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Original Article

Analysis Cultural Ecological Values In Traditional Batak Toba Settlement

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ABSTRACT
This research explores the embedded cultural ecological values within traditional Batak Toba settlements and their contribution to promoting sustainable development. Utilizing a qualitative ethnographic methodology, the study investigates how indigenous knowledge reflected in spatial organization, vernacular architecture, and socio-cultural practices establishes harmony between people and their natural surroundings. Results indicate that the settlement patterns of the Batak Toba, grounded in kinship systems and customary traditions, play a vital role in the sustainable stewardship of natural resources. These cultural values not only support environmental conservation but also strengthen the community's cultural identity. The study highlights the critical need to incorporate cultural ecological principles into contemporary development planning to ensure environmentally sustainable and culturally sensitive growth.

KEYWORDS
Cultural Ecology; Traditional Settlements; , Batak Toba; Sustainable Development

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INTRODUCTION

The Batak Toba ethnic group, as one of the largest ethnic groups in Indonesia, is known for its rich cultural heritage and social system, which have been passed down from their ancestors through generations. This culture encompasses various aspects of daily life, ranging from beliefs, kinship relations, livelihoods, marriage, to customs that continue to be preserved. One of the main characteristics of the Batak Toba society is the patrilineal kinship system, where the primary lineage is traced through the father's side, and the importance of the *marga* (clan) as part of their identity (Simanjuntak, 2022). This identity is also reflected in various cultural elements such as *tarombo* (family genealogy), traditional ceremonies, *ulos* (traditional woven cloth), food, clothing, language, behavior, and housing.

The majority of the Batak Toba ethnic group reside in the regencies of Humbang Hasundutan, North Tapanuli, Toba Samosir, and Samosir (Simanjuntak, 2006). One of

the areas in Samosir Regency that still preserves traditional Batak Toba settlements is Lintongnihuta Village, Ronggurnihuta District. In this context, traditional Batak Toba settlements are not merely physical structures but also a tangible manifestation of local wisdom that integrates ecological and cultural values. The design and spatial layout of these settlements reflect a balance between humans and nature, where every element, from architecture to resource management, is built based on a profound understanding of the surrounding environment (Sibarani et al., 2024).

However, with the passage of time and modernization, the customary values and culture of the Batak Toba have begun to change. Many people, especially those living in urban areas, have started to abandon their language, culture, and traditions, although there are also efforts to strengthen Batak identity. Traditional Batak Toba settlements function not only as places of residence but also as manifestations of local wisdom based on harmony between humans and the environment. Today, traditional Batak Toba houses face challenges from modernization, yet the ecological and cultural values contained within them remain valuable heritage that must be preserved (Eni, 2017). The Batak Toba ethnic group, inhabiting the area around Lake Toba in North Sumatra, possesses a rich and complex architectural heritage. The Rumah Bolon, often referred to as the traditional Batak Toba house, is one of the most significant expressions of their cultural identity (Siahaan, 2019).

Therefore, a comprehensive study is necessary to explore the cultural ecological values inherent in traditional Batak Toba settlements. This study aims to investigate how local wisdom in spatial arrangement, architecture, and lifestyle of the Batak Toba community can contribute to supporting sustainable development. Thus, these values can be preserved and applied in the context of contemporary development, in order to maintain environmental sustainability while also safeguarding the cultural identity of the Batak Toba for the future.

This study employs a qualitative ethnographic method to explore the cultural ecological values present in traditional Batak Toba settlements as an effort to support sustainable development. The research location is in Lintongnihuta Village, Ronggurnihuta District, Samosir Regency. A qualitative approach was chosen to gain an in-depth understanding of the various cultural, social, and ecological aspects inherent in the settlement. Data were collected through direct field observations to study the physical conditions of the settlement, spatial layout, traditional house architecture, as well as social interactions among the community. In addition, in-depth interviews were conducted with local residents, customary leaders, and community administrators to uncover cultural values, local wisdom, and sustainable environmental management practices. To complement the field data, this study also conducted a literature review from various sources such as books, journals, and official documents related to Batak Toba culture, traditional architecture, and sustainable development concepts.

The analysis of cultural ecological values in traditional Batak Toba settlements within the context of sustainable development is based on a theory that integrates the dimensions of ecology, culture, and development. Cultural ecology is a comprehensive approach that examines the reciprocal relationship between humans and the living environment within a cultural framework. This theory emphasizes the importance of culture and local wisdom in the sustainable management of natural resources. Humans are regarded as an inseparable part of nature, making the creation of balance between the two a key factor in achieving sustainable development. The cultural values passed down through generations contain knowledge and practices that contribute to environmental conservation and biodiversity preservation (Nur, 2021).

The state of the art in research on cultural ecological values in traditional Batak Toba settlements reveals that the Batak Toba community maintains a close relationship between culture and the natural environment, particularly in preserving the ecological balance in the Lake Toba region. Previous research conducted by Tobing, R. R., & Hutabarat, G. M. (2019) examined the relationship between clan kinship structures and the physical configuration of traditional Batak architecture. Hutaginjang Village in Sianjur Mula-Mula District is a traditional village that continues to uphold the customary values and traditions of the Batak Toba people. The study focused on exploring kinship aspects as well as the architectural design of traditional house units in Hutaginjang Village. The research findings indicate a significant correlation between the spatial arrangement of the settlement and the social structure of the Batak Toba community, observable at the village, hamlet, and individual housing scales.

The study by Sibarani et al. (2021) explains that changes in the "huta" pattern or traditional settlement of the Batak Toba community in Tipang Village, which is one

of the tourist destinations in the Lake Toba area, show several significant changes in the traditional house occupancy patterns. Physically, there are alterations in the design of traditional houses, particularly regarding the position of the entrance door. Previously, the entrance faced the direction of Mount Tipang; however, currently, some entrances have been redirected toward the main road. The study by Siahaan et al. (2022) reveals that the ecological spatial layout developed from Batak Toba architecture emphasizes two main aspects: site planning, building form, and orientation. Considering these distinctive characteristics, the traditional site planning that adopts vernacular architectural principles can be used as a foundation for designing site plan solutions that are appropriate for the common conditions in the urban areas of Lake Toba.

Research Limitations and Innovations of This Study Research that comprehensively integrates cultural ecological aspects within the context of traditional Batak Toba settlements remains very limited. Most previous studies have predominantly focused on either cultural or ecological aspects independently, without adopting an integrated holistic approach. A holistic approach that simultaneously unites the dimensions of ecology, culture, and sustainable development is necessary to provide a comprehensive understanding of the cultural ecological values in traditional Batak Toba settlements. Furthermore, an in-depth analysis of the relationship between these cultural ecological values and the settlement patterns and spatial organization of traditional Batak Toba has not been systematically explored in prior research.

Moreover, utilizing recent field studies in traditional settlements as empirical foundations can enrich the understanding of how cultural values influence conservation behavior and environmental management, particularly in the face of modernization dynamics. This research is expected to make a significant contribution to the development of natural resource management models based on Batak Toba local wisdom, which can serve as alternative sustainable development solutions aligned with the characteristics of the Lake Toba region and its surroundings.

METHOD

Research Location

The research location is situated in Lintongnihuta Village, Samosir Regency, which is recognized as one of the villages that still preserves the authenticity of traditional Batak Toba settlements. This village was selected as the research site because it steadfastly upholds the authentic cultural values and traditional Batak Toba architecture, making it a significant representation for understanding the traditional lifestyle and local wisdom of the Batak Toba community.

Lintongnihuta Village exhibits a settlement spatial arrangement and social structure that clearly reflect the relationship with cultural ecological values, making it an appropriate site to examine the connection between local wisdom and sustainable natural resource management. The choice of this location is also based on the village's potential as a model for conserving cultural and environmental values amidst the social and economic development in the Lake Toba region.

Data Methods Collection

Data collection methods in this study were conducted through: (1) Participant Observation, where the researcher actively engaged in the daily life of the studied community while observing their behaviors, social interactions, and activities. This observation aims to gain an in-depth understanding from an insider's perspective. (2) In-depth Interviews, conducted in a structured or semi-structured manner with community members to explore their perspectives, experiences, values, and cultural meanings. These interviews allow the researcher to obtain rich and detailed qualitative data. (3) Field Notes, wherein the researcher meticulously records all significant events, interactions, and atmospheres during the observation and interview processes for further analysis. (4) Visual Documentation, using photographs, videos, or sketches to document the visual aspects of the studied culture and environment. This documentation provides clearer context to the obtained data. (5) Document Analysis, conducted by collecting and analyzing related documents such as archives, historical records, and local media to understand the cultural and social background of the researched community.

Data Analysis

Data analysis in this study was conducted qualitatively using an ethnographic thematic approach to comprehensively describe the cultural ecological values influencing social behavior and spatial organization in traditional Batak Toba settlements. The stages of data analysis include: (1) Data Transcription. Data from in-depth interviews, participant observations, and field documentation were transcribed verbatim to facilitate further analysis. (2) Coding and Theme Identification. The researcher coded the transcripts and field notes to identify categories or main themes related to cultural ecological values, settlement patterns, and social relationships. (3) Data Description. At this stage, the data are presented in detail to depict the cultural characteristics and ecological patterns observed in the traditional settlements. The researcher acts as a narrator, bringing forth the perspectives of the Batak Toba community through rich and in-depth narratives. (4) Data Analysis. The researcher examines relationships among the identified themes, compares them with relevant literature and theories, and evaluates the meaning of each category within the socio-ecological context of the Batak Toba society. (5) Data Interpretation. The final stage involves critically interpreting the data to draw conclusions about how cultural ecological values impact the social structure and spatial organization of traditional settlements. This interpretation is also linked to sustainable development concepts relevant to the Lake Toba context. (6) Data Triangulation. Data validity is strengthened through triangulation by comparing findings from observations, interviews, and documents to ensure accuracy and consistency.

By applying this analytical method, the study is expected to produce a comprehensive and valid depiction of cultural ecological values in traditional Batak Toba settlements and their implications for environmental management and sustainable development.

RESULTS AND DISCUSSION

Research on traditional Batak Toba settlements indicates that the cultural ecological values inherent in these communities are deeply rooted and play a vital role in promoting sustainable development.

1. Spatial Structure Of Settlements Based On The Principles Of Cultural Ecology

Traditional settlements of the Batak Toba ethnic group are known as *huta*, which generally follow a linear pattern consisting of two rows of buildings facing each other: a row of houses (*jabu*) and a row of granaries (*sopo*). Between these two rows lies a courtyard called *balai desa*, which functions as a communal space for social interaction and community activities (Ongkojoyo et al., 2023). The spatial layout of Batak Toba settlements, grounded in cultural ecology, is strongly influenced by kinship values, customs, and a harmonious relationship with the surrounding environment. The *huta* serves as an independent settlement unit with its own authority and acts as the center of social interaction among individuals and families within the community.

The physical structure of traditional Batak Toba villages consists of traditional houses facing a shared courtyard (*pogu ni alaman*), with the large house (*ruma bolon*) serving as the residence for the extended family, and *sopo* functioning as granaries or dwellings for the younger generation. This settlement pattern pays close attention to the socio-cultural aspects of *Dalihan Na Tolu*, which is the principle governing the relationships among *hula-hula* (wife-givers), *boru* (wife-takers), and *dongan tubu* (clan members). This principle forms the basis for spatial arrangement and social interaction within the village. The spatial layout of the settlement reflects the kinship system and lineage (*tarombo*), where physical spaces such as houses, courtyards, and ceremonial grounds are organized according to the social structure and customs passed down through generations.

From an ecological perspective, this spatial arrangement also considers the wise management of natural resources, protection against external threats such as fortifications and protective trees, as well as the sustainable use of land for agriculture and customary activities. The architecture of traditional Batak Toba houses utilizes natural materials like wood and ijuk (sugar palm fiber), featuring environmentally friendly designs rich in symbolic meaning for example, the supporting pillars symbolize family strength, while the soaring roof represents the connection with the Creator. The symmetrical spatial pattern, with an open space at the village center (*alaman*) and uniform gateways (*angkul-angkul*), creates a communal area that functions as a place for deliberation and the conduct of customary

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Traditional Batak Toba houses are oriented to face the sun, optimizing natural light and ventilation. This design choice provides multiple advantages for the residents' health, comfort, and energy use. Morning sunlight exposure delivers vitamin D, which is vital for maintaining strong bones, healthy skin, and a robust immune system. Furthermore, natural light in the early hours stimulates serotonin production, enhancing mood, productivity, and overall well-being. Sunlight also acts as a natural disinfectant by eliminating viruses and bacteria and inhibiting the growth of mold and mildew inside the home, contributing to a healthier indoor environment.

In addition, the orientation of the house facing the sun also supports energy efficiency and reduces costs, as optimal sunlight decreases the need for artificial lighting during the day, resulting in lower electricity bills. In winter or cooler climates, sunlight entering the house provides natural warmth, thereby reducing the use of heating devices. Natural light also enhances comfort and the atmosphere of the home by making rooms feel more spacious, bright, and pleasant for activities. Houses facing the morning sun (east) are usually cooler and less hot during the afternoon, creating a more comfortable indoor environment.

Within the framework of sustainable development that prioritizes environmental and ecological aspects, adequate natural lighting not only creates a fresh and comfortable morning atmosphere but also reduces electricity consumption, thereby lowering carbon emissions. Consequently, houses become more environmentally friendly and contribute to environmental conservation. Traditionally, roofs with pointed shapes and ijuk (sugar palm fiber) coverings functioned to reduce heat and maintain indoor thermal comfort. However, many have now shifted to using more practical materials such as metal sheets. The use of natural materials like wood, bamboo, and ijuk in house construction helps minimize environmental impact because these materials are readily available, eco-friendly, and require relatively low energy during their production processes.

Figure.1. Rumah Bolon in Huta Sitonggi-tonggi
(Source: Personal field documentation)

2. Cultural Ecological Values Reflected in the Traditional Settlement Patterns of the Batak Toba

The traditional Batak Toba house utilizes natural materials readily available in the surrounding environment, such as wood, bamboo, and ijuk (sugar palm fiber), making them easily accessible to the local community. Its construction process employs nail-free techniques and uses reusable materials, thereby minimizing negative environmental impacts and reducing energy consumption during construction.

The stilt house design is well-suited to the local climate conditions. This elevated structure helps avoid ground moisture and potential flooding while creating optimal air circulation to keep indoor temperatures cool without the need for additional cooling devices. Moreover, the use of ijuk roofing and the building's north-south orientation are designed to minimize direct exposure to sunlight, naturally maintaining thermal comfort inside the house.

The utilization of natural resources in the Batak Toba community is conducted in an efficient and sustainable manner. Wind is harnessed not only for natural ventilation but also for drying clothes and woven textiles. Sunlight functions as a source of natural illumination during the daytime and facilitates the drying of agricultural produce. Rainwater and river water are treated through filtration and recycling processes to fulfill daily needs, reflecting prudent and environmentally conscious water management practices.

Furthermore, the social structure of the Batak Toba society supports environmental sustainability. Customary values such as *Dalihan Na Tolu* emphasize the importance of harmonious social relationships and a collective spirit of mutual cooperation, ensuring that natural resource utilization is carried out collectively and responsibly. This fosters a strong sense of community and contributes to the preservation of the surrounding environment.

Effective environmental management is also evident in the design of stilt houses, which not only provide comfort for inhabitants but also allocate space for livestock beneath the dwelling. The manure produced by these animals is subsequently used as organic fertilizer in agriculture, thereby establishing a sustainable ecological cycle.

Figure.2. The lake serves as the community's water source in Huta Sitonggi-tonggi.
(Source: Personal field documentation)

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3. Social Relations and Local Wisdom as Pillars of Sustainability

The ecological concept within Batak Toba culture plays a pivotal role in the spatial organization of settlements by integrating local wisdom, customary practices, and the physical environmental conditions into spatial planning and management. The ecological site plan of Batak Toba settlements is grounded in vernacular architecture that is highly responsive to the natural and cultural context. The arrangement of houses and their orientation are adapted to environmental characteristics such as topography, climate, and natural resources, thereby creating dwellings that are comfortable, sustainable, and in harmony with the surrounding ecosystem.

All components of traditional Batak Toba houses are constructed from natural materials readily available in the surrounding environment, such as wood, bamboo, ijuk (sugar palm fiber), and rattan. The joints between structural elements do not utilize nails; instead, they employ binding and carving techniques, allowing the house structure to be easily assembled and disassembled without generating hazardous waste.

Figure.3. Joro-joro (Place of Worship and Ritual Devotion to God) in Huta Sitonggi-tonggi, Lintongnihuta Village. (Source: Personal field documentation)

The spatial layout of Batak Toba settlements (*huta*) is designed with careful consideration of building orientation relative to cardinal directions and the surrounding environmental conditions. Houses and rice granaries (*sopo*) are arranged in parallel rows facing each other, creating an open central space that functions as a venue for social interaction and communal activities. This pattern also facilitates effective air circulation, optimal natural lighting, and maintains privacy and security for the inhabitants.

Batak Toba houses and settlements are designed in accordance with the topography and geographical conditions, such as on hillsides or in proximity to water sources. This design approach reflects the community's

adaptive capacity to the natural environment while simultaneously maintaining the ecological balance of the surrounding ecosystem. These cultural ecological values illustrate that traditional Batak Toba settlements serve not only as residential spaces but also as tangible manifestations of the harmonious relationship among humans, culture, and the natural environment.

Social relations and local wisdom within traditional Batak Toba settlements play a crucial role in supporting the sustainability of their communities. This is primarily realized through the kinship system and cultural values embodied in the concept of *Dalihan Na Tolu*, which serves as the fundamental framework for regulating social interactions and relationships among community members. The Batak Toba social system, exemplified by *Dalihan Na Tolu*, emphasizes the importance of mutual cooperation (*gotong royong*) and respect for nature.

This local wisdom is reflected in the collective and sustainable management of natural resources, including water management, agricultural land use, and livestock utilization. Livestock are kept beneath stilt houses, and their manure is used as fertilizer for rice fields and crops, thereby creating an environmentally friendly closed ecological cycle. The Batak Toba social system, comprising three main elements *hula-hula, hahanggi*, and *boru*forms the foundation for social interaction, decision-making, and the implementation of customary practices. This system maintains social balance and harmony among community members while regulating the collective use of natural resources (Purba et al., 2024).

Dalihan Na Tolu governs the interactions among the three principal kinship groups: *hula-hula* (the wife's family), *dongan tubu* (clan relatives), and *boru* (the wife-receiving family). This system fosters mutual respect, cooperation, and strong solidarity among community members, thereby creating a harmonious social balance and preventing conflicts. Batak Toba local wisdom also emphasizes values such as *somba marhula-hula* (respecting the wife's family), collaboration, and mutual assistance, which are manifested through communal work activities (*marsiadapari*). These practices strengthen social cohesion and contribute to the sustainability of the community.

This social system not only regulates familial relationships but also serves as a behavioral guideline in communal life, emphasizing collective welfare and respect for ancestors. These values are continuously actualized in various aspects of daily life as well as in the implementation of traditional ceremonies. Thus, the social relationships founded on the local wisdom of *Dalihan Na Tolu* constitute a fundamental basis supporting the sustainability of traditional Batak Toba settlements in social, cultural, and ecological dimensions.

The role of Batak Toba local wisdom in maintaining environmental balance and the sustainability of settlements is crucial and encompasses various aspects, including spiritual, social, and sustainable natural resource management. In Batak Toba culture, the environment is not merely perceived as a physical entity but also holds profound spiritual significance. For instance, the *hariara* tree is regarded as a link between the real world and the ancestral spirits, leading the community to nurture the tree and its surrounding environment with deep respect and spiritual awareness. This perspective fosters a holistic balance among humans, nature, and ancestors, thereby promoting sustainable environmental conservation.

Local wisdom values such as *Dalihan Na Tolu* and the spirit of mutual cooperation (*gotong royong*) strengthen social solidarity and collective environmental management. The community works collectively to protect and maintain the natural environment, including the development and upkeep of environmentally friendly settlements. These values are transmitted across generations and serve as behavioral guidelines for the Batak Toba people in preserving nature. Environmental education grounded in this cultural foundation is essential to ensure the continuity of environmental conservation in the future.

In essence, Batak Toba's indigenous knowledge serves as the ethical and practical basis for sustainable environmental management, seamlessly integrating spiritual, social, and ecological dimensions into the community's daily existence. Consequently, this wisdom underpins both environmental equilibrium and the enduring viability of their traditional settlements.

CONCLUSSION

Traditional Batak Toba settlements reflect strong cultural ecological values that are deeply integrated into the social, cultural, and natural environmental aspects of the community. This is evident in the use of environmentally friendly local materials, the stilt house design adapted to the climate and land contours, and the spatial layout of settlements that promotes air circulation and ecosystem balance. Batak Toba local wisdom, particularly rooted in the philosophy of *Dalihan Na Tolu*, governs social relations and the collective, sustainable management of natural resources, including the conservation of forests, water, and agricultural land.

Furthermore, the Batak Toba community holds a spiritual perspective that regards nature as an integral part of sacred life, thereby encouraging efforts toward sustainable environmental conservation. Traditions and customary regulations, passed down through generations, function as mechanisms for controlling the utilization of natural resources, maintaining ecosystem balance, and supporting the continuity of settlements. Consequently, the cultural ecological values embedded in traditional Batak Toba settlements not only contribute to environmental preservation but also reinforce the community's cultural and social identity. These values are critically important and can serve as foundational principles in designing and implementing sustainable development in the Lake Toba region and its surroundings, ensuring that development prioritizes not only economic aspects but also the preservation of local cultural and ecological sustainability.

This study has several limitations that need to be acknowledged. First, the scope of the research is limited to a single location, namely Lintongnihuta Village in Samosir Regency, which may not fully represent the overall variation of cultural ecological values in traditional Batak Toba settlements across the broader Lake Toba region. Second, the data collected are qualitative and heavily reliant on the researcher's interpretation, making the possibility of subjective bias unavoidable. Third, the rapid socio-economic changes occurring in the area affect the preservation of cultural values; however, this study does not deeply explore how these values adapt sustainably to modernization processes.

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Conflict of interest The author has no competing interests to declare that are relevant to the content of this article.

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