**BUKTI KORESPONDENSI ARTIKEL**
**JURNAL NASIONAL TERAKREDITASI SINTA 2**

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|---|---|---|
| Judul Artikel | : | Empowering Pre-service Biology Teachers through Sustainability Action: An Ethnobotanical Inventory Project in Cirebon |
| Jurnal | : | Biodidaktika: Jurnal Biologi dan Pembelajarannya Volume 21 Nomor 1 (2026) Halaman 100-112 |

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| 1. | Bukti Konfirmasi Submit Manuskrip | 23 Desember 2025 |
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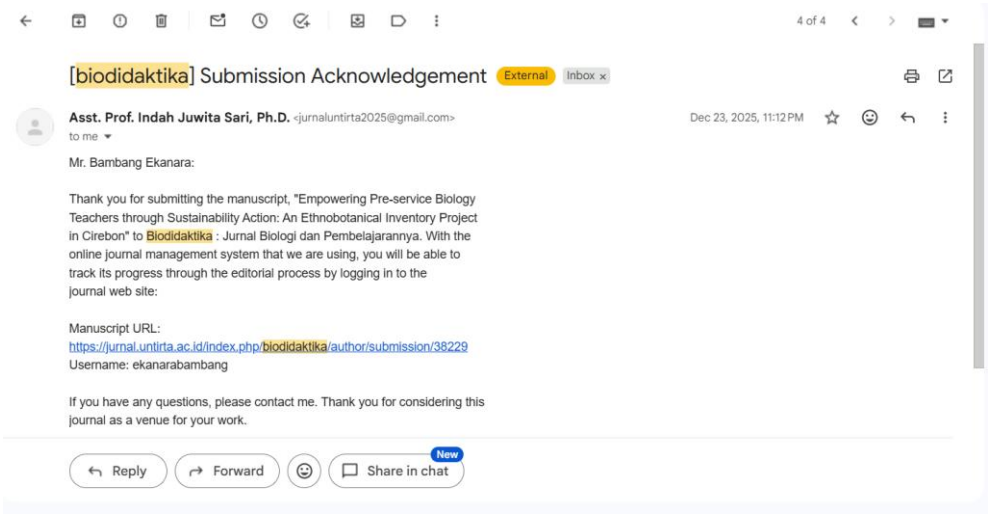
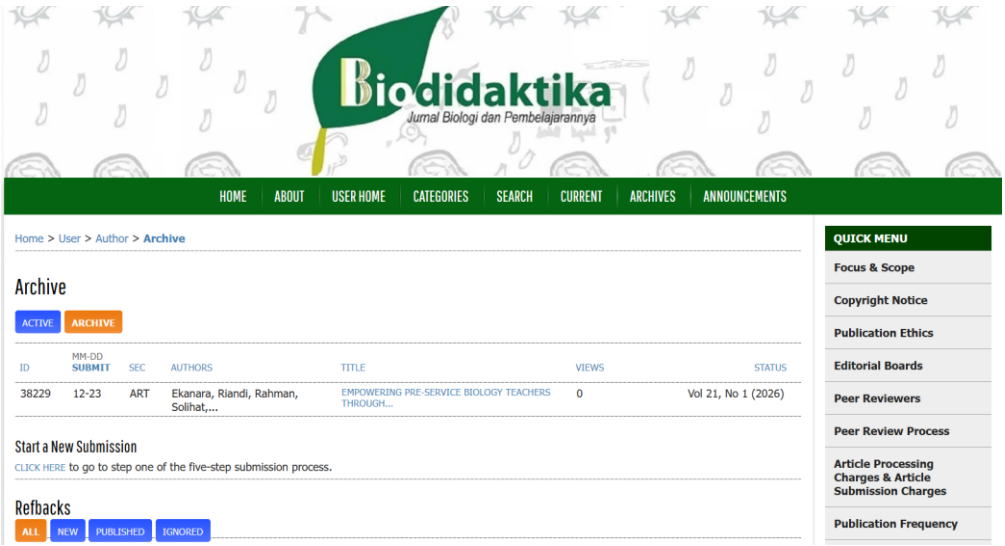
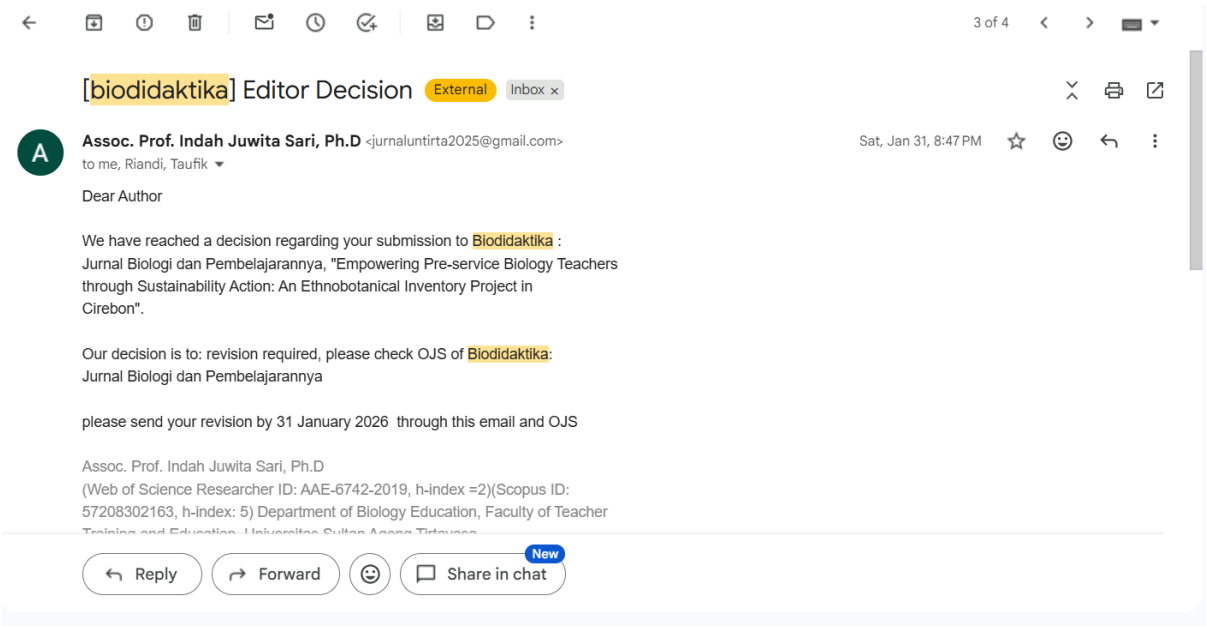
1. Proses Submit Manuskrip



2. Bukti Revisi



3 of 4

[biodidaktika] Editor Decision External Inbox ×

**Assoc. Prof. Indah Juwita Sari, Ph.D** <jurnaluntirta2025@gmail.com> Sat, Jan 31, 8:47 PM

to me, Riandi, Taufik

Dear Author

We have reached a decision regarding your submission to Biodidaktika : Jurnal Biologi dan Pembelajarannya, "Empowering Pre-service Biology Teachers through Sustainability Action: An Ethnobotanical Inventory Project in Cirebon".

Our decision is to: revision required, please check OJS of Biodidaktika: Jurnal Biologi dan Pembelajarannya

please send your revision by 31 January 2026 through this email and OJS

Assoc. Prof. Indah Juwita Sari, Ph.D
(Web of Science Researcher ID: AAE-6742-2019, h-index =2)(Scopus ID: 57208302163, h-index: 5) Department of Biology Education, Faculty of Teacher Training and Education, Universitas Sultan Ageng Tirtayasa

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**REVIEW PAPER**

**TITTLE: Empowering Pre-service Biology Teachers through Sustainability Action: An Ethnobotanical Inventory Project in Cirebon**

1) Does the paper contribute to the body of knowledge?

**Overall judgement:** *Partially, but the novelty and knowledge contribution are not yet articulated with sufficient analytical clarity.*

**What to highlight (sentences/phrases) + suggested revisions**

- **Highlight:** "Few studies have examined how the act of planning and executing an ethnobotanical inventory empowers the pre-service teachers themselves."
  **Suggested revision:** "Few studies have examined how planning and conducting an ethnobotanical inventory shapes pre-service teachers' sustainability agency and ESD-related competencies."
  **Comment:** The gap statement is promising but should specify *what* is examined (agency, competence, pedagogical design principles) to clarify the contribution.
- **Highlight:** "Therefore, this article aims to describe how…"
  **Suggested revision:** "Accordingly, this study examines how…"
  **Comment:** "Aims to describe" signals a descriptive report rather than a contribution that advances understanding through analysis.
- **Highlight:** "The results demonstrate that the project successfully cultivated sustainability agency."
  **Suggested revision:** "Findings suggest that the project fostered students' sustainability agency, evidenced by [insert observable indicators drawn from interview excerpts/artifacts]."
  **Comment:** Claims about contribution require explicit evidence and operational indicators, not only summary assertions.

2) Is the paper technically sound?

**Overall judgement:** *Not fully. The manuscript requires major methodological clarification and alignment between manuscript type and study design.*

**Critical technical issues (with "highlight + fix")**

- **Highlight:** "Employing a qualitative case study design…"
  and "This study employed a qualitative case study design…"
  **Suggested revision:** "This study employed a qualitative multiple-case study design…"
  **Comment:** With Group A/B/C treated as separate cases, "multiple-case" (collective case study) is more accurate.
- **Highlight:** "The participants were selected using purposive sampling techniques…"
  **Suggested revision (add details):** "Participants were selected via purposive sampling. Each case consisted of ___ students (total n = ___). One–two representatives per group (n = ___) participated in interviews. The project lasted ___ weeks/months."
  **Comment:** Missing participant counts, interview n, duration, and case boundaries weaken replicability and trustworthiness.
- **Highlight:** "To ensure the validity of the findings, data were collected using triangulation methods…"
  **Suggested revision:** "To enhance trustworthiness, we triangulated data sources (observations, documents, and interviews) and conducted [member checking/peer

debriefing/audit trail/negative case analysis]."

**Comment:** "Triangulation" needs procedural detail. Consider using qualitative trustworthiness terminology.

- **Highlight:** "The collected data were analysed using thematic analysis."

  **Suggested revision:** "Data were analyzed using thematic analysis following [e.g., Braun & Clarke], including familiarization, initial coding, theme development, and refinement. Coding was conducted by ___; discrepancies were resolved by ___."

  **Comment:** The analysis description is currently too generic to evaluate rigor.
- **Highlight:** "These groups were selected because they successfully navigated…"

  **Suggested revision:** "These groups were selected because they completed all project phases and produced dissemination artifacts."

  **Comment:** Avoid evaluative wording ("successfully")—use observable selection criteria.

3) Is the subject matter presented in a comprehensive manner?

**Overall judgement:** *Moderately comprehensive as a project narrative, but not comprehensive in evidentiary depth and analytic structure.*

**Key places to strengthen comprehensiveness**

- **Highlight:** "This initiative required pre-service teachers to navigate a complete cycle of sustainability action…"

  **Suggested revision:** "The project engaged students in a sustainability action cycle: (1) initiation… (2) collaboration… (3) action… (4) reflection and dissemination…"

  **Comment:** If "cycle" is central, describe all phases consistently and show how each phase links to data and themes.
- **Highlight:** "The first major finding… translation of theoretical conservation concepts into concrete sustainability actions…"

  **Suggested revision:** Add a brief evidence line: "This is evidenced by [quote(s)/artifact excerpts/field-note examples]."

  **Comment:** The Results section contains broad claims but limited direct evidence (quotes, excerpts, analytic displays).
- **Highlight:** "The final and most empowering aspect…"

  **Suggested revision:** "A key empowering aspect was producing pocket books as dissemination artifacts…"

  **Comment:** Replace superlatives ("most empowering") with analytic explanation supported by evidence.

4) Are the references provided applicable and sufficient? Please note that suggesting one's own references as a reviewer if not relevant to the article, or at an excessive level, is unethical and is not permitted.

**Overall judgement:** *Generally applicable, but the reference list requires quality control (accuracy, completeness, credibility) and stronger coverage of empirical teacher-education/ESD research.*

- **Highlight: Reference formatting inconsistencies and incomplete entries across the reference list.**

  **Suggested revision:** "Please standardize references according to the journal's required style (e.g., APA 7th), verify bibliographic completeness (publisher/journal, volume, issue, pages), and provide valid DOI links where available."

  **Comment:** Poor reference hygiene can lead to desk rejection regardless of study quality.
- **Highlight:** "Retrieved from doi:10.3390/…"

**Suggested revision:** Use a standard DOI format (e.g., "https://doi.org/...") and remove extra spaces.
**Comment:** The current DOI formatting looks non-standard and error-prone.

5) Are there references that are not appropriate for the topic being discussed? If yes, then please indicate which references should be removed.

**Overall judgement:** *Some references may be questionable due to credibility or weak relevance; they should be reconsidered or replaced with more traceable/peer-reviewed sources.*
**References to reconsider**

- **Highlight (reference entry):** Fauzan, A. (2025). *The Impact of Modernization... The Journal of Academic Science*, 3(2), 29–36.
  **Comment:** The journal's scholarly status is unclear. If it is not a well-established peer-reviewed outlet or cannot be verified, it should be removed or replaced.
- **Highlight (reference entry):** Moektiwardoyo, et al. (2018). *Ethnobotany Study of Ritual Plants* (book). Deepublish.
  **Comment:** A local book source can be useful for contextual grounding, but the manuscript should justify why it is used and complement it with stronger peer-reviewed international literature.
- **Highlight (reference entry):** Sobel, D. (2004). *Education for meaning and social justice*. Orion Society.
  **Comment:** The entry looks incomplete/possibly inaccurate (title details). If bibliographic information cannot be verified, it should be corrected or removed.

## Recommendation

- ○ Accept (minor edits)
- Ø **Reject (updates required before resubmission)**
- ○ Reject (do not encourage resubmit)

## Confidential Comments to the Editor

The manuscript addresses a timely topic (ESD and sustainability agency in pre-service biology teacher education through community-based ethnobotany). However, it currently reads as an empirical qualitative multiple-case study while being framed as a "review paper," and it lacks key methodological information (participant counts, interview n, project duration, analytic steps). Claims are often stated with strong certainty ("demonstrate/proves/validate/successfully") without presenting sufficient primary evidence (e.g., interview excerpts, field-note quotes, artifact analysis). I recommend **major revision and resubmission** after clarifying study type, improving trustworthiness reporting, adding an ethics statement, and cleaning the manuscript format and references.

## Comments to the Author

**Strengths**

- The project design is meaningful for ESD: it connects local knowledge, fieldwork, and dissemination artifacts (pocket books), which can foster authentic learning and community reciprocity.
- The cross-case context (ritual/cultural keystone species vs medicinal plants linked to pharmacological sources) is interesting and potentially valuable for culturally responsive science education.

**Major revisions required**

1. **Align the manuscript type with the actual design.** This is an empirical qualitative study, not a review paper. Please revise the category and structure accordingly.
2. **Add missing methodological details.** Provide participant numbers per group, interview sample size, project duration, and clear case boundaries.
3. **Operationalize "sustainability agency/empowerment."** Define indicators and show how your data support each indicator with quotations and artifact excerpts.
4. **Make analysis auditable.** Specify thematic analysis procedures (approach, coding steps, coder roles, and how themes were validated).
5. **Improve scholarly tone and avoid over-claims.** Replace "prove/demonstrate/validate/successfully" with cautious qualitative wording ("suggest/indicate") unless strong evidence is presented.
6. **Reference quality control.** Standardize references, verify credibility of uncertain sources, and correct incomplete DOI/bibliographic information.

**Minor edits**

- Fix grammar/typographic issues (e.g., "students-built relationships," punctuation, plural consistency).

Reviewer 2

- Please carefully revise the entire manuscript to ensure that the English language is clear, accurate, and academically appropriate throughout the text.
- The authors are advised to check the manuscript for similarity and ensure that the similarity index is below 25%, as well as to verify that the content does not contain AI-generated text.
- All figures and tables presented in the manuscript should be properly cited and explicitly referred to in the main body of the text.
- The authors should strengthen the articulation of the research gap and clearly justify the urgency and significance of the study.

## Hasil Revisi

BIODIDAKTIKA: Jurnal Biologi dan Pembelajarannya, Vol.X, No.X, 20XX, pp. X-X
e-ISSN XXXX-XXXX. DOI. 11.11111/X.vXiX.X

**Empowering Pre-service Biology Teachers through Sustainability Action: An Ethnobotanical Inventory Project in Cirebon**

Submitted Date Month Year, Revised Date Month Year Accepted Date Month Year
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Abstract

Integrating Education for Sustainable Development (ESD) into teacher education requires shifting from theoretical knowledge to practical action competence. Accordingly, this study examines how an Ethnobotanical Inventory Project empowers pre-service biology teachers to navigate the complexities of community-based conservation. Employing a qualitative multiple-case study design, the research focuses on three student working groups (total *n* = 23 students) at UIN Siber Syekh Nurjati Cirebon who investigated distinct cultural sites: the Mundu coastal area, the Buyut Trusmi sacred site, and the Singkup agrarian village. Data were collected through field observations, semi-structured interviews, and analysis of student artifacts. The results suggest that the project cultivated sustainability agency. Students developed interpersonal competence by negotiating access with traditional custodians (*Paraji* and *Kuncen*) and demonstrated scientific literacy by validating local knowledge with botanical taxonomy. Furthermore, the inventory highlighted a dichotomy in plant conservation motivations: "Cultural Keystone Species" driven by ritual needs in Mundu and Trusmi (e.g., *Jasminum sambac*), versus pharmacologically validated medicinal plants in Singkup (e.g., *Curcuma xanthorrhiza*). It is concluded that incorporating local wisdom into biology learning serves as a strategic pedagogical tool to foster future teachers who are scientifically literate, culturally sensitive, and capable of leading sustainability actions.

Keywords: Ethnobotany, Local Wisdom, Pre-service Biology Teachers, Student Agency, Sustainability Action.

### INTRODUCTION

In the rapidly changing landscape of the 21st century, Higher Education Institutions (HEIs) are under increasing pressure to lead the transition towards a sustainable future. The integration of Education for Sustainable Development (ESD) into teacher education programs is not merely an option but a global imperative, aligned with the United Nations' Sustainable Development Goals (SDGs), particularly Goal 4 (Quality Education) and Goal 15 (Life on Land) (Rieckmann, 2018; UNESCO, 2020). Future educators are expected to possess not only content knowledge but also the "sustainability competencies" required to address complex environmental challenges (Bürgener & Barth, 2018; Imara & Altinay, 2021; A. Redman, Wiek, & Barth, 2021). Consequently, teacher training programs must evolve from traditional, content-heavy curricula to more transformative, action-oriented pedagogies.

Biology education, in particular, plays a pivotal role in fostering environmental stewardship. Pre-service biology teachers stand at the forefront of this mission, as they will shape the ecological mindset of the next generation. It is essential that these candidates develop a strong sense of "agency", the capacity to act independently and make choices that support sustainability (Bezeljak, Scheuch, & Torkar, 2020; Chisingui & Costa, 2020; Jeronen, Palmberg, & Yli-Panula, 2017; E. Redman, Wiek, & Redman, 2018). However, developing this agency requires more than classroom lectures; it demands immersive experiences where students can interact directly with the biosphere and the communities that depend on it. Without

this practical engagement, biology education risks remaining abstract and disconnected from real-world conservation issues.

Despite the clear urgency, a persistent gap remains in teacher education globally and in Indonesia. While many pre-service teachers demonstrate high levels of environmental knowledge, they often display low levels of 'action competence' (Hedefalk, Almqvist, & Lidar, 2014; Sinakou, Donche, & Van Petegem, 2022; Vare et al., 2019). Few studies have examined specifically how the pedagogical process of planning and executing an ethnobotanical inventory shapes pre-service teachers' sustainability agency and ESD-related competencies. Most existing literature focuses on the *product* of such inventories (plant lists) rather than the *educational impact* on the students conducting them.

Literature on the educational value of ethnobotany has grown significantly in recent years. Internationally, studies have highlighted how ethnobotanical projects can enhance scientific literacy, critical thinking, and cultural appreciation among students. For instance, research by Zidny, Sjöström, and Eilks (2020) demonstrated that connecting science curricula with indigenous knowledge systems significantly increases student engagement and conceptual understanding. These studies confirm that "place-based education" is an effective strategy for making science relevant.

In the Indonesian context, numerous studies have documented the richness of local ethnobotanical knowledge. Research has extensively catalogued plant utilization in various regions, such as the medicinal plants of Java or the ritual flora of Bali (Mulyanto, Iskandar, Iskandar, & Wiyanti, 2024; Sujarwo, Caneva, & Zuccarello, 2020; Wijana, Mulyadiharja, & Riawan, 2020). Specifically in West Java and Cirebon, researchers have documented local plant utilization (Tresnawati, Saleh, & Wardani, 2020). However, the majority of these studies are purely descriptive, focusing on the *inventory of plants*, the species, their uses, and their phytochemical properties. While the botanical and anthropological aspects of ethnobotany in Indonesia are well-documented, there is a scarcity of research focusing on the *educational process* of these inventories. Few studies have examined how planning and conducting an ethnobotanical inventory shapes pre-service teachers' sustainability agency and ESD-related competencies. The existing literature rarely addresses how dealing with the challenges of field research, such as building rapport with community leaders or navigating cultural taboos, contributes to the development of sustainability competencies. Thus, there is a need to shift the research focus from the *product* to the *process*.

This study is situated in Cirebon, West Java, a region uniquely characterized by the intersection of Islamic heritage, coastal culture, and agrarian traditions. Cirebon faces a dual challenge: rapid modernization that threatens biodiversity and the gradual erosion of traditional knowledge

among the younger generation (Ningrum & Abdullah, 2025). The specific locations selected for this study, the coastal area of Mundu, the sacred site of Buyut Trusmi, and the agrarian village of Singkup, represent "living laboratories" where traditional ecological knowledge is still practiced but increasingly fragile.

To address the educational gap and the local conservation need, the Department of Biology Education at UIN Siber Syekh Nurjati Cirebon implemented the "Ethnobotanical Inventory Project." This initiative required pre-service teachers to navigate a complete cycle of sustainability action: (1) *Initiation*, where they identified local partners; (2) *Collaboration*, where they engaged with cultural custodians (e.g., *Paraji* and *Kuncen*); and (3) *Action*, where they documented and analysed botanical data. Unlike typical assignments, this project emphasized student autonomy and community service.

Theoretically, this study views "empowerment" through the lens of Action Competence in ESD. Empowerment in this context is defined as the process by which students gain the confidence, skills, and motivation to contribute to solving environmental problems (Mogensen & Schnack, 2010). By shifting the role of students from passive learners to active "knowledge preservers," this project aims to instil a sense of ownership over their local environment and culture.

Accordingly, this study examines how the Ethnobotanical Inventory Project fosters sustainability agency among pre-service biology teachers. It specifically seeks to answer: How does the process of inventorying local plants empower students to navigate the complexities of community-based conservation? By analysing student experiences across three distinct case studies (ritual, sacred, and medicinal plant inventories), this research provides a replicable model for teacher education programs seeking to integrate local wisdom into sustainability action.

## METHODS

### Research Design

This study employed a qualitative multiple-case study design to explore the development of pre-service teachers' sustainability agency (Yin, 2018). This design was selected to allow for replication logic across the three distinct communities investigated, thereby strengthening the external validity of the findings. By treating each student working group as a separate "case," the study captures the complex interaction between student learning processes and the unique social realities of each site.

### Context and Participants

The research was conducted within the *Conservation Biology* course at the Department of Biology Education, UIN Siber Syekh Nurjati Cirebon. The project spanned 7 weeks, following

a Project-Based Learning (PjBL) model. Participants were selected using purposive sampling based on their active involvement in the inventory projects. The total number of participants was 23 students, divided into three working groups: 1) Group A (Mundu): Investigated ritual plants in the *Nujuh Bulan* tradition (n = 7 students); 2) Group B (Trusmi): Investigated sacred plants in the *Buyut Trusmi* cultural site (n = 8 students); and 3) Group C (Singkup): Investigated medicinal plants in the agrarian village of Singkup (n = 8 students).

**Data Collection**

To enhance trustworthiness and minimize researcher bias, we triangulated data from three sources:

1. Observations: Direct observation of students' activities during the planning (campus) and action (fieldwork) phases.
2. Documents: Analysis of project artifacts, including inventory sheets, field notes, and the final *Pocket Books*.
3. Interviews: Semi-structured interviews were conducted with two representatives from each group (total n = 6) to probe their personal experiences and challenges.

Furthermore, strictly following qualitative validity standards, we conducted member checking by returning the interview transcripts and draft booklets to the community representatives and student participants to ensure the data accurately reflected their views and experiences.
Data Analysis Data were analysed using thematic analysis following the six phases outlined by Braun and Clarke (2006): (1) familiarization with data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report. The coding process focused on identifying markers of sustainability competencies, such as agency, collaboration, and problem-solving. To ensure reliability, the initial coding was conducted by the first author and subsequently reviewed by the co-authors to ensure inter-rater reliability and minimize subjective bias. Discrepancies in coding were resolved through consensus discussions.

## RESULTS AND DISCUSSION

### Translating Knowledge into Action: The Process of Community-Based Inquiry

The first major finding of this study is the translation of theoretical conservation concepts into tangible sustainability actions. Unlike traditional laboratory-based biology instruction, this project required pre-service teachers to navigate complex social-ecological systems. The analysis of student activities from the initial planning to the creation of dissemination products reveals three critical phases of empowerment: (1) Navigating social access, (2) Contextualizing scientific knowledge, and (3) Reciprocity through dissemination.

The "Action" component of ESD requires students to step outside the academic "ivory tower" and engage with community realities. Our data shows that all groups faced the initial challenge of gaining trust from the local custodians of knowledge (*Kuncen* and *Paraji*). In the Mundu Case, students negotiated with a traditional birth attendant to understand the *Nujuh Bulan* ritual. In the Trusmi Case, access to the sacred *Buyut* area required strict adherence to customary laws (e.g., prohibition of damaging plants). In the Singkup Case, students built relationships with local mothers to document herbal recipes.

This negotiation process fostered interpersonal competence, as students learned to navigate cultural hierarchies. As one student from Group A noted:

> *"At first, the Paraji was hesitant to share the details of the 'rujak' ingredients because she considered it hereditary family knowledge. We realized we could not just come and extract data. We visited her multiple times, not to interview, but just to talk and listen. Once we explained that our goal was to document this wisdom so her grandchildren would not forget it, her demeanor changed completely. She finally welcomed us and even taught us the philosophy behind the coconut carving."*

This finding validates the theory of "Place-Based Education" (Sobel, 2004), which argues that authentic learning occurs when students connect with the local community. Furthermore, the students' ability to negotiate access demonstrates the development of interpersonal competence as a key sustainability competency (Cebrián, Junyent, & Mulà, 2020; Rieckmann, 2018; Arjen E. J. Wals, 2011; Arjen E. J. Wals & Corcoran, 2023). By engaging with these key informants, students moved beyond being passive observers to becoming "legitimate peripheral participants" in the community of practice (Harris & Jones, 2012).

The students demonstrated scientific literacy by cross-referencing local knowledge with academic literature. For instance, the Trusmi Group validated the use of "Bidara" (*Ziziphus mauritiana*) and "Namnam" (*Cynometra cauliflora*). While the community primarily reveres *Bidara* as a sacred plant for spiritual cleansing, the students confirmed its pharmacological potential. In their final report, they integrated this cultural belief with scientific evidence of the plant's antioxidant and anti-inflammatory properties. This rigorous verification process bridged the gap between 'myth' and 'science', effectively connecting the sacred site's traditions with

modern botanical science. This indicates that the project encouraged students to perform rigorous literature verification, transforming oral traditions into validated botanical knowledge.

The final and most empowering aspect of the process was the creation of educational artifacts. The *Pocket Books* produced by the students serve as concrete evidence of this synthesis (see Figure 1). Unlike typical assignments submitted only to lecturers, these booklets were designed for the community. For example, the Singkup Booklet is structured to be user-friendly, featuring clear photos, morphological descriptions, and practical uses.

The inclusion of phytochemical references in the Singkup booklet shows that students performed rigorous literature verification to validate local claims. This creation of public-facing products represents the "Action" in Action Competence (de Haan, 2010; Mogensen & Schnack, 2010; Sinakou et al., 2022). Students were not just learning *about* sustainability; they were acting *for* sustainability by documenting and preserving disappearing knowledge. In the context of Indonesian higher education, this supports the *Merdeka Belajar Kampus Merdeka* (MBKM) policy, which emphasizes project-based learning that results in tangible societal contributions (Andika, Suryadi, Hidayat, Warlim, & Nurdin, 2025; Kurniawan et al., 2024). The booklets serve as a permanent archive of local wisdom that might otherwise be lost, fulfilling the students' role as agents of conservation.

a.


b.

c.


Figure 1. The Visualization of the Pocket Books Produced as Dissemination Artifacts, representing: (a) the Mundu Group, (b) the Singkup Group, and (c) the Trusmi Group.

**Ethnobotanical Diversity in Cirebon: Intertwining Cultural Heritage and Conservation**

Beyond the pedagogical impact, the project generated an inventory of local flora, revealing a distinct pattern of plant utilization across the three study sites. The students' findings highlight that plant conservation in Cirebon is driven by two primary motivations: cultural significance (ritualistic needs) and pharmacological utility (health needs).

In the *Buyut Trusmi* site, students documented how customary laws (taboos) effectively protect biodiversity. The prohibition of damaging plants in the sacred area has preserved species that serve dual purposes: spiritual and medicinal. A prime example identified in the *Trusmi Pocket Book* is "Srigading" (*Nyctanthes arbortristis*). While locally revered as a sacred flower planted in the *Buyut* complex, students documented its pragmatic use by the community: the dried flowers are brewed as tea to lower fever. This finding highlights a sophisticated "eco-spiritual" conservation model where plants are protected not just for their utility, but because they are embedded in the sacred landscape of the *Memayu* tradition.

In contrast to the coastal ritualistic focus, the agrarian community of Singkup maintained a rich knowledge of ethnomedicine. The *Pocket Book of Medicinal Plants* produced by the students serves as an inventory of species used for preventive and curative care. A critical aspect of the students' work was cross-referencing local claims with scientific literature. For instance, the Singkup community uses *Coleus atropurpureus* to treat wounds and inflammation. In their final report, students corroborated this usage by citing the presence of flavonoids and tannins in the plant, which are known anti-inflammatory agents (Hamidah, Moektiwardoyo, & Abdassah, 2019). For a more detailed overview, the plant species documented during the fieldwork are presented in Table 1.

Table 1. Detailed Overview of the Plant Species Documented During the Fieldwork.

| No | Local Name | Scientific Name | Family | Part Used | Traditional Use/Function (Student Findings) | Location (Group) |
|---|---|---|---|---|---|---|
| A | Ritual & Cultural Keystone | | | | | |
| 1 | Melati | *Jasminum sambac* | Oleaceae | Flower | Mandatory symbol of purity in Nujuh Bulan (7th-month pregnancy) & Memayu rituals. | Mundu & Trusmi |
| 2 | Kelapa Gading | *Cocos nucifera var. eburnea* | Arecaceae | Fruit | Carved with Wayang figures for Nujuh Bulan ritual (symbol of hope/protection). | Mundu |
| 3 | Srigading | *Nyctanthes arbor-tristis* | Oleaceae | Flower | Sacred plant in Buyut Trusmi; dried flowers brewed as tea to lower fever. | Trusmi |
| 4 | Kembang Tujuh Rupa | *Mixed Species (Rose, Ylang, etc.)* | Various | Flower | Used in Siraman (cleansing bath) rituals for spiritual purification. | Mundu |
| B | Medicinal & Herbal (Ethnofarmacology) | | | | | |
| 5 | Jawer Kotok | *Coleus atropurpureus* | Lamiaceae | Leaf | Crushed and applied topically to treat wounds and inflammation. | Singkup |
| 6 | Temulawak | *Curcuma xanthorrhiza* | Zingiberaceae | Rhizome | Boiled to improve appetite and maintain liver health (hepatoprotector). | Singkup/Mundu |
| 7 | Kunyit Hitam | *Curcuma caesia* | Zingiberaceae | Rhizome | Rare species used as antioxidant and treatment for internal ailments. | Singkup |
| 8 | Benalu Cengkih | *Dendrophthoe pentandra* | Loranthaceae | Whole plant | Brewed as a tea to treat cancer/tumors (parasite on Clove trees). | Singkup |
| 9 | Sereh | *Cymbopogon citratus* | Poaceae | Stalk | Boiled as herbal drink (Wedang) for warming the body; also, mosquito repellent. | Singkup/Mundu |
| 10 | Sirih | *Piper betle* | Piperaceae | Leaf | Antiseptic wash for hygiene; chewed for dental health. | Mundu |
| 11 | Kersen | *Muntingia calabura* | Muntingiaceae | Leaf | Boiled water of leaves used to lower high blood pressure. | Trusmi |
| 12 | Namnam | *Cynometra cauliflora* | Fabaceae | Fruit/Leaf | Treatment for cough; fruit is high in Vitamin C. | Trusmi |
| 13 | Binahong | *Anredera cordifolia* | Basellaceae | Leaf | Boiled or crushed for rapid wound healing and post-surgery recovery. | Singkup |
| 14 | Kenikir | *Cosmos caudatus* | Asteraceae | Leaf | Consumed fresh (Lalap) to improve appetite and reduce body odor. | Singkup |
| C | Dual Function (Spice & Medicine) | | | | | |
| 15 | Bawang Merah | *Allium cepa* | Amaryllidaceae | Bulb | Crushed (topical) for fever relief; antibacterial spice. | Mundu/Singkup |

| No | Local Name | Scientific Name | Family | Part Used | Traditional Use/Function (Student Findings) | Location (Group) |
|---|---|---|---|---|---|---|
| 16 | Bawang Putih | *Allium sativum* | Amaryllidaceae | Bulb | Consumed to lower cholesterol and hypertension; main kitchen spice. | Mundu |
| 17 | Daun Seledri | *Apium graveolens* | Apiaceae | Leaf | Decoction used for cleaning kidneys/diuretic; soup flavoring. | Mundu |
| 18 | Jeruk Nipis | *Citrus aurantiifolia* | Rutaceae | Fruit | Mixed with soy sauce (Kecap) to treat coughs. | Trusmi |

Processing and Maintenance Students also documented specific processing methods, such as boiling for *Cymbopogon citratus* (*Sereh*) and direct consumption (*lalap*) for *Ocimum basilicum* (*Kemangi*). Documenting these methods is crucial, as French, Pieroni, and Quave (2016); Pieroni and Quave (2014) emphasize that the erosion of traditional knowledge often begins with the loss of "how to use" rather than the loss of the plant itself.

A cross-case analysis reveals that the majority of these plants are not harvested from the wild forest but are maintained in *pekarangan* (home gardens). Whether it is the *Pandan* (*Pandanus amaryllifolius*) for cooking in Singkup or the *Bunga Setaman* for rituals in Mundu, these plants are cultivated within the household compound. This finding supports the argument by Bernholt, Kehlenbeck, Gebauer, and Buerkert (2009); Galluzzi, Eyzaguirre, and Negri (2010) that home gardens serve as critical *in-situ* conservation units, particularly in areas undergoing rapid modernization like Cirebon.

## CONCLUSION

This study concludes that the implementation of an Ethnobotanical Inventory Project serves as a strategic pedagogical model to empower pre-service biology teachers. The findings suggest that by engaging directly with local communities in Cirebon, students effectively navigated the transition from passive learners to active agents of sustainability. First, regarding student empowerment, the project cultivated essential sustainability competencies. Students developed interpersonal competence by negotiating social access with traditional custodians (*Paraji* and *Kuncen*) and demonstrated scientific literacy by corroborating indigenous knowledge with botanical literature. The creation of dissemination products (*Pocket Books*) evidences that students have internalized the responsibility to preserve and share knowledge, effectively bridging the gap between academic science and community service. Second, regarding the ethnobotanical findings, the study revealed a distinct bio-cultural pattern in Cirebon. The inventory highlights a dichotomy in conservation motivations: a "Conservation through Culture" approach in coastal and sacred sites (Mundu and Trusmi) driven by ritual needs (e.g.,

*Jasminum sambac*), versus a "Conservation through Utility" approach in agrarian communities (Singkup) driven by pharmacological needs (e.g., *Curcuma xanthorrhiza*). Ultimately, this research implies that integrating local wisdom into biology teacher education is not merely an academic exercise but a necessity for producing future teachers who are culturally sensitive and capable of leading sustainability actions.

## SUGGESTIONS

Based on the findings regarding the "Ethnobotanical Inventory Project" and its impact on pre-service biology teachers, this study proposes several recommendations for future research and practical implementation:

1. Integration of Quantitative Ecological Analysis

   While this study provided a rich qualitative inventory of plant uses and cultural values, it did not assess the ecological status of the species. Future studies should incorporate quantitative ecological methods, such as calculating the Index of Cultural Significance (ICS) and performing vegetation analysis. This would provide objective data on the abundance and distribution of the identified "Cultural Keystone Species" (e.g., *Jasminum sambac* in Mundu), offering a more precise basis for conservation planning.
2. Longitudinal Study on Student Agency

   The current study captured student empowerment within the limited duration of the 7-week course. Future research should conduct a longitudinal study to track these pre-service teachers after they enter the professional workforce. It is crucial to investigate whether the "Sustainability Agency" developed during this project translates into their actual teaching practices and ability to initiate environmental programs in schools.
3. Laboratory Validation of Ethnomedicinal Claims

   The students in the Trusmi and Singkup groups demonstrated scientific literacy by cross-referencing local claims with secondary literature. Future projects should advance this by collaborating with Chemistry or Pharmacy departments to conduct phytochemical screening on the specific plant populations found in Cirebon. This would empirically corroborate the local community's claims regarding plants like *Coleus atropurpureus* (*Jawer Kotok*) or *Cynometra cauliflora* (*Namnam*).
4. Utilization of Artifacts for Ecotourism and Education

   The dissemination products created by the students, specifically the *Pocket Books* (*Buku Saku*), should be utilized beyond the classroom. It is recommended that these booklets be distributed to local village governments and integrated into community programs. Specifically, for the *Buyut Trusmi* Cultural Site, these booklets can serve as educational

guides for Ethno-tourism, adding a layer of botanical education to the existing cultural tourism experience. This ensures that the academic "Action" creates a lasting impact on the community.

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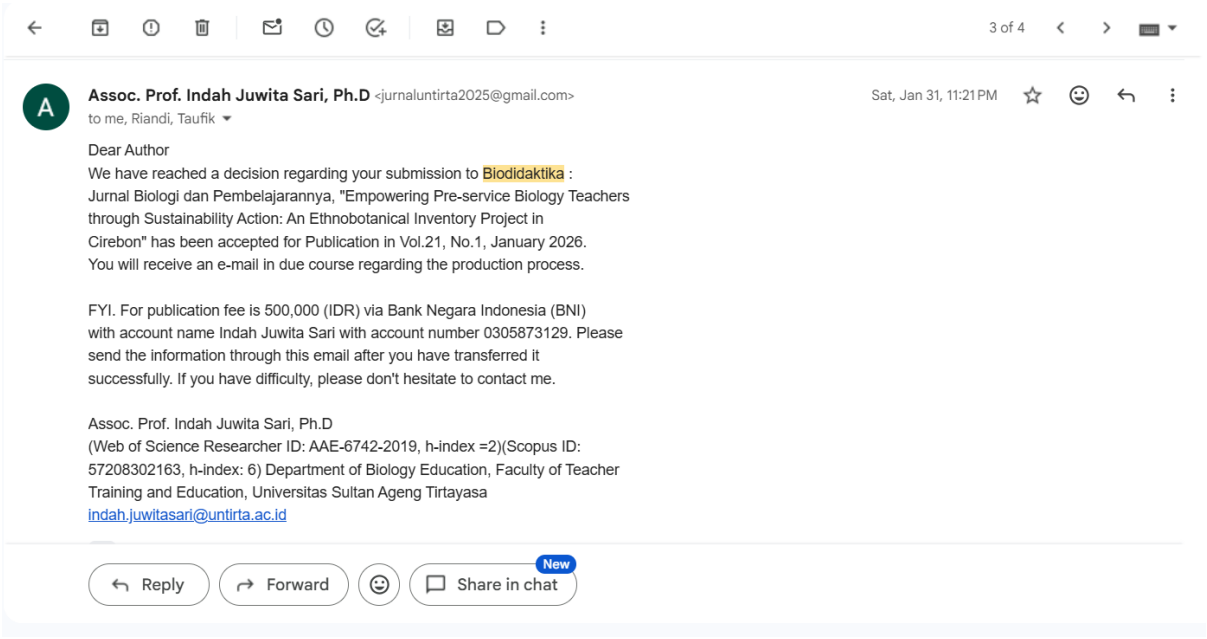

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## Empowering Pre-service Biology Teachers through Sustainability Action: An Ethnobotanical Inventory Project in Cirebon

*Bambang Ekanara, Riandi Riandi, Taufik Rahman, Rini Solihat, Lilit Rusyati*

### Abstract

Integrating Education for Sustainable Development (ESD) into teacher education requires shifting from theoretical knowledge to practical action competence. This study aims to describe how an Ethnobotanical Inventory Project empowers pre-service biology teachers to navigate the complexities of community-based conservation. Employing a qualitative case study design, the research focuses on three student working groups at UIN Siber Syekh Nurjati Cirebon who investigated distinct cultural sites: the Mundu coastal area, the Buyut Trusmi sacred site, and the Singkup agrarian village. Data were collected through field observations, semi-structured interviews, and analysis of student artifacts. The results demonstrate that the project successfully cultivated sustainability agency. Students developed interpersonal competence by negotiating access with traditional custodians (Paraji and Kuncen) and demonstrated scientific literacy by validating local knowledge with botanical taxonomy in their dissemination products (Pocket Books). Furthermore, the inventory highlighted a dichotomy in plant conservation: "Cultural Keystone Species" driven by ritual needs in Mundu and Trusmi (e.g., Jasminum sambac), versus pharmacologically validated medicinal plants in Singkup (e.g., Curcuma xanthorrhiza). It is concluded that incorporating local wisdom into biology learning serves as a strategic pedagogical tool to

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