AVE Trends in Intelligent Organisational Behaviour

Organizational Perspectives on Ergonomic Factors Influencing Tourist Comfort in Nature-Based Tourism

Ni Ketut Dewi Irwanti[1,*]

[1]Faculty of Health, Psychology, Engineering and Computer Science, Triatma Mulya University, North Kuta, Bali, Indonesia. dewiirwanti66@gmail.com[1]

[*]Corresponding author

Abstract: The contemporary paradigm of tourism management has undergone a fundamental shift from merely increasing visitor numbers toward optimising tourist comfort and destination system performance. This study investigates the influence of ergonomic tourism destination dimensions on tourist comfort at Kebun Raya Eka Karya Bedugul, Bali — a nature-based botanical garden destination situated at an altitude of 1,250–1,450 meters above sea level. Five ergonomic dimensions were examined: human resource capacity for service delivery, infrastructure and facility design, information and communication technology, tourist activities, and environmental conditions of the destination. Tourist comfort was operationalised as a multidimensional construct encompassing physical, psychological, and cognitive comfort. An explanatory quantitative approach was adopted, utilising Structural Equation Modelling–Partial Least Squares (SEM-PLS) with data collected from 100 purposively selected tourists. Results demonstrated that four dimensions — facility design ($\beta = 0.150$, $p < 0.05$), information and communication technology ($\beta = 0.269$, $p < 0.01$), tourist activities ($\beta = 0.258$, $p < 0.01$), and environmental conditions ($\beta = 0.447$, $p < 0.001$) — significantly influenced tourist comfort. Conversely, human resource capacity in service delivery did not yield a statistically significant effect ($\beta = 0.038$, $p > 0.05$). Environmental conditions emerged as the most dominant determinant of tourist comfort. These findings underscore the critical importance of integrating applied ergonomics principles in nature-based tourism destination planning and management to achieve sustainable, safe, and comfortable tourist experiences.

Keywords: Ergonomic Tourism; Tourist Comfort; Nature-Based Tourism; SEM-PLS and Destination Management; Physical Environments; Service Facilities; Inherent Complexity.

Cite as: N. K. D. Irwanti, "Organizational Perspectives on Ergonomic Factors Influencing Tourist Comfort in Nature-Based Tourism," *AVE Trends in Intelligent Organisational Behaviour*, vol. 1, no. 1, pp. 35–44, 2026.

Journal Homepage: https://www.avepubs.com/user/journals/details/ATIOB

Received on: 13/07/2025, **Revised on:** 18/09/2025, **Accepted on:** 25/10/2025, **Published on:** 03/03/2026

DOI: https://doi.org/10.64091/ATIOB.2026.000289

1. Introduction

The global tourism paradigm is undergoing a fundamental transformation. Rather than focusing exclusively on increasing visitor arrivals, destination managers are increasingly recognising the importance of optimising tourist comfort and overall destination system performance. In this evolving perspective, a tourism destination is best understood as a complex service system formed by the dynamic interaction among human actors, physical environments, service facilities, tourist activities, and information systems [4]; [14]. The inherent complexity of this system demands integrated and holistic destination management strategies that ensure both sustainability and competitive advantage in the global tourism marketplace. This systemic understanding of tourism destinations aligns naturally with the principles of ergonomics — a scientific discipline concerned

with understanding and optimising the interactions among humans and other elements of a system, with the primary goals of enhancing human well-being, safety, and overall system performance [7]. In the context of tourism, ergonomics provides both a technical framework and a conceptual lens for the design, management, and evaluation of destination systems. Applied ergonomics in tourism — increasingly referred to as ergo-tourism — emphasises the integration of ergonomic principles into destination structures and activities to create experiences that are safe, healthy, efficient, and comfortable for tourists [41]. Empirical evidence confirms that such applications improve the quality of the tourist experience and destination competitiveness [33]; [3].

Tourist comfort is the outcome of system optimisation, resulting from the interactions among tourists as end-users, physical facilities, service quality, and environmental conditions [11]. From an ergonomic standpoint, well-planned facility layouts and high-quality services are critical factors in shaping tourists' perceptions of physical and psychological comfort [21]. This comfort is closely linked to achieving tourist well-being through a travel experience characterised by minimal friction and barriers [13]. In nature-based tourism destinations, environmental factors play a crucial role in shaping visitor decision-making processes and satisfaction levels. Conversely, non-ergonomic infrastructure and substandard service quality can generate environmental stress [24]. Such conditions force tourists to make cognitive adaptations to various logistical and technical obstacles encountered in the field, thereby increasing mental workload. The accumulation of this cognitive burden can trigger physical and cognitive fatigue, ultimately degrading the overall quality of the tourism experience. Ergonomics scholarship has consistently demonstrated that anthropometrically sound facility design, ergonomic information systems, activities aligned with user capacity, comfortable environmental conditions, and adequate service personnel work capacity represent the primary determinants of human comfort and performance in service systems [7]. Nature-based tourism destinations, such as botanical gardens and highland recreational areas, possess unique and demanding ergonomic characteristics. One exemplary case is Kebun Raya Eka Karya Bedugul, Bali's botanical garden, which is managed in accordance with Presidential Regulation of the Republic of Indonesia Number 93 of 2011 [26]; [39].

This regulation delineates three distinct functional zones: (1) a reception zone encompassing the main gate, ticketing area, information centre, and visitor facilities; (2) a management zone; and (3) a collection zone housing the botanical specimens. Beyond its role as a plant conservation area, the garden features interpretation boards that provide brief information about the plant collections and their ecological functions. Empirically, visitor numbers to Kebun Raya Eka Karya Bedugul reached 230,000 in the first half of 2022 (January–June), a significant increase from the same period in 2020, when 162,386 visits were recorded. Despite this growing visitation, various visitor reviews, particularly on Sarstedt et al. [16], have identified comfort-related issues, including difficulties in reading information on interpretation boards. This finding is consistent with Catahan et al. [10], who noted that the garden still has limitations in providing comprehensive information about its potential. Such conditions risk diminishing tourist comfort and restricting visitors' understanding of the botanical collection's diversity [38]. Additionally, waste management issues have been frequently cited by visitors. From an ergonomic perspective, the presence of waste and olfactory pollution demonstrably reduces destination quality and negatively impacts tourist comfort during the visit. From a physical environment perspective, Kebun Raya Eka Karya Bedugul's location at 1,250–1,450 meters above sea level, combined with daytime temperatures ranging between 17–25°C and nighttime temperatures of 10–15°C, and relative humidity reaching 70–90%, creates bioclimatic conditions that deviate from the optimal human comfort range of 21–27.5°C and 30–65% relative humidity [8]. These environmental characteristics, combined with additional factors such as wind speed, solar radiation, noise levels, and air quality, constitute critical ergonomic challenges for this destination [35].

Tourist activities at botanical gardens typically unfold over extended durations, involving sustained physical mobility, spatial information processing, and direct exposure to varying environmental conditions [36]. Environmental ergonomics research consistently demonstrates that such factors significantly shape thermal, psychological, and cognitive comfort in outdoor settings [29]; [9]. Consequently, a systems-ergonomics approach that integrates human, environmental, and service dimensions is essential for effective management of nature-based tourism destinations. Despite the clear relevance and growing body of literature on ergonomics in tourism contexts, applied ergonomics research in this field remains dominated by partial approaches that assess comfort in isolation from the holistic design of the destination system. Studies that simultaneously integrate service personnel work capacity, facility design, information and communication systems, tourist activities, and environmental conditions within a single ergonomic framework are relatively scarce.

Such integrative approaches, however, enable a more comprehensive understanding of how tourist comfort emerges from systemic interaction. Based on this foundation, the present study aims to analyse the influence of ergonomic tourism destination dimensions — encompassing service human resource work capacity, infrastructure and facility design, information and communication technology, ergonomic tourist activities, and environmental conditions of the destination — on tourist comfort as a physical, psychological, and cognitive ergonomic outcome at Kebun Raya Eka Karya Bedugul, Bali. This research aspires to contribute to the development of the applied ergonomics in tourism systems literature and to provide a scientific basis for designing and managing tourism destinations based on human–system compatibility principles.

2. Research Method

2.1. Research Design

This study employed an explanatory quantitative approach designed to test causal relationships between applied ergonomics dimensions of tourism destinations and tourist comfort [30]. The explanatory approach was selected because the research focuses on hypothesis testing grounded in the theoretical framework of ergonomics and human–environment–service interaction [42]. Data analysis was conducted using Structural Equation Modelling–Partial Least Squares (SEM-PLS). This method was selected because it is appropriate for predictive models involving multidimensional latent constructs, does not require normally distributed data, and is effective with moderate sample sizes [45]. Furthermore, SEM-PLS is widely employed in applied ergonomics research, service systems studies, and investigations of human–environment interactions [46].

2.2. Research Location

The research was conducted at Kebun Raya Eka Karya Bedugul, Bali, a nature-based tourism destination characterised by outdoor activities of relatively long duration and intensive interaction among tourists, facilities, information systems, physical environment, and service personnel. These characteristics make this location highly relevant for investigating ergonomic compatibility between humans, the environment, and the service system in the context of nature-based tourism.

2.3. Population and Sample

The study population comprised all tourists visiting Kebun Raya Eka Karya Bedugul in 2025. A non-probability sampling approach was adopted, using purposive sampling, in which respondents were selected based on specific criteria aligned with the research objectives. Eligibility criteria included: (1) tourists aged at least 17 years, and (2) individuals possessing adequate verbal and nonverbal communication abilities to complete the questionnaire independently. Sample size determination was based on statistical power considerations in PLS-SEM analysis. According to Hair et al. [15], PLS-SEM is a variance-based method and is relatively tolerant of moderate sample sizes, particularly for predictive and exploratory analyses. Statistical power analysis, following Tosi [46] and adapted for PLS-SEM by Hair et al. [15], indicates that detecting a medium structural effect size ($f^2 = 0.15$) at a 5% significance level with 80% statistical power requires approximately 85–100 respondents. Therefore, 100 respondents were deemed sufficient to generate reliable parameter estimates.

2.4. Variable Measurement

The measurement of ergonomic tourism destination variables in this study drew on the concept of applied ergonomics, emphasising alignment between human characteristics and systems, facilities, activities, and environments. The ergonomic dimensions analysed included: (1) human resource work capacity in service delivery, (2) infrastructure and facility design, (3) information and communication technology, (4) tourist activities, and (5) environmental conditions of the destination. These five dimensions represent the primary domains of physical, cognitive, environmental, and organisational ergonomics, collectively forming the human–environment–service fit construct [25]. Tourist comfort was measured as a multidimensional construct encompassing physical, psychological, and cognitive comfort. This approach aligns with holistic comfort theory, which views comfort as the product of interactions among physical environmental conditions, individual psychological responses, and cognitive processes involved in understanding and evaluating experience [22]. In applied ergonomics, physical comfort relates to anthropometric appropriateness and environmental conditions; psychological comfort relates to feelings of safety, calm, and freedom from stress; while cognitive comfort relates to ease of information processing and reduced mental workload during interaction with the system and environment [19]; [7].

2.5. Research Instrument

Data collection was conducted through field observation, structured interviews using questionnaires, and a literature review to reinforce the conceptual framework. The research instrument consisted of a closed questionnaire employing a 5-point Likert scale, ranging from strongly disagree (1) to strongly agree (5). The questionnaire was designed to capture tourists' perceptions of the degree of ergonomic compatibility at the destination and the level of comfort experienced during their visit.

2.6. Data Analysis Technique

Data analysis was performed using the SEM-PLS approach in two main stages:

- **Stage 1: Measurement Model Evaluation (Outer Model)** — encompassing the assessment of indicator reliability, internal construct consistency, convergent validity, and discriminant validity. Indicators with outer loading values below the established threshold were excluded to improve the measurement model's quality.
- **Stage 2: Structural Model Evaluation (Inner Model)** — aimed at testing causal relationships among latent variables through path coefficient values (β), t-statistic values, and p-values obtained through the bootstrapping procedure.

These analytical stages ensured that the research model possessed sound measurement quality and structurally interpretable relationships grounded in scientific rigour.

3. Results and Discussion

3.1. Descriptive Analysis of Respondents

The descriptive characteristics of tourists visiting Kebun Raya Eka Karya Bedugul are presented in Table 1. The proportion of male tourists (51%) and female tourists (49%) was relatively balanced, indicating that the destination attracts visitors from both genders. Variations in tourism preferences and motivations by gender have been documented in studies of young traveller motivation, where demographic factors such as age and gender contribute to differences in travel behaviour and goals.

Table 1: Descriptive analysis results

Item	Category	Frequency (n)	Percentage (%)
Gender	Male	51	51
	Female	49	49
Age	17–25 years	58	58
	26–37 years	20	20
	38–45 years	4	4
	> 45 years	18	18
Occupation	Civil Servant	1	1
	Lecturer	27	27
	Private Employee	16	16
	Student	56	56

In terms of age distribution, the majority of respondents belonged to the 17–25-year age group (58%), followed by the 26–37-year age group (20%). The dominance of younger age groups is consistent with a substantial body of literature demonstrating that young tourists (Generation Z and Millennials) actively engage in tourism experiences that are exploratory, interactive, and experience-oriented, particularly at natural and educational destinations. This generational characteristic implies heightened sensitivity to the quality of information systems, digital accessibility, and environmental aesthetics — factors directly related to the ergonomic dimensions examined in this study.

By occupational category, the majority of respondents were students (56%), followed by lecturers (27%). This composition indicates that Kebun Raya Eka Karya Bedugul tends to attract visitors from young and academic groups with educational and conservation orientations — characteristics commonly documented in botanical garden tourism and eco-educational tourism research. Empirical studies on botanical garden visitor experiences confirm that perceptions, information experiences, and interactions with the physical environment significantly impact visitor satisfaction, while simultaneously reinforcing the destination's role as an important environmental education space for students and academics [12].

3.2. Measurement Model Evaluation (Outer Model)

The measurement model evaluation results are presented in Table 2. Assessment was conducted based on construct reliability and validity criteria appropriate for SEM-PLS analysis [15].

Table 2: Measurement outer model results

No.	Variable	Indicators	Outer Loadings	Cronbach's Alpha	Composite Reliability	AVE
1	Human Resources (X1)	X1.1	0.655*	0.754	0.890	0.801
		X1.2	0.674*			

		X1.3	0.873			
		X1.4	0.916			
2	Facility Design (X2)	X2.1	0.811	0.840	0.751	0.602
		X2.2	0.739			
3	ICT (X3)	X3.1	0.721	0.748	0.840	0.568
		X3.2	0.713			
		X3.3	0.834			
		X3.4	0.740			
4	Tourist Activities (X4)	X4.1	0.774	0.775	0.856	0.600
		X4.2	0.861			
		X4.3	0.702			
		X4.4	0.759			
5	Environmental Conditions (X5)	X5.1	0.806	0.878	0.911	0.673
		X5.2	0.766			
		X5.3	0.810			
		X5.4	0.836			
		X5.5	0.880			
6	Tourist Comfort (Y)	Y1.1	0.867	0.860	0.915	0.782
		Y1.2	0.879			
		Y1.3	0.906			

Note: **Values below 0.700 were excluded from subsequent analysis*

The measurement model evaluation reveals that all constructs demonstrate sound internal consistency, with Composite Reliability exceeding 0.70 and Cronbach's Alpha exceeding 0.60. Average Variance Extracted (AVE) values for all constructs exceeded 0.50, confirming convergent validity [15]. Two indicators within the Human Resources construct (X1.1 and X1.2) had outer loadings below 0.70 and were consequently eliminated to enhance model quality. All remaining indicators demonstrated adequate outer loading values and effectively represented their respective latent constructs. Discriminant validity was assessed using the Fornell-Larcker Criterion, as presented in Table 3.

Table 3: Fornell-Larcker criterion (discriminant validity)

No.	Variable	X4	Y	X5	X2	X1	X3
1	Tourist Activities (X4)	0.774					
2	Tourist Comfort (Y)	0.691	0.884				
3	Environmental Conditions (X5)	0.591	0.826	0.820			
4	Facility Design (X2)	0.007	0.218	0.083	0.776		
5	Human Resources (X1)	0.202	0.315	0.334	0.049	0.895	
6	ICT (X3)	0.585	0.771	0.711	0.107	0.292	0.754

The Fornell-Larcker Criterion results confirm that each construct's square root of AVE (diagonal values in bold) exceeded its correlations with all other constructs, thereby satisfying discriminant validity requirements. This finding indicates that all constructs were distinct and measured unique dimensions of the ergonomic tourism destination system, providing a sound basis for structural model testing. Conceptually, these results demonstrate that the ergonomic destination dimension indicators — spanning physical, cognitive, organizational, and environmental domains — effectively represent the human–environment–service fit framework.

3.3. Structural Model Evaluation (Inner Model) and Hypothesis Testing

Structural model testing was conducted to assess the influence of ergonomic tourism destination dimensions on tourist comfort (Y). The results of path coefficient analysis are presented in Table 4.

Table 4: Path coefficients for hypothesis testing

No.	Path Hypothesis	Standardized β	T-Statistic	P-Value	Hypothesis Result
1	H1: X1 → Y	0.038	0.767	0.443	Rejected
2	H2: X2 → Y	0.150	2.568	0.011	Supported
3	H3: X3 → Y	0.269	3.429	0.001	Supported
4	H4: X4 → Y	0.258	3.265	0.001	Supported
5	H5: X5 → Y	0.447	6.148	0.000	Supported

The structural model results reveal that four of the five hypothesised relationships were statistically supported, while one was rejected. The following section provides a detailed discussion of each finding in relation to the theoretical and empirical literature.

3.4. Discussion

3.4.1. Human Resource Work Capacity and Tourist Comfort (H1 — Rejected)

The human resource capacity dimension of service delivery did not significantly influence tourist comfort (β = 0.038; t = 0.767; p = 0.443). This finding is contrary to the general theoretical expectation that service personnel quality directly shapes tourist comfort. However, this result can be understood within the specific context of Kebun Raya Eka Karya Bedugul as a nature-based botanical garden destination. At such destinations, tourists primarily seek engagement with the natural environment, botanical collections, and interpretive experiences, rather than intensive interactions with service personnel. Consequently, the role of service staff — while present — may be overshadowed by environmental and facility factors that mediate the tourist experience more directly. This finding partially contradicts previous studies that found positive correlations between ergonomic employee satisfaction in hospitality and tourism contexts and tourist satisfaction outcomes [17]. However, the divergence may be explained by contextual differences.

Hotel and hospitality environments involve continuous, high-contact service interactions, whereas botanical garden tourism involves primarily self-guided exploration with infrequent service touchpoints. In such naturalistic settings, tourists' comfort perceptions are more strongly shaped by the ambient environment and their own physical and cognitive states than by interpersonal service encounters. Furthermore, the relatively small number of operational service personnel visible to visitors within the extensive 157.5-hectare garden area may reduce the salience of this dimension in shaping comfort perceptions. This finding does not diminish the long-term strategic importance of service human resource development for destination competitiveness. Rather, it suggests that in large-scale outdoor natural destinations, the ergonomic optimisation of the physical environment, information systems, and activity design may yield more immediate comfort dividends than investments in service personnel capacity alone [32].

3.4.2. Facility Design and Tourist Comfort (H2 — Supported)

Infrastructure and facility design demonstrated a significant positive influence on tourist comfort (β = 0.150; T = 2.568; p = 0.011). This finding affirms the fundamental ergonomic principle that the physical design of facilities — including accessibility, layout, pedestrian pathways, rest areas, sanitation facilities, and parking — plays a critical role in creating user comfort. Well-designed facilities reduce physical strain, minimise navigation confusion, and create conditions conducive to positive visitor experiences. This result is consistent with de Almeida et al. [2], who demonstrated that ergonomic design principles significantly enhance visitor comfort and usability in recreational settings. It also aligns with El-Sherbeeny et al. [1], whose research on learning-based tourism environments confirmed that physical environment elements — including architectural planning, spatial layout, accessibility, and supporting facilities — directly influence visitor behaviour and satisfaction levels.

The relatively moderate path coefficient (β = 0.150) compared to other significant variables suggests that, while facility design is necessary for comfort, it functions as a threshold factor: Adequate design prevents discomfort, but excellence in other dimensions (particularly environmental quality and information access) more powerfully elevates comfort. From an ergonomic design perspective, the findings suggest that Kebun Raya Eka Karya Bedugul's facility infrastructure, encompassing walkways, directional signage, rest shelters, toilet facilities, and visitor reception areas, is an important comfort determinant that warrants continued systematic improvement informed by anthropometric data and universal design principles [34]. Given the altitude and terrain challenges of this highland botanical garden, facility ergonomics — including step gradients, path surfaces, and seating provisions — are particularly critical for accommodating diverse visitor age groups and physical capacities.

3.4.3. Information and Communication Technology and Tourist Comfort (H3 — Supported)

The information and communication technology (ICT) dimension exerted a significant positive influence on tourist comfort (β = 0.269; T = 3.429; p = 0.001). This finding highlights the critical role of ergonomic information systems in reducing cognitive load and enhancing the quality of the tourist experience at nature-based destinations. When information is clear, accessible, visually ergonomic, and accurately represents the destination's attractions and services, tourists can navigate with confidence, make informed decisions, and fully engage with their surroundings without the cognitive burden of uncertainty or information overload. The result validates the ergonomic communication principles articulated by Mukhopadhyay [28], who emphasised that ergonomics applied to visual communication — including pictograms, icons, information boards, and maps — is essential for ensuring user-friendly information environments. It also corroborates findings regarding the role of digital signage in enriching visitor experiences and reinforcing place identity at tourism destinations [37]. In the context of Kebun Raya Eka Karya Bedugul, where visitor reviews specifically flagged difficulties with the readability of interpretation boards, the significance of this dimension is particularly resonant. Kroemer and Grandjean [23] and Sutalaksana [44] have emphasised that poorly designed visual displays can cause misinterpretation, cognitive fatigue, and even safety risks — effects that are directly antithetical to tourist comfort. The significant influence of ICT on comfort in this study, therefore, underscores the practical urgency of applying ergonomic display design principles to all information media at the destination, from physical interpretation boards and wayfinding signage to digital platforms, including the official website and social media channels [40]; [27]. Investments in cognitively accessible information systems represent high-impact opportunities to enhance comfort at this destination.

3.4.4. Tourist Activities and Tourist Comfort (H4 — Supported)

Tourist activities demonstrated a significant positive influence on tourist comfort (β = 0.258; T = 3.265; p = 0.001). This finding reflects the ergonomic principle that the compatibility between activity demands and tourists' physical and cognitive capacities is a critical determinant of the comfort and quality of the tourism experience. When activities are appropriately matched to visitors' physiological capabilities, fitness levels, and health status, the risk of fatigue, musculoskeletal strain, and physical discomfort is minimised, allowing tourists to derive maximum enjoyment and meaning from their visit. This result is consistent with the empirical evidence of Berry and Leob [6], who found that biomechanical factors, particularly fatigue accumulation and energy expenditure, significantly affect tourist satisfaction and comfort, with increasing fatigue systematically reducing overall comfort levels. At Kebun Raya Eka Karya Bedugul, the physical demands of navigating a 157.5-hectare terrain at high altitude, particularly for elderly visitors or those with limited physical fitness, represent genuine ergonomic challenges.

The significant influence of this dimension in the current study suggests that activity design — including trail difficulty ratings, provision of rest stations at ergonomically appropriate intervals, optional transport facilities within the garden, and activity options calibrated for different age and fitness groups — represents an important avenue for comfort optimisation. Manuaba [25] emphasised that factors including age, gender, anthropometry, health and nutritional status, physical fitness level, and physical work capacity shape ergonomic human capacity. Given the predominantly young demographic of Kebun Raya Eka Karya Bedugul's visitors (58% aged 17–25), the destination's current activity design may already be relatively compatible with the majority of its user base. However, the 18% of visitors aged over 45, along with visitors with physical limitations, may require more targeted ergonomic accommodations in activity design and facility provision to ensure equitable comfort across all visitor segments.

3.4.5. Environmental Conditions and Tourist Comfort (H5 — Supported, Strongest Effect)

Environmental conditions emerged as the most dominant determinant of tourist comfort, demonstrating the strongest significant positive influence (β = 0.447; T = 6.148; p < 0.001). This finding powerfully affirms the centrality of environmental ergonomics in nature-based tourism destinations. It aligns comprehensively with the theoretical and empirical literature on outdoor thermal comfort, environmental quality, and tourist well-being. The destination's distinctive bioclimatic profile contextually explains the strong influence of environmental conditions at Kebun Raya Eka Karya Bedugul [31]. Located at 1,250–1,450 meters above sea level with temperatures ranging from 17–25°C (daytime) to 10–15°C (nighttime) and relative humidity of 70–90%, the destination's ambient conditions fall partially outside the optimal human bioclimatic comfort range of 21–27.5°C and 30–65% relative humidity [8]. Cool temperatures at this altitude risk causing physical discomfort through increased muscle contraction, joint stiffness, and heightened injury risk. Environmental ergonomics research demonstrates that sub-optimal thermal conditions in outdoor tourism settings significantly shape visitors' thermal, psychological, and cognitive comfort [29]; [9].

This finding is further corroborated by Huang et al. [20], who found that tourism climate comfort evaluation — integrating variables such as air temperature, relative humidity, wind speed, and sunshine duration — is a crucial approach for assessing comfort levels at tourism destinations and supporting more responsive destination management planning. Similarly, Hasanah [18] confirmed that climate comfort indices, such as the Tourism Climate Index (TCI) and Temperature Humidity Index (THI),

correlate with visitation patterns at cultural and natural tourism sites, with more thermally comfortable conditions attracting larger visitor numbers. Research at nature-based tourism destinations in tropical highland regions confirms that visitors' comfort perceptions are strongly shaped by microclimatic variables, including air temperature and humidity, which together determine the outdoor thermal experience [43]. Beyond thermal conditions, the finding also reflects the influence of additional environmental quality dimensions, including air pollution, waste management quality, noise levels, and visual aesthetic quality of the natural landscape.

In the context of ergonomics, Ballantyne et al. [5] demonstrated that waste presence and olfactory pollution reduce destination quality and negatively impact tourist comfort. The strong effect of environmental conditions in this study ($\beta = 0.447$) — markedly higher than other significant dimensions — indicates that environmental quality management represents the highest-priority investment for comfort optimisation at this nature-based destination. Destination managers would achieve the greatest comfort improvements by focusing on microclimate management strategies, environmental cleanliness programs, waste management systems, and the preservation of natural landscape quality. The overall pattern of results — with environmental conditions ($\beta = 0.447$) exerting the most dominant influence, followed by ICT ($\beta = 0.269$), tourist activities ($\beta = 0.258$), and facility design ($\beta = 0.150$) — reveals that physical and environmental ergonomics factors are more immediately salient in shaping tourist comfort at nature-based destinations than organisational ergonomics factors such as service personnel capacity. This ordering provides destination managers with a clear evidence-based hierarchy of investment priorities.

4. Conclusion

This study has examined the influence of five ergonomic tourism destination dimensions on tourist comfort at Kebun Raya Eka Karya Bedugul, Bali, using a quantitative explanatory approach with SEM-PLS analysis. The findings yield several important conclusions for both academic scholarship and practical destination management. Four of the five ergonomic dimensions examined demonstrated significant positive influences on tourist comfort. Environmental conditions of the destination emerged as the most dominant determinant ($\beta = 0.447$; $p < 0.001$), followed by information and communication technology ($\beta = 0.269$; $p < 0.001$), tourist activity design ($\beta = 0.258$; $p < 0.001$), and infrastructure and facility design ($\beta = 0.150$; $p < 0.05$). In contrast, human resource work capacity in service delivery did not exert a statistically significant influence on tourist comfort ($\beta = 0.038$; $p > 0.05$), a finding that is contextually explained by the self-guided, environment-immersive nature of botanical garden tourism, where direct service interactions are infrequent relative to environmental and informational experiences. These findings collectively affirm that the application of ergonomic principles constitutes a pivotal framework for planning and managing nature-based tourism destinations. The dominance of environmental ergonomics factors in this study underscores the necessity of proactive environmental quality management — including microclimatic comfort strategies, comprehensive waste management systems, noise control, and natural landscape preservation — as the primary lever for enhancing tourist comfort. The significant influence of ICT underscores the importance of designing information systems — from interpretation boards and wayfinding signage to digital platforms and mobile applications — in line with cognitive ergonomics and visual display design principles, ensuring that tourists can access, process, and utilise destination information with minimal cognitive load.

The significant effect of tourist activity design highlights the importance of calibrating activity demands to the physical and cognitive capacities of diverse visitor segments, with particular attention to elderly visitors and those with physical limitations. From a theoretical standpoint, this study contributes to the growing body of applied ergonomics in tourism systems literature by empirically validating a multidimensional ergonomic framework — integrating physical, cognitive, organisational, and environmental ergonomics — as a comprehensive lens for understanding the formation of tourist comfort in nature-based destinations. The holistic human–environment–service fit framework operationalised in this study provides a replicable model for future ergonomic research in diverse tourism destination contexts. From a practical standpoint, destination managers at Kebun Raya Eka Karya Bedugul and comparable nature-based tourism sites are encouraged to: (1) prioritize environmental quality management as the highest-impact comfort investment; (2) systematically redesign information systems according to ergonomic visual display and cognitive load principles; (3) calibrate activity designs to accommodate diverse visitor physical capacities; and (4) continuously improve facility ergonomics based on anthropometric data and universal design standards. Future research may extend this framework by incorporating mediating variables such as tourist well-being and behavioural intentions, by employing longitudinal designs to assess seasonal variations in ergonomic comfort at highland destinations, and by expanding the sample to include international tourists for cross-cultural comparison. The integration of objective physiological measures of comfort — such as heart rate variability, skin temperature, and cognitive load indicators — with perceptual survey data would further strengthen the scientific rigour of ergonomic tourism research.

Acknowledgement: The author sincerely acknowledges the academic support, research facilities, and encouragement provided by Triatma Mulya University, which contributed significantly to the successful completion of this research work.

Data Availability Statement: The research data are available from the corresponding author upon request, provided that such

sharing complies with ethical considerations and participant confidentiality agreements.

Funding Statement: The author confirms that no financial assistance, grant support, sponsorship, or external funding was received for conducting this research or preparing the manuscript.

Conflicts of Interest Statement: The author declares the absence of any conflicts of interest related to this study.

Ethics and Consent Statement: Consent was obtained from the organisation and individual participants during data collection. Ethical approval and participant consent were received.

References

1. A. M. El-Sherbeeny, B. S. Al-Romeedy, M. H. A. Elhady, S. Sheikhelsouk, O. Alsetoohy, S. Liu, and H. A. Khairy, "How is job performance affected by ergonomics in the tourism and hospitality industry? Mediating roles of work engagement and talent retention," *Sustainability*, vol. 15, no. 20, p. 14947, 2023.
2. D. S. de Almeida, R. Simões, F. Brito e Abreu, A. Lopes, and I. Boavida-Portugal, "A carrying capacity calculator for pedestrians using OpenStreetMap data: Application to urban tourism and public spaces," in Information and Communication Technologies in Tourism, *Springer*, Cham, Switzerland, 2024.
3. A. Andriansyah, S. Subchan, K. Pamungkas, I. Geraldina, A. H. Arifin, and C. A. Manggarani, "Exploring sustainable tourism resources to realise ergo green tourism in Indonesia," *Aptisi Transactions on Technopreneurship*, vol. 7, no. 2, pp. 334–342, 2025.
4. A. Baktash, A. Huang, E. de la Mora Velasco, M. F. Jahromi, and F. Bahja, "Agent-based modelling for tourism research," *Current Issues in Tourism*, vol. 26, no. 13, pp. 2115–2127, 2023.
5. R. Ballantyne, J. Packer, and J. Falk, "Visitors' learning for environmental sustainability: Testing short- and long-term impacts of wildlife tourism experiences using structural equation modelling," *Tourism Management*, vol. 32, no. 6, pp. 1243–1252, 2011.
6. J. M. Berry and R. G. Loeb, "Ergonomics of the anesthesia workspace," in Anesthesia Equipment: Principles and Applications, *Elsevier*, Amsterdam, Netherlands, 2021.
7. R. S. Bridger, "Introduction to Human Factors and Ergonomics," 4th ed., *CRC Press*, Florida, United States of America, 2018.
8. M. Cetin, "Using GIS analysis to assess urban green space in terms of accessibility: Case study in Kutahya," *International Journal of Sustainable Development and World Ecology*, vol. 22, no. 5, pp. 420–424, 2015.
9. S. Coccolo, J. Kämpf, J. L. Scartezzini, and D. Pearlmutter, "Outdoor human comfort and thermal stress: A comprehensive review on models and standards," *Urban Climate*, vol. 18, no. 12, pp. 33–57, 2016.
10. N. Catahan, M. Hopwood, and P. Suraweera, "Botanic Garden Tourism, Social Value, Health, and Well-Being," *J. Zool. Bot. Gard.*, vol. 5, no. 2, pp. 187–199, 2024.
11. H. E. Dewi, R. Adityawati, and H. S. H. Subagyo, "The effect of facilities layout and services on visitors' comfort in Keboen Kopi Karanganjar agro-tourism Blitar," *IOP Conference Series: Earth and Environmental Science*, Malang, East Java, Indonesia, 2021.
12. G. Díaz-Meneses and M. Amador-Marrero, "Visitor Experience at Viera y Clavijo Botanic Garden: Satisfaction and Loyalty Antecedents," *Journal of Outdoor Recreation and Tourism*, vol. 47, no. 9, p. 100778, 2024.
13. J. Ebejer, "The benefits of tourism and travel to the tourist's well-being: A conceptual discussion," in Tourism, Travel, and Hospitality in a Smart and Sustainable World, *Springer*, Cham, Switzerland, 2023.
14. A. Fyall and B. Garrod, "Destination management: A perspective article," *Tourism Review*, vol. 75, no. 1, pp. 165–169, 2019.
15. J. F. Hair, J. J. Risher, M. Sarstedt, and C. M. Ringle, "When to use and how to report results of PLS-SEM," *European Business Review*, vol. 31, no. 1, pp. 2–24, 2019.
16. M. Sarstedt, C. M. Ringle, and J. F. Hair, "Partial least squares structural equation modeling," in Handbook of Market Research, *Springer*, Cham, Switzerland, 2022.
17. P. Harit and K. Arjun, "Ergonomic employee satisfaction and tourist experiences: A review of indirect impacts on tourist satisfaction in the hotel industry," *American Journal of Psychiatric Rehabilitation*, vol. 28, no. 5, pp. 51–60, 2025.
18. N. A. I. Hasanah, D. Maryetnowati, F. N. Edelweis, F. Indriyani, and Q. Nugrahayu, "The climate comfort assessment for tourism purposes in Borobudur Temple Indonesia," *Heliyon*, vol. 6, no. 12, pp. 1–9, 2020.
19. M. Helander, "A Guide to Human Factors and Ergonomics," 2nd ed., *CRC Press*, Florida, United States of America, 2005.
20. X. Huang, Y. Hui, J. Chen, Z. Huang, X. Li, and X. Yang, "Research progress on the evaluation of tourism climate comfort and its application in China: A bibliometrics-based review," *Atmosphere*, vol. 16, no. 6, p. 714, 2025.

21. K. Sinsup and S. Phumsathan, "Creative Tourist Segmentation for Nature-Based Tourism: A Social Media Framework for Sustainable Recreation Planning and Development in Thailand's National Parks" *Sustainability*, vol. 17, no. 22, p. 10005, 2025.
22. K. Kolcaba, "Comfort Theory and Practice: A Vision for Holistic Health Care and Research," *Springer*, New York, United States of America, 2003.
23. K. H. E. Kroemer and E. Grandjean, "Fitting the Task to the Human: A Textbook of Occupational Ergonomics," 5th ed., *CRC Press*, Florida, United States of America, 1997.
24. T. H. Lee and F. H. Jan, "Market segmentation based on the environmentally responsible behaviors of community-based tourists: Evidence from Taiwan's community-based destinations," *International Journal of Tourism Research*, vol. 21, no. 3, pp. 400–411, 2019.
25. A. Manuaba, "A total approach in ergonomics is a must to attain humane, competitive, and sustainable work systems and products," *Journal of Human Ergology*, vol. 36, no. 2, pp. 23–30, 2007.
26. A. Mehrabian and J. A. Russell, "An Approach to Environmental Psychology," *MIT Press*, Cambridge, Massachusetts, United States of America, 1974.
27. H. Mu'asyir, T. Tundo, H. Rahmani, and M. D. Oktaviandi, "UI/UX Design for Online Booking Optimization in Increasing the Tourism Potential of the Leuwi Asih Area" *Journal of Information and Communication Technology*, vol. 9, no. 3, pp. 1133–1142, 2025.
28. P. Mukhopadhyay, "Visual Ergonomics for Communication Design: A Layperson's Approach," *CRC Press*, Florida, United States of America, 2023.
29. M. Nikolopoulou, "Outdoor thermal comfort," *Frontiers in Bioscience*, vol. 3, no. 6, pp. 1552–1568, 2011.
30. D. Norman, "The Design of Everyday Things," Revised ed., *Basic Books*, New York, United States of America, 2013.
31. V. Olgyay, "Design with Climate: Bioclimatic Approach to Architectural Regionalism, New and Expanded ed," *Princeton University Press*, New Jersey, United States of America, 2015.
32. H. T. Panigoro, R. N. S. Sayekti, and M. Askiyanto, "The Influence of Facilities, Service Quality of Staff, and Tourist Attraction Appeal on Tourist Satisfaction in Hiking Tourism," *Journal of Indonesian Economic Research*, vol. 3, no. 1, pp. 40–51, 2025.
33. E. A. Pavlíková, O. N. Özdogan, and C. Yilmaz, "Ergonomic approach in tourism for visitors with special needs," in *Public Recreation and Landscape Protection—With Environment Hand in Hand? Proc. 14th Conf.,* Brno, Czech Republic, 2023.
34. S. Pheasant and C. M. Haslegrave, "Bodyspace: Anthropometry, Ergonomics and the Design of Work,"3rd ed., *CRC Press*, Florida, United States of America, 2005.
35. B. M. Pulat, "Fundamentals of Industrial Ergonomics," *Prentice Hall*, New Jersey, United States of America, 1992.
36. R. Qiyad and O. O. Zerouali, "The influence of tourism infrastructure on tourist satisfaction: The case of the Agadir destination," *International Journal of Digitalization and Applied Management*, vol. 2, no. 1, pp. 160–178, 2025.
37. L. Quan, I. Hong, T. Lee, and C. Yoo, "Estimating the social value of digital signage landmarks as sustainable tourist attractions," *Sustainability*, vol. 16, no. 4, p. 1695, 2024.
38. N. Stanton, P. M. Salmon, and L. A. Rafferty, "Human Factors Methods: A Practical Guide for Engineering and Design," *Ashgate Publishing*, England, United Kingdom, 2013.
39. G. Salvendy, "Handbook of Human Factors and Ergonomics," 3rd ed., *Wiley*, New Jersey, United States of America, 2006.
40. R. P. Sari and S. R. Henim, "Measurement and analysis of tourism website user experience using usability techniques," *Journal of Applied Engineering and Technological Science*, vol. 4, no. 1, pp. 539–546, 2022.
41. H. Setiawan, S. Susanto, M. Rinamurti, and Y. D. Pratama, "Implementation of ergo-tourism and local wisdom to design tourism village governance based on Balinese culture in Darma Buana, Belitang II, South Sumatera Province," *Journal of Tourism science*, vol. 2, no. 3, pp. 237–247, 2024.
42. M. Smith and L. Puczkó, "Health, Tourism and Hospitality: Spas, Wellness and Medical Travel," 2nd ed., *Routledge*, London, United Kingdom, 2014.
43. N. Y. Sudiar, Y. Koesmaryono, P. Perdinan, and H. S. Arifin, "Climate comfort in nature-based tourism at tropical region," *Agromet*, vol. 33, no. 2, pp. 53–61, 2019.
44. I. Z. Sutalaksana, J. H. Tjakraatmadja, and R. Anggawisastra, "Teknik Perancangan Sistem Kerja," *Bandung Institute of Technology*, Bandung, Indonesia, 2006.
45. J. Sweller, P. Ayres, and S. Kalyuga, "Cognitive Load Theory," *Springer*, Cham, Switzerland, 2011.
46. F. Tosi, "Ergonomics and design," in Design for Ergonomics, *Springer*, Cham, Switzerland, 2020.