

# Forest Zoning as a Pedagogical System: Intergenerational Transmission of Ecological Knowledge in the Dukuh Indigenous Community

Romy Faisal Mustofa<sup>1</sup>, Randy Fadillah Gustaman<sup>\*1</sup>, Lilis Rosita<sup>1</sup>

\*randy.fadillah@unsil.ac.id

<sup>1</sup>Universitas Siliwangi

## Abstract

Amidst global environmental change, the erosion of Traditional Ecological Knowledge (TEK) poses a critical threat to biodiversity conservation and sustainable governance. While TEK is widely recognized, the mechanisms of its intergenerational transmission, particularly how it is embedded within spatial governance, remain a significant gap in cultural ecology and Indigenous studies. This study examines how the forest zoning system of the Dukuh Indigenous community in West Java, Indonesia, functions as a pedagogical infrastructure. Using a qualitative instrumental case study design, data were collected over eight months through participant observation, in-depth interviews, and documentary analysis with customary leaders, elders, adults, and youth, followed by thematic analysis. Findings reveal that the zoning system, comprising five zones including leuweung tutupan (protected forest) and leuweung larangan (sacred forest), operates not merely as a resource management tool but as a spatial curriculum. Knowledge is transmitted through experiential learning mediated by the spatial logic of the zones, where each zone dictates distinct pedagogical encounters encoding values of restraint, reciprocity, and ecological guardianship. This mechanism, termed spatial pedagogy, differs from transmission patterns in comparable Indigenous communities by embedding normative ecological lessons within the physical act of navigating the landscape, without reliance on formal instruction. This article contributes to cultural ecology by challenging static views of environmental governance and demonstrating how spatial structures function as dynamic socio-cultural learning infrastructures. It extends scholarship on Indigenous ecological knowledge by specifying spatial pedagogy as a mechanism through which governance systems inherently reproduce the ecological ethics they are designed to enforce.

Received 12 December 2025  
Revised 27 March 2026  
Accepted 9 April 2026  
pp. 63-81

## Keywords

*Cultural Ecology, Dukuh Indigenous Community, Forest Zoning System, Indigenous Ecological Knowledge, Intergenerational Knowledge Transmission*

## To cite this article

Mustofa, R. F., Gustaman, R. F., Rosita, L. (2026). Forest Zoning as a Pedagogical System: Intergenerational Transmission of Ecological Knowledge in the Dukuh Indigenous Community. *Diakronika* 26(1), 63-81. <http://doi.org/10.24036/diakronika/vol26-iss1/509>.



This work is licensed under the Creative Commons Attribution-ShareAlike 4.0 International License.

## Introduction

For centuries, Indigenous communities across the Indonesian archipelago have developed sophisticated ecological knowledge systems that underpin sustainable environmental management. This body of knowledge, known as Traditional Ecological Knowledge (TEK), is understood as an accumulated repository of understandings, practices, and beliefs concerning human–environment relationships, transmitted intergenerationally through lived experience and ritual processes. Numerous studies have demonstrated that Indigenous ecological knowledge significantly contributes to biodiversity conservation, ecosystem resilience, and sustainable resource governance. Globally, Indigenous Peoples manage or hold tenure to over a quarter of the world's land surface, supporting disproportionately high levels of biodiversity. Quantitative analyses indicate that lands managed by Indigenous peoples intersect with over 40% of Key Biodiversity Areas and account for 54% of the world's remaining intact forests (Institute, 2024).

In Indonesia, Indigenous communities uphold a variety of ecological knowledge systems that are deeply embedded within their customary institutions. The Constitutional Court Decision No. 35/PUU-X/2012 (*Mahkamah Konstitusi Republik Indonesia, 2012*) signifies a significant legal milestone by declaring that "*hutan adat*" (customary forests) are no longer classified as part of state forests but are regarded as forests owned by Indigenous communities. This legal recognition is further implemented through Government Regulation No. 23 of 2021 (Pemerintah Republik Indonesia, 2021) and the Minister of Environment and Forestry Regulation No. 9 of 2021 (K. L. H. dan K. R. Indonesia, 2021). Despite these legislative advances, the practical application of such policies remains inconsistent. As of 2024, the Ministry of Forestry has officially recognized approximately 260,000 hectares of customary forests (Kementerian Kehutanan Republik Indonesia, 2024), whereas the Ancestral Domain Registration Agency (BRWA) has mapped over 30.1 million hectares of potential Indigenous territories (Adat, 2024).

Among such communities, Kampung Adat Dukuh in Garut Regency, West Java, sustains a robust relationship with its surrounding forest through a customary zoning system. The Dukuh community categorizes forest regions into several classifications: *leuweung garapan* (cultivation forest), *leuweung tutupan* (protected forest), *leuweung larangan* (forbidden forest), *leuweung cadangan* (reserve forest), and *leuweung titipan* (entrusted forest), each bearing distinct ecological functions and moral regulations that govern resource utilization. This zoning system establishes a graduated spectrum of access and restriction, integrating ecological principles into the spatial organization of the landscape.

Previous research on Indigenous ecological knowledge has extensively documented its content, conservation values, and integration with science; however, fewer studies have systematically examined how such knowledge is transmitted across generations. The pedagogical role of spatial management systems, such as forest zoning, remains insufficiently explored. Drawing from place-based pedagogy and informal learning theory (Lave & Wenger, 1991), I conceptualize this role as the process whereby the landscape's spatial structure functions as a site of situated learning, transmitting values and practices through daily engagement. Understanding these mechanisms is urgent for the Dukuh community, which faces pressures from plantation expansion, youth out-migration, and digital media competition, all amidst incomplete formal recognition of customary forests.

This study examines how ecological knowledge is transmitted across generations within the forest zoning system of the Dukuh Indigenous community, addressing the question: How does this zoning system function as a socio-cultural mechanism involving structured, recurring processes that encompass social relations, cultural practices, and institutional arrangements for intergenerational knowledge transmission? This article contributes to the fields of Indigenous ecological knowledge and cultural ecology by illustrating how spatial management systems concurrently serve as pedagogical and social mechanisms essential for the preservation of knowledge. Existing scholarship has primarily concentrated on three areas: socialization through family, storytelling, and ritual; cognitive aspects of

traditional ecological knowledge (TEK) acquisition; and place-based education. However, these approaches have predominantly considered space as merely a backdrop or content, rather than as a structured pedagogical framework.

This study offers a process-oriented understanding by conceptualizing the zoning system as a spatial curriculum. It diverges from previous research in three ways. Firstly, while Indigenous pedagogy studies emphasize who teaches and what is taught, this study demonstrates how spatial arrangements structure the timing, sequence, and mode of learning. Secondly, unlike place-based education's focus on emotional connection, it elucidates how zoning categories operationalize graded access and spatially distributed authority, with each zone delineating social roles, permissible activities, and accountability. Thirdly, in contrast to socialization studies emphasizing explicit instruction, it accentuates implicit learning embedded in daily practices, wherein moral norms are internalized through embodied engagement with zone-specific constraints and consequences. Accordingly, the spatial system functions not as a passive container but as an active pedagogical agent that generates and perpetuates ecological knowledge.

The Dukuh spatial-pedagogy system anticipates place-based education by designated the forest as the classroom and promoting participatory learning. It embodies ecopedagogy's concept of ecological citizenship (Kahn, 2010) through the *titipan* guardianship concept. Notably, its spatial differentiation across zones, from *garapan* (practice) to *larangan* (ethics) to *titipan* (theology), establishes a comprehensive developmental curriculum that is fully institutionalized rather than merely experimental.

### **Research Methods**

This study employs a qualitative instrumental case study methodology (Stake, 1995) to investigate the transmission of intergenerational ecological knowledge within the forest zoning system of the Dukuh Indigenous community. The research design is classified as instrumental rather than intrinsic, as the case aims to elucidate the broader phenomenon of how spatial management systems function as mechanisms for knowledge dissemination, rather than being examined for their inherent characteristics. A single case has been selected over a collective design to facilitate in-depth analysis and to generate theoretical insights regarding the relationship between spatial organization and pedagogical processes. The study endeavors to achieve analytical generalization (Yin, 2018), rather than statistical generalizability.

Notably, this research adopts a theory-developing stance. Instead of solely applying existing frameworks such as situated learning (Lave & Wenger, 1991) or place-based pedagogy (Gruenewald, 2003), it aims to extend these theories by conceptualizing the forest zoning system as an autonomous pedagogical infrastructure. While the literature on Indigenous knowledge transmission emphasizes social actors (elders) and cultural practices (storytelling, rituals) as primary vehicles, this study posits that spatial systems, through internal differentiation and embedded rules, can structure the timing, sequence, and mode of learning. By analyzing the Dukuh case instrumentally, the study proposes a theoretical framework, spatial pedagogy, that can be examined in other contexts where customary spatial classifications influence intergenerational learning (Stake, 2005).

The research was conducted in Kampung Adat Dukuh, Garut, West Java. Utilizing purposive sampling, informants were selected based on inclusion criteria reflecting intergenerational transmission: customary leaders (*kuncen*, *sesepuh*) required formal recognition and a minimum of thirty years of residence; adults needed five years of active participation in forest activities; and youth (aged 15–24) were born and raised locally and currently engaged in forest-related activities under the supervision of elders. A total of fifteen informants participated, comprising one *kuncen*, four elders, five adults, and five youth. The determination of sample size was guided by data saturation, in accordance with the standards of qualitative case studies (Hennink & Kaiser, 2022). The group of ten male and five female informants reflected gender-specific roles, with men predominantly involved in

clearing and customary deliberations, and women primarily engaged in seed selection, planting, and the transmission of knowledge related to non-timber forest products and domestic activities.

Youth aged 15–18 typically accompany their parents to leuweung garapan under direct supervision, exemplifying guided participation. Individuals aged 19–24 increasingly participate in leuweung tutupan and leuweung cadangan, often independently, indicating a transition towards legitimate peripheral participation (Lave & Wenger, 1991). Data collection occurred over eight months (January–August 2024) while the researcher was resident in the Dukuh territory. Participant observation adhered to the participant-as-observer framework (Spradley, 1980), encompassing activities ranging from swidden farming to ritual preparations, which were documented in field notes. Semi-structured interviews were conducted with all fifteen informants in Sundanese, each lasting between 90 and 180 minutes, addressing four domains: life histories, forest zoning and regulations, learning pathways, and intergenerational changes. All interviews were audio-recorded, transcribed, and translated.

The documentation analysis encompassed externally produced materials, including the 2024 customary forest recognition decree (Kementerian Kehutanan Republik Indonesia, 2024), spatial maps (Badan Registrasi Wilayah Adat, 2024), and academic reports, alongside community-generated materials such as hand-drawn maps, photographs of boundary markers, and transcribed oral histories. Methodological triangulation (Denzin, 1978) across participant observation, interviews, and documents served to enhance credibility. Data analysis adhered to the interactive model proposed by Miles, Huberman, and Saldana, which comprises three interconnected stages: data condensation, data display, and conclusion drawing.

The process of data condensation commenced with the transcription of all interviews and field notes. This was followed by coding utilizing a combination of inductive and deductive methodologies. Deductive codes were established based on the research framework, encompassing actors involved, learning processes (e.g., observation, direct instruction, trial and error), and cultural media of transmission (e.g., ritual, oral tradition, daily practice). Inductive codes emerged organically from the data itself, capturing emic categories specific to the Dukuh community. Coding was performed manually using Microsoft Excel and physical coding sheets, thereby enabling the researcher to maintain close engagement with the data. Initial codes included: *ngiring ka huma* (accompanying to the fields), *dititah* (being instructed to perform tasks), *ningali* (observing), *dipikareueus* (a sense of pride as motivation), *teu meunang motong* (prohibition against cutting), *leuweung larangan téh keramat* (the forbidden forest is sacred), and *kudu ngajaga* (an obligation to protect). These codes were subsequently categorized into broader themes such as guided participation, spatially-graded access, ritual reinforcement, and moral accountability.

The presentation of data involved the development of analytical matrices that explicitly connected forest zone categories to pedagogical mechanisms. For illustrative purposes, one matrix aligned each zone (*leuweung garapan*, *leuweung tutupan*, *leuweung larangan*, *leuweung cadangan*, *leuweung titipan*) with observed learning processes (e.g., guided participation, independent practice, ritual instruction), social actors involved, and types of ecological values internalized. This matrix framework facilitated systematic comparison across zones, revealing that *leuweung garapan* primarily served as a site for guided participation and practical skill acquisition, while *leuweung larangan* functioned through ritual instruction and the internalization of sacred prohibitions. These matrices acted as analytical tools to synthesize data from interviews, observations, and documents into a coherent thematic narrative. Indicators of internalization were operationalized to move beyond abstract claims. For the purposes of this study, "internalization" was considered evident when informants demonstrated: (1) verbal articulation, the ability to explain zone-specific rules and their rationales without prompting; (2) behavioral consistency, the observed adherence to customary rules even when not under direct supervision; (3) emotional response, expressions of discomfort, fear, or respect when

discussing violations of zone-specific prohibitions; and (4) spontaneous transmission, instances where youth independently corrected peers or younger children regarding zone-appropriate behavior. These indicators were applied during both observation and interview analysis to empirically substantiate claims about knowledge internalization.

Verification and trustworthiness were addressed through multiple strategies following (Lincoln & Guba, 1985) criteria for qualitative research. Credibility was established through triangulation of sources and methods. Source triangulation involved comparing accounts across informant categories, kuncen, elders, adults, and youth, to identify converging and diverging perspectives. Methodological triangulation cross-checked observational data with interview findings and documentary evidence. Additionally, prolonged engagement in the field (eight months of residence) and persistent observation of knowledge transmission events across different contexts contributed to credibility. Confirmability was ensured through a reflexive journal maintained throughout fieldwork, documenting the researcher's assumptions, positionality, and analytical decisions. Furthermore, member checking was conducted with the kuncen and two elders, who reviewed a summary of preliminary findings to verify the accuracy of interpretations and to confirm that the researcher had captured community perspectives faithfully. Minor clarifications were made following their feedback. Transferability was addressed through thick description (Geertz, 1973) of the Dukuh context, the forest zoning system, and the socio-cultural mechanisms of knowledge transmission, enabling readers to assess the applicability of findings to other Indigenous communities with comparable spatial management systems.

## **Result**

### **Community of Kampung Dukuh**

Kampung Dukuh, an indigenous village situated in Garut Regency, West Java, preserves ancestral traditions while navigating continuity through mechanisms such as differentiated rule adherence, kinship organization, and the charismatic authority of the kuncen. Located at an elevation of 800–1,200 meters (Hidayat et al., 2016), its historical remoteness (Hilman & Hendriawan, 2018) has contributed to the preservation of customary governance, although recent infrastructural developments have enhanced external connectivity (Lahpan et al., 2025). The community's relationship with nature is articulated through the principle of reciprocity: "The forest is our mother; we must protect it" (Dandirwalu & Qodim, 2021). This is reflected in prohibitions on the felling of certain trees, ritual protocols concerning sacred forests, and collective maintenance of water sources. These values are internalized through education and enforcement (Hayati et al., 2019). Socially, the community distinguishes between Dukuh Dalam (direct descendants of the founding figure), who observe strict prohibitions, and Dukuh Luar (related families with fewer obligations). Authority over the forest, particularly over leuweung larangan, resides with the elders of Dukuh Dalam and the kuncen. Consequently, the youth of Dukuh Dalam learn both practical and ritual aspects of forest governance, whereas the youth of Dukuh Luar primarily acquire practical knowledge (Sidiq, 2022). Social cooperation in communal activities functions within this differentiated social structure (Hidayana & Lahpan, 2022).

Cooperative activities are intrinsically linked to the forest zoning system. Timber intended for residential construction is obtained from designated zones under the supervision of elders (Hidayat et al., 2016), while materials used for ceremonial offerings originate from customary forests managed collectively (Dandirwalu & Qodim, 2021). Knowledge transfer takes place during these activities, with elders instructing youth on appropriate procurement practices (Sofianto et al., 2023). Additionally, the younger generation employs digital platforms to express cultural heritage while upholding traditional values (Lahpan et al., 2025). Kampung Dukuh has been officially designated as a Culture Preservation Region (Hilman & Hendriawan, 2018), emphasizing its indigenous wisdom in managing human–nature interactions (Hayati et al., 2019).

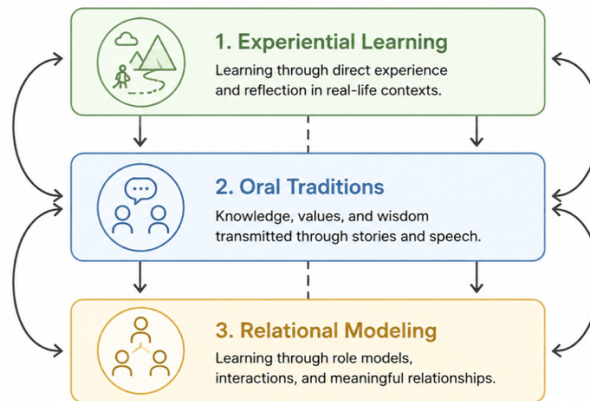


Figure 1. Conceptual illustration of three interrelated and mutually reinforcing pathways: Experiential Learning, Oral Traditions, and Relational Modeling. These pathways interact cyclically in the transmission and co-creation of knowledge, values, and wisdom

Source(s): Author's own elaboration

Religious life integrates Islam with pre-Islamic adat, forming a coherent symbolic system. Customary forest regulations derive dual authority from syariat and adat, reinforced by ancestral piety. The Ngabukti ritual at the sacred grave in leuweung larangan reaffirms prohibitions, while Muludan involves sourcing offerings from designated zones with youth instruction. These rituals create collective effervescence (Durkheim, 1995), transmitting the spatial logic of zoning as inseparable from religious observance. From a cultural ecology perspective, the Dukuh zoning system validated by Islamic and ancestral authority constitutes a cultural core that regulates resource utilization. Ritual functions as a mechanism for ecological governance (Rappaport, 1968), with the kuncen embodying charismatic authority (Weber, 1978). Informants associated forest prohibitions with spiritual and material consequences: “If [the forbidden forest] is damaged, harvests fail, illness comes” (elder). Youth primarily learn rules through ritual contexts, such as Ngabukti, where elders reinforce prohibitions. This transmission operates through habitus (Bourdieu, 1977), as youth internalize values via repeated practices, for example, collecting leaves from leuweung titipan during Muludan under elder supervision, thereby embedding ecological knowledge within a framework of spiritual accountability.



Figure 2. Kampung Dukuh, Garut  
Source(s): Author's own elaboration

Table 1 below delineates the five traditional forest zones (leuweung) acknowledged by the Dukuh indigenous community. For each zone, the table specifies its ecological role, the particular regulations and prohibitions enforced, the customary sanctions administered for infractions, and the educational significance conveyed to younger generations through these customs.

Table 1. five customary forest zones (leuweung) of the Dukuh indigenous community

Zone Name	Ecological Function	Rules/Prohibitions	Customary Sanctions	Pedagogical Value
<b>Leuweung Larangan</b>	Total conservation; safeguards water systems, prevents erosion, maintains soil fertility, and stabilizes the microclimate.	Absolute prohibition – no logging, harvesting, or entry, except for specific ritual purposes.	Severe sanctions: expulsion from the community (dipoyok), heavy fines in the form of livestock (buffalo/chicken), plus a ritual cleansing ceremony (sajen).	Sacredness & Obedience. Young people learn that certain natural areas are sacred and inviolable, instilling deep respect for ancestors and nature.
<b>Leuweung Tutupan</b>	Rehabilitation & fallow reserve. Former cultivation areas left to regrow; restores soil fertility and biodiversity for future use.	No planting or felling. Even naturally dead wood may not be taken. The closure period lasts 10–25 years until the customary leader reopens the area.	Social sanctions (verbal warnings), light customary fines, and an obligation to manually restore the area to its natural state.	Responsibility & Patience. Teaches the concept of forest fallow cycles and the importance of giving nature time to recover (fallowing system). Instills restraint from instant exploitation.
<b>Leuweung Garapan</b>	Food production zone. Allowed for shifting cultivation or mixed gardens to meet community subsistence needs.	No chemical pesticides; must use intercropping (perennial and seasonal crops); mass commercial sale outside the community is prohibited.	Violations (e.g., farming in a forbidden zone) can result in confiscation of harvest or a required communal feast to apologize to the earth.	Self-reliance & Ecology. Young people learn that meeting food needs must not damage the ecosystem. They are taught farming methods that work in harmony with nature (no synthetic chemicals).
<b>Leuweung Cadangan</b>	Buffer & resource zone. Provides	Selective harvesting. Only	Customary fines requiring	Planning & Prioritization.

	specific materials (timber for traditional houses, bamboo for crafts) and acts as a buffer between other zones.	certain species may be taken, and only in specified quantities; clear-cutting is forbidden.	tree replacement of timber several times over, or payment of a customary fee valued much higher than market price.	Teaches the importance of using resources selectively. Young people learn that not all resources can be taken at any time only for primary needs.
<b>Leuweung Titipan</b>	Heritage & protection zone. Usually small forests around springs, ancestral graves, or steep cliffs believed to have spiritual guardians.	Absolute prohibition on damaging, littering, or polluting water sources in the area. Activities are extremely limited (e.g., taking water for rituals).	Believed to bring mystical consequences (illness, misfortune) passed down through generations, along with social ostracism for “violating what was entrusted by the ancestors.”	Spirituality & Water Conservation. Instills the understanding that water and ancestral heritage are sacred and must be protected. Teaches a sense of shame (isin) for damaging areas entrusted by ancestors.

Source(s): Author's own elaboration

With regard to the research question concerning the transmission and enforcement of indigenous ecological knowledge, Table 1 illustrates that the Dukuh’s zoning system functions not merely as a resource management instrument but also as an integrated pedagogical framework. Each zone associates a unique ecological function with graduated sanctions, ranging from substantial fines and expulsion for sacred Leuweung Larangan to social warnings for Leuweung Tutupan, thereby embedding environmental norms into everyday life. The 'pedagogical values' column explicitly demonstrates that these zones impart virtues such as obedience, patience, self-reliance, and planning.

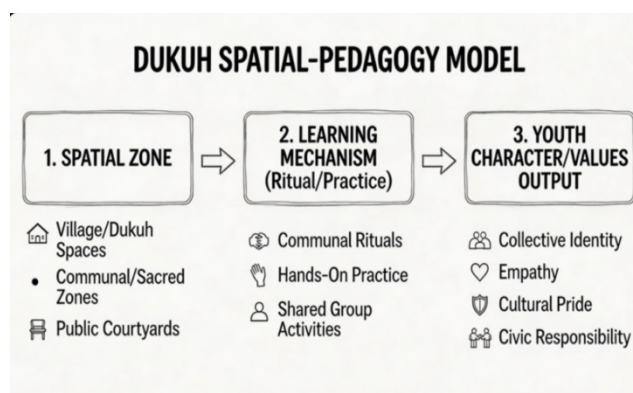


Figure 3. Dukuh Spatial-Pedagogy Model

Source(s): Author's own elaboration

This alignment between ecological degradation and moral failure is empirically reinforced by an informant's statement: *"If you take wood from the Leuweung Cadangan without permission, the customary leader will fine you three times the market price. We teach our children: 'The forest is not a store; you take only what is needed, and only when the adat says yes.'"* Such verbatim accounts confirm that customary sanctions and spiritual beliefs (e.g., mystical consequences in Leuweung Titipan) function as deterrents while simultaneously instilling a sense of collective responsibility and intergenerational stewardship.

## **Discussion**

The Dukuh worldview of balance among humans, nature, and the Creator structures an informal curriculum instantiated through forest zoning. Leuweung garapan teaches reciprocity through guided participation; leuweung tutupan teaches restraint through explicit rules and corrective feedback; leuweung larangan teaches reverence through ritual affirmation. This spatial arrangement constitutes a curriculum of place, transforming cosmology into graduated, place-specific learning. In leuweung garapan, reciprocity requires ritual offerings before harvest; in leuweung tutupan, selective withdrawal prohibits cutting living trees; in leuweung larangan, abstention maintains ecological and spiritual balance. This aligns with the dwelling perspective (Ingold, 2000), where reciprocal obligations embed in spatial practice. Transmission occurs through habitus (Bourdieu, 1977) youth learn zone-appropriate reciprocity through guided participation, with elders modeling the balance of taking and giving.

The proverb *"gunung ulah dilebur, leuweung ulah diruksak, cai ulah dikotoran, sawah ulah diruksak"* (do not destroy mountains, damage forests, pollute waters, or ruin rice fields) encapsulates ecological ethics within a parallel and rhythmic structure that enhances memorability and facilitates oral transmission (Ong, 1982). Its spatial logic follows the hydrological flow from upstream to downstream. Youth members recite it spontaneously, demonstrating its role as a "verbal charter" (Vansina, 1985) that authorizes and faithfully transmits knowledge. This ecological consciousness has given rise to a distinctive conservation model (Effendi et al., 2018). Unlike state-sponsored or community forestry schemes (Ministry of Environment and Forestry Regulation No. 9/2021), the Dukuh model is characterized by three features: (1) spatial pedagogy involving age-graded learning embedded within forest zones; (2) integration of sacred authority derived from Islamic teachings and ancestral lineage, which is distinct from adat-only systems in other Sundanese communities; and (3) internal differentiation into Dukuh Dalam and Dukuh Luar, creating layered transmission pathways absent in more homogeneous customary communities. Essentially, it integrates conservation, spiritual obligation, and intergenerational pedagogy into a unified spatial system, a socio-pedagogical conservation model, where ecological sustainability is achieved through embodied knowledge reproduction across generations.

The findings suggest that the Dukuh forest zoning system functions as a fundamental pedagogical instrument for the transmission of ecological values, aligning with Traditional Ecological Knowledge (TEK) as a cumulative body of culturally conveyed knowledge (Berkes, 2018). This transmission occurs through three interconnected pathways that constitute a pedagogical triad. Experiential learning within zoned landscapes constitutes the primary pathway, embedding knowledge through practical activities and fostering habitus. Oral traditions, including myths, proverbs, and taboos, serve as the mediating pathway, transforming embodied experience into codified knowledge via mnemonic devices (Ong, 1982) and sanctified rules (Rappaport, 1968). Relational modeling by elders forms the scaffolding pathway, strategically calibrating involvement according to developmental stages (Wood et al., 1976) through guided participation (Rogoff, 2003).

These pathways are nested and interdependent. Experiential learning provides foundational material; oral traditions confer symbolic structure; relational modeling supplies social scaffolding that integrates both into a coherent trajectory. Their convergence is observable in rituals like Ngabukti, where youth engage experientially, oral traditions are recited, and elders model protocols with

corrective feedback exemplifying a community of practice (Lave & Wenger, 1991) where newcomers learn through legitimate peripheral participation (Zarger, 2002; Cajete, 1994). Primary actors in transmission include the kuncen as highest authority on zoning rules and spiritual consequences, community elders as knowledge keepers, adults (25–50) as intermediaries reinforcing daily transmission, and youth (15–24) as active recipients. This pattern reflects vertical and oblique transmission, demonstrating resilience against historical disruptions (Carroll et al., 2025; Lima Mota et al., 2023).

Social mechanisms employ contextual pedagogy: the instructional framework differs according to zone, activity, and developmental stage. Principal mechanisms encompass direct accompaniment and imitation, place-based storytelling wherein landscape functions as a mnemonic device, and enforcement via social and spiritual sanctions (Rappaport, 1968). Transmission contexts are organized by the zoning system. *Leuweung garapan* imparts reciprocity through collective labor. *Leuweung cadangan* promotes sustainable harvesting and intergenerational foresight. *Leuweung titipan* and *larangan* nurture reverence and restraint through ritual prohibitions. *Leuweung tutupan* reinforces collective responsibility. These place-based contexts underscore relationality, lived experience, and reciprocity.

Core values of conservation namely restraint and respect for ecological limits, as well as reciprocity through ritualistic offerings, were consistently observed across various informant categories. An elder articulated: “The forest is not ours to use up. We are only caretakers.” Reciprocity is demonstrated via offerings made prior to resource collection (Correia et al., 2025), aligning with practices within other Indigenous systems (Ibau Lod, 2025). This research reveals a spatial zoning system functioning as a dynamic pedagogical framework that sustains Traditional Ecological Knowledge (TEK) across generations. Building upon Berkes (2018), it emphasizes sacred landscapes as moral-ecological boundaries (Rahardjanto et al., 2025), thereby highlighting community-led transmission processes critical for sustainable governance and Indigenous self-determination.

### **The Forest Zoning System as a Pedagogical Instrument**

Findings indicate that the Dukuh forest zoning system operates as a spatial pedagogical instrument, differing from Baduy’s oral tradition and Dukuh’s ritual cycles (Yuliani et al., 2022). Each zone, comprising *garapan*, *tutupan*, *larangan*, *cadangan*, and *titipan*, serves specific pedagogical functions, integrating learning within the material environment to support intergenerational transmission and forest conservation.

The zoning system establishes a spatially encoded developmental curriculum. Similar to how formal education employs grade levels, the Dukuh zones sequence learning based on age and competence: *Leuweung garapan* involves learning through guided participation, where children accompany their parents and receive direct instructions, such as being told to perform tasks; *Leuweung tutupan* emphasizes learning through corrective feedback, including social sanctions and replanting obligations; *Leuweung larangan* facilitates learning through education by absence, where elders recount stories of transgressions and their repercussions, with visible boundary markers imparting restraint; and *Leuweung titipan* employs theological-pedagogical framing, exemplified by the concept of *titipan Pangaéran*, which signifies God’s trust and fosters a sense of guardianship. The material and regulatory properties characteristic of each zone create unique pedagogical affordances, delineating what learners can do and, consequently, what they can learn. The mode of learning is not selected arbitrarily but is guided by the spatial logic inherent to each zone. This is analogous to how a science laboratory enables experimentation, whereas a mosque encourages contemplation. The Dukuh zoning system functions as a distributed pedagogical technology wherein space itself determines the method of transmission.

The zoning system automatically regulates the timing and sequence of learning without the need for written syllabi. A child cannot bypass from *garapan* to *larangan*, as the spatial logic enforces a

developmental trajectory. This embodies the essence of a curriculum embedded within space. Lave & Wenger's (1991) concept of Legitimate Peripheral Participation (LPP) is relevant here. Youth progression follows a well-defined spatial trajectory: at ages 6–7, children engage in *ngiring ka huma* (accompanying to the fields), representing peripheral participation; at ages 10–12, they assist with planting and weeding, indicating increased centrality; at ages 15–18, they work independently and instruct younger siblings, approaching full participation; and at ages 19–24, they engage with *tutupan* and *cadangan*, attaining legitimate participation in higher-order governance. The zoning system materializes the concentric circles of LPP, with each zone representing a level of legitimate access.

Periphery → *Leuweung garapan* (children, close supervision)

Semi-periphery → *Leuweung cadangan* (adolescents, collective decisions)

Core → *Leuweung tutupan* (adults, full responsibility)

Sacred core (narrative only) → *Leuweung larangan* (kuncen and elders)

The zones function as an assessment system. When a youth demonstrates competence in *garapan*, they are granted access to *cadangan*. This is equivalent to passing a grade level, but the assessment is embedded in spatial practice rather than in tests. The landscape itself certifies learning. Moral accountability is not taught abstractly but embodied through the consequences tied to specific places. Each zone has its own "jurisprudence." The consequences are immediate, tangible, and spatially specific. A young person who takes wood from *tutupan* without permission does not receive a lecture; instead, they are made to replant trees in that very zone. The place becomes the teacher, and the consequence becomes the lesson. This represents experiential learning at its most powerful.

Drawing on Basso's (1996) concept of "wisdom sits in places," the Dukuh landscape functions as a mnemonic device, serving as a memory aid embedded in space. Physical markers such as uncut trees and bamboo stakes serve to trigger the recall of rules and narratives. The spatial sequence in the proverb reflects the geographical reality, facilitating ease of remembrance. Ritual locations, specifically at the edge of the *larangan*, activate collective memory through repeated performances.

In the absence of written texts or formal educational institutions, the Dukuh utilize space as a repository of knowledge. Each boundary marker functions as a metaphorical "book"; each ritual site serves as a "classroom." The zoning system ensures that knowledge is not confined within individual minds but is instead distributed throughout the landscape, accessible to all who traverse it. Raymond Williams' (1977) concept of the "structure of feeling" pertains to deeply internalized dispositions that are perceived as natural rather than externally imposed. The Dukuh's zoning system engenders a fiduciary structure of feeling, an intrinsic, pre-reflective sense that humans are custodians rather than proprietors. This understanding is cultivated through repetitive, place-specific actions: (1) Children repeatedly hear the phrase "this is entrusted, not owned" when passing water sources (*titipan*). (2) Youth continually experience that *cadangan* (storage) is "saved for grandchildren" through collective deliberation. (3) The entire community consistently performs rituals at the boundaries of *larangan*, reaffirming that certain spaces are inviolable. True education extends beyond mere information transfer to encompass character formation. The zoning system functions as a character-forming mechanism, operational through embodied, repeated practices in designated locations. It does not resemble conventional schooling; rather, it embodies life itself. This very quality underpins its effectiveness.

The distinctive assertion of Spatial Pedagogy and the innovative aspect of the Dukuh case is that space functions not merely as a passive container for learning, but as an active pedagogical agent. The zoning system imparts ecological ethics not through explicit instruction but via graduated access, zone-specific consequences, boundary markers, and repetitive place-bound practices. It constitutes a curriculum that remains perpetually open, a classroom without walls, and a teacher that ceaselessly endeavors, composed of trees, trails, and tangible consequences. Consequently, the Dukuh forest zoning system is recognized as a pedagogical framework precisely because its spatial logic structures,

sequences, and enforces the transmission of ecological knowledge across generations, thereby making the landscape itself the most enduring and efficacious educator.

### **Elders as Primary Knowledge Holders and Transmitters**

Elders, particularly the *kuncen*, function as primary custodians of knowledge, possessing memories anchored in land and tradition. This perspective aligns with scholarly research emphasizing elders as essential transmitters of Traditional Ecological Knowledge (TEK); Dukuh's preservation of elder authority exemplifies resilience in the face of colonial disruption (Carroll et al., 2025). The process of transmission is inherently relational, whereby youth acquire knowledge through accompaniment, observation, and the gradual assumption of responsibilities, aligning with Indigenous methodologies and the principles of Storywork (Archibald, 2021). Additionally, elders play a mediating role in fostering relationships with the more-than-human world (Correia et al., 2025).

### **Oral Traditions, Myths, and Taboos as Ecological Wisdom**

Experiential learning and oral traditions are profoundly embedded in Dukuh: stories are conveyed during activities, fostering situated learning (Lave & Wenger, 1991). The landscape serves as a mnemonic device, with youth observing that elders recount ancestral stories linked to specific locations. This integration creates redundant pathways of learning that bolster cultural resilience (Carroll et al., 2025). Oral traditions embody ecological wisdom through narratives and taboos. An elder's account of a man who desecrated the sacred forest and subsequently suffered illness until ritual restoration underscores respect for environmental limits. Such narratives function as cultural keystone stories. In Dukuh, prohibitions against cutting sacred trees safeguard watersheds, while seasonal harvesting restrictions ensure species sustainability, exemplifying ecological wisdom embedded in cultural practices (Ibau Lod, 2025).

### **Values Transmitted: Conservation and Reciprocity**

The findings delineate two fundamental values: conservation restraint, respect for ecological limits, and intergenerational responsibility coupled with reciprocity through rituals and the preservation of balance. An elder articulated: "The forest is not ours to exploit. We are merely custodians... This is the reason why the sacred forest must remain untouched." In response to contemporary pressures, the community enhances the transmission of these values through structured initiatives: annual *musyawarah adat* now focus on youth engagement; the *kuncen* assigns youth to elders via a mentorship framework; ritual events include dedicated instruction on forest conservation; participatory mapping involves youth as educators; and elders collaborate with local educational institutions. These initiatives exemplify reflexive adaptation (Carroll et al., 2025).

Reciprocity is practiced through offerings before collecting forest products, embodying "stimulating reciprocity" (Correia et al., 2025) and operationalizing ecological justice (Schlosberg, 2007) extending justice beyond distribution to recognize nature's intrinsic worth. This aligns with Indigenous justice frameworks linking stewardship to cultural survival and intergenerational responsibility. Synthesizing these principles, I propose the Dukuh Spatial-Pedagogy Model, characterized by: (1) graded spatial zones structuring age-appropriate learning; (2) multimodal transmission (experiential, oral, ritual, relational); and (3) embodied moral accountability internalized through zone-specific consequences. This model offers a transferable framework in which spatial systems function both as conservation infrastructure and pedagogical apparatus.

The forest zoning system (*garapan*, *tutupan*, *larangan*, *cadangan*, *titipan*) constitutes more than mere content to be conveyed; it forms a spatially organized pedagogical infrastructure. Knowledge is not solely linked to sacred sites; rather, it is generated by the inherent spatial logic of the zones themselves. Berkes regards sacred space as a symbol or moral prompt. The Dukuh case illustrates that zoning functions as an autonomous transmission mechanism, with each zone possessing its own

curriculum, methodology, and assessment criteria. In essence, TEK is transmitted not only through space but is also enacted by it. This perspective shifts the focus from the content of knowledge to the manner in which space facilitates learning, namely, spatial pedagogy.

The comparative dimension of this study represents one of the article's primary contributions, particularly in demonstrating how indigenous educational practices are structured through distinct yet interconnected cultural mechanisms. Although the previous discussion outlined similarities and differences among the Dukuh, Baduy, and Kasepuhan communities descriptively, the comparison remained embedded within narrative form. To provide a clearer analytical framework, Table 2 systematically presents the principal features of knowledge transmission across the three communities. The comparison focuses on five major dimensions: transmission mechanisms, the role of space, age-based access, sacred authority, and social differentiation.

Table 2. Principal Features of Knowledge Transmission Across the Three Communities

Features	Dukuh Community	Baduy Community	Kasepuhan
<b>Transmission Mechanism</b>	Experiential learning through daily practice, communal participation, and ritual engagement	Oral traditions, customary teachings, and embodied ritual practices	Intergenerational transmission through agricultural rituals, oral instruction, and customary ceremonies
<b>Role of Space</b>	Sacred and communal spaces function as sites of socialization and ecological learning	Spatial segregation between sacred and ordinary areas regulates knowledge circulation	Traditional houses, rice barns ( <i>leuit</i> ), and ritual spaces serve as educational and cultural centers
<b>Age-Based Access</b>	Knowledge acquired progressively according to participation and maturity	Certain sacred knowledge restricted to elders and customary authorities	Elders mediate access to ritual and cultural knowledge based on age and social responsibility
<b>Sacred Authority</b>	Religious and customary leaders act as moral and educational authorities	Strong authority vested in <i>puun</i> and customary leaders	Authority maintained through adat institutions and ancestral legitimacy
<b>Social Differentiation</b>	Social roles shaped by kinship, ritual participation, and communal obligations	Distinct customary hierarchy between leaders, ritual actors, and ordinary members	Differentiation based on lineage, ritual status, and customary responsibilities

Source(s): Author's own elaboration

The data concerning the Baduy and Kasepuhan communities were derived from secondary literature sources, whereas the Dukuh community data were obtained through primary field research and ethnographic observation. The table demonstrates that all three communities maintain educational systems deeply embedded within customary structures, sacred values, and intergenerational relationships. However, important differences emerge in the organization of authority, regulation of knowledge access, and the spatial dimensions of learning. The Dukuh community emphasizes participatory and experiential engagement in everyday communal life, while the Baduy community places stronger restrictions on sacred knowledge through customary hierarchy and spatial regulation. Meanwhile, the Kasepuhan community integrates agricultural traditions and adat institutions as central

mechanisms for cultural continuity. These findings reinforce the argument that indigenous education in Sundanese traditional communities operates not merely as informal learning, but as a culturally regulated system of knowledge reproduction, moral formation, and social cohesion.

Notwithstanding the contributions delineated above, it is imperative to acknowledge several limitations. Firstly, this investigation employs a single-case design centered on the Dukuh community in West Java. While the in-depth qualitative methodology engenders rich contextual insights, the transferability of such findings to other Indigenous or customary communities, with varying ecological, social, or political histories, necessitates cautious application. Readers are advised to evaluate contextual similarities prior to extrapolating the spatial-pedagogy model to other settings. Secondly, the fieldwork was executed over an eight-month period, which, although adequate for observing seasonal agricultural cycles and major rituals, inevitably omitted certain ritual events occurring annually or on multi-year schedules. The lack of extended immersion across multiple full ritual cycles may constrain the study's capacity to capture rarer pedagogical instances, such as the reopening ceremonies for *Leuweung Tutupan*, which transpire once every 10–25 years. Thirdly, the findings predominantly reflect male perspectives, as key informants, including the *kuncen* and most elders, were primarily men. Women's roles in transmitting ecological knowledge, particularly within *Leuweung Garapan* and household-level practices, were comparatively underrepresented, potentially omitting gendered dimensions of Traditional Ecological Knowledge (TEK) transmission. Future research should intentionally prioritize women's voices. Fourthly, the comparative assertions regarding the *Baduy* and *Kasepuhan* communities (summarized in Table 2) are solely grounded in secondary literature rather than primary ethnographic data. Although these sources are reputable, the absence of direct comparative ethnographic research implies that observed differences may partly stem from divergent research methodologies or historical documentation styles, rather than authentic community distinctions. These limitations do not invalidate the study's conclusions but underscore the necessity for multi-site, longitudinal, and gender-balanced studies to further evaluate and refine the spatial-pedagogy framework.

## **Conclusion**

This investigation explored the transmission of intergenerational ecological knowledge within the forest zoning system of the Dukuh Indigenous community. The five-tier classification, *leuweung garapan*, *tutupan*, *larangan*, *cadangan*, and *titipan*, serves as a dynamic pedagogical framework wherein learning is intrinsically linked to agricultural practices, harvesting activities, and ritualistic traditions. The process of transmission occurs through a hierarchical structure: experiential learning in designated landscapes constitutes the foundational level; oral traditions, including myths, taboos, and proverbs, encapsulate embodied experiences; and relational modeling by elders, notably the *kuncen*, offers scaffolding that sequences and integrates these pathways. The fundamental values conveyed include restraint, particularly in distinguishing need from greed, and reciprocity, which are operationalized through offerings and the fiduciary concept of *titipan Pangaéran* (God's trust). This positions the youth as custodians and guardians rather than owners.

Theoretically, this study contributes to the concept of pedagogical infrastructures as spatially organized systems that structure intergenerational learning as a byproduct of everyday practice, extending Berkes's (2018) work on sacred ecology. The Dukuh case demonstrates that TEK resilience depends on spatial organization that encodes, triggers, and transmits knowledge. Pressures include knowledge concentration in the *kuncen*, youth out-migration, and market logics. The community adapts through structured mentorship, ritual intensification, and school integration. The five zones form a functional synergy: each teaches distinct values such as reciprocity, restraint, reverence, intergenerational patience, and guardianship, yet resilience resides in their interdependence. For sustainability discourse, the Dukuh model offers a place-based fiduciary ethic, suggesting that policy

should support conditions of practice, including intergenerational interaction, ritual cycles, and spatial access, rather than merely formal recognition.

Recognize forest zoning as a pedagogical system, rather than merely a tenure category. The current customary forest recognition (SK Hutan Adat) predominantly emphasizes legal tenure. Amend the assessment criteria to incorporate documentation of internal zoning systems (zona pemanfaatan, perlindungan, larangan, titipan, cadangan) as evidence of functional transmission of Indigenous Ecological Knowledge (TEK). Additionally, integrate a “spatial pedagogy index” into the verification process for customary forest recognition. Communities that maintain a graded zoning system coupled with intergenerational learning mechanisms should be given priority for recognition and support. Physical markers such as uncut trees, bamboo stakes, and stone piles are not solely boundary indicators; they serve as mnemonic devices that evoke the remembrance of rules and narratives. Current forestry operations often remove or overlook these markers. Therefore, issue a technical guideline (Petunjuk Teknis) explicitly prohibiting the removal or alteration of customary boundary markers within recognized customary forests, and include these markers as protected features within forest management plans. The practices of the Dukuh community, including participatory mapping with youth, annual musyawarah adat, and rituals like Ngabukti, are not merely “cultural events” separate from conservation efforts; rather, they constitute the fundamental mechanisms that reproduce ecological ethics. It is recommended to utilize Social Forestry funding for ritual cycle maintenance, intergenerational mapping workshops, and youth-elder mentorship programs. Currently, such funding is limited to physical infrastructure and commodity production. State national parks often designate a single “strict protection” zone; however, the Dukuh model demonstrates that graded access, ranging from cultivation to sacred core, can effectively achieve both conservation objectives and intergenerational learning. It is proposed to pilot a “spatial pedagogy zone” within select national parks adjacent to Indigenous territories, where local communities are empowered to manage graded access zones that emulate the Dukuh five-zone system.

### **Acknowledgment**

The authors wish to express their sincere gratitude to the Research and Community Service Institute (LPPM) of Siliwangi University for the financial support and facilities provided throughout the implementation of this research. The assistance provided through the internal grant scheme for the 2025 Fiscal Year (Number: 270/UN58.06/PM.00.00/2025) was instrumental in the successful execution of the field study and data analysis concerning the inheritance of ecological values in the Indigenous Village of Dukuh, Garut.

The support provided has served as a solid foundation and a catalyst for the smooth execution of the entire research endeavor titled "Intergenerational and Ecological Value Inheritance in the Indigenous Village of Dukuh, Garut Regency." The strategic financial assistance facilitated the research team in conducting optimal field data collection, while the academic support from LPPM supplied the essential framework and validation for the research methodologies.

Thanks to the participation of LPPM Siliwangi University, the scientific contribution of this research has been realized. It is hoped that the results and findings of this study can provide benefits not only for the advancement of science but also for the preservation of the local wisdom of indigenous communities.

### **References**

- Adat, B. R. W. (2024). Data potensi wilayah adat di Indonesia per Desember 2024.
- Ansori, F. M., Rusmana, D., & Hakim, A. (2020). Kehidupan keberagaman masyarakat Kampung Adat Dukuh Cikelet-Garut, Jawa Barat. *Al-Tsaqafa: Jurnal Ilmiah Peradaban Islam*, 17(2), 221–232.
- Archibald, J. (2021). Indigenous Storywork as a Basis for Curricula That Educate the Heart, Mind, Body, and Spirit. *Oxford Research Encyclopedia of Education*.

<https://doi.org/10.1093/acrefore/9780190264093.013.1175>

- Basso, K. H. (1996). *Wisdom sits in places: Landscape and language among the Western Apache*.
- Berkes, F. (2018a). *Sacred Ecology* (4th ed.). Routledge.
- Berkes, F. (2018b). *Sacred Ecology* (4th ed.).
- Bourdieu, P. (1977). *Outline of a theory of practice*.
- Brondízio, E. S., Aumeeruddy-Thomas, Y., Bates, P., Carino, J., Fernández-Llamazares, Á., Ferrari, M. F., Galvin, K., Reyes-García, V., McElwee, P., Molnár, Z., Samakov, A., & Shrestha, U. B. (2021). Locally Based, Regionally Manifested, and Globally Relevant: Indigenous and Local Knowledge, Values, and Practices for Nature. *Annual Review of Environment and Resources*, 46, 481–509. <https://doi.org/10.1146/annurev-environ-012220-012127>
- Cajete, G. (1994). *Look to the mountain: An ecology of indigenous education*.
- Carroll, D., Houndolo, M. M., George, A. B., & Redvers, N. (2025). Knowledge Connects Our Hearts and Lands: A Qualitative Research Study on Stewarding Indigenous Traditional Ecological Knowledges for Community Well-Being. *International Journal of Environmental Research and Public Health*, 22(10), 1573.
- Correia, J. E., Piaguage Lucitante, J., Weiss, L., Narváez, N., Lucitante, L., Biaguaje, A., Piaguaje, Y., Suale, A., Payaguaje, A., Piaguage, E., Simmons, C., & Esbach, M. (2025). Stimulating reciprocity: How human–plant relations support Indigenous cultural revitalization and stewardship in the Ecuadorian Amazon. *People and Nature*, 7, 1151–1170. <https://doi.org/10.1002/pan3.70019>
- Dandirwalu, R., & Qodim, H. (2021). Baileo as a peace model for christian and muslim communities in maluku. *HTS Teologiese Studies / Theological Studies*, 77(3), 1–11. <https://doi.org/10.4102/hts.v77i3.6529>
- Denzin, N. K. (1978). *The research act: A theoretical introduction to sociological methods* (2nd ed.).
- Dockery, A. M. (2020). Inter-generational transmission of Indigenous culture and children’s wellbeing: Evidence from Australia.
- Durkheim, E. (1995). *The elementary forms of religious life* (K.).
- Effendi, M. R., Setiadi, E., & Nandang, H. M. Z. (2018). Religiusitas Masyarakat Adat Kampung Dukuh Kabupaten Garut Jawa Barat. *Interdisciplinary Journal of Communication*, 3(1), 125–146. <https://doi.org/10.18326/inject.v3i1.125-146>
- Fa L, J. E. & L. (2025). Weaving the Middle Spaces Between Indigenous and Scientific Knowledge for Biodiversity Conservation and Ecology.
- Fa, J. E., & Luiselli, L. (2025). Weaving the Middle Spaces Between Indigenous and Scientific Knowledge for Biodiversity Conservation and Ecology. *African Journal of Ecology*, 63, e70030. <https://doi.org/10.1111/aje.70030>
- Fisher, M. R., Moeliono, M., & Mulyana, A. (2018). Assessing the effectiveness of community-based forest management in Indonesia: A systematic review. *Forest Policy and Economics*, 96, 1–12.
- Flyvbjerg, B. (2006). *Five misunderstandings about case-study research*.
- Garnett, S. T., Burgess, N. D., Fa, J. E., Fernández-Llamazares, Á., Molnár, Z., Robinson, C. J., Watson, J. E. M., Zander, K. K., Austin, B., Brondízio, E. S., Collier, N. F., Duncan, T., Ellis, E., Geyle, H., Jackson, M. V., Jonas, H., Malmer, P., McGowan, B., Sivongxay, A., & Leiper, I. (2018). A spatial overview of the global importance of Indigenous lands for conservation. *Nature Sustainability*, 1(7), 369–374. <https://doi.org/10.1038/s41893-018-0100-6>
- Geertz, C. (1960). *The religion of Java*.
- Geertz, C. (1973). *The interpretation of cultures*.
- Gruenewald, D. A. (2003). *The best of both worlds: A critical pedagogy of place*.
- Guest, G., Namey, E., & Chen, M. (2020). A simple method to assess and report thematic saturation in qualitative research. *PLOS ONE*, 15(5), e0232076. <https://doi.org/10.1371/journal.pone.0232076>

- Hayati, F., Mansyur, A. S., & Aulia, E. S. N. (2019). Character education model based on local wisdom: An ethnographic study in Kampung Dukuh, Ciroyom, Garut Regency, West Java. *Proceedings of the 3rd Asian Education Symposium (AES 2018)*, 433–438. <https://doi.org/10.2991/aes-18.2019.99>
- Hennink, M., & Kaiser, B. N. (2022). Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social Science & Medicine*, 292, 114523. <https://doi.org/10.1016/j.socscimed.2021.114523>
- Hidayana, I. S., & Lahpan, N. Y. K. (2022). Makna budaya pohon aren dalam pendekatan ekologi budaya di Kampung Adat Dukuh, Cikelet, Garut. *Panggung*, 32(4), 436–451.
- Hidayat, S., Hikmat, A., & Zuhud, E. A. M. (2016). Kajian etnobotani masyarakat Kampung Adat Dukuh Kabupaten Garut, Jawa Barat. *Media Konservasi*, 15(3). <https://www.neliti.com/id/publications/231324/kajian-etnobotani-masyarakat-kampung-adat-dukuh-kabupaten-garut-jawa-barat>
- Hilman, I., & Hendriawan, N. (2018). Local wisdom of Indigenous community of Kampung Dukuh as culture preservation in Ciroyom Village, Cikelet district, Garut Regency, West Java Province. *IOP Conference Series: Earth and Environmental Science*, 145, 12028. <https://doi.org/10.1088/1755-1315/145/1/012028>
- Hutchins, E. (1995). *Cognition in the wild*.
- Ibau Lod, C. M. (2025). *Dayak Kenyah Local Wisdom: Sustainable Spatial Planning, Biodiversity Conservation, and Ecological Harmony*. *Prosiding Seminar Nasional Filsafat 2025*.
- Indonesia, K. K. R. (2024). *Rekapitulasi penetapan hutan adat per Desember 2024*.
- Indonesia, K. L. H. dan K. R. (2021). *Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor 9 Tahun 2021 tentang Pengelolaan Perhutanan Sosial*.
- Ingold, T. (2000). *The perception of the environment: Essays on livelihood, dwelling and skill*.
- Institute, W. R. (2024). *Data on Indigenous Peoples and local communities' lands and biodiversity*.
- Kahn, R. (2010). *Critical pedagogy, ecoliteracy, and planetary crisis: The ecopedagogy movement*.
- Karima, E. M., Wulandari, F. T., Firza, F., & Abianza, E. (2024). Transversal competencies in augmented reality-based history learning. 10(2), 299–308.
- Koentjaraningrat. (1985). *Javanese culture*.
- Lahpan, N. Y. K., Putra, B. D., Hidayana, I. S., & Budiman, A. (2025). Digital pilgrimage: The role of online platforms in preserving and promoting Kampung Dukuh's religious heritage. *Mudra Jurnal Seni Budaya*, 40(2). <https://doi.org/10.31091/mudra.v40i2.3155>
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.
- Lima Mota, M. R., Lauer-Leite, I. D., & Novais, J. S. de. (2023). Intergenerational transmission of traditional ecological knowledge about medicinal plants in a riverine community of the Brazilian Amazon. *Polibotánica*, 56, 311–329. <https://doi.org/10.18387/polibotanica.56.16>
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE Publications.
- McGregor, D., Whitaker, S., & Sritharan, M. (2020). Indigenous environmental justice and sustainability. *Current Opinion in Environmental Sustainability*, 43, 35–40.
- Morse, J. M. (2015). *Critical analysis of strategies for determining rigor in qualitative inquiry*.
- Mulyani, A., & Siscawati, M. (2022). Customary forest recognition in Indonesia: Progress, challenges, and implications for Indigenous communities. *Forest and Society*, 6(2), 456–473.
- Nelson & Reed, G, M. K. (2025). *Indigenous critiques and recommendations for reclaiming nature-based solutions*.
- Ong, W. J. (1982). *Orality and literacy: The technologizing of the word*.
- Permana, R. C. E. (2016). *Kearifan lokal masyarakat adat Baduy dalam konservasi lingkungan hidup*.
- Quinlan, M. B., & Quinlan, R. J. (2007). *Modernization and medicinal plant knowledge in a Caribbean*

- horticultural village. *Medical Anthropology Quarterly*, 21(2), 169–192. <https://doi.org/10.1525/maq.2007.21.2.169>
- Rachmaningsih, I. (2013). The cultural reconstruction of taboo under Mama Uluk's leadership in Kampong Dukuh, a Sundanese traditional hamlet in Garut Regency West Java Indonesia (Unpublished manuscript).
- Rahardjanto, A., Husamah, Hudha, A. M., & Permana, T. I. (2025). Ecocultural practices in East Java, Indonesia: A hermeneutic phenomenological study on "Reresik Kali" as local wisdom for river conservation. *Social Sciences & Humanities Open*, 12, 102176. <https://doi.org/10.1016/j.ssaho.2025.102176>
- Rappaport, R. A. (1968). Pigs for the ancestors: Ritual in the ecology of a New Guinea people.
- Reyes-García, V., Fernández-Llamazares, Á., García-del-Amo, D., & Cabeza, M. (2023). The geography of Indigenous and local knowledge: A systematic review. *Global Environmental Change*, 78, 102632.
- Rogoff, B. (2003). The cultural nature of human development.
- Rohaeni, A. J., & Emilda, N. (2021). Wisata religi berbasis kearifan lokal dan pemberdayaan ekonomi masyarakat adat Kampung Dukuh. *Panggung*, 31(3). <https://doi.org/10.26742/panggung.v31i3.1716>
- Schlosberg, D. (2007). Defining environmental justice: Theories, movements, and nature.
- Schuster, R., Germain, R. R., Bennett, J. R., Reo, N. J., & Arcese, P. (2019). Vertebrate biodiversity on indigenous-managed lands in Australia, Brazil, and Canada equals that in protected areas. *Environmental Science & Policy*, 101, 1–6. <https://doi.org/10.1016/j.envsci.2019.07.002>
- Sidiq, M. A. (2022). Masyarakat Kampung Adat Dukuh dalam mempertahankan kearifan lokal di era modernisasi (Studi deskriptif pada masyarakat Kampung Adat Dukuh di Cikelet Kabupaten Garut).
- Sinthumule, N. I. (2023). Traditional ecological knowledge and its role in biodiversity conservation: a systematic review.
- Siscawati, M., Banjade, M. R., Liswanti, N., Herawati, T., Mwangi, E., & Mulyana, A. (2017). Forest tenure reform in Indonesia: When formal and customary rights clash. CIFOR.
- Sobel, D. (2004). Place-based education: Connecting classrooms and communities.
- Spradley, J. P. (1980). Participant observation.
- Stake, R. E. (1995). The art of case study research.
- Stake, R. E. (2005). *Qualitative Case Studies*.
- Stake, R. E. (2006). Multiple case study analysis.
- Steward, J. H. (1955). Theory of culture change: The methodology of multilinear evolution.
- Toledo & Barrera-Bassols, N, V. M. (2017). *The Biocultural Landscape*.
- Tuerah, M. S. R., & Tuerah, J. M. (2023). Kurikulum Merdeka dalam Perspektif Kajian Teori: Analisis Kebijakan. *Jurnal Ilmiah Wahana Pendidikan*, Oktober, 9(19), 982. <https://doi.org/10.5281/zenodo.10047903>
- Vansina, J. (1985). Oral tradition as history.
- Weber, M. (1978). *Economy and society: An outline of interpretive sociology* (G).
- Wessing, R., & Barendregt, B. (2021). The Baduy: A traditional community in the face of modernity. *Bijdragen Tot de Taal-, Land- En Volkenkunde*, 177(2–3), 299–327.
- Whyte, K. (2018). Indigenous science (fiction) for the Anthropocene: Ancestral dystopias and fantasies of climate change crises.
- Widianingsih, I., Sumaryana, A., & Hidayat, R. (2020). Kasepuhan adat governance: Between tradition and state recognition. *Jurnal Ilmu Pemerintahan*, 15(2), 145–168.
- Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, 17(2), 89–100.

*Forest Zoning as a Pedagogical System: Intergenerational Transmission of Ecological Knowledge in the Dukuh Indigenous Community*

Yin, R. K. (2018). *Case Study Research and Applications* (6th ed.

Yuliani, E. L., Moeliono, M., & Colfer, C. J. P. (2022). The Kasepuhan of Mount Halimun-Salak: Customary forest management in West Java. In C. J. P. Colfer & R. L. Wadley (Eds.), *Forests and livelihoods in Southeast Asia* (pp. 112–134). Routledge.

Zarger, R. K. (2002). *Children's Ethnoecological Knowledge: Situated Learning And The Cultural Transmission Of Subsistence Knowledge And Skills Among Q'eqchi' Maya*.