JBEE 2(1) (2026) 211-219

Journal of Biology, Environment, and Edu-Tourism
E-ISSN: 3109-0575

https://journals.widhatulfaeha.id/index.php/jbee/index

Analysis of Ecotourism-Based Science Learning Materials: A Case Study of Tourism in Pemepek Village

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Article Info
Article History
Received: April 5th, 2025
Revised: April 10th, 2025
Accepted: April 28th, 2025
Published: April 30th, 2025:

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Abstract
Despite the growing recognition of ecotourism as an educational resource, the systematic integration of local sites into formal science curricula remains underexplored in rural Indonesian contexts. This study analyzes the potential of three ecotourism destinations in Pemepek Village, Central Lombok: Lembah Datu, Pindah Alam, and Forest Area with Special Purpose (FAWSP) Rarung, or KHDTK Rarung, as contextual science learning materials for elementary and junior high school levels. Employing a qualitative descriptive approach, the research used field observations and science concept rubrics to identify educational themes and analyzed the data using the Miles and Huberman interactive model. The findings reveal that each site offers distinct scientific content: Lembah Datu provides insights into riparian ecosystems and simple machines; Pindah Alam facilitates learning on the hydrological cycle, hydrostatic pressure, and renewable energy; and KHDTK Rarung supports the study of biodiversity, symbiosis, and biotechnology. Collectively, these destinations function as "nature laboratories" that bridge abstract scientific theory with real-world observation. By synthesizing these findings, the research contributes an ethnoscience-based framework that guides educators in developing innovative, place-based curriculum strategies. Ultimately, this study demonstrates how local ecotourism can be transformed into a pedagogical tool to enhance scientific literacy through direct environmental engagement.

DOI: https://doi.org/10.65622/jbee.v1i3.258

Keywords: Ecotourism, Science Education, Pemepek Village, Nature Laboratory, Contextual Learning.

INTRODUCTION

Contextual science learning requires resources that connect abstract concepts to authentic, real-world phenomena, yet many schools, particularly in rural Indonesia, rely heavily on textbook-based instruction that limits students' firsthand experience (Muliadi & Yuliani, 2025; Muliadi et al., 2025). Ecotourism has emerged as a promising solution to this challenge, integrating environmental education with direct engagement in natural and cultural settings (Subongkod et al., 2025; Joshi et al., 2025). By immersing learners in functioning ecosystems and authentic communities, ecotourism sites provide the experiential context that fosters conceptual understanding, scientific process skills, environmental awareness, and critical thinking (Kurnia & Suryadharma, 2016; Hariani, 2024; Hanaf et al., 2025). Furthermore, ecotourism encourages direct engagement with both the natural landscape and the diverse cultural heritage of local communities, making it highly compatible with ethnoscience-based pedagogical approaches (Zhang et al., 2026; Suryawan et al., 2025).

Ecotourism-based science education is highly effective in improving conceptual understanding, science process skills, environmental awareness, critical thinking, and scientific literacy among school students (Hariani, 2024; Kurnia & Suryadharma, 2016; Hanafi et al., 2025; Paspina et al., 2025). Contextual learning approaches that anchor instruction in real-world settings prevent misconceptions and increase motivation to learn by connecting theory to tangible phenomena (Muliadi & Yuliani, 2025). Despite this growing evidence base, systematic efforts to identify, categorize, and map the science content available within specific local ecotourism destinations for direct curriculum integration remain scarce, particularly in rural Indonesian villages that possess rich

ecological and cultural assets but have limited structured educational resources.

Pemepek Village in Central Lombok Regency exemplifies this opportunity. Since 2016, the village has developed three primary ecotourism destinations, Lembah Datu, Pindah Alam, and the Kelicung area within KHDTK Rarung, through community-based management that adheres to ecotourism principles (Suteja et al., 2019; Nurhilallaily et al., 2025). These destinations feature diverse ecological characteristics, including riparian agriculture, hydrological infrastructure, and protected forest biodiversity. Numerous schools are located near these sites; however, no study to date has systematically analyzed the full spectrum of science learning content embedded across all three destinations or provided a structured framework for integrating them into school curricula. This represents a critical research gap, as the untapped educational potential of these sites risks being overlooked without evidence-based documentation of their pedagogical value.

In doing so, the study goes beyond prior descriptive inventories by synthesizing identified concepts thematically and linking them to specific curriculum topics, thereby providing educators with an actionable, contextually grounded resource for developing innovative, ethnoscience-based learning materials (Suryaningsih, 2018; Syukur et al., 2024). Ultimately, such integration supports not only improved science learning outcomes but also environmental stewardship and the sustainable development of local ecotourism (Tien et al., 2024; Al Idrus et al., 2025). To address this gap, the present study aims to analyze the science learning content available at the three ecotourism destinations in Pemepek Village and propose a framework for integrating these materials into formal science curricula for Elementary (primary school) and Junior High School (lower secondary school) students.

METHODS

Time and Place

This research was conducted in Pemepek Village, Pringgarata District, Central Lombok Regency. The study focused on three primary tourism destinations within Pemepek Village **(Figure 1)**, Lembah Datu **(Figure 2),** Pindah Alam **(Figure 3),** and KHDTK Rarung **(Figure 4).** These three locations were purposively selected because they align with the study's objective to analyze science concepts within an ecotourism framework. Field research was conducted in March 2026. The study location map was created using Google Earth, a valid tool. and a credible tool for Geospatial Data (Liang, Gong & Li, 2018).

Figure 1. Pemepek Village (Google Earth, 2026)

Figure 2 Lembah Datu (8°33'36.49"S 116°16'47.58" E) (Google Earth, 2026)

Figure 3 Pindah Alam (8°34'25.93"S 116°15'59.53" E) (Google Earth, 2026)

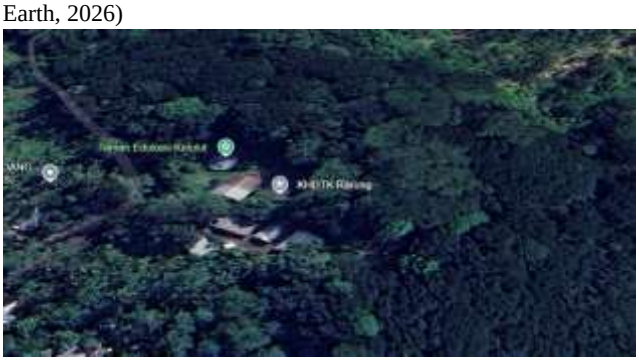

Figure 4 KHDTK Rarung (8°33'33.32"S 116°17'37.61" E) (Google Earth, 2026)

Research Design

This study employed a qualitative descriptive design, appropriate for systematically exploring and documenting the educational potential of specific natural sites without reducing the richness of contextual phenomena to numerical data (Cresswell, 2014; Sugiyono, 2023). In qualitative research, the researcher serves as the primary instrument, integrating direct observation with theoretical analysis to derive meaning from field contexts

(Abdussamad, 2021). This design was chosen because the research objective of identifying and categorizing science concepts embedded in ecotourism destinations requires an interpretive, thematic approach rather than quantitative measurement. Data collection used two complementary techniques: (1) structured field observation, guided by an observation checklist and a science concept identification rubric developed from the primary school/lower secondary school science curriculum, to systematically record the ecological characteristics and educational features of each site; and (2) a systematic literature review to provide theoretical triangulation and curriculum alignment for the identified concepts. This dual-method approach ensures both empirical grounding and theoretical validity of the findings.

Research Sites and Unit of Analysis

In keeping with the qualitative nature of this study, the unit of analysis comprises three ecotourism case study sites within Pemepek Village, rather than a statistical population and sample. Three sites were purposively selected based on the following explicit criteria: (1) being officially recognized and operationally active ecotourism destinations within Pemepek Village; (2) possessing distinct ecological or geographical characteristics that offer diverse science content; and (3) being accessible and manageable within the study period (Jaswadi et al., 2025). The resulting study sites are Lembah Datu (a riparian valley ecosystem), Pindah Alam (a lake-and-dam hydrological site), and KHDTK Rarung/Kelicung (a protected research forest). Within each site, the unit of observation comprised the physical and biological features, environmental processes, human-nature interactions, and any existing educational infrastructure visible during systematic field visits. This purposive approach was chosen to enable a focused, in-depth analysis of science educational content within each distinct natural tourism area (Sugiyono, 2023).

Research Procedure

The research procedure was structured into three sequential stages. During the preparation stage, a systematic literature review was conducted to establish the theoretical and curricular framework and to identify relevant science topics in the primary school/lower secondary school curriculum that could be mapped to ecotourism contexts. The observation stage involved multiple systematic field visits to each of the three destinations to document ecological features, human-nature interactions, educational infrastructure, and observable science phenomena using the structured observation checklist. Photographic documentation and field notes were recorded concurrently to support later analysis. In the analysis and synthesis stage, field data were triangulated with findings from the literature review to verify the scientific accuracy and curriculum relevance of identified concepts. The triangulated data were then organized thematically by site and curriculum topic to produce the final analytical framework.

Data Analysis

Data analysis followed the interactive model of Miles et al. (2014), encompassing four concurrent activities: data collection, data reduction, data display, and conclusion drawing and verification. In the data reduction stage, field observation notes and literature findings were coded thematically using open coding to identify recurring science concepts associated with each site's ecological features. These codes were grouped by science topic (e.g., ecosystems, hydrological processes, biodiversity) and mapped to the relevant primary school/lower secondary school science curriculum indicators. In the data display stage, categorized findings were organized into thematic matrices by site and topic to enable systematic comparison and pattern identification across the three locations. The conclusion drew on these patterns to synthesize an integrated framework for ecotourism-based science learning materials, and verification was achieved through triangulation of field observations with peer-reviewed literature. The specific stages of this analytical process are illustrated in **Figure 5.**

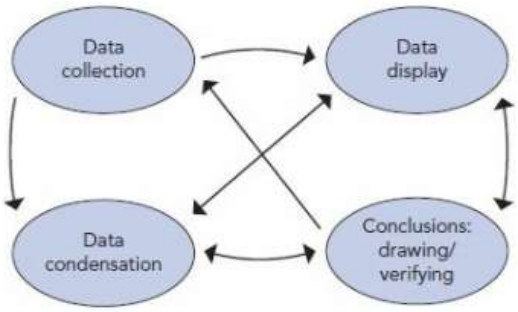

Figure 5 The Miles and Huberman Analysis Model

RESULT AND DISCUSSION

Systematic field observation and thematic analysis across the three ecotourism destinations in Pemepek Village revealed a rich and diverse inventory of science concepts applicable to the Primary School and Lower Secondary School curriculum. Each site demonstrated a distinct ecological and functional character that supports a unique yet complementary set of science learning topics. Taken together, the three destinations address science curriculum themes spanning life sciences, earth sciences, physical sciences, and applied technology, as summarized in the sections below. The three flagship destinations analyzed are Lembah Datu, Pindah Alam, and KHDTK Rarung/Kelicung.

Natural Tourism Destinations in Pemepek Village

Lembah Datu

Lembah Datu is located in Gelogor Hamlet, Pemepek Village, and features a diverse landscape of valleys, dense riparian vegetation, terraced rice fields, and a river flowing through an active traditional agricultural area (**Figure 6**). The site is managed with direct community participation, and conservation activities, including riverbank tree planting and the preservation of traditional farming practices, form a core part of site management.

Field observation identified four primary science concept clusters at this site. The most prominent ecological feature is the functioning ecosystem at the interface of agricultural and riparian zones, where both biotic components (paddy plants, riverbank trees, river macroinvertebrates) and abiotic components (soil, water, sunlight) are directly observable, making it an ideal site for teaching ecosystem concepts and ecological balance. The presence of live aquatic bioindicators, particularly dragonflies and other

aquatic insects, also enables real-world application of biological water quality assessment, linking environmental conservation with life science concepts.

Figure 6. Landscape of the Lembah Datu natural tourism area.

Pindah Alam

Situated in South Cerorong Hamlet, Pindah Alam features a panoramic landscape that integrates lake, river, and mountain views, with the Sedau Dam as its most educationally significant physical feature (**Figure 7**). Field observations at this site identified four key applied science concepts spanning the earth and physical sciences.

Figure 6. The Pindah Alam tourism destination

The Sedau Dam is particularly valuable as a concrete, observable example for teaching hydrostatic pressure: its visible design, thicker at the base and narrower at the top, directly illustrates that water pressure increases with depth, a concept that is abstract and counterintuitive when encountered only in textbooks. The dam also provides a natural entry point for discussing micro-hydro power generation as an example of New and Renewable Energy (NRE), anchoring sustainability themes in local, tangible infrastructure.

KHDTK Rarung

As a Forest Area with Special Purposes (Kawasan Hutan Dengan Tujuan Khusus), KHDTK Rarung serves as both a research forest and a community-managed forest area. The Kelicung tourism destination lies within the KHDTK Rarung zone and attracts visitors with its pristine forest environment. This destination offers a wide array of educational and ecological attractions, including diverse flora and fauna, educational sites for Kelulut and Trigona honey cultivation, deer conservation areas, and extensive biodiversity trekking. Furthermore, an active Women's Farmers Group (Kelompok Wanita Tani) allows tourists to observe and purchase various local community products processed from forest resources, providing a direct link to food biotechnology and applied science. Field observations at KHDTK Rarung identified four distinct clusters of science concepts spanning applied biology, ecology, and biotechnology, making it the site with the broadest life-science curriculum coverage among the three destinations studied.

Figure 7. Kelulut Education Spot in KHDTK Rarung

Identification of Science Content in Pemepek Village Tourism Destinations

The scientific concepts identified through systematic observation at each destination are thematically grouped by site below and mapped to their relevant primary school/lower secondary school science curriculum topics. **Table 1** summarizes the complete curriculum concept mapping across all three sites. The most notable finding from this categorization is that each site addresses a distinct

primary science domain—life sciences and mechanics at Lembah Datu, physical and earth sciences at Pindah Alam, and applied biology and conservation science at KHDTK Rarung—yet all three sites share an overarching emphasis on ecological processes and environmental conservation, reflecting the ecotourism character of Pemepek Village.

Table 1. Mapping of Science Learning Concepts at Ecotourism Destinations in Pemepek Village to the Primary School/Lower Secondary School Curriculum

No.	Desti-nation	Science Concept	School Level	Relevant Curriculum Topic / Basic Competency
1	**Lembah Datu**	Ecosys-tems and Living Interac-tions	Primary School/Lower Secondary School	Biotic and abiotic components; food chains and webs; ecological balance (primary school grade 5–6 / lower secondary school grade 7)
		Environmental Conservation (Riparian)	Primary School/Lower Secondary School	Riparian buffer zones; erosion prevention; hydrological cycle interactions (primary school/grade 6 / lower secondary school grade 7–8)
		Simple Machines in Traditional Agriculture	Primary School/Lower Secondary School	Levers and inclined planes; mechanical advantage; work and force (primary school grade 5 / lower secondary school grade 8)
		Water Pollution and Biological Indicators	Lower Secondary School	Water quality assessment; macroinvertebrates as bioindicators; human impact on water bodies (lower secondary school grade 7–8)
2	**Pindah Alam**	The Hydrological Cycle	Primary School/Lower Secondary School	Evaporation, condensation, precipitation; roles of water bodies and aquatic plants in maintaining water balance (primary school grade 5 / lower secondary school grade 7)
		Hydrostatic Pressure (Sedau Dam)	Lower Secondary School	Pascal's law; pressure and depth relationship; engineering application of dam design (lower secondary school grade 8)
		New and Renewable Energy (NRE)	Lower Secondary School	Micro-hydro power; energy transformation; sustainability and renewable energy sources (lower secondary school grade 9)
		Aquatic Ecology	Primary School/Lower Secondary School	Aquatic food chains; fish populations and fishing as human–ecosystem interaction; reservoir ecology (primary school grade 6 / lower secondary school grade 7)
3	**KHDTK Rarung / Kelicung**	Classification of Living Things	Lower Secondary School	Morphological identification of plants, fauna (deer, snakes), and insects (trigona bees); taxonomy and dichotomous keys (lower secondary school grade 7)
		Symbiosis and Pollination (Kelulut/Trigona)	Primary School/Lower Secondary School	Mutualistic symbiosis; pollination process; roles of insects in plant reproduction (primary school grade 6 / lower secondary school grade 7)
		In-situ and Ex-situ Conservation	Lower Secondary School	Role of protected forest areas (khdtk) in biodiversity preservation; endangered species and conservation strategies (lower secondary school grade 9)
		Food Biotechnology (Honey Products)	Lower Secondary School	Conventional biotechnology, fermentation, and natural food preservation, applied microbiology (lower secondary school grade 9)

As summarized in Table 1, the science content at each destination spans distinct yet complementary curriculum domains. Lembah Datu offers the richest cross-disciplinary coverage, spanning life sciences (ecosystems and biotic-abiotic interactions), environmental science (riparian conservation and water pollution), and physical science (simple machines in traditional agriculture), making it suitable for both primary and lower secondary school levels. The site's agricultural landscape enables students to observe biological water-quality indicators, such as dragonflies and aquatic macroinvertebrates, as proxies for river health, a methodological approach typically introduced only theoretically at the lower secondary school level. Pindah Alam focuses on earth and physical sciences, with the Sedau Dam as its most pedagogically distinctive feature. The dam's structural design directly illustrates the principle that hydrostatic pressure increases with water depth, a concept mapped to the lower secondary school Grade 8 curriculum. The site also supports the study of the hydrological cycle and aquatic ecology, providing vertical curriculum coherence from primary school through lower secondary school. KHDTK Rarung / Kelicung offers the broadest life-science coverage: biodiversity classification of trees, fauna, and insects (lower secondary school Grade 7); mutualistic symbiosis through stingless bee pollination (lower secondary school Grades 7–8); in-situ and ex-situ conservation through the KHDTK management zone (lower secondary school Grade 9); and conventional food biotechnology through the Women's Farmers Group honey-processing activities (lower secondary school Grade 9).

Taken together, the 12 science concepts mapped across the three sites cover six major lower secondary school curriculum themes, confirming the potential of Pemepek Village's ecotourism cluster as a comprehensive "nature laboratory" for science education.

Discussion

The thematic analysis of the three ecotourism destinations in Pemepek Village confirms their substantial potential as contextual science-learning resources while revealing important distinctions in the types and depth of science content each site can offer. Notably, this study extends beyond previous single-site descriptive inventories by providing a comparative analysis across three ecologically distinct sites, enabling a richer mapping of curriculum coverage. Lembah Datu's primary educational strengths lie in life sciences and environmental processes, specifically ecosystem dynamics, riparian conservation, and the biomechanics of traditional agriculture, which align directly with primary school and lower secondary school curriculum topics on ecosystems and simple machines. This finding corroborates Syukur et al. (2024), who demonstrated that natural environments, such as mangrove areas, serve as invaluable resources for science learning. However, unlike mangrove-focused studies that primarily address biological science, Lembah Datu offers the additional advantage of integrating physical science concepts (e.g., simple machines) within an agricultural and cultural context, reflecting the ethnoscience dimension often absent from urban or coastal ecotourism studies. Pindah Alam, by contrast, centers on physical and earth sciences, with the Sedau Dam serving as an especially powerful pedagogical artifact. The dam structure allows for direct, observable application of hydrostatic pressure principles, a concept students typically encounter only in abstract textbook form. Hariani (2024) found that ecotourism-based learning materials consistently improve students' conceptual understanding of abstract science topics; the Sedau Dam exemplifies this affordance, distinguishing Pindah Alam from other ecotourism sites that are predominantly life-science-oriented. Furthermore, the dam's connection to renewable energy (micro-hydro) addresses the emerging curriculum theme of sustainability science in a concrete, locally relevant way, a capacity not identified in prior ecotourism learning studies from this region.

KHDTK Rarung emerges as the most biodiverse site and is uniquely positioned to support applied biology and conservation education. Its combination of classified flora and fauna, stingless bee cultivation, deer conservation, and Women's Farmers Group activities allows educators to address the classification of living things, mutualistic symbiosis, biotechnology, and both in-situ and ex-situ conservation within a single field visit. This integrated scope aligns with Martin et al. (2025), who found that ethnopedagogy-based e-modules incorporating ecotourism elements significantly enhanced students' independent learning and critical thinking. However, unlike module-based interventions, the present study's approach foregrounds the site itself as the primary learning medium, suggesting that even without formally developed materials, KHDTK Rarung's inherent complexity provides sufficient content richness for multi-topic inquiry learning. A key pattern emerging from the cross-site synthesis is that all three destinations function as complementary "nature laboratories" that, taken together, provide nearly comprehensive coverage of the primary school/lower secondary school science curriculum. This complementarity means that ecotourism-based learning in Pemepek Village need not be confined to a single visit or topic; rather, educators can design a progressive, multi-visit curriculum framework in which different sites build on each other's content. This finding adds a novel structural dimension to the field, as prior studies, including those by Kurnia and Suryadharma (2016) and Hanafi et al. (2025), have generally focused on the educational value of individual sites or single curriculum topics without examining cross-site curricular complementarity.

From an outcomes perspective, integrating these sites into science education is expected to enhance multiple dimensions of student learning simultaneously. Direct engagement with functioning ecosystems and community-managed resources supports the development of scientific literacy (Paspina et al., 2025; Imaduddin et al., 2025), environmental awareness and stewardship (Suryaningsih, 2018; Al Idrus et al., 2019), and problem-solving skills through real-world application (Funa, 2026). Furthermore, outdoor learning environments have consistently been shown to increase student engagement and motivation beyond what classroom settings can achieve (McKenna, 2025; Chau & Arruzza, 2026). Importantly, this study also reveals a reciprocal benefit: integrating local schools into ecotourism education can support the sustainable development of tourism itself by cultivating future generations of environmentally conscious community members and visitors (Tien et al., 2024; Hassan et al., 2026). This positions science education not merely as a beneficiary of ecotourism resources but as an active contributor to ecotourism sustainability, a relationship that merits further policy-level attention. The primary limitation of this study is that its scope is analytical and inventorial rather than experimental; the effectiveness of specific integration strategies in producing measurable student learning gains remains to be tested through quasi-experimental or action research designs. Future research should therefore focus on developing, implementing, and evaluating curriculum materials derived from this framework, with particular attention to differentiated applications across grade levels and the use of digital tools to extend site-based learning beyond the field visit itself.

CONCLUSION

This study demonstrates that the three ecotourism destinations in Pemepek Village (Lembah Datu, Pindah Alam, and KHDTK Rarung/Kelicung) collectively constitute a comprehensive, multidisciplinary contextual science-learning resource for primary and lower-secondary school students. Each site offers a distinct yet complementary set of science concepts: Lembah Datu supports learning in ecosystems, riparian conservation, and simple machines within an agricultural context; Pindah Alam enables applied study of the hydrological cycle,

hydrostatic pressure, and renewable energy through the Sedau Dam; and KHDTK Rarung provides rich content on biodiversity classification, mutualistic symbiosis, conservation strategies, and food biotechnology through its stingless bee cultivation and community activities. Taken together, these sites function as interconnected "nature laboratories" that can transform abstract science curriculum content into tangible, experiential learning opportunities. This study's primary contribution is the cross-site, curriculum-mapped analytical framework it provides, which goes beyond single-site descriptions to reveal the complementary educational potential of a local ecotourism cluster. This framework offers science educators and curriculum developers a practical, evidence-based foundation for designing ethnoscience-based, place-based learning materials and field study programs. Future research should focus on developing, implementing, and empirically evaluating specific curriculum materials derived from this framework, as well as exploring digital extensions that allow site-based learning to continue in the classroom.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the managers of the tourism destinations in Pemepek Village for their invaluable support throughout this study. We also extend our appreciation to the research team members for their dedicated collaboration. We hope that the findings of this research contribute significantly to the future development of science education.

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