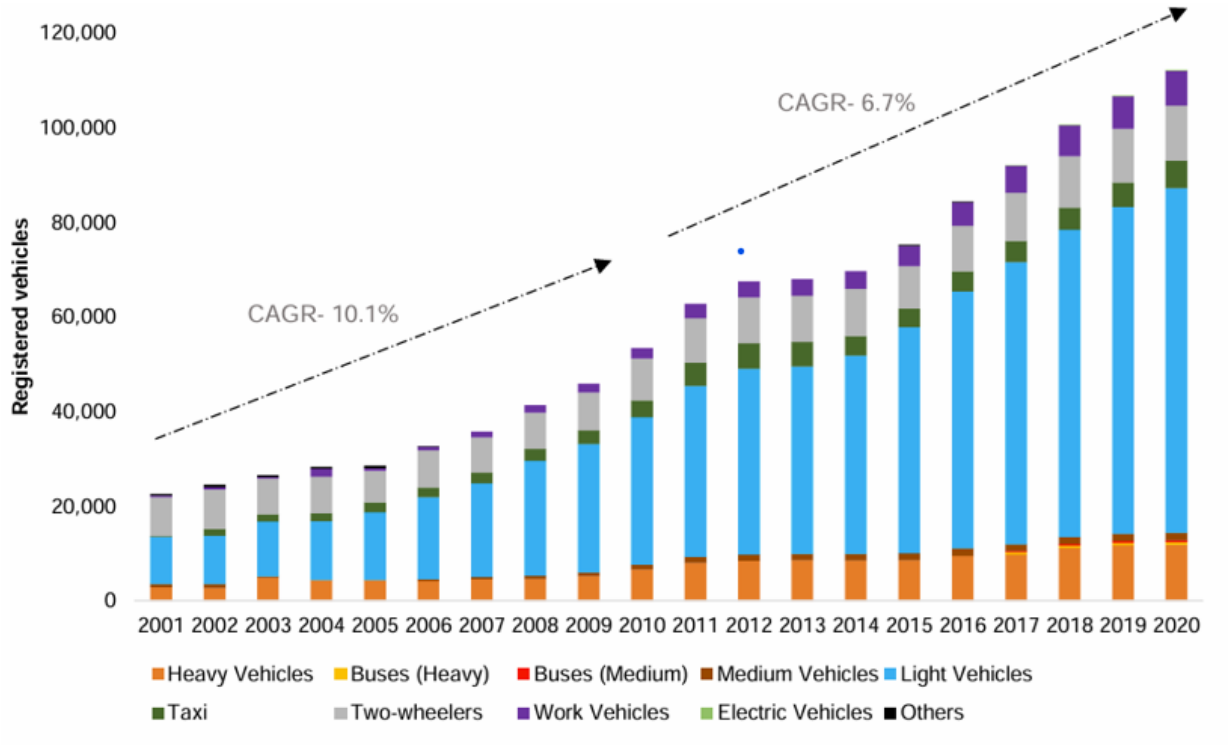

Figure 1: Trends in motor vehicle registrations in Bhutan (2001-2020)

The dynamics of demand and supply patterns within Bhutan's transport sector have played a bigger role in shaping the landscape of economic, social, and environmental sustainability [13]. Such changes help to provide valuable perceptions of the relationship between sustainability and economic growth [2]. Factors such as population growth, urbanization trends, and economic development have highly influenced the demand for transport services in Bhutan [18]. Additionally, emphasizing the availability and efficiency of transport infrastructure boosts meeting the demand for transportation services [2][6]. Similarly, development ensures adequate support for the region's expected growth and transportation demand, improving efficient transport systems and excellent mobility for all [14]. The National Council of Bhutan in 2022 forecasted the country's urban population growth to reach 56.8% by 2047 in major cities. This would exert pressure on urban mobility demands and deteriorate the air quality. This indicates the future negative impact of the transport sector in Bhutan. The figure 2 depicts the urban population growth.

The report stated the demand for Utility Vehicles between 2014 and 2015 in the Transport sector, which revealed that the utility vehicles demand has increased to 400 and the price paid was Nu.550 million, while in 2015, the demand increased significantly to 1200 vehicles and the government paid Nu.1300 million[11]. This data depicts a notable increase in demand, signifying growth and a shift in the transport market during the year. Likewise, the report also highlighted the increase in the fuel price to 9.24 billion, indicating that there is a huge import of fossil fuel in the country.

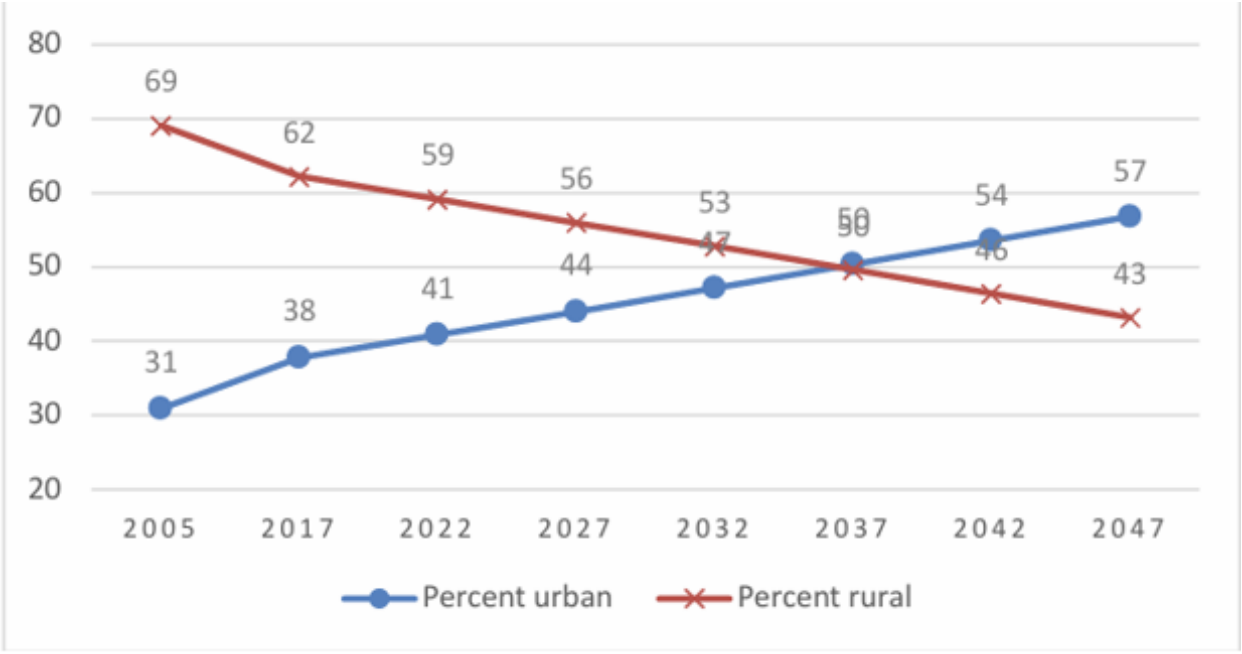

Figure 2: Rural-Urban Population Projection *(National Council of Bhutan, 2022)*

2.2 Externalities in the Transport Sector

Negative externality is a useful framework to analyze the environmental implications of transport activities. It occurs when the social cost of economic activity like air pollution from vehicle emissions is not borne by all stakeholders involved in the sector. Rather, these costs are externalized onto society in the form of environmental degradation and public health impacts [5]. Policy intervention and setting standards are necessary to adopt the social costs of transportation. It has been also coined that emphasizing the importance of ensuring reliable and affordable transport services for the growth and socio-economic development of a nation is extremely essential [3][14][16]. Similarly, the absence of a pricing mechanism and regulatory framework in the transport sector births economic externality theories like the theory of market failure.

Hence, by internalizing external costs and aligning incentives with sustainability objectives, Bhutan can ensure efficient resource allocation and proper investment decisions in the transport sector.In addition, one of the negative externalities is a traffic higher congestion rate in Bhutan as revealed in the previous study. It increases delays and travel time and thereby increases the internal cost for passengers, leading to the biggest problem associated with the transport sector over the past few years in the country [19]. However, under such situations, only limited passengers opt for alternative modes of transport such as public transit and biking to avoid congestion.

A synthesis table below provides a consolidated view of the literature showing authorship, thematic focus, findings, and identified gaps.

2.3 Sustainability Challenges

2.3.1 Infrastructure and Institutional Weaknesses

Bhutan's transport sector faces systemic issues; roads, high maintenance costs, unsafe and unsustainable and inadequate private sector engagement [15][1]. Regulatory gaps such as weak enforcement of zoning or emission standards further limit progress [20]. Figure 3 highlights a rising trend in private vehicle ownership, worsening congestion and undermining safety. Although multiple policies exist,

such as the Road Act of 2024 and the Road Safety and Transport Act of 1999, they lack coherence and implementation capacity [10]. This results in fragmented governance and limited accountability.

Table 1: Consolidated View of the Literature

Author(s) & Year	Focus Area	Key Findings	Gaps Identified
Penjore (2021)	Growth Trends	Transport shapes socio-economic-environmental dynamics	Lack of quantification of impact
World Bank (2022)	Urbanization & Mobility	Urban growth raises transport demands	Weak integration of transport & land-use planning
National Council (2015)	Vehicle Demand	Surge in vehicle imports, fossil fuel use	No cost-benefit analysis on vehicle subsidies
RAA (2020) & Infrastructure & Policy	Regulatory and institutional constraints	Implementation barriers are rarely evaluated	Lack of evaluation frameworks
MoIC (2021)	Emissions & GHG	40% CO_2 emissions from transport	Lack of scenario modelling for emission projections
NEC (n.d)	Environmental Impacts	Rising NO_2 and CO_2 emissions from road transport	No monitoring framework for pollutants

2.3.2 Environmental Sustainability

Environmental degradation is a major concern for Bhutan as its commitment to remaining carbon neutral is strained by rising transport-related emissions. The National Environment Commission reported that transport accounts for nearly 40% of national CO emissions [12]. Knowing these challenges may effectively devise strategies to support Bhutan's sustainable development goals, among others [17]. The greenhouse gas emissions and air pollutants are the key challenges across transport activities in Bhutan, affecting the lush green environments and surroundings [12]. Then Ministry of Information and Communications [10] coined the combustion of fossil fuels in vehicles has contributed more carbon dioxide (CO2) and nitrogen oxides (NOX), deteriorating air quality and health issues in the country.

As reported by the National Environment Commission (NEC), the transport sector alone contributes approximately 40% of total CO2 emissions, significantly cumulating air pollution in the country. The figures Figures 4 and 5 show the estimated trend of per-capita GHG emission in Bhutan (2020-2050) and the increase in vehicles [12]. The figures project GHG emission project 2050, indicating a worrying upward trend. However, existing studies do not model the potential impact of green alternatives, such as electric vehicles or modal shifts to rail, suggesting an underexplored research area.

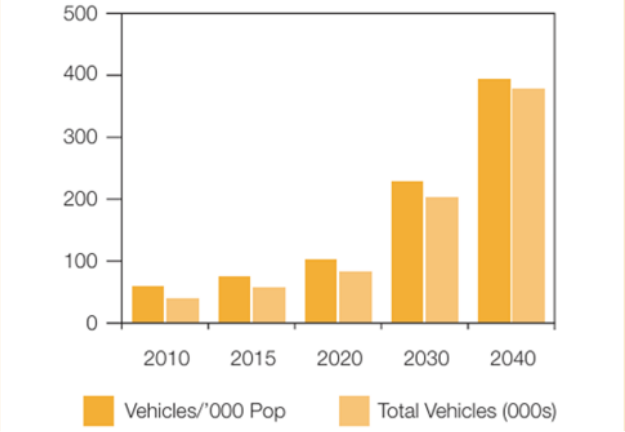

Figure 3: Growth in Vehicle Ownership *(Asian Development Bank,2013)*

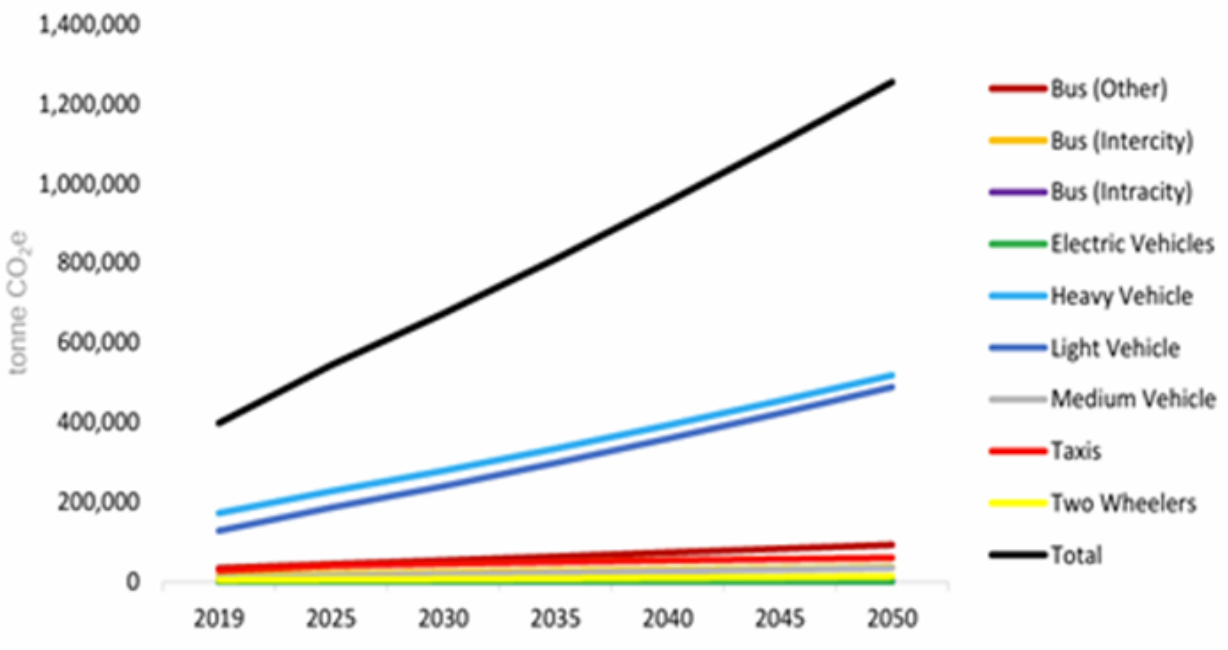

Figure 4: GHG Emissions Projection (2019-2050) *(Ministry of Information and Communications, 2021)*

2.3.3 Policy Effectiveness and Gaps

Bhutan's transport Acts like the Road Safety and Transport Act 1999, the Road Act of the Kingdom of Bhutan 2004, National Transport Policy 2006, and Road Safety and Transport Regulations 2021, aim at promoting sustainable development for addressing transport challenges and maintain accountability among the stakeholders [9][17]. Moreover, in 2006 Bhutan released one of the notable transport policies called National Transport Policy (NTP) in response to the UN's Development Program and to make inclusive planning for a low-carbon future. This policy aligns with one of the pillars of GNH and aims to promote a safe, efficient, and environmentally sustainable transport system in the country. The NTP consists of a series of strategies and measures to ensure sustainable transportation modes in the country, ensuring environmental conservation. The GNH principles are embedded in all existing policies to ensure safety, inclusivity, and environmental safety in the transport sector. However, despite comprehensive frameworks and Acts, the country is confronted

with institutional capacity limitations, competing priorities and resource constraints as reported by [1][20].

The performance evaluation mechanism and practical implementation remain a challenge. On the other hand, some evidence also suggests that the existing regulations and Acts have led to some improvement in the system such as infrastructure augmentation, expansion of transport networks and installation of fuel depots across the country. In brief, Table 2 shows the existing policies in Bhutan's transport sector offer a basis for upholding sustainable development, stakeholder engagement, and effectiveness of policy enforcement and implementation in Bhutan despite some shortcomings [8][20][6].

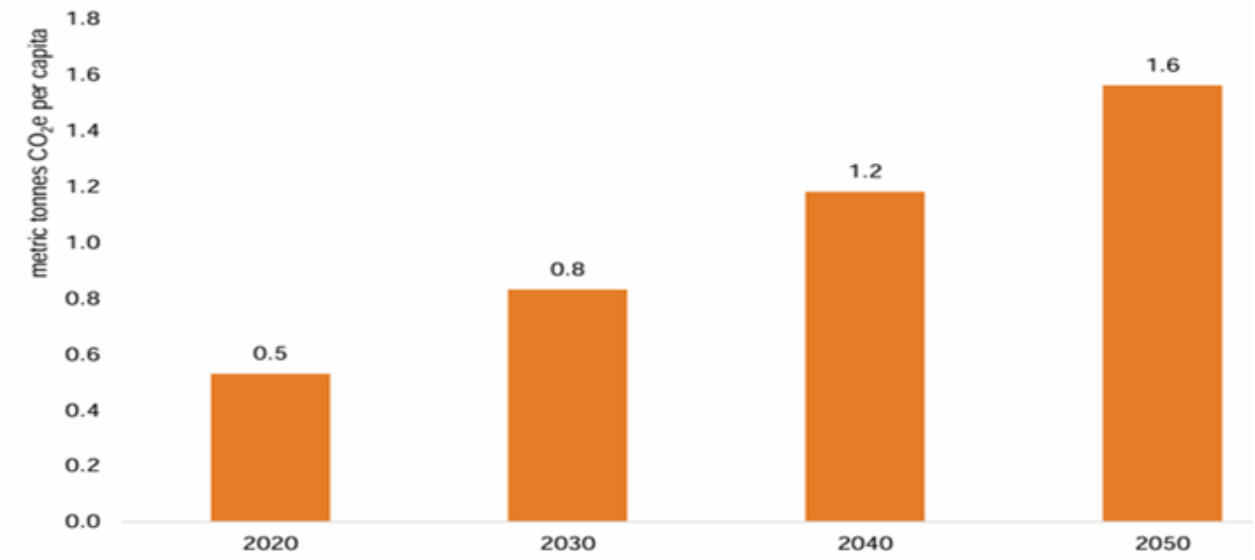

Figure 5: Estimated trends of per capita GHG emission in Bhutan (2019-2050)) *(Ministry of Information and Communications, 2021)*

3 Recommendation

Achieving sustainability in Bhutan's transport sector requires coordinated policy, technological innovation, and inclusive stakeholder engagement. The government's initiatives such as promoting more clean energy vehicles and investing in renewal energy infrastructure would lay a promising foundation for future growth. Moreover, expansion of electric charging stations and pilot deployment of hydrogen-powered vehicles could catalyze green transport adoption [1][4][7].

To meet the transport sector's sustainability targets and policy conditions, Bhutan can critically evaluate the effectiveness of the existing transport policies in consultation with the relevant stakeholders to examine compliance levels and the impact of the policies. Benchmarking is another effective tool which, the Royal Government of Bhutan may adopt to compare Bhutan's transport sector performance against international best practices and study the performance of the transport sector. The effectiveness and its significance are identified by modern research scholars like Kohler [5]. Such an initiative can offer valuable insights into the relative effectiveness of policy measures in the sector.

Besides government initiatives, an individual commitment through voluntarism and stakeholder sustainability-driven programs also plays a significant role in achieving sustainable development goals in the transport sector. For instance, to promote sustainability, Bhutanese transport operators may adopt eco-friendly platforms (technologically driven programs) to augment existing transport services and carry out corporate social responsibilities to make a difference in the sector.

Finally, policies must address social equity and regional disparities, ensuring that remote and vulnerable communities are not excluded from sustainable transport interventions. Multistakeholder collaboration is key to creating a resilient, low-carbon, and inclusive transport system for future generations.

Table 2: Synthesis of Key Challenges, Policies, and Gaps in Bhutan's Transport Sector

Thematic Area	**Key Challenges**	**Current Policies/Actions**	**Gaps and Needs**
Growth Trends	Rapid vehicle imports, urban congestion	Import regulations, urban zoning (weakly enforced)	Lack of integrated land-use and transport planning
Infrastructure	Inadequate road design, poor maintenance	Road Safety and Transport Act (1999)	Weak institutional coordination and enforcement
Environmental Impact	High emissions, fossil fuel dependency	Carbon neutrality pledge, EV incentives	No emissions modelling or green transport roadmap
Policy & Governance	Fragmented policies, limited evaluation	National Transport Policy (2006)	No performance benchmarks or impact assessments
Social Inclusion	Urban-rural disparity, equity concerns	None specific	No targeted interventions for low-access regions

4 Conclusion

This review synthesizes insights from diverse literature to assess the sustainability challenges. Growth dynamics, and governance structures shaping Bhutan's transport sector. While economic growth has spurred rising vehicle ownership and infrastructure expansion, this trend has also exacerbated environmental degradation, social disparities and institutional strain.

The review divulges that the most important efforts needed are in three dimensions: the environmental, social and economic to resolve the sector's sustainability challenges. The evidence also indicates that the prevailing policies and initiatives support the sector's sustainable development and act as the foundation for the growth of Bhutan's transport sector. Besides this conclusion, the review also acknowledges its limitations as the comprehensive analysis on this topic may not have been possible given the lack of availability of data and the scope of the literature reviewed across thematic areas; growth trends, externalities, infrastructure, and policy. The review identifies persistent gaps such as minimal stakeholder engagement, weak regulatory enforcement, limited integration of GNH principles in transport design, and absence of empirical policy impact evaluation. These shortcomings suggest that Bhutan's transport strategy remains largely reactive, rather than anticipatory and adaptive.

Future research should address these gaps by:

- conducting empirical studies to assess the real-world outcomes of existing transport interventions,
- applying benchmarking frameworks to compare Bhutan's progress with that of similar countries,

- developing scenario-based models for emission-related matters and policy impact,
- exploring the integration of GNH values into transport policy using multidimensional indicators.

Moreover, particularly research involving civil society, local governments, and the private sector can enrich future analysis and ensure content-relevant solutions. Ultimately, aligning Bhutan's transport transformation with its broader GNH vision will require not only policy reforms, but also a deeper cultural, institutional, and technological shift toward inclusive and sustainable mobility.

5 Acknowledgement

I would like to sincerely appreciate Jigme Namgyel Engineering College for the encouragement and support in undertaking this review for publication in the Journal of Advances in Engineering, Technology and Management (JAETM). Their motivation has been invaluable throughout this review process. My final gratitude to Grammarly software for assisting in checking the basic typos and structure of this literature review.

References

[1] Asian Development Bank, "Bhutan Transport 2040 Integrated Strategic Vision," Asian Development Bank, 2013. [Online]. Available: https://www.adb.org/sites/default/files/publication/30268/bhutan-transport-2040.pdf

[2] J. Holmgren, "Demand and Supply of Public Transport—The Problem of Cause and Effect," *Elsevier EBooks*, pp. 405–421, 2005. [Online]. Available: https://doi.org/10.1016/b978-008044580-9/50116-1

[3] M. Janic, "Sustainable Transport in the European Union: A Review of the Past Research and Future Ideas," *Transport Reviews*, vol. 26, no. 1, pp. 81–104, 2006. [Online]. Available: https://doi.org/10.1080/01441640500178908

[4] M. Kadłubek, "Examples of Sustainable Development in the Area of Transport," *Procedia Economics and Finance*, vol. 27, pp. 494–500, 2015. [Online]. Available: https://doi.org/10.1016/s22125671(15)01026-6

[5] J. Köhler, "Globalization and Sustainable Development: Case Study on International Transport and Sustainable Development," *The Journal of Environment & Development*, vol. 23, no. 1, pp. 66–100, 2013. [Online]. Available: https://doi.org/10.1177/1070496513507260

[6] Kuensel, "Invest in public transport," *Kuensel*, 2023. [Online]. Available: https://kuenselonline.com/invest-in-public-transport/

[7] Y. Lhaden, "E-mobility project installs more EV charging stations," *Kuensel Corporation*, 2023. [Online]. Available: https://kuenselonline.com/e-mobility-project-installs-more-ev-charging-stations/

[8] S. Mehta and U. Bangkok, "SUTI Report for Thimphu City 1," [Online]. Available: https://www.unescap.org/sites/default/files/Thimphu.pdf

[9] Ministry of Economic Affairs, "Energy Efficiency in Transport Sector," pp. 1–73, 2015. [Online]. Available: https://www.moenr.gov.bt/wp-content/uploads/2018/07/Final-Transport-EE-report.pdf

[10] Ministry of Information and Communications, "Low Emission Development Strategy for Surface Transport 2021," pp. 9–33, 2021. [Online]. Available: https://www.moit.gov.bt/wp-content/uploads/2023/10/LEDS_SurfaceTransport.pdf

[11] National Council of Bhutan, "Review of Policies Related to Vehicle: Issues, Consequences & Recommendations Imports," pp. 1–37, 2020. [Online]. Available: https://parliament.bt/uploads/topics/16927841747824.pdf

[12] National Environment Commission, "Headline: Bhutan called for an urgent dialogue on mountain and climate change," [Online]. Available: http://www.nec.gov.bt/news/headline-bhutan-called-for-an-urgent-dialogue-on-mountain-and-climate-change-at-the-openi

[13] U. Penjore, "Transport to Facilitate the Economy," *The Druk Journal*, vol. 6, no. 1, 2020. [Online]. Available: https://drukjournal.bt/transport-to-facilitate-the-economy/

[14] L. Quendren, "Gelephu Urban Corridor: Transformative Infrastructure Project Nears Completion," *Kuensel Corporation*, 2024. [Online]. Available: https://kuenselonline.com/gelephu-urban-corridor-transformative-infrastructure-project-nears-completion/

[15] Royal Audit Authority of Bhutan, "Performance Audit of Safety and Sustainable Road Transport System," pp. 1–118, 2022. [Online]. Available: https://www.bhutanaudit.gov.bt/wp-content/uploads/2022/06/Performance-Audit-on-Safe-and-Sustainable-Road-Transport-System-English.pdf

[16] T. Stillwater, P. L. Mokhtarian and S. A. Shaheen, "Carsharing and the Built Environment," *Transportation Research Record: Journal of the Transportation Research Board*, vol. 2110, no. 1, pp. 27–34, 2009. [Online]. Available: https://doi.org/10.3141/2110-04

[17] UNDP, "Bhutan Sustainable Low-emission Urban Transport Systems," 2022. [Online]. Available: https://www.undp.org/bhutan/projects/bhutan-sustainable-low-emission-urban-transport-systems

[18] World Bank Group, "Bhutan Country Environment Analysis: Taking the Green Growth Agenda Forward," 2024. [Online]. Available: https://www.worldbank.org

[19] M. Gurung and E. H. S. Elangbam, "A Study on Challenges of Passenger Transport System in Bhutan," *International Journal of Multicriteria Decision Making*, vol. 9, no. 2, p. 136, 2022. [Online]. Available: https://doi.org/10.1504/ijmcdm.2022.128899

[20] T. Nidup and Y. Dorji, "Study on the Need of a Green Transport System in Thimphu City," *Diverse Journal of Multidisciplinary Research*, 2020.

[21] H. Snyder, "Literature Review as a Research Methodology: An Overview and Guidelines," *Journal of Business Research*, vol. 104, pp. 333–339, 2019. [Online]. Available: https://ideas.repec.org/a/eee/jbrese/v104y2019icp333-339.html

[22] B. van Wee and D. Banister, "Literature Review Papers: The Search and Selection Process," *Journal of Decision Systems*, vol. 33, no. 4, pp. 1–7, 2023. [Online]. Available: https://doi.org/10.1080/12460125.2023.2197703