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Homestay-tourism - A viable alternative to the perils of overtourism in the Darjeeling hills of West Bengal, India

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ABSTRACT

The highly popular tourist destination Darjeeling, lovingly named the 'Queen of Hills', has been facing the menace of excessive and unrestricted tourism development due to massive tourist influx throughout the year. This has resulted in ecological degradation in terms of the proliferation of multistoried buildings, unchecked felling of trees, piles of garbage, increased road networks on wobbly hillsides, unbridled tinkering with the social structure of hilly ethnic communities, etc. Homestay-based tourism can offer a sustainable solution to the perils of overtourism in Darjeeling hills, not only by preaching and following responsible tourism practices but also by diverting a substantial portion of tourist inflow to various unexplored virgin areas of Darjeeling hills, thereby playing a balancing role among tourism, the environment and economic development of the local populace and the region altogether. The present study aims to address these concerns and propose effective suggestions and recommendations to meaningfully contribute to the sustainable socioeconomic growth of this region suffering from problems of unemployment, poverty, illiteracy and inadequate infrastructure through the effective utilization of the opportunity presented by homestay tourism, which makes use of the 4Rs of sustainable tourism, i.e., reduce, reuse, recycle and regulate. The study concludes that homestay tourism in Darjeeling hills still remains in its infancy in relation to sustainability endeavours.

Introduction

Overtourism and sustainability are two interconnected concepts in the field of tourism and travel that have gained significant attention in recent years. They highlight the challenges and concerns associated with the rapid growth of tourism in certain destinations and the need to manage tourism in a way that is environmentally, socially, and economically sustainable (Cronin, 1990). Achieving a balance between satisfying tourists' desires and preserving the well-being of host communities and the environment is key to ensuring the long-term viability of tourism. Responsible tourism practices and effective destination management address overtourism and promote sustainability in tourism. In the Indian context, the travel mantras 'Bharat Darshan' and 'Atithi Devo Bhava' also manifest the same motto of sustainability-oriented responsible tourism through the 'Incredible India' campaign. The COVID-19 pandemic has temporarily reduced tourism in popular areas and led destinations to rethink their tourism strategies while keeping sustainability in mind. Sustainable tourism practices efficiently manage all resources through various tourism supply chain members for attaining twin purposes—meeting socioeconomic and aesthetic needs and conserving biodiversity while respecting cultural integrity and life-support agendas (UNWTO, 2003). In addition to being a powerful contributor to economic growth, cultural exchange, and job creation, tourism's rapid expansion also poses numerous environmental and sociocultural challenges that invite sustainability issues in tourism

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to minimize the negative impacts of tourism while maximizing its benefits and thereby ensuring that this industry remains viable for future generations. By adhering to the principles of environmental conservation, economic development, sociocultural respect, and visitor education, the tourism industry can contribute positively to global sustainability goals. It can offer benefits beyond economic gain by enriching the lives of local communities and fostering cross-cultural understanding when the challenges of sustainable tourism are addressed through dedication and cooperation among stakeholders and tourists themselves. Overtourism and sustainability are closely interrelated challenges, and both revolve around managing and balancing tourism impacts on destinations and the environment to ensure the long-term viability of tourism while minimizing negative consequences by promoting responsible tourism, protecting the environment and promoting long-term socioeconomic development in local communities. Sustainable and responsible tourism practices at hill destinations are essential for preserving the natural beauty, cultural heritage, and economic well-being of these areas. Responsible or ethical tourism driven by sustainability principles recognizes the interconnectedness of tourism with the environment, society, and economy to meet the needs of present tourists and host communities without compromising the ability of future generations to meet their own needs. Traveler, businesses and governments should be encouraged to work together to ensure sustainable and equitable tourism by providing visitors with enjoyable and memorable experiences, together with prioritizing safety and sustainability in mountain regions and preserving the natural beauty and cultural heritage of these areas. Darjeeling, which is nested in the eastern Himalayas of India, is currently replanted under various tourism challenges, including overdevelopment, environmental degradation and loss of cultural authenticity (Bhutia, 2014a). A large influx of tourists has led to overcrowding, traffic congestion, and strained resources (Banerjee, 2018). In light of these challenges, homestays have emerged as a potentially sustainable solution by addressing the environmental, cultural, and economic challenges associated with traditional tourism; encouraging low-impact travel; supporting local communities; and fostering cultural exchange. In homestays, tourists can experience a clean, hygienic and affordable stay in a homely ambience with pleasant hospitality by host family, experiencing local tradition, customs and relishing authentic native cuisines ('thukpa', 'momo', 'raisak', etc.). Homestays, by providing a budget-friendly platform to tourists, play an imperative role in bringing tourists close to the cultural heritage and traditions of Darjeeling hills and thereby contributing to local employment generation and boosting regional economic growth (Bhutia, 2014b). The galloping count of homestays in the Darjeeling Hills has acted as an impetus to tribal rural communities to increase their socioeconomic conditions post-pandemic time since homestays far from crowded spots are safe for health-conscious tourists. The 4Rs of sustainable tourism, i.e., reduce, reuse, recycle, and regulate, can be applied in the context of homestays to promote responsible and environmentally friendly tourism with enhanced overall guest experience. For an insightful analysis of homestay tourism as a viable alternative to overtourism in the Darjeeling hills, this work reviewed the current status of ecofriendly practices maintained by homestay owners to reap the sustainable benefits and desirability of such practices in homestays using the fuzzy-based Harrington measure (Harrington, 1965), which in turn guides homestay-tourism stakeholders in decision-making by highlighting areas requiring attention to work upon. Homestays are a subset of community-based tourism. This paper also used the framework of 'coupling-coordination' to assess the degree of synergy between different elements of tourism and the local economy to ensure sustainable tourism practices considering the interconnectedness of various stakeholders and factors influencing the growth of homestay-tourism in Darjeeling hills. The coupling coordinated development of this region via homestay-tourism has been evaluated here by sustainable homestay-tourism capacity (SHTC) from three perspectives: economic and infrastructural (EIP), sociocultural and community-attitude (SCCAP), and eco-friendly practices (EFP).

Research Gap and Objective

Currently, in the context of the Darjeeling hills, fewer studies are available portraying the present

status and desirability of ecofriendly homestays as viable, sustainable solutions to overtourism and assessing the extent of synergistic coordination between tourism and the ecological environment for the upgradation and development of the socioeconomically backward hilly area of Darjeeling.

The objective of the present study is to:

- Investigate the present performance status of ecofriendly practices adopted in homestays across Darjeeling hills and the desirability of such practices in homestays as sustainable remedies for the fatal effects of overtourism.
- The degree to which synchronized efforts undertaken by local stakeholders of homestay tourism as a part of 'responsible tourism' are synchronized to dampen the perils of overtourism in Darjeeling was evaluated using the 'coupling coordination model'.

Material and Methods

Study design and location

This study used a descriptive type design in the form of a cross-sectional study of 200 tourist guests who stayed or preferred to stay in the homestays of the study location using convenience sampling (Bryman, 2016) due to the respondents' easy accessibility close to hand to assess the present performance of different ecofriendly practices prevailing in the homestays across offbeat hilly hamlets of the Darjeeling hills and to obtain deep insight into collaborative initiatives by the members of the local tourism supply chain in attaining sustainable, environmentally friendly socioeconomic development in this region through homestay ventures.

Data collection

The requisite primary data were collected via both the online and offline modes from the respondents through questionnaires during the peak period of April 2023 and May 2023. The questionnaires consisted of demographic information and statements relating to the 13 different ecofriendly practices maintained in homestays categorized in 4 dimensions (Table 1) and 34 sustainability factors classified in 6 subdimensions under 3 key metrics (Table 2) identified from past literature and fi interviews. The data were collected in two phases initially by asking participants to rate the performances of 13 ecofriendly practices on homestays and then to rate the evaluations of the homestay-tourism-related sustainability measuring factors through a 5-point Likert scale ranging from 1 (the lowest) to 5 (the highest matter of concern) with respect to the statement/question that serves as inputs for the degree of coupling-coordination assessment. To evaluate the performance and desirability of ecofriendly measures used in homestays, the fuzzy weighting method and mixed approach involving entropi and the co-efficient of variation were used to assess the sustainable impact of homestays using a coupling-coordination framework.

Use of the fuzzy concept

Here, fuzzy logic was used to handle uncertainty and vagueness in the data for eco-friendly practices in the homestays since Likert-scale responses might not always be precise and could have some ambiguity due to inherent uncertainty in human responses. Here, triangular fuzzy numbers (TFNs) were assigned to each linguistic variable on a 5-point Likert scale (Table 3) for each eco-friendly practice rating. The weighted-average defuzzified value using TFN-centroids for fuzzy-ratings is calculated by

$$\text{Weighted Centroid jth factor} = \frac{\Sigma\,(\text{Frequency of ith Rating for jth factor} \times \text{Centroid of TFN for ith Rating})}{\Sigma\,\text{Frequency of ith Rating}} \quad \ldots\ldots \text{Eqn (1)}$$

Mixed mechanism of weighting the variables concerned

The reason behind adopting mixed-weighting approach in this study using entropy and coefficient-of-variation adheres to dampen the outlier-influence through connectivity among multiple datasets and counteract equalization-problem arising out of entropy-only approach (Xia *et al*., 2020),

Entropy-based weighting method: Here, m criteria and n samples are used in the evaluation, and the measured value of the i^{th} criterion in the j^{th} sample is denoted as x_{ij}. In the first step of normalization of the measured values, the normalized value of the i^{th} criterion in the j^{th} sample is denoted by p_{ij} and calculated using the following formula:

$$\boldsymbol{pij} = \frac{\boldsymbol{xij}}{\sum_{\boldsymbol{j=1}}^{\boldsymbol{n}} \boldsymbol{xij}} \ldots\ldots \text{Eqn. (2)}$$

Table 1: Different ecofriendly practices prevailing in homestays

Eco-friendly Practice Code	Dimension	Eco-friendly Practices
EFP1	Energy	Energy-efficient appliances, Solar-panel
EFP2		Improved insulation and weatherization
EFP3		Routine Maintenance to prevent leakages
EFP4	Water	Rainwater harvesting and graywater recycling
EFP5		Leak-proof fixtures, appliances with routine maintenance
EFP6		Replacing sewage by toilet-flushing
EFP7	Food Processing and Usage	Using locally sourced, organic produce for fooding
EFP8		Avoiding processed-foods and plastic bottles
EFP9		Using excess food or kitchen-waste for livestock or composted
EFP10	Other	Using rightly placed dustbins/waste-bins
EFP11		Using cotton/jute bags and earthen pots
EFP12		Eco-friendly building materials with low environmental impact, recycling
EFP13		Informing Guests to maintain ecofriendly practices

Source: Author's own work from the past literature and field survey

The entropy denoted by E_i of the i^{th} criterion is given by

$$Ei = -\frac{\sum_{j=1}^{n} pij\, ln(pij)}{ln(n)} \ldots \quad \ldots\ldots \text{Eqn. (3)}$$

The entropy value E_i ranges between 0 and 1. The weight of the i^{th} parameter (w_i) is given by

$$Wientropy = \frac{1-Ei}{\sum_{i=1}^{m}(1-Ei)} \ldots \quad \ldots \text{Eqn. (4)}$$

Coefficient of variation-based weighting method: The coefficient of variation for the dataset (Xij) m×n, i.e., 'm' observations for 'n' factors, is calculated using the following steps after normalization.

First, the mean and standard deviation for each of the 'n' column factors are determined as

$$\bar{X}j = \frac{1}{m}\sum_{j=1}^{m} Xij \quad \text{and}$$

$$Sj = \sqrt{\frac{1}{m}\sum_{1}^{m}(Xij - \bar{X}j)^2} \ldots\ldots \text{Eqn. (5)}$$

Second, using the mean and standard deviation calculated above, the coefficient of variation is determined using the equation below:

$$COVj = \frac{Sj}{[\bar{X}j]} \ldots\ldots \text{Eqn. (6)}$$

Table 2: Impacts of the homestay business on various sustainability dimensions

Sustainability Dimension	Subdimension	Description of Constituent Factors with code
Economic and Infrastructural (EI)	Economic (E)	Good source of alternative earning to household (EI_E1)
		Increased scope for new jobs and ancillary business opportunities (EI_E2)
		Enhanced standard of living of local people (EI_E3)
		Revenue generation and foreign-exchange earnings (EI_E4)
		Promotion and sale of local ethnic-handicrafts and cuisines (EI_E5)
		Regional literacy profile (EI_E6)
		Unemployment scenario (EI_E7)
	Infrastructure (I)	More educational institutions and gross-enrollment (EI_I1)
		Increasing no of hospitals/health-centers (EI_I2)
		Increasing number and density of homestays (EI_I3)
		Growing number of car/taxi and other tourist vehicles (EI_I4)
		No of tour-operators, drivers and tour-guides (EI_I5)
		No. of motorable and link-roads for last-mile connectivity (EI_I6)
		Guest-crowding and howling (EI_I7)
		Nonbiodegradable waste generation (EI_I8)
Sociocultural and Community Attitude (SCCA)	Sociocultural (SC)	Empowering local women in their socioeconomic status (SCCA_SC1)
		Assistance in cultural exchange (SCCA_SC2)
		Promotion and preservation of local ethnic/traditional culture (SCCA_SC3)
		Familiarization with technological advancements (SCCA_SC4)
		Generating a sense of self-accomplishment through ownership (SCCA_SC5)
		Growing no. of associations related to cultural and art-affairs (SCCA_SC6)

	Community Attitudinal (CA)	Increased community-brotherhood and social-equity (SCCA_CA1)
		Local people will refrain from unlawful activities due to engagement in homestay-operations (SCCA_CA2)
		Degree of irritation due to hampering calm and quiet life in hills (SCCA_CA3)
		Manifestations of annoyance and agitated behavior with tourists (SCCA_CA4)
		Reduction of agricultural activities (SCCA_CA5)
		Noise, air pollution (SCCA_CA6)
Eco-friendly practices (EFP)	Homestay level factors	Use of Solar and Energy-efficient items and ecofriendly construction materials (EFP_HS1)
		Improved insulation, weatherization and routine maintenance for leakage-free electric and water lines (EFP_HS2)
		Use of locally grown, organic produce for guest-fooding (EFP_HS3)
		Reuse/Recycling/Treatment of liquid wastes (EFP_HS4)
		Waste management and disposal (EFP_HS5)
	General Community Factor	Banning of nonbio degradable plastic items in the homestay premises and surroundings (EFP_GC1)
		Local awareness level about protection & conservation natural resources (EFP_GC2)

Source: Author's own work from the past literature (Bhutia, 2014) and field survey

Table 3: TFN for Likert-based linguistic variables

Likert Scale Rating	Linguist Variables of Likert Scale	TFN	Centroid of TFN
1	Very Low	(1, 1, 2)	1.250
2	Low	(1, 2, 3)	2.000
3	Medium/Can't Say	(2, 3, 4)	3.000
4	High	(3, 4, 5)	4.000
5	Very High	(4, 5,5)	4.750

Source: Author's compilation

Finally, the weight is calculated after normalizing the COVj using

$$\mathbf{Wjcov} = \frac{\mathbf{COVj}}{\sum_{1}^{m} \mathbf{COVj}} \text{……Eqn. (7)}$$

Considering the equal importance of each entropy and coefficient of variation method (Wang, 1999 and Liu *et al.*, 2015), where ∑Wi=1 for the i-th criterion/attribute, the combined weight is given by

$$\mathbf{Wjcombined} = \mathbf{0.5.Wjentropy} + \mathbf{0.5.Wjcov}$$

………Eqn. (8)

The normalization logic used here is given below for factors

Normalized

$$\mathbf{Score_{ij}} = \frac{\mathbf{Weighted\ Xij - Minimum\ Weighted\ Xij}}{\mathbf{Maximum\ Weighted\ Xij - Minimum\ weighted\ Xij}}$$

Favoring sustainability

$$= \frac{\mathbf{Maximum\ Weighted\ Xij - Weighted\ Xij}}{\mathbf{Maximum\ Weighted\ Xij - Minimum\ weighted\ Xij}}$$

Unfavorable for sustainability

The Harrington Desirability function

The Harrington Desirability function or the Harrington Desirability Index (HDI) is used to assess and optimize multiple criteria simultaneously. Developed by C.R. Harrington in the 1960 s, the scale can be adapted and applied to assess and improve sustainability/eco-friendliness in homestay-tourism operations. Multiple criteria are transformed into a single value ranging from 0 (highly undesirable) to 1 (highly desirable).

Step 1: Find the mean EFP (mean EFPi) for each of the factors

2: Determine the TFN value for the mean EFPi

3. The desirability index (DI) is calculated for each of the i-th factors as

$$\mathbf{DIi} = \frac{\mathbf{Likert\ Mean\ EFPi - TFN\ Low}}{\mathbf{TFN\ High - TFN\ Low}} \text{ …..Eqn (9)}$$

4. The composite/overall Harrington desirability index (HDI) was determined by

$$\mathbf{HDI} = \sqrt[k]{(\mathbf{DI1\ x\ DI2\ x\ DI3\ x\ \ldots X\ DIi})} \text{……Eqn. (10)}$$

where k is the number of criteria.

Coupling Coordination Framework

In the context of homestay-based sustainable nature-tourism, it is used to make tourism activities economically viable, socially beneficial to local communities and environmentally responsible over the long term to ensure sustainability. In practice, this model helps planners and policymakers make decisions about sustainable tourism development by judiciously balancing the interests of tourists, the environment and local communities and contributing to conservation efforts. The sustainability dimensions used in this study Economic (7 attributes) and Infrastructural (8 attributes) (EI) Sociocultural (6 attributes) and Community Attitudinal (6 attributes) (SCCA) Eco-friendly practices (EFP) at the Homestay level (5 attributes) and General Community level (2 attributes) To determine the 6 subdimensional scores, the following equations are used:

$$\mathbf{EI\_Ei} = \sum_{i=1}^{7} \mathbf{Wcomb.Mean\ normalised\ Rating\ (Xij)}$$

Eqn (11a)

$$\mathbf{EI\_Ii} = \sum_{i=1}^{8} \mathbf{Wcomb.Mean\ normalised\ Rating\ (Xij)}$$

Eqn (11b)

$$\mathbf{SCCA\_SCi} = \sum_{i=1}^{6} \mathbf{Wcomb.Mean\ normalised\ Rating\ (Xij)}$$

Eqn (12a)

$$\mathbf{SCCA\_CAi} = \sum_{i=1}^{6} \mathbf{Wcomb.Mean\ normalized\ Rating\ (Xij)}$$

Eqn (12b)

$$\mathbf{EFP\_HSi} = \sum_{i=1}^{5} \mathbf{Wcomb.Mean\ normalized\ Rating\ (Xij)}$$

Eqn. (13a)

$$\mathbf{EFP\_GCi} = \sum_{i=1}^{2} \mathbf{Wcomb.Mean\ normalized\ Rating\ (Xij)}$$

Eqn (13b)

$$\mathbf{EI = W_{comb}\,(EI\_Ei + EI\_Ii)}\ldots\ldots\ldots \text{ Eqn. (14a)}$$

$$\mathbf{SCCA = W_{comb}\,(SCCA\_SCi + SCCA\_CAi)}\ldots \text{Eqn (14b)}$$

$$\mathbf{EFP = W_{comb}\,(EFP\_HSi + EFP\_GCi)}\ldots\ldots \text{ Eqn. (14c)}$$

Finally, the sustainable homestay tourism capacity (SHTC) index is calculated as follows:

$$\mathbf{SHTC = W_{comb\_EI}\ EI + W_{comb\_SCCA}\ SCCA + W_{comb\_EFP}\ EFP}$$
Eqn. (15)

A greater SHTC index value, i.e., close to 1 (Table 4), indicates a higher sustainability conscious development level (Tang, 2015; Xu and Hou, 2019 and Yang *et al*., 2022): Here, the 'coupling index' indicates the extent of coordination/synergy between tourism development and environmental conservation through regulations, eco-friendly practices and community involvement. Here, the assessment mechanism consists of measuring the coupling indices among 3 subdimensions for 200 homestays across the hilly hamlets of Darjeeling and evaluating the influence of these subdimensions on SHT. In equational form, the steps are given below:
The coupling index ($CI^{EI\text{-}SCCA\_EFP}$) for the i-th homestay (i = 1, 2, 3….. 200) is given by

$$\mathbf{CI^{EI\_SCCA\_EFP}} = \sqrt[1/3]{\frac{\mathbf{EIi \times SCCAi \times EFPi}}{[\mathbf{(EIi + SCCAi + EFPi)/3}]^3}} \ldots\ldots \textbf{Eqn (16)}$$

As the CI approaches 1, the interactive influence between the systems increases (Liu *et al*., 2021).
Now, we use the combined coordination indicator for 3 dimensions,

$$\mathbf{CCI^{EI\_SCCA\_EFP}}\text{, via Eqn. (8)}$$

$$\mathbf{CCI^{EI\_SCCA\_EFP} = Wj_{combEI}.\ EI}\boldsymbol{i}\ \mathbf{+Wj_{combSCCA}.\ SCCA}\boldsymbol{i}\ \mathbf{+ Wj_{combEFP}.\ EFP}\boldsymbol{i}\ \ldots\ldots\ldots \text{ Eqn (17)}$$

where $Wj_{combEI} + Wj_{combSCCA} + Wj_{combEFP} = 1$

The final overall coupling coordination degree for the 3 sustainability dimensions is

$$\mathbf{OCCD^{EI\_SCCA\_EFP} = \sqrt{(CI^{EI\_SCCA\_EFP} x\ CCI^{EI\_SCCA\_EFP})}}\ \ldots\ldots\ldots \text{ Eqn. (18)}$$

Table 4: Classification of coupling-coordination degree and coordination

Coupling (CI) and Coupling-Coordination Degree (CCD)	Coordination Level
0.00-0.09	Extreme disorder
0.10 - 0.19	Severe disorder
0.20 - 0.29	Moderate disorder
0.30 - 0.39	Mild disorder
0.40 - 0.49	On the verge of disorder
0.50 - 0.59	Grudging coordination
0.60 - 0.69	Primary coordination
0.70 - 0.79	Intermediate coordination
0.80 - 0.89	Good coordination
0.90 - 1.00	Quality coordination

Source: (Tang, 2015 and Yang *et al*., 2022)

Demographic analysis

The demographic profile first revealed that the genderwise male–female proportions were almost equal: male (n=97, 48.5%) and female (n=103, 51.5%) for homestay owners and female (n=106, 53%) and male (n=94, 47%) for tourists. The age groups of major homestay-owners were defined as middle-aged between 40 and 50 years (n=79, 39.5%), followed by aged older than 50 years (n=16, 8%) and young (n=39, 19.5%). Similarly, for tourists, the majority were between 30 and 50 years (n=145, 72.5%), while aged people were least common (n=16, 8%). In terms of occupation, the majority of homestay-hosts were housewives (n=74, 37%), although agro-farming (n=55, 27.5%) and other businesses (n=45, 22.5%) were fair in number. In the same respect, for tourists, self-employed individuals (n=50, 25%) and housewives (n=43, 21.5%) constitute the majority share. Interestingly, the majority of tourists (n=156, 78%) and homestay owners (n=130, 65%) are educated, i.e., from high-school passes to graduates/postgraduates. The majority of the homestay runners were Govt-registered (n=141, 70.5%), while fewer were unregistered (n=40, 20%). In terms of residential

origin, the majority of the participants were from West Bengal (n=111, 55.5%), followed by other Indian states (n=74, 37%), and foreigners represented a small proportion of the population (n=15, 7.5%). A chi-square test was conducted to ascertain the presence of any demographic effect on homestay-owner awareness and the benefits of ecofriendliness and environmental conservation (Table 5). The results revealed the significant impact of only age (chi-square=11.41, df=12, $p<0.05$) and educational status (chi-square=30.74, df=16, $p<0.001$), where educational status exhibited a greater effect (cramer V = 0.81) than age (cramer V = 0.33).

Performance review of ecofriendly practices in homestays using fuzzy logic

According to the fuzzy approach of Eqn. (1), homestay-tourists consider foodstuffs made of local produce, water discharged in toilets, maintenance for leakage prevention in electric lines, nonuse of processed food and plastic water bottles and leakproof water conservation items with maintenance as the five eco-friendliest measures prevailing in these homestays (Table 6).

Table 5: Chi-square test results

Demographic Factors of Homestay Owner	Pearson's chi-square	p value	x-crit	Sig	Cramer V
Age	11.4084	0.022	9.4877	yes	0.32962
Gender	5.9767	0.201	9.4877	no	0.17287
Present Occupation	6.9952	0.136	9.4877	no	0.28356
Educational Status	30.7433	0.000	9.4877	yes	0.80877
Tenure in this Homestay Business	24.1719	0.235	31.410	no	0.17382

Table 6: Variables of eco-friendly practices in homestays with fuzzy weights

Variable Code	Ecofriendly Practices Dimension	Defuzzified Crisp Value (Weighted Centroid)	Rank as per Fuzzy Approach	Mean Defuzzified Weighted Crisp value of Dimension
EFP1	Energy Conservation	3.5588	9	3.7763
EFP2		3.5888	8	
EFP3		4.1813	3	
EFP4	Water Conservation	2.8900	13	3.5871
EFP5		3.6675	5	
EFP6		4.2038	2	
EFP7	Food Processing & Usage	4.3063	1	3.8938
EFP8		3.7563	4	
EFP9		3.6188	7	
EFP10	Other Eco-friendly measures	3.6263	6	2.8233
EFP11		3.3375	11	
EFP12		3.3263	12	
EFP13		3.4875	10	

Hence, food processing and water conservation appear to be major thrust areas for owners to look upon as guests for ecological sustainability. Considering dimensionwise mean defuzzified crisp values, food processing and usage held the top positions, followed by energy, water and other dimensions, in descending order of priority to the homestay hosts.

Desirability of ecofriendly practices in sustainable homestay tourism

To examine the desirability of ecofriendly practices for making homestay tourism sustainable for the Darjeeling hills, the Harrington desirability index (HDI) was applied using Equations (9) and (10). The composite HDI (Table 7) suggests that considering all 13 eco-friendly measures adopted by Homestays of Darjeeling Hills under 4 broad dimensions achieved 73.37% desirability in terms of tourist feedback, indicating that the implementation of eco-friendly practices is fair, although it is amenable to improvement. In terms of factorwise performance, rainwater harvesting and the use of leakproof water-efficient equipment were the most common practices, followed by electricity conservation measures and the reuse of excess foodstuffs. Owners should be more concerned about three areas: usage of processed food, eco-friendly materials, paint for construction, decoration and increased maintenance in rooms, and electric and water-related matters.

Coupling coordination model in Darjeeling-based homestay tourism

To assess the sustainability score for homestay-tourism across 3 key dimensions and 6 subdimensions, the equations from Eqn. (11a) to (14c) were used, and the sustainable homestay tourism capacity (SHTC) index score was calculated using Eqn. (15). The results of the sustainability assessment for homestay tourism across the Darjeeling hills (Table 8) showed that the individual subdimensional performance was relatively good for the infrastructure and sociocultural factors.

Table 7: Harrington desirability index for eco-friendly measures of homestay

Variable Code	Ecofriendly Practices Dimension	Mean EFPi	Linguistic Category	Applicable TFN	Harrington DI for ith EFP	Overall HDI
EFP1	Energy Conservation	3.620	Medium/Can't Say	(2, 3, 4)	0.810	0.7337
EFP2		3.650	Medium/Can't Say	(2, 3, 4)	0.825	
EFP3		4.300	High	(3, 4, 5)	0.650	
EFP4	Water Conservation	2.885	Low	(1, 2, 3)	0.943	
EFP5		3.740	Medium/Can't Say	(2, 3, 4)	0.870	
EFP6		4.315	High	(3, 4, 5)	0.658	
EFP7	Food Processing & Usage	4.430	High	(3, 4, 5)	0.715	
EFP8		3.840	High	(3, 4, 5)	0.420	
EFP9		3.690	Medium/Can't Say	(2, 3, 4)	0.845	
EFP10	Other Eco-friendly measures	3.680	Medium/Can't Say	(2, 3, 4)	0.840	
EFP11		3.375	Medium/Can't Say	(2, 3, 4)	0.688	
EFP12		3.355	Medium/Can't Say	(2, 3, 4)	0.678	
EFP13		3.535	Medium/Can't Say	(2, 3, 4)	0.768	

Table 8: Dimension wise sustainability score of homestay tourism

Sustainability Dimension	Sub dimension	Coded Constituent Factors	Impact on Sustainability	Combined Weight, (Entropy+ CoV) Wt_{comb}	Normalized Mean rating	Weighted Mean Score Subdimension wise
EI	E	EI_E1	Favorable	0.0153	0.9150	0.07839
		EI_E2	Favorable	0.0075	0.9350	
		EI_E3	Favorable	0.0135	0.7483	
		EI_E4	Favorable	0.0127	0.8200	
		EI_E5	Favorable	0.0131	0.7683	
		EI_E6	Favorable	0.0169	0.6675	
		EI_E7	Unfavorable	0.0334	0.4650	
	I	EI_I1	Favorable	0.0178	0.7025	0.1387
		EI_I2	Favorable	0.0477	0.4300	
		EI_I3	Unfavorable	0.0682	0.2717	
		EI_I4	Unfavorable	0.0679	0.2500	
		EI_I5	Favorable	0.0132	0.7583	
		EI_I6	Favorable	0.0386	0.4975	
		EI_I7	Unfavorable	0.0501	0.4583	
		EI_I8	Unfavorable	0.0575	0.3125	
SCCA	SC	SCCA_SC1	Favorable	0.0118	0.7625	0.08988
		SCCA_SC2	Favorable	0.0233	0.6450	
		SCCA_SC3	Favorable	0.0212	0.6900	
		SCCA_SC4	Favorable	0.0482	0.4463	
		SCCA_SC5	Favorable	0.0221	0.6488	

		SCCA_SC6	Favorable	0.0288	0.5325	
	CA	SCCA_CA1	Favorable	0.0103	0.8113	0.09774
		SCCA_CA2	Favorable	0.0237	0.6600	
		SCCA_CA3	Unfavorable	0.0349	0.5175	
		SCCA_CA4	Unfavorable	0.0339	0.5288	
		SCCA_CA5	Unfavorable	0.0373	0.5250	
		SCCA_CA6	Unfavorable	0.0502	0.3625	
EFP	HS	EFP_HS1	Favorable	0.0215	0.6688	0.07848
		EFP_HS2	Favorable	0.0348	0.5633	
		EFP_HS3	Favorable	0.0213	0.7150	
		EFP_HS4	Favorable	0.0323	0.4713	
		EFP_HS5	Favorable	0.0209	0.6725	
	GC	EFP_GC1	Favorable	0.0248	0.6338	0.03127
		EFP_GC2	Favorable	0.0252	0.6163	

Community attitudes were also found to be favorable, but eco-friendly practices at the community level were more poor than those at the homestay level. Overall, sustainability was included in the economic and infrastructural dimensions (Table 9), however, for ecofriendly practices, the homestay-tourism of the Darjeeling hills was a poor contributor to sustainability, and the overall sustainability score for homestay-tourism capacity across the study area was very unsatisfactory (0.0413), revealing disorganized coordination among the dimensions (Tang, 2015 and Yang *et al.*, 2022).When assessing the synergistic effects of homestay-tourism and environmental conservation through regulations, eco-friendly practices and community involvement using Eqn. (16-17), the findings (Table 10) reveal that the extent of coupling, i.e., mutually influential interactions among the 3 main sustainability dimensions, is moderately unsatisfactory, i.e., mild/close to disorder (Tang, 2015 and Yang *et al.*, 2022). The overall degree of coupling-coordination among the 3 sustainability-dimensions in homestays across study areas determined using Eqn. (18) was unsatisfactory (Yang *et al.*, 2022) due to the presence of moderate imbalance/disorder (Table 11). The outcome of the present work, with the rapid growth of homestay tourism in the Darjeeling hills, reveals mutually exclusive contradictions between community development and ecological sustainability, which resembles the outcomes of earlier studies (Muhanna, 2006 and Hall, 2010). The desirability analysis for ecofriendly homestay-tourism practices using Harrington's method signals high necessity since homestays are currently the preferred alternative for vacation spending in offbeat, crowd-free, home-only ambience. It also highlights areas to work upon seriously, such as avoidance of processed food and plastics, use of eco-friendly materials and paints for construction, decorations, maintenance of

Table 9: Dimension wise Sustainability Score of Homestay Tourism

Sustainability Dimension	Sub dimension	Coded Constituent Factors	$Wt_{combined}$ for Sub_ dimension	$Wt_{combined}$ for Dimension	Sub_ dimension wise Total Weighted Score	Dimension Wise Total Weighted Score
EI	E	EI_E1	0.1124	0.4734	0.059	0.0279
		EI_E2				
		EI_E3				
		EI_E4				
		EI_E5				
		EI_E6				
		EI_E7				
	I	EI_I1	0.3611			
		EI_I2				
		EI_I3				
		EI_I4				
		EI_I5				
		EI_I6				
		EI_I7				
		EI_I8				
SCCA	SC	SCCA_SC1	0.1555	0.3457	0.033	0.0113
		SCCA_SC2				
		SCCA_SC3				
		SCCA_SC4				
		SCCA_SC5				
		SCCA_SC6				
	CA	SCCA_CA1	0.1903			
		SCCA_CA2				

		SCCA_CA3				
		SCCA_CA4				
		SCCA_CA5				
		SCCA_CA6				
EFP	HS	EFP_HS1	0.1308	0.1808	0.012	0.0021
		EFP_HS2				
		EFP_HS3				
		EFP_HS4				
		EFP_HS5				
	GC	EFP_GC1	0.0500			
		EFP_GC2				
Total Sustainable Homestay Tourism Capacity (SHTC) Score: 0.0413						

Table 10: Degree of coupling for sustainable homestay tourism at Darjeeling

Dimensionwise Total weighted Score for EI	0.0279*
Dimensionwise Total weighted Score for SCCA	0.0113*
Dimensionwise Total weighted Score for EFP	0.0021*
Coupling Index ($CI^{EI\_SCCA\_EFP}$) among 3 dimensions [Eqn.(16)]	0.39493

*** Data from Table 9**

Table 11: Calculation of the overall coupling-coordination degree for homestay-tourism

Sub-Dimension Pairwise Coupling Coordination (CC)	**Calculated Value**	**Equation Used**	**Value Equivalent to Classification of Tang (2015) &Yang *et al.* (2022)**
Combined Coupling Indicator (CCI) for 3 subdimensions, $CCI^{EI\_SCCA\_EFP}$	0.0175	Eqn.(17)	0.0175
Overall Coupling-Coordination Degree, $OCCD^{EI\_SCCA\_EFP}$	26.286	Eqn.(18)	0.2629

electrical and water lines and regulating tourist behavior.This study, while assessing overall sustainability through homestay-tourism, revealed that the Infrastructural, Sociocultural and Community-attitude sub dimensions were only favorable, but the practice of ecofriendliness at the community level was very poor, which resulted in a poor overall sustainability score (0.0413) for

homestay-tourism capacity across the study area as per past research guidelines (Tang, 2015 and Yang *et al.*, 2022). Application of 'Coupling Coordination Model' in Darjeeling based homestay-tourism to evaluate the degree of synchronized efforts by local tourism-stakeholders revealed coupling (i.e., mutually influential interaction among 3 main sustainability-dimensions) is not upto-the-mark rather close to disorder which in turn made overall degree of coupling-coordination among them unsatisfactory (0.2629) indicating lack of synchronization among tourism, economic and environmental coordination. However, pairwise coupling analysis indicates fair synergy only between EFP and SCCA for individuals with minor disorders, while other pairs exhibit a medium to severe lack of synchronized efforts toward sustainable tourism. Irrespective of the growing trend of homestay tourism in Darjeeling, this extent of coupling coordination manifests the poor quality of responsible tourism as rapid growth of the tourism economy and decreasing ecological sustainability restrict each other, resulting in moderate disorder. These findings match those of previous research (Lai *et al.*, 2020).

Conclusion

Current study investigated the current scenario of various ecofriendly measures used in homestays across Darjeeling hills and produced 3-fold findings. First, demographic age and education about homestay-hosts play instrumental roles in making them more inclined to seek ecofriendliness without hampering the environment, ethnic culture or tradition of the Darjeeling hills. Second, as per evaluations by guest-tourists, food-processing and energy conservation are primarily taken care of by the homestay-hosts, while water-conservation, use of recycled items, adequate usage of dust-bins and ecofriendly construction materials lack attention and hence registered below-average performance to the guests. Third, from the desirability of eco-friendly practices in homestays to secure a sustainable future of tourism-led development in Darjeeling, this study votes for its utmost necessity since tourists in post-pandemic times prefer to stay at crowd-free, home environments in the laps of pristine nature. As a potentially sunrise niche segment of Darjeeling's hill-tourism industry, local communities, tourism departments, local experts and policy makers need to undergo thought transformation in tourism-centric socioeconomic regional development without hampering the environment and ecology through restructuring the local tourism industry, promoting ecofriendly homestays in offbeat hilly areas of Darjeeling, strengthening environmentally friendly consciousness among local people and implementing strict regulatory regimes for tourism to ensure a sustainable future. In summary, the outcome of the present study reveals that homestays have the utmost potential as sustainable tourism practices against the evils of overtourism in Darjeeling but still remain in a nascent stage with respect to sustainability, and enough endeavours are needed in sustainability platforms from all stakeholders to offer a bright future for homestay tourism, which will uplift the socioeconomic standards of Darjeeling hills.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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