

Exploring the Potential of Rail Tourism in Sabah for Sustainable Tourism Development

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ABSTRACT

Rail tourism is a low impact, sustainable product for Special Interest Tourists (SITs) which combines heritage conservation and community development. This study examines the potential for Sabah's North Borneo Railway (NBR) to contribute to sustainable development by examining traveller experiences and perceptions. A quantitative approach was used with 200 passengers on the Tanjung Aru-Tenom line who were selected through purposive sampling and who completed a structured questionnaire. The data were analyzed using descriptive statistics, exploratory factor analysis (EFA) and multiple regression. The findings suggest that travellers associate Sabah's rail tourism with nostalgia, scenery enjoyment and cultural education. Three dimensions of sustainability, ecological, cultural heritage and economic benefits explained 72% of the total variance. The results of the regression analysis revealed that satisfaction was significantly influenced by cultural interpretation ($\beta = 0.42$, $p < 0.001$) and environmental perception ($\beta = 0.37$, $p < 0.01$), but challenges such as irregular schedules, poor facilities, and low marketing visibility remained. The paper concludes that enhancing service delivery, heritage narration, and digital integration can help diversify Sabah's tourism profile and promote inclusive rural development. As one of the first empirical studies on rail tourism in Malaysian Borneo, the study provides a data-driven perspective for regional management and sustainable tourism policy.

Keywords: Rail Tourism, Sustainable Tourism, Heritage Railway, Special Interest Tourist, Environmental Responsibility

INTRODUCTION

Tourism industry has been recognized as a sector that played a vital role in boosting the socioeconomic growth of a country. This simultaneously has shaping the local cultural identities and applied the conversation practices across the region. From that, sustainable tourism has evolved from a niche concept to a foundational framework for responsible destination management over the past two decades (GSTC, 2018; Moyle, Moyle, Ruhanen, Weaver, & Hadinejad, 2020; UNWTO, 2022). Through community-focused projects and eco-friendly transportation systems, it aims to bring together environmental protection, cultural authenticity, and economic benefits. Rail tourism, a segment of transport and heritage tourism, has attracted heightened interest in the overarching sustainability dialogue for its dual role as a sustainable travel alternative and a medium for heritage interpretation (Pafféri & Remenyik, 2023; Lopes & Simões, 2025).

Rail tourism encompasses journeys by travellers that are primarily for leisure or cultural purposes, using the existing railway infrastructure that was often associated with the experiences on board and historical or scenic routes along the journey. Globally, rail tourism has reemerged as a sustainable alternative to mass tourism, and it is supported by renewed public interest in slow travel and nostalgia (Quattrini, Berrocal Menárguez, & Zamorano Martin, 2023; UIC Communications, 2024 & (Thraenhart, 2024). Several countries such as Japan, Spain, Switzerland, and the United Kingdom, have successfully leveraged rail heritage to promote regional tourism diversification and community-based tourism (Jamaludin, Nasir, & Ibrahim, 2022; Peira, Giudice, &

Miraglia, 2022). These initiatives have demonstrated that railways are not merely transport corridors but also a dynamic cultural landscape that can reflect technological evolution, local identity, and collective memory, which can later be contribute to the development of railway tourism.

In Southeast Asia, and particularly in Malaysia, railway heritage has been presented as a largely untapped potential for sustainable tourism development. Malaysia's earliest railways were constructed during the British colonial era and were integral to plantation economies and later as an inter-regional connectivity (Liew, Rahman, & Siah, 2025). Today, while Peninsular Malaysia has witnessed the revitalization of heritage lines by Keretapi Tanah Melayu Berhad (KTMB), Sabah's North Borneo Railway (NBR) has been the only operational heritage railway in Malaysian Borneo. NBR was currently operated by the Sabah State Railway Department, and the line connects from Tanjung Aru to Tenom, traversing landscapes of paddy fields, river valleys, and small settlements deeply embedded in colonial and indigenous histories.

Research Problem and Gap

Despite its strong historical significance and picturesque journey, Sabah's rail tourism remains underdeveloped and under-researched from time to time. Compared to other heritage attractions such as Mount Kinabalu Park or Sipadan Island, the NBR receives limited promotional and institutional attention, even though a new product of rail tourism has been introduced. This gap occurs from the perception that railways serve primarily as transport infrastructure rather than a tourism attraction. Therefore, the North Borneo Railway's potential as a sustainable tourism product that may be linked with heritage preservation, rural development, and environmental awareness has yet to be explored by researchers and travellers themselves (Kunjuraman & Hussin, 2020; Abdullah & Syed Jaafar, 2021).

Previous studies by Kayat, (2014) & Jin, Ling Siow, & Fabian, (2024) were primarily focused on the sustainability of ecotourism and community-based tourism in Malaysia. The study has left a theoretical and empirical hole in rail tourism research. Furthermore, there is insufficient understanding of tourist motivations, experience satisfaction, and perceived sustainability outcomes associated with heritage railway experiences. As for that, this study addresses these deficiencies by experimentally investigating the North Borneo Railway's potential as a driver for sustainable tourism development in Sabah.

The relative underdevelopment and scarcity of scholarly inquiry into Sabah's rail tourism represent a significant missed opportunity in the global travel landscape. Bridging this research gap is vital for the international tourist market, as modern travelers increasingly seek authentic, "slow travel" experiences that offer a departure from mass-market attractions. By formalizing the understanding of the North Borneo Railway's unique value proposition, stakeholders can develop targeted international branding that elevates it to the status of a world-class heritage icon. Furthermore, rigorous research provides the evidence-based framework needed to ensure the service meets global standards of safety, sustainability, and digital integration, ultimately transforming the railway from a local transport necessity into a premier, research-backed destination that competes effectively with iconic rail journeys across Asia and Europe.

Research Objectives

The primary objective of this study is to investigate the possibilities of rail tourism in Sabah to facilitate sustainable tourism growth. The study specifically seeks to:

- i. Analyze the experiences, expectations, and satisfaction levels of tourists traveling on the Tanjung Aru–Tenom route.
- ii. Identify key sustainability dimensions that are associated with rail tourism in Sabah.
- iii. Determine the influence of sustainability perceptions and service attributes on overall tourist satisfaction in rail tourism in Sabah.
- iv. Examine the operational and promotional challenges that will limit the rail tourism development in Sabah.
- v. Provide strategic recommendations to integrate rail tourism into Sabah's sustainable tourism framework.

As for that, this study will contribute both theoretically and practically to the sustainable tourism study. Theoretically, this study will extend the Triple Bottom Line (TBL) framework by Elkington (1997) into the domain of rail tourism. It is by integrating the ecological, cultural, and economic dimensions into an integrated evaluative model of TBL. Not only that, but this study will also align with the Experience Economy Theory by Pine & Gilmore (1999) and suggests that meaningful experiences drive satisfaction and loyalty in tourism contexts more than mere services.

Practically, the study will generate empirical insights that are relevant to the policymakers, which include the Sabah State Railway Department, and tourism stakeholders that are seeking to diversify regional tourism products. This paper will position rail tourism as a strategic pathway toward inclusive, sustainable development by highlighting on how cultural storytelling, interpretation of the environment, and community participation can enhance visitor experiences.

LITERATURE REVIEW

Concept of Rail Tourism

Rail tourism is the combination of traveling to a place by train and using the train as the destination (Dickinson & Lumsdon, 2011; Jensen & Bird, 2016; Soldatenko et al., 2026). The idea includes the experience of traveling by train including seeing railway infrastructure such stations, tunnels, and viaducts and going to railway museums. According to Lee & Chen, (2016); Peira et al. (2022) & UIC, (2024), rail tourism encompasses heritage train journeys, scenic routes, themed rail tours, and contemporary rail-based leisure experiences. Ahead of its function as a mobility, rail tourism has made the most of the experiential and symbolic dimensions of rail travel, which are nostalgia, cultural immersion, and environmental consciousness (Christou, 2018; Hall, 2019; Peira et al., 2022; & Lorena, Alexander, Revilla & Moure, 2024).

These days, rail tourism is a type of special interest tourism (SIT). This is because the major market for this is tourists who are interested in specialized rail travel (SROT) (UIC, 2020). SIT is a niche market that focuses on meaningful travel experiences, cultural immersion, and eco-friendly activities (Laowirojanakul, Pooripakdee, & Weerapaiboon, 2024). Different from mass tourism, the purpose of the SIT was to focus on learning about the ancestry throughout the journey, recalling the memories, or being conscious of the environment (Earl & Hall, 2023). The routes of the railway were identified as the key attraction of the rail tourism itself, especially those with the beautiful scenery, historic trains, themed experiences, and the slower pace of the journey (Louth, 2025; Light, Dragan, & Crețan, 2026; and Soldatenko et al., 2026). These were a more thoughtful approach to travel that fits with SIT preferences (Thraenhart, 2024). Additionally, rail-based tourism products are being marketed as an eco-friendly option that reduces carbon emissions while encouraging local involvement and community growth (Lowson, 2021; Janchai & Suvittawat, 2025). With experiences in rail tourism, SIT portfolios not only add variety to tourism options but also promote responsible tourism trends that are growing in both developed and developing economies.

Globally, rail tourism has evolved from a heritage preservation activity to a strategic component of sustainable tourism. In Europe, historic railway lines such as the Glacier Express in Switzerland and the Jacobite Steam Train at Scotland, has blend the heritage engineering with destination storytelling (Halsall, 2001; Bhati, Pryce, & Chaiechi, 2014; Peira et al., 2022) to create a rail tourism product. Similarly, Japan's Kyushu Seven Stars Cruise Train integrates luxury tourism with regional revitalization, offering curated narratives that highlight local crafts and cuisine (Khoikhina, 2021; Qu & Zollet, 2024). These examples demonstrate that railways can be positioned as cultural landscapes as they can serve as powerful vehicles for education, heritage interpretation, and sustainable mobility.

Rail Tourism and Sustainable Development

Rail tourism in other ways had aligned closely with the United Nations' Sustainable Development Goals (SDGs). It's involved particularly Goal 8, which focuses on Decent Work and Economic Growth, Goal 11, Sustainable Cities and Communities, and Goal 13, that cover on Climate Action (UNWTO, 2022). Rail travel is a low-carbon way to get around. It can emit up to 70% less pollution per passenger-kilometre than using air transport (Åkerman, 2013).
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Kamb, Larsson, & Nässén, 2021). Rail travel also encourages movement of tourists to spread out to others location, which will ease the burden of overtourism in popular places and boost rural economies (Jamaludin et al., 2022; Thraenhart, 2024; Brajcich, 2025).

From a sustainability perspective, rail tourism contributes to:

- i.helps the environment by using less fossil fuel and causing less traffic.
- ii.Socio-cultural sustainability by preserving local heritage and fostering cultural exchange.
- iii.Economic sustainability by creating inclusive job opportunities in rural areas.

The Triple Bottom Line (TBL) framework that proposed by Elkington (1997) will remain as a foundation for analyzing these intersecting dimensions. In most tourism research, the TBL has been applied to evaluate the transport efficiency, heritage conservation, and community participation (Stoddard, Pollard, & Evans, 2012; Romalee, Laesan, Arminsen, Mullsap, & Pairoj, 2025; Nica, Chiriță, & Georgescu, 2025). As for that, this study will extend TBL framework into the rail tourism context by examining how ecological awareness, cultural appreciation, and local economic integration interact to shape traveller satisfaction.

Heritage Tourism and Cultural Interpretation

Heritage tourism is one of the fastest-growing parts of world tourism. This is because people want to experience, learn about, and protect the past (Bonet, 2013; Adetunji & Dorcas, 2024; Najib & Rahman, 2025). It emphasizes authenticity, identity, and a sense of place that show qualities also embedded within heritage railways. Railway lines are often used in museums that narrate industrial progress and colonial histories.

Interpretation is an important part of travelling that makes travel a meaningful part of tourism (Park,Choi, & Lee, 2019). Supported by Zhou and Wang (2024), interpretive media, such as onboard explanations, signage, and local guides, make customers feel more emotionally involved and satisfied. As in the rail tourism context in Malaysia, cultural interpretation remains underdeveloped (Abdullah & Syed Jaafar, 2021). Most of the time, it's just brochure explanations instead of engaging stories. So, improving the quality of interpretation can help connect the dots between preserving heritage and teaching visitors.

Malaysian Tourism Context and Sabah's Heritage Railway

Malaysia's tourism policy, currently implemented in Sabah, prioritizes diversification and sustainability, as evidenced by the National Tourism Policy 2020–2030 and the Sabah Tourism Blueprint 2030. These strategic documents promote the inclusion of rural, cultural, and ecotourism offerings to encourage balanced development (Ministry of Tourism, Arts and Culture Malaysia, 2020).

Unlike cultural trails and ecotourism, rail tourism in Malaysia has not received much attention in research. Keretapi Tanah Melayu Berhad (KTMB), the national railway operator in Peninsular Malaysia, has initiated projects aimed at attracting tourists, such as the Jungle Railway route to Dabong. Nevertheless, the environmental impacts of these endeavours have received limited scholarly attention (Jamaludin et al., 2022). The North Borneo Railway (NBR) in Sabah, in contrast, was constructed in 1896, a product of the colonial period, and it holds both practical and symbolic significance. From Tanjung Aru to Tenom, it goes through the rice fields, river, sunset area, jungles, and villages where the Kadazan-Dusun communities are present. As for that, this makes it a great place for experience and community-based tourism (Abdullah et al., 2021).

Still, NBR isn't very well known among tourists from both inside and outside the country because of problems with infrastructure, unreliable service schedules, and not enough advertising. Lowson, in their respective studies (2021) and Soldatenko et al. (2026) highlight the potential of incorporating community involvement and cultural narratives along the railway line to convert the journey into a dynamic heritage experience. Consequently, this approach to rail tourism could foster the development of enduring livelihoods and a strengthened regional identity.

Tourist Motivation and Experience in Rail Tourism

Rail tourism often mirrors the traits of Special Interest Tourism (SIT), where curiosity, nostalgia, and the quest for knowledge are key motivators, rather than a primary emphasis on leisure activities (Jensen & Bird, 2016; Lee & Chen, 2016; Peira et al., 2022). Holbrook and Schindler (2003) supported by Tan et al., (2025), suggest that individuals visiting heritage sites develop a psychological connection to the past, which subsequently cultivates emotional satisfaction and cultural comprehension. Similarly, Uslu et al. (2023) and Baygloo & Soltani (2025) found that how authentic a destination seems strongly affects tourists' loyalty to that destination, especially at heritage sites.

Consequently, rail tourism attracts individuals motivated by both leisure and specific objectives, a perspective supported by Mertena and Kaaristo (2024), Bursa et al. (2025), and Vu & Schafroth (2025). In Sabah, a place known for its rich cultural tapestry and stunning landscapes, these incentives can be amplified through hands-on experiences. Think trips to local markets close to train stations, engaging with the indigenous people, and joining in cultural events that take place right on the trains.

Conceptual Framework

This research integrates the Triple Bottom Line (TBL) and Experience Economy frameworks to investigate the relationship between sustainability aspects and traveler contentment. The proposed conceptual model (Figure 1) suggests that ecological sustainability, acknowledgment of cultural heritage, and economic advantages for the community collectively impact tourist satisfaction and subsequent behaviors, including intentions to revisit and recommend the destination.

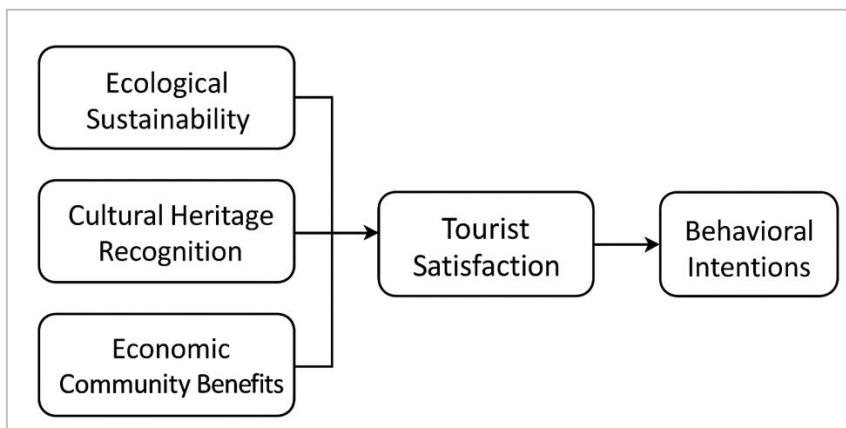


Figure 1: Conceptual Framework of Sustainable Rail Tourism in Sabah

This framework underpins the subsequent quantitative analysis, linking theory with empirical validation.

METHODOLOGY

Research Design

This investigation utilized a quantitative research design, specifically a structured questionnaire survey, to assess tourist experiences, perceptions, and satisfaction levels concerning the North Borneo Railway (NBR). A cross-sectional methodology was employed to gather data from passengers who had recently utilized the Tanjung Aru–Tenom route. The adoption of quantitative methods was justified by their capacity to facilitate the identification of underlying constructs and the examination of statistical relationships among variables (Creswell & Creswell, 2018)

The study's framework was informed by the Triple Bottom Line (TBL) theory (Elkington, 1997) and the Experience Economy concept (Pine & Gilmore, 1999). The proposed model suggested that overall tourist satisfaction is significantly influenced by three sustainability dimensions: ecological, cultural, and economic.

Therefore, this satisfaction then predicts behavioral intentions, such as the likelihood of returning to or recommending the destination.

Population and Sampling Procedure

The study population included both local and international tourists who used the North Borneo Railway (NBR) between February and April 2025. Data from the Sabah Railway Department showed that an average of 1,200 passengers traveled on the Tanjung Aru–Tenom line each month during the study period. Using Cochran's formula for sample size, a minimum of 180 responses was needed to achieve a 95% confidence level and a 5% margin of error. To ensure the results were reliable, 200 valid questionnaires were collected.

The purposive sampling was applied to specifically target those passengers with characteristics relevant to the objectives of this study, particularly those who had recently experienced the Tanjung Aru–Tenom railway journey and thus would be able to provide informed responses on their rail tourism experience. Nevertheless, the purposive sampling may cause a selection bias, as the travellers with an interest in heritage, rail or tourism experiences may be more likely to take part in the study. As such, the sample may not be representative of the broader tourist population in Sabah, particularly those who primarily use the railway for transportation and not for tourism activities.

However, to limit the potential for bias, the study used a structured questionnaire with proven measurement items and achieved a sample size considered sufficient for the statistical analyses performed. Therefore, the findings should be read with the understanding that the findings are the views of travellers who experienced the North Borneo Railway as a tourism and heritage attraction and not representative of the entire visitor population to Sabah. Future studies may want to use probability sampling such as stratified random sampling to increase the generalizability of the findings and give better representation of the diversity of local and international travellers.

A purposive sampling technique was used to target passengers at three main stations:

- i. Tanjung Aru (urban departure point),
- ii. Beaufort (intermediate rural town),
- iii. Tenom (terminal station, heritage and agro-tourism hub).

Trained enumerators distributed self-administered questionnaires to passengers at each station before and after the journey

Research Instrument

The questionnaire consisted of four sections in table 1.

Table 1: Structure of Questionnaire

Section	Focus	No. of Items	Scale
A	Demographic Profile	6	Nominal
B	Travel Experience & Motivation	8	5-point Likert
C	Perceived Sustainability Dimensions	15	5-point Likert
D	Satisfaction & Behavioral Intentions	8	5-point Likert

Items that being used to measure sustainability dimensions were adapted from validated scales by Stylidis (2020) and Bosak (2016). For satisfaction and behavioral intention, the items were adapted from Chen & Chen (2010).

Validity and Reliability Testing

Content Validity

A discussion of the questionnaire with three stakeholders from Sabah State Railway was conducted to clarify and assess the study's relevance. Minor wording adjustments were made.

Construct Validity

An Exploratory Factor Analysis (EFA) was performed utilizing Principal Component Analysis (PCA) with Varimax rotation to discern underlying characteristics of sustainability. Sampling competence was confirmed via the Kaiser-Meyer-Olkin (KMO) test ($0.864 > 0.6$ threshold), and Bartlett's Test of Sphericity was significant ($\chi^2 = 2,184.52$, $df = 210$, $p < 0.001$), indicating suitability for factor analysis. Three clear factors emerged, explaining 72.4% of the total variance. All factor loadings exceeded 0.70, and Cronbach's alpha values indicated good internal consistency (Hair et al., 2019):

Table 2: Reliability Coefficients (Cronbach's α) of Study Constructs

Factor	KMO	Cronbach's α	Variance Explained (%)
Ecological Sustainability	0.846	0.89	27.3
Cultural Heritage Recognition	0.812	0.87	24.1
Economic Community Benefits	0.801	0.85	21.0
Overall Model	0.864	0.91	72.4

Data Collection Procedure

The survey was conducted around 10-week period. The study objectives were explained to the respondents, and they subsequently provided informed consent. The questionnaires were both physically disseminated at the railway stations in Sabah and digitally completed through QR codes. Participation was voluntary and anonymous, in accordance with Universiti Teknologi Malaysia's Research Ethics Guidelines (2023).

There were 212 surveys returned, however only 200 were useable after cleansing the data and getting rid of incomplete responses. The response rate was 94.3%, which is good enough for behavioral research (Hair et al., 2019).

Data Analysis Techniques

Data analysis was performed using SPSS Version 26 following a three-step procedure:

- Descriptive Statistics: To summarize demographic profiles, travel motivations, and overall satisfaction.
- Exploratory Factor Analysis (EFA): To validate the dimensionality of sustainability constructs.
- Multiple Regression Analysis (MRA): To examine causal relationships between sustainability factors and satisfaction, and between satisfaction and behavioral intentions.

Descriptive Statistics

Means, standard deviations, and frequency distributions were computed for all variables.

Regression Analysis

Regression models were tested to determine the predictive strength of each sustainability factor on tourist satisfaction. The following model was applied:

$$\text{Satisfaction} = \beta_0 + \beta_1 (\text{Eco}) + \beta_2 (\text{Cultural}) + \beta_3 (\text{Economic}) + \varepsilon$$

A second model tested the relationship between satisfaction and behavioral intention:

$$\text{Behavioral Intention} = \beta_0 + \beta_4 (\text{Satisfaction}) + \varepsilon$$

Assumptions of normality, multicollinearity ($VIF < 3$), and homoscedasticity were verified and met. The study used study by Hair et al. (2019) to figure out the model that fit indices (R^2 and F-values) meant.

Ethical Considerations

The research adhered to the principles of informed consent, voluntary participation, and confidentiality. There was no personal information collected, and the people who answered the questions were told they might quit at any time. The Research Ethics Committee at Universiti Teknologi Malaysia approved the project as ethical (Ref: UTM/URP/2024/119). All data were assessed anonymously and employed solely for academic purposes. This plan makes it possible to reliably and accurately determine how long Sabah's rail tourism will last. Using both EFA and regression analysis together is a great way to uncover the most critical sustainability elements that determine how happy and behavioral tourists are.

FINDINGS & DISCUSSION

Respondent Profile

Table 3 summarizes the demographic characteristics of the 200 respondents. The majority were female (56%), aged 26–40 years (48%), with a balanced mix of domestic (61%) and international (39%) tourists. Approximately 58% were first-time visitors to the North Borneo Railway, and 42% had prior experience with heritage or scenic rail tours elsewhere.

Table 3: Respondent Demographic Profile (n = 200)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	88	44.0
	Female	112	56.0
Age Group	18–25 yrs	32	16.0
	26–40 yrs	96	48.0
	41–55 yrs	52	26.0
	56 yrs +	20	10.0
Origin	Domestic (Malaysia)	122	61.0
	International	78	39.0
Education Level	Secondary	38	19.0
	Diploma / Bachelor's	102	51.0
	Postgraduate	60	30.0
Purpose of Visit	Leisure / Holiday	142	71.0
	Educational / Cultural	38	19.0
	Others	20	10.0
Previous Rail Experience	Yes	84	42.0
	No	116	58.0

Descriptive Statistics of Key Constructs

Respondents rated all items on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Overall mean scores exceeded 3.50, indicating favorable perceptions across sustainability and satisfaction dimensions in Table 4.

Table 4: Descriptive Statistics for Main Constructs

Construct	Mean (M)	Standard Deviation (SD)	Interpretation
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Ecological Sustainability	3.94	0.63	High agreement
Cultural Heritage Recognition	4.12	0.57	Very high agreement
Economic Community Benefits	3.76	0.70	Moderate-to-high
Tourist Satisfaction	4.08	0.60	Very high
Behavioral Intentions	4.15	0.55	Very high

Note. Interpretation scale: 1–2.49 = Low; 2.50–3.49 = Moderate; 3.50–5.00 = High

Exploratory Factor Analysis (EFA)

All 15 sustainability items loaded cleanly on three components consistent with the conceptual framework. The KMO value = 0.864 and Bartlett's test ($\chi^2 = 2,184.52$, $p < .001$) confirmed sampling adequacy.

Table 5: Rotated Component Matrix of Sustainability Constructs

Item Example	Ecological	Cultural	Economic
Rail travel reduces environmental impact	0.84	0.12	0.18
Scenic views enhance appreciation of nature	0.79	0.20	0.16
Journey preserves historic heritage	0.21	0.82	0.18
Interaction with local guides enriches culture	0.26	0.80	0.19
Railway creates jobs for locals	0.15	0.23	0.78
Promotes village markets near stations	0.19	0.17	0.81

Extraction = Principal Component Analysis; Rotation = Varimax; all loadings > 0.60 retained. Cumulative variance explained = 72.4%.

Reliability Analysis

Internal consistency for each construct exceeded the recommended threshold of 0.70.

Table 6: Reliability Coefficients (Cronbach's α)

Construct	No. of Items	Cronbach's α	Interpretation
Ecological Sustainability	5	0.89	Excellent
Cultural Heritage Recognition	5	0.87	Good
Economic Community Benefits	5	0.85	Good
Tourist Satisfaction	4	0.88	Excellent
Behavioral Intentions	4	0.86	Good

Multiple Regression Analysis

Model 1: Predicting Tourist Satisfaction

The first regression model examined how the three sustainability dimensions predicted tourist satisfaction:

$$\text{Satisfaction} = \beta_0 + \beta_1(\text{Eco}) + \beta_2(\text{Cultural}) + \beta_3(\text{Economic}) + \epsilon$$

Model fit was significant ($F(3, 196) = 44.23$, $p < .001$) with $R^2 = 0.403$, indicating that 40.3 % of the variance in satisfaction was explained by sustainability factors.

Table 7: Regression Results for Predictors of Tourist Satisfaction

Predictor	β	t	Sig. (p)
Ecological Sustainability	0.37	4.92	0.001
Cultural Heritage Recognition	0.42	5.63	0.001
Economic Community Benefits	0.25	2.49	0.014
Model Summary	$R^2 = 0.403$; Adj. $R^2 = 0.392$		

Note. Dependent variable = Tourist Satisfaction. If all VIF < 3 indicates no multicollinearity.

The largest effect was cultural heritage recognition ($\beta = 0.42$), followed by ecological sustainability ($\beta = 0.37$) and economic benefit ($\beta = 0.25$).

Model 2: Predicting Behavioral Intentions

A second regression examined the impact of tourist satisfaction on behavioral intentions:

$$\text{Behavioral Intentions} = \beta_0 + \beta_4(\text{Satisfaction}) + \epsilon$$

The results indicated $R^2 = 0.261$ ($F(1, 198) = 69.98, p < .001$). Satisfaction was a strong predictor of intentions ($\beta = 0.51, p < .001$).

Table 8: Regression Results for Satisfaction → Behavioral Intentions

Predictor	β	t	Sig. (p)	R^2
Tourist Satisfaction	0.51	8.36	0.001	0.261

Higher satisfaction led to greater probability of recommending or revisiting the railway experience.

Model Visualization

The framework illustrates figure 2 show a path analysis of how sustainability dimensions lead to Tourist Satisfaction, which then drives Behavioral Intentions such as recommending the rail service or revisiting). The model uses Standardized β Values to show the strength of each relationship which the higher the number, the stronger the influence.



Figure 2: Structural Framework of Sustainable Rail Tourism (Standardized β Values).

The model illustrates on how interrelated sustainability components contribute to enhanced the satisfaction and behavioral outcomes of the Specialize Rail-Oriented Traveler (SROT) in the future.

Quantitative evaluations have enhanced that awareness of cultural heritage is the primary element in influencing tourist satisfaction, Illustrating the experiential importance of interpretive storytelling on the North Borneo Railway. The significance of ecological practices and community benefits underscores the necessity of adopting a comprehensive perspective on sustainability. As for that, satisfaction is a crucial predictor of behavioral loyalty, aligning with existing studies on historical tourism by Chen & Chen (2010) and Styliadis (2020). The results confirm all four hypotheses (H1–H4) outlined in the conceptual framework.

DISCUSSION

In the context of the North Borneo Railway (NBR), Sabah, this study investigated the correlations between sustainability dimensions, including ecological sustainability, cultural heritage recognition, and economic community benefits, and their collective influence on tourist satisfaction and behavioral intentions. The findings offer empirical evidence that sustainable tourism practices are essential for the long-term competitiveness of destinations and the enhancement of positive visitor experiences.

The regression results confirm that all three sustainability dimensions significantly influence tourist satisfaction, with cultural heritage recognition emerging as the strongest predictor. This finding resonates with earlier studies suggesting that heritage interpretation and cultural immersion enhance the emotional and cognitive engagement of visitors (Liu & Thuraivelam, 2024; Liang et al., 2024). The results also validate the conceptual framework grounded in the Triple Bottom Line (TBL) and Experience Economy theories, establishing a vigorous foundation for linking sustainability to experiential quality and behavioral outcomes.

Ecological Sustainability and Tourist Experience

The substantial positive impact of ecological sustainability ($\beta = 0.37$, $p < 0.01$) suggests that visitors perceive the North Borneo Railway as an environmentally conscious travel choice. Specifically, respondents linked the train journey with scenic enjoyment and minimal environmental impact. This observation aligns with Gössling and Hall's (2019) assertion that low-carbon transportation options foster a sense of environmental responsibility in tourists.

The research indicates that travel experiences' perceived authenticity and moral satisfaction can be amplified by environmentally conscious attributes. It's consistence with the study of Han (2021) & Laachach & Alhemimah (2024). By adopting green technologies, waste reduction strategies, and sustainable energy initiatives, the railway can strengthen its reputation as a pioneer in eco-friendly transportation in Malaysia. These strategies align with the Malaysian National Tourism Policy 2020–2030, which promotes carbon-efficient tourism infrastructure.

Cultural Heritage Recognition as the Key Determinant

The standardized coefficient for recognizing cultural heritage was the highest ($\beta = 0.42$). This suggests that how tourists understand heritage has the strongest effect on their satisfaction. Survey results showed that participants placed considerable value on the nostalgic and historical aspects of the NBR experience. This included the restoration of colonial-era locomotives and the historical information about Sabah shared during the trip. This observation aligns with Pine and Gilmore's (1999) Experience Economy framework, which suggests that stories and cultural performances elevate standard travel into impactful experiences.

In this context, the North Borneo Railway serves a dual purpose: it functions as both a transportation system and a mobile heritage museum. This dual function helps to promote cultural education and the preservation of identity. Conversely, the study's findings indicated deficiencies within the interpretive presentation, particularly the lack of interactive guides and the limited availability of multilingual resources, which could impede deeper engagement among international visitors. Consequently, the implementation of digital interpretation systems, guided cultural narratives, and community-based storytelling approaches might enhance the visitor experience of a given location.

The sustainability dimensions identified in this study should also be read together with the specific features of the North Borneo Railway (NBR). The experience context for tourists to develop their sustainability perceptions is provided by the colonial history of the railway, the ethnic diversity of the communities living along the corridor, the transition from the urban context of Tanjung Aru to the more rural contexts of Beaufort and Tenom, and the views of agricultural landscapes and river valleys. The cultural heritage recognition dimension might be strengthened especially by the tangible relation of the railway to the colonial history of Sabah and its historical role in regional transportation and agricultural development, offering opportunities for heritage interpretation and learning.

Similarly, ecological sustainability aspect could be associated with the passage of the railway through a range of landscapes such as agricultural areas, wetlands and forest areas which could enhance scenic appreciation and environmental awareness. The economic community benefits dimension is also indicative of the potential role of the railway in connecting rural communities with urban markets and visitors, although further investigation

is required into the extent to which local communities currently participate in and benefit from tourism activities. Therefore, it would be interesting for future research to investigate if these characteristics of context are different in different parts of the railway route, and to what extent this affects tourists' perceptions of cultural, ecological and economic sustainability.

Economic Community Benefits and Inclusive Development

Despite its comparatively lower coefficient ($\beta = 0.25$), the economic factor remained statistically significant ($p < 0.05$), indicating that tourists consider observable community advantages as essential to sustainable tourism. Participants expressed positive sentiments regarding the availability of local goods at railway stations and their interactions with rural vendors.

These results are consistent with Styliadis's (2020) research, which highlighted the influence of perceived local benefits on visitor perceptions and destination image. In Sabah, the railway infrastructure offers a unique avenue for bolstering local microenterprises and invigorating rural economies, especially within the Beaufort and Tenom districts. As a result, policy initiatives might encompass the creation of certified "Rail Heritage Markets" at key railway stations, prioritizing women-led and indigenous enterprises to ensure a fair distribution of economic advantages.

Tourist Satisfaction and Behavioral Intentions

The strong link between satisfaction and future actions ($\beta = 0.51$, $p < 0.001$) highlights the lasting importance of emotional fulfillment in building tourist loyalty. Tourists who reported higher satisfaction were significantly more likely to recommend the North Borneo Railway and express plans to return. This finding supports the work

of Chen and Chen (2010) and Prayag et al. (2020), who showed that satisfaction is a key factor in connecting destination experience with future behaviors. From a managerial standpoint, this implies that improving satisfaction through elevated service quality, increased comfort, and more profound interpretive experiences can directly contribute to the sustained success of rail tourism. Loyalty, which arises from satisfaction, is particularly beneficial within specialized markets such as Special Interest Tourism (SIT), where repeat visitation and favorable word-of-mouth communication are essential for destination branding, as Novelli (2005) has noted.

As the positive relationship between satisfaction and behavioral intentions is in line with previous tourism studies (Chen & Chen, 2010; Prayag et al., 2020), the behavioral intentions should not necessarily be interpreted as future actual behavior. Tourist intention to revisit or recommend a destination might be influenced by practical and contextual factors such as costs of travel, availability of time, competing destinations, and general economic or travel conditions. The relatively high behavioral intention score ($M = 4.15$, $SD = 0.55$) obtained in this study suggests that respondents are positively willing to revisit and recommend the North Borneo Railroad; but the magnitude to which these intentions will translate into actual repeat visitation cannot be ascertained from the current cross-sectional data. Thus, future research could investigate actual revisit behavior via follow-up surveys, loyalty program data, online booking data, or other digital data sources that are available and ethically permissible. Such evidence would provide a stronger evaluation of the relationship between tourist satisfaction, behavioral intentions and actual repeat visitation and could help tourism stakeholders in developing strategies for converting favorable visitor experiences into sustained visitation.

CONTRIBUTION & IMPLICATIONS

Theoretical Contributions

This study contributes to the expanding domain of sustainable heritage tourism by employing empirical data to incorporate sustainability considerations into a model of tourist behavior. More precisely, the research demonstrates the impact of environmental, cultural, and economic dimensions on tourist satisfaction, achieved by broadening the Triple Bottom Line (TBL) Framework to conceptualize sustainability as a multidimensional construct.

According to the Experience Economy Theory, the results underscore that sustainability initiatives serve not only ethical obligations but also enhance experiential value, emotional connection, and authenticity. When applied to rail tourism in Southeast Asia, the existing empirical research has primarily concentrated on railway-based heritage tourism within Malaysia. As for that, this research provides new insights into how heritage transport systems can serve as catalysts for sustainable regional development.

Managerial Implications

From a managerial and operational standpoint, the following recommendations are proposed for the Sabah Railway Department and Sabah Tourism Board. First is the service enhancement. The frequency and reliability of train schedules and introducing modern amenities such as digital ticketing, Wi-Fi and comfort upgrades while maintaining the heritage aesthetic can be implemented. The next steps involve creating multilingual storytelling systems, augmented reality heritage apps, and interactive onboard experiences to boost cultural engagement.

Digital innovation can rejuvenate heritage railways by marrying historical charm with “frictionless” technology. Location-based augmented reality (AR) and multilingual audio apps can allow passengers to visualize historical events and landscapes in real time, rather than cluttering vintage carriages with modern signage. IoT-enabled predictive maintenance and “Digital Twin” modelling can help the Sabah Railway Department monitor the structural health of aging locomotives and tracks and ensure higher reliability and safety while retaining the original engineering.

But digital tools do not just useful for storytelling. They can also help to make operations more efficient to meet the demands of today’s traveler. Smart ticketing platforms can therefore be integrated to link train bookings with local eco-lodges and community cooperatives, creating a coherent digital ecosystem to ensure a seamless journey. Discreet high-speed connectivity and hidden charging ports installed within restored interiors can also allow

“Bleisure” travellers to stay connected and ensure the North Borneo Railway remains competitive as a premier attraction in the modern tourism market.

To foster community involvement, the collaborations between the Sabah Railway Department and local cooperatives guarantee direct economic benefits for nearby communities. This approach could establish the North Borneo Railway as a sustainable, premier attraction, leveraging cross-promotions with eco-lodges, rural homestays, and cultural festivals. Finally, training local guides and station vendors in heritage interpretation, sustainable practices, and hospitality standards will ensure a consistently high-quality visitor experience.

Policy Implications

At the policy level, the research findings are consistent with Malaysia's Shared Prosperity Vision 2030 and the Sabah Tourism Master Plan (2020–2035), both of which prioritize inclusivity and environmental responsibility. Specifically, the integration of sustainable rail tourism into the national tourism strategy allows for the North Borneo Railway to serve as a model project for the integration of green mobility and rural tourism. From an economic perspective, providing tax incentives or grant programs to encourage sustainable improvements could motivate heritage rail operators to adopt renewable energy sources, eco-design principles, and waste reduction strategies.

In terms of environmental protection, Malaysia's national heritage network should include Heritage Preservation Legislation and related policies. The aim is to safeguard railway heritage and the landscapes that accompany it. Lastly for regional planning, Regional Connectivity with the expansion of rail tourism routes beyond Tenom could link coastal and interior regions, diversify visitor flows and disperse economic benefits.

LIMITATIONS & FUTURE RESEARCH

This research makes a positive contribution to understanding the heritage railway experience but there are limitations in the generalisability of the results because of the purposive sampling. The participants were selected based on certain criteria relating to their status as travellers with an active interest in heritage or rail tourism and so the results may be representative of a niche group rather than the wider tourist population (Campbell et al., 2020). This judgmental sampling, however, according to Tongco (2007) is useful for qualitative in-depth analysis but is subject to selection bias as the researcher is purposefully selecting informants with specific knowledge or experience. Also, subjective purposive sampling is not representative of a target population, due to sampling errors that cannot be quantified and publication bias, which is generally perceived negatively in broader quantitative contexts with non-random techniques (Stratton, 2024). As such, results should be interpreted of this specific traveler segment and not as a representational generalization to the entire Sabah visitors. Future studies might overcome these limitations by using probability sampling approaches such stratified random sampling to get a more diverse and representative cross-section of the local and international markets (Campbell et al., 2020). By dividing the respondents into groups according to demography, travel frequency, or interest, a fairer view may be obtained on how different groups prioritise and negotiate different historical values (Amaris, 2026).

Future research may adopt a longitudinal design to follow up changes in traveller satisfaction and behavioural intentions over time, especially if digital innovations and modernisation programs are rolled out gradually (Qian et al., 2018). A comparison of the North Borneo Railway with other existing heritage railways in Southeast Asia or a big-data sentiment analysis based on social media would provide a wider benchmark to assess competitive advantage and service excellence in the changing digital tourism environment (Tao, 2025). The cross-sectional design provides a snapshot of tourists' experiences and perceptions at one point in time and therefore limits the ability to determine how satisfaction and behavioral intentions may change over time or following changes in tourism services. Visitor experiences may also change with seasonal conditions such as weather, landscape features, visitor numbers and cultural events along the railroad route. Moreover, tourist satisfaction may be affected by the gradual introduction and adoption of new digital innovations such as augmented reality applications, multilingual audio guides and integrated ticketing platforms. These changes cannot be adequately captured through a single cross-sectional assessment. Future research should therefore consider longitudinal designs that follow travellers over different periods and, where possible, before and after specific service or

technological interventions. Such research could provide stronger evidence regarding changes in tourist satisfaction and behavioural intentions and help tourism and heritage rail operators evaluate the effectiveness of specific service improvements over time.

Another limitation is the exclusive focus on tourists' perceptions of sustainability dimensions. Members of the communities living along the railway corridor were excluded from the study, although community participation and benefit sharing are important considerations in sustainable tourism development. Specifically, the economic community benefits dimension measures tourists' perceptions of potential benefits to local communities, rather than direct evidence of actual economic benefits experienced by local communities, e.g. income generation, employment opportunities, or other livelihood effects. Therefore, the results should not be taken as a direct measure of the railway's actual economic or social impacts on the communities adjacent to it. Future studies should include community perspectives using mixed method approaches, including tourist surveys with interviews or focus groups with local residents, tourism operators and other stakeholders. This research may also provide a better understanding of the impact of the railway on local livelihoods, cultural preservation, environmental responsibility, and community participation and opportunities to improve local benefit-sharing and community participation in sustainable rail tourism development.

CONCLUSION

This study examined the potential of rail tourism in Sabah, specifically assessing the North Borneo Railway (NBR) as a way to encourage sustainable tourism growth. Using a quantitative approach and a sample of 200 participants, this study examined how ecological sustainability, the recognition of cultural heritage, and the economic benefits for the local community affected tourist satisfaction and their future intentions. Rail tourism in Sabah, it seems, is about more than just a sentimental journey through history. It's a present-day, dynamic force for fostering enduring transformation. By carefully combining environmental protection, cultural storytelling, and community empowerment, the North Borneo Railway can become a key player in promoting inclusive and responsible tourism.

The results corroborated that all three sustainability dimensions substantially influence satisfaction, thereby affirming the multifaceted character of sustainable tourism. Cultural heritage recognition, in particular, proved to be the most important factor, highlighting the essential role of narrative interpretation and heritage immersion in creating impactful visitor experiences. Furthermore, ecological sustainability and economic advantages demonstrated noteworthy positive correlations, indicating that tourists value travel experiences that are ethical, have minimal environmental impact, and prioritize community engagement. This finding highlights the intrinsic link between sustainability and experiential dimensions in modern tourism practices. Tourists' contentment transcends simple enjoyment when they recognize their travel as a contribution to heritage conservation, community welfare, and environmental responsibility, thereby transforming into a sense of purpose.

Furthermore, the study revealed a strong predictive relationship between tourist satisfaction and later behavioral intentions. This supports the idea that positive and responsible tourism experiences lead to both loyalty and advocacy. These results, taken together, imply that rail tourism can function as a strategic instrument for diversifying Sabah's tourism portfolio, promoting inclusive development, and furthering environmental conservation goals. As Sabah anticipates the post-pandemic tourism resurgence, rail tourism offers a unique opportunity to demonstrate that heritage mobility can enable not only travel through scenic areas but also advancement toward a sustainable future.

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