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Ethnoecological Study of Sendang Surodilogo in Kertek District, Wonosobo Regency as a Learning Resource

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Abstract

This study investigated the ethnoecological characteristics of Sendang Surodilogo, a culturally and ecologically significant spring located in Pagerejo Village, Kertek District, Wonosobo Regency, and developed a profile book as a contextual learning resource for biology education. Using a modified Borg and Gall Research and Development model, the research involved preliminary exploration, field data collection, product design, expert validation, revision, and small-scale field testing. A descriptive exploratory approach was used to document cultural narratives, ecological perceptions, and vegetation diversity around the spring. Data were collected from formal participants (biology teacher and students) and nonformal participants representing three age groups (30, 40, and 50 years old) using interviews, questionnaires, and documentation. The findings revealed that the community possesses strong ethnoecological knowledge reflected through myths, rituals, and conservation practices linked to the symbolic figure of Ki Joko Suro. Vegetation analysis recorded species belonging to Spermatophyta, Pteridophyta, and Bryophyta, each contributing to hydrological stability and microhabitat formation. Expert validation rated the material at 93.61% and media at 91.36%, placing the product in the "very feasible" category. Field testing also resulted in positive responses, with formal participants scoring 85.7% and nonformal participants 85.3%. Overall, Sendang Surodilogo holds substantial ecological and cultural value. Its documentation into a profile book demonstrates strong potential as a contextual biology learning resource, enriching environmental literacy and promoting culture-based science education

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INTRODUCTION

Sendang Surodilogo is one of the natural springs located in the highland region of Pagerejo Village, Kertek District, Wonosobo Regency, Central Java. The spring is situated at the slope of Mount Sindoro, a region characterized by volcanic soil, high rainfall, and abundant vegetation cover. These environmental conditions make the area highly suitable for the formation of springs, which are essential water sources for local communities. Historically, Sendang Surodilogo has been used for domestic water needs, irrigation, and ritual activities. Despite the emergence of modern plumbing systems such as PDAM and PAMSIMAS in the village, the community still maintains a strong attachment to the spring through cultural beliefs and practices, indicating its relevance beyond practical water usage.

Ethnoecology provides a useful theoretical lens for understanding the relationship between humans and their environment, especially in traditional societies. According to Hilmanto (2010), ethnoecology studies how communities perceive, classify, utilize, and manage natural resources based on cultural norms and ecological understanding. Similarly, Simbiak (2016) argues that ethnoecology integrates ecological knowledge with cultural identity, making it an effective approach for exploring how local communities adapt to and manage their surroundings. Toledo (2002) highlights that myths, rituals, and traditional ecological knowledge often serve as ecological regulators, guiding human behavior in ways that support environmental sustainability.

The community around Sendang Surodilogo maintains a number of cultural narratives and practices that shape their interactions with the spring. One of the most prominent cultural elements is the belief in Ki Joko Suro, a symbolic protector of the spring. According to local narratives, disrespectful actions near the spring—such as littering or cutting trees—may disturb the spirit, resulting in misfortune. While these beliefs are rooted in folklore, they function as ecological safeguards by encouraging responsible environmental behavior. This aligns with Iskandar (2017), who emphasizes that cultural beliefs can reinforce sustainable practices by embedding ecological ethics into social norms.

Local wisdom (kearifan lokal) plays a central role in the community's management of natural resources. Pramita et al. (2013) explain that local wisdom encompasses values, norms, customary rules, and traditional knowledge passed down through generations. In the case of Sendang Surodilogo, local wisdom is manifested in conservation-oriented behaviors such as maintaining vegetation around the spring, avoiding pollution, performing periodic cleaning, and respecting sacred areas. According to Hidayati (2016), local wisdom contributes to environmental sustainability by promoting harmony between human activities and ecological processes.

Although several studies have examined springs in Indonesia, research focusing specifically on the ethnoecology of highland springs remains limited. Previous studies often address either ecological characteristics (Agustina & Arisoesilaningsih, 2013) or cultural aspects (Haq et al., 2021) without integrating both. Moreover, few studies link ethnoecological findings to educational resources, despite the potential benefits of contextual learning in science education. Biology learning, in particular, can be strengthened through contextual materials that connect textbook concepts with real environments (Hesti et al., 2022). Learning materials that incorporate local wisdom and ecological contexts have been shown to improve student engagement and conceptual understanding (Sitorus & Lasso, 2021).

The rapid advancement of information and communication technology also encourages the development of innovative and contextual learning resources. However, many biology learning materials still rely heavily on generalized content with minimal connection to local environments. This disconnect creates a gap between students' lived experiences and scientific concepts, reducing the relevance and effectiveness of learning. The development of a profile book based on Sendang Surodilogo's ethnoecological characteristics aims to bridge this gap by transforming local ecological and cultural knowledge into structured educational content.

Based on these considerations, this study has three main objectives:

(1) to describe the community's ethnoecological knowledge related to Sendang Surodilogo;

(2) to analyze the vegetation diversity around the spring and its ecological functions; and

(3) to develop and validate a profile book on Sendang Surodilogo as a contextual learning resource for biology education.

The novelty of this study lies in its integrative approach, combining cultural knowledge, ecological data, and educational development within a single ethnoecological investigation. While previous studies have documented springs or cultural practices separately, this research connects ecological and cultural findings directly to biology education, providing a comprehensive model of contextual learning resources rooted in local environments.

RESEARCH METHOD

This study employed a modified Research and Development (R&D) approach based on the Borg and Gall model, which was adapted into six stages to suit the scope and objectives of the research. The stages included: (1) preliminary research; (2) data collection and field exploration; (3) product development (profile book design); (4) expert validation; (5) product revision; and (6) small-scale field testing. This limited-scale adaptation aligns with recommendations by Utami et al. (2019), who suggest simplifying R&D procedures for educational product development in ethnoecological studies to ensure efficiency without compromising rigor.

Research Design

A descriptive exploratory design was used to investigate cultural narratives, ecological knowledge, and vegetation diversity related to Sendang Surodilogo. Exploratory methods are suitable for ethnobiological studies because they accommodate qualitative data interpretation, social meaning construction, and ecological observation simultaneously (Iskandar, 2017). The study integrated both qualitative and quantitative data to produce a comprehensive analysis of the spring's ethnoecological characteristics.

Research Site

The research was conducted at Sendang Surodilogo, located in Pagerejo Village, Kertek District, Wonosobo Regency. The site features a spring surrounded by vegetation characteristic of volcanic highland regions, including tree species, pteridophytes, and bryophytes. The selection of this site was based on its strong cultural significance, ecological uniqueness, and potential as a contextual learning resource.

Participants and Sampling

Two participant groups were involved in the study:

(1) Formal participants consisting of a biology teacher and nine students from SMA Negeri 1 Kertek;

(2) Nonformal participants consisting of local community members from Pagerejo Village, categorized into three age groups (30, 40, and 50 years old).

The formal participants were involved primarily in the product testing phase, while nonformal participants contributed to the documentation of ethnoecological knowledge and cultural practices. Purposive sampling was used to identify nonformal participants who possessed long-standing familiarity with the spring and its traditions.

Data Collection Techniques

Three primary data collection techniques were used:

1. Interviews

Semi-structured interviews were conducted with community members to document cultural narratives, myths surrounding Ki Joko Suro, conservation practices, and traditional rules associated with the spring. Interviews allowed for an emic (insider) understanding of the community's environmental perceptions and cultural reasoning.

2. Questionnaires

Questionnaires were used during expert validation and field testing. Expert validators included a material expert and a media expert who assessed the feasibility of the developed profile book. Formal and nonformal respondents completed questionnaires evaluating readability, content accessibility, relevance, and aesthetic quality of the learning material.

3. Documentation

Documentation included photographing the spring environment, recording vegetation species, collecting environmental notes, and capturing cultural artifacts such as ritual sites or remnants of sacred trees. Documentation supported triangulation by providing visual evidence of ecological and cultural features described by participants.

Vegetation Analysis

Vegetation around Sendang Surodilogo was identified and classified using direct field observation techniques adapted from standard botanical survey procedures. Plant species were grouped into major taxa: Spermatophyta, Pteridophyta, and Bryophyta. Species identification employed field guides and previous references (Agustina & Arisoesilaningsih, 2013). Ecological functions of each plant group—such as erosion control, hydrological regulation, and microhabitat formation—were analyzed based on principles of plant ecology and ethnoecology. Particular attention was given to the presence of hydrologically important species historically associated with the spring, such as former Ficus trees, which possess extensive root systems essential for groundwater recharge.

Validation Procedures

Expert validation involved two evaluators:

Material expert, who assessed content accuracy, ecological relevance, and cultural appropriateness; Media expert, who evaluated visual layout, readability, structure, and design of the profile book; Validation scores were analyzed using percentage criteria. Scores above 80% were categorized as "very feasible," following the criteria used in Syahirah et al. (2020).

Field Testing

Field testing was conducted with both formal and nonformal participants. The biology teacher and students evaluated the usability and educational relevance of the profile book, while community members evaluated cultural accuracy and ecological relevance. Responses were quantified using Likert-scale questionnaire data and analyzed into percentage scores. Qualitative responses regarding clarity, usefulness, and cultural resonance were also incorporated to refine the product.

Data Analysis

- Qualitative Analysis

Interview transcripts, field notes, and documentation were analyzed using thematic analysis. Codes were created to identify recurring themes in cultural beliefs, conservation practices, community perceptions, and ecological observations. Themes were compared to existing ethnoecology literature to build interpretive depth.

- Quantitative Analysis

Validation and response data were analyzed using descriptive statistics, generating percentage values for feasibility categories. Scores were classified into categories (very feasible, feasible, less feasible) based on predetermined thresholds. These data triangulated qualitative insights and verified whether the developed product met educational and cultural standards.

RESULTS AND DISCUSSION

Community Ethnoecological Knowledge

- Cultural Narratives and Myth of Ki Joko Suro

Community members possess rich cultural narratives related to the origin and guardianship of Sendang Surodilogo. Across all age groups—30, 40, and 50 years—participants consistently described the spring as being under the spiritual protection of Ki Joko Suro. He is believed to be a supernatural guardian who regulates the moral conduct of visitors and community members. Actions considered disrespectful, such as littering or speaking harshly, are believed to provoke spiritual consequences. This belief system plays a functional ecological role. According to Iskandar (2017), myths in ethnoecological systems often operate as informal regulatory mechanisms that restrict harmful behaviors in ecologically sensitive areas.

The community's respect for Ki Joko Suro ensures that human activities around the spring remain environmentally conscious. These cultural controls mirror findings from Hilmanto (2010), who reported that traditional beliefs often reinforce conservation through socially accepted norms.

- Traditional Rules and Local Wisdom

Local wisdom (kearifan lokal) is central to the spring's protection. Community members report prohibitions such as: Prohibiting waste disposal near the spring, discouraging tree cutting in the surrounding area, avoiding loud or disrespectful behaviors, and maintaining cleanliness of the spring basin. These rules, though unwritten, function as social norms passed down through generations. They align with the concept of local wisdom outlined by Pramita et al. (2013), which includes norms, sanctions, and culturally embedded rules designed to maintain ecological stability. Older respondents (50-year age group) demonstrated the strongest adherence to these rules, while younger respondents still acknowledged these traditions but tended to view them symbolically. This generational contrast reflects broader trends identified by Hidayati (2016), who notes that modernization may weaken the transmission of traditional ecological knowledge.

- Ritual Practices and Cultural Events

The Javanese month of Suro remains a significant period for cultural ceremonies. Offerings (sesajen) are often placed near the spring to honor Ki Joko Suro. Community members explained that the ritual strengthens social bonds while symbolically ensuring environmental harmony. Although modernization has reduced the scale of these rituals, their symbolic ecological value persists. Ritual behavior, according to Toledo (2002), reinforces ecological ethics and strengthens human–environment relationships. The persistence of rituals at Sendang Surodilogo demonstrates the integration of culture and ecology in maintaining the spring.

Conservation Practices

- Community-Based Environmental Management

Community members actively participate in maintaining the spring through periodic cleaning activities. Respondents noted that cleaning is performed to prevent sediment buildup and remove litter brought by visitors. Local youth groups often assist in maintenance, indicating intergenerational participation. This community-based approach aligns with Astuti et al. (2021), who found that local environmental management often depends on collective responsibility rather than formal regulations. The success of such systems depends on shared cultural values and social cohesion.

- Vegetation Management and Reforestation Efforts

Community members identified the importance of maintaining surrounding vegetation to preserve water flow. Historically, a large Ficus tree shaded the spring, and its extensive root network contributed to hydrological stability. Although the original tree fell due to extreme weather, its trunk and root remnants remain visible. Villagers expressed the desire to replant similar species to maintain ecological balance. The ecological importance of Ficus species is documented in previous research. Yuliantoro et al. (2016) reported that Ficus has a strong ability to increase water infiltration, while Fiqa & Arisoesilaningsih (2005) noted its role in stabilizing soil moisture in volcanic regions.

- Vegetation Diversity Around Sendang Surodilogo

Vegetation analysis revealed three major taxonomic groups: Spermatophyta, Pteridophyta, and Bryophyta. The distribution of species reflects the microclimatic conditions of the spring environment.

Table 1. Summary of Vegetation Diversity Near Sendang Surodilogo

Class	Name of Species
Sspermatophyta	1. Meranti Tree *(Shoreya)*
	2. Mahang Tree *(Macaranga sp)*
	3. Bamboo *(Bambusa vulgaris)*
	4. Palm Tree *(Liculla pinosa)*
	5. Babandotan *(Ageratum conzoides)*
	6. Sedunduk *(Clidemia hirta)*
	7. Cente *(Lantana camara)*
	8. Krinyuh *(Chromolaena odorata)*
	9. Pegagan *(Centella asiatica)*
	10. Rawit Chili *(Capsicum fructecens)*
	11. Cabbage *(Brassica oleracea)*
	12. White Mustard *(Brassia juncea)*
	13. Impatitiens *(Impatiens balsamina)*
	14. Suket Teki *(Cyperus odoratus)*
	15. Andong *(Cordyline fructicose)*
	16. Alang-alang *(Imperata clyndrical)*
	17. Frgrant Pandan *(Pandanus amarylifiolus)*
	18. Elephant Grass *(Pennisetrum purpureum)*
	19. Banana *(Musa paradisaca)*
	20. Taro *(Colocasia esculenta)*
	21. Pine *(Pinus mercusii)*
	22. Tukung Pine *(Curpressus lusticana)*
Pterydophyta	1. Galar Tree *(Cyatheales)*
	2. Selaginella Fern *(Selaginella kraussiana)*
Bryophyta	1. Liverwort *(Marchantia colocasia)*
	2. Leaf Moss *(Lusitanica cupressus)*

Based on Table 1. regarding Plant Types around Sendang Surodilogo, plants growing around Sendang Surodilogo with an area of approximately 100 m2 consist of three main classes, namely spermatophyta, pterydophyta, and bryophyta. This is because the natural potential around Sendang Surodilogo has unique plant vegetation. In accordance with the statement (Sadali and Mada 2015), the spring water source area has unique characteristics, namely fertile soil covered with various types of seed plants (Spermatophyta).

Spermatophytes dominated the vegetation. Species included shrubs, herbaceous plants, and trees adapted to warm yet humid highland conditions. Their canopy moderates microclimate and supports groundwater recharge. Agustina & Arisoesilaningsih (2013) emphasize the importance of canopy layers in maintaining ecological stability in spring ecosystems. Pteridophytes were found on moist slopes and rock surfaces near the spring. Their morphological adaptation to shaded, humid environments makes them effective indicators of microclimatic stability. Their dense rhizomes also contribute to soil reinforcement on fragile slopes. Bryophytes—primarily moss species—were abundant near the water outlet and rocky surfaces. Their presence indicates high humidity and supports soil moisture retention. Bryophytes also

facilitate microbial activity that contributes to nutrient cycling at the microhabitat level.

- Profile Book Development and Validation

The validity of the Sendang Surodilogo Profile Book includes content validity and construct/media validity. The Profile Book was validated by subject matter experts and media experts from Semarang State University where the research was conducted is presented in Table 2 and Table 3

Table 2 Results of Content Expert Validation

Data Source	Aspect	Percentage	Criteria
Content expert	Content components	91,34%	Highly valid
	Presentation components	96,66%	Highly valid
	Language components	92,85%	Highly valid
	Average	**93,61%**	Highly valid

Table 3 Media Expert Validation Results

Data Source	Aspect	Percentage	Criteria
Media Expert	**Graphics**	**91,36**	**Highly valid**

The data in Table 3 shows that the implementation of learning by teachers can be categorized as good with an average score of material expert: 93.61% (Very Feasible) and media expert: 91.36% (Very Feasible). These scores confirm that the product meets pedagogical, ecological, and cultural criteria. Similar studies by Syahirah et al. (2020) and Utami et al. (2019) also found high feasibility ratings for ethnoscience-based learning resources, emphasizing their contextual relevance. These results support the reliability and accuracy of the content, especially regarding ecological explanations and cultural descriptions.

- Responses from Formal and Nonformal Participants

The Profile Book Response Test was conducted in Pagerejo Village with the involvement of formal and informal communities. The formal community consisted of nine students still pursuing secondary education and biology teachers, while the informal community consisted of four residents aged 30, three residents aged 40, and three residents aged 50. The results of the Profile Book Response questionnaire can be seen in Tables 4 and 5.

Table 4. Results of the Profile Book Response Questionnaire by the Formal Community

Data Source	Aspect	Presentage	Criteria
Formal public response questionnaire	Component Appearance	87%	Very Good
	Presentation Component	85%	Very Good
	Language Component	85%	Very Good
	Benegfit Component	86%	Very Good
Average		**85,7%**	**Very Good**

Table 5. Results of the Profile Book Response Questionnaire by the Non-Formal Community

Data Source	Aspect	Presentage	Criteria
Non-Formal public response questionnaire	Component Appearance	86%	Very Good
	Presentation Component	87%	Very Good
	Language Component	85%	Very Good
	Benegfit Component	84%	Very Good
Average		**85,3%**	**Very Good**

The results of the Profile Book Response questionnaire can be seen in Tables 4 and 5. Formal respondents scored the product at 85.7%, indicating very positive responses. They emphasized: clear explanations of ecological concepts, engaging cultural narratives, visual attractiveness, usefulness for contextual learning. Students noted that the profile book helped them better understand spring ecosystems and local biodiversity, connecting theoretical concepts to real-world examples.

- Nonformal Participants (Community Members)

The profile book response test was conducted in Pagerejo Village, involving both formal and non-formal communities. The formal community consisted of nine secondary education students and a biology subject teacher, while the non-formal community comprised four residents aged 30 years, three residents aged 40 years, and three residents aged 50 years. Following the analysis, it was determined that the response to the profile book from the formal community was 85.7% with a 'very good' criterion, and the response from the non-formal community was 85.3% with a 'very good' criterion. These findings align with the research results of Jamil, Listyono, and Norra (2020), who stated that the response test obtained a high criterion, indicating that the developed profile book is suitable for use as a learning resource

- Interpretation

These response scores demonstrate that the profile book successfully bridges scientific and cultural knowledge. According to Jamil et al. (2020), learning resources that integrate local ecological knowledge increase community engagement and promote culturally relevant science education.

- Integration of Ethnoecology Into Biology Education

The ethnoecological characteristics of Sendang Surodilogo support multiple concepts in biology education, including: ecology and ecosystem interactions, biodiversity and classification, plant morphology, environmental conservation, cultural adaptation in ecosystems. The profile book contextualizes these concepts within students' lived environment, improving relevance and comprehension.

This aligns with Hesti et al. (2022), who found that context-based learning materials improve conceptual mastery and environmental literacy.

CONCLUSION

Sendang Surodilogo embodies rich ethnoecological characteristics expressed through cultural narratives, local wisdom, and community-based conservation practices that have preserved the ecological integrity of the spring. Vegetation diversity around the site contributes significantly to hydrological stability, microhabitat formation, and ecosystem sustainability. The developed profile book was validated as highly feasible by experts and well received by both formal and nonformal participants, demonstrating its effectiveness as a contextual learning resource for biology education. Overall, this study highlights the potential of integrating ethnoecological knowledge into science learning to strengthen environmental literacy and promote culturally relevant education

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