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ORIGINAL RESEARCH

Exploring the passengers' socio-economic structure and its impact on the perception of railway infrastructures and services in Tripura, India

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Abstract

The railway is a cost-efficient transport system that ensures economic development, social well-being, environmental sustainability and regional cooperation. As a prime mode of public transportation, it provides significant passenger service throughout the world. It is necessary to understand what passengers think about railway infrastructures and services to enhance passenger satisfaction, increase ridership and reduce the railway policy gap. Many socio-economic factors like education, income and occupation may influence the epistemological thought process of passengers about railway infrastructure and service quality. This study was conducted in Tripura, North-eastern India, to examine the effect of a passenger's socio-economic structure on their perception of railway infrastructures and services. About 735 samples were collected from all 27 railway stations of Tripura through stratified random sampling. To understand passenger perceptions about railway infrastructure, a 5-Point Likert Scale has been used. A Modified Satisfaction Index (MSI) has been proposed to analyse the degree of passenger satisfaction by modifying an existing method. The Kuppuswamy socio-economic scale has been used to identify the association of social class on passenger perception to address the policy gap and provide alternative technical solutions by formulating effective strategies for enhancing service quality. The contribution of the study is to provide insights into the importance of considering socio-economic factors in enhancing service quality and improving passenger satisfaction. Additionally, the proposed MSI can offer a reliable and practical tool for measuring passenger satisfaction with railway services.

Keywords Railway infrastructures · Passenger perception · Modified Satisfaction Index · Kuppuswamy socio-economic scale

JEL classification L92 · H54 · R41 · R58 · O21 · O53

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1 Introduction

The railway is a mass public transport mode with unique features such as large capacity, a high safety level, comparatively high comfort, relatively high speed, a reasonable fare, and care for the environment (da Silva and Mendes 2020; Roy et al. 2019; Roy and Mitra 2018; Goralzik and Vollrath 2017; Kumuthadevi 2017; Tyrinnopolos and Antoniou 2016; Saputra 2010). Those attributes make the railway a privileged mode of public transport with certain infrastructural facilities. Existing railway infrastructural facilities create an epistemological viewpoint among the passengers (Yusoff et al. 2021; Khalil et al. 2016; Stojic et al. 2012). An optimistic view of infrastructural facilities creates an epistemological existentialism approach among the passengers (Singh 2018; Yang et al. 2018; Flynn 2006). By following the concept of epistemological existentialism, it is plausible to think that what is rational for people to believe on the basis of their evidence can vary if they have different frameworks or sets of epistemic standards (Callahan 2021). Therefore, passenger psychology on infrastructure attributes can be defined through epistemological existentialism. Epistemological existentialism always advocates a positive mindset of the passenger. An individual railway passenger, over time, makes differing epistemological existentialistic commitments on different infrastructural attributes. On the antipodes, there is another approach to passenger perception called epistemological nihilism. Epistemological nihilism is a fundamental concept of nothingness (Gertz 2019; Stevens 2016; Diken 2008), which is the form of philosophical scepticism that believes knowledge does not exist, or, if it does exist, it is unattainable for human beings. The infrastructural attributes that do not impact the perceptual attribution of the railway passengers may consider their perception as epistemological nihilism. This approach represents the negative mindsets of the passengers in terms of infrastructural attributes. Both epistemological existentialistic and nihilistic knowledge of the passengers help to develop a contextual framework for passenger demands.

The psycho-behavioural approach of the passengers is reflected in their perceptual view. The perceptual view of the passengers has been justified in light of Epistemological existentialism and nihilism.

Passenger demand for travelling shows a certain pattern among the various age groups using railways transportation (Rosa 2021; Akiyama and Okushima 2009). In order to identify the passenger demand for the betterment of railway infrastructural facilities in the travel behaviour of the passengers, the age-sex structure, the occupational pattern, and educational standards of the passengers have been examined (Chan and Yuan 2017; Gutiérrez and Ortuño 2017; Li et al. 2006).

For the last couple of decades, the demand for passenger mobility has significantly increased due to rapid urban development, rural to urban migration and industrial development (Qiao and Yeh 2021; Tripathi and Kaur 2017; Abramović 2015; Jones 2014; Singh 2006). In developing countries, the public transport demand is much higher than in the developed countries (Iles 2005; Matto et al. 2013). The least costly service plays an essential role in the mode choice among passengers (Rodrigue and Slack 2017; Lin and Huang 2015), and the railway

provides the least costly service to the passengers (Avenali et al. 2020; Gopalan et al. 2020; Yeboah et al. 2019; Agarwal 2008). In the present decades, the railway transport sector has become an important sector of passenger mobility, with a rapid speed.

According to the International Union of Railways, about half the world passenger-kilometres are held by China (1550 billion passenger-kilometres) and India (1157 billion passenger-kilometres). China, the largest populated country, operated 27,370 billion passengers per day in 2019 (UIC 2019). The second-largest populated country in the world, India, handled about 8439 billion railway passengers per day in 2019 (UIC 2019). The Indian Ministry of Railways developed dedicated lines, station infrastructures, passenger amenities and increased the frequency of passenger trains with some digital innovations, like passenger data systems, passenger car factory mechanization, predictive maintenance, train signals, ground control systems, ticketing methods, or a GPS-based train tracking system (Ministry of Railways 2020). India is a Country of diversified social groups, different economic strata and heterogeneous cultures. Even within a region, numerous socio-economic groups carry different cultures, values, beliefs and mindsets. When people of different socio-economic classes travel by train, they obtain idiosyncratic experiences with railway infrastructures and services. The experience of the passengers generates their perception by availing the infrastructural facilities and services, sometimes beyond expectation and sometimes not. The gap between experience and expectation is termed satisfaction. The passenger perception is reflected in their level of satisfaction. But the degree of satisfaction among passengers with railway infrastructures and services varies from region to region, even within the region. Several researches reported that passenger satisfaction depends on passenger expectations as well as age, gender, the purpose of the journey and journey frequency (Ibrahim et al. 2021). Passenger perception about railway infrastructure has changed due to the dynamic nature of infrastructural development. The advancement of railway engineering with artificial intelligence and the approach towards complex systems influence human perception (Tokody et al. 2020). Nevertheless, how the social-economic structure of the passengers makes an impact on passenger satisfaction and passenger demand has not yet been well addressed. Therefore, our research question is: does the social-economic structure of the passengers have any role in passenger perception and satisfaction?

The main objective of the study is to explore the passengers' socio-economic structure and its impact on the perception and satisfaction with railway infrastructures and services in Tripura, India.

To reach this goal, data from a sample of passengers from all 27 railway stations of Tripura were collected through stratified random sampling; a 5-Point Likert Scale has also been used. A Modified Satisfaction Index (MSI) has been proposed to analyse the degree of passenger satisfaction by modifying an existing method. The Kuppuswamy socio-economic scale has been used to identify the association of social class with passenger perception to address the policy gap and provide alternative technical solutions by formulating effective strategies for enhancing service quality.

The paper is structured into six sections. After this brief introduction, the study area is described, and the adopted methodology is introduced. In Sect. 4, passenger

perceptions of station and train infrastructure are introduced, and passenger satisfaction is evaluated using MSI. An analysis of the passenger perceptions varying with the socio-economic structure of the railway passengers is then proposed, and finally, some conclusive remarks are proposed.

The results of the study can contribute to the Indian Railways by providing recommendations and insights to improve the railway infrastructure and services in this region, while also serving as a model for similar research in other areas.

Exploring the passengers' socio-economic structure and its impact on the perception of railway infrastructures and services in Tripura, India, is an important and relevant topic for both the Indian railways and the wider field of practice and theory. Understanding the passengers' socio-economic structure is essential for railway operators, as it helps them to tailor their services to better meet the needs of their customers. More specifically, it allows them to identify which services are most in demand, which routes are most popular, and which types of passengers are most likely to use their services. In Tripura, India, this understanding is particularly pressing, given the region's diverse socio-economic makeup. The area is home to a range of different social groups and economic classes, each with their unique needs and expectations. By exploring the relationships between socio-economic structure and the perception of railway infrastructures and services, we can gain valuable insights into how to improve the quality of railway services in the region.

Moreover, this research is important to the wider field of practice and theory. By studying how socio-economic factors impact passenger perceptions of railway services, we can better understand the role that social structures play in shaping travel behaviours and attitudes towards transport infrastructure more broadly. This understanding is not only relevant to the Indian context but is also transferable to other global settings, where similar social structures may influence travel behaviours. In summary, exploring the passengers' socio-economic structure and its impact on the perception of railway infrastructures and services in Tripura, India, is a critical research topic that has important implications for both the Indian railways and the wider field of practice and theory. Through this research, we can better understand how socio-economic factors shape customer perceptions of railway services, providing vital insights for improving the quality of railway services in the region, and advancing our knowledge of travel behaviours and attitudes towards transport infrastructure.

The importance of considering socio-economic factors in enhancing service quality and improving passenger satisfaction is highlighted in the study. The proposed MSI can offer a reliable and practical tool for measuring passenger satisfaction with railway services. The study provides recommendations for addressing the policy gap and formulating effective strategies for enhancing service quality.

2 Study area

The research has been conducted in Tripura, a North-eastern state of India, which covers 10,486 km^2 geographical area. Tripura is a strategically situated landlocked state; Bangladesh encircles it to the north, south and west (856 km), and Indian

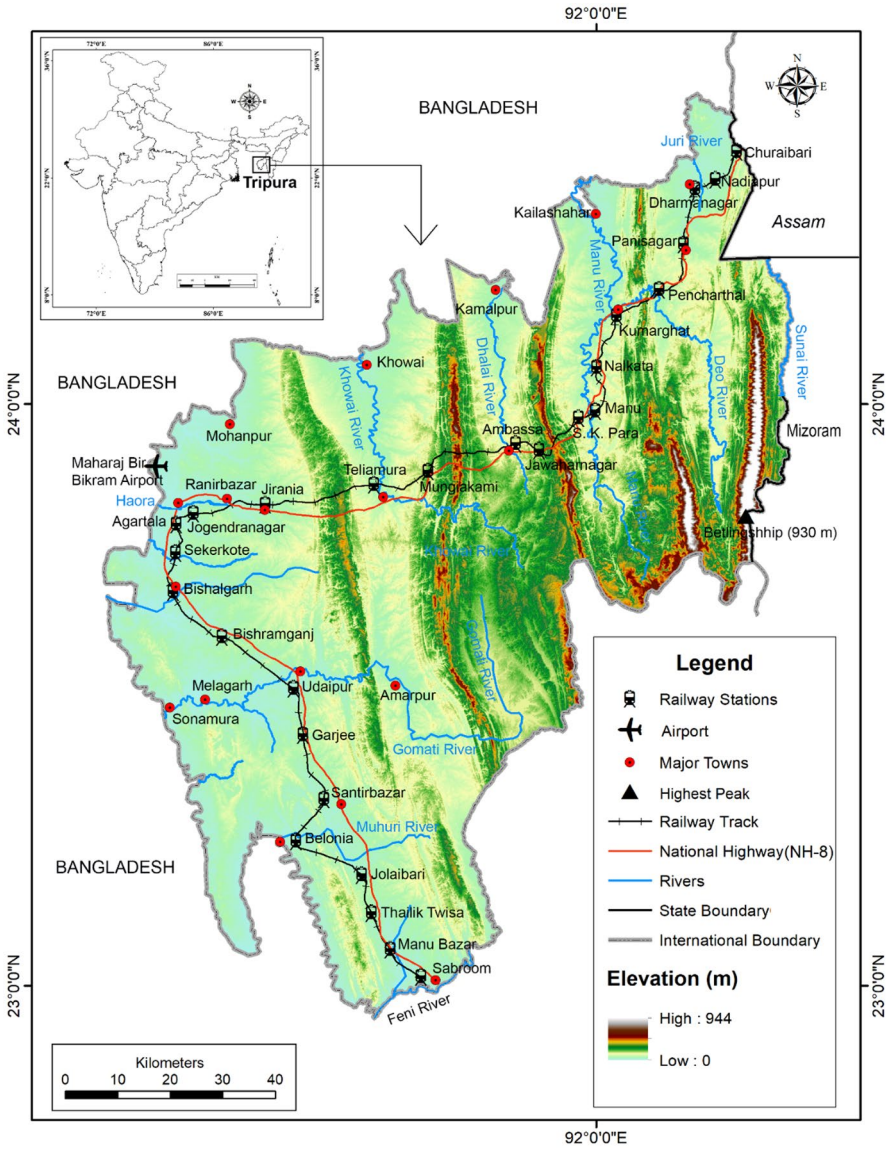

Fig. 1 Location Map of the Study Area

states Assam (53 km) and Mizoram (109 km) encircle it to the northeast and east, respectively (Fig. 1).

Geographically the state is a part of the Purvanchal Eastern Mountains, and the whole region represents a low-lying plain pierced by a series of low-drawn hillocks. About 60 per cent of its land is hilly, while the remaining 40 per cent is plain land. The state has six anticlinal hill ranges; the railway track crosses the major hills,

namely Longtharai (515 m), Atharamura (481 m) and Baramura (249 m) from north to south. Many rivers, narrow streams, gullies and ravines originated from those hills. The Tropic of Cancer runs through Tripura. Generally, this region experiences seasons like summer, rain, autumn and winter. The months of June to September are typically ranged as the rainy season at Tripura. The monsoonal winds bring heavy rains, which ultimately cause frequent floods in the state. During monsoon, the landslide is a common phenomenon in the hilly terrain of this region; as a result, condition of the roads of Tripura becomes very poor (Sen et al. 2013). In these circumstances, the railway became the prime mode of transportation in Tripura to communicate with the other North-eastern states and the country (Roy and Mitra 2016).

The study is encompassed within the state of Tripura, India. About 264 km of operational railway track extends between Churaibari Railway Station in the North and Sabroom in the South, with twenty-five intermediate stations (Fig. 1).

The study area of Tripura in North-eastern India is particularly significant for Indian railways due to its strategic location near the border with Bangladesh (Mitra and Roy 2016). The railway infrastructure in Tripura plays a crucial role in facilitating trade and commerce between India and Bangladesh, thereby contributing to the economic development of the region and the country's GDP. Additionally, Tripura hosts numerous tourist attractions, and Indian railways serve as a vital mode of transportation for tourists visiting the state. The present study's contribution lies in highlighting how socio-economic factors play a crucial role in shaping passenger perceptions of railway infrastructures and services in such a critical region, and how this information can help in formulating effective strategies for enhancing service quality and improving passenger satisfaction. Moreover, the proposed MSI offers a practical tool for measuring passenger satisfaction with railway services in a manner that accounts for the nuances of socio-economic factors.

3 Methodology

The proposed methodology is aimed to explore the passengers' socio-economic structure and its impact on the perception of the railway station and train infrastructure in Tripura (India).

Primary and secondary data were collected. Data on passenger perceptions and satisfaction has been collected directly from the passengers through a survey form specifically arranged for our research objectives (primary data). Secondary data refers to data on monthly passenger mobility provided by the operator and collected from the office of the station master in that station having ticket counters. Twelve parameters, i.e., ticket counters (Malhotra et al. 2019; Thanaraju et al. 2019), drinking water supply (Shahezad 2013; Gadge et al. 2015; Kumar 2018), sanitation facilities (Parihar et al. 2015; Roy and Mitra 2016), waiting rooms (Huang and Lin 2017), passenger shelters (Roy et al. 2019) seating arrangements (Roy and Mitra 2020), public addressing systems (Harrison 2001), medical facilities (Abhilash et al. 2020), police booths (Geetika et al. 2016), the way complaints and suggestions are handled (Roy and Mitra 2020), ticket checking systems (Achaliya et al. 2018) and internet facilities (Srivastava 2019) are

considered to understand the passenger perception about railway station infrastructure in Tripura.

To evaluate the passenger perception of the train infrastructure, eight parameters have been considered, such as the condition of the compartments (Paffi et al. 2011), the speed of the trains (da Silva and Mendes 2020), the condition of the lights and fans at the compartments (da Silva and Mendes 2020), electric switch (Press Trust of India 2021), toilet conditions, the availability of water at the toilets (Srinivas 2018; Stephan and Crawford 2016), alarm chains (Mitchell 2011), on train security services (Salonen 2018; Promsri 2015; Hu et al. 2013).

A five-point Likert Scale has been used to understand the perceptual infrastructural quality of the state's railway transport system. Based on this data, the Satisfaction Index has been calculated to understand the degree of passenger satisfaction; this index has been obtained by modifying the methodology proposed in Hall, et al. (1975) by introducing formula (1):

$$MSI_j = \frac{\left(N_s - N_d\right)}{\left(N - N_m\right)} = \frac{\left(N_s - N_d\right)}{\left(N_s + N_d\right)} \tag{1}$$

where,

MSI_j = Modified Satisfaction Index of parameter j.

N = Number of total passengers.

N_S = Number of passengers having responded with "good" and "very good".

N_d = Number of passengers having responded with "bad" and "very bad".

N_m = Number of passengers having responded with "moderate".

MSI_j is ranging from -1 to 1, because if all $\left(N_s + N_d\right)$ passengers have an either very good or good impression of a parameter j, then $N_d = 0$ and MSI_j is equal to 1. On the contrary, if all $\left(N_s + N_d\right)$ passengers have very bad or bad impressions on the railway infrastructural parameters j, then $N_s = 0$ and MSI_j is equal to -1.

Then, the socio-economic structure of rail passengers is analysed. Socio-economic status (SES) is one of the important factors in the decision-making process when policy intervention through the bottom-up approach is implemented. The most commonly used scale for determining the SES of an individual living in an urban context is the Kuppuswamy socio-economic scale; it has three basic socio-economic components: education, occupation and income.

The socio-economic status of an individual railway passenger is the result of the linear additive function of the basic socio-economic components, which are expressed in formula (2):

$$SES_i = \sum \left[Edu_i + Occ_i + Inc_i\right] \tag{2}$$

where

SES_i = Socio Economic Status of individual railway passenger.

Edu_i = Educational score of individual railway passenger.

Occ_i = Occupational score of individual railway passenger.

Inc_i = Income level score of individual railway passenger.

The modified Kuppuswamy scale is frequently used to measure the socio-economic class (Mishra and Singh 2003; Dudala 2013; Gadhave and Nagarkar 2015; Kishore et al. 2015; Oberoi 2015; Thakkar and Rawat 2015; Sharma 2017; Singh et al. 2017; Bashar 2019; Wani 2019; Saleem and Jan 2021). It was modified to enable SES assessment of a family rather than an individual. The parameters were modified as education and occupation of the Head of the Family and the income of the whole family. More specifically, the modified Kuppuswamy scale updated for the year 2016 has been adopted to understand the socio-economic structure of the railway passengers of Tripura because the survey was conducted in the years 2018–2019, and at that time 2016 was the the year with the smallest amount of measurements.

The Kuppuswamy socio-economic scale is used to categorize the passengers' socio-economic status into three groups, namely lower, middle and upper class. This classification was based on the occupation, education and income of a passenger's family. The perception of railway infrastructure and services was measured using a 5-Point Likert scale which contained statements related to the railway station facilities, cleanliness, security, customer service, and train punctuality.

After calculating SES of each passenger, the Chi-Square test was performed on the data collected to analyse the relationship between the socio-economic status and perception of railway infrastructure and services. The null hypothesis assumed that there was no association between the socio-economic status and perception of railway infrastructure and services, while the alternative hypothesis assumed that there was a significant association between these variables. A p value of less than 0.05 was considered statistically significant.

The results of the Chi-Square test showed that there was a significant association between the socio-economic status and perception of railway infrastructure and services ($\chi^2 = 187.63$, $df = 4$, $p < 0.001$). The majority of the upper-class passengers perceived railway infrastructure and services to be of better quality than lower and middle-class passengers. This indicates that socio-economic factors have a significant impact on passenger perception of railway infrastructure and services.

The main advantage of this methodology is that it helps policy-makers and stakeholders to identify specific areas for improvement and tailor interventions to the needs and preferences of different socio-economic groups. It also contributes to filling the research gap on the impact of socio-economic factors on railway infrastructure quality and passenger perception, which has significant implications for designing more effective transport policies and investments.

The research methodology is shown in the flow chart reported in Fig. 2.

4 Data collection

About 735 surveys have been collected from passengers using the different railway stations. The railway transport system in Tripura was developed phase by phase since 1951, but after 2019 the passenger train service covers all the areas of the region. Passenger mobility data for the month of November 2019 has been used to determine the sample size in order to guarantee accuracy in estimating proportions

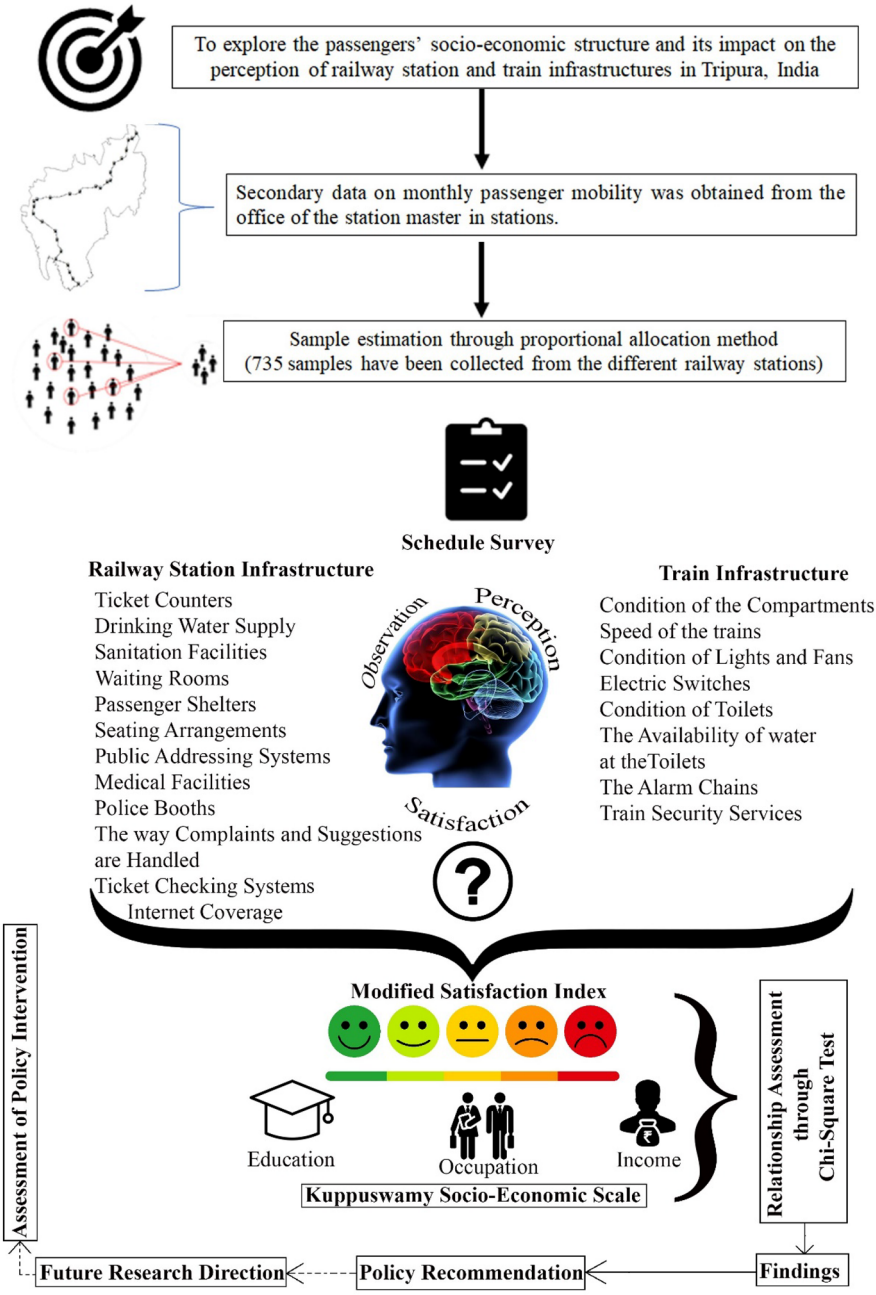

Fig. 2 Flow diagram of research procedures

by considering a 95% confidence level, a percentage picking a choice or response equal to 50% (0.5) and a marginal error of 4%. Secondary data are not available in 22.22% (6) of the railway stations, that is, in Nadiapur, Nalkata, S.K. Para, Jawaharnagar, Sekerkote and Thailik Twisa due to the non-functional ticket-selling system. Cochran's method has been used to determine the minimum population size (5) for those stations. The remaining 705 samples have been allocated through the proportional allocation method.

Sample data were collected directly from the stations and trains through the specifically arranged survey form. Descriptive statistics have been calculated to understand the phenomena associated with passenger demands. SPSS v.26 has been used for verifying the significance of the differences among groups of respondents.

5 Passenger perception and satisfaction

5.1 Passenger perception on station infrastructures

By considering passenger perception about station infrastructure, it can be observed that railway users express prevalently good judgements for the major part of the analysed attributes, and a moderate judgement for a few attributes such as sanitation and medical facilities, passenger shelters and police booths. Positive perception is a psychological mechanism that always envisions a satisfied attribute among the passengers (Halpern and Mwesiumo 2021; Shiwakoti et al. 2022). Therefore, it is established that the major part of the railway passengers of Tripura expressed satisfaction with all the station infrastructures, ranging from a very good to a moderate level. More specifically, about 54.01 and 7.76 per cent of the passengers believe that the ticket counters of the railway stations of Tripura are good or very good, respectively, which means they are pretty satisfied with the existing infrastructural attributes in different railway stations (Table 2). It can be observed that those passengers travelling from southern parts of Tripura have a better perception of ticket counters because railway stations in this area were established very recently, after 2014. About 28.30 per cent of the railway passengers of Tripura do not feel any perceptual difference about the infrastructural conditions of the ticket counters. 5.85 per cent and 4.08 per cent of the passengers have a bad or very bad perception of the conditions of the ticket counters, respectively, which reflects that the conditions of the ticket counters at a few railway stations are very poor (Table 1).

The availability of drinking water at the railway stations is also considered a minimum passenger amenity (Pravithra 2018). Indian Railways ensure safe drinking water supply to the passengers; groundwater is the primary source of drinking water for railway stations in India (Ministry of Railways 2017; Pandey 2015; Sahni et al. 2010). In Tripura, about 67.35 per cent of the passengers used to take drinking water from different railway stations; the remaining 32.65 per cent of the passengers do not drink the water from the railway station mainly due to quality. Only 2.42 per cent of the passengers consider the quality of drinking water supply at the railway stations very good, but the perceived quality of drinking water supply is good

Table 1 Passenger perception on station infrastructures (per cent values)

Station infrastructure attributes	Very good	Good	Moderate	Bad	Very bad
Ticket counters	7.76	54.01	28.30	5.85	4.08
Drinking water supply	2.42	46.26	40.00	8.08	3.23
Sanitation facilities	1.59	23.41	33.76	29.78	11.46
Waiting rooms	3.95	48.85	30.59	13.98	2.63
Passenger shelters	5.47	29.96	36.39	19.15	9.03
Seating arrangements	11.43	40.95	28.84	15.51	3.27
Public addressing systems	28.75	39.52	21.81	8.22	1.70
Medical facilities	0.00	43.48	51.30	3.48	1.74
Police booths	2.03	25.00	45.27	27.70	0.00
The way complaints and suggestions are handled	3.45	41.38	27.59	20.69	6.90
Ticket checking systems	8.20	29.51	40.98	15.30	6.01
Internet coverage	12.77	23.36	31.75	17.15	14.96

Table 2 Operational classification of railway stations of Tripura

Category of railway station	Class characteristics	Name of the railway stations	Percentage
B	A railway station where the Line Clear (LC) indication may be given before the line section within the station has been cleared for the reception of a train. Branch lines and routes with lower running speeds fall into this category	Churaibari, Dharmanagar, Panisagar, Pencharthal, Kumarghat, Manu, Ambassa, Mungiakami, Teliamura, Jirania, Agartala, Bishalgarh, Bishramganj, Udaipur, Garjee, Santirbazar, Belonia, Jolaibari, Manu Bazar and Sabroom	74.07
D	A station where a signalling system does not exist. Entire operation control by preceding and succeeding railway stations are called category D railway stations	Nadiapur, Nalkata, S.K. Para, Jawaharnagar, Jogendranagar, Sekerkote and Thailik Twisa	25.93

Source: Station Master, Bishramganj, 2019

according to 46.26 per cent of the passengers (Table 1). It has been observed that about 8.08 per cent and 3.23 per cent of the passengers said the quality of the drinking water supply is bad or very bad, respectively (Table 1).

Sanitation facilities are a developmental intervention to promote human health and hygiene. Sanitation facilities are basic passenger amenities in the railway stations of India, and the power and protocell for sanitation/cleanliness of railway stations are well-defined (Railway Board 2018). Different railway stations in Tripura have different kinds of sanitation facilities. It has been observed that 29.78 per cent and 11.46 per cent of the railway passengers have stated that sanitation facilities of the railway station of Tripura are bad or very bad, respectively (Table 1). It has been

found that about 23.41 per cent of the passengers say sanitation facilities of the railway stations of Tripura are good enough. 33.76 per cent of the railway passengers believe that sanitation facilities of the railway stations are moderate (Table 1).

In 2022, about 7,325 railway stations will have waiting rooms/halls. The waiting room is a minimum essential amenity in the railway stations, which is ensured to all categories of railway stations except Suburban Stations (SG) and Halt Stations (HG). It has been found that all 27 railway stations of Tripura have waiting room facilities. The perceptual service quality of the waiting rooms varies from station to station. It has been observed that about 3.95 per cent of the passengers of different railway stations in Tripura have a very good perception of waiting room facilities (Table 2). According to passenger opinion, a few railway stations of Tripura, like Dharmanagar, Panisagar, Mungiakami, Agartala, Udaipur, Garjee, Thailik Twisa and Sabroom railway station have high- quality waiting rooms. About 48.85 per cent of the state's railway passengers say the quality of waiting rooms at railway stations is good. About 30.59 per cent of the passengers has been found who do not to have a solid polarised perception of the infrastructural quality of the waiting rooms. The service quality of the waiting rooms was perceived as poor in the train stations of Churaibari, Nadiapur, Pencharthal, Nalkata, S. K. Para, Jawaharnagar and Jirania. About 2.63 per cent of railway passengers consider the infrastructural quality of the waiting rooms very bad; these conditions have been prevalently observed for most of the stations in northern Tripura. More specifically, about 80 per cent of Nadiapur railway station passengers perceived that the waiting rooms condition is very bad due to non-maintenance.

A passenger shelter is an essential amenity in the railway station for the passengers to get relief from the scorching heat and rain. An amount of 20,867.67 sq. metres of passenger shelter was found in the railway stations of Tripura, with an average value of passenger shelters of about 772.88 sq. metres (Roy and Mitra 2020). There are considerable variations in the passenger shelters found at the different railway stations: in Dharmanagar, the average passenger shelter area is about 3097 sq. metres, while in Nadiapur, no passenger shelter exists at all. According to the report of the Meteorological Department of India, during monsoon, Agartala has an average rainfall of 1922 to 2855 mm in summer, and an average temperature of 35 °C to 40 °C (Meteorological Centre 2020). Notably, insufficient passenger shelter infrastructure is a common phenomenon in Nadiapur station, directly influencing passenger perceptions. However, it has been observed that 5.47 per cent and 29.96 per cent of railway passengers believe that the perceptual quality of passenger shelters is very good and good, respectively (Table 2). The main reasons for their perception depend on the services like shelter during hot summer and rainy monsoon. According to the perception of 36.39 per cent of the passengers, the perceived quality of passenger shelters is moderate, and about 19.15 per cent of the passengers believe that passenger shelters at railway stations are bad. The small size, short length, poor seating capacity, and lack of electrical devices like lights, fans, and charging points within the passenger shelters create a negative passenger perception. The dissatisfaction level of 9.03 per cent of passengers is pretty high, which is the main stimulus expressed that the perceived quality of passenger shelters is very bad (Table 1).

The Ministry of Railways, Government of India, considers the seating arrangements a minimum essential passenger amenity at the stations. Under the prescribed minimum essential passenger amenities, 75 seats should be arranged on each platform for the B category of railway stations and 50 for the D category; for the A category of railway stations, 100 seats should be arranged on each platform.

It has been observed that about 74.07 per cent of the railway stations in Tripura fall into category B, where a minimum of 75 seats should be available; the remaining 25.93 per cent of the railway stations fall into category D, then 50 seats should be available for the passengers (Table 2).

From the survey, it has been observed that about 11.44 per cent of railway passengers think the seating arrangements at the station is very good. About 40.95 per cent of the passengers who regularly travelled feel that the seat arrangement is good enough. A moderate evaluation of seating arrangements at the railway stations is given by 28.84 per cent of the passengers. About 15.51 per cent and 3.27 per cent of the passengers reaffirm that the seating arrangements are bad and very bad, respectively (Table 1).

A Public Addressing (PA) system is an automated sound amplification and distribution system through a microphone, loudspeakers and amplifier for addressing people for announcements of movements of trains, for example. PA systems are used for fast and regulated communication with large groups of passengers. It is an essential facility provided by Indian Railways for the announcement to passengers and other railway users at the railway station areas, information regarding arrival, departure and the late running of trains, and essential information about railway traffic (Sharma et al. 2018). PA system's frequency without the loudspeakers' voice coils shall be within ± 3 dB from 100 to 10,000 Hz. The frequency range can be additionally limited up to 4000 Hz to improve speech intelligibility in noisy and reverberant locations (Ministry of Railways 2011). In Tripura, all railway stations have PA systems except category D, as reported in Table 2. The passenger perception of PA systems varies from station to station. It has been observed that the major part of the passengers of Bishalgarh (66.67%), Bishramganj (50.00%), Agartala (41.54%), Jolaibari (40.00%), Sabroom (38.46%) railway stations perceived that PA system of the respective station is very good. Kishangarh, Bishramganj, Jolaibari and Sabroom railway stations were developed recently; as a result, PA systems are new and well-functioning. Agartala is the largest and most crowded railway station in the state, which is the main reason for maintaining the PA system of this station.

According to 52.50 per cent of passengers of the Belonia railway station, the PA system of the station is good enough because it was installed in October 2019. By considering the overall sample, about 28.75 per cent and 39.52 per cent of the railway passengers believe that the PA system of railway stations of Tripura, respectively, is very good and good, and about 21.81 per cent of the passengers have a neutral opinion about the PA system. About 8.22 per cent and 1.70 per cent of the railway passengers felt that the PA system is bad and very bad, respectively (Table 1).

The Indian Ministry of Railways provided medical facilities at all railway stations. In Tripura, it has been observed that all railway stations have minimum medical facilities except for Nadiapur, Nalkata, S. K. Para, Jawaharnagar and Sekerkote.

Station Superintendents (SS) or in the absence of SS, Station Masters (SM) maintain a first aid box encompassing a wide range of medicines and dressing materials as recommended by All India Institute of Medical Sciences (AIIMS), New Delhi. If any passengers fall sick at the railway station, the front-line staff, i.e., SS/SM, make arrangements to offer a first-aid facility. Generally, SM retains a list of railway hospitals, government and private hospitals, and ambulance services near the railway station, along with their address, available facilities, and contact details.

It has been observed that only 15.64 per cent of the passengers of Tripura make use of medical facilities. Among them, about 43.48 per cent of the passengers say the perceived quality of the medical facilities is good. 51.30 per cent of the passengers who used medical facilities at the station agree with a moderate level of quality of the facilities (Table 1). About 3.48 and 1.74 per cent of the railway passengers consider the medical facilities of different railway stations bad and very bad, respectively. Their response was driven by the gap between the actual facility and their expectations.

In Tripura, only nine railway stations, namely Dharmanagar, Kumarghat, Manu, Ambassa, Teliamura, Agartala, Udaipur, Belonia and Sabroom have police booths from the Government Reserve Police Force (GRPF). The primary role of the GRPF is to maintain law and order within railway station premises. The stations fall under the jurisdiction of district police; Railway Protection Force (RPF) is the parent agency of GRPF. It has been found that about 2.20 per cent of the passengers gave a very good evaluation of security services at the railway stations of Tripura (Table 1). The passengers which evaluated the security services as being very good experienced that GRPF and RPF are always working hard to eliminate anti-social activities at the railway stations. About 25.00 per cent of the passengers believe the service quality of the police booths are good because GRPF sincerely control the vehicular and passenger traffic in the station premises, maintain law and order at station premises, prevent trains from overcrowding, perform surveillance in loaded passenger trains, examine the empty carriages on arrival at terminal stations like Sabroom, Agartala and Dharmanagar. About 45.27 per cent of the passengers are not much concerned about the police booths. Their judgement on security services at the railway stations of Tripura is moderate. However, many of them were very content with the fact that passengers are safe from anti-social activities due to the availability of GRPF at the stations. The expectation of 27.70 per cent of the railway passengers of Tripura is much higher on security services as is reflected in the passengers' bad evaluation (Table 1).

Indian Railways offer complaints and suggestion boxes at every railway station. Physically, it is located at the office of SS or SM. In Tripura, 22 railway stations have complaints and suggestion boxes, except for Nadiapur, Nalkata, S.K. Para, Jawaharnagar and Sekerkote. From the survey, it has been observed that only 3.94 per cent of the passengers have used these services. About 3.45 per cent of the passengers of different railway stations in Tripura replied that the service quality of handling complaints and suggestions is very good because they found that the railway authority has implemented their suggestions. A group of passengers (41.38%) who used to submit suggestions and complaints about the service quality of the railway station evaluate the service quality as good; they believe complaints and suggestions of

passengers are handled positively by the railway authority, which try to resolve the issues within the legitimates framework (Table 1). About 27.59 per cent of the railway passengers believe the service quality of handling complaints and suggestions are moderate because sometimes the railway company does not take action about the complaint. Feedback from 20.69 per cent and 6.90 per cent of the passengers of different railway stations are bad and very bad, respectively. An anonymous passenger of Dharmanagar railway station was aggrieved with the way complaints were handled because he filed a complaint many times, but unfortunately, the grievance committee of the railway station never addressed his issue (Table 1).

The ticket checkers regularly check the tickets in the running trains or at the exit points, because many passengers travel without ticket. About 61.5 per cent of the passengers perceive that ticket inspection is executed, while 21.0 per cent of the passengers say ticket inspection is not properly executed. This may be due to inadequate employees, whereas 17.5 per cent of the passengers say that ticket inspection is carried out occasionally (Roy et al. 2019). It has been observed that about 8.20 per cent of the passengers from different railway stations evaluate the service of ticket inspections as very good (Table 1), mainly the stations with passenger waiting rooms, such as Agartala, Dharmanagar, Jirania, and Sabroom. About 29.51 per cent of railway passengers considered the ticket-checking system as being good. According to them, only during the holidays the frequency of ticket inspections at different railway stations reaches a higher dimension, but on other days the ticket inspections are executed in a tolerable way. About 6.01 per cent of the passengers state that they do not encounter any ticket inspectors at the stations at all; in the same way, 15.30 per cent of the passengers do seldom encounter ticket inspectors at the railway stations of Tripura, so their evaluation on ticket inspections is bad (Table 1).

The Ministry of Railways of the Government of India announced the provision of free Wi-Fi (Internet) facilities to all the railway stations of India, excluding category D of railway stations. In Tripura, 77.78 per cent of the railway stations have Wi-Fi facilities except for the stations of Nadiapur, Nalkata, S. K. Para, Jawaharnagar, Sekerkote and Thailik Twisa stations. However, internet speed varies from station to station due to radio coverage, which developed a psychological state among the passengers. According to 12.77 per cent of the passengers, the internet coverage at the railway stations of Tripura is very good (Table 1). The internet speed provided by the RailTel corporation is very high and uninterrupted, which is reflected in the passenger perception. It has been found that 23.36 per cent of the passengers state that Wi-Fi coverage at different railway stations are good, their response being due to the speed of the internet and a user-friendly login portal. On the other hand, the opinion of 17.15 per cent and 14.96 per cent of the passengers on Wi-Fi facilities at different railway stations are bad and very bad, respectively (Table 1).

5.2 Passenger perception of train infrastructure

Recently, a broad-gauge line with new trains, including the DEMU train, was introduced in Tripura, which helps to heighten the opinion among the passengers. However, there are no added facilities on the trains. A few factors such as the condition of

the compartments, speed of the trains, condition of lights and fans, electric switches, the condition of the toilets, the availability of water at the toilets, the alarm chains and on-train security services are considered when passenger perceptions are collected in a systematic way (Roy et al. 2019).

By considering the passenger perception about the analysed train infrastructures, it has been observed that railway users expressed prevalently good opinions for the major part of the analysed attributes and a moderate opinion for a few attributes such as the condition of the toilets, the availability of water at the toilets and the alarm chains.

More specifically, it has been observed that about 67.48 per cent of the passengers perceive that the compartment conditions are good enough (Table 3). An additional 3.27 per cent of the passengers agree with the response of the modal group. About 26.53 per cent of the passengers neither agreed nor disagreed with the responding modal group. However, it has been found that 2.72 per cent of the passengers have an opposed point of view to the major part of the interviewed railway passengers. Among them, 0.95 per cent and 1.77 per cent of the passenger opinions on the condition of the compartments of the train running in Tripura are very bad and bad, respectively (Table 3).

From 1964 to 2014, people of Tripura used to travel inter-state or intra-state by a slow-moving meter gauge train. However, with the new broad-gauge line, the speed of the trains increased significantly. The passenger train speed in Tripura varies between 44 km/h to 86 km/h, reaching a maximum of 120 km/h for DEMU trains. Perception about the speed of a train varies from passenger to passenger. According to 4.63 per cent, passenger trains are very fast. Most of them generally travel by DEMU train, which is comparatively faster than regular passenger trains. About 11.5 per cent of the passengers in this group say that the speed of the trains is fast, especially at night time. According to 67.07 per cent of the interviewees, passengers believe the trains speed is quite fast compared to Meter Gauge. As per the perception of 25.99 per cent of the passengers, the speed of the trains is moderate (Table 3). Moreover, about 2.18 per cent and 0.14 per cent of the passengers say that the speed of the trains is slow and very slow, respectively.

Table 3 Passenger perception of train infrastructure (per cent values)

Train infrastructure attributes	Very good	Good	Moderate	Bad	Very bad
Condition of the compartments	3.27	67.48	26.53	1.77	0.95
Speed of the trains	4.63	67.07	25.99	2.18	0.14
Condition of lights and fans	0.00	78.23	16.87	4.49	0.41
Electric switches	6.03	59.35	26.28	6.80	1.55
Condition of toilets	0.15	29.90	36.67	24.59	8.69
Availability of water at the toilets	0.00	16.05	46.39	32.25	5.30
Alarm chains	0.00	18.18	72.73	9.09	0.00
On-train security services	0.47	63.95	12.09	22.09	1.40

About 64.5 per cent of the passengers do not encounter any problems with the light switches. In some coaches, the switches are broken; as a result, the passengers perceive this as negative (34.5 per cent). Many passengers do not even know that there are switches for lights and fans. During the quality assessment of the light and fan condition, about 78.23 per cent of passengers agreed with finding good infrastructural conditions, and 16.87 per cent of passengers were impartial on this issue (Table 3). About 4.49 per cent and 0.41 per cent of passengers, respectively, believe that light and fan conditions are bad and very bad.

Electric switches are rated as very good by 6.03 per cent of the passengers because the major part of the trains has modern functions (Table 3). Because of similar opinions, electric switches are evaluated as good by 59.35 per cent of the passengers. 26.28 per cent of the passengers are neutral on this issue, whereas electric switch conditions are rated as bad or very bad by 6.80 and 1.55 per cent of the passengers, respectively (Table 3). They stated that the switches are not working properly, which lets the passenger opinion on them sink to very low level.

The condition of the train toilets is bad for about 24.59 per cent of the passengers, and 8.69 per cent claim that their condition is very bad because of insufficient water supply, broken taps and bad smells from the toilets; while 36.67 per cent of the passengers say that toilet conditions are moderate because they have resigned themselves to the situation (Table 3). Only 29.90 per cent of the passengers say the toilet condition is good, probably because the train which runs in the southern area of Tripura has relatively new toilets and the toilet conditions are good. About 0.15 per cent of the passengers of Tripura believe that the conditions of on-train sanitation facilities is very good (Table 3).

About 32.25 per cent and 5.30 per cent of the passengers have a bad and very bad opinion on the availability of water at the toilets or from the taps, but in some toilets, water is not available because either the taps or the toilets are jammed (23.5 per cent of the passengers). About 46.39 per cent of the passengers are neither pleased nor dissatisfied with the availability of water in the train toilets or sinks (Table 3). About 16.05 per cent of the passengers think it is good to have water in a train toilet or sink. It is very hard to find any passengers who believe the availability of water in the train toilets or sinks is very good.

An alarm chain is an essential piece of equipment in the train; it is used only for emergency purposes. According to the Railways Act, pulling the emergency chain without a valid reason is an offence and attracts a jail term of three years or a fine of up to RS 1,000. Once the chain is pulled, the train has to be detained and the delay affects other trains on the stretch. In certain situations, pulling the chain in a train is valid; that is when a companion or child misses the train; the train catches fire; an elderly or differently-abled person is taking time to board the train while it starts running; an incident of theft or robbery occurs in the train or suddenly someone's health deteriorates on board. About 72.73 per cent of the passengers have a moderate confidence in the alarm chains. About 18.18 per cent of the passengers have a good opinion on the alarm chains; they found that alarm chains are performing well to stop the train in emergency situations, and 9.09 per cent of passengers differ from that opinion, because they think that the chain is not working properly because of

the poor maintenance of the train. It is very hard to find any passengers who believe the alarm chains of the train is very good (Table 3).

There are always security facilities in local trains as well as in express trains for passenger safety and security: about 0.47 per cent and 63.95 per cent of the passengers agree that on-train security services are very good and good, respectively. They found that the Railway Protection Force on the train to protect passengers from any kind of misdemeanour work well. 12.09 per cent of the passengers feel neutral towards the security services on the train. 22.09 per cent and 1.40 per cent of the passengers state that there are not enough on-train security services and have a bad and very bad opinion on them, respectively (Table 3).

5.3 Passenger satisfaction

Considering the MSI introduced in Sect. 3, passenger satisfaction with station and train infrastructures was assessed. It has been observed that passengers are highly satisfied with the medical facilities (0.786), public addressing systems (0.746), ticket counters (0.723), drinking water supply (0.623) and waiting rooms (0.521). Similarly, passengers are satisfied with the existing seating arrangements (0.472), ticket checking systems (0.278), the way complaints and suggestions are handled (0.238), the passenger shelters (0.114), and internet coverage (0.059). At the same time, passengers are dissatisfied with police booths and sanitation facilities (Fig. 3). It has been found that no passenger is highly dissatisfied with the existing station infrastructures (Fig. 3). According to MSI, the overall satisfaction level of the passengers about station infrastructures is 0.406, which indicates that passengers are satisfied with the station infrastructures.

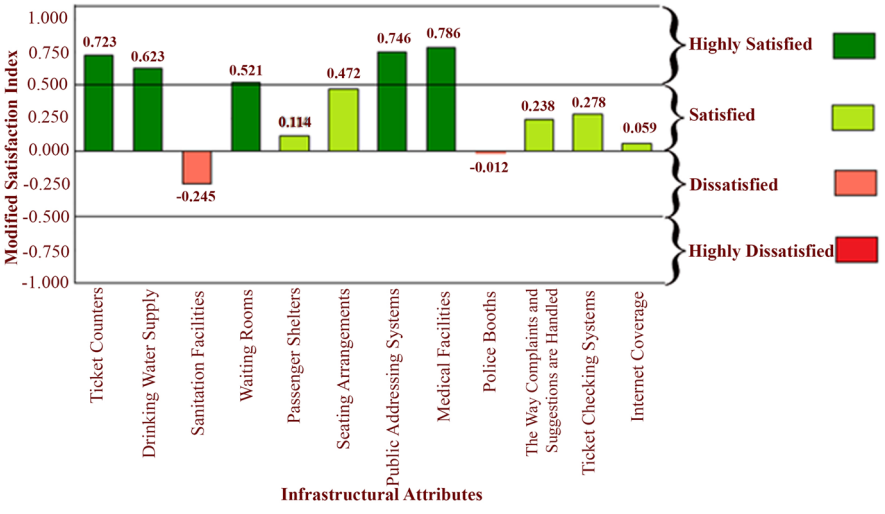

Fig. 3 Modified Satisfaction Index on station infrastructure

Eight infrastructural characteristics of the train, i.e., condition of the compartments, speed of the trains, condition of lights and fans, electric switches, condition of toilets, the availability of water at the toilets, the alarm chains and train security services, have been considered for understanding the level of passenger satisfaction using the MSI.

It has been observed that passengers are highly satisfied with the speed of the trains (0.938), the condition of the compartments (0.926), the condition of lights and fans (0.882), and the electric switches (0.774). In terms of the alarm chains (0.466) and train security services (0.333), railway passengers of Tripura are satisfied (Fig. 3).

On the other hand, it has been found that passengers are dissatisfied with the availability of water at the toilets (−0.051) and the condition of the toilets (−0.401). The overall level of satisfaction with train infrastructure is 0.751, which depicts those passengers are highly satisfied with train infrastructure (Fig. 4).

6 Causality of diversified passenger perception

The passenger perception of the railway transport system impacts policy formulation, which is essentially associated with long-term planning and infrastructure development (Solvoll et al. 2020; Matthews 1995; Poore 1993). At the individual level, the socio-economic structure is one of the important factors in the decision-making process because passenger needs vary due to the diversified characteristics of the railway users. The modified Kuppuswamy scale has been used to understand the socio-economic structure of the railway passengers of Tripura. Following this methodology, in Table 5 the basic socio-economic component for classifying the

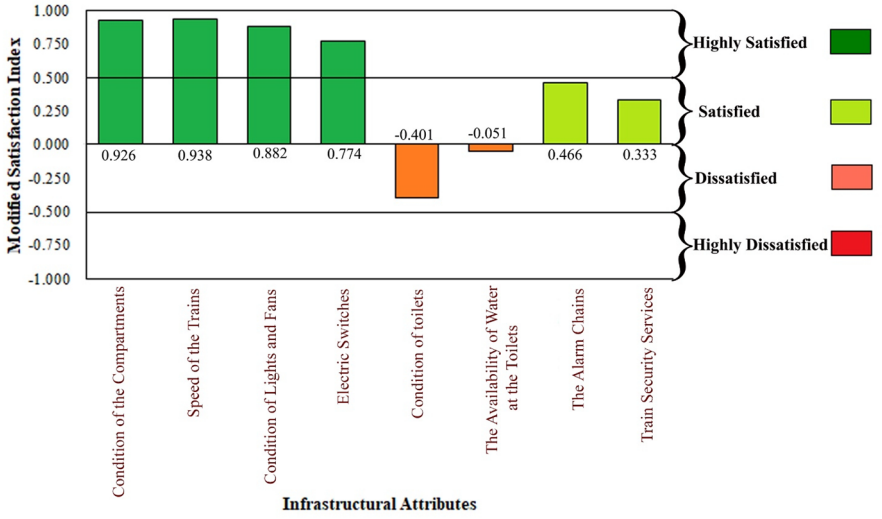

Fig. 4 Modified Satisfaction Index on train infrastructure

Table 4 Basic socio-economic component for classification of the railway passengers

(A)	Education	Score	Frequency	Percentage
1	Professional degree or honours	7	31	4.22
2	Graduate or post graduate	6	197	26.80
3	Intermediate or post high school diploma	5	118	16.05
4	High school certificate	4	183	24.90
5	Middle school certificate	3	123	16.73
6	Primary school certificate	2	69	9.39
7	Illiterate	1	14	1.90
(B)	Occupation	Score	Frequency	Percentage
1	Professional	10	108	14.69
2	Semi-professional	6	106	14.42
3	Clerical, shop owner, farmer	5	224	30.48
4	Skilled worker	4	170	23.13
5	Semi-skilled worker	3	49	6.67
6	Unskilled worker	2	24	3.27
7	Unemployed	1	54	7.35
(C)	Family per capita Income per month	Score	Frequency	Percentage
1	≥RS 42,876	12	51	6.94
2	RS 21,438–42,875	10	119	16.19
3	RS 16,078–21,437	6	138	18.78
4	RS 10,719–16,077	4	247	33.61
5	RS 6431–10,718	3	122	16.60
6	RS 2165–6430	2	56	7.62
7	≤RS 2164	1	2	0.27

Table 5 Socio-economic classification of the railway passengers

Score	Socioeconomic class	Sub-class	Frequency	Percentage
26–29	Upper class	Upper class (I)	59	8.03
16–25	Middle class	Upper middle class (II)	206	28.03
11–15		Lower middle class (III)	373	50.75
05–10	Lower class	Upper lower class (IV)	97	13.20
<5		Lower class (V)	0	0.00

Reference score: Bashar (2019)

railway passengers is reported, namely education, occupation and family income scores for each category included in the Kuppuswamy scale.

It has been found that 4.22 per cent of the railway passengers have professional or honours degrees. About 26.80 per cent of the passengers confirm that they have graduate or post-graduate levels of education, and 16.05 per cent have intermediate or post-high school diplomas. 24.90 per cent of the railway passengers of Tripura

have high-school certificates, whereas about 16.73 and 9.39 per cent of passengers who usually travel by train in Tripura have middle or primary school certificates (Table 4). It has been observed that most parts of the railway passengers of Tripura have a graduate or post-graduate level of education, which reveals that the educational standard is relatively high among railway passengers of the state.

Regarding the occupational structure, 14.69 per cent of the railway passengers are involved in professional work. Semi-professional works are done by 14.42 per cent of the railway passengers of Tripura. A modal group of railway passengers (30.48%) mainly covers clerics, shop owners, and farmers (Table 4). On the other hand, skilled, semi-skilled and unskilled workers are also using the railway transport system in Tripura for their daily movements (33.07%). About 7.35 per cent of the railway passengers of Tripura are identified as unemployed; mainly students, homemakers or job aspirants.

According to income level, it has been found that about 33.61 per cent of the railway passengers earn between RS 10,719 and RS 16,077. This income group is predominant in the travellers using the railways in Tripura. Moreover, 6.94 per cent of the railway passengers of Tripura have a comparatively higher income ($\geq$RS 42,876), whereas only 0.27 ($\leq$RS 2,164) have very poor income (Table 4).

The socio-economic class of each railway passenger has been calculated by using the linear additive function of education, occupation and income, and finally, the socio-economic classes were identified for all the samples, as reported in Table 5.

Notably, 8.03 per cent of the passengers belong to the upper socio-economic class. About 78.78 per cent belong to the middle-class, prevalently to the lower middle class. The remaining 13.20 per cent of the passengers using railway transportation in Tripura belong to the upper lower socio-economic class (Table 5). It is hard to find any railway passengers of Tripura belonging to the lower socio-economic class.

To understand the relationship between socio-economic status and passenger perception, a Chi-Square test has been performed. It has been found that the perception about the ticket counters, seating arrangements, public addressing systems, the way complaints and suggestions are handled, and ticket checking systems and the alarm chains of the train is not driven by the socio-economic structure of the passengers (Table 6). Perception and demand regarding those parameters are based on the cognitive learning process, and existentialism controls the knowledge level of the passengers. On the other hand, 70 per cent of infrastructural attributes, i.e., drinking water supply, sanitation facilities, waiting rooms, passenger shelters, medical facilities, police booths, internet coverage, condition of the compartments, speed of the trains, condition of lights and fans, electric switches, the condition of toilets, the availability of water at the toilets and on-train security services are evaluated according to the socio-economic structure of the passengers (Table 6).

It has been found that upper-class passengers who used to drink purified or bottled water at their homes have a very bad perception about drinking water supply at the stations. However, upper-lower class or lower middle-class passengers who usually take water from the well have a good perception of the drinking water supply provided at the station. Similarly, in terms of security services, upper-class passengers are mostly dissatisfied because they want more security as they usually carry

Table 6 Correlation between the Socio-economic class of the railway passengers and the passenger perception about the railway infrastructural attributes

No	Station infrastructure attributes	Chi-square	p Value	Significant at 5% level
1	Ticket counters	13.5354	0.33136	Not significant
2	Drinking water supply	21.2142	0.04733	significant
3	Sanitation facilities	24.0386	0.02982	Significant
4	Waiting rooms	194.8572	0.00001	Significant
5	Passenger shelters	212.6	0.00001	Significant
6	Seating arrangements	12.1826	0.43113	Not significant
7	Public addressing systems	12.623	0.39703	Not significant
8	Medical facilities	22.9838	0.02786	Significant
9	Police booths	70.8629	0.00001	Significant
10	The way complaints and suggestions are handled	9.6231	0.64899	Not significant
11	Ticket checking systems	6.5692	0.88472	Not significant
12	Internet coverage	88.668	0.00001	Significant
No	Train infrastructure attributes	Chi-square	p Value	Significant at 5% level
1	Condition of the compartments	69.9464	0.00001	Significant
2	Speed of the trains	38.4225	0.00013	Significant
3	Condition of lights and fans	41.4237	0.00004	Significant
4	Electric switches	34.9247	0.00048	Significant
5	Condition of toilets	55.4246	0.00001	Significant
6	Availability of water at the toilets	94.3376	0.00001	Significant
7	Alarm chains	0.6857	1.00000	Not significant
8	On-train security services	52.4216	0.00001	Significant

precious things with them. At the same time, upper-lower class or lower-middle-class passengers are not much concerned about security services as they are not so worried about any financial loss. This is found analogously in train security services, too. Only the alarm chain facility is rated very similarly by the members of the different socio-economic structure types (Table 6). Interestingly, the socio-economic structure of the passengers is mostly influencing their opinion and the associated demand for railway transportation in Tripura. It is found that passenger demand can be attributed to socio-economic factors. Social hierarchies are broadly defined as systems of social organisation in which some individuals enjoy a higher social status than others (Sidanius and Pratto 1999). Taking into account the socio-economic hierarchies of the railway passengers of Tripura, a demand hierarchy model has been developed based on the Maslow social hierarchy theory. Initially, we classified the passengers' social class using the Kuppuswamy socio-economic scale. Then we sorted the responses of the passengers by taking into account the social class of the

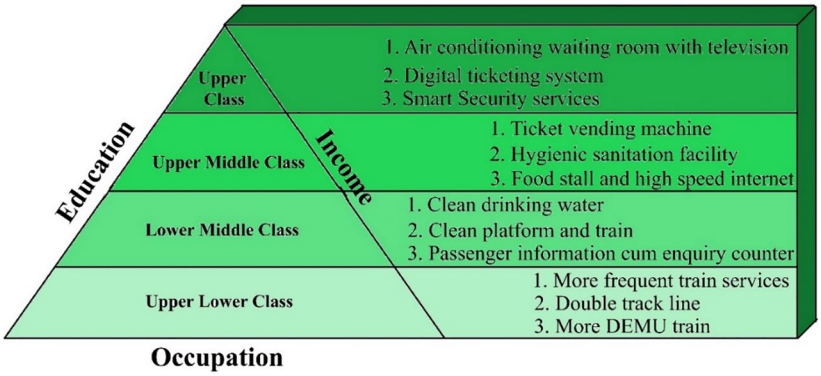

Fig. 5 Socio-economic structure-based demand hierarchy model for railway passengers

passengers. The top 3 responses were taken from each social class of the passengers. It has been observed that passengers with lower socio-economic hierarchies are only focusing on basic services like frequency of train services, an increasing number of DEMU trains, double track lines etc. (Fig. 5). Lower middle-class passengers demand quality service like cleanliness and want more information on the services provided. Upper-middle-class railway passengers of Tripura put more value on the quality of services. They usually demand hygienic sanitation facilities, ticket vending machines, food stalls, and high-speed internet facilities (Fig. 5).

It has been observed that upper-class railway passengers (8.01%) of Tripura demand an air-conditioning waiting room with television, a digital ticketing system, smart security services, and a high-speed train. Obviously, this demand can be addressed after fulfilling other demands placed by different socio-economic classes on certain characteristics more influencing a basic quality of service. More specifically, emphasis should be given to lower-middle-class passengers (50.67%) in the bottom-up policy-making approach.

7 Conclusion

The perceptions and demands of passengers on the railway infrastructure in Tripura are influenced by the cognitive learning process and the socio-economic structure of the passengers, which is determined by their education, occupation, and income. Their perception of infrastructure has not significantly changed in the post-Covid era. The study suggests that the top-down approach planning followed by Indian railways could be improved through a bottom-up approach, which involves catering to the needs and preferences of passengers. The study used a survey form and secondary data to analyse twelve parameters for railway station infrastructure and eight parameters for train infrastructure, calculating a MSI to determine the degree of passenger satisfaction. The

study found that socio-economic status is a significant factor in passenger perception of railway infrastructures. There is a need for effective strategies to enhance service quality and address the policy gap in railway infrastructures, considering the socio-economic background of passengers. However, the study has some limitations in its methodology design, and future research could broaden the geographic scope, use more rigorous sampling methods, and collect qualitative data for a more comprehensive understanding of passenger perceptions. Overall, this study has important implications for railway operators and policy-makers in Tripura and beyond.

The future development of the proposed research will focus on the assessment of the perceptions through a multi-level bottom-up approach at a micro-level regional scale. Every policy intervention will be measured in the light of individual viewpoints which reflect the social demand of a particular area.

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Declarations

Conflict of interest Authors disclose non-financial interests that are directly or indirectly related to the work submitted for publication.

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