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ENHANCING ENVIRONMENTAL SUSTAINABILITY IN CONSERVATION TOURISM THROUGH THE TOTAL ERGONOMICS SHIP APPROACH

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Abstract

This research aimed to examine the enhancement of environmental sustainability in conservation tourism using total ergonomics, represented by SHIP model (systemic, holistic, interdisciplinary, and participatory). The results showed that SHIP dimensions significantly improved sustainable tourism outcomes, with the holistic principle showing the greatest effect using a quantitative approach with Partial Least Squares Structural Equation Modeling (PLS-SEM). Total ergonomics was reported as an integrative framework for advancing sustainable and inclusive tourism development.

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INTRODUCTION

Sustainable tourism development is a global priority because the concept strengthens the economy while preserving environmental and cultural integrity (Jaelani et al., 2023). In Indonesia, tourism contributes approximately 4.3% to the national GDP 4 (BPS, 2025). Kemenparekraf (2024) introduced the National Tourism Development Index to increase sustainable and inclusive tourism transformation nationwide. In the context of conservation areas, the principle of sustainability emphasizes the optimized use of natural resources, as well as the maintenance of biodiversity, ecosystems, and life support systems. A holistic and systematic approach that integrates ergonomic principles is essential for ensuring efficient, comfortable, and safe interactions between humans and the environment (Shang, 2020). A systemic, holistic, interdisciplinary, and participatory total ergonomics approach (SHIP) can be an effective solution for managing conservation tourism destinations while considering social, economic, and cultural sustainability.

The holistic principle shows the need to balance economic, social, cultural, and environmental aspects to ensure sustainable tourism management (Niewiadomski & Brouder, 2024). Interdisciplinary collaboration across tourism, social, cultural, and environmental sciences facilitates more comprehensive management solutions. Meanwhile, participatory engagement ensures active inclusion of local communities, enhancing ownership and long-term sustainability (Widawski et al., 2023; Krittayaruangroj et al., 2023). Even though several research have explored tourism sustainability, most focus on a single dimension such as economic impact or community empowerment (Megawati et al., 2023).

Different research systematically applying ergonomics in conservation tourism remains limited, even though ergonomic considerations can enhance visitor comfort and promote environmental sustainability (Suparti et al., 2023). Most previous research has focused on single dimensions of sustainable tourism, such as economic impacts or community empowerment, without integrating ergonomic principles into governance. This research addresses the gap by applying SHIP total ergonomics framework as an integrated approach to sustainable tourism management in conservation areas. The novelty lies in positioning ergonomics as a design tool and strategic governance model that unifies environmental, social, cultural, and ergonomic dimensions, offering the first evidence-based framework to analyze the consistency of human well-being with ecological preservation and cultural continuity (Widawski et al., 2023; Krittayaruangroj et al., 2023; Niewiadomski & Brouder, 2024; Lu, 2025; Widawski et al., 2023; Krittayaruangroj et al., 2023; Lu, 2025). The original contribution is the development of a practical ergonomics-based governance model for conservation tourism, integrating the SHIP framework to balance human well-being with ecological and socio-cultural sustainability.

Indonesia has several natural conservation areas that serve as main attractions, such as national parks, protected forests, and lakes, offering environmentally friendly tourism experiences. The current major challenges of conservation tourism are related to the environment and the sustainability of local culture. According to Baloch et al. (2023), there is damage caused by over-exploitation of natural resources, increasing amounts of waste, and negative impacts on local culture. Belsoy et al. (2012) showed that tourism could cause degradation of flora and fauna, which threatens biodiversity in several conservation areas in the world, including Bali.

Doi: 10.47608/jki.v19i22025.221-238

METHODOLOGY

Research Type and Design

This research used a descriptive qualitative-quantitative approach (Camilli Trujillo et al., 2022). Quantitative and qualitative designs could be justified in mixed methods to strengthen, refine, or refute plausible explanations of phenomena (Ryba et al., 2022). A Likert-scale questionnaire (1 = strongly disagree to 4 = strongly agree) was used to assess respondents' opinions and perceptions of SHIP ergonomics in sustainable conservation tourism management. The instrument was tested for validity and reliability (Taherdoost, 2021; Sukmawati et al., 2023).

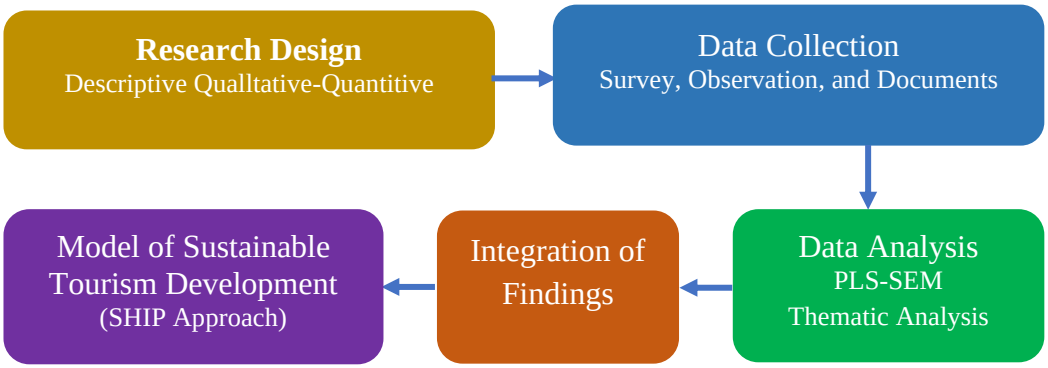

Figure 1. Research Methodology Flow of the Mixed-Methods Research

Source: Research Data, 2025

Research Location and Sample

This research was conducted in several conservation tourism villages in Bali that apply sustainability and ergonomic principles. Participants comprised tourism managers and practitioners in SHIP-based conservation tourism. A non-probability (accidental) sampling method was used due to the identifiable population characteristics (Berndt, 2020; Kim, 2022). Although this approach limits external validity (Andrade, 2021), but effectively captures relevant actors within conservation tourism settings. The sample size was determined following Hair et al. (2019), who recommended five to ten times the number of observed indicators. With 28 indicators analyzed, the minimum required sample was 280 respondents.

Framework and Hypothesis Development

The SHIP (systemic, holistic, interdisciplinary, and participatory) ergonomic method plays a significant role in encouraging sustainable tourism within conservation areas to harmonize humans with tasks, work organizations, and the environment, thus complementing the goal of sustainable conservation tourism. The systemic approach aims to manage interrelated systems, social, cultural, economic, industrial, agricultural, and environmental into one tourism system, thereby producing tourist destinations that foster the sustainability of both ecosystems and socio-cultures (Kant, 2023). Holistic means considering comprehensively all related aspects, such as social, economic, cultural, and environmental, that provide direct benefits to local communities without damaging existing cultural and social values. Interdisciplinary means the involvement of all related disciplines is integrated. Integrating knowledge from various fields, such as tourism, environment, to

Doi: 10.47608/jki.v19i22025.221-238

create a sustainable tourism management system (Shang, 2020). Furthermore, participatory is an approach that includes all stakeholders, especially the community, tourism business actors, and policy makers, actively part of planning, implementation, and evaluation of tourism management. This can raise awareness and community involvement in preserving the environment and culture (Suparti et al., 2023) to realize sustainable tourism from social, cultural, economic, and environmental aspects. Thus, conservation-based tourism management must prioritize environmental and cultural sustainability while simultaneously improving the welfare of local communities

Sustainability in tourism is highly dependent on the application of sustainable management principles. The application of a SHIP-based management model, which includes a systemic, holistic, interdisciplinary, and participatory approach, can provide a solution to maintain a balance between economic needs and environmental conservation (Table 1).

Table 1. Principle Ergonomic SHIP on Tourism Application

Principle	Key Function	Tourism Application	Supporting Evidence
Systemic	Govern interconnected social, cultural, economic, ecological systems.	Prevent resource conflicts.	Lu, (2025)
Holistic	Balance economic, social, cultural, ecological aspects.	Prevent environmental damage.	Niewiadomski & Brouder, (2024)
Interdisciplinary	Integrate multiple disciplines.	Combine traditional wisdoms with modern approaches.	Widawski et al., (2023)
Participatory	Engage stakeholders in tourism planning.	Strengthen community involvement as tourism actors.	Suparti et al., (2023)

Source: Research Data, 2025

Based on this framework, the following research hypotheses were proposed:

1) H_1: A systemic total ergonomic approach has a positive effect on socially, culturally, economically, and environmentally sustainable tourism in conservation tourism areas.
2) H_2: Holistic principles in the total ergonomic approach have a positive effect on socially, culturally, economically, and environmentally sustainable tourism in conservation tourism areas.
3) H_3: Interdisciplinary principles in the total ergonomic approach have a positive effect on socially, culturally, economically, and environmentally sustainable tourism in conservation tourism areas.
4) H_4: Local community participation in tourism planning and management has a positive effect on socially, culturally, economically, and environmentally sustainable tourism in conservation tourism areas.
5) H_5: Integration of SHIP total ergonomic principles can create socially, culturally, economically, and environmentally sustainable tourism in conservation tourism areas.

The relationship between variables in the application of the SHIP total ergonomics approach in sustainable tourism management in Bali is presented in Figure 2. The SHIP

Doi: 10.47608/jki.v19i22025.221-238

approach, involving systemic, holistic, interdisciplinary, and participatory elements, was integrated with ergonomic factors to support sustainable tourism development that includes economic, social, cultural, and environmental aspects. Ergonomic factors applied in SHIP can improve sustainable tourism (1. social sustainability, 2. cultural sustainability, 3. economic sustainability, and 4. environmental sustainability).

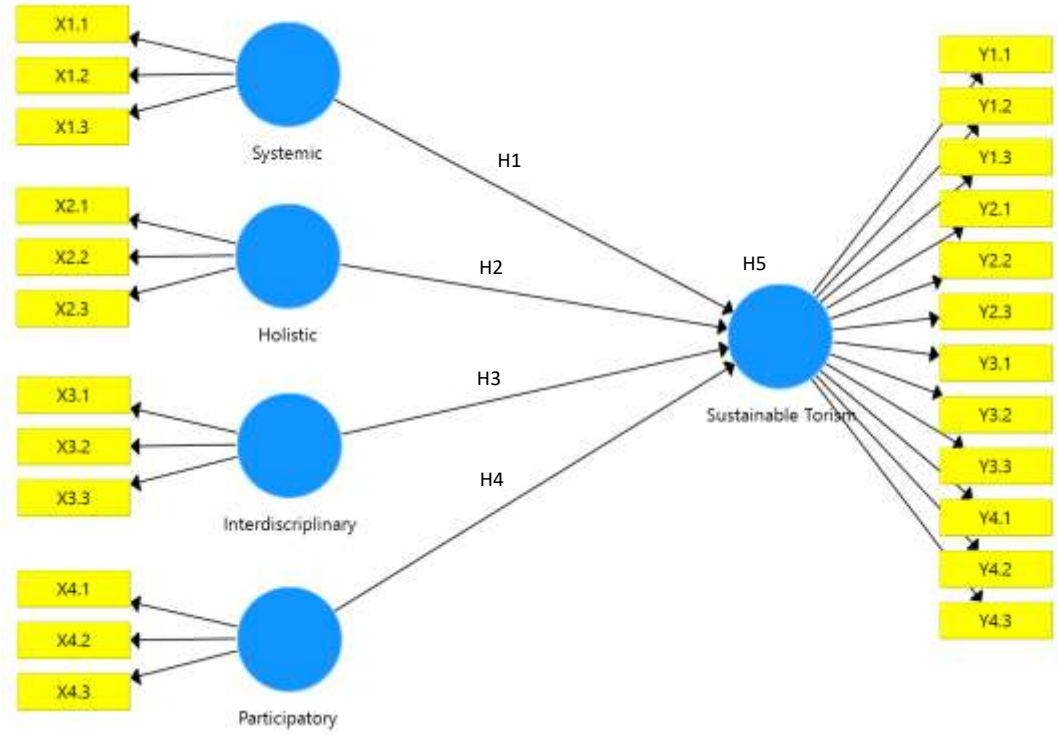

Figure 2. Relationship Between Variables Model SEM PLS

Source: Research Data, 2025

Research Instruments

A structured questionnaire was used to assess tourist perceptions and the application of SHIP ergonomics in conservation tourism. This covered four SHIP dimensions, including systemic, holistic, interdisciplinary, and participatory and four sustainability aspects, namely social, cultural, economic, and environmental. The instrument captured both service experiences and community-based management practices. The answers to the checklist instrument (Table 2) were categorized into 4 Likert scales (1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree), measuring a person's subjectivity to the measured phenomenon, which is valid and reliable (Sukmawati et al., 2023). Indicators were arranged based on constructs adapted from relevant and current literature, ensuring conceptual and empirical alignment. The results of the Gregory formula questionnaire validity test obtained a coefficient index of 0.916, thereby confirming the validity and suitability for data collection (Gregory, 2000). Based on expert validity, a questionnaire trial was then carried out involving 30 respondents to ensure item clarity, reliability, and consistency (Taherdoost, 2021), and the results of filling out the questionnaire were tested for validity and reliability using SPSS version 22. The reliability

Doi: 10.47608/jki.v19i22025.221-238

test of the main dimensions of the questionnaire showed that the Cronbach's alpha values ranged from 0.721 to 0.891, indicating that all question items were reliable, as each value exceeded the acceptable threshold of 0.7 hence the list of questions in the questionnaire was declared reliable.

Table 2. Questionnaire Items for Assessing the Implementation of SHIP Ergonomics in the Governance of Conservation Tourism

No.	Questionnaire Items	References
X	**SHIP ERGONOMICS**	
X1	**SYSTEMIC**	
X1.1	Existing policies and regulations in tourism village governance incorporate considerations for the preservation of natural resources and local cultural heritage within conservation tourism areas.	Martin Mowforth & Ian Munt, (2016); Scott & Gössling, (2025)
X1.2	There is consistent coordination among the tourism, agriculture, industry, and environmental sectors in managing destinations within conservation areas.	Widawski et al., (2023)
X1.3	Environmentally friendly technologies are used to mitigate the environmental impact of tourism activities in conservation areas.	Buckley, (2012)
X2	**HOLISTIC**	
X2.1	Tourism management policies in conservation areas adopt a holistic approach that incorporates economic, social, and environmental aspects through planning, implementation, and evaluation processes to ensure long-term sustainability.	Lesar et al., (2023)
X2.2	Integrated approaches including customary and administrative villages, industry, and the community result in tangible economic benefits for residents while preserving the natural and cultural environment.	Widawski et al., (2023)
X2.3	Tourism managers consider social, cultural, and economic aspects simultaneously to improve the social well-being of local communities in conservation destinations.	Melanie K. Smith, (2023)
X3	**INTERDISCIPLINARY**	
X3.1	Destination management in conservation areas that includes professionals from tourism, environmental, and economic disciplines is more effective in conserving the ecosystem.	Buckley, (2012)
X3.2	Cross-disciplinary collaboration enhances the effectiveness of strategies to minimize the negative environmental impacts of tourism.	Buckley, (2012)
X3.3	An interdisciplinary approach across professions results in more effective solutions for balancing tourism development and environmental conservation.	Hall, (2024)
X4	**PARTICIPATORY**	
X4.1	Active participation of local communities in tourism planning contributes to more appropriate and socially responsive policy outcomes.	Widawski et al., (2023)
X4.2	Active participation of local communities in tourism management improves their economic well-being without compromising environmental and cultural sustainability.	Hall, (2024)
X4.3	Community participation in tourism governance fosters a better balance between economic development and environmental conservation.	Melanie K. Smith, (2023)
Y	**SUSTAINABLE TOURISM**	
Y1	**Social Sustainability in Conservation Tourism Areas**	
Y1.1	Tourism activities in conservation areas have enhanced the quality of life of local communities without undermining their cultural values.	Buckley, (2012)

Doi: 10.47608/jki.v19i22025.221-238

No.	Questionnaire Items	References
Y1.2	Conservation tourism provides opportunities for local communities to be included in decision-making processes that influence their social sustainability.	Buckley, (2012)
Y1.3	Sustainable tourism management strengthens social cohesion and collaboration between local communities and destination managers.	Melanie K. Smith, (2023)
Y2	**Cultural Sustainability in Conservation Tourism Areas**	
Y2.1	Tourism governance supports the preservation of traditional and local cultures without compromising the cultural identity of local communities.	Melanie K. Smith, (2023)
Y2.2	Conservation tourism has raised awareness and appreciation for local culture among both tourists and the community.	Hall, (2024)
Y2.3	Tourism activities in conservation areas create spaces for local communities to preserve and develop their cultural heritage.	Melanie K. Smith, (2023)
Y3	**Economic Sustainability in Conservation Tourism Areas**	
Y3.1	Conservation tourism provides sustainable economic benefits to local communities without degrading natural ecosystems.	Buckley, (2012)
Y3.2	Tourism-generated revenue supports the development of infrastructure and services that benefit the local population.	Hall, (2024)
Y3.3	Economic sustainability in conservation areas is achieved through collaboration between tourism and other sectors such as agriculture and local crafts.	Lesar et al., (2023)
Y4	**Environmental Sustainability in Conservation Tourism Areas**	
Y4.1	Tourism management in conservation areas prioritizes biodiversity conservation and ecosystem preservation while preventing environmental degradation.	Buckley, (2012)
Y4.2	Tourism activities are managed to minimize negative impacts on natural environments and resources.	Hall, (2024)
Y4.3	Conservation tourism ensures the sustainable use of natural resources without threatening ecological balance.	Lesar et al., (2023)

Source: Research Data, 2025

Data Collection

Data were collected independently according to the research objectives using qualitative and quantitative methods through checklist instruments and questionnaires (Taherdoost, 2021) using a four-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree) for 280 respondents. The questionnaire was distributed through direct contact with respondents in tourism organizations in the Munduk Village area, representing conservation areas. Respondent demographics include organizations, which are positions, types of organizations (hotels, travel agencies, tourism offices, and tour guides), and years of experience as conservation tourism actors.

Data Analysis Procedure

The data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS, following a two-step analytical approach comprising the measurement and structural model evaluation (Joseph F. Hair Jr. et al., 2021). The measurement model was assessed for reliability and validity through composite reliability ($\geq$ 0.70), average variance extracted ($\geq$ 0.50), and discriminant validity using the Heterotrait-Monotrait ratio (HTMT < 0.90) recognized as a superior criterion over the traditional Fornell-Larcker test (Henseler et al., 2015). After confirming the adequacy, the structural model was evaluated by analyzing path coefficients, coefficient of determination

Doi: 10.47608/jki.v19i22025.221-238

(R^2), effect sizes (f^2), and predictive relevance (Q^2) based on the blindfolding procedure (Hoppner & Vadakkepatt, 2019). Significance levels for the hypothesized relationships were obtained through bootstrapping with 5,000 resamples, ensuring robust estimation for the predictive capacity and explanatory power in line with best practices in PLS-SEM.

Hypothesis Testing with SEM-PLS

This research used SEM-PLS, a statistical method suitable for testing complex relationship models between variables to test the relationship between variables. SEM-PLS allowed data analysis to test direct relationships between variables and consider indirect effects (Joseph F. Hair Jr. et al., 2021). In this context, SEM-PLS was used to test five main hypotheses in describing the prediction of latent independent variables (exogenous) of SHIP implementation (Hidayat & Patricia Wulandari, 2022).

RESULTS AND DISCUSSION

Measurement Model Assessment

The measurement model was assessed by convergent validity, discriminant validity, and composite reliability. The convergent validity was validated since the outer loadings exceeded the threshold of 0.70, and the average variance extracted (AVE) values ranged from 0.864 to 0.901, satisfying the minimum criterion of 0.50 (Joseph F. Hair Jr. et al., 2021). The constructs systemic, holistic, interdisciplinary, participatory, and sustainable tourism showed adequate convergent validity (Figure 3 and Table 3).

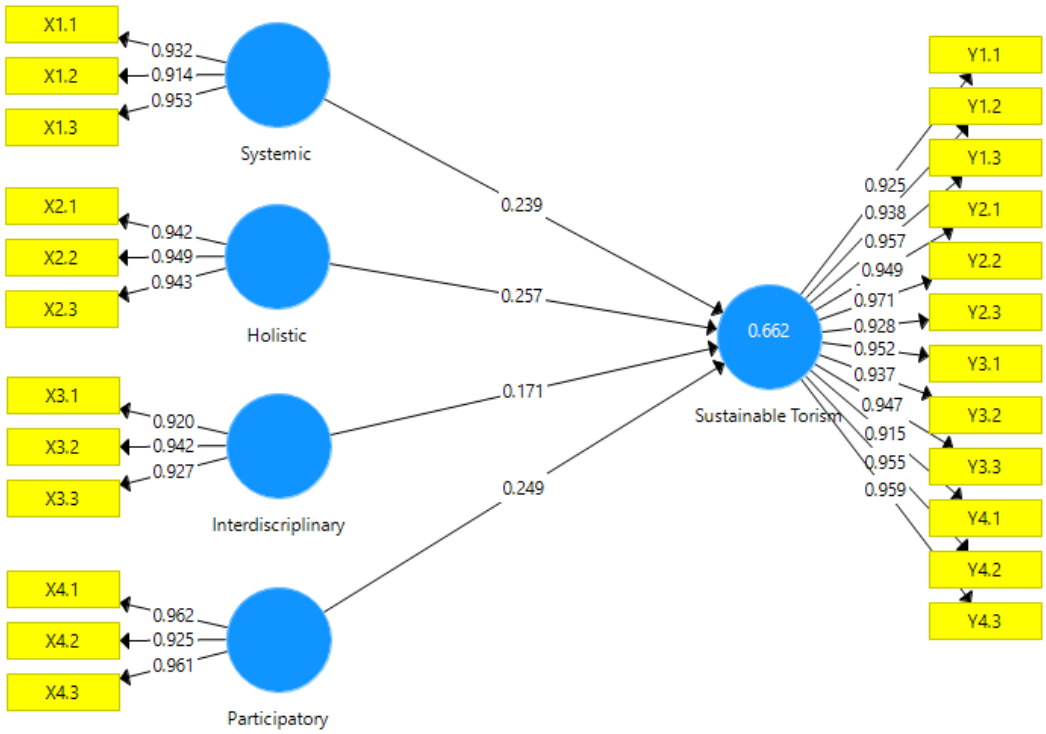

Figure 3. Estimated Structural Model Based on SEM-PLS Algorithm
Source: Research Data, 2025

Doi: 10.47608/jki.v19i22025.221-238

Table 3. Convergent Validity Assessment: Indicator Loadings and AVE Values

Construct	Indicator	Loading Factor	Cut-off Value	AVE	Convergent Validity
Systemic	X1.1	0.932	0.70	0.870	Valid
	X1.2	0.914	0.70		Valid
	X1.3	0.953	0.70		Valid
Holistic	X2.1	0.942	0.70	0.892	Valid
	X2.2	0.949	0.70		Valid
	X2.3	0.943	0.70		Valid
Interdisciplinary	X3.1	0.920	0.70	0.864	Valid
	X3.2	0.942	0.70		Valid
	X3.3	0.927	0.70		Valid
Participatory	X4.1	0.962	0.70	0.901	Valid
	X4.2	0.925	0.70		Valid
	X4.3	0.961	0.70		Valid
Sustainable Tourism	Y1.1	0.925	0.70	0.892	Valid
	Y1.2	0.938	0.70		Valid
	Y1.3	0.957	0.70		Valid
	Y2.1	0.949	0.70		Valid
	Y2.2	0.971	0.70		Valid
	Y2.3	0.928	0.70		Valid
	Y3.1	0.952	0.70		Valid
	Y3.2	0.937	0.70		Valid
	Y3.3	0.947	0.70		Valid
	Y4.1	0.915	0.70		Valid
	Y4.2	0.955	0.70		Valid
	Y4.3	0.959	0.70		Valid

Source: Research Data, 2025

Note:

- Loading Factor: All values > 0.70, showing acceptable item reliability.
- AVE: Reported once per construct, as per international convention.
- Convergent Validity: Marked "Valid" when both loading and AVE meet criteria.

Composite reliability values ranged from 0.950 to 0.990, while Cronbach's Alpha values were above 0.90, showing high internal consistency across all constructs (Table 4).

Table 4. Construct Reliability and Convergent Validity

Construct	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Systemic (X1)	0.925	0.926	0.953	0.870
Holistic (X2)	0.940	0.942	0.961	0.892
Interdisciplinary (X3)	0.922	0.934	0.950	0.864
Participatory (X4)	0.945	0.950	0.965	0.901
Sustainable Tourism (Y)	0.989	0.991	0.990	0.892

Source: Research Data, 2025

Doi: 10.47608/jki.v19i22025.221-238

Three approaches were used to evaluate discriminant validity, which are the Fornell-Larcker criterion, cross-loadings, and the Heterotrait-Monotrait (HTMT) ratio. The Fornell-Larcker criterion showed that the square roots of AVE for each construct exceeded inter-construct correlations, suggesting acceptable discriminant validity. Additionally, the cross-loading analysis reported that each indicator loaded more strongly on the associated construct than on any other. HTMT values were below the recommended threshold of 0.90, confirming discriminant validity across constructs.

Structural Model Assessment

The coefficient of determination (R^2), predictive relevance (Q^2), and standardized root mean square residual (SRMR) were analyzed to evaluate the inner model. The R^2 value for sustainable tourism of 0.662 showed that approximately 66.2% of the variance was explained by the exogenous constructs. This suggested a substantial explanatory power according to the classification of Nguyen et al (2024). The Q^2 value for sustainable tourism of 0.582 reported a strong level of predictive relevance. The SRMR value of 0.058 showed a good model fit below the threshold of 0.08, which denoted a "perfect fit" according to Hu & Bentler (1999).

Hypotheses Testing

The direct effects of SHIP variables on sustainable tourism were examined using bootstrapping with 500 subsamples.

Table 5. Direct Effects and Hypothesis Testing

Hypothesis	Path	Coefficient (β)	t-Statistic	p-Value	Result
H_1	Systemic → Sustainable Tourism	0.239	3.914	0.000	Supported
H_2	Holistic → Sustainable Tourism	0.257	4.382	0.000	Supported
H_3	Interdisciplinary → Sustainable Tourism	0.171	2.264	0.024	Supported
H_4	Participatory → Sustainable Tourism	0.249	3.765	0.000	Supported

Source: Research Data, 2025

All hypothesized relationships were statistically significant ($p < 0.05$). The strongest predictor of sustainable tourism is holistic ($\beta = 0.257$), followed closely by participatory ($\beta = 0.249$) and systemic ($\beta = 0.239$). Despite having the smallest coefficient ($\beta = 0.171$), interdisciplinary research suggested a significant positive effect.

The structural model was tested using bootstrapping to assess the significance and strength of the hypothesized relationships.

H_1: *A systemic total ergonomic approach has a positive effect on socially, culturally, economically, and environmentally sustainable tourism in conservation tourism areas.*

The results confirmed that the systemic dimension significantly and positively affected sustainable tourism ($\beta = 0.239$, $t = 3.914$, $p < 0.001$). This suggested that a higher application of systemic thinking in ergonomic design and planning was associated with more sustainable tourism practices.

Doi: 10.47608/jki.v19i22025.221-238

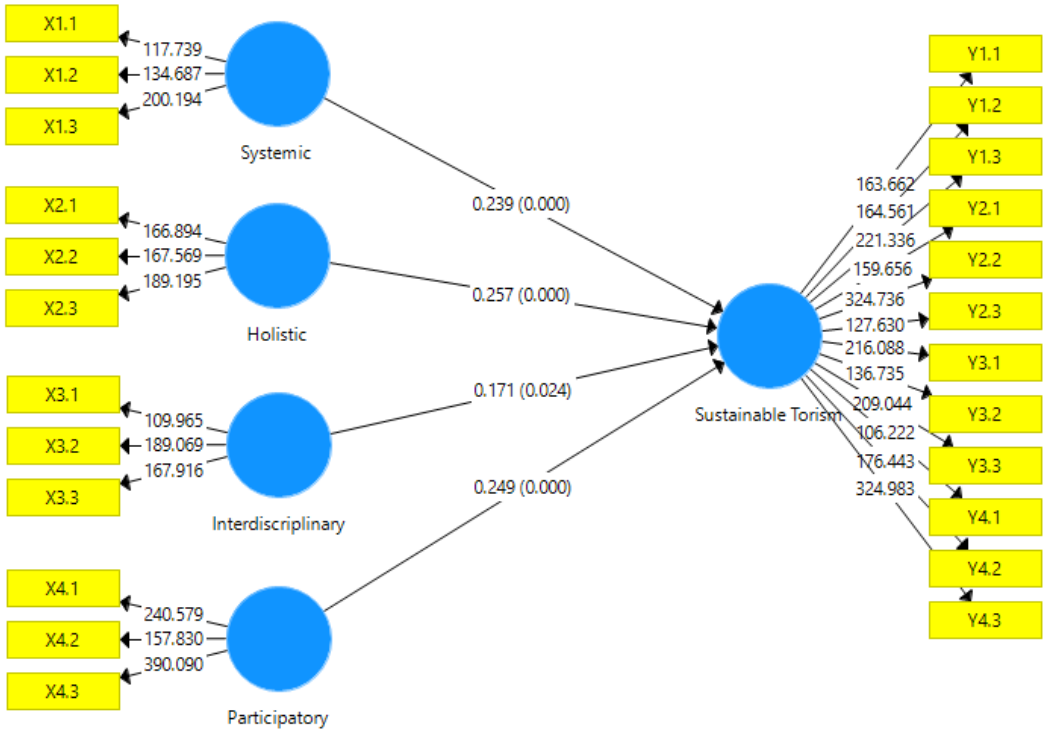

Figure 4. PLS-SEM Model Estimation, Bootstrapping Method
Source: Research Data, 2025

H_2: *Holistic principles in the total ergonomic approach have a positive effect on socially, culturally, economically, and environmentally sustainable tourism in conservation tourism areas.*

The holistic construct showed the strongest direct effect ($\beta = 0.257$, $t = 4.382$, $p < 0.001$), affirming that a holistic design orientation integrating interrelated social-ecological components significantly enhanced sustainable tourism in conservation areas**.**

H_3: *Interdisciplinary principles in the total ergonomic approach have a positive effect on socially, culturally, economically, and environmentally sustainable tourism in conservation tourism areas.*

Even though interdisciplinary practices exhibited a positive path coefficient ($\beta = 0.171$), the t-statistic (2.264) and p-value (0.024) showed moderate significance. Based on the research criteria, this result suggested that interdisciplinary approaches were not sufficient without stronger integration or contextual support.

H_4: *Local community participation in tourism planning and management has a positive effect on socially, culturally, economically, and environmentally sustainable tourism in conservation tourism areas.*

Participatory factors significantly affected sustainable tourism ($\beta = 0.249$, $t = 3.765$, $p < 0.001$). This reinforced the importance of inclusive tourism governance and stakeholder engagement, specifically including local communities in the planning and management process**.**

Doi: 10.47608/jki.v19i22025.221-238

Model Explanation and Integration

H_5*: Integration of SHIP total ergonomic principles can create socially, culturally, economically, and environmentally sustainable tourism in conservation areas.*

The overall explanatory power of the model is substantial, and the adjusted R^2 for sustainable tourism is 0.657. Therefore, 65.7% of the variance is accounted for by the SHIP ergonomic framework. This confirms that the integrated application of total ergonomic design can effectively support sustainability outcomes in conservation-based tourism settings. H_5 is supported, emphasizing the value of applying a multidimensional ergonomic design to enhance the sustainability performance of tourism initiatives.

Discussion

The results show the significant positive effect of systemic ergonomic (H_1) thinking on sustainable tourism ($\beta = 0.239$, $t = 3.914$, $p < .001$) in line with the perspective that tourism functions as a complex socio-ecological system. Scratching (Taveras-Dalmau & Coghlan, 2025) emphasized the importance of systems thinking to show the hidden feedback loops in tourism, such as unsustainable extraction and poaching. Similarly, Gerber et al. (2025) reported systems thinking in adapting tourism in response to climate threats. These perspectives support the result by integrating systemic ergonomics, allowing managers to address interdependencies and promote resource-use efficiency and policy coherence in conservation tourism.

The holistic governance approach (H_2) had the strongest effect on sustainable tourism ($\beta = 0.257$, $t = 4.382$, $p < .001$), supporting Artal-Tur & Badillo-Amador (2024), who emphasized multidimensional indicators for measuring tourism sustainability. Moreover, Li et al. (2025) connected integrative governance with cultural preservation and economic well-being. The results confirm that adaptive, holistic planning balancing environmental, cultural, and economic dimensions is essential for sustainable management of conservation tourism areas.

Despite the significance of interdisciplinary collaboration (H3) ($\beta = 0.171$, $t = 2.264$, $p = .024$), the weakest effect is reported among the four constructs. This may reflect practical challenges in balancing diverse disciplinary perspectives within local tourism governance, including limited institutional coordination, sectoral silos, and varying professional priorities in conservation areas (Elshall & Badir, 2025; Li et al., 2025). In Bali, integration between environmental, cultural, and social science stakeholders is often partial, which constrains the full impact of interdisciplinary initiatives. Strengthening institutional frameworks, shared methodologies, and capacity-building among agencies enhances the effectiveness of interdisciplinary collaboration in conservation tourism governance.

The results for the participatory governance principle (H_4) ($\beta = 0.249$, $t = 3.765$, $p < .001$) confirm the critical role of community participation. Previous research on sustainable tourism showed that stakeholder inclusion enhanced equitable benefit distribution, identity formation, and custodianship of heritage (Schulte & Paris, 2024). The work in Vietnam reported that community empowerment preserved cultural identity and stimulated economic development (Nguyen Thi et al., 2024). These results are consistent with the empirical research, showing the important role of participatory ergonomics in conservation tourism.

Doi: 10.47608/jki.v19i22025.221-238

The SHIP model explained 65.7% of the variance in sustainable tourism (adjusted $R^2 = 0.657$), confirming the robustness of the holistic ergonomic framework. Sangpikul (2017) integrated a design-management-governance model, emphasizing that combining human-centered systems with governance mechanisms obtained sustainable outcomes. This research confirms the ergonomic framework as an effective model for sustainable tourism in conservation areas. The results showed the relevance in addressing tourism's socio-ecological complexity, particularly in destinations like Bali. The framework offers practical value as a diagnostic and planning tool for designing participatory, system-oriented, and culturally responsive tourism strategies. Policymakers at the national and regional levels can leverage the model to balance conservation tourism initiatives with sustainable strategies outlined in the RPJMN and regional master plans, ensuring that environmental protection, cultural preservation, and community empowerment are systematically addressed. The framework can guide decision-making, policy coordination, and investment prioritization in conservation areas by integrating SHIP principles. However, the cross-sectional and location-specific nature of the research limits broader generalization. Future research should adopt longitudinal, comparative, and mixed-methods approaches to explore the applicability of SHIP across diverse contexts.

Each SHIP dimension is consistent with the strategic tourism policies of Indonesia. The systemic dimension corresponds to the RPJMN 2025–2029 priority on integrated ecosystem-based tourism, emphasizing cross-sectoral coordination between environment, culture, and local economy. The holistic dimension reinforces the Tourism Village 4.0 framework, which integrates digital innovation, green practices, and cultural authenticity to strengthen community-based destinations. Meanwhile, the interdisciplinary dimension supports the development of collaborative governance mechanisms outlined in the National Tourism Development Index (Kemenparekraf, 2024). The participatory dimension is similar to the policy of the Ministry on empowering local communities and creative industries to enhance social inclusion and resilience. This consistency shows that the SHIP framework has theoretical robustness and complements the ongoing transformation toward sustainable, inclusive, and innovation-driven tourism governance.

CONCLUSION

In conclusion, this research confirms the SHIP total ergonomics framework as a powerful foundation for sustainable tourism in conservation areas. Empirical results show that the dimensions contribute significantly to sustainability, with the holistic principle being most influential. The high explanatory power (adjusted $R^2 = 0.657$) of the model reports relevance in navigating socio-ecological complexity. Community participation is developed as a transformative driver of inclusive and resilient tourism governance. This research contributes an ergonomics-based management model integrating environmental, social, cultural, and design dimensions into a cohesive governance strategy. The novelty positions total ergonomics as a design aid and strategic instrument for policy, planning, and sustainability standards. Embedding the model within institutional frameworks can balance tourism development with long-term ecological and community well-being.

Several policy directions are proposed to institutionalize the SHIP framework within Indonesia's tourism governance. The Ministry of Tourism and Creative Economy (*Kemenparekraf*) must incorporate SHIP principles into the National Sustainable Tourism Guidelines (*RIPARNAS*) and the National Tourism Development Index (2024) to ensure

Doi: 10.47608/jki.v19i22025.221-238

system-wide integration of sustainability standards. Capacity-building programs should be established to strengthen local government and community competencies in participatory and ergonomic-based destination management. Inter-ministerial collaboration mechanisms among tourism, environment, and cultural agencies are essential to operationalize systemic governance. Furthermore, pilot projects in priority conservation areas such as Bali, Komodo, and Raja Ampat can report the effectiveness of SHIP and serve as models for nationwide implementation.

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Doi: 10.47608/jki.v19i22025.221-238

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Doi: 10.47608/jki.v19i22025.221-238

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