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Batadoba–Lena Cave as a Multidisciplinary Tourism Destination: Integrating Archaeological, Geoheritage, & Astro-Tourism Perspectives for Sustainable Development in Sri Lanka

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ABSTRACT

Batadoba–Lena pre historic cave, a significant geological and cultural heritage site in Sri Lanka, presents a unique opportunity for sustainable tourism development through a multidisciplinary approach. This review synthesizes geological, ecological, archaeological, and socio-economic perspectives to assess the cave's potential as a sustainable ecotourism destination. Geologically, the cave's karst formations offer insights into paleoclimatic conditions, while its biodiversity, including endemic troglobitic species, underscores its ecological importance. Archaeologically, the site contains prehistoric artifacts including fossils, reflecting its historical and anthropological value. However, unregulated tourism poses risks such as habitat degradation, vandalism, and cultural erosion. By integrating geoconservation and pale conservation strategies, community-based tourism frameworks, and policy recommendations, this study proposes a holistic management model that balances conservation with socio-economic benefits. The findings emphasize the necessity of stakeholder collaboration, scientific monitoring, and adaptive governance to ensure the long-term sustainability of Batadoba–Lena Cave as a heritage tourism site. Since 2013, the research team at Eco Astronomy Inc. has extensively supported the Sri Lankan government in developing a sustainable tourist approach for the Batadombalena cave site. Their efforts aim to provide visitors with a comprehensive understanding of ecotourism, archaeotourism, adventure tourism, and astrotourism, ensuring a well-rounded and enriching experience while preserving the site's ecological and cultural heritage. This multidisciplinary perspective provides a replicable framework for similar ecologically sensitive regions, contributing to global discourse on sustainable heritage tourism.

Article information | Key Words: Batadoba–Lena, geoheritage, archaeoastronomy, geotourism, astrotourism, sustainable tourism, Sri Lanka.

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INTRODUCTION

Nestled in the Sabaragamuwa Province, approximately 8 kilometers from Kuruwita, the Batadoba–Lena prehistoric cave stands as a remarkable convergence of cultural, geological, and scientific significance (Perera 2011; Sumanarathna, 2016). Beyond its archaeological and paleontological value, the cave presents a unique opportunity for multidisciplinary tourism, combining rich heritage, striking geological formations, fascinating paleontological findings, and potential for astro-tourism (Sumanarathna, 2018b). This rare blend of natural and cultural elements positions Batadoba–Lena as a distinctive destination, surpassing sites that focus on a single tourism aspect. The concept of multidisciplinary tourism at Batadoba–Lena Cave fosters an enriching and comprehensive visitor experience (Sumanarathna, 2013). By intertwining the narratives of ancient civilizations, geological evolution, and celestial observation, the site can offer a holistic understanding that appeals to diverse interests—from history buffs and archaeology enthusiasts to nature lovers and astronomy seekers (Sumanarathna, 2018a; Falchi, 2016). This integrated approach not only enhances visitor engagement but also encourages longer stays, boosting regional economic benefits. By catering to multiple market segments, the destination strengthens its resilience and broadens its global appeal (Buckley,2012).

Figure 01: Panoramic view of Batadombalena prehistoric cave from paragala trail. Image: Aravinda Ravibhanu© 2013.

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Developing Batadoba–Lena as a multidisciplinary tourism hub aligns with Sri Lanka's sustainable development goals, enhancing the nation's tourism sector while safeguarding its cultural and natural heritage. Through eco-tourism and responsible tourism practices, the cave's unique attributes can be preserved for future generations while supporting local communities. This strategy diversifies Sri Lanka's tourism offerings, making it more competitive on the global stage and fostering a resilient, adaptable industry. By embracing a multifaceted approach, Batadoba–Lena exemplifies how heritage, nature, and science can come together to create a sustainable and compelling tourism model (Table 03 & 04).

Archaeological Significance of Batadoba–Lena Cave

Batadoba–Lena Cave holds profound archaeological significance, primarily due to the extensive evidence of early human habitation, notably associated with the Balangoda Man (Deraniyagala, 1992; Perera et al., 2011). Archaeological investigations at the site have revealed habitation dating as far back as 8,000 years BCE, with more recent findings indicating occupation between 31,000- and 18,000-years BP (Before Present) (Wedage et al., 2019). The discoveries at Batadoba–Lena Cave have been instrumental in supporting the "Out of Africa" hypothesis, suggesting that early humans migrated through South Asia, including Sri Lanka, during their global dispersal (Roberts et al., 2015; Deraniyagala, 1992). The extended duration of human presence at this location underscores its importance in understanding the patterns of early human migration and their adaptation to the diverse environments of South Asia (Perera et al., 2011). The multiple layers of occupation spanning thousands of years provide a rich archaeological record for studying the evolution of human behavior and technology in the region (Wedage et al., 2019).

A variety of artifacts have been unearthed at Batadoba–Lena Cave, providing valuable insights into the lives and technologies of its early inhabitants. Among these are stone tools, some interpreted as arrow or spearheads, indicating hunting activities (Deraniyagala, 1992). Archaeologists have also discovered carefully crafted and perforated beads made from ostrich eggshell fragments, suggesting early forms of ornamentation and possibly symbolic behavior (Perera et al., 2011). Notably, the site has yielded microliths, including geometric forms, with some dated as old as 36,000 years BP (Wedage et al., 2019). These small, sophisticated tools,

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often made of quartz and chert, highlight the advanced hunting techniques of the early inhabitants (Deraniyagala, 1992). Additionally, bone projectile points have been found, further supporting the evidence of hunting (Perera et al., 2011). The discovery of marine shells within the cave indicates that the inhabitants engaged in trade or had contact with coastal regions, showcasing early social networks and exchange systems (Roberts et al., 2015). Dietary habits are also revealed through the discovery of seeds from plants such as *Artocarpus nobilis* (breadfruit), *Musa paradisiaca* (banana), and *Aleurites triloba* (candlenut), suggesting a diverse resource base (Wedage et al., 2019) (Table 01). The sheer variety of these artifacts, ranging from practical tools to decorative items, points toward a relatively complex cultural and technological development among the early human communities that inhabited the cave (Deraniyagala, 1992).

Figure 02: A. From inside to outside view of batadomabalena Cave. B. From outside to inside view of batadomabalena cave. C. View of batadomabalena Cave [middle can see *Musa paradisiaca*] from the rubble land at right cover. Image: Aravinda Ravibhanu© 2016.

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The artifacts discovered at Batadoba–Lena Cave primarily date back to the late Pleistocene and Holocene eras, aligning with the Mesolithic period in Sri Lanka, a cultural stage characterized by the use of microliths (Perera et al., 2011: Sumanarathna, 2017). Remarkably, the microliths found at Batadoba–Lena Cave predate similar finds in Europe, suggesting an earlier emergence or independent development of this technology in South Asia (Wedage et al., 2019). The archaeological findings are closely associated with the Balangoda culture, named after the region where the first evidence of this Mesolithic culture was defined (Deraniyagala, 1992). The age of these artifacts' places Batadoba–Lena Cave as a crucial site for understanding the early Mesolithic period in South Asia, potentially reshaping our understanding of the timeline of human cultural evolution in this part of the world (Roberts et al., 2015). The significantly older dates of these tools compared to other regions suggest the possibility of independent innovation or very early transmission of technological knowledge (Wedage et al., 2019).

Figure 03: A. Shells of snail fossils via 3rd excavation of "Batagobalena Pre Historic Site" by Dr.Nimal Perera and his team in 2005. Image © Nimal Perera 2005. B. Snail semi- fossils *Oligospira skinneri*. C. *Acavus superbus* | Location: Batadombalena, Kuruvita | Depth: 10ft. © SMKA 2005. Image: ©Aravinda Ravibhanu 2019.

Batadoba–Lena Cave is recognized alongside Pahiyangala and Beli Lena as one of the three most significant archaeological sites in Sri Lanka that provide evidence of the Balangoda culture (Deraniyagala, 1992). While Batadoba–Lena Cave has yielded evidence of habitation dating back approximately 31,000 to 18,000 years BP, older human remains, around 37,000 years BP, have been discovered at Pahiyangala (Perera et al., 2011). Further research at Fa-Hien Lena has revealed evidence of bow-and-arrow technology dating back approximately 48,000 years, representing some of the earliest known examples outside of Africa (Wedage et al., 2019). Additionally, Kitulgala Beli-lena has provided lithic assemblages dating back to around 45,000

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years BP, offering another key site for understanding early human technological adaptations in Sri Lanka's rainforest environments (Roberts et al., 2015). By examining the similarities and differences in the archaeological records of these sites, a more comprehensive understanding of early human settlement patterns, technological advancements, and cultural diversity across different ecological zones of Sri Lanka during the prehistoric period can be developed (Deraniyagala, 1992). Comparing artifact types, dating, and environmental contexts across these locations helps to reconstruct migration routes, technological innovations, and adaptations to various ecological niches (Wedage et al., 2019).

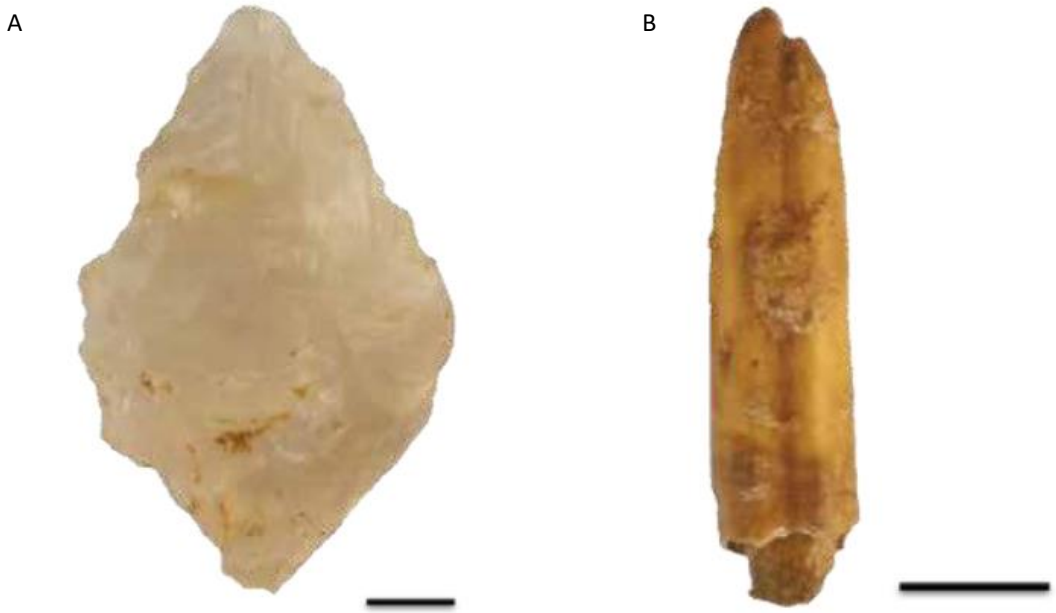

Figure 04: Left: Balaingoda point from Balangoda culture in Sri Lanka | Location -Kuruvita © SMKA| Image ©Aravinda Ravibhanu 2019. Bone Point with attached neck surface from Balangoda culture Sri Lanka | Location - Kuruvita © SMKA. Image ©Aravinda Ravibhanu 2019.

Geoheritage of Batadoba–Lena Cave and Surrounding Area

The geological formation of Batadoba–Lena Cave is characterized as a karst cave, situated within a 78-meter-high limestone rock formation on Vithana Kanda hill. Karst landscapes, including cave systems, are formed through the natural dissolution of soluble rocks such as limestone by slightly acidic water over extended periods (Ford & Williams, 2007). The classification of Batadoba–Lena Cave as a karst cave signifies a long and complex geological history, suggesting the potential for unique geological formations both within the cave and in the surrounding landscape (Kumari et al., 2019). Karst regions are typically marked by distinctive features such

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as sinkholes, underground drainage networks, and intricate cave systems, all resulting from the chemical weathering of the bedrock (Gunn, 2004).

Figure 05: A: The Batadomba-lena cave site exhibits signs of anthropogenic activity, particularly on the left side adjacent to the main cave. | Image ©Aravinda Ravibhanu 2017. B. Batadomba-lena excavation strata in 2005. Image © Nimal Perera 2005. C.Excavation at Batadomba-lena (1982–1983) Reveals Human Skeletal Remains. Image extract from © Nimal Perera.

Batadoba–Lena Cave comprises two primary caverns, Maha Lena (Large Cave) and Kuda Lena (Small Cave), each with distinct dimensions (Department of Archaeology, Sri Lanka, 2018). Maha Lena is a spacious cave measuring approximately 24 meters in length, 15 meters in height, and 18 meters in width, capable of sheltering a significant number of people. Kuda Lena, while smaller, is still substantial, with dimensions of around 9 meters in length and 9 meters in width (Table 02). In addition to these main chambers, the broader rock formation contains numerous smaller caves, with a total length estimated to be around 500 meters (Perera et al., 2019). While not explicitly detailed in initial descriptions, the potential exists for the formation of speleothems such as stalactites and stalagmites within these limestone caves, which are common features of karst environments (White, 2019). Furthermore, Batadoba–Lena Cave is located within the Sabaragamuwa Basin, a region known for its rich deposits of Quaternary fossils, including those

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from the Pleistocene and Holocene epochs (Manamendra-Arachchi et al., 2005). The size and structural complexity of the cave system, coupled with its location in a basin abundant with paleontological evidence, significantly enhance its scientific value for studying the region's geological history and paleoenvironmental conditions (Sumanarathna, 2017b).

The Rakwana mountain range, situated along the northern margin of the Sinharaja rainforest within the Sabaragamuwa Basin, has been identified as a significant geodiversity hotspot, indicating a rich variety of geological features and processes. Recent geological surveys within the Sabaragamuwa Basin have also led to the discovery of extensive cave systems within the crystalline limestone (marble) formations of the Pannila Mountain region, locally known as 'Pannila Hunugala' (Sumanarathna, 2017c). These findings highlight the broader geological significance of the region, of which Batadoba–Lena Cave is a part. Recognizing Batadoba–Lena Cave as an integral component of the Sabaragamuwa Basin's overall geodiversity could significantly enhance its potential as a geoheritage site, warranting greater attention in regional conservation efforts (Sumanarathna, 2018a). Framing the cave within this larger geological context emphasizes its regional importance and could provide a stronger foundation for seeking protected area status or attracting funding for further research and conservation initiatives (Sumanarathna, 2018b).

Exploring the Astro-Tourism Potential at Batadoba–Lena Cave

While specific data on light pollution levels around Batadoba–Lena Cave is not explicitly available, its remote location, distanced from major urban centers, suggests the potential for relatively dark skies. Sri Lanka has been recognized for its "pristine skies" in discussions on emerging astro-tourism opportunities. The absence of significant industrial development near the cave further supports the likelihood of minimal artificial light at night (ALAN), a critical factor for astronomical observation (Falchi et al., 2016). However, a detailed light pollution assessment using tools such as the Bortle Scale or satellite-based radiance data would be necessary to definitively evaluate the site’s suitability for astro-tourism (Kyba et al., 2017).

The available research does not provide specific details on celestial visibility from Batadoba–Lena Cave. However, Sri Lanka’s varied topography, including highland regions and less populated areas, is generally conducive to stargazing. This suggests that the cave’s location,

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possibly at an elevated altitude and distanced from major light sources, could offer favorable night-sky visibility. Factors such as elevation, atmospheric clarity, and surrounding terrain—including potential forest cover—would need evaluation in a site-specific assessment (Chambers et al., 2016).

Figure 06: A. Exploring Ancient Skies: Archeoastronomy and Astro-tourism Workshop at Batadobalena in 2013. B. Long-range, vista of the Sabaragamuwa Basin from Balana Gala. C. Special Workshop on Astro-tourism Applications for Eco Astronomy Students (2017). Images: ©Aravinda Ravibhanu

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No direct cultural or historical astronomical connections to Batadoba–Lena Cave are documented in existing literature. However, comparative studies highlight that other Sri Lankan sites, such as Danigala Circular Rock, exhibit archaeological, astronomical, and cultural significance suggesting that similar multidisciplinary heritage may exist elsewhere. The lack of explicit records does not preclude potential ethno-astronomical ties, which could be uncovered through community engagement, oral history research, and archival analysis (Holbrook et al., 2008). Indigenous astronomical knowledge, often embedded in local traditions, may reveal undocumented celestial associations with the cave (Ruggles, 2015).

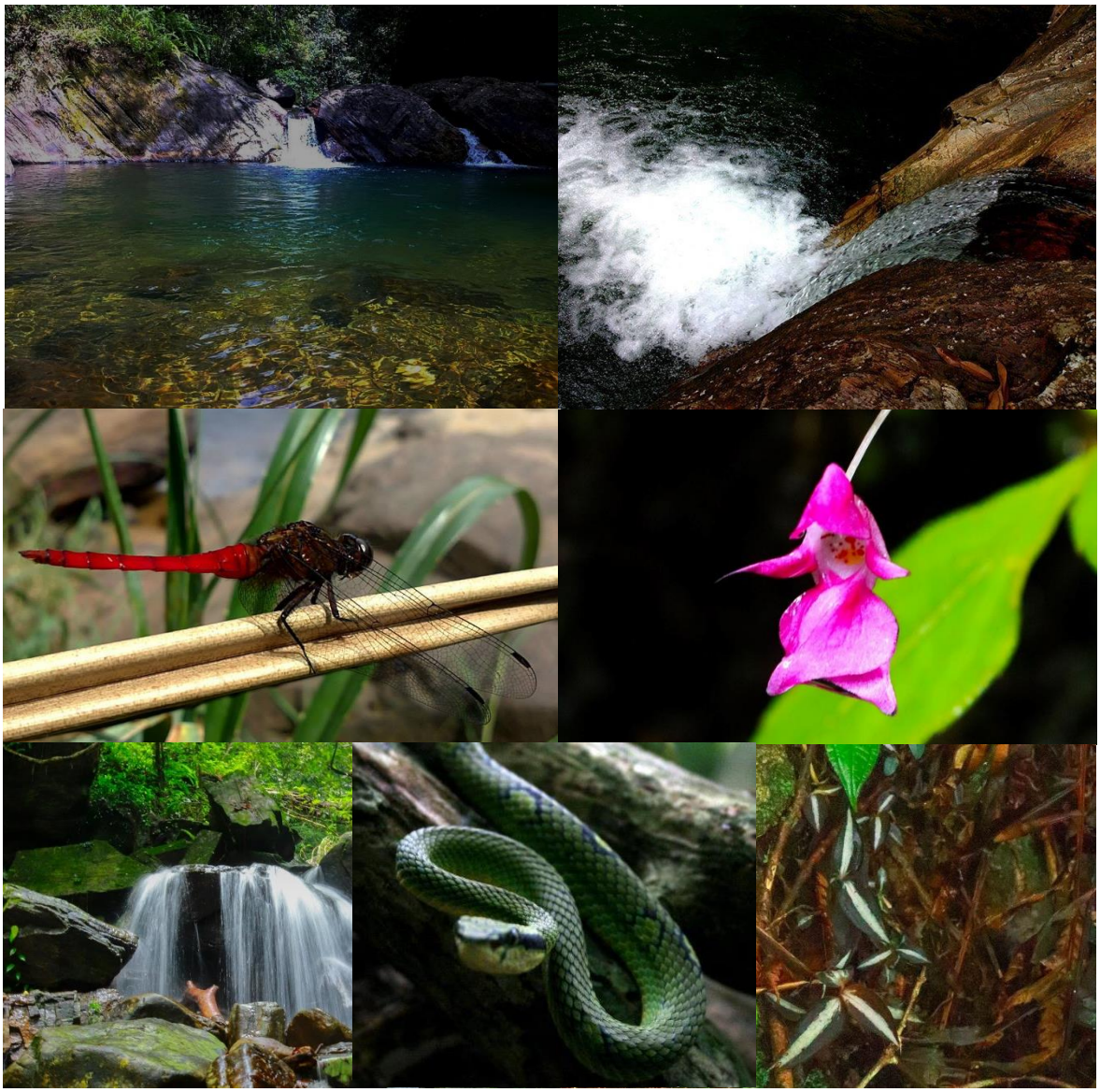

Figure 07: Step into the wild,The Batadoba-lena cave trail via Dundola reveals rich ecological wonders**.** Images: Aravinda Ravibhanu© 2012-2015.

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The true potential of Batadoba–Lena Cave as a tourism destination lies in the synergistic combination of its archaeological significance, geoheritage value, and astro-tourism possibilities, creating a holistic and enriching experience for visitors (Dowling & Newsome, 2018). This convergence of historical, geological, and celestial narratives can appeal to a broader range of interests than a site focusing on a single tourism aspect (Timothy & Boyd, 2015). The unique selling proposition of Batadoba–Lena Cave stems from this blend, distinguishing it from other Sri Lankan destinations that emphasize beaches, ancient cities, or wildlife. By offering a multifaceted experience, the cave can attract intellectually curious travelers seeking deeper connections with history, nature, and the cosmos (Table 03,04)

Several integrated experiences could be developed to showcase Batadoba–Lena Cave's multidisciplinary significance. Guided tours could highlight archaeological findings alongside the cave's geological formation and paleoenvironmental context. Interpretation centers could display artifacts alongside geological timelines and astronomical data relevant to past human habitation, such as constellations visible during those periods (Rappenglück, 2015). Night-time events could combine stargazing with storytelling about ancient inhabitants' possible celestial connections, drawing on ethno-astronomical research if available (Iwaniszewski, 2016). Such curated experiences enhance engagement by interweaving historical, geological, and astronomical dimensions (Poria et al., 2009).

Sustainable Tourism Development at Batadoba–Lena Cave: Tourism in Sri Lanka: Current Scenario and Policy Context.

The sustainable development of Batadoba–Lena Cave as a tourism destination requires adherence to internationally recognized principles and best practices in sustainable tourism (UNEP & UNWTO, 2005). This includes minimizing environmental impact, supporting local economies, and preserving the site's cultural and natural heritage (UNESCO, 2012). If astro-tourism is pursued, responsible lighting practices must be implemented to protect the darkness of the night sky, aligning with guidelines from the International Dark-Sky Association. Integrating these principles from the planning stage is essential for ensuring long-term tourism viability and maximizing benefits for local communities and ecosystems (Buckley, 2012). Sustainable tourism must balance environmental, social, and economic considerations to ensure equitable distribution of benefits among stakeholders.

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Applying these principles to Batadoba–Lena Cave requires site-specific strategies. Visitor access must be regulated to protect fragile geological formations and archaeological deposits, following best practices in cave tourism management (Cigna & Forti, 2013). Involving local communities in tourism activities ensures economic benefits and fosters conservation support (Tosun, 2000). If astro-tourism is developed, strict light pollution controls should be enforced (Falchi et al., 2016). Additionally, visitor education programs should highlight the cave's archaeological, geological, and astronomical significance to promote responsible behavior (Moscardo, 1996). A tailored approach is necessary to address the cave's unique heritage and ecological context (Hall & McArthur, 1998).

Long-term preservation requires robust conservation plans for the cave and surrounding rainforest, informed by heritage management frameworks (ICOMOS, 2008). Clear regulations for tourism activities must be established to mitigate damage (Eagles et al., 2002), alongside continuous impact monitoring to enable adaptive management (NPS, 2011). Proactive management is critical to safeguarding heritage integrity, as irresponsible tourism poses significant risks (McKercher & du Cros, 2002). Ongoing assessment and policy adjustments are essential to ensure sustainable tourism practices (Butler, 1999).

Sri Lanka's tourism sector boasts a diverse array of attractions, encompassing renowned cultural heritage sites such as Anuradhapura, Polonnaruwa, Sigiriya, Dambulla, and Kandy. Nature-based tourism also plays a pivotal role, with the country's pristine beaches, national wildlife parks, and picturesque highlands drawing significant visitor interest. Emerging niche markets, including eco-tourism, are gaining traction, while the potential for astro-tourism is increasingly being explored. This well-established diversity in Sri Lanka's tourism portfolio creates an ideal foundation for integrating a multidisciplinary site such as Batadoba–Lena Cave. A thorough analysis of the existing tourism landscape enables the identification of synergies, ensuring the cave's development complements and enriches the nation's current offerings.

The Sri Lankan government has designated tourism as a key driver of economic growth, implementing strategic policies to foster sustainable sectoral expansion. *Tourism Vision 2019* outlines a roadmap to position Sri Lanka as a premier high-value destination while preserving its natural and cultural heritage. Ambitious targets include attracting 2.5million tourists by 2019 and generating US$4 billion in revenue. Sustainability remains a core focus, with initiatives aimed at safeguarding the country's ecological and historical assets for future

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generations. Institutional reforms, such as the establishment of the National Tourism Commission, have been introduced to enhance sectoral governance. Additionally, infrastructure upgrades and streamlined visa processes seek to improve accessibility for international visitors. These measures collectively indicate a conducive policy environment for innovative tourism developments, including the strategic promotion of Batadoba–Lena Cave.

Despite its potential, Sri Lanka's tourism industry faces challenges, particularly in diversifying its product offerings and source markets. Effective management of tourism-related environmental impacts and maintaining service quality amid rising visitor numbers are also critical concerns. However, these challenges present opportunities to innovate, catering to evolving market demands while adopting sustainable practices. The development of Batadoba–Lena Cave as a multidisciplinary destination could address diversification needs by providing a unique, multifaceted attraction. Nevertheless, meticulous planning and sustainable management frameworks will be essential to mitigate environmental risks and ensure a high-quality visitor experience.

Potential Impacts of Developing Batadoba–Lena Cave for Tourism: Recommendations and Conclusion

The development of Batadoba–Lena Cave as a tourism destination presents substantial economic opportunities, particularly for the local community in Kuruwita. An increase in visitor numbers is expected to generate employment across multiple sectors, including tour guiding, hospitality, transportation, and artisanal crafts. Additionally, tourism growth can enhance regional and national revenue streams, bolstering Sri Lanka’s broader economy. The expansion of tourism may also stimulate local entrepreneurship, encouraging the establishment of guesthouses, restaurants, and souvenir shops to accommodate visitor demand. These economic benefits have the potential to uplift community livelihoods and drive sustainable regional development.

From a sociocultural standpoint, promoting Batadoba–Lena Cave as a tourism site can heighten awareness and appreciation of its unique cultural and natural heritage among both residents and tourists. Such development may facilitate meaningful cultural exchange, fostering mutual understanding and respect. However, without proper community engagement and careful

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management, tourism growth could inadvertently lead to cultural insensitivity or displacement. To mitigate these risks, inclusive planning that prioritizes local participation is essential. Ensuring that the community benefits directly from tourism activities will cultivate a sense of ownership and enhance the initiative's long-term social sustainability.

The tourism development of Batadoba–Lena Cave also necessitates careful consideration of potential environmental impacts. Increased foot traffic may threaten the cave's fragile ecosystem and archaeological integrity, necessitating sustainable waste management, pollution control, and resource conservation measures. If astro-tourism is pursued, stringent regulations to minimize light pollution will be critical to preserving the area's night skies. Furthermore, expanded infrastructure and vehicular traffic could adversely affect the surrounding natural environment. To address these challenges, comprehensive environmental impact assessments must be conducted, followed by the implementation of robust mitigation strategies. Achieving a balance between economic gains and environmental preservation is paramount to ensuring the sustainable development of this site.

To ensure the sustainable and responsible development of Batadoba–Lena Cave as a multidisciplinary tourism destination, the following strategic recommendations are proposed:

1.Conduct Comprehensive Impact Assessments:

Rigorous environmental and cultural heritage impact assessments must be conducted to evaluate potential risks and benefits associated with tourism development. These assessments should account for the site's archaeological significance, the delicate cave ecosystem, and its astro-tourism potential, including an in-depth analysis of light pollution effects.

2.Develop a Holistic Management Plan:

A structured management plan should be formulated in consultation with key stakeholders, including local communities, archaeologists, geologists, tourism authorities, and conservation bodies. This plan must define protocols for visitor management, heritage conservation, educational interpretation, and community involvement.

3.Implement Robust Conservation Strategies:

Proactive conservation measures should be enforced to safeguard the cave's geological features, archaeological relics, and surrounding biodiversity. Strategies may include controlled access to sensitive zones, environmental monitoring, and anti-vandalism measures to ensure long-term preservation.

4.Prioritize Sustainable Infrastructure Development:

Infrastructure projects—such as walkways, visitor centers, and lighting systems—must adhere to sustainable design principles, minimizing ecological disruption and maintaining aesthetic harmony with the natural landscape. If astro-tourism is pursued, lighting installations should comply with dark sky preservation standards.

- **Enhance Educational and Interpretive Initiatives:**
  Comprehensive educational programs and interpretive materials should be developed to underscore Batadoba–Lena Cave's multidisciplinary value. Tailored for diverse audiences, these initiatives will foster greater public awareness and appreciation of the site's cultural, geological, and astronomical significance.

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- **Expand Research Efforts:**
  Further interdisciplinary research is essential to fully assess the site's astro-tourism viability, including precise light pollution mapping and investigations into potential historical astronomical linkages through community engagement and archival studies.
- **Promote Ethical Tourism Practices:**
  Visitors should be encouraged to adopt responsible tourism behaviors, emphasizing heritage preservation, environmental stewardship, and support for local economies through awareness campaigns and guided experiences.

Sri Lanka has long been renowned as a premier tourist destination, celebrated as the "Pearl of the Indian Ocean." Its rich history, documented in ancient chronicles, along with its equatorial climate, ensures year-round sunshine and diverse ecosystems that foster ecotourism. The island's extensive coastline attracts beach enthusiasts, while its ancient monuments and cultural heritage sites draw visitors interested in history and archaeology.

In recent years, following the resolution of past conflicts, new opportunities have emerged in the tourism sector. Among these, paleo-biodiversity tourism has gained significant interest, offering insights into ancient ecosystems and early human interactions with their environment. This discipline explores geological eras, prehistoric civilizations, and the island's deep ecological history, dating back approximately 125,000 years. Given its locations within lush forests and near pristine waterways, paleo-biodiversity tourism aligns closely with ecotourism.

However, as a newly introduced niche, paleo-biodiversity tourism is best promoted alongside complementary offerings such as cave tourism, nature tourism, adventure tourism, and astro-tourism. In this context, Batadoba–Lena Cave stands out as a key attraction, combining archaeological, geological, and astro-tourism potential.

To fully realize this site's value, sustainable development strategies must be prioritized. This includes heritage conservation, community engagement, and minimizing environmental impacts. By adopting a balanced approach to tourism development—supported by ongoing research and stakeholder collaboration—Batadoba–Lena Cave can serve as a model for responsible heritage tourism, contributing to both national tourism growth and local socio-economic benefits.

Future success will depend on strategic planning, preservation efforts, and the integration of this unique site into Sri Lanka's broader tourism portfolio.

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APPENDIX

Table 1: Timeline of Archaeological Findings at Batadoba–Lena Cave and Sabaragamuwa basin.

Artifact Type	Estimated Age
Stone tools (arrow/spearheads)	10,000 years BP
Human skeletal remains (Balangoda Man)	31,000 - 18,000 years BP
Stone arrowheads/spearheads	31,000 - 18,000 years BP
Microliths (geometric)	36,000 years BP
Bone | include Sabaragamuwa beds: *Geoemyda trijuga sinhaleyus, Trionyx punctata sinhaleyus,Crocodylus sinhaleyus, Hystrix sivalensis sinhaleyus, Cuon javanicus, Palaeoloxodon namadicus sinhaleyus, Hypselephas hysudricus sinhaleyus, Elephas maximus sinhaleyus Rhinoceros sinhaleyus, Sri Lankan subspecies of rhinoceros, Rhinoceros kagavena, Sus sinhaleyus, Hexaprotodon sinhaleyus, Bibos sinhaleya, Gona sinhaleya, Panthera leo sinhaleyus,Panthera tigris.*	36,000 - 18,000 years BP
Marine shells	31,000 - 18,000 years BP
Plant seeds : Alsophila zeylanica (Pini Baru), Bambusa vulgaris Schard (Bambu), Ochlandra stridual Thwaites (Bata), Ochlandra fasciculata Thwaites (Katu Kithul), Caryota urens Linne (Kithul), Elaeocarpus subvillosus Arn (Gal Veralu), Myristica dactylodies Caertn (Malaboda), Canarium zeylanicum (Kekuna), Coscinium fenestrum Coleber (Veni Val) (Deraniyagala, 1958).	31,000 - 18,000 years BP

Table 2: Guiding Principles for Responsible Astro-Tourism

Cave Name	Length (m)	Height (m)	Width (m)	Key Geological Features
Maha Lena	24	15	18	Karst cave, Rock shelter
Kuda Lena	9	-	9	Karst cave, Rock shelter

Table 3: Principles of Responsible Astro-Tourism

Principle	Description	Relevance to Batadoba–Lena Cave
Use light responsibly	Adopt DarkSky's ROLAN principles for outdoor lighting.	Crucial for preserving dark skies if astro-tourism is pursued; minimize light spill and use appropriate spectrum lighting.

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Protect the natural environment	Avoid disruption to wildlife and natural habitats.	Essential for preserving the surrounding rainforest ecosystem and the cave environment.
Support well-being of residents	Consider the needs and activities of local communities.	Ensure that tourism benefits the local community and minimizes any negative impacts on their way of life.
Honor local cultures	Respectfully integrate local traditions and knowledge with free, prior, and informed consent.	Explore potential ethno-astronomical connections and involve the community in the interpretation of the site.
Adhere to local regulations	Comply with all relevant local laws and support regulations protecting natural darkness.	Necessary for legal operation and long-term protection of the site's resources.
Foster sustainable economic growth	Generate meaningful economic benefits for local people and communities.	Aim to create jobs and opportunities for local businesses through tourism activities.

Table 4: Assessing the Economic, Social, and Environmental Effects of Tourism Development.

Impact Category	Potential Positive Impacts	Potential Negative Impacts	Mitigation Strategies
Economic	Job creation, increased revenue, opportunities for local businesses.	Potential for economic dependence on tourism, price inflation for locals.	Diversify tourism offerings, prioritize local employment and sourcing, implement fair pricing policies.
Social	Increased awareness of heritage, cultural exchange, local pride.	Potential cultural sensitivity issues, overcrowding, impact on local traditions.	Engage the local community in planning and management, implement visitor limits, promote respectful behavior among tourists.
Environmental	Potential for funding conservation through tourism revenue.	Risk to cave environment and archaeological deposits, waste generation, light pollution.	Implement strict access controls, invest in sustainable waste management, adopt dark sky lighting practices, conduct regular environmental monitoring and implement mitigation measures.

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