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Ethnobiology of wonosobo batik: Biology education reference book based on local wisdom

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ARTICLE INFO	ABSTRACT
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Keywords: Batik Motifs Biodiversity Ethnoscience Local Knowledge	Wonosobo batik motif interprets the rich nature, the geographical conditions, and the existing culture through distinctive motifs and utilizes several plant parts as its natural dyes. Utilizing the potential of flora and fauna in batik is not yet widely known by the public due to limited information. This study aims to determine the ethnobiological profile of Wonosobo Batik and to determine the feasibility of a reference book entitled Ethnobiology of Wonosobo Batik from a material and media perspective. The research methods use a qualitative approach (field study) followed by research and development (R&D) using the 4-D model developed by Thiagarajan, which was later limited to 3-D (Define, Design, Develop). Based on exploration result, 22 species of flora and fauna were identified as being used in Wonosobo Batik. These flora and fauna are classified in 16 order groups for flora and 3 orders for fauna. The order groups in flora are <i>Brassicales</i> , <i>Apiales</i> , <i>Agaricales</i> , <i>Arecales</i> , <i>Solanales</i> , <i>Fabales</i> , <i>Myrtales</i> , <i>Sapindales</i> , <i>Poales</i> , <i>Malpighiales</i> , <i>Gentiales</i> , <i>Ericales</i> , and the order groups in fauna are <i>Psittiformes</i> , <i>Anseriformes</i> , and <i>Galliformes</i> . Each order group has its own philosophical significance and benefits. The developed reference book was categorized as excellent, with a score 85.4% for material validity and 95% for media validity.

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INTRODUCTION

Indonesia is a country located in the tropics, between the Pacific and Indian Oceans, and between the Asian and Australian continents. Those conditions make Indonesia part of the “Megadiversity” category, a country with rich biological diversity compared to other countries (Iskandar, 2017). The wealth of natural biological resources is essential for communities as a source of textiles, construction materials, food, medicinal purposes, spices, equipment, traditional needs, fuel, and other necessities (Purwanto, 2020). On the other hand, local knowledge of natural resources also serves as a source of knowledge and technology that benefits their social, economic, and cultural well-being. Culture originates from the habits of society, as social beings who interact with one another to create their own culture, which is then preserved from generation to generation (Mahdayeni et al., 2019).

Indonesian culture that has become part of the national identity is batik. Batik is a dyeing technique that uses a candle as a protective medium, allowing the color to be absorbed as desired (Hardi et al., 2022). The evolution of times has caused batik, once worn only by people in royal circles, to become a necessity for the public. Most regions have also developed regional batik suited to their environments, leading to these motifs being named after their regions of origin (Trixie, 2020).

One region that has successfully developed regional batik is Wonosobo Regency. Wonosobo Batik motifs are divided into two types: geometric and non-geometric (Alamsyah, 2019). The selection of Wonosobo as a locus for ethnobiological research was based on supporting ecological and socio-cultural considerations. Ecologically, Wonosobo is situated between several large mountains, such as Mount Sindoro and Mount Sumbing, resulting in high biodiversity and a varied ecosystem. Socio-culturally, the Wonosobo community still holds on to traditions strongly and preserves them from generation to generation. Local knowledge about the use of plants for food, economic purposes, medicine, and cultural rituals is still widely practiced by the community.

One method to delve deeper into community interactions and explore the potential and role of natural resources within the community is an ethnobiological study. This study can integrate local knowledge with scientific knowledge. Ethnobiology scientifically studies biology, including animals (zoology), plants (botany), and the environment or ecology (Iskandar, 2017). Ethnobiology can serve as a conservation tool because of the knowledge that comes from interaction between communities and their environment, as well as their ethical understanding of natural resources (Himmia et al., 2014). Ethnobiological data, including identification data, characteristics, potential information, innovations, species mapping, and ecological status mapping, can serve as a reference for sustainable biodiversity management. (Purwanto, 2020).

Meanwhile, observations and interviews revealed that public knowledge of the ethnobiology of Wonosobo batik is not well documented. Previous research by Alamsyah (2019) has been limited to the development of Wonosobo batik motifs and has not yet examined ethnobiology in depth, including the identification of flora and fauna in batik, philosophical and ecological meanings, and natural coloring in Wonosobo batik. This becomes proof of a gap between the existing wealth of potential and the still-limited scientific documentation. There is concern that this gap in public knowledge could undermine local wisdom and reduce public awareness of the importance of environmental conservation; for these reasons, this study is crucial. Based on this, the study focuses on the following research questions: (1) What is the ethnobiological profile of Wonosobo batik? (2) How valid is the developed media?

The novelty of this research lies in the development of a reference book. The reference book titled “Ethnobiology of Wonosobo Batik” is essential as a primary resource that provides comprehensive information. Building on previous research focused on the evolution of batik motifs, this reference book supplements existing information with extensive documentation. The reference book can serve as a resource for the public to understand the potential of local resources. The developed reference book also serves as a structured, scientific medium for archiving the ethnobiological knowledge of Wonosobo Batik. All biological studies on flora, fauna, and the environment related to Wonosobo Batik are analyzed and presented in a reference book. Hopefully, the reference book will provide the community with knowledge of the potential natural resources in their area and encourage them to continue preserving batik as a cultural heritage.

The reference book developed has the potential to serve as a supplement to the school curriculum. Referring to the development study conducted by Sukadari et al. (2023). Adding local context from surrounding resources can help students align scientific learning with local contexts, making the material easier to understand. The use of educational media integrated with local wisdom is a strategy

for preserving cultural values (Lestari et al., 2021).

METHODS

Research Design

This study employs a qualitative approach (field study) followed by research and development (R&D). The field study, conducted as the initial phase of the research, uses a descriptive exploratory approach. The descriptive approach is used to analyze, describe, and present data systematically so that it can be understood, and conclusions can be drawn, whereas the exploratory approach is used to discover or explore a variable and its conditions as they are so that they can be used to describe a phenomenon (Akbar et al., 2018). In qualitative research, the researcher serves as the primary instrument, responsible for observing, reviewing documents, and collecting data through interviews and documents (Creswell & Poth, 2013).

To ensure the trustworthiness of qualitative data, several strategies were employed: (1) Triangulation of sources: Data were collected from seven informants with different backgrounds (local community, batik entrepreneurs, craftsmen, and cultural office). (2) Triangulation of methods: observation, in-depth interviews, and documentation were used; (3) Member checking interview transcripts and identified species were rechecked by three informants to confirm accuracy. (4) Peer debriefing: the findings were discussed with two biology education lecturers who were not involved in the data collection; (5) Audit trail: all raw data (interview notes, photos, observation sheets) were archived and made available for external review.

The data obtained through descriptive exploratory methods were further developed into a reference book. The development of this reference book was carried out using the 4-D research and development model (Thiagarajan et al., 1974) but was limited to the 3-D (Define, Design, Develop) phase due to time constraints. which was limited to 3-D (Define, Design, Develop) due to time constraints. The R&D (Research and Development) method is a scientific methodology that encompasses the stages of investigation, design, production, and validity testing of the developed product (Sugiyono, 2021)

Descriptive exploratory research data were used from the beginning of ethnobiological data collection. The ethnobiological data obtained were then used as substantive raw material and integrated at each stage of development (Define, Design, Develop). In the define stage, exploratory data is analysed to identify knowledge gaps or local potential that has not been systematically documented. This stage also formulates development objectives based on the exploratory findings. Data from interview, observations, and documentation are classified to determine the topics discussed in the Reference Book. The classified data serves as the basis for compiling the book outline in the design stage. Late in the development stage, exploratory data is systematically compiled. Documentation is also integrated as illustrations to strengthen the reader's understanding. The compiled reference book is then validated by experts to assess and evaluate material and media aspects. The validity test was conducted by an expert in the relevant field.

Population and Samples

The study population was the Wonosobo community. This study used purposive sampling. The purposive sampling technique is selecting research subjects based on specific, predetermined criteria and objectives. Purposive sampling is a sampling technique based on specific criteria that aims to acquire data highly relevant to the research focus (Arikunto, 2010). The sample in this study consists of 7 informants, who are presented in Table 1.

Table 1

List of Respondents.

Respondent Code	Gender	Occupation
A	Female	Local Communities
LN	Female	Batik Business Owner
S	Female	Batik Business Owner
LH	Female	Batik Business Owner
BF	Female	Batik craftsmen
W	Male	Batik craftsmen
AD	Male	Cultural Heritage Expert Team at the Wonosobo Regency Tourism Office

This diverse sampling of backgrounds significantly supports the acquisition of comprehensive information needed to explore ethnobiological data. Batik entrepreneurs represent aspects of production, economic value, and motif knowledge from the entrepreneur's perspective. In contrast, batik craftsmen represent manufacturing techniques and symbolic meaning, while figures from the Tourism and Culture Office represent policy, development history, and in-depth information on Wonosobo batik. Data collected from multiple stakeholders complements the required information, ranging from practitioners and business actors to regulators. Data saturation was reached through the seven informants due to repeated information. Data saturation can be characterized by a lack of new insights or information from informants (Creswell, 2015).

Instrument

The instruments used in this study were an observation sheet, an interview guide, and a validation sheet. The observation sheet contained indicators to be observed in Wonosobo Batik. The interview guide outlined the questions to be asked of the informants. The development of the reference book also employed a validation sheet, which served as a tool to assess several criteria for considering product quality. The observation sheet is presented in Table 2, and the interview guide is presented in a grid format in Table 3.

Table 2

Observation Sheet Grid

Objects being observed	Indicators
The process of making batik	Tools used
	Material used
	Functions
Wonosobo Batik Motifs	Name of motifs
	Image of motifs
	Type of dyes
	Identified species
	Philosophies of batik

Table 3

Interview Guidelines.

Speakers	Indicators
Local Community	Knowledge about Wonosobo Batik
	The habits of wearing batik
	Wonosobo Batik motifs and philosophies
Batik Entrepreneurs	Histories of the establishment batik business
	Types of batik produced
	The motifs created
	Dyes used in batik
Batik craftsmen	Tools and materials used
	Batik techniques
	Colouring in batik
Wonosobo Regency Tourism and Culture Office	Histories of Wonosobo Batik
	Types of Wonosobo Batik
	Wonosobo Batik motifs
	Characteristics of Wonosobo Batik
	Utilizations of flora and fauna

Procedure

The research was conducted through observation, interviews, and documentation, followed by research and development (R&D). Observation is the direct examination of an object's actual condition, including observing, recording, and deeply understanding the research object (Romdona et al., 2025). Interviews were conducted with various sources considered representative to gather ethnobiological information. Documentation was carried out to strengthen the research data; in this case, it took the form of photographs of batik and the manufacturing process, as well as documentation from interviews

with sources. These documents were crucial for recording information and processing data. The collected data and documentation were then subjected to in-depth analysis and literature review to confirm the data. The analysis data were developed into a reference book. The compiled reference book was then subjected to material and media validity tests.

Data Analysis Techniques

The data analysis technique used in qualitative research is thematic analysis. Thematic analysis is a technique for analyzing data by identifying patterns that emerge from the data collected by the researchers (Braun & Clarke, 2006). Thematic analysis is conducted in 6 stages. In stage (1), Familiarisation with the Data, namely, understanding all data from result exploration. (2) Generating initial codes, namely, giving codes to the data comprehensively. (3) Searching for themes, namely, codes are grouped into more general themes. (4) Reviewing themes, namely, reviewing the themes that have been formed based on the data obtained. (5) Defining and Naming Themes: After reviewing themes, the researcher formulates interesting and informative themes. (6) Producing the Report: writing the analysis result for each theme, supported by other supporting data. Thus, this study identifies patterns of flora and fauna utilization and describes the philosophical and ecological meanings of Wonosobo Batik. Meanwhile, for the R&D used in this study, a feasibility test was conducted through validation and media tests. The material validity test indicators are presented in Table 4.

Table 4

Material Expert Validity Test Indicators (BNSP, 2014).

No.	Indicators
1.	Currentness of Material
2.	Accuracy of Material
3.	Reference Book Presentation Techniques
4.	Linguistics

In addition to the material validity test, a media expert validity test was also carried out, the indicators of which are presented in Table 5

Table 5

Media Expert Validity Test Indicators

No.	Indicators
1.	Reference Book Sizes
2.	Reference Book Cover Designs
3.	Reference Book Content Designs
4.	Linguistics

The assessment used a 1-4 Likert scale. Each number was converted into a category: (1) Inadequate, (2) Fairly Adequate, (3) Adequate, and (4) Very Adequate. The validation score was then calculated using the formula proposed by Arikunto (2010). Furthermore, the validity categories of reference books by Arikunto (2010) are presented in Table 6.

Table 6

Data Analysis Score Intervals.

No.	Indicators	Categories	Information
1.	$80\% < X < 100\%$	Very good	Very worthy, no need for revision
2.	$60\% < X < 80\%$	Good	worthy, no need for revision
3.	$40\% < X < 60\%$	Enough	Enough, necessary revisions
4.	$20\% < X < 40\%$	Not Enough	Not Suitable, Necessary revision
5.	$0\% < X < 20\%$	Very less	Very inadequate, needs revision

RESULTS AND DISCUSSION

Grouping of Orders identified in Wonosobo Batik

The flora and fauna used in batik are categorized by order. Research findings indicate that 19 orders are found in Wonosobo Batik. These are divided into 16 orders for flora and 3 orders for fauna, all grouped under the class Aves. Each order comprises one species, except for the orders Arecales, Poales, and Malvales. The classification of flora in Wonosobo Batik is shown in Figure 1.

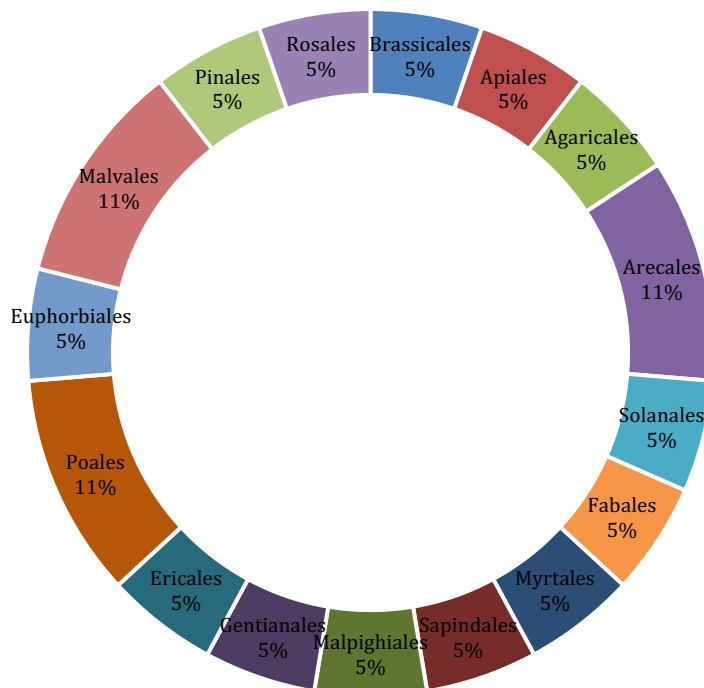


Figure 1. Grouping Flora Order in Wonosobo Batik

Orders *Arecales*, *Poales*, and *Malvaes* become the most numerous flora group utilized. Order *Arecales* used as a batik motif. Order *Arecales* have characteristics general in the form of a big woody plant, the trunk varies from tall and big to short and small, and is not branched (monopodial), leaves are big with an arrangement of bone finger or pinnate, flowers are small, and the fruit is produced in the form of a stone fruit (Wahyunindita et al., 2016). The selection of this motif is also based on agricultural commodities in Wonosobo Regency.

The *Poales* order is used as a motif and a batik tool. *Poales* order is one of the largest groups of monocotyledonous plants, encompassing important families such as the *Poaceae*, *Cyperaceae*, and *Typhaceae* (Bhagya et al., 2026). Bamboo is widely used as a motif and as a tool in batik. This is due to the abundance of bamboo in Wonosobo, especially in the lowlands. The factor that contributes to the abundant growth of various plants in Wonosobo is the soil, which is dominated by andosol (Gani et al., 2021).

The *Malvaes* order is used in batik as a raw material for making cloth and wax. Species belonging to this order include cotton trees and damar trees. Plants belonging to the order *Malvaes* are characterized by single-leaf trees or shrubs and numerous stamens that form a columnar structure (Tjitrosoepomo, 2010).

The predominance of motifs inspired by the orders *Arecales*, *Poales*, and *Malvaes* in Wonosobo batik reflects the community's interaction with the surrounding environment. In line with Alamsyah's (2019) research, which states that Wonosobo batik motifs are broadly categorized into geometric and non-geometric types, the morphological characteristics of flora serve as the inspiration for the shapes of non-geometric motifs among batik artisans. The following diagram illustrates the classification of plant orders in Wonosobo batik, as shown in Figure 2.

Figure 2 shows that there are 3 orders used in Wonosobo Batik. The 3 orders combined in one class Aves. The dominance of the Aves class in Wonosobo Batik motifs is due to its morphology, which is well-suited for use as an ornament in batik. The prevalence of Aves as batik motifs in Wonosobo stems from their morphology, which lends itself well to both geometric and non-geometric designs. The choice of birds as batik motifs illustrates how the community interprets its environment.

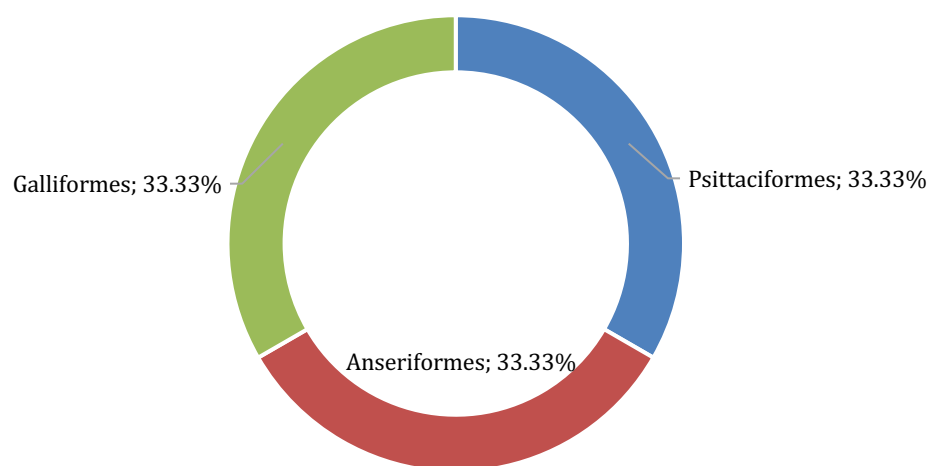


Figure 2. Grouping of Fauna Order in Wonosobo Batik

The Meaning of Wonosobo Batik Motif

In the context of ethnobiology, the potential of Wonosobo Regency in the agricultural, cultural, and tourism sectors described above is not a separate entity. All of this reflects the ecosystem conditions that make Wonosobo a highly promising region, both in terms of natural resources, culture and traditions, tourism, and so forth. The community certainly wants to promote, preserve, and enhance this potential.

Based on the research conducted, the data show that the motifs used are flora and fauna. In addition to serving as motif inspiration, some flora are also used as natural dyes in Wonosobo Batik. Eleven floral species have been identified in batik motifs, including carica, purwaceng, button mushrooms, snake fruits, red chillies, coconuts, teas, and bamboos. Meanwhile, three fauna species are featured in Wonosobo Batik: parakeets, ducks, and peacock. The ethnobiological significance is presented in [Table 7](#).

Table 7

The meaning of the Wonosobo Batik motifs.

No.	General Names	Species	Meanings
1.	Carica	<i>Carica pubescens</i>	Symbol fertility land
2.	Purwaceng	<i>Pimpinella alpina</i>	Symbol Humanism
3.	Button Mushroom	<i>Agaricus bisporus</i>	Symbol Ability to endure life
4.	Snake fruit	<i>Salacca zalacca</i>	Symbol Prosperity
5.	Red Chilli	<i>Capsicum annum</i>	Symbol Courage
6.	Coconut	<i>Cocos nucifera</i>	Symbol Usefulness
7.	Bamboo	<i>Bambusa sp.</i>	Symbol Strenght
8.	Tea	<i>Camellia sinensis</i>	Symbol Work Hard
9.	Parakeet	<i>Psittacula alexandri</i>	Symbol Truth
10.	Duck	<i>Anas platyrhynchos</i>	Symbol of Local Wisdom
11.	Peacock	<i>Pavo muticus</i>	Symbol Beauty

Carica (*Carica pubescens*) is a typical highland plant with a morphology similar to papaya, a palmate leaf vein arrangement, a hollow stem, a taproot type, white flowers, and fruit that changes from green to yellow when ripe (Rahmawati & Savita, 2022). Ethnobiologically, Carica is commonly used as a raw material for traditional foods and as a source of income. Carica, as a batik motif, represents the fertility of the Wonosobo Region, since this plant cannot be grown everywhere.

Purwaceng (*Pimpinella alpina*) is a plant with a round, branched, soft stem and dark green pinnately compound leaves. Purwaceng roots are often used as herbal medicine because their constituents can improve reproductive organ function and prevent free radicals (Hardiningsih et al., 2023). Phytosterols in Purwaceng roots can help reduce cholesterol. Purwaceng is interpreted as a symbol of humanism. This is due to the popular belief that Purwaceng can be used to enhance vitality and stamina. Administering medicine using Purwaceng is also seen as a form of humanism.

Button mushrooms (*Agaricus bisporus*) are round, white, and light brown in color, lack chlorophyll, and have short stems. Button mushrooms can prevent degenerative disease and cancer (Tjokrokusumo, 2015). Mushrooms are a vital agricultural commodity grown in the highlands, supporting the economic growth of local communities. Therefore, the button mushroom motif reflects the community's ability to survive.

Snake fruit (*Salacca zalacca*) is a plant with compound, pinnate leaves ranging in length from 3 to 7 meters. The leaf stalks and leaflets are covered with numerous, thin, sharp thorns. Furthermore, the underside of the leaves is covered with a white waxy coating (Christie & Lestari, 2020). Snake fruit has white flesh covered in a skin that is scaly (Yoga & Rabani, 2022). Snake fruit also plays a crucial socio-economic role for the people of Wonosobo. Economically, snake fruit is a commodity that provides a livelihood for many farmers in Wonosobo, especially in areas outside the Dieng Plateau.

Red chili (*Capsicum annum*) has a round to oval green leaf morphology; the base of the leaf forms a circle and tapers at the tip of the leaf, the stem is round and green, the flower color varies (white, greenish white, or purple), which grows in the leaf axils; and the fruit color is red to dark red (Rifki et al., 2024). Chili leaves are used as a medicine for boils and fever, and red chilies to treat toothache (Elfi et al., 2022). The bioactive compounds, including capsinoids, phenols, alkaloids, carotenoids, and flavonoids, can also be used as anticancer, antimicrobial, and antioxidant agents (Fadholly et al., 2023). Chillies with red colour are used as a symbol of courage

The Coconut (*Cocos nucifera*) has long fibrous roots, a stem without cambium, pinnate leaves, coconut flowers enclosed by a sheath, and white fruit enclosed by a shell (Riono et al., 2022). The coconut tree in batik is inspired by the relief of a parakeet bird and a *manggar*, or coconut flower, found at the Watu Gong site. This demonstrates the very close relationship between the Wonosobo people at that time and nature, especially coconut trees. This batik conveys the meaning that the plant, often referred to as the tree of life, is very beneficial to the community.

Bamboo (*Bambusa sp.*) is a plant that has stems with nodes and segments, fibrous roots, and on each segment, there is a midrib made of modified leaves. The fronds consist of midrib leaves, frond ears, and ligule (Ruma et al., 2023). The people of Wonosobo use bamboo to make the *Bundengan*, a traditional musical instrument from the Region. Bamboo is also used as a raw material for crafts. In Wonosobo, there is a bamboo with a distinct morphology, known locally as *bambu rengkol*. Rengkol bamboo has a winding shape, resembling a *keris* (a dagger). Rengkol bamboo is a local wisdom that integrates biology, culture, and spirituality. Ethnobiologically, this batik represents the richness of local flora, namely bamboo, whose unique stem morphology is evident.

Tea (*Camellia sinensis*) has green leaves; this plant has flat, round fruit with seeds in each fruit (Ramlah, 2017). In addition to its health benefits, tea also has social, cultural, and economic roles. Tea is always served to guests, so it is often used as a symbol of hospitality and the community's warmth. From an economic perspective, the tea industry provides extensive employment opportunities, including farmers, tea pickers, and tea processing workers, so the presence of this commodity greatly benefits the economy of the Wonosobo community.

The Parakeet (*Psittacula alexandri*) is a bird belonging to the order *Psittacidae*. It has a large head, a hooked beak, and eats fruit, seeds, and pollen. It also has strong, agile legs (Ulfah, 2013). Furthermore, members of the order *Psittaciformes* are also known for their ability to mimic sounds, intelligence, and brightly colored feathers (Puspitasari et al., 2024). The parakeets in Wonosobo Batik were inspired by reliefs discovered during excavations at the Watu Gong site in Tumenggungan Village, Selomerto District, Wonosobo Regency. There has been no specific research on these reliefs, but when compared to parakeet reliefs identified at Morangan Temple and Sojiwan Temple, these birds symbolize the repetition of sacred teachings (Fitriyani & Munandar, 2025). In the Jataka tales, parakeets often act as messengers of wisdom or truth. According to Widodo's (2007) research, parakeets are found between 5° 56'-8° 25' South Latitude and 105° 20' - 144° 22' East Longitude. Wonosobo's geographical coordinates are 7°11' - 7°36' south latitude and 109°43' - 110°04' east longitude. From this data, it can be concluded that Wonosobo is within the distribution area of the parakeets. The discovery of the parakeet's relief likely signifies wisdom and adherence to the teachings of truth. The creation of the parakeet batik motif is evidence that the Wonosobo community also views the region from a historical perspective.

Ducks (*Anas platyrhynchos*) have spoon-shaped beaks, webbed feet, and waxy feathers. They also have relatively long necks, slender bodies, and dark brown feathers (Hasibuan et al., 2023). Ducks in

Wonosobo Batik are closely related to the *Bundengan*. The *Bundengan* is a musical instrument from Wonosobo made from bamboo slats, bamboo fronds, and palm fibers, producing sounds similar to those of a gamelan instrument. The *Bundengan* was originally developed by duck herders, who used it for protection from inclement weather while herding (Hamdan et al., 2024). In this case, ducks are depicted as one of the livestock widely kept by the Wonosobo community and, along with the *Bundengan*, have become symbols of Wonosobo local wisdom.

The peacock (*Pavo muticus*) has a long tail composed of 120 to 150 feathers. These feathers are shaped like a wonderful fan and are large, extending from the base of the tail. The green peacock also relies on its strong legs for its movements (Aliyah et al., 2014). The peacock is also a bird known for the beauty of its feathers. Although not a native animal in Wonosobo, the peacock is depicted in batik for its beautiful plumage. In Wonosobo Batik, the peacock symbolizes that every individual has unique strengths, so there is no need to compare with one another.

Visualization of the Use of Flora and Fauna in Wonosobo Batik

The flora and fauna in Wonosobo Batik are categorized into three use categories. These flora and fauna are used as batik motifs, natural dyes, and even as both motifs and dyes. A diagram of their use is shown in Figure 3.

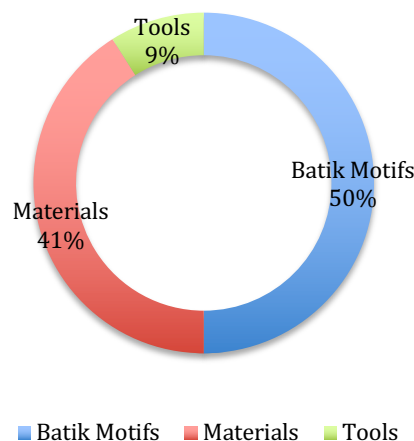


Figure 3. Visualization of the Use of Flora and Fauna in Wonosobo Batik.

Figure 3 shows that flora and fauna are the most commonly used motifs. The percentage is 50%. 41% are used as materials, and 9% are used as batik tools. If expressed numerically, there are 11 species used for motifs, 9 for materials, and 2 species used for tools.

Flora and Fauna Conservation Status

The flora and fauna used in Wonosobo batik have varying conservation statuses. The conservation status is shown in Figure 2. Based on analysis using the IUCN (International Union for Conservation of Nature), 4 species have no conservation status, not evaluated (NE); 3 species have limited data or Data Deficient (DD); 7 species are of Least Concern (LC) due to their high prevalence; 2 species are Near Threatened (NT), 3 are Vulnerable (VU), and 3 are Endangered (EN).

Species for which there is no data include coconut, *tarum*, bamboo, and jackfruit. Furthermore, species with limited data include carica, bamboo, and tea. Species at low risk of extinction include button mushrooms, snake fruit, red chili, *jelawe*, *tingi*, castor bean, and duck. Near-threatened species include mahogany and the parakeet. Three species vulnerable to extinction are *purwaceng*, pine, and cotton. Threatened species include coffee, the green peacock, and the cat's eye dammar. Conservation status data can be seen in Figure 4.

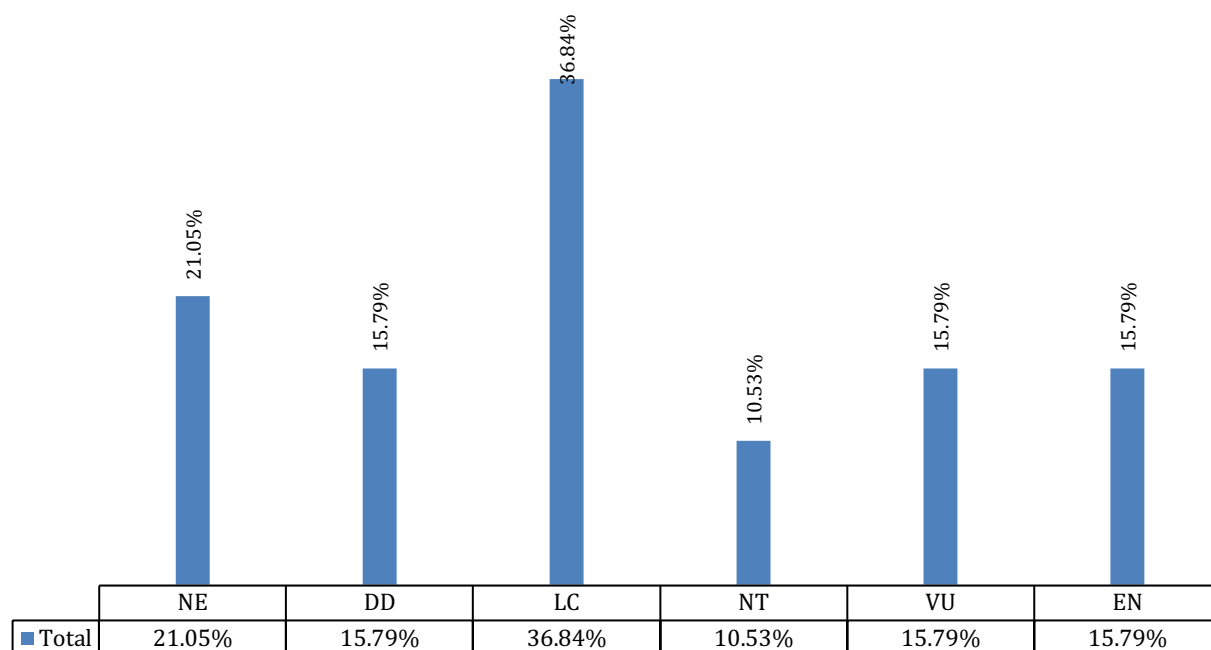


Figure 4. Flora and Fauna Conservation Statuses.

Based on [Figure 4](#), the use of flora and fauna in batik does not directly impact conservation status. This is because most flora and fauna are used only as inspiration for batik motifs, not as direct raw materials. However, this conservation status is crucial because it can serve as a reference for preserving these species to ensure their continued existence and as a recommendation for further research on species for which there is still limited data. If a species featured in Wonosobo batik becomes extinct, understanding the ecology and meaning of the motifs will no longer be relevant. Therefore, understanding their conservation status will encourage the public to play an active role in conservation efforts.

Feasibility Test Results Analysis

In the development research or R&D (Research and Development), the following are the results of the feasibility test analysis according to the indicators in [Tables 3](#) and [4](#). Data obtained from the assessment by the subject-matter expert validator is presented in [Table 8](#).

Table 8

Analysis of Material Expert Validation Result.

No.	Evaluation Aspects	Material Expert Assessments	
		Scores	Maximum Scores
1.	Currentness of Materials	7	8
2.	Accuracy of Materials	10	12
3.	Reference Book Presentation Techniques	11	12
4.	Linguistics	13	16
Total Score		41	
Maximum Score		48	
Percentage		85.4%	

Based on [Table 8](#), the analysis of the validation results by material experts shows a percentage an 85.4% rate. The total percentage value falls within the very good category, according to [Table 6](#). The best aspects are the material's topicality and the presentation techniques in the reference books. The aspect that needs improvement is the linguistic aspect.

Table 9

Analysis of Media Expert Validation Result.

No.	Assessment Aspects	Material Expert Assessment	
		Scores	Maximum Scores
1.	Reference Book Size	4	4
2.	Reference Book Cover Design	18	20
3.	Reference Book Content Design	23	24
4.	Linguistics	12	12
Total Score		57	
Maximum Score		60	
Percentage		95%	

Based on [Table 9](#), the analysis of media expert validation results shows a 95% rate. The best aspects are the size of the reference book, the content design, and the linguistics. The aspect that needs improvement is the cover design. The total percentage value falls within the very good category according to [Table 6](#). The assessment of the reference book media by the media expert validator indicates that the reference book titled "Ethnobiology of Wonosobo Batik" is considered very Good.

The Potential of the Ethnobiology Batik Reference Book as an Educational Resource

The development of validated reference books is relevant as a contextual resource for biology learning. Based on the research findings, this book can be integrated into several high school subjects, particularly in 10th grade. The subject matter and examples of its application are presented in [Table 10](#).

Table 10

Example of the Reference Book Implementation

Content	Implementation
Biodiversity	Data on the flora and fauna found in batik motifs can serve as concrete examples of local biodiversity, so that students not only learn the theory but also gain firsthand experience with the species that are part of their culture.
Classification of organisms	Findings regarding the orders Arecales, Poales, and Malvales, as well as the class Aves, can be used as case studies to help students develop their understanding of taxonomy.
Ecology and conservation	Conservation status data (IUCN) is used as supplementary material to discuss biotic and abiotic factors as well as the urgency of species conservation.

The implementation of reference books based on local wisdom aligns with the context of the Merdeka Curriculum, serving as a supplementary source of local content through an ethnosience approach. The application of ethnosience in education is defined as the integration of local wisdom and traditions—including the knowledge, practices, and cultural heritage values of a community — into the learning process (Idul & Fajardo, 2023). In the context of this research, ethnobiological knowledge of batik is transformed into scientific understanding regarding biodiversity, classification, ecology, and conservation. This aligns with previous research by Lestari (2021), which highlighted Ngawi Batik as the primary content developed in instructional materials and found that it successfully enhanced students' motivation, knowledge, and learning outcomes. Thus, the integration of ethnobiology into learning is expected to serve as values-based education, such as character education, and to enrich students' knowledge and learning experiences. From a community perspective, the developed reference book can serve as an educational tool for conservation, enhance science literacy, and bridge local wisdom and scientific knowledge.

CONCLUSION

The geographical conditions of Wonosobo give rise to flora and fauna that support sustainable life. These flora and fauna are used as food, medicine, economic resources, and other purposes. Geographical and cultural development also inspire the Wonosobo community to immortalize these in batik motifs. These motifs carry their own philosophical meaning. The flora and fauna found in exploration are carica, purwaceng, button mushroom, snake fruit, red chili, coconut, bamboo, parakeet,

duck, green peacock, *tarum*, *jelawe*, pine, cotton, mahogany, *tingi*, coffee, and tea. Meanwhile, the developed reference book was deemed highly feasible, with validation percentages from material experts of 85.4% and from media experts of 95%, respectively, and is therefore included in the very good category. Reference books that have been tested for feasibility are highly recommended for adoption and implementation as sources of information for the community and conservation education media and as complementary materials for local content-based curricula. This study highlights several implications: that local knowledge can be scientifically documented and integrated into formal or non-formal educational frameworks to bridge knowledge gaps. The reference book developed provides concrete tools for communities to preserve local biodiversity knowledge, understand the scientific value of their cultural products, and potentially foster environmental awareness and the sustainable use of natural resources.

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