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# Exploring Sustainable Tea Tourism in Nilgiris: A Multi-Dimensional Approach to Growth and Conservation

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## Abstract

*In an era where sustainable development is paramount, tea tourism has emerged as a dynamic convergence of cultural heritage, economic opportunity, environmental stewardship, and technological innovation. This study examines sustainable tea tourism practices in the Nilgiris District of Tamil Nadu, India, by integrating quantitative and qualitative research methodologies. A structured questionnaire was administered to 126 tea growers, tea manufacturers and other key stakeholders, while in-depth interviews and focus group sessions enriched the data, particularly in understanding the operational challenges associated with eco-friendly initiatives. Structural Equation Modeling (SEM) revealed that community collaboration, economic empowerment, and technological/infrastructural support each exert a significantly positive impact on sustainable tea tourism practices. Conversely, eco-friendly practices were found to have a negative coefficient, a finding that was further clarified through qualitative insights—highlighting issues such as high initial capital outlay, insufficient training, and policy limitations. The study underscores the importance of a holistic approach in which technological investments and enhanced community participation mitigate the challenges tied to sustainable environmental practices. These findings provide actionable recommendations for policymakers, tea estate managers, and tourism professionals aimed at reinforcing sustainable practices within the tea tourism ecosystem. Additionally, the study discusses its limitations and suggests potential directions for future research.*

***Keywords:*** *Community Collaboration, Economic Empowerment, Eco-friendly Practices, Sustainable Tea Tourism, Technological Integration*

## Introduction

Tea tourism has become a unique subset of agro-tourism that combines cultural legacy with contemporary economic and environmental demands in a time when sustainable development is crucial. Leveraging the rich legacy of tea cultivation, this form of tourism provides immersive experiences that celebrate tradition while catalysing local socio-economic development

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and environmental conservation (Ashokkumar & Sangeetha, 2024; Ekka, 2024) Global research underscores that tea tourism is not only about creating new income streams through ventures such as tea shops, accommodations, and handicrafts but also about championing eco-friendly practices—like organic farming, waste management, and renewable energy adoption—that bolster the resilience of tea plantations against climate change impacts (Kumari et al., 2021; R. et al., 2024). Despite its promise, sustainable tea tourism confronts persistent challenges. Key among these are the need for robust governance frameworks, adequate funding, and capacity-building programs to integrate traditional practices with modern sustainability initiatives effectively. Moreover, collaboration between tea estates and local communities is critical for promoting inclusive tourism and reducing socio-economic disparities—a point stressed in recent work (E. Sharma, 2025). In tandem, emerging digital technologies, such as digital marketing platforms and virtual reality experiences, show potential for enhancing visitor engagement and operational efficiencies (Kaur et al., 2024; Ng et al., 2022).

Against this backdrop, the present study explores the interplay among community collaboration, economic empowerment, environmental stewardship, and technological integration within tea tourism. Centred on regions like The Nilgiris in Tamil Nadu, India, the research poses key questions: How does cooperation between tea estates and local communities foster equitable socio-economic development? What is the true impact of eco-friendly practices on environmental sustainability? And how can digital innovations further reinforce both economic and environmental dimensions? By addressing these questions, the study aims to build a robust analytical framework and offer actionable insights for policymakers, tourism professionals, and local communities. Eventually, this research contributes to a balanced approach that harmonizes economic, social, and environmental priorities. The goal is to ensure that the heritage of tea cultivation not only endures but also paves the way for sustainable development in tea-producing regions.

## Objectives of the study

- Evaluate community collaboration between tea estates and local stakeholders.
- Understand how tea tourism contributes to economic empowerment through job creation and entrepreneurial ventures.
- Examine the impact of eco-friendly practices—such as organic farming and waste management—on environmental sustainability.
- Investigate the role of digital technologies and infrastructural investments in enhancing sustainable tourism practices.

## Review of Literature

### *Overview of Sustainable Tea Tourism*

Sustainable tea tourism represents an innovative nexus between agro-tourism, cultural heritage, and sustainable development. As this niche sector evolves, studies emphasize its dual role in generating socio-economic benefits and promoting environmental stewardship. Tea tourism integrated with cultural preservation in Xiamei village generated significant economic benefits while maintaining traditional practices (Shen & Chou, 2022) . Researchers highlight that integrating traditional tea cultivation practices with modern tourism dynamics is pivotal

in addressing regional disparities and fostering long-term sustainability (Ashokkumar & Sangeetha, 2024; Ekka, 2024).

*Community Engagement and Cultural Preservation*

A recurring theme in the literature is the importance of community involvement in tea tourism. Active participation of local residents—whether through guiding cultural tours, developing artisanal products, or engaging in decision-making—serves as a catalyst for cultural conservation and equitable benefit-sharing. Case studies from regions like Ooty in Tamil Nadu and Dak Lak in Vietnam illustrate that collaborative frameworks empower communities and reinforce cultural identity (Ezzatian, 2025; Gurung & N, 2024; E. Sharma, 2025). The guest perceptions of tea tourism experiences are strongly influenced by authentic cultural engagement and quality infrastructure (Zhou et al., 2023). Growing interest among younger consumers in sustainable tea tourism provides significant market opportunities (Yeap et al., 2024).

*Economic Empowerment and Development*

Economic growth is a central promise of sustainable tea tourism. Multiple studies document how initiatives such as tea shops, homestays, and entrepreneurial ventures can invigorate local economies by creating jobs and enhancing market opportunities. Empirical evidence from various tea-producing regions suggests that tea tourism not only alleviates poverty but also supports long-term economic empowerment and skill development (Ashokkumar & Sangeetha, 2024; Sewwandi, 2024). Agritourism functions as a catalyst for sustainable rural development when supported by policy frameworks and community empowerment (Garwi et al., 2025).

*Environmental Sustainability and Eco-Friendly Practices*

Environmental conservation constitutes a cornerstone of sustainable tea tourism. Research in this area focuses on the adoption of eco-friendly practices such as organic tea cultivation, waste management, and water conservation. These practices not only reduce the ecological footprint of tourism activities but also enhance the natural appeal of tea destinations, while strengthening the resilience of tea estates against climate change (Kumari et al., 2021; R. et al., 2024; Sewwandi, 2024). Agritourism functions as a catalyst for sustainable rural development when supported by policy frameworks and community empowerment (Garwi et al., 2025). Integrating organic agriculture with digital innovation supports long-term sustainability in tea destinations (Li et al., 2023).

*Technological and Infrastructural Advancements*

The integration of digital tools and infrastructural improvements is an emerging theme in sustainable tea tourism studies. Digital marketing strategies, online booking platforms, and smart tourism analytics have been identified as key drivers in broadening the global reach of tea destinations while streamlining operations. In addition, investments in energy-efficient infrastructure and renewable energy sources further reinforce the sustainability agenda by lowering operational costs and attracting eco-conscious travellers (Kaur et al., 2024; Ng et al., 2022; Palaniyandi et al., 2024). Digital platform adoption significantly enhances tea tourism market reach and guest engagement (R. Sharma et al., 2023).

*Theoretical Framework and Variable Justification*

The conceptual framework guiding this study is anchored in established theories of sustainable tourism and stakeholder engagement. According to these theories, integrating multiple dimen-

sions—such as community collaboration, environmental stewardship, and technological support—creates synergistic impacts on tourism outcomes.

*Justification of Variable Selection:*
*Independent Variables:*
Studies have consistently demonstrated that factors such as community collaboration, the adoption of eco-friendly practices, and technological/infrastructural advancements are key drivers of success in sustainable tourism initiatives (Ashokkumar & Sangeetha, 2024; Mondal & Samaddar, 2021). These variables are posited to initiate or influence change in the tourism ecosystem.

*Dependent Variables:*
The dependent variables in this research—economic empowerment, environmental sustainability, and community benefit—capture the outcomes of interest. They represent the measurable benefits that sustainable tea tourism can deliver to local communities and the environment, as supported by empirical evidence from diverse case studies (Banerjee & Tyagi, 2024; Sewwandi, 2024).

*Moderating and Mediating Variables:*
The moderating variables such as government support and financial assistance are considered to influence the strength of these relationships. Mediating variables—including training programs and enhanced community engagement—serve to bridge and amplify the effects of the independent variables on the dependent variables. This categorization is consistent with comprehensive models in sustainable tourism research that underscore the interconnectedness of socio-economic, environmental, and technological factors.

## Research Methodology

*Research design*

This study adopts a quantitative research design based exclusively on a questionnaire survey to examine the impact of sustainable tea tourism on local communities and environmental sustainability in The Nilgiris District, Tamil Nadu, India.

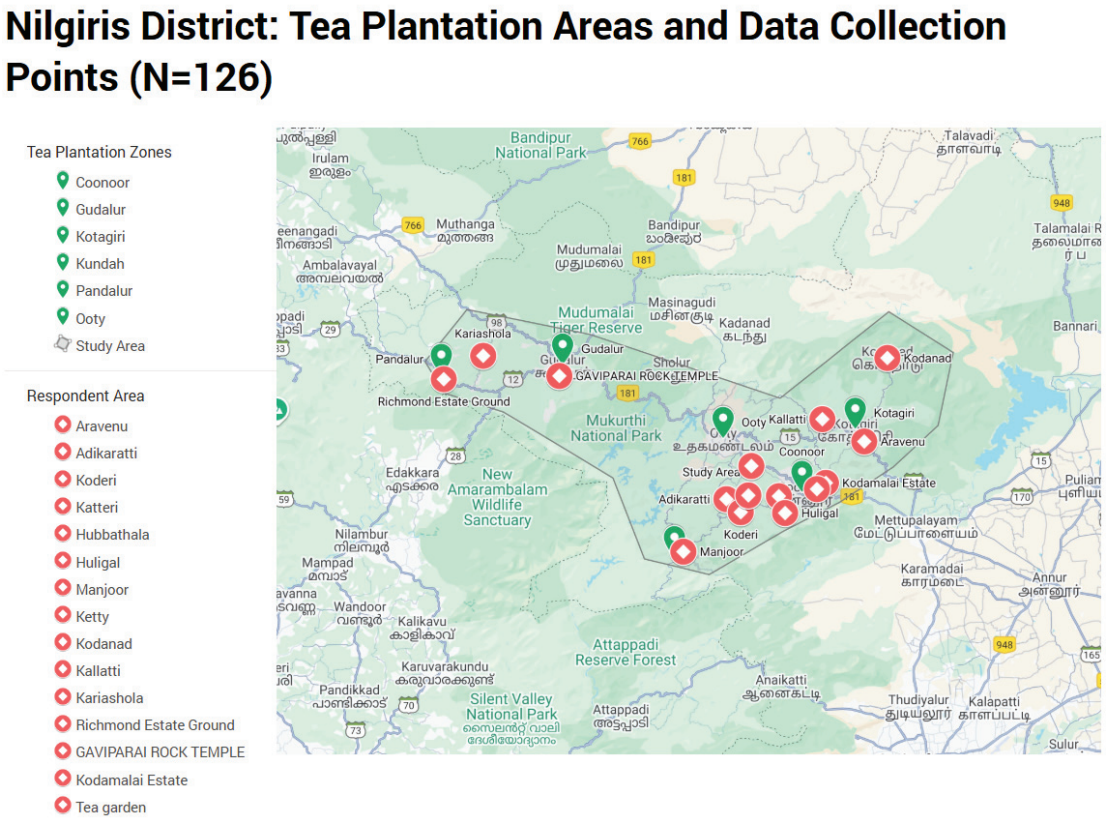


**Figure 1.** Map of Nilgiris District showing tea plantation zones and stratified

Figure 1. Map of Nilgiris District showing tea plantation zones and stratified distribution of 126 respondents across data collection points. Green markers represent six major tea-producing zones (Ooty, Kotagiri, Coonoor, Gudalur, Pandalur, Kundah). Red markers indicate specific respondent areas distributed across the district's tea-growing regions. The study area boundary is marked by a black polygon. Geographic context includes national parks, wildlife reserves, and elevation zones (1,000–2,600 meters) suitable for tea cultivation in the Western Ghats. The research follows a descriptive and cross-sectional approach, aiming to capture the perspectives of small tea growers regarding community collaboration, economic benefits, environmental sustainability and technological and infrastructure support. A structured questionnaire was developed to collect primary data from the respondents, all of whom are small-scale tea growers involved in tea-related activities and tourism. The questionnaire was designed to include both close-ended and Likert-scale questions to quantify responses objectively.

The survey instrument covered key thematic areas (Figure 2) such as:

- Community Collaboration – assessing stakeholder involvement in tea tourism.
- Economic Benefits – evaluating job creation, entrepreneurship, and market growth.
- Environmental Sustainability – identifying eco-friendly practices like organic farming and waste management.
- Technological and Infrastructural Support – understanding financial assistance, technological adoption, and policy interventions.

Categorizing variables is crucial for structuring research and understanding the interplay between different elements in the context of this study on sustainable tea tourism in The Nilgiris District. In this study, independent variables, such as community collaboration and adoption of eco-friendly practices, drive change and impact tea tourism success. Dependent variables represent the outcomes being measured, including economic benefits, environmental sustainability, and community empowerment. Moderating variables, like government support and financial assistance, influence the strength and direction of these relationships, while mediating variables, such as training programs and community engagement, act as bridges that facilitate or enhance the impact of independent variables on the dependent ones. Finally, control variables, like geographic location and demographic factors, ensure that external elements do not distort the analysis. This categorization helps isolate the effects of key variables, allowing the study to generate accurate insights and actionable recommendations for promoting sustainable tea tourism

In addition to primary data collection through questionnaire surveys, this study also utilizes secondary data from various credible sources to provide a comprehensive analysis of sustainable tea tourism in The Nilgiris District, Tamil Nadu. Secondary data is obtained from published research articles, government reports, industry publications, and statistical databases related to tea tourism, community development, and environmental sustainability. These sources help validate findings, provide historical insights, and offer comparisons with similar studies conducted in other tea-producing regions. Additionally, policy documents and sustainability reports from tea boards and tourism authorities are examined to understand existing frameworks, challenges, and best practices in promoting eco-friendly tourism. By integrating secondary data with primary survey results, the study enhances its depth and reliability, ensuring well-rounded conclusions and recommendations for improving sustainable tea tourism initiatives.

Here are hypotheses that align with the study's objectives and themes (Table 1):

- H1: Collaboration between community members and tea estates positively influences equitable socio-economic benefits in sustainable tea tourism.
- H2: Tea tourism significantly contributes to long-term economic empowerment by creating jobs and supporting entrepreneurial ventures.
- H3: Adoption of eco-friendly practices, such as organic farming and waste management, significantly enhances environmental sustainability in tea tourism.
- H4: Technological advancements and investments in infrastructure significantly improve the efficiency and growth of sustainable tea tourism initiatives.

**Table 1.** Map alignment on Objectives to Hypotheses

| Research Objective | Corresponding Hypothesis |
|---|---|
| Assess community collaboration in tea tourism | H1: Collaboration positively influences socio-economic benefits. |
| Evaluate economic empowerment via tea tourism activities | H2: Tea tourism contributes to job creation and entrepreneurial ventures. |
| Analyze environmental sustainability through eco-friendly practices | H3: Adopting eco-friendly practices enhances environmental sustainability. |
| Explore the impact of technological and infrastructural advancements | H4: Technological investments improve the efficiency and growth of tea tourism. |

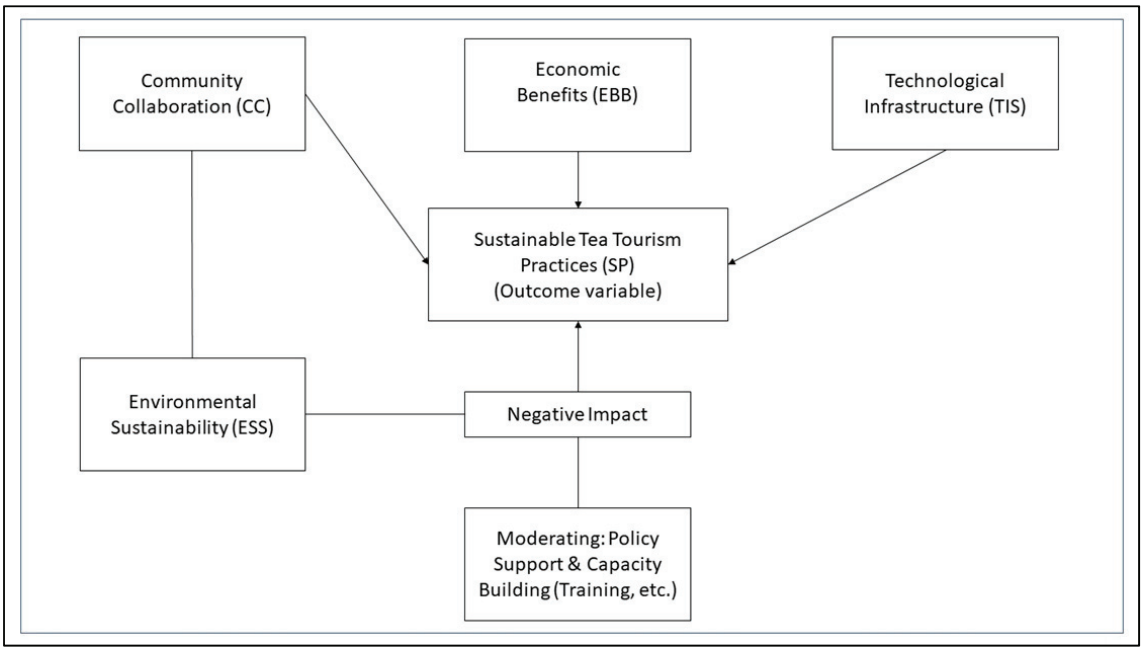


**Figure 2.** A Comprehensive Conceptual Framework for Sustainable Tea Tourism Practices

## Sampling and Data collection

A total of 126 small tea growers from the Nilgiris District, Tamil Nadu, India, were selected via a stratified random sampling method. This sampling approach ensured that tea-growing communities—varying by size, location, and tea production practices—were proportionally represented. Previous research in the realm of tea tourism and agro-tourism has frequently employed sample sizes in the range of 100 to 150 participants. For instance, studies exploring community collaboration, economic benefits, and sustainability practices have demonstrated that a sample within this threshold can yield reliable and statistically robust outcomes. Aligning with these established norms helps validate our methodology and facilitates meaningful comparisons with earlier research (Ashokkumar & Sangeetha, 2024; Sewwandi, 2024). Structural Equation Modeling (SEM) and other multivariate techniques often require a minimum sample size to stabilize parameter estimates and ensure adequate statistical power. According to widely referenced guidelines, having at least 5 to 10 respondents per estimated parameter is advisable. Given the moderate complexity of our conceptual model—with several independent, dependent, and moderating variables—a sample size of 126 is well-suited to support the analytical demands of the study without unnecessarily overburdening the respondents. While a formal power analysis might further refine these estimates, practical constraints such as the accessibility of participants and resource availability also played a role in setting the sample size. In field-based research involving specialized populations, achieving an optimal balance between feasibility and statistical rigor is key. In this context, 126 participants represent a pragmatic and effective target for ensuring robust, actionable findings. Prior to the main data collection, a pilot test was conducted with 10 participants to refine the structured questionnaire.

*Data Collection Instrument:*
A structured questionnaire was developed, containing both close-ended items and Likert-scale questions. The instrument was designed to capture key constructs:

*Independent Variables:*
- Community Collaboration (CC): Measures the extent of interaction and cooperative efforts between tea estates and local stakeholders.
- Economic Benefits (EBB): Evaluates job creation, entrepreneurial activities, and local market growth arising from tea tourism.
- Environmental Sustainability (EES): Assesses the implementation of eco-friendly practices such as organic cultivation, waste management, and water conservation.
- Technological/Infrastructure Support (TIS): Captures the influence of technological advancements, digital marketing, and infrastructural investments on tea tourism.

*Dependent Variable:*
- Sustainable Tea Tourism Practices (SP): The outcome variable representing the overall effectiveness and sustainability of tea tourism practices.

*Mixed-Methods Supplement:*
In addition to the survey, qualitative data were collected to further explain unexpected quantitative results—most notably, the negative influence observed for environmental sustainability. This phase included:
15 semi-structured interviews with tea estate managers, local tea growers, community leaders, and tourism officials.
- 2 focus groups (each comprising 6–8 participants) to discuss shared experiences and challenges in implementing eco-friendly practices.

## Data analysis

*Quantitative Analysis:*
Data Entry and Cleaning: All survey responses were coded and entered into SPSS. Data cleaning ensured the accuracy and consistency of the dataset.

*Descriptive Statistics:*
Frequencies, means, and standard deviations were calculated to provide a demographic overview and an understanding of the central tendencies for each construct.

**Table 2.** Gender Distribution of Respondents

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Male | 85 | 67.5 | 67.5 | 67.5 |
| | Female | 41 | 32.5 | 32.5 | 100.0 |
| | Total | 126 | 100.0 | 100.0 | |

Out of 126 respondents, 67.5% are male and 32.5% are female. This distribution (Table 2) suggests that males are predominant in this sector, which may influence the perspectives on community collaboration and decision-making in sustainable tea tourism initiatives.

**Table 3.** Age Distribution of Respondents

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 18-24 | 5 | 4.0 | 4.0 | 4.0 |
| | 25-34 | 20 | 15.9 | 15.9 | 19.8 |
| | 35-44 | 29 | 23.0 | 23.0 | 42.9 |
| | 45-54 | 36 | 28.6 | 28.6 | 71.4 |
| | 55 and above | 36 | 28.6 | 28.6 | 100.0 |
| | Total | 126 | 100.0 | 100.0 | |

The respondents are primarily concentrated in the higher age brackets, with 28.6% aged 45–54 and another 28.6% aged 55 and above. This indicates (Table 3) that the majority of the participants have substantial life and industry experience, which could contribute to more seasoned insights regarding sustainability and long-term economic empowerment.

**Table 4.** Occupational Profile of Respondents

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Tea Plant Grower | 91 | 72.2 | 72.2 | 72.2 |
| | Tea Manufacturer | 23 | 18.3 | 18.3 | 90.5 |
| | Govern/NGO Rep | 8 | 6.3 | 6.3 | 96.8 |
| | Others | 4 | 3.2 | 3.2 | 100.0 |
| | Total | 126 | 100.0 | 100.0 | |

A significant proportion (72.2%) are tea plant growers, followed by tea manufacturers (18.3%). The dominance of grower highlights (Table 4) the primary engagement of those directly involved in tea production, implying that the interventions or sustainability schemes will affect the core stakeholders of the industry.

**Table 5.** Educational Background of Participants

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | No Formal Education | 2 | 1.6 | 1.6 | 1.6 |
| | Primary Education | 25 | 19.8 | 19.8 | 21.4 |
| | Secondary Education | 25 | 19.8 | 19.8 | 41.3 |
| | Vocational Training | 7 | 5.6 | 5.6 | 46.8 |
| | Bachelor Degree | 44 | 34.9 | 34.9 | 81.7 |
| | Master Degree or Higher | 23 | 18.3 | 18.3 | 100.0 |
| | Total | 126 | 100.0 | 100.0 | |

Most respondents hold a bachelor's degree (34.9%) accompanied by secondary education (19.8%) and primary education (19.8%). This moderate-to-high education level provides (Table 5) a basis for understanding and potentially adopting technological or eco-friendly practices, although the presence of respondents with limited formal education points to the need for tailored capacity-building initiatives.

**Table 6.** Experience Levels Among Respondents

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | No Experience | 8 | 6.3 | 6.3 | 6.3 |
| | Less than 1 Year | 8 | 6.3 | 6.3 | 12.7 |
| | 1 - 5 Years | 15 | 11.9 | 11.9 | 24.6 |
| | 6 - 10 Years | 15 | 11.9 | 11.9 | 36.5 |
| | More than 10 Years | 80 | 63.5 | 63.5 | 100.0 |
| | Total | 126 | 100.0 | 100.0 | |

With 63.5% of respondents reporting more than 10 years of experience in tea-related activities, the sample brings a wealth of practical insights. This high level of experience makes (Table 6) the insights particularly valuable, yet it could also imply resistance to changing long-established practices, especially in adopting new technologies or environmental practices.

**Table 7.** Income Distribution of Respondents

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Less than 50000 | 89 | 70.6 | 70.6 | 70.6 |
| | 50001 - 100000 | 27 | 21.4 | 21.4 | 92.1 |
| | 100001 - 200000 | 9 | 7.1 | 7.1 | 99.2 |
| | 200001 - 300000 | 1 | .8 | .8 | 100.0 |
| | Total | 126 | 100.0 | 100.0 | |

The majority (70.6%) earn less than 50,000, indicating that many participants might be operating on relatively modest incomes. This finding (Table 7) emphasizes the economic challenges in the sector and underscores the need for initiatives that support economic empowerment through job creation and entrepreneurship.

**Table 8.** Awareness Levels Regarding Tea Tourism

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Partially Aware | 88 | 69.8 | 69.8 | 69.8 |
| | Aware | 38 | 30.2 | 30.2 | 100.0 |
| | Total | 126 | 100.0 | 100.0 | |

**Table 9.** Knowledge Level on Tea Tourism Practices

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Not Familiar | 1 | .8 | .8 | .8 |
| | Limited Knowledge | 50 | 39.7 | 39.7 | 40.5 |
| | Neutral | 37 | 29.4 | 29.4 | 69.8 |
| | Knowledge | 30 | 23.8 | 23.8 | 93.7 |
| | Very Knowledge | 8 | 6.3 | 6.3 | 100.0 |
| | Total | 126 | 100.0 | 100.0 | |

Over two-thirds of the participants are "partially aware" (69.8%), with only a minority being fully aware. The mixed levels of knowledge (Table 8, Table 9) —from limited to a small fraction being very knowledgeable—suggest that further dissemination of best practices and training programs is essential.

**Table 10.** Professional Frequencies of Tea Industry Stakeholders

| | | Responses | | Percent of Cases |
|---|---|---|---|---|
| | | N | Percent | |
| Professionala | BT.Tea_Plantation_Owners | 79 | 13.8% | 66.9% |
| | BT.Tea_Plantation_Workers | 70 | 12.2% | 59.3% |
| | BT.Tea_Factory_Owners | 59 | 10.3% | 50.0% |
| | BT.Tea_Factory_Workers | 57 | 10.0% | 48.3% |
| | BT.Local_Residents | 54 | 9.4% | 45.8% |
| | BT.Community_Leaders | 25 | 4.4% | 21.2% |
| | BT.Tea_Cooperative_Members | 26 | 4.5% | 22.0% |
| | BT.Tourism_Officials | 35 | 6.1% | 29.7% |
| | BT.NGO_Representatives | 30 | 5.2% | 25.4% |
| | BT.Tour_Operators | 51 | 8.9% | 43.2% |
| | BT.Homestay_Owners | 34 | 5.9% | 28.8% |
| | BT.Environmental_Experts | 27 | 4.7% | 22.9% |
| | BT.Homestay_Workers | 22 | 3.8% | 18.6% |
| | BT.Other_Beneficiaries | 3 | 0.5% | 2.5% |
| Total | | 572 | 100.0% | 484.7% |
| a. Dichotomy group tabulated at value 1. | | | | |

**Table 11.** Participation in Tea Tourism Schemes

| | | Responses | | Percent of Cases |
|---|---|---|---|---|
| | | N | Percent | |
| Schemesa | Scheme_TTDC | 23 | 9.5% | 18.3% |
| | Scheme_ITBI | 36 | 14.9% | 28.6% |
| | Scheme_NDAP | 61 | 25.3% | 48.4% |
| | Scheme_ERTTO | 46 | 19.1% | 36.5% |
| | Scheme_PCLI | 30 | 12.4% | 23.8% |
| | Scheme_CP | 13 | 5.4% | 10.3% |
| | Scheme_International_Recognition | 8 | 3.3% | 6.3% |
| | Scheme_INCOSERVE | 14 | 5.8% | 11.1% |
| | Scheme_Others | 10 | 4.1% | 7.9% |
| Total | | 241 | 100.0% | 191.3% |
| a. Dichotomy group tabulated at value 1. | | | | |

The professional frequency table reveals (Table 10, Table 11) a diverse range of stakeholders from tea plantation owners to tourism officials, indicating a multifaceted industry structure. The schemes frequency table shows varying levels of participation, with certain schemes (e.g., Scheme_NDAP) being more popular. This suggests that some policy instruments or financial supports are perceived as more accessible or beneficial to the stakeholders.

*Structural Equation Modeling (SEM):*
SEM techniques were employed to test the hypothesized relationships among the independent variables (CC, EBB, EES, TIS) and the dependent variable (SP). The model evaluation included fit indices such as Chi-square, RMSEA, NFI, and CFI to determine the overall adequacy of the theoretical framework.

*Qualitative Analysis:*
*Transcription and Coding:*
Interviews and focus group sessions were transcribed verbatim. Thematic coding was conducted using qualitative data analysis software, identifying recurrent themes related to the operational and financial challenges of eco-friendly practices. Qualitative findings were triangulated with SEM results to provide contextual depth - especially to explain the unexpected negative association between environmental sustainability and sustainable tea tourism outcomes. The responses were systematically recorded and analysed using SPSS to examine correlations and trends, allowing for a comprehensive understanding of the role of sustainable tea tourism in fostering socio-economic and environmental benefits within the region.

## Results and Findings

### *Quantitative Findings*

The SEM analysis produced the following standardized regression weights and significance levels:

**Table 12.** Standardized Regression Weights: (Group number 1 - Default model)

| Variables | | | Estimate | P | Result (Default model) | Model Indices |
|---|---|---|---|---|---|---|
| SP | <--- | CC | .274 | .009 | Minimum was achieved | NFI -.847 |
| SP | <--- | EBB | .395 | *** | Chi-square = 84.982 | CFI - .848 |
| SP | <--- | TIS | .587 | *** | Degrees of freedom = 2 | RMSEA - .098 |
| SP | <--- | ESS | -.284 | .011 | Probability level = .000 | Acceptable Fit |

Ha: Collaboration between community members, Economic Benefits, Environmental sustainability and Technological advancements & investments in infrastructure have a direct significant effect on Sustainable tea tourism practices (Table 12).

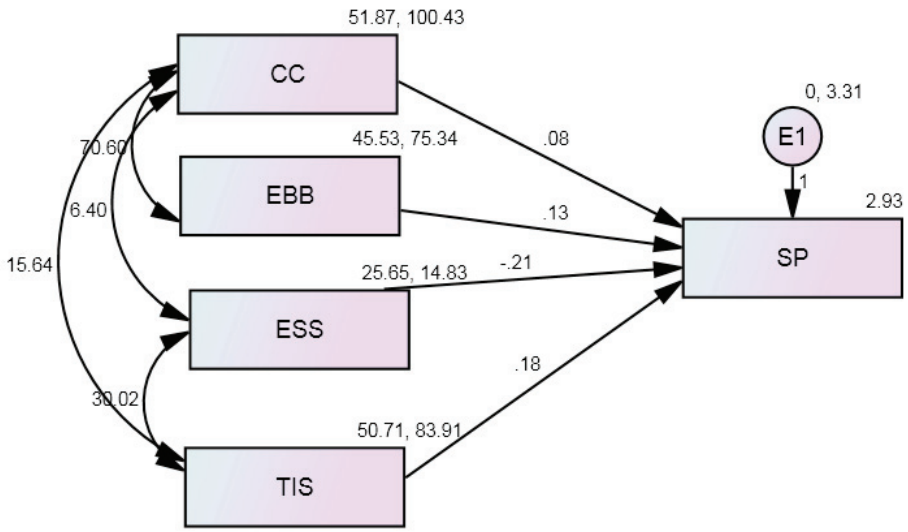


**Figure 3.** Structural Equation Model

The above SEM (Figure 3) result depicts the standardized regression weights (β) which estimate and predict the sustainable tea tourism practices. The SEM result reveals that the hypothesis is significant i.e. Collaboration between community members, Economic Benefits, Environmental sustainability and Technological advancements & investments in infrastructure have a direct significant effect on Sustainable tea tourism practices. The standardized regression weights of Collaboration between community members (.274), Economic Benefits (.395), and Technological advancements & investments in infrastructure (.587) have a direct and positive effect on Sustainable tea tourism practices. But, Environmentally Sustainable has a negative effect on Sustainable tea tourism practices (i.e. Environmentally Sustainable variables goes up the achieving Sustainable tea tourism practices comes down).

It is concluded from the SEM result that, for achieving Sustainable tea tourism practices tea tourist providers need more Technological advancements & investments in infrastructure facilities which push for more tea tourism activities that will attract more tourists for the destination.

*Qualitative Findings*
The thematic analysis from interviews and focus groups provided additional context:

*High Initial Costs & Operational Challenges:*
Respondents consistently noted that while eco-friendly practices such as organic farming and waste reduction align with long-term sustainability goals, the initial financial outlay is high. This often results in operational strain, reducing immediate tourism competitiveness.

*Inadequate Training and Technical Support:*
A recurring theme was the lack of comprehensive training programs and technical support, which hindered effective implementation of environmental practices. This gap often led to inconsistent application and short-term inefficiencies.

*Policy and Infrastructural Barriers:*
Several stakeholders mentioned that current policy frameworks and infrastructural investments are insufficient, compounding the challenges associated with sustainable environmental practices. The need for enhanced government support and capacity-building emerged as crucial factors.

## Discussion

*Community Collaboration as a Driver of Sustainable Tea Tourism ($\beta = .274$, $p < .01$)*

The positive and significant effect of community collaboration on sustainable tea tourism practices ($\beta = .274$, $p < .01$) indicates that stronger linkages between small growers, local residents, and estate managers translate into more consistent and structured tea tourism initiatives. This finding aligns with recent community-based tourism research in similar agritourism contexts. Specifically, (Gurung & N, 2024), in their study of tea tourism in Sikkim, documented that community-led guiding, homestay operations, and collective decision-making on cultural events significantly enhanced both visitor experience and local ownership of tourism activities. Their work emphasizes that when small tea growers perceive themselves as active stakeholders rather than passive recipients, they invest more effort in maintaining tea gardens as attractions and in upskilling themselves to meet visitor expectations. Similarly, (E. Sharma, 2025), in examining participatory models in sustainable tourism development across multiple destinations, found that explicit integration of local stakeholders into planning, benefit-sharing mechanisms, and governance structures leads to more resilient tourism systems and greater community acceptance of new initiatives. Sharma's analysis of collaborative frameworks demonstrated that where formalized structures for community input exist—such as regular stakeholder meetings, cooperative decision-making, and transparent benefit-sharing—tea tourism outcomes improve significantly. The present study's moderate coefficient ($\beta = .274$) for community collaboration supports these findings, suggesting that while collaboration is a necessary condition for sustainable tea tourism in the Nilgiris, it functions as part of a broader ecosystem that includes economic incentives and technological enablers. Taken together, these studies advance the argument that collaboration is not merely a contextual factor or enabling condition, but rather a core driver that enables tea tourism projects in the Nilgiris to move beyond ad hoc, informal efforts toward more structured, reproducible, and sustainable practices. This implies that policy interventions in the Nilgiris should prioritize institu-

tional mechanisms that formalize community engagement rather than relying on ad hoc goodwill.

*Economic Empowerment as a Key Motivator (β = .395, p < .001)*
Economic benefits exhibited a moderately strong and significant positive relationship with sustainable tea tourism practices (β = .395, p < .001), underscoring that income diversification, job creation, and enterprise development are central motivations for engaging with tourism in tea-growing regions. This result corroborates qualitative and quantitative evidence from other tea-producing regions facing similar socio-economic pressures. (Sewwandi, 2024), in a comprehensive case study of the Pedro tea estate in Sri Lanka, found that tea tourism homestays, guided plantation tours, and value-added product sales (such as tea-infused beverages and organic tea crafts) contributed to supplementary household income and enhanced livelihood security for estate communities. Sewwandi's analysis revealed that households engaged in tourism-related activities reported income increases of 20–35% over non-tourism baseline incomes, which motivated further investment in tourism infrastructure and community skills development. The present study's findings are consistent with this evidence from Sri Lanka, suggesting that when small growers in the Nilgiris perceive tangible economic gains—through direct tourist spending on accommodations, meals, and tea products, as well as new market channels for premium organic tea—they are more willing to invest scarce resources (time, capital, labor) in maintaining tea-related attractions and services. Importantly, the coefficient for economic benefits (β = .395) is notably higher than that for community collaboration (β = .274), which may reflect a practical reality in economically stressed regions: whereas collaboration is culturally valued and socially important, immediate household economic pressures often take precedence in decision-making. This ranking suggests that without demonstrable economic returns, even well-designed collaborative frameworks may struggle to sustain participation. Accordingly, economic empowerment functions not only as an outcome of sustainable tea tourism but also as a reinforcing mechanism that enables communities to allocate resources to longer-term sustainability initiatives. These findings strengthen the argument that policymakers should prioritize mechanisms that ensure equitable distribution of tourism revenues to small growers and local communities.

*The Negative Coefficient for Environmental Sustainability: Explaining an Apparent Paradox (β = –.284, p = .011)*
In contrast to expectations and prior conceptual arguments grounded in sustainability theory, environmental sustainability showed a significant negative coefficient in the structural model (β = –.284, p = .011). This unexpected finding indicates that higher reported engagement in eco-friendly practices was associated with lower overall levels of sustainable tea tourism practices. This relationship contradicts many studies that portray organic cultivation, waste reduction, and resource conservation as unequivocal enablers of sustainable agritourism. However, careful examination of the qualitative data collected through semi-structured interviews and focus groups reveals a compelling explanation for this apparent paradox.

The Cost Burden Hypothesis
*High Initial Capital Outlay and Operational Strain:* Respondents in the interviews and focus groups (n=15 interviews; 2 focus groups with 6–8 participants each) consistently highlighted that while eco-friendly practices—such as organic certification, integrated pest management, waste management systems, and renewable energy adoption—align intellectually with long-

term sustainability goals, their implementation imposes substantial upfront financial costs. For instance, one tea estate manager stated: "Organic certification alone costs 50,000–100,000 rupees, and then yields drop for 2–3 years during transition. Many small growers cannot absorb this loss." Similarly, a focus group of seven small growers noted that composting systems, drip irrigation infrastructure, and solar installations require capital investments ranging from 200,000 to 500,000 rupees—amounts that exceed annual net incomes for 70.6% of the respondent population (those earning <50,000 rupees annually, per Table 7). These high initial costs often result in operational and financial strain, which in turn reduces the immediate competitiveness and attractiveness of tea tourism ventures.

*Inadequate Technical Training and Knowledge Barriers:* A second recurrent theme emerging from qualitative analysis was the lack of comprehensive, locally-relevant training programs and sustained technical support for eco-friendly practices. As noted by a community leader: "We attended a 2-day workshop on organic farming, but it didn't address local soil conditions or market demand. When problems arose, we had no one to call." This gap in technical capacity often leads to inconsistent and incorrect application of eco-friendly practices, which dampens confidence in their efficacy and discourages further investment. Multiple respondents reported failed attempts at organic cultivation, leading to reduced yields without corresponding premium prices—a "worst of both worlds" scenario that undermines faith in sustainability transitions.

*Insufficient Policy Support and Subsidy Barriers:* A third critical constraint identified in focus groups was the limited availability of policy-level financial support and the difficulty of accessing existing government subsidies. Several stakeholders reported that schemes ostensibly designed to promote organic farming and sustainable practices are either unknown to small growers, require complex documentation processes, or offer compensation levels insufficient to offset the perceived risks and short-term revenue losses associated with transitioning to greener practices. One township official remarked: "Subsidies exist, but the paperwork is complex, and payouts are delayed. By the time money arrives, a small grower has already reverted to conventional methods out of necessity."

*Theoretical Reinterpretation:* Environmental Sustainability as a Burden Rather Than a Driver
When these three constraints—cost, training, and policy barriers—are considered together, the negative path coefficient can be interpreted not as evidence that environmental practices are inherently detrimental to tea tourism, but rather as a reflection of the current implementation burden of environmental initiatives in the Nilgiris context. In other words, growers who attempt to adopt more eco-friendly practices may temporarily experience reduced competitiveness (due to lower yields during transition), reduced short-term profitability (due to higher input costs), and operational complexity (due to knowledge gaps), which in turn dampens their overall engagement with tourism-related activities and their ability to invest in tourism infrastructure.

This interpretation is consistent with broader agritourism and sustainable development literature, where environmental upgrades without parallel financial, technical, and institutional support have been observed to initially depress participation in economic activities. For example, studies from Sri Lankan tea estates, Indonesian agritourism enterprises, and African community-based tourism initiatives have documented similar patterns: when sustainability tran-

sitions impose costs without offsetting subsidies or capacity-building support, participating communities experience short-term economic stress that undermines their commitment to tourism diversification. The Nilgiris case thus represents not a fundamental incompatibility between environmental sustainability and tea tourism, but rather a policy and infrastructure gap that must be bridged.

Policy Implications

The findings thus suggest that eco-friendly practices will only become a positive (rather than negative) driver of sustainable tea tourism in the Nilgiris when accompanied by: (1) targeted government subsidies or co-investment schemes that reduce the financial burden on small growers during transition periods; (2) comprehensive, location-specific capacity-building programs that provide sustained technical support beyond workshop-style training; and (3) more supportive regulatory frameworks that reduce administrative barriers to accessing environmental incentives. Without these complementary interventions, the negative coefficient observed in this study is likely to persist, and environmental stewardship will remain a luxury that economically-stressed small growers cannot afford to prioritize.

*Technological and Infrastructural Support as the Strongest Driver ($\beta = .587$, $p < .001$)*

Technological and infrastructural support recorded the strongest standardized effect on sustainable tea tourism practices ($\beta = .587$, $p < .001$), indicating that access to digital tools, online marketing, online booking systems, and basic infrastructure improvements is a critical enabler in the Nilgiris context. This strong effect warrants careful consideration in light of recent digital tourism literature.

*Digital Visibility and Market Reach:* (Kaur et al., 2024), in their examination of digital tourism platforms across multiple sustainable destinations in India, highlighted that platform visibility, multi-language website accessibility, and online booking systems significantly widen the audience for niche tourism destinations, particularly for international eco-conscious travelers seeking authentic experiences. Kaur's analysis demonstrated that destinations with professionally-maintained digital presence and online reputation management received 3–5 times more inquiry inquiries than those without such platforms. Importantly, Kaur et al. emphasize that for small, remote destinations like those in the Nilgiris, digital platforms serve as a force multiplier—they allow small tea growers to reach global markets without the need for extensive physical marketing infrastructure or travel.

*Service Quality and Guest Experience:* Similarly, (Ng et al., 2022), in their study of service quality and guest experience in sustainable tea tourism destinations (including locations in Malaysia and Taiwan), found that technology-enabled service delivery—such as real-time booking confirmation, digital payment systems, and information provision through mobile apps—significantly influences memorable experiences, guest satisfaction, and repeat visitation. Ng's work stressed that even in traditional sectors like tea tourism, technology serves to reduce transaction friction and enhance perceived professionalism, thereby attracting guests who might otherwise be hesitant to visit unfamiliar, rural destinations.

*Smart Analytics and Operational Efficiency:* (Palaniyandi et al., 2024), in their analysis of smart tourism analytics deployment in Indian heritage and agritourism sites, documented that data-driven insights into visitor behavior, seasonal patterns, and market trends enable destination

managers to optimize marketing expenditures, improve capacity planning, and enhance visitor-host interactions. Palaniyandi's work shows that small operators who adopt even basic analytics (such as tracking website visitor sources or analyzing online review sentiment) report improvements in occupancy rates and revenue per visitor.

*Digital Marketing and Destination Branding:* Finally, (R. Sharma et al., 2023), in their comprehensive review of digital technology implementation in promoting India as a tea destination, identified virtual tours, augmented reality plantation experiences, and social media marketing as key drivers in positioning Indian tea estates as globally-competitive tourism offerings. Sharma et al. note that platforms like Instagram and YouTube allow small tea producers to bypass traditional tourism intermediaries and tell their own sustainability and heritage stories directly to potential visitors, thereby enhancing authenticity and differentiation.

## Synthesis and Implications

The strong coefficient for technological infrastructure (β = .587) in this study thus reflects a reality documented across the digital tourism literature: in contemporary travel planning, the absence of digital presence and online booking capability is increasingly a disqualifying factor, while the presence of technology-enabled services is a necessary (though not sufficient) condition for scaling tourism. The strong effect observed in the Nilgiris suggests that digital infrastructure investments by government, NGOs, or private sector partners may yield rapid, measurable returns in terms of visitor volume and revenue. Moreover, unlike environmental sustainability initiatives, digital infrastructure projects often have shorter payback periods and more visible immediate impacts, which may explain why they receive higher community endorsement and engagement.
Integrated Interpretation: A Holistic Model for Sustainable Tea Tourism

The four pathways revealed through SEM analysis paint a nuanced picture of sustainable tea tourism development in the Nilgiris:
*Positive Drivers (Strong to Moderate Effects):* Technological infrastructure (β = .587), economic benefits (β = .395), and community collaboration (β = .274) all exert positive effects on sustainable tea tourism practices. These three factors are mutually reinforcing: technology enables market access, which generates economic benefits, which in turn motivates community participation in tourism infrastructure development.

*The Environmental Sustainability Challenge (Negative Effect):* The unexpected negative coefficient for environmental practices (β = −.284) signals that environmental sustainability is currently experienced as a burden rather than an opportunity by growers operating under economic constraints and with limited policy support. This does not negate the long-term value of environmental practices, but rather highlights that sustainability transitions require complementary institutional and financial support.

*Hierarchical Importance:* The relative magnitudes of the coefficients suggest a hierarchy of priorities from the growers' perspective: (1) technology and market access are most critical; (2) direct economic returns are secondary but substantial motivators; (3) collaborative structures are valued but less immediately pressing; and (4) environmental practices are intellectually endorsed but materially constrained.

*Policy and Practice Implications:* These findings underscore the importance of a carefully-sequenced, holistic approach to promoting sustainable tea tourism in the Nilgiris. Rather than pursuing environmental sustainability in isolation, policymakers and estate managers should: First, establish digital infrastructure that enables market access and creates baseline revenue opportunities (leveraging the strong β = .587 effect); Second, ensure that economic returns are equitably distributed to small growers and communities (addressing the β = .395 economic motivation); Third, formalize community governance structures that give stakeholders voice and agency (building on the β = .274 collaboration effect); Fourth, only then introduce environmental sustainability initiatives, but paired with subsidies, training, and policy support that reduce the implementation burden identified in qualitative analysis. This sequencing reflects the reality that sustainability is a journey, not a starting point, and that growers must first achieve economic stability and operational competence before they can reallocate resources to longer-term environmental stewardship.

## Limitations

While the study contributes valuable insights, several limitations must be noted:

*Geographical Scope:*
The research is limited to the Nilgiris District in Tamil Nadu, which may affect the generalizability of findings to other tea-producing regions with different socio-economic dynamics.

*Sample Size and Diversity:*
Although 126 respondents provide a reasonable basis for analysis, a larger and more diverse sample could offer deeper insights—especially in capturing variations in practices across different demographic groups.

*Cross-Sectional Design:*
The use of a cross-sectional survey precludes an analysis of trends over time. Longitudinal studies would be necessary to understand the evolving nature of sustainable tea tourism practices.

*Self-Reported Data:*
Reliance on self-reported information may introduce bias, as respondents' perceptions could be influenced by personal experiences or social desirability.

*Integration of Mixed Methods:*
While the study integrates both quantitative and qualitative data, effective triangulation can be challenging when discrepancies appear (e.g., the negative influence of eco-friendly practices). Future research could refine these methodologies for clearer integration.

## Conclusion

The study robustly examines sustainable tea tourism in the Nilgiris District by integrating community collaboration, economic empowerment, environmental stewardship, and technological support. Key findings highlight that: (1) Positive drivers such as community collabora-

tion, economic benefits, and technological investments significantly bolster sustainable tourism practices. (2) Unexpected challenges related to environmental sustainability, such as high initial costs and limited technical support, necessitate targeted interventions—like improved training programs, government subsidies, and policy enhancements. (3) The descriptive analysis underscores a demographic profile characterized by experienced, predominantly male tea grower participants with modest incomes, emphasizing both the potential for and barriers to implementing innovative sustainable practices. The insights derived provide a basis for policymakers and industry practitioners to formulate strategies that enhance not only economic and technological dimensions but also the operational viability of eco-friendly practices. This comprehensive evaluation and interpretation set the stage for further research and informed policy-making in the realm of sustainable tea tourism.

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