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Exploring The Potential of Java Mountain Flora Collections As Interpretive Materials For Tourism At The Baturraden Botanical Garden

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Abstract

As an essential ex-situ conservation area, the Baturraden Botanical Garden (BBG) plays a crucial role in preserving Javanese mountain flora, particularly threatened endemic species such as Nepenthes adrianii, Scutellaria slametensis, and Homalomena bellula. However, the integration of these botanical collections into structured destination interpretation ecosystems remains under-optimized. This study aims to evaluate the potential of BBG's flora collections as primary interpretive materials and design a customized tourism interpretation framework tailored to visitor psychographics. Employing a qualitative descriptive methodology, data were gathered through semi-structured interviews, field observations, and comprehensive literature reviews. The empirical results reveal that while BBG curates 722 plant species systematically arranged across taxonomic and thematic zones, its visitor profile is highly concentrated within the youth demographic (aged 17–27), predominantly comprising students with a strong preference for active educational experiences. Consequently, this study establishes that a direct interpretation mechanism—specifically structured guided walks utilizing interactive, experiential pedagogies—is the most effective strategy. The proposed interpretive content centers on endemic flora taxonomy and core conservation values to actively enhance visitors' pro-environmental behavior. Operational diagnostics reveal that limited human resource capacity and a lack of certified local guides act as critical institutional constraints. Ultimately, these findings underscore that strategic botanical interpretation not only transforms ex-situ collections into actionable conservation education mediums but also strategically reinforces the destination's competitive identity as a sustainable ecotourism hub.

Keywords: *Baturraden Botanical Garden, ex-situ conservation, tourist psychographics, environmental education, tourism interpretation.*

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INTRODUCTION

In the contemporary Anthropocene era, botanical gardens have transitioned from static repositories of plant taxa to dynamic agents of ex-situ conservation and environmental advocacy. Within the framework of sustainable ecotourism, these specialized spaces are uniquely positioned to balance ecological preservation with experiential education, local empowerment, and self-funding mechanism generation (Page & Dowling, 2001). The operationalization of ecotourism is intrinsically governed by a tripartite symbiosis: rigorous biodiversity conservation, active community integration, and transformative visitor education. However, a persistent global

challenge within protected areas is the "visitor-conservation paradox," wherein escalating tourist arrivals often translate into heightened environmental pressure rather than improved ecological consciousness. This disconnect is primarily driven by an interpretation deficit, where the intrinsic scientific value of biological collections fails to resonate meaningfully with the non-expert public.

In developing economic landscapes like Indonesia, this phenomenon is increasingly pronounced. Data from the Ministry of Tourism of the Republic of Indonesia (2024) indicated a robust expansion in domestic mobility, with tourist movements in Central Java alone surging by 15.25%, rising from 114,358,219 in 2023 to 131,803,213 in 2024. While this massive influx offers profound socio-economic opportunities, it simultaneously underscores an urgent structural need for destination managers to mainstream environmental education. Without specialized communication mechanisms, high visitation volumes merely perpetuate superficial consumption of green spaces, squandering the potential of botanical destinations to act as active hubs for pro-environmental behavior modification.

The Baturraden Botanical Garden (BBG), situated in Kemutug Lor Village, Banyumas Regency, serves as a critical geographic focal point for addressing this challenge. Officially inaugurated in 2015, BBG is mandated with the ex-situ preservation of vulnerable Javanese mountain flora, harboring invaluable species endemic to the volcanic ecosystem of Mount Slamet, such as Nepenthes adrianii and Homalomena bellula. Despite the high ecological significance of these collections, their integration into the site's primary tourism interface remains highly rudimentary. The complex evolutionary narratives, ecological interdependencies, and conservation micro-stories embedded within these alpine specimens remain largely inaccessible to general visitors, exposing a severe under-optimization of the garden's experiential assets.

To bridge this cognitive gap between complex botanical sciences and tourist experiential perceptions, the deployment of strategic tourism interpretation is non-negotiable. Interpretation operates not merely as information dissemination, but as an advanced educational communication mechanism designed to translate raw scientific data into accessible, emotionally resonant conceptual narratives (Nugroho, 2020). Modern interpretation frameworks utilize both direct mechanisms (e.g., personalized guided interactions) and indirect modalities (e.g., non-personal digital signage) to foster deeper environmental stewardship (Tsaniah et al., 2022). To operationalize this effectively within an ecotourism setting, the structural layout must be underpinned by structured thematic design principles.

Thematic interpretation layout is a vital prerequisite for successful environmental communication; it systematically structures pedagogical messages into a cohesive mental framework, allowing visitors to internalize the ecological value of Javanese montane biodiversity efficiently. A well-conceptualized theme deepens destination attachment, enhances visitor satisfaction, and serves as a powerful catalyst for active destination branding and competitive positioning (Al Idrus et al., 2025). Despite its proven efficacy, empirical research addressing the systematic conversion of localized volcanic microflora into structured thematic interpretive programs remains scarce in Southeast Asian botanical literature. Consequently, this study seeks to fill this theoretical and empirical void. This research aims to comprehensively assess the interpretive potential of the botanical diversity within the Baturraden Botanical Garden and formulate an empirical, context-specific interpretation framework optimized for both the site's delicate ecological assets and its prevailing visitor psychographics.

LITERATURE REVIEW

Ecotourism Dynamics in Botanical Gardens

The conceptualization of ecotourism within modern protected spaces extends beyond conventional nature-based travel; it represents a highly structured framework aimed at synthesizing ecological preservation with the socio-economic advancement of local

communities. Within this paradigm, botanical gardens have emerged as pivotal spaces where the traditional mandates of scientific research and ex-situ biodiversity conservation converge with sustainable tourism delivery. This strategic evolution responds to a profound global shift in consumer behavior, characterized by an accelerating demand for authentic, immersive, and environmentally responsible experiences (Dutta, 2024). Consequently, modern botanical gardens are no longer static display areas but are active conduits for environmental pedagogy and green innovation.

The strategic viability of a botanical garden as a premier ecotourism destination relies heavily on its structural landscape integrity and taxonomic diversity. The spatial arrangement and visual aesthetics of living collections constitute primary experiential assets. Empirical assessments, such as those conducted at the Cibodas Botanical Garden, indicate that diverse landscape typologies within botanical enclosures function as distinct spatial attractions that influence visitor distribution and movement. When a landscape is empirically classified as possessing exceptionally high visual quality, it significantly enhances the destination's baseline attractiveness (Yulianti et al., 2020).

Beyond aesthetic parameters, contemporary ecotourism literature conceptualizes botanical gardens as socio-ecological ecosystems that deliver multi-tiered ecosystem services. The integration of high-density floral collections acts as a catalyst for social innovation, driving visitor engagement through interactive horticultural practices, botanical education, and nature-based therapeutic interventions. To bridge the intrinsic tension between rigorous conservation objectives and high-quality visitor experiences, destination managers must deploy advanced educational initiatives, including structured interpretive paths and specialized environmental programs (Catahan et al., 2024). These mechanisms are essential for transforming passive sightseeing into active environmental literacy, thereby securing long-term destination sustainability.

Typologies and Attributes of Nature-Based Tourism Attractions

Within the architecture of tourism systems, tourist attractions function as the primary operational catalysts, governing travel motivations, spatial behavior, and destination selection (Ismayanti & Rahmah, 2025). This functional centrality is reflected in national regulatory frameworks, such as Indonesian Law No. 10 of 2009, which establishes that a tourist attraction comprises any unique, intrinsically valuable, and aesthetically significant entity—whether entirely natural or enhanced through deliberate human intervention—capable of generating visitor interest. However, in Q1 academic discourse, the evaluation of nature-based attractions must transcend descriptive attributes, focusing instead on the systemic balance between resource consumption and destination carrying capacity to prevent the irreversible degradation associated with overtourism.

The structural evaluation of natural and semi-natural attractions is traditionally predicated on four core attributes: rarity (uniqueness of the biophysical assets), visual beauty (aesthetic appeal), authenticity (ecological integrity), and facilitated accessibility supported by robust educational interpretation. These attributes manifest across a spectrum of environmental typologies, ranging from high-biodiversity ecosystems in national parks and complex coastal mangrove networks to distinct volcanic landforms and historically significant anthropogenic landscapes, such as terraced agricultural systems. Within a sustainable ecotourism framework, these natural assets cannot be treated as mere commercial commodities. Instead, they require specialized management protocols to ensure that high tourist volumes do not compromise the underlying ecological baseline of the site.

Theoretical Foundations of Environmental Interpretation

Environmental interpretation is conceptualized in contemporary sustainable tourism theory as an advanced communication mechanism designed to translate complex scientific phenomena into accessible, emotionally resonant, and cognitively structured narratives for the non-expert public (Nugroho, 2020). Within botanical environments, interpretation serves a dual purpose: it acts as an experiential amplifier that elevates recreational activities into transformative educational journeys, while simultaneously functioning as a soft-management tool for visitor behavioral modification. By translating complex taxonomic data and ecological processes into meaningful thematic concepts, effective interpretation deepens visitors' systemic awareness of biodiversity loss and conservation exigencies.

The operationalization of interpretive communication relies on a combination of personal and non-personal delivery modalities. Personal interpretation includes direct interactions such as expert-guided walks, specialized workshops, and live botanical demonstrations, which foster high levels of emotional engagement. Conversely, non-personal interpretation utilizes physical on-site media, educational information centers, and modern digital innovations, including QR code-enabled trail networks and augmented reality interfaces. These multi-channel mechanisms distinguish botanical gardens from generic municipal parks by establishing a clear educational identity. Furthermore, by instilling pro-environmental behaviors—such as adherence to strict spatial zoning, mitigation of littering, and respect for fragile flora—strategic interpretation actively reduces the negative impacts of overtourism, directly supporting destination resilience and localized sustainable economic practices.

METHODS

Research Design and Temporal Framework

This study utilized a mixed-method descriptive exploratory research design, predominantly employing a qualitative approach integrated with supporting descriptive statistics to map visitor profiles. The empirical field investigation was systematically executed over four months from June to September 2024. To ensure a comprehensive capture of visitor dynamics, operational behaviors, and varying density patterns, data collection procedures spanned both standard weekdays and peak weekends. This dual-temporal framework was essential to capture a representative cross-section of tourist typologies and situational behaviors within the botanical garden.

Sampling Strategy and Participant Selection

The target population for this research encompasses all domestic and international travelers who visited the Baturraden Botanical Garden (BBG) during the study period. Given the non-finite nature of the visitor population, a non-probability convenience sampling technique (often operationalized as accidental sampling) was deployed for the visitor survey segment. While sample sizing in complex structural models demands large cohorts, exploratory destination diagnostic studies focusing on basic demographic distribution and interpretive framework design find sufficient statistical representation within a baseline of 100 to 200 respondents (Hair et al., 2021). Accordingly, a sample of 100 active visitors was recruited directly on-site. The selection was predicated on the inclusion criteria that the respondent had spent a minimum of 45 minutes exploring the garden's zones, thereby ensuring they possessed sufficient experiential exposure to evaluate the site's interpretive potential.

Data Collection Modalities

To achieve robust data triangulation and safeguard the validity of the findings, primary and secondary data were gathered through three integrated modalities: 1) Structured Questionnaire

Surveys: A paper-based, instrument-assisted survey was administered on-site to the 100 sampled tourists. This instrument was specifically designed to capture quantitative psychographic and demographic profiles, including age distribution, educational attainment, travel motivations, and baseline environmental awareness; 2) Direct Field Observations: Systematic, non-participant observations were conducted across BBG's specialized taxonomic and thematic zones. This protocol focused on mapping the spatial distribution of living collections, evaluating the physical readiness of existing signage, and documenting behavioral tracking of visitor movement patterns and interaction levels with the flora; and 3) Semi-Structured Interviews: Qualitative depth interviews were held with key institutional stakeholders, including destination managers, conservation staff, and local site guides. These interactions focused on diagnosing operational constraints, assessing human resource capacities, and identifying structural barriers to the implementation of certified guiding programs.

Secondary data was simultaneously curated through an extensive literature study of institutional reports, regional tourism statistics, and the official botanical registry of BBG to verify the exact taxonomy and status of the Javanese montane flora collections.

Data Analysis and Qualitative Rigor

The analytical framework followed a sequential explanatory process, blending quantitative descriptive statistics with qualitative thematic analysis. Quantitative data derived from the visitor surveys were processed using descriptive statistical software to generate percentage frequencies, mean scores, and cross-tabulations, visually conceptualizing visitor demographics and preferences.

Concurrently, qualitative data from field notes, observational matrices, and interview transcripts were analyzed using Miles and Huberman's framework, which entails data reduction, data display, and conclusion drawing/verification. The process began with structural coding to isolate thematic threads regarding "endemic flora potential," "interpretive friction," and "operational bottlenecks." The integration of quantified visitor profiles with qualitative resource audits allowed for the empirical formulation of a highly customized, structurally grounded thematic interpretation framework.

RESULTS AND DISCUSSION

Strategic Potential of BBG's Flora Collections as Interpretive Assets

Situated strategically at the Southern topography of Mount Slamet, the Baturraden Botanical Garden (BBG) leverages its microclimatic advantages to function as a premier ex-situ repository for vulnerable Javanese montane flora. Empirically, the garden manages a living collection encompassing 722 distinct plant species and 3,293 individual specimens. This extensive biodiversity registry was systematically curated through localized propagation, intra-institutional germplasm exchanges, and extensive field exploration initiatives across key volcanic corridors in Java Island (detailed in Table 1). From a tourism destination management perspective, this high-density taxonomic richness cannot be viewed merely as scientific data; rather, it constitutes a primary "experiential asset" with substantial potential to be converted into high-value thematic interpretive programs.

Table 1. Geographical Origins of Living Collection Exploration Operations

No	Province	Exploration and Accession Locations
1	West Java	Mount Ciremai, Mount Tilu
2	Central Java	Mount Slamet, Mount Merbabu, Mount Prau, Mount Bisma, Petungkriyono Forest Corridor, Mount Ungaran, North Mount Lawu, Mount Kumbang, Pringombo I—III Nature Reserve

No	Province	Exploration and Accession Locations
3	Special Region of Yogyakarta	Mount Merapi, Menoreh Hills Range
4	East Java	South Mount Lawu, Mount Welirang, Mount Arjuna, Mount Wilis, Mount Kelud

Source: Research data, 2026

While the overarching thematic layout of BBG focuses on "Javanese Montane Flora", the true competitive advantage of the destination—referred to in pricing and positioning theories as the rarity premium—lies in its collection of micro-endemic species native to Mount Slamet. Although these endemic taxa represent a small percentage of the total living collection, their extreme rarity, severe ecological vulnerability, and localized evolutionary history grant them high narrative value. In the context of experiential ecotourism, these specimens serve as ideal focal points for structured storytelling, allowing guides to bridge abstract global biodiversity crises with concrete, localized conservation narratives.

Nepenthes adrianii

Out of the 64 Nepenthes species recorded across the Indonesian archipelago—predominantly concentrated in the evolutionary hubs of Kalimantan and Sumatra—BBG successfully cultivates 8 distinct species. The most dominant and vital population within this carnivorous guild is Nepenthes adrianii, a highly localized pitcher plant endemic to Mount Slamet. The garden's proximity to the species' native sub-alpine habitat (altitudinal ranges between 950 and 2,000 masl) provides an optimal microclimate for successful ex-situ acclimatization and display.

From an interpretive standpoint, N. adrianii possesses three distinct narrative anchors capable of capturing visitor attention: 1) Ecological Symbiosis and Micro-Habitat Narratives: The plant exhibits complex epiphytic relationships, utilizing host trees like Sarangan (*Castanea argentea Bl.*) and *Puspa (Schima wallichii)* to anchor its lifecycle. This can be structured into guided walks illustrating forest canopy dynamics; 2) Biomedical and Anthropogenic Utility: Recent biochemical validations indicate that *N. adrianii* synthesizes *ethyl acetate*, an organic compound demonstrating strong inhibitory activities against oral carcinoma cells. This adds a compelling "biodiversity-for-humanity" storyline to the tour; and 3) Morphological Fascination: The specimen displays high visual quality, characterized by substantial pitchers extending up to 30 cm, a heavily serrated peristome, and vivid color variations ranging from yellowish-green to deep red.

Crucially, the interpretation of N. adrianii must be integrated with soft-enforcement conservation messages. The species faces severe extinction pressures due to rampant illegal poaching for the commercial ornamental plant trade. By emphasizing its legal status under Government Regulation No. 7 of 1999 and its international trade restrictions in Appendix II of CITES, tour guides can transform visual appreciation into active environmental advocacy, dampening illegal market demands through consumer education.

Scutellaria slametensis

Scutellaria slametensis is a rare flowering herb belonging to the Lamiaceae family, signifying a vital botanical asset native exclusively to the Mount Slamet ecosystem. Named derived from the Latin term for a small dish or shield—denoting its unique calyx architecture—this species offers significant potential for taxonomic and evolutionary interpretation. In developing on-site interpretive materials, S. slametensis can be leveraged to teach visitors about evolutionary divergence and speciation. While morphologically analogous to Scutellaria javanica, it maintains strict phenotypical distinctions, specifically its delicate light blue-purple calyx pigmentation and attenuated leaf bases. This visual distinctiveness can be utilized in interactive "spot-the-difference" pedagogical games during guided student walks, sharpening visitors' observation skills regarding montane biodiversity.

Homalomena bellula Schott

Commonly designated as the endemic aroid (*talas*) of Mount Slamet, Homalomena bellula Schott is categorized as a threatened taxon under the Vulnerable threshold of the IUCN Red List. The primary interpretative hook for this species lies in its bizarre evolutionary history and unique survival mechanics. Unlike conventional Homalomena species, *H. bellula* features a unique tuberous rhizome growth morphology that mirrors the subterranean architecture of the ginger family (*Zingiberaceae*). Furthermore, its historical narrative resembles a botanical mystery: following its initial discovery and documentation by the Austrian botanist Heinrich Wilhelm Schott in 1863, the plant was missing in nature for over a century until a small relict population was rediscovered in the Pancuran Tujuh thermal corridor at the base of Mount Slamet, Baturraden. This narrow, highly fragmented geographic distribution (restricted between 750 and 1,287 masl) highlights its high vulnerability. Presenting this species within an ex-situ interpretation path allows BBG to validate its institutional mission, shifting the visitor's perception of the garden from a simple public park to a vital sanctuary preventing permanent extinction.

Spatial Architecture and Functional Zonation of Collection Management

The systematic analysis of morphological variations across species at the Baturraden Botanical Garden (BBG) is intrinsically bound to its operational management framework, specifically governing inventory, documentation, and spatial curation. The distinct vegetative and generative characteristics of the specimens serve as the foundational parameters for orchestrating living plant collections into strategic spatial zones tailored to their specific ecological requirements. Empirically, BBG's collection layout operationalizes a dual-structured grouping matrix consisting of 8 distinct taxonomic patterns and 7 targeted thematic patterns (delineated in Table 2). From a destination management perspective, this highly structured layout functions as a sophisticated visitor management mechanism that balances public accessibility with strict conservation protocols.

Table 2. Spatial Curation Matrix: Taxonomic and Thematic Layouts at BBG

No.	Taxonomic Pattern	No.	Thematic Pattern
1	*Orchidaceae* (orchids)	1	Flora of Java Garden
2	*Lauraceae* (camphor-like)	2	Medicinal Garden
3	*Myrtaceae* (myrtles/guavas)	3	Fern Garden
4	*Euphorbiaceae* (spurges)	4	Bamboo Garden
5	*Araceae* (aroids)	5	Liana Garden
6	*Sapindaceae* (soapberries)	6	Gum Garden
7	*Nepenthaceae* (pitcher plants)	7	Useful Plants
8	*Meliaceae* (mahogany/duku-likes)		

Source: Research data, 2024

This dual-pattern spatial architecture serves a crucial multi-functional purpose. Structurally, it streamlines internal maintenance, monitoring, and conservation workflows for the garden's staff. Concurrently, it optimizes the visitor flow architecture by reducing cognitive fatigue among tourists during their destination experience. The thematic gardens are deliberately anchored along the primary circulation corridors, maximizing accessibility and supported by high-visibility directional and interpretative signage. Conversely, collections categorized under strict taxonomic patterns are segregated into specialized, off-axis planting plots or localized ex-situ greenhouse infrastructures. This strategic distribution prevents mass tourism bottlenecks by dispersing visitor density across varied spatial nodes.

Specialized Spatial Nodes and Experiential Features

To accommodate diverse visitor psychographics while preserving fragile germplasm, BBG segregates its high-value attractions into distinct experiential typologies: The Orchid Greenhouse (Controlled Conservation Node). BBG serves as a vital sanctuary for 30 distinct orchid species, encompassing both delicate epiphytic and terrestrial varieties. To protect these high-sensitivity specimens from anthropogenic damage, the management utilizes a specialized climate-controlled greenhouse infrastructure. This facility is integrated into the educational tourism pathway as a restricted guided zone, where visitors can admire the living collection strictly under the direct supervision of garden staff. Imposing strict thresholds on visitor carrying capacity and limiting dwell times within this micro-space functions as an effective physical risk-mitigation strategy, preventing ecological degradation while delivering a premium, informative experience.

The Conceptual Flower Bed (Anthropogenic Aesthetic Node): Recognizing the high demand for recreational and visual satisfaction among domestic tourists, the management has engineered high-quality artificial visual landscapes in the form of structured flower beds. These aesthetic features arrange diverse flowering species into precise, visually compelling geometric configurations. Strategically placed away from fragile endemic preservation zones, these flower beds serve as designated recreational nodes where visitors can freely walk, interact, and engage in photography. This layout successfully channels high-impact recreational behaviors into resilient, human-modified zones, buffering the garden's sensitive botanical core from the pressures of overtourism.

Structural Formulation of Tourism Interpretation Strategies

Adaptive Scientific Communication Framework (The Human-Led Interface)

The systematic dissemination of complex botanical science within protected enclosures necessitates a paradigm shift from passive, top-down lectures to highly adaptive, non-formal environmental communication, particularly when navigating youth demographics. To operationalize this effectively, the standard AIDA (Attention-Interest-Desire-Action) hierarchy of effects model is transfigured into a structured pedagogical matrix tailored to the cognitive processing habits of young visitors: First, Attention (Triggering Cognitive Awakening): The initial phase focuses on breaking visitor passivity upon entry. Empirically, this is achieved by ensuring high visibility and proactive physical deployment of interpretive personnel at major arrival thresholds, instantly offering structured guiding services to incoming student cohorts.

Second, Interest (Sequential Information Scaffolding): Youth and student demographics process environmental data via sequential input channels. To prevent cognitive overload, information architecture must follow a scaffolded delivery: guides first introduce high-accessibility narratives—such as local folklore, indigenous utilization, or the unique etymology of plant names—before transitioning to formal scientific nomenclature, taxonomic classifications, and complex biological properties. Advanced scientific data, including the biochemical properties of Nepenthes adrianii or the rare rhizomatous morphology of Homalomena bellula, are introduced only after baseline rapport is secured.

Third, Desire (Cultivating Conservation Stewardship): Rather than treating rare plants as commercial commodities to be harvested—an exploitative framing that directly contradicts BBG's ex-situ conservation mandate—the "Desire" phase must focus on cultivating a profound aspiration for ecological preservation and scientific inquiry. Guides can stimulate this by utilizing rich visual materials, interactive field magnifying lenses, and short multimedia clips that demonstrate how specialized propagation techniques save micro-endemic species from permanent extinction in the wild.

Fourth, Action (Empowering Pro-Environmental Behavior): The interpretive arc must culminate in actionable behaviors that match the physical and intellectual capacities of the youth cohort. This is manifested through structured, hands-on activities embedded within the tour,

such as micro-propagation workshops, guided seed-sorting tasks, and participatory botanical maintenance under institutional supervision. This directly transforms passive tourists into active conservation advocates.

Digital Interpretation Modalities and Non-Personal Media Strategies

To mitigate chronic institutional constraints—specifically the shortage of certified local guides and limited human resource capacity—BBG must systematically deploy non-personal digital interpretation channels to cater to independent, self-guided travelers. Given that the contemporary visual habits of young tourists are highly centered on photography and social media documentation, the garden's management should strategically re-engineer conventional photo spots into high-value "Scientifically-Themed Interpretive Installations." By embedding vibrant infographic displays and micro-evolutionary facts directly into the physical backdrops of these visual aesthetic nodes, routine photography is seamlessly cross-pollinated with environmental education.

Furthermore, to facilitate an autonomous yet deep educational journey for independent visitors, high-performance Quick Response (QR) codes must be integrated at strategic interpretation nodes across both taxonomic and thematic garden trails. When scanned via personal mobile devices, these digital markers instantly bridge the physical specimen with a cloud-based interpretive portal. This portal delivers bite-sized, engaging multi-language audio guides, high-resolution botanical diagrams, and interactive spatial maps. The deployment of this decentralized digital infrastructure ensures that the absence of physical guiding personnel does not result in an interpretation deficit, thereby maintaining the destination's structural commitment to sustainable ecotourism delivery

Formulation of Tourist Guiding Material and Framework Design

Analyzing visitor profiles and psychographic traits is a critical prerequisite when designing interpretive materials, as it directly dictates the relevance, cognitive absorption, and subsequent impact of environmental messaging on tourist behaviors. By unpacking visitor motivations, educational backgrounds, and pre-visit expectations, interpretive designers can strategically customize narrative structures and delivery styles to construct meaningful, high-resonance experiences for distinct audience segments. This audience-centric approach significantly intensifies the emotional and cognitive convergence between the core interpretive message and the holistic visitor experience. Furthermore, recalibrating communication assets to align with the visitors' cognitive maturity, cultural values, and linguistic capabilities plays an instrumental role in fostering deep socio-ecological understanding and driving positive behavioral shifts toward conservation and long-term environmental preservation.

In the context of the Baturraden Botanical Garden (BBG), target audience segmentation reveals a distinct concentration of youth and student demographics. This requires management to shift away from static, low-engagement communication channels. While generic visual boards may satisfy multi-generational family cohorts, tech-savvy student demographics demand interactive digital interventions and highly personalized, adaptive interpretive assets. Leveraging digital data and contextualized storytelling allows destination managers to optimize communication efficiency, transforming abstract scientific data into actionable conservation awareness.

Optimization of Human-Led Guiding Techniques

Given that BBG's primary experiential assets comprise living, high-sensitivity montane flora collections, the deployment of face-to-face direct interpretation is identified as the most effective guiding mechanism. Direct interpretation functions as an interactive communication interface designed to bridge the physical presence of the visitor with the deep intrinsic, ecological, and

scientific values of the botanical specimens. This mechanism is operationally deployed through highly structured guided walks, immersive storytelling, live botanical demonstrations, and participatory observation protocols. Within this educational ecosystem, the interpreter acts not as a passive lecturer but as a dynamic facilitator who contextualizes complex botanical sciences within localized cultural narratives to elevate the overall quality of the experience. This high-touch approach is exceptionally successful in cultivating emotional involvement because information delivery can be recalibrated in real-time to match the immediate feedback and characteristics of the listeners.

Furthermore, the structural success of environmental communication relies heavily on the linguistic and rhetorical properties utilized by the guide. The language style deployed at BBG must blend educational rigor with persuasive communication to ensure that visitors internalize core conservation values. In strict accordance with the international tourist guiding code of ethics, all delivered narratives must remain entirely neutral, strictly devoid of discriminatory biases regarding ethnicity, religion, race, or intergroup relations.

Linguistic flexibility must also be strategically managed; although localized student clusters heavily dominate the visitor flow, interpreters must refrain from utilizing regional dialects completely. Localized languages are restricted strictly to non-core interpretive segments—such as ice-breaking interactions or welcoming protocols—to preserve cultural authenticity without undermining the professional and inclusive delivery of scientific facts. Concurrently, non-verbal communication, including strategic body language, physical gesturing, and eye contact, must be utilized to actively command visitor focus, directing their attention back and forth between the physical details of the botanical specimens and the presenter's structural explanations.

Structural Design of Interpretive Materials

The architectural layout of BBG's thematic and taxonomic gardens allows for a highly structured, spatial sequencing of interpretive content. Under the guided walk framework, the thematic materials are dynamically adjusted to correspond with the physical specimens encountered along the trail. Interpreters are required to emphasize high-conservation-value flora unique to the Mount Slamet ecosystem heavily. Crucially, because micro-endemic species such as Nepenthes adrianii, Scutellaria slametensis, and Homalomena bellula are curated within proximate spatial clusters, guides can execute simultaneous comparative interpretations, highlighting distinct evolutionary adaptation strategies within a single spatial node. This multi-tiered narrative approach is supplemented by specific interpretive protocols designed for the high-value Orchid Greenhouse. The operational execution of this curricular material is systematized into a professional pedagogical blueprint detailed in Table 3.

Table 3. Pedagogical Blueprint and Interpretive Material Design for BBG

Stage	Activity	Material
Opening	Welcoming protocols, safety briefings, and orientation.	Comprehensive macro-introduction to BBG; geographical and historical genesis of the garden; orientation of primary institutional functions; and introduction to the global imperative of ex-situ montane conservation.
Field Interpretation	Scaffolded guided walk along thematic corridors.	High-accuracy taxonomic introduction: scientific nomenclature; native micro-habitat conditions; specialized ex-situ acclimatization techniques; evolutionary uniqueness; rarity index; and potential anthropogenic/ecological utility.
Interactive Education	Active field-based botanical observations.	Hands-on morphological diagnostic training (structural analysis of leaf shapes, carnivorous pitchers, calyx architectures); introductory non-destructive propagation methodologies; tool handling; and live scientific planting demonstrations.

Stage	Activity	Material
Hands-on Experience	Immersive experiential simulation.	1. Execution of technical protocols regarding low-impact botanical cultivation, conservation monitoring, and specimen maintenance.
		2. Interactive role-playing exercises positioning visitors as "Citizen Biologists" to deepen cognitive empathy and scientific engagement.
Evaluation	Dynamic debriefing and active Q&A interactions.	Strategic processing of field data; assessment of information retention regarding the montane species introduced during the guided walk.
Closing	Pro-environmental advocacy campaign and departure.	1. Reinforcement of personal responsibility and civic participation in biodiversity preservation networks.
		2. Distribution of botanical starter kits (endemic-safe seedlings and fundamental tools) to catalyze practical backyard conservation actions.

Source: Research data, 2024

To validate the educational efficacy of this blueprint, interpreters must actively monitor visitor knowledge acquisition and shifts in conservation awareness. The institutionalization of a structured Q&A session serves a dual purpose: it allows guides to clarify lingering scientific misconceptions while simultaneously utilizing visitor feedback as a real-time diagnostic dataset to iteratively refine the depth, tone, and delivery of interpretive materials for future cohorts.

Diagnostics of Institutional and Operational Constraints

Despite the exceptional latent potential of BBG's living collections, the empirical investigation identifies severe institutional bottlenecks that undermine the systematic delivery of high-quality ecotourism interpretation. The primary structural constraint is a severe deficit in human resource allocation specifically dedicated to tourism destination management. Currently, the site operates with a core team of only three individuals tasked with the simultaneous execution of complex administrative duties, daily ticketing operations, and visitor management workflows. This severe labor constraint makes the permanent deployment of structured, human-led guided tours logistically impossible during high-density visiting windows.

Compounding this quantitative deficit is a qualitative gap in professional capacities: the existing human resources at BBG completely lack professional, national, or international tour guide certifications. This absence of certified interpretive training severely limits the personnel's capacity to translate raw botanical data into advanced, non-formal environmental education frameworks.

Consequently, a direct operational symptom of this interpretation deficit is highly visible: the vast majority of visitors consistently fail to explore the full geographical boundaries of the botanical garden, instead clustering heavily around superficial entry zones. This spatial stagnation is directly attributable to the absence of continuous guiding interventions and clear, structured trail navigation. Without professional guides to incentivize deeper spatial exploration through captivating storytelling, the garden's remote thematic nodes remain structurally isolated, leaving valuable ex-situ interpretive assets severely underutilized.

Discussion

The empirical insights decoded from this study offer a critical, multi-layered understanding of how localized ex-situ botanical collections can be strategically transfigured into high-value ecotourism assets. The foundational audit of the Baturraden Botanical Garden (BBG) underscores a high-density germplasm repository—harboring 722 species and 3,293 specimens—which represents a formidable "rarity premium" within Southeast Asian nature-based tourism

destinations. However, from a critical destination management perspective, raw taxonomic richness alone does not inherently guarantee active visitor engagement. The transition from passive sightseeing to active environmental literacy is strictly gatekept by the quality, accessibility, and structural delivery of the site's interpretive framework.

Synthesis of the "Rarity Premium" and Experiential Storytelling

The high concentration of micro-endemic species native to the Mount Slamet volcanic ecosystem—specifically Nepenthes adrianii, Scutellaria slametensis, and Homalomena bellula—presents an unparalleled opportunity to leverage modern experiential storytelling (Sun et al., 2024). In contemporary ecotourism literature, micro-endemics serve as ideal narrative anchors because their biological vulnerability and isolated evolutionary history evoke stronger emotional responses from visitors compared to widespread cosmic flora. For instance, the multifaceted attributes of N. adrianii—blending complex canopy epiphytic symbioses with advanced biomedical utilities (anti-carcinoma properties) and striking morphological aesthetics (30 cm carnivorous pitchers)—allow tour interpreters to construct highly engaging, multi-dimensional pedagogical pathways. Rather than bombarding non-expert student cohorts with dry taxonomic data, the adaptive scaffolding method developed in this study enables a progressive cognitive transition: starting with accessible cultural etymology, moving into visible morphological anomalies, and culminating in profound legal and ethical arguments regarding poaching pressures and CITES international trade restrictions.

This sequential information architecture successfully bridges the "visitor-conservation paradox" highlighted in early tourism communication models (Nowacki, 2021). By framing the micro-endemics not merely as passive scenic backdrops but as "living biological sanctuaries," the interpretive content actively triggers a cognitive shift from superficial tourism consumption to a deep, active desire for personal environmental stewardship.

CONCLUSION

This study successfully decodes the strategic importance of living plant collections as primary experiential assets and foundational interpretive materials within the Baturraden Botanical Garden (BBG). The empirical findings confirm that the systematic conversion of raw taxonomic data into structured, multi-layered thematic narratives plays a transformative role in destination management. Well-designed tourism interpretation frameworks do more than facilitate basic information dissemination; they fundamentally bridge the "visitor-conservation paradox" by translating complex montane biology into emotionally resonant messages that cultivate active pro-environmental behaviors and shape a highly competitive, sustainability-oriented destination image.

Furthermore, this research underscores that the efficacy of environmental pedagogy is strictly contingent upon its alignment with visitor psychographics and demographic characteristics. Given that BBG's primary market is heavily concentrated within the youth and student demographics, the depth, tone, and delivery mechanisms of the interpretive programming must bypass conventional, passive lectures. Instead, they must prioritize scaffolded information architecture, immersive "Citizen Biologist" simulations, and active hands-on conservation experiences.

Finally, this study establishes that decentralized digital interpretation modalities, such as strategic QR-code networks, can serve as highly viable substitution mechanisms. By integrating adaptive digital infrastructures with resilient spatial curation matrices, BBG can overcome human resource limitations, optimize its destination carrying capacity, and successfully fulfill its core dual mandate as a critical ex-situ conservation sanctuary and a premier, modern ecotourism hub.

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