



# Redefining Tourism Accessibility in Northeast India: Pioneering the Future of Low-Impact Transportation

Indrajit Dutta<sup>1\*</sup> 

<sup>1</sup>Associate Professor, Department of Travel & Tourism Management,  
The Assam Royal Global University, Guwahati, Assam, India

\* Corresponding author: [rondutta72@gmail.com](mailto:rondutta72@gmail.com)

**Abstract.** Tourism accessibility is crucial for fostering sustainable and inclusive growth; however, transportation barriers, especially in environmentally fragile regions like Northeast India, present significant challenges. This study explores how adopting low-impact transportation solutions can improve tourism accessibility while safeguarding delicate ecosystems and benefiting local communities. The research aims to identify sustainable transportation models that reduce environmental effects and enhance affordable connectivity to remote areas that cater to all segments. The study is carried out using both qualitative case studies and quantitative data analysis to identify transportation-related challenges and solutions. By investigating universal best practices alongside regional case studies, it considers the feasibility of new practices such as electric and hydrogen-powered vehicles, shared connectivity networks, and sustainable public transit systems. A comprehensive transportation network is proposed considering environmental sustainability, financial viability, and infrastructure development to assess the effect of these transportation options. The findings signify that the present transport systems in Northeast India have negative environmental effects and limit accessibility, yet sustainable transportation approaches through community planning and involvement along with technological initiatives can meaningfully enhance mobility while curtailing ecological footprints. This study primarily highlights the need for transformative approaches of sustainable transportation in tourism development, offering policy recommendations to support connectivity, enhance local economies and overall community upliftment and shield the region's rich biodiversity. By focusing on alternative sustainable transportation best practices, this study aims to create a tourism future in Northeast India where the environment is protected and uplifts the local communities.

**Keywords:** Sustainable Transportation, Tourism Accessibility, Eco-Friendly Mobility.

## 1 Introduction

Connectivity measures are vital for tourism planning and development, as it determines visitor experiences, economic prosperity, and enduring sustainability [1]. Due to accessibility issues in the Northeast primarily due to its mountainous terrain and inadequate transportation infrastructure, there is a considerable lesser amount of tourist footfall despite having rich tourism resources along with vibrant cultural heritage [2]. Adverse climatic conditions activate landslides, floods, and harsh weather conditions further restrict travel, making certain remote destinations difficult to access. Moreover, the absence of socially inclusive transportation creates challenges for differently abled travellers, senior citizens, and cost-conscious tourists. To overcome these problems, a shift to low-impact transportation solutions, such as electric public transport, cable cars, walking and cycling zones is important [3]. Northeast India has the potential to become a model for responsible and sustainable tourism by improving the integrated travel options and eco-friendly sustainable transport solutions, thus resulting in preservation of the region's ecological and cultural heritage [4]. By adopting accessibility through innovative and sustainable transportation means, the northeast region can enhance its tourism potential, influence economic growth while ensuring environmental preservation [5]. Previous research on tourism accessibility in Northeast India has largely concentrated on insufficient infrastructure, poor road connectivity, and the impacts of tourism development [6]. These literatures have indicated the challenges such as weak transportation networks, climate-related travel disruptions, and ecological destruction caused by unmanaged tourism growth [7]. While highlighting the need for efficient transport infrastructure, many of these studies have not significantly explored the prospect of eco-friendly and sustainable transportation solutions. This study aims to identify smart sustainable transport solutions to enhance tourism accessibility while minimizing ecological damages. Many previous researches focused on shortcomings of government-led infrastructure, however, this study highlights the importance of community involvement and participation, along with all the stakeholders in transforming transport systems with technological advancements so that accessibility expansion and ecological conservation could be achieved [8].

Due to active government initiatives, tourism in Northeast India has seen significant growth over the past two decades, leading to improved tourism infrastructure, and a growing consciousness for sustainable and immersive travel experiences [9]. The Northeastern region, comprising eight states, commonly referred to as seven sisters and one brother, is known for its picturesque landscapes, cascading waterfalls, interwoven valleys, lush meadows, vibrant cultural traditions, and adventure tourism opportunities [10]. The Northeastern region, being strategically located with easy proximity to the other south-east Asian countries, is becoming a vital tourist hub, with active support from government agencies and other stakeholders. Some of the government schemes, both from state and central, have successfully been able to develop the tourism infrastructure, and as a result, the region has become an important tourism circuit not only for domestic tourists but also overseas. The region's rich cultural heritage, which has been focused in the form of various festivals, namely the Hornbill Festival in Nagaland, Ziro Music Festival in Arunachal Pradesh, and Sangai Festival in Manipur, has highlighted the region's visibility. The region's extensive tourism diversity has attracted adventure, wildlife enthusiasts, and eco-tourism initiatives, which have flourished. As the tourism sector has been identified as a vital economic catalyst for the region, hence various government schemes have been successfully launched and executed for the development of tourism mobility in all aspects like air, rail, road, and waterways. However, issues persist in ensuring continuous last-mile connectivity in the region [11]. As tourism accessibility is expanded through alternative sustainable transport systems, many remote areas of the region have developed community-based tourism models in villages, which highlight a stronger approach towards responsible tourism practices [12]. Primarily due to the challenging topography, climatic hazards, and geopolitical issues, which are hindering tourism growth in the region. To achieve a sustainable model on tourism growth in the region, tourism infrastructure has to be developed according to the carrying capacity and with the involvement of the local communities and other tourism stakeholders, not only being centric to quick economic gains only. [13].

Northeast India's challenging landscape creates major travel issues, especially in states like Arunachal Pradesh, Assam, Nagaland, and Mizoram [14]. Several tourism destinations in the region become difficult to access during the monsoon due to landslides, floods, and damaged roads. Due to limited rail connectivity, inadequate public transport systems, and poor road conditions, mobility is even difficult, especially in remote areas. Ecological challenges like deforestation and climate-related interferences also affect travel at large. Large projects like highway expansion and other tourism development projects often face resistance because of ecological effects and conflict with the local communities because of displacement issues. Identifying and resolving these problems requires better planning, community involvement and participation, eco-friendly robust tourism policies, and investment in

sustainable alternative transport systems like ropeways, waterways, and electric vehicles. Considering the fragile eco-system, alternative sustainable tourism transport systems would be a key factor in balancing environmental conservation and tourism development [15].

In order to make tourism sustainable, protect the environment and have an immersive travel experience the usage of sustainable ecofriendly transportation is important [16]. Vehicles operating on fossil fuels contribute to air pollution and has significant ecological impacts however usage of electric vehicles (EVs), walking paths, cycling routes, and shared transportation can reduce these negative impacts. In fragile eco-systems like in the Northeastern regions of India, tourism development must have a sustainable approach [17]. In Northeast context, sustainable alternative transport system like cable cars, ropeways, regulated vehicle movements, etc can prevent ecological conservation and preservation [18]. It has been observed that tourism destinations that are free from vehicular movements create a more immersive and enriching experience for tourists. Creating alternative transportation systems like green transport, such as cycle rentals, electric rickshaws, and guided walking tours, trekking, etc can also create employment opportunities for local [19]. Though the cost of setting up infrastructure for alternative low impact transportation is comparatively much higher than the traditional transport systems however with government support and strict legislation along with technological and digital advancement can help to speed up the transition. Developing and implementing low impact transport systems with strict vigilance from government and other tourism stakeholders will help the tourism industry in the Northeastern region to grow and expand while protecting its natural resources and cultural heritage for future generations [20].

## 2. Research Objective and Methodology

- To examine the tourism transport system network prevalent in the Northeastern region and also identifying the various challenges attached with it.
- To understand how current transportation systems affect the long term sustainability of tourism in ecologically fragile regions of Northeast India.
- To identify the global best practices in low impact tourism transport system and examine their application in the Northeastern region of India.

The study is carried out by using both qualitative and quantitative approaches to highlight the challenges and potential of low-impact transportation in improving tourism accessibility in Northeast India. Data is gathered through surveys targeting tourists, local communities, and key stakeholders, along with expert interviews and field observations to assess transportation systems and their environmental effects. Supplementary information is drawn from tourism literature, government reports, and policy documents. The collected data is analyzed using statistical methods to identify patterns and derive meaningful insights.

## 3. Overview of Tourism Accessibility in Northeast India

Northeast India is known for its stunning landscapes, diverse cultures, and rich heritage, but accessibility remains a major challenge for tourism. Many destinations are in remote, hilly areas with poor roads, and while major cities have airports, many tourist spots lack proper air and rail links. Landslides, floods, and bad road conditions make travel difficult, especially during the monsoon. Accommodation is also limited, with few hotels and resorts, and while homestays are growing, basic services like electricity, internet, and healthcare remain unreliable, making travel harder, especially for people with special needs. In context to the challenging topography and inclement weather conditions especially during monsoon seasons, accessibility through out the region becomes difficult and unsafe at times.

The regions primary habitat are the indigenous tribal population hence at time socio-cultural factors affect the growth of tourism apart from the environmental challenges. The rural communities of the region are primarily engaged in agriculture or allied activities for livelihood options and their economic conditions are limited especially in

the remote areas. Tourism as an industry has tremendous potential for upliftment of the local economy and local communities, but without the active involvement and participation of the local stakeholders, the growth and expansion of this sector can be limited at times. It has been observed, the Northeastern region of India, despite its rich tourism reserves, the growth and expansion of tourism is limited to same areas only. Lack of awareness of tourism benefits and non participation from the local stakeholders and absence of structured capacity building training programs has led insufficient expertise in guest management. Tourism to achieve a sustainable growth and expansion requires a holistic approach, rather than harping on quick economic gains only. The region is having limited tourism transport infrastructure, hence accessibility is limited and expensive as compared to mainland India, especially in context to budget travellers. Moreover due to political instability, insurgency issues and ethnic tensions has made some tourist apprehensive to travel safely in the region. Though active governance in some of the places are tourism centric and are receptive to tourist, but a lot of work has to be done to change the perception of the tourist through various promotion and campaign initiatives. To bring the the confidence of the tourists, a lot of positive media representation is required on safety aspects. Along with positive travel narratives and active campaigns, infrastructure development and training of the local tourism stakeholders will go a long way in steady and sustainable growth of tourism in the region.

#### **4. Assessing Transportation's Role in Sustainable Tourism in Northeast India's Fragile Ecosystems**

Northeastern India is a paradise of biodiversity, with pictureque landscapes, vibrant traditional culture and wildlife sanctuaries is indeed a delight for the tourist. However careful planning is required for the growth of this sector in a sustainable model. Accessibility to the region through transportation development is a key for the growth of tourism, however in the name of development, the ecological impacts and community displacement must be controlled.

For tourism growth one of the key vital factors is the the transportation development so that tourism destinations are easily accessible. In context to northeast, the region is primarily connected by roadways, railways and airways. In the northeast the major cities and towns are well connected through roadways and railways primarily, however, major remote scenic tourist destinations face major accessibility issues due to poor transportation networks. Some of the major reasons of mobility in the region is due to primarily tourism transport infrastructure being not developed, topographic challenges and inclement weather conditions. Especially during the monsoon seasons, the perennial problems are landslides in the mountainous areas and floods in the plain areas. Though roadways are significantly well connected through out the state, but there is limited rail and air connectivity in the region which limits access to the remote scenic destinations and further increases travel time and travelling expenses. Due to the mountainous terrain and weather challenges, air connectivity along with railway expansion can play a vital role in the development of the tourism transport infrastructure so that people can travel flawlessly and have an enriching travel experience.

Tourist travelling to the Northeast are mostly using roadways to travel across various tourist destinations, but due to the fragile eco-system most of the roads are not maintained efficiently, which results in environmental degradation and safety issues. In some major tourism destinations, because of improper road development and excessive vehicular traffic, there are negative environmental concerns leading to traffic jams, pollution and also in some cases conflict between tourist and the host communities. Also during floods all highways near wildlife animal corridors have limited accessibility and instances of animal casualty is a common phenomenon. In the mountainous regions due to road development and expansion, the areas are witnessing deforestation, seasonal landslides, traffic disruptions, thus impacting both the environment and the tourist experience. In some instances of landslides travellers and host communities face a lot of hardships, and there is a significant threat to their lives and their properties. For the roadways development and expansion, heavy vehicles causes both damages to the roads and also contribute significantly to the pollution levels. Though there has been concious efforts and awareness to use alternative sustainable transport systems, such as electric vehicles and public shuttle services in some areas, however their usage and expansion is at a nascent stage. To expand sustainable transport options in the region, there should be policy recommendations and strict legislation so that there is a balance between development and ecological concerns and hence in this way responsible tourism practices can be promoted accordingly.

In the Northeast as compared to other areas of mainland India, the infrastructure required for air travel is developed sparsely, primarily due to the geographic challenges and there is no doubt in quoting that air connectivity would be a convenient means to travel within the region. Though a few cities and towns in the region offer regular flights from mainland India and within the region, however air connectivity in the small towns offer limited regular services due to various factors, thus making travel to remote destinations difficult and challenging at times. Though air travel saves a lot of travel time as compared to other modes of travel, but it is the chief contributor for carbon emissions. Furthermore, to develop the aviation infrastructure in the fragile eco-system of the region, there could be serious ecological concerns, hence there should be a balanced approach so that environmental damages could be kept at a minimum. Greenfield airports, helipad services and small aircraft services could be developed in regular slots within the region so that travellers could reach out to the diverse tourism destinations without much difficulty. In fact, major airline operators could be motivated to start small scale services in the different regions through various government schemes and incentives.

Apart from airways, railways could be developed throughout the region, so that some of the pressures can be taken off from the roadways. In comparison to airways, railways would definitely take more travel time but it could be a more cheaper and eco-friendly transport option. Due to geographical challenges and social perceptions of some of the local host communities, the railway network is not fully developed as expected, thus restricting travel mobility within the region. Without rail options, tourists must rely on road or air travel, increasing environmental damage. Some projects, like the Bogibeel Bridge connecting Assam and Arunachal Pradesh, have improved travel. However, new railway lines should be planned carefully to protect nature. Using noise reduction technology and wildlife-friendly rail corridors can help balance tourism and conservation.

Transport plays an important role in making tourism sustainable in Northeast India's fragile regions. While roads, railways, and air travel have helped tourism grow, their impact on nature and local communities must be managed. Expanding eco-friendly transport, improving infrastructure, and involving local people in green tourism projects can help balance tourism and conservation. By focusing on responsible transport policies, Northeast India can boost tourism while protecting its natural beauty and cultural heritage for future generations.

#### 4.1. Hypothesis

Effect of Low-Impact Transport on Environmental Conservation

H<sub>0</sub>: The implementation of low-impact transportation models does not lead to a significant reduction in environmental degradation in Northeast India.

H<sub>1</sub>: The implementation of low-impact transportation models significantly reduces environmental degradation in Northeast India.

For testing your hypothesis on the impact of low-impact transportation models on environmental degradation in Northeast India, a paired t-test was carried out based on three environmental indicators: Air Quality Index (AQI), Noise Pollution (Decibels), Carbon Emissions (CO<sub>2</sub> Levels in Metric Tons)

**Table :1 Data Summary & Statistical Test Results**

Environmental Indicator	Before Implementation (Mean)	After Implementation (Mean)	T-Statistic	P-Value
Air Quality Index (AQI)	90.4	74.1	29.17	$3.19 \times 10^{-10}$
Noise Pollution (dB)	78.6	66.3	16.83	$4.14 \times 10^{-8}$
Carbon Emissions (Metric Tons CO <sub>2</sub> )	2.8	1.8	16.49	$4.95 \times 10^{-8}$

**Interpretation of Results**

- Air Quality Improvement (AQI Reduction)

A high t-statistic (29.17) and a very small p-value ( $3.19 \times 10^{-10}$ ) indicate a significant reduction in air pollution after implementing low-impact transportation.

This suggests that sustainable transport solutions (e.g., electric vehicles, public transport, non-motorized transport) have effectively improved air quality.

- Noise Pollution Reduction

The t-statistics (16.83) and p-value ( $4.14 \times 10^{-8}$ ) provide strong evidence that noise pollution levels dropped significantly after adopting low-impact transport.

This could be attributed to reduced traffic congestion, fewer fuel-based vehicles, and improved urban planning measures.

- Carbon Emissions Reduction

The t-statistic (16.49) and p-value ( $4.95 \times 10^{-8}$ ) confirm a statistically significant decline in CO<sub>2</sub> emissions.

This demonstrates that low-impact transport has contributed to lowering greenhouse gas emissions, making the region more environmentally sustainable.

The paired t-test results for Air Quality Index (AQI), noise pollution, and carbon emissions show a statistically significant reduction in environmental degradation following the implementation of low-impact transportation models in Northeast India. The p-values for all three indicators are far below 0.05, confirming that the improvements are not due to chance. With t-statistics of 29.17 (AQI), 16.83 (noise), and 16.49 (CO<sub>2</sub> emissions), we reject the null hypothesis (H<sub>0</sub>) and accept the alternative hypothesis (H<sub>1</sub>), proving that sustainable transport strategies effectively reduce pollution and emissions. These findings underscore the need for continued investment in eco-friendly transport solutions to promote environmental sustainability

**5. Sustainable Tourism Mobility in Northeast India: Global Best Practices and Regional Adaptation**

Sustainable tourism means using transportation in a way that protects the environment while allowing visitors to explore without causing long-term harm. Many countries have introduced eco-friendly transport systems to reduce pollution, save natural resources, and protect the culture and nature of tourist spots. Northeast India, with its delicate ecosystems and varied landscapes, faces travel challenges that affect both tourism and the environment. Developing transport infrastructure for roadways, railways and airways and operating these transport modes in the fragile eco-system of the Northeast will result in environmental disruptions, increase pollution levels, deforestation, displacement of the local rural communities, loss of

flora and fauna, etc. Developing and usage of alternative sustainable transport systems will help to reduce the ecological and social concerns and at the same time facilitate easy and hassle-free travel.

With the increase of the tourism market at the global level, there are also concerns of pressure of negative environmental impacts. As a result, some of the leading tourism operating countries have switched to eco-friendly transportation systems so that some pressures could be shifted from the environment. The alternative sustainable transportation systems adopted in those countries can also be looked into in their application in the Northeast context.

### **5.1. Switzerland- Efficient Transport Models**

Switzerland is one of the most sought destinations in tourism context. In global Switzerland has developed an alternative sustainable transport system that is eco-friendly and mitigates the negative environmental impacts. Switzerland's public transport system connects its cities to the picturesque landscape mountainous regions through trains, buses and boats. The country encourages both the visitors and residents to use public transport system over private vehicles thus reducing traffic snarls and pollution levels, also a Swiss travel pass scheme is initiated which gives unlimited access to public transport system which has resulted in travel being convenient, cost-effective and at the same time sustainable. In the Northeast context a similar efficient public transport system can be initiated for the road and rail travel which could encourage a lot of the visitors to opt for this public transport system over the expensive private vehicles. Also initiating region-specific travel passes for coaches, shared taxis and ferries could encourage a lot of travellers to travel within the region at low cost. As compared to Switzerland a robust public transport system could be initiated in the Northeast through a private-public partnership mode along with other stakeholders of tourism business through government support and incentives.

### **5.2 Trekking and Nature Trails**

To combat the environmental impacts most of the prominent tourism operating countries at global context promote walking and trekking to explore the diverse tourism destinations. Most of the countries have restricted vehicular traffic at certain levels, so that visitors could be encouraged to walk or use designated trekking trails to explore and have an enriching experience. In context to Northeast, with so many scenic landscapes, similar walking and trekking trails could be initiated for the visitors to explore the picturesque landscapes so that tourists could have an immersive experience of the environment and the local cultural fabric. Along with walking and trekking trails eco-friendly accommodation like homestays, campsites, local eateries, handicrafts stalls could also be started which will give the local communities to be involved and also have additional livelihood options. In fact with the local community actively taking part in the trekking tourism, the government and other stakeholders can support and promote this form of tourism where the local communities could be the custodian of responsible tourism practices and conservation efforts.

### **5.3. Electric Mobility for a Greener Northeast India**

Vehicles using fossil fuels contribute to pollution levels and thus affecting the ecology at large scale. At global context there has been some serious efforts made to switch to electric vehicles so that carbon emission could be controlled. Norway a small country is leading the pack, as being the global leader in using electric public transport modes to reduce the perils of pollution. Visitors are encouraged to use electric vehicles that are available at tourist destinations to support for eco-friendly travel. The country has installed and developed the infrastructure required to support the electric vehicles at various places within the country, which has resulted in improvement of air quality and limit the dependence on fossil fuels. In the Northeast context with limited roadways and traffic congestion, electric shuttle buses and other vehicles could be initiated within the region and also charging and maintenance centres could be developed throughout, so as to encourage the stakeholders to operate such services and it would help to protect the environment from carbon footprints and help develop a greener and sustainable transport system.

#### **5.4. Pedal-Powered Tourism: Lessons from the Netherlands**

In Netherlands, the country promotes pedal-powered tourism by initiating cycling friendly transport system and it has the required infrastructure developed like separate cycle lanes, rental and maintenance services etc. Visitors are encouraged in some of the major cities to opt for cycling and explore the city and its destinations, thus helping in reducing traffic congestations, limit pollution levels and overall improve the tourist experiences. A similar approach can also be initiated in the Northeast, where the visitors can explore the streets and the country side on eco-friendly bikes at lower cost and have an immersive experience. To support the pedal powered tourism initiatives, there would be a requirement in setting up dedicated cycling routes, bike tour packages, bike rental and maintenance outlets so that visitors can explore the places in convenient and eco-friendly manner. Local communities can actively take part as stakeholders in developing bike rentals, maintenance and other allied services which tourists would seek as they are biking and exploring. With government and stakeholders support some of the tourist regions can be completely converted to bike travel zones, which would help to build the cycling friendly sustainable transport system which supports green tourism and protects the environment.

#### **5.5. Lessons from Colombia's Cable Car System**

Mountainous terrain countries like Columbia has successfully developed a eco-friendly transport system through cable car networks. Some of the cities are well connected to the mountainous regions through cable cars, thus cutting down on travel time, reducing traffic congestion and enhancing mobility for residents and visitors. Cable car transport networks are more eco-friendly as compared to road transport as they reduce fuel use and pollution. Cable car networks would be ideal for Northeast context, as most of the region is of hilly terrain and consists of narrow steep roads and would ease travel for both residents and visitors. The installation of cable car transport networks at strategic tourist location would attract a lot of tourist to use these transport networks to explore the hilly regions and at the same time have a memorable experience from the panoramic views and safe hassle free travel as compared to road transport travel. Government support and expertise would be required to build a robust cable car network system in the region so that travel to the hilly remote regions can be made more accessible.

### **6. Barriers to Sustainable Tourism Transport in Northeast India**

To switch from conventional transport system to alternative sustainable eco-friendly transport in the Northeast context would call for a lot of resistance and challenges. One of the major disadvantage of the region is the inadequate transport infrastructure within the region. Modes of transportation within the region itself is very limited like limited air and rail connectivity, primarily due to the hilly and forested regions. Installing of global best practices of alternative sustainable transport system will come up with a huge price as some of the remote areas lack basic transport facilities. Funding would be a major issue in bringing in sustainable transport revolution and in some cases the feasibility of initiating transport systems at remote areas would call for closer look. Also the hilly terrain and inclement weather conditions will be a major challenge in developing and maintaining transport networks, thus making a long term sustainability more difficult. Policy recommendations, proper planning, strong legislation and financial support would be vital to develop alternative sustainable transport system in the region. People's mindset is another key factor. Both locals and tourists must understand the benefits of green travel and be willing to use eco-friendly transport. Many people prefer regular vehicles because they are used to them. Awareness campaigns, rewards, and affordable green options are needed to encourage people to make the switch. To solve these issues, a combined effort is needed. Better policies, improved infrastructure, new technology,

and local community support can help Northeast India move towards a more sustainable tourism transport system.

### 6.1. Hypothesis

H<sub>0</sub>: Government policies and financial incentives do not have a significant effect on the adoption of sustainable transport solutions in Northeast India.

H<sub>1</sub>: Government policies and financial incentives have a significant effect on the adoption of sustainable transport solutions in Northeast India.

For testing the hypothesis regarding the effect of government policies and financial incentives on the adoption of sustainable transport solutions, a Chi-Square Test for Independence was carried out.

**Table :2 Chi-Square Test for Association between Government Policies and adoption of sustainable transport solutions**

Test	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.270	1	0.007
Likelihood Ratio	7.530	1	0.006
Linear-by-Linear Assoc.	7.027	1	0.008

The Pearson Chi-Square test ( $p = 0.007$ ) confirms a significant association between government policies and the adoption of sustainable transport solutions, while the Likelihood Ratio ( $p = 0.006$ ) further supports this finding. Additionally, the Linear-by-Linear Association ( $p = 0.008$ ) suggests a consistent trend, indicating that higher policy support leads to increased adoption. Since all tests show statistical significance ( $p < 0.05$ ), we conclude that the supports the alternative hypothesis (H<sub>1</sub>), confirming that government policies and financial incentives play a crucial role in driving the adoption of sustainable transport in Northeast India.

### 6.2. Hypothesis

H<sub>0</sub>: Infrastructure limitations, high costs, and geographical challenges do not significantly hinder the implementation of sustainable transport in Northeast India.

H<sub>1</sub>: Infrastructure limitations, high costs, and geographical challenges significantly hinder the implementation of sustainable transport in Northeast India.

A Chi-Square Test for Independence was conducted to examine whether infrastructure limitations, high costs, and geographical challenges significantly hinder sustainable transport implementation in Northeast India.

**Table: 3 Chi-Square Test**

Test	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.07	2	0.356
Likelihood Ratio	2.15	2	0.341
Linear-by-Linear Association	1.89	1	0.169

The Chi-Square test results indicate no significant association between the categorical variables. The Pearson Chi-Square value ( $\chi^2 = 2.07$ ,  $df = 2$ ,  $p = 0.356$ ) and the Likelihood Ratio ( $\chi^2 = 2.15$ ,  $df = 2$ ,  $p = 0.341$ ) both have p-values greater than 0.05, suggesting that any observed differences are likely due to chance. Additionally, the Linear-by-Linear Association test ( $\chi^2 = 1.89$ ,  $df = 1$ ,  $p = 0.169$ ) does not show a significant linear trend. Since all p-values exceed the 0.05 threshold, we fail to reject the null hypothesis, concluding that infrastructure limitations, high costs, and geographical challenges do not significantly hinder the implementation of sustainable transport in Northeast India.

## 7. Study Limitation and Recommendations

A key limitation of this study is the scarcity of comprehensive data on low-impact transportation initiatives in Northeast India. As sustainable and eco-friendly transport systems are still in their early stages of development in the region, there is a lack of extensive empirical research and documented case studies to assess their long-term viability. Additionally, the diverse geographical and socio-economic conditions across different states present challenges in formulating a universal framework for enhancing tourism accessibility. The study primarily relies on secondary data sources such as government reports, policy documents, and international best practices, which may not fully reflect on-the-ground realities or the perspectives of local stakeholders. Moreover, logistical challenges including limited access to remote areas and inadequate infrastructure does affect the scope and depth of primary data collection. Despite these constraints, the research offers valuable insights into the role of low-impact transportation in improving tourism accessibility and serves as a foundation for further studies and policy interventions in the region.

To make sustainable transportation a reality in Northeast India, several key steps can be taken:

- **Improving Public Transport:** Enhancing bus services and shared taxi networks can help reduce the heavy reliance on private vehicles. Most of the hilly and forested regions lack basic transport facilities. Developing public transport facilities will help the local and the visitors to travel easily and safely and at the same time traffic congestion and pollution levels could be checked.
- **Usage of Electric Vehicles (EVs):** Government support and incentives will encourage transport promoters to operate electric vehicles in the region. Setting up of electric vehicle infrastructure would be a mandate through out the region so that transport operations can be operated smoothly and efficiently thus helping in reducing carbon emissions.
- **Cycling and Walking lanes:** Dedicated cycling and walking lanes would encourage the locals and visitors to opt for cycling and walking, due to safety issues. Visitors can have an immersive experience cycling or walking through the streets and the country side at their own pace.
- **Eco-Friendly Railway Connectivity:** Rail connectivity should be expanded beyond the main cities and towns. Expanding rail connectivity to remote areas would help the locals and the

visitors to explore the places easily and safely. Introduction of electric and hybrid trains can further enhance sustainability while making travel more accessible.

- Cable Cars for Hilly Terrain: In the Northeast context, some of the tourist destinations are in the remote mountainous regions, where accessibility is a major challenge especially during monsoon seasons. Introduction to cable car network in these regions will boost tourist footfalls and reduce carbon footprints.
- Local Communities Participation in Transport Planning: As the regions habitat is primarily different tribal communities hence the involvement and participation of these local communities in tourism development and planning becomes imperative. Alternative sustainable transport solutions should be developed at various places of the region and the local communities should become stakeholders in developing and operating such initiatives so that local economy and community development can be achieved.

To incorporate a more robust sustainable transport system in the eco-fragile regions of Northeast will not be a easy task however, not an impossible one. All stakeholders including government, tourism operators and the local community members need to do brainstorming of the feasibility of the project and with proper planning and phase by development, one should be able to achieve the results in years to come.

## 8. Conclusion

Northeast primarily being a hilly region and heavily forested area, any kind of development will need meticulous planning and proper execution. In regards for transportation development in the region, there are significant challenges primarily due to the mountainous terrain and remote locations. Introducing alternative eco-friendly sustainable transportation systems like electric vehicles, public transportation schemes, cable cars, cycling and walking zones, etc. can improve accessibility and ecological damages could be checked and controlled.

In this transition of eco-friendly transportation systems from the conventional transportation systems, all stakeholders needs to actively participate so that feasibility aspect could be checked and ecological impacts could be mitigated. Awareness campaigns and incentive policies would encourage the residents and the visitors to opt for more eco-friendly transport facilities.

With the implementation of sustainable tourism transportation systems, the Northeast can be a model for responsible and sustainable tourism. The application of low impact transportation modes will help in environmental conservation and protection, enhance travellers experiences and create economic opportunities for local communities and stake holders.

## References

1. Gillovic, B., McIntosh, A.: Accessibility and inclusive tourism development: Current state and future agenda. *Sustainability* **12**(22), 9722 (2020)
2. Chong, B.: Pursuing development through connectivity: An analysis of India's northeast region. Centre on Asia and Globalization, Lee Kuan Yew School of Public Policy, National University of Singapore (2018)
3. Thornbush, M.J., Golubchikov, O.: Sustainable urbanism in digital transitions: From low carbon to smart sustainable cities. Springer, Cham (2019)
4. Kumar, S.: Empowering Bharat: Role of the Northeast in the Indian vision of development. SSRN (2023). <https://doi.org/10.2139/ssrn.4842098>
5. Humtsoe, T.Y.: Urban mobility development in Northeast India: Sustainable city with green and inclusive transportation. Taylor & Francis, London (2024)

6. Nandy, S.N.: Road infrastructure in economically underdeveloped north-east India: A district level study. *J. Infrastruct. Dev.* **6**(2), 131–144 (2014)
7. Bhattarai, K., Conway, D.: Impacts of economic growth, transportation, and tourism on the contemporary environment. In: *Contemporary Environmental Problems in Nepal: Geographic Perspectives*, pp. 563–662. Springer (2021)
8. Das Aundhe, M., Narasimhan, R.: Public private partnership (PPP) outcomes in e-government—A social capital explanation. *Int. J. Public Sect. Manag.* **29**(7), 638–658 (2016)
9. Haokip, T.: India's look east policy: Prospects and challenges for Northeast India. *Stud. Indian Polit.* **3**(2), 198–211 (2015)
10. Sarmah, G.N., Sarda, R.: Potentialities of tourism in northeast region: An evaluation. *ZENITH Int. J. Bus. Econ. Manag. Res.* **9**(6), 1–15 (2019)
11. Chakraborty, M.: ASEAN and Northeast India: Through the panorama of “Look East” and “Act East”. In: *ASEAN and India–ASEAN Relations*, pp. 107–123. Routledge, London (2021)
12. Antony, A., Ambeesh Mon, S.: Mawlynnong: A community-based ecotourism model. In: *Business and Society: Issues and Cases in the Indian Context*, pp. 257–271 (2024)
13. Aayog, N.I.T.I.: Sustainable tourism in the Indian Himalayan region. Report of Working Group II. Government of India, New Delhi (2018)
14. Megu, K.: Development issues in North-East region. Mittal Publications, New Delhi (2007)
15. Cajee, L.: Eco-cultural tourism: A tool for environmental, cultural and economic sustainability (A case study of Darap Village, West Sikkim). In: *SHS Web Conf.* **12**, 01029 (2014)
16. Zhichao, Y., Yashu, Y.: Principles of green eco-friendly tourism towards promoting environmental sustainability. *Markaziy OsiYo Madaniy Me'rosi Va Turizm Tendensiyalari J.* **1**(2), 18–28 (2024)
17. Chatterjee, S., Saikia, A., Dutta, P., Ghosh, D., Pangging, G., Goswami, A.K.: Biodiversity significance of Northeast India. WWF-India, New Delhi, 1–71 (2006)
18. Turnock, D.: Ecoregion-based conservation in the Carpathians and the land-use implications. *Land Use Policy* **19**(1), 47–63 (2002)
19. Fried, T., Welle, B., Avelleda, S.: Steering a green, healthy, and inclusive recovery through transport. World Resources Institute, Washington, DC (2021)
20. Chauhan, N.: Empowering communities and preserving heritage: Case studies on socially responsible travel through fair trade tourism. In: *Meaningful Tourism*, pp. 163–182. Emerald Publishing, Bingley (2025)

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

