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Pedestrianisation and Sustainable Tourist Behaviour in MG Marg, Gangtok

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ABSTRACT

Rapid tourism growth in Himalayan urban centres has intensified concerns regarding environmental degradation, congestion, socio-cultural transformation, and sustainability management within ecologically fragile mountain destinations. In this context, the present study examines sustainable urban tourism behaviour in MG Marg, Gangtok, one of the most prominent pedestrianised tourism spaces in the Eastern Himalayas. The study aims to identify the major behavioural dimensions influencing tourists' and vendors' perceptions regarding environmental sustainability, cultural preservation, service quality, accessibility, and local economic participation.

The research is based on primary data collected through structured questionnaire surveys conducted among 100 randomly selected tourists and local vendors in MG Marg. A quantitative and analytical research design was adopted using Principal Component Analysis (PCA) to reduce multiple correlated sustainability indicators into interpretable latent behavioural dimensions. The study incorporated variables related to environmental sustainability, socio-economic sustainability, cultural preservation, resource efficiency, accessibility, service quality, experiential satisfaction, and future behavioural intention.

The PCA results identified seven principal components explaining 68.544% of the total variance. The extracted components highlighted the significance of service quality, environmental comfort, waste management, cultural authenticity, socio-cultural interaction, and local economic participation in shaping sustainable tourism behaviour within the pedestrianised market environment.

The findings reveal that pedestrianisation has positively contributed to reduced congestion, improved walkability, enhanced tourism experience, and stronger environmental awareness among respondents. Additionally, local entrepreneurship, heritage preservation, and community interaction emerged as important dimensions of sustainable urban tourism perception.

The study concludes that MG Marg represents a successful model of sustainable urban tourism transformation within the Himalayan region where environmental management, tourism development, and community participation coexist within a pedestrian-oriented public space. The research further emphasises the importance of integrated sustainability planning, behavioural awareness, ecological conservation, and carrying-capacity management for ensuring long-term urban tourism sustainability in fragile mountain destinations.

Keywords: Sustainable Urban Tourism, Pedestrianisation, Principal Component Analysis (PCA), MG Marg, Gangtok, Himalayan Tourism, Sustainable Tourist Behaviour, Environmental Sustainability,

INTRODUCTION

The rapid expansion of tourism activities across urban destinations has intensified global concern regarding the environmental, socio-cultural, and economic sustainability of tourism-dependent spaces (Buckley, 2012; Budeanu, 2015). Sustainable tourism emerged as a critical response to the ecological degradation and socio-spatial inequalities generated by mass tourism models, advocating a balanced relationship between tourism development, environmental conservation, and community wellbeing (Buckley, 2012).

Contemporary sustainable tourism discourse increasingly emphasises the integration of environmental protection, socio-cultural preservation, and equitable economic growth within destination planning frameworks through the principles of the

Triple Bottom Line approach (Kiss, 2004). Consequently, sustainable tourism is now recognised not merely as an alternative tourism model but as a comprehensive governance framework applicable across diverse tourism landscapes and spatial contexts (Budeanu, 2015).

Within sustainable tourism literature, tourist behaviour and perception have emerged as central determinants influencing destination sustainability outcomes and environmental resilience (Zsóka et al., 2013). Sustainable tourist behaviour encompasses environmentally responsible consumption practices, respect for local socio-cultural systems, and participation in conservation-oriented activities during travel experiences (Chang et al., 2013). Theoretical models such as the Theory of Planned Behaviour argue that tourists' sustainable behavioural intentions are shaped by environmental awareness, subjective norms, and perceived behavioural control (Armitage & Conner, 2001). However, previous studies have identified a persistent gap between environmental attitudes and actual sustainable practices within tourism spaces, indicating that tourist behaviour is strongly influenced by contextual destination-specific conditions and spatial experiences (Antonetti, 2014). Therefore, understanding the behavioural dimensions of sustainability within tourism destinations has become a major research priority in tourism psychology and urban tourism studies.

The growing emphasis on sustainable urban tourism has further expanded scholarly attention toward the relationship between tourism, urban planning, and public space management within densely populated city environments (Clavé, 2019). Unlike conventional ecotourism destinations, urban tourism systems are characterised by complex interactions between tourists, residents, infrastructure, and commercial spaces, often generating environmental congestion, socio-spatial inequality, and infrastructural stress (Buhalis, 2020). In response, pedestrian tourism spaces, green infrastructure, and eco-friendly urban planning strategies are increasingly promoted as mechanisms for improving urban sustainability and enhancing tourist experience (Mansourihanis, 2026). Pedestrianisation, in particular, significantly reduces vehicular pollution, improves walkability, enhances socio-cultural interaction, and strengthens the aesthetic quality of tourism environments (Chebe et al., 2025). Consequently, sustainable urban tourism increasingly depends on the efficient management of public spaces and tourism-commercial interactions within urban market systems.

These concerns become substantially more critical within fragile mountain environments, particularly across the Himalayan region, where tourism expansion directly intersects with ecological vulnerability and severe spatial constraints (Butler, 2020). Himalayan tourism destinations are characterised by steep topography, limited infrastructural carrying capacity, climatic instability, and ecologically sensitive landscapes, making them highly vulnerable to environmental degradation generated by overtourism and unregulated urbanisation (India Today NE, 2025). The concentration of tourist flows within mountain towns has intensified waste generation, groundwater depletion, vehicular congestion, biodiversity loss, and socio-cultural commodification across several Himalayan destinations (McDuie-Ra, 2026). Simultaneously, climate change acts as a force multiplier by accelerating glacial retreat, increasing landslide frequency, and intensifying hydro-meteorological risks within mountain tourism systems (Butler, 2020). Consequently, sustainable tourism management within Himalayan urban centres requires integrated approaches combining ecological conservation, spatial planning, behavioural regulation, and infrastructural resilience.

Situated within the ecologically fragile Eastern Himalayas, the Indian state of Sikkim represents a significant case study for examining sustainable tourism governance within mountain urban environments (Dam, 2025). Over the past two decades, Sikkim has actively promoted eco-tourism development through policies emphasising biodiversity conservation, community participation, waste reduction, and environmentally sensitive tourism practices (Dam, 2025). Nevertheless, rapid tourism growth has simultaneously intensified environmental pressure across major urban destinations, particularly within the capital city of Gangtok, where rising tourist density has generated challenges related to traffic congestion, waste management, and urban environmental stress (McDuie-Ra, 2026). Despite progressive sustainability initiatives such as single-use plastic ban, organic tourism promotion, and ecotourism zoning, maintaining effective carrying capacity within densely concentrated urban tourism spaces remains a critical challenge for the state (Gachuiwo et al., 2025).

Within Gangtok, Mahatma Gandhi Marg (MG Marg) has emerged as one of the most prominent examples of sustainable urban tourism space transformation in the Indian Himalayas, where a historically congested commercial corridor was systematically pedestrianised and redeveloped into a vehicle-free public space aimed at enhancing walkability, environmental quality, and overall tourism experience (Chatterjee et al., 2017). The pedestrianisation initiative substantially reduced vehicular emissions, enhanced public accessibility, improved aesthetic conditions, and increased commercial vitality within the city core (Chatterjee et al., 2017). Consequently, MG Marg is frequently celebrated as a successful model of sustainable urban tourism planning and public space regeneration within mountainous urban environments. However, despite its increasing tourism significance, existing studies primarily focus on infrastructural transformation, urban aesthetics, and policy narratives while providing limited attention toward understanding tourist behavioural sustainability within this highly regulated market space (McDuie-Ra, 2026).

Simultaneously, methodological limitations remain evident within sustainable tourism research conducted in Himalayan urban destinations. Existing studies in Sikkim and similar mountain tourism regions predominantly rely on descriptive analysis, qualitative ethnography, or policy-based assessments to examine tourism impacts and visitor perception (Chatterjee et al., 2017; McDuie-Ra, 2026). Limited research has employed advanced multivariate statistical approaches capable of identifying the latent psychological and behavioural dimensions influencing sustainable tourist behaviour within complex urban tourism environments. In this context, Principal Component Analysis (PCA) provides a robust methodological framework for reducing large sets of correlated behavioural indicators into interpretable latent dimensions representing tourist perception, environmental consciousness, spatial comfort, and sustainability-oriented behaviour (Harman, 1976; Jolliffe & Cadima, 2016). PCA has increasingly been recognised as an effective analytical tool for examining sustainable tourism indicators, behavioural intentions, and tourist perception structures within multidimensional tourism systems (Punzo et al., 2022).

Despite growing literature on sustainable tourism, three major research gaps remain insufficiently addressed. First, limited studies have examined sustainable urban tourism behaviour specifically within Himalayan pedestrian market spaces characterised by ecological fragility, spatial density, and tourism-commercial interaction (Butler, 2020; India Today NE, 2025). Second, there remains a notable absence of PCA-based behavioural sustainability studies within the context of Sikkim tourism research, restricting empirical understanding of the latent dimensions governing sustainable tourist behaviour in the region (McDuie-Ra, 2026). Third, MG Marg itself has received minimal scholarly attention from a behavioural sustainability perspective despite functioning as one of the most significant pedestrian tourism spaces in the Eastern Himalayas (Chatterjee et al., 2017).

Against this backdrop, the present study aims to examine sustainable urban tourism behaviour within MG Marg, Gangtok, through the application of Principal Component Analysis. The study seeks to identify the latent behavioural dimensions shaping tourist perception, environmental responsibility, sustainable consumption practices, and destination experience within this Himalayan market space. By integrating sustainable tourism theory, urban spatial analysis, and multivariate behavioural modelling, the research contributes to the growing discourse on sustainable urban tourism within ecologically vulnerable mountain destinations. Furthermore, the findings are expected to provide data-driven insights for policymakers, urban planners, and tourism authorities striving to balance tourism growth, environmental sustainability, and public space management within Himalayan urban tourism systems.

METHODOLOGY

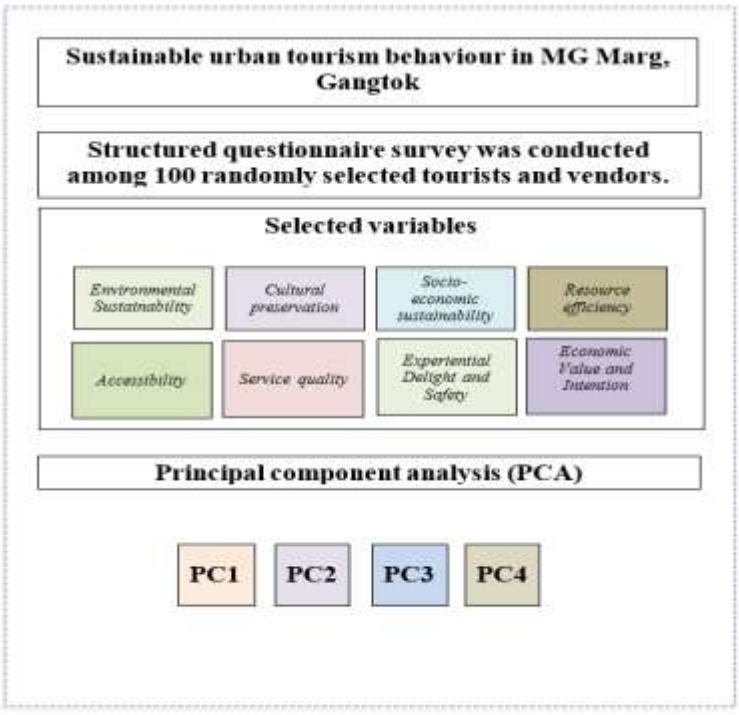


Figure 1 : Methodological flowchart

The present study adopted a quantitative, descriptive, and analytical research design (Figure 1) to examine sustainable urban tourism behaviour within MG Marg, Gangtok, Sikkim. The study aimed to identify the major behavioural dimensions influencing tourists' and vendors' perceptions regarding environmental sustainability, public space management, tourism experience, and sustainable consumption practices within a pedestrianised Himalayan urban market environment. A cross-sectional survey approach was employed to collect primary data from respondents during the field investigation period.
The research integrated behavioural tourism analysis with multivariate statistical modelling through the application of Principal Component Analysis (PCA). This approach was selected to reduce multiple correlated behavioural variables into a smaller set of interpretable latent components representing the dominant dimensions of sustainable urban tourism behaviour.

Data Sources
The study was primarily based on primary data collected through field survey methods. Secondary data were also utilised to support the theoretical and conceptual framework of the research. Secondary information was collected from journal articles, government reports, tourism policy documents, books, online databases, and published research relating to sustainable tourism, urban tourism, pedestrianisation, and Himalayan tourism systems.

Sampling Technique and Sample Size
A total of 100 respondents were selected for the study through random sampling techniques. The sample consisted of both tourists and local vendors operating within the MG Marg area. The inclusion of these two respondent groups enabled the study to capture diverse perspectives regarding sustainable tourism practices, environmental behaviour, destination experience, and tourism-commercial interaction within the market space.

Respondents were approached directly within different sections of MG Marg during peak tourism and commercial activity periods. Random selection was maintained to minimise sampling bias and ensure representative behavioural responses across different age groups, occupations, and visitor categories.

Methods of Data Collection
Primary data were collected through structured questionnaire surveys, field observation, and informal interaction with respondents. The questionnaire is included variables related to:

Table 1 Sustainability Indicators and Variable Coding Framework

Variables	*Code*	*Indicator*
Environmental Sustainability	E1	Eco-friendly packaging encouraged
	E2	Efficient waste management
	E3	Environmental awareness information available
Cultural Preservation	C1	Promotion of local traditions
	C2	Indigenous craftsmanship authenticity
	C3	Contribution to heritage preservation
Socio-Economic Sustainability	SE1	Support to local artisans and vendors
	SE2	Opportunities for local entrepreneurs
	SE3	Preference for local economy over malls
Resource Efficiency	RE1	Natural lighting and ventilation
	RE2	Sustainable water facility management
	RE3	Energy-saving measures visible
Accessibility	A1	Accessibility through eco-friendly transport
	A2	Signs for eco-friendly facilities
	A3	Reduced congestion and noise pollution
Service Quality	SQ1	Respectful and professional service
	SQ2	Sustainable local food services
	SQ3	Product origin information available
Experiential Delight and Safety	EDS1	Delight and relaxation experience
	EDS2	Cultural interaction with sellers
	EDS3	Safe and secure environment
Economic Value and Intention	EVF1	Fair price for sustainable products
	EVF2	Recommendation and revisit intention

A five-point Likert Scale was used to measure respondent perceptions and behavioural attitudes, where:

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Neutral
- 4 = Agree
- 5 = Strongly Agree

Field observation methods were additionally used to examine pedestrian movement, waste disposal practices, crowd concentration, tourism-commercial interaction, and environmental conditions within the study area.

Data Processing and Statistical Analysis

Collected data were coded, tabulated, and analysed using Statistical Package for the Social Sciences (SPSS). Descriptive statistical techniques such as frequency distribution, percentage analysis, mean values, and standard deviation were initially applied to understand respondent characteristics and general perception patterns.

To identify the dominant latent behavioural dimensions influencing sustainable urban tourism behaviour, Principal Component Analysis (PCA) was employed. PCA was selected because of its effectiveness in reducing large numbers of correlated variables into smaller interpretable components without substantial loss of information.

Before applying PCA, the suitability of the dataset for factor extraction was tested through:

- Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy
- Bartlett's Test of Sphericity

Components with Eigenvalues greater than 1 were retained following Kaiser's criterion. Varimax Rotation was applied to improve interpretability and simplify factor structure. Variables with factor loadings greater than 0.50 were considered significant contributors to a component.

Study area

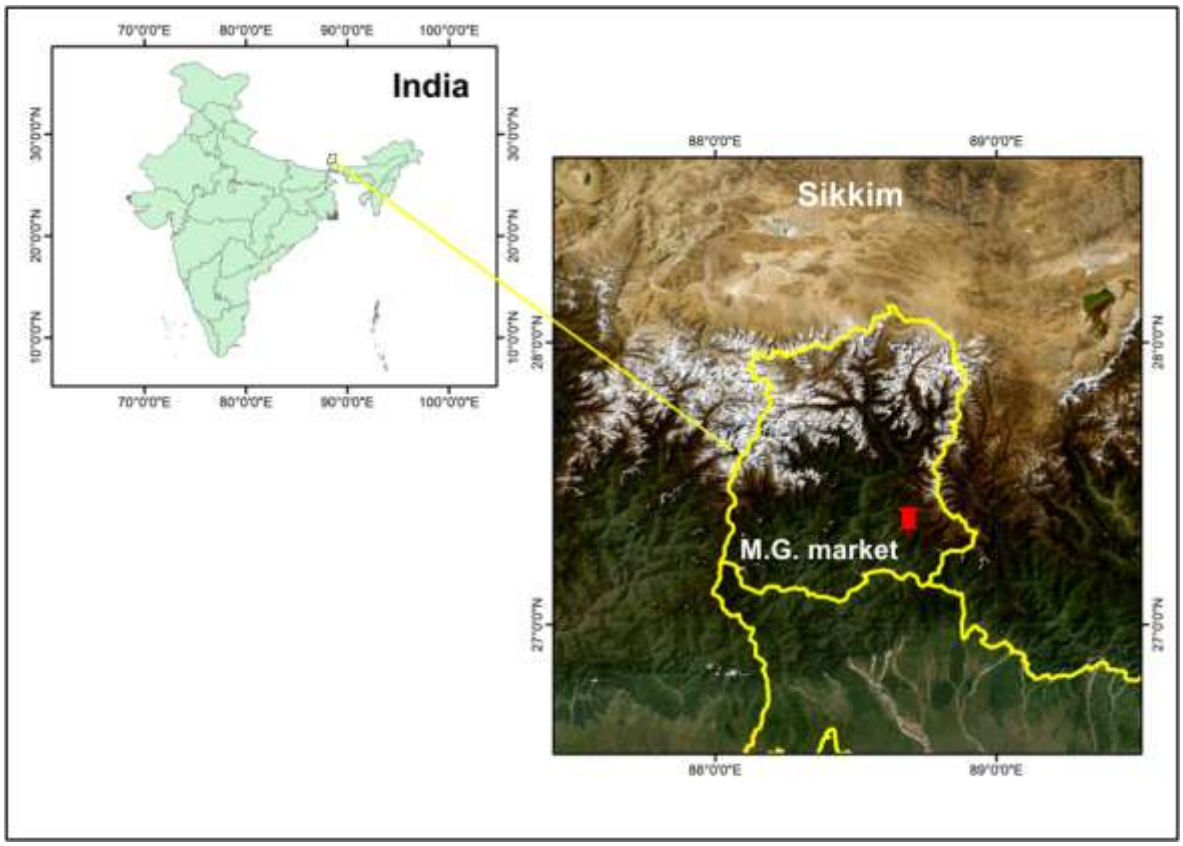


Figure 2 Study Area

RESULT & DISCUSSION

Table 2 Correlation Matrix of Sustainable Urban Tourism Behaviour Variables

	E1	E2	C1	C2	C3	SE1	SE2	RE1	RE2	RE3	A1	A2	A3	SQ1	SQ2	EDS1	EDS2	EDS3	EVF1	EVF2
E1	1.000	0.131	0.344	-0.142	0.058	-0.286	0.216	-0.117	0.072	0.172	0.060	-0.030	-0.187	-0.027	-0.076	0.101	0.224	-0.183	0.128	-0.267
E2	0.131	1.000	0.027	-0.092	0.212	0.146	-0.227	0.017	0.018	0.169	-0.236	0.030	0.232	0.135	-0.101	-0.042	0.032	0.045	0.196	-0.013
C1	0.344	0.027	1.000	0.092	0.224	0.194	0.374	-0.048	-0.071	0.162	0.081	0.367	-0.085	-0.027	0.160	0.039	0.325	-0.067	0.131	0.128
C2	-0.142	-0.092	0.092	1.000	0.092	-0.101	-0.036	-0.149	-0.165	0.355	-0.294	-0.333	-0.023	0.198	0.211	0.180	-0.176	0.127	0.170	-0.107
C3	0.058	0.212	0.224	0.092	1.000	0.305	-0.077	0.082	0.212	0.168	-0.124	-0.017	-0.114	0.125	-0.089	-0.210	0.009	-0.127	0.321	0.074
SE1	-0.286	0.146	0.194	-0.101	0.305	1.000	0.027	0.296	0.070	-0.080	-0.083	0.351	0.236	0.104	0.034	-0.040	0.189	0.107	0.118	0.333
SE2	0.216	-0.227	0.374	-0.036	-0.077	0.027	1.000	0.060	0.111	-0.011	0.282	0.155	-0.193	-0.145	0.113	0.214	0.098	-0.277	0.072	-0.066
RE1	-0.117	0.017	-0.048	-0.149	0.082	0.296	0.060	1.000	0.030	0.127	-0.111	-0.151	-0.122	-0.221	-0.173	-0.060	0.020	0.129	-0.091	0.501
RE2	0.072	0.018	-0.071	-0.165	0.212	0.070	0.111	0.030	1.000	-0.189	0.144	0.071	-0.034	0.174	0.180	-0.198	0.114	-0.207	0.292	-0.098
RE3	0.172	0.169	0.162	0.355	0.168	-0.080	-0.011	0.127	-0.189	1.000	-0.198	-0.201	-0.073	-0.102	-0.105	0.180	0.074	0.197	-0.057	0.272
A1	0.060	-0.236	0.081	-0.294	-0.124	-0.083	0.282	-0.111	0.144	-0.198	1.000	0.383	0.217	-0.074	0.098	-0.035	0.244	-0.321	-0.127	-0.133
A2	-0.030	0.030	0.367	-0.333	-0.017	0.351	0.155	-0.151	0.071	-0.201	0.383	1.000	0.122	-0.064	0.041	-0.064	0.309	-0.118	-0.128	-0.040
A3	-0.187	0.232	-0.085	-0.023	-0.114	0.236	-0.193	-0.122	-0.034	-0.073	0.217	0.122	1.000	0.452	0.205	0.099	-0.214	0.093	0.154	0.095
SQ1	-0.027	0.135	-0.027	0.198	0.125	0.104	-0.145	-0.221	0.174	-0.102	-0.074	-0.064	0.452	1.000	0.351	0.045	-0.256	-0.039	0.581	-0.116
SQ2	-0.076	-0.101	0.160	0.211	-0.089	0.034	0.113	-0.173	0.180	-0.105	0.098	0.041	0.205	0.351	1.000	0.167	0.031	-0.159	0.434	-0.062
EDS1	0.101	-0.042	0.039	0.180	-0.210	-0.040	0.214	-0.060	-0.198	0.180	-0.035	-0.064	0.099	0.045	0.167	1.000	-0.241	0.053	0.004	-0.120
EDS2	0.224	0.032	0.325	-0.176	0.009	0.189	0.098	0.020	0.114	0.074	0.244	0.309	-0.214	-0.256	0.031	-0.241	1.000	-0.056	-0.222	0.019
EDS3	-0.183	0.045	-0.067	0.127	-0.127	0.107	-0.277	0.129	-0.207	0.197	-0.321	-0.118	0.093	-0.039	-0.159	0.053	-0.056	1.000	-0.140	0.530
EVF1	0.128	0.196	0.131	0.170	0.321	0.118	0.072	-0.091	0.292	-0.057	-0.127	-0.128	0.154	0.581	0.434	0.004	-0.222	-0.140	1.000	-0.180
EVF2	-0.267	-0.013	0.128	-0.107	0.074	0.333	-0.066	0.501	-0.098	0.272	-0.133	-0.040	0.095	-0.116	-0.062	-0.120	0.019	0.530	-0.180	1.000

The correlation matrix presented in Table 3 demonstrates the interrelationship among the twenty sustainability indicators associated with environmental behaviour, socio-cultural perception, service quality, accessibility, and economic sustainability within MG Marg. Several moderate positive correlations indicate the existence of interconnected behavioural patterns among respondents. Strong positive associations were observed between service quality and fair pricing perception (SQ1–EVF1 = 0.581), reduced congestion and service quality (A3–SQ1 = 0.452), sustainable food service and economic value perception (SQ2–EVF1 = 0.434), and natural lighting with revisit intention (RE1–EVF2 = 0.501). These relationships suggest that tourists who perceived the pedestrian environment as organised, accessible, and environmentally comfortable were also more likely to report higher levels of satisfaction, economic trust, and behavioural loyalty toward the destination. Similar interrelationships between environmental quality, visitor satisfaction, and behavioural intention have been identified in sustainable urban tourism studies, particularly within pedestrian-oriented tourism spaces where infrastructural comfort directly shapes tourist experience.

Table 3 Total Variance Explained through Principal Component Analysis

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.697	13.486	13.486	2.697	13.486	13.486	2.458	12.288	12.288
2	2.608	13.040	26.525	2.608	13.040	26.525	2.190	10.948	23.236
3	2.232	11.159	37.684	2.232	11.159	37.684	2.099	10.496	33.732
4	1.988	9.940	47.624	1.988	9.940	47.624	1.980	9.902	43.634
5	1.674	8.369	55.993	1.674	8.369	55.993	1.798	8.989	52.623
6	1.392	6.960	62.953	1.392	6.960	62.953	1.721	8.604	61.228
7	1.118	5.591	68.544	1.118	5.591	68.544	1.463	7.316	68.544
8	.977	4.886	73.430						
9	.845	4.225	77.656						
10	.767	3.834	81.490						
11	.662	3.311	84.801						
12	.542	2.709	87.510						
13	.520	2.598	90.108						
14	.413	2.064	92.172						
15	.378	1.889	94.061						
16	.369	1.844	95.906						
17	.304	1.518	97.424						
18	.219	1.097	98.521						
19	.172	.861	99.382						
20	.124	.618	100.000						

Extraction Method: Principal Component Analysis.

The PCA suitability assessment justified the application of multivariate dimensional reduction techniques for analysing behavioural sustainability indicators. The Total Variance Explained table in Figure 3 reveals that seven principal components with Eigenvalues greater than 1 were extracted following Kaiser's criterion. Together, these seven components explained 68.544% of the total variance, indicating satisfactory explanatory power for behavioural interpretation within social science research. Component 1 explained 13.486% of the variance, followed by Component 2 explaining 13.040%, while Components 3, 4, 5, 6, and 7 contributed 11.159%, 9.940%, 8.369%, 6.960%, and 5.591% respectively. The cumulative variance exceeded 50% after the fifth component, demonstrating that the extracted components collectively captured a substantial proportion of the behavioural variability associated with sustainable urban tourism practices in MG Marg. The gradual reduction in Eigenvalues further indicates that sustainable tourism perception in the study area is governed by multiple latent behavioural dimensions rather than a single homogeneous sustainability construct.

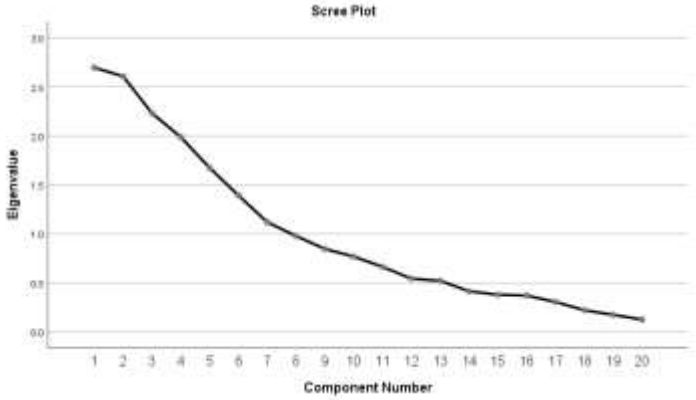


Figure 3 Scree Plot Showing Eigenvalue Distribution of PCA Components

The Scree Plot presented in Figure 4 further validates the seven-component solution. The curve exhibits a sharp decline during the initial components followed by a gradual flattening after the seventh component, indicating the transition from meaningful variance contribution to random residual variance. The scree inflection confirms that the first seven components contain the most statistically significant behavioural information. Similar scree patterns have been observed in PCA-based tourism behavioural studies where sustainability perception emerges as a multidimensional construct involving environmental consciousness, experiential quality, socio-cultural interaction, and infrastructural satisfaction.

Table 4 Initial Component Matrix of PCA

Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
E1	.355	-.133	-.172	.563	-.183	.304	.331
E2	-.091	.230	.349	.136	-.293	.589	.294
C1	.327	-.198	.361	.581	.341	.116	-.143
C2	-.215	.481	-.208	.410	.255	-.128	-.448
C3	.034	.169	.496	.386	-.421	-.080	-.121
SE1	-.049	-.030	.799	-.102	.170	-.075	-.017
SE2	.443	-.279	-.045	.329	.337	-.386	.288
RE1	-.418	-.269	.365	.051	-.062	-.448	.413
RE2	.414	.099	.259	-.075	-.401	-.356	.082
RE3	-.394	.018	.023	.628	.156	.178	.032
A1	.566	-.344	-.019	-.302	.218	.011	.077
A2	.450	-.379	.395	-.207	.259	.294	-.142
A3	.058	.424	.286	-.451	.351	.355	.207
SQ1	.230	.768	.212	-.108	.050	.061	.014
SQ2	.405	.437	.095	.008	.389	-.254	-.185
EDS1	-.009	.191	-.291	.196	.572	.046	.428
EDS2	.256	-.544	.270	.197	-.031	.177	-.333
EDS3	-.671	.027	.162	-.043	.250	.133	-.095
EVF1	.343	.693	.271	.221	-.126	-.176	.110
EVF2	-.577	-.200	.520	-.010	.257	-.198	.078

Extraction Method: Principal Component Analysis.
a. 7 components extracted.

Table 5 Rotated Component Matrix after Varimax Rotation

Rotated Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
E1	-.187	-.406	.090	.142	.119	.514	.468
E2	.144	.041	.059	.036	.070	-.144	.818
C1	.096	.057	.258	.713	.068	.409	.065
C2	.286	-.147	.752	-.050	-.075	-.046	-.304
C3	.102	.146	.277	.168	.648	-.061	.251
SE1	.280	.645	-.115	.368	.167	-.102	.078
SE2	-.024	.021	-.126	.181	.063	.783	-.251
RE1	-.272	.736	-.039	-.231	.198	.219	.029
RE2	.167	-.018	-.312	-.049	.640	.086	-.048
RE3	-.141	.148	.655	.082	-.149	.198	.262
A1	.019	-.160	-.602	.319	-.113	.219	-.178
A2	.082	.045	-.444	.708	-.105	-.020	.035
A3	.636	.159	-.289	-.004	-.378	-.187	.264
SQ1	.797	-.097	.034	-.131	.122	-.109	.132
SQ2	.650	-.090	.041	.133	.048	.174	-.362
EDS1	.231	-.018	.137	-.190	-.523	.536	.042
EDS2	-.311	-.028	-.057	.702	.153	-.009	.000
EDS3	-.055	.464	.335	-.052	-.369	-.309	.058
EVF1	.683	-.083	.141	-.126	.467	.179	.137
EVF2	-.101	.839	.148	.064	-.099	-.067	-.019

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 16 iterations.

The Rotated Component Matrix shown in Figure 5 provides clearer interpretability of the extracted behavioural dimensions through Varimax rotation. Rotation improved the separation of variables and reduced cross-loading effects, thereby facilitating meaningful conceptual interpretation of the latent sustainability dimensions.

Component 1 exhibits high positive loadings for respectful and professional service (SQ1 = 0.797), sustainable local food services (SQ2 = 0.650), reduced congestion and noise pollution (A3 = 0.636), and fair price perception for sustainable products (EVF1 = 0.683). This component can be interpreted as the "Urban Service Efficiency and Tourist Satisfaction Dimension." The strong clustering of service quality, pricing fairness, and congestion reduction suggests that respondents associated pedestrianisation with improved tourism management efficiency and enhanced commercial experience. The absence of vehicular traffic within MG Marg likely contributes to increased walkability, lower environmental stress, and greater interaction between tourists and commercial establishments. Earlier studies on pedestrian tourism corridors similarly argue that vehicle-free urban spaces improve tourism functionality, public comfort, and destination attractiveness through enhanced mobility and environmental quality.

Component 2 demonstrates strong positive loadings for revisit intention (EVF2 = 0.839), natural lighting and ventilation (RE1 = 0.736), support to local artisans and vendors (SE1 = 0.645), and safe and secure environment perception (EDS3 = 0.464). This component may be conceptualised as the "Environmental Comfort and Behavioural Loyalty Dimension." The strong relationship between environmental comfort variables and revisit intention indicates that tourists' future destination preference is heavily influenced by perceptions of safety, climatic comfort, and environmentally organised public spaces. The pedestrian infrastructure of MG Marg appears to create an atmosphere of spatial comfort and psychological relaxation, thereby strengthening destination attachment and repeat visitation intention. Sustainable tourism literature consistently identifies environmental comfort and destination security as major determinants of tourist loyalty behaviour within urban tourism systems.

Component 3 contains high positive loadings for indigenous craftsmanship authenticity (C2 = 0.752), energy-saving measures visibility (RE3 = 0.655), and moderate negative loading for accessibility through eco-friendly transport (A1 = -0.602). This component may be interpreted as the "Cultural Authenticity and Resource Sustainability Dimension." The high loading of cultural authenticity suggests that tourists place substantial importance on indigenous identity, local craftsmanship, and traditional cultural representation within the tourism landscape. Simultaneously, the significance of visible energy-saving measures indicates growing environmental consciousness among visitors regarding sustainable

resource management. However, the negative accessibility loading suggests that some respondents perceived limitations in transportation convenience due to pedestrian restrictions or inadequate eco-friendly mobility systems during peak tourist activity. Similar tensions between sustainability regulation and mobility convenience are frequently observed in mountain tourism destinations characterised by spatial congestion and topographic limitations.

Component 4 is strongly associated with promotion of local traditions (C1 = 0.713), cultural interaction with sellers (EDS2 = 0.702), and accessibility signage for eco-friendly facilities (A2 = 0.708). This component represents the "Socio-Cultural Interaction and Heritage Communication Dimension." The component highlights the critical role of cultural engagement and informational accessibility in shaping sustainable tourism experience. MG Marg functions not only as a commercial marketplace but also as a socio-cultural interaction space where tourists engage directly with local traditions, vendors, and indigenous practices. The presence of eco-friendly signage further strengthens tourists' awareness regarding sustainable behavioural practices within the pedestrian environment. Sustainable urban tourism studies increasingly emphasise that cultural communication and local interaction significantly enhance experiential authenticity and heritage appreciation among visitors.

Component 5 demonstrates strong positive loadings for contribution to heritage preservation (C3 = 0.648), sustainable water facility management (RE2 = 0.640), experiential delight and relaxation (EDS1 = 0.523), and moderate loading for economic value perception (EVF1 = 0.467). This component can be interpreted as the "Ecological Conservation and Experiential Sustainability Dimension." The findings suggest that respondents perceive environmental conservation and heritage preservation as integral components of tourism satisfaction. Efficient water management and ecological maintenance appear to contribute directly to tourists' experiential quality and emotional attachment toward the destination. Considering the fragile ecological context of the Eastern Himalayas, resource conservation within urban tourism systems becomes essential for sustaining both environmental resilience and visitor experience quality.

Component 6 is strongly dominated by opportunities for local entrepreneurs (SE2 = 0.783), experiential delight (EDS1 = 0.536), eco-friendly packaging encouragement (E1 = 0.514), and environmental awareness information availability (E2 = 0.589). This component represents the "Community-Based Economic Sustainability and Environmental Awareness Dimension." The results indicate that respondents positively associate sustainability with local economic participation, environmental education, and responsible consumption practices. The pedestrian market environment of MG Marg appears to facilitate stronger tourist-vendor interaction, thereby supporting local entrepreneurship and community-based economic systems. Simultaneously, visible environmental awareness campaigns and eco-friendly packaging initiatives strengthen tourists' perception of responsible destination management.

Component 7 demonstrates the strongest loading for efficient waste management (E2 = 0.818), followed by moderate loading for eco-friendly packaging encouragement (E1 = 0.468). This component may be identified as the "Waste Management and Environmental Regulation Dimension." The dominance of waste management variables reflects the importance of cleanliness, organised disposal systems, and environmental regulation within MG Marg. The findings indicate that tourists strongly recognise visible environmental governance measures implemented within the pedestrian corridor. Sikkim's broader environmental policies, including restrictions on plastic use and emphasis on cleanliness, likely reinforce these positive sustainability perceptions among visitors. Effective waste management within densely concentrated mountain tourism destinations is especially critical because ecological degradation and carrying-capacity stress are intensified under conditions of spatial limitation and overtourism pressure.

Overall, the PCA findings reveal that sustainable urban tourism behaviour in MG Marg is governed by an integrated behavioural system combining environmental regulation, service efficiency, socio-cultural interaction, economic participation, ecological awareness, and infrastructural comfort. The pedestrianisation of MG Marg has significantly transformed the market into a multifunctional sustainable tourism space where environmental cleanliness, cultural authenticity, tourism satisfaction, and community participation operate simultaneously. The multidimensional PCA structure confirms that sustainable tourism management in Himalayan urban destinations cannot rely solely on infrastructural intervention but requires integrated planning strategies incorporating behavioural awareness, ecological conservation, local economic inclusion, and sustainable public space governance.

CONCLUSION

The study demonstrates that sustainable urban tourism behaviour in MG Marg is influenced by a combination of environmental, socio-cultural, economic, and infrastructural factors. The application of Principal Component Analysis successfully identified seven major behavioural dimensions explaining 68.544% of the total variance, reflecting the multidimensional nature of sustainability perception within the pedestrianised tourism environment.

The findings indicate that pedestrianisation has significantly enhanced environmental quality, walkability, service efficiency, tourist satisfaction, and socio-cultural interaction within MG Marg. Indicators such as waste management, reduced congestion, cultural authenticity, professional service quality, and support for local entrepreneurship emerged as important determinants of sustainable tourism behaviour and revisit intention among respondents.

The study further highlights that sustainable urban tourism in Himalayan destinations requires integrated planning approaches combining ecological conservation, public space management, behavioural awareness, and community participation. MG Marg represents an important example of sustainable urban tourism transformation where tourism development, environmental regulation, and local economic participation coexist within a fragile mountain environment. However, increasing tourist pressure and ecological vulnerability emphasise the need for continuous sustainability monitoring, effective carrying-capacity management, and long-term policy intervention for maintaining urban environmental resilience in Gangtok.

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