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Research Article

Exploring The Tradition of *Berlari Diatas Tual Sagu* And Its Potential for Science Education: A Case Study In Bokor Village, Meranti Islands, Indonesia

Sri Aryani[1], Aldeva Ilhami[1]
[1]Department of Science Education, Faculty of Education and Teacher Training, Universitas Islam Negeri Sultan Syarif Kasim Riau, Riau, Indonesia

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Corresponding author:
11911020283@students.uin-suska.ac.id

ABSTRACT

This study explores the scientific values embedded in the indigenous tradition of *berlari di atas tual sagu* (running on floating sago logs) practiced by communities in the Meranti Islands, Indonesia, and its potential application in science education. Using a qualitative case study approach, data were collected through in-depth interviews, field observations, photographs, and field notes in Bokor Village, Rangsang Barat District. Data analysis followed the interactive model of Miles and Huberman, including data reduction, display, verification, and conclusion drawing. The findings show that this cultural practice contains implicit scientific concepts related to physics, biology, and environmental science. The use of wooden sticks to move sago logs reflects principles of mechanical advantage and energy efficiency, while the floating ability of the logs demonstrates buoyancy and density concepts. In addition, community practices in selecting and transporting sago illustrate ecological adaptation to peatland environments. Analysis of the sago logs also reveals knowledge related to plant structure and classification. These findings indicate that indigenous knowledge can be reconstructed into contextual scientific learning resources that support culturally responsive pedagogy and increase student engagement. Integrating local wisdom into science education not only preserves cultural heritage but also provides meaningful and observable learning experiences. The study highlights the importance of indigenous practices as valuable pedagogical resources and encourages further research on transforming local knowledge into educational frameworks.

Keywords:
Ethnoscience, Ethnobotany, Tual Sagu, Science Learning, *Metroxylon sagu Rottb*

INTRODUCTION

Culture is a cumulative system of beliefs, practices, and knowledge transmitted across generations, shaping social norms, identities, and community practices (Ilhami et al., 2018). Indonesia, characterised by its archipelagic geography and rich ethnic diversity, exhibits a remarkable variety of local traditions, including language, culinary practices, performing arts, and agricultural methods (Tiaraputri & Diana, 2019). Among these, the province of Riau demonstrates strong adherence to Malay cultural values, in which local wisdom has historically played a central role in resource management, social cohesion, and community education (Banda, 2013; Ramadhea et al., 2025). Such cultural heritage embodies practical knowledge that is often overlooked in formal education but holds potential for integration into science learning, particularly when the community's practices exhibit natural, mathematical, or physical principles.

In the Meranti Islands, local communities maintain unique agricultural and cultural practices that are closely intertwined with their environment, including sago cultivation, peatland management, and associated rituals (Mulyani, 2020). Sago (Metroxylon sagu Rottb.) is a primary staple in the region and a central economic resource, with cultivation methods adapted to the ecological characteristics of peatland soils (Ratmini, 2012). One distinct tradition, *berlari di atas tual sagu*, or running on floating sago logs, emerged from the practical need to count and transport sago logs from plantations to rivers and processing facilities. This tradition has been preserved as intangible cultural heritage and recognised nationally for its uniqueness (Sugiyanto, 2019). Beyond its cultural significance, this practice offers a tangible medium for illustrating scientific phenomena such as buoyancy, force, simple machines, and plant anatomy, making it a potential resource for context-based science education.

Despite the cultural and educational potential of local practices, there remains a significant gap in systematically analysing indigenous knowledge and translating it into scientifically validated concepts. Traditional science education in Indonesia and similar contexts has often prioritised abstract, decontextualised content, thereby limiting students' engagement and the applicability of learning to their lived experiences (Daniah, 2019). Studies suggest that without bridging indigenous knowledge with formal science, opportunities for culturally responsive pedagogy and the reinforcement of local heritage are missed (Ilhami et al., 2018). Consequently, identifying mechanisms to reconstruct community practices into scientific frameworks is essential for both preserving cultural identity and enhancing the quality of science education.

Previous attempts to integrate local wisdom into science education have focused primarily on ethnobotany, ecological knowledge, and agricultural practices (Baxter & Jack, 2015). For example, traditional methods of cultivating sago and other crops have been used to illustrate ecological principles such as nutrient cycles, soil-water interactions, and plant growth dynamics (Amarillis et al., 2020). However, the specific practice of running on sago logs has not been rigorously explored, leaving a methodological gap in understanding how the kinetic and mechanical aspects of indigenous activities can be reconstructed into scientific principles. Common approaches in literature include qualitative ethnoscience research using case studies and interviews, combined with observational and participatory methods, to capture both technical knowledge and cultural meanings (Herrera et al., 2016).

Several studies have emphasised the pedagogical advantages of contextualising science learning through local practices. Ilhami et al. (2018) demonstrated that integrating local fishing taboos into classroom lessons enhanced students' understanding of aquatic ecosystems and resource sustainability. Similarly, (Daniah, 2019) highlighted that using community-based agricultural practices could provide concrete illustrations of mechanical work and energy principles, thereby improving conceptual comprehension and student engagement. These approaches suggest that culturally embedded practices can be mapped onto scientific concepts such as Archimedes' principle, simple machines, and plant structure when systematic reconstruction and interpretation are applied.

Research on ethnoscience further supports the notion that local knowledge systems can offer structured learning opportunities aligned with formal science curricula. For instance, the interactive Miles and Huberman model of qualitative analysis allows researchers to distil indigenous knowledge into analyzable constructs, providing a methodological bridge between traditional practices and scientific principles (Ilyas, 2016). By coding community narratives and observational data, indigenous concepts such as buoyancy, mechanical advantage, and classification can be formalised, offering a novel pedagogical resource that preserves cultural integrity while facilitating science literacy.

While the literature provides strong justification for integrating local wisdom into science education, no prior studies have systematically examined the *berlari di atas tual sagu* tradition within this framework. Existing research documents the socio-cultural and economic significance of sago cultivation in Meranti (Mulyani, 2020; Sugiyanto, 2019), yet the kinetic, mechanical, and ecological dimensions of the practice remain unexplored. This gap presents an opportunity to investigate how the practice functions as a medium for learning core scientific concepts and to develop a structured approach for translating indigenous knowledge into pedagogically relevant scientific knowledge.

The present study aims to address this research gap by analysing and reconstructing the indigenous knowledge embedded in *berlari di atas tual sagu* into scientifically validated concepts suitable for science education. This study offers a novel demonstration of the linkage between a culturally unique kinetic activity and principles of physics, biology, and ecology, thereby providing a framework for integrating local traditions into formal education. The scope of the study includes qualitative analysis of community practices, interviews with local informants, and mapping traditional knowledge onto scientific constructs such as Archimedes' principle, simple machines, plant tissue organisation, and environmental adaptation. By doing so, the research not only preserves intangible cultural heritage but also proposes an innovative method to contextualise science education, promoting meaningful learning experiences that are culturally and ecologically grounded.

METHODS

This study employed a qualitative case study design, widely recognised for its ability to explore complex phenomena in their real-life context while preserving the richness of participants' perspectives (Baxter & Jack, 2015). Case study methodology allows researchers to examine a defined situation or phenomenon in depth, utilising multiple sources of evidence to produce a holistic understanding of the subject under investigation (Herrera et al., 2016). In the context of this study, the phenomenon of interest is the tradition of *berlari di atas tual sagu* in Bokor Village, Meranti Islands, Indonesia, and its potential to be reconstructed into scientifically meaningful knowledge. The qualitative case study approach was selected because it facilitates an in-depth exploration of indigenous knowledge practices while enabling systematic mapping onto scientific principles, a process that requires contextual sensitivity and interpretive rigour.

The study was conducted in Bokor Village, located in the Rangsang Barat District of the Meranti Islands. The geographic coordinates of the region range from approximately 0°42'30" to 1°28'0" north latitude and 102°12'0" to 103°10'0" east longitude, situating the village within the eastern coastal area of Sumatra (Rachman et al., 2016). The village itself is traversed by the Bokor River, which serves as the primary channel for transporting sago logs from plantations to processing facilities. The choice of Bokor Village as the study site is based on the long-standing tradition of running on sago logs during routine sago harvesting. These practices offer a unique opportunity to analyse indigenous knowledge that combines cultural, ecological, and mechanical elements, making the site particularly suitable for ethnoscience-based research

Figure 1. Map of Bokor Village, Meranti island

Data collection was primarily conducted through in-depth interviews with local informants who possess direct experiential knowledge of the practice. Two participants were selected purposively, including a community leader and an experienced sago farmer, representing both institutional knowledge and practical expertise. The selection criteria emphasised local residency, direct engagement with sago cultivation, and familiarity with the tradition, ensuring that the collected data accurately reflected the community's indigenous knowledge (Baxter & Jack, 2015). The interview protocol included open-ended questions designed to elicit detailed narratives regarding the origins, purposes, techniques, and cultural significance of running on sago logs. Interviews were conducted in the local language and subsequently transcribed and translated into English for analysis. The interactive nature of the interviews allowed participants to provide clarifications and elaborate on their responses, thereby enhancing the depth and authenticity of the data (Herrera et al., 2016).

In addition to interviews, direct observation and field documentation were employed to capture the procedural and environmental aspects of the tradition. The researcher recorded video footage and photographs of the sago log transportation process, highlighting the mechanics of rolling logs, assembling log rafts, and the kinetic practice of running on them. This multimodal data collection approach ensures that both verbal and non-verbal dimensions of indigenous knowledge are preserved, enabling a more accurate reconstruction into scientific concepts. Observations were guided by a framework that emphasised key scientific elements, such as force, buoyancy, mechanical advantage, and plant structure, which may be embedded in traditional practices (Amarillis et al., 2020; Daniah, 2019).

The analysis of the collected data followed the interactive model proposed by Miles and Huberman, which encompasses data reduction, data display, conclusion drawing, and verification (Ilyas, 2016). Data reduction involved identifying and selecting segments of interviews and observations that were directly relevant to the research objectives, such as descriptions of log handling, running speed and balance, and environmental considerations. During this stage, non-essential details were removed while retaining culturally meaningful elements. Data display involved organising the information into tables and conceptual frameworks that allowed for systematic comparison and interpretation. Table 1, for instance, illustrates the reconstruction of community knowledge into scientific knowledge by mapping practical activities onto the principles of physics, biology, and environmental science. The table demonstrates how indigenous practices, such as using long wooden sticks to roll sago logs, can be interpreted in terms of work and simple machines, and how the buoyancy of sago logs can be understood through Archimedes' principle.

The subsequent stage of conclusion drawing involved interpreting the reduced and organised data to identify underlying scientific principles inherent in the tradition. Patterns were examined regarding how traditional practices encode knowledge about material properties, force application, plant growth, and ecosystem interactions. For example, the repeated practice of running on sago logs not only reflects efficiency in counting logs but also implicitly demonstrates understanding of density differences between sago wood and water. This process illustrates the potential to translate culturally embedded experiences into scientifically valid educational content, a technique consistent with prior ethnoscience studies (Daniah, 2019; Ilhami et al., 2018; Safitri, 2025). Verification was conducted through triangulation, comparing interview narratives, direct observation, and field documentation to ensure consistency and accuracy of interpretation. Any discrepancies were clarified with participants during follow-up discussions, reinforcing the credibility and trustworthiness of the findings.

Ethical considerations were carefully addressed throughout the research process. Informed consent was obtained from all participants, ensuring they were aware of the study's objectives, procedures, and intended use of the findings. Confidentiality was maintained, and participants' identities were anonymised in reporting. Additionally, respect for cultural practices was paramount; observations and interviews were conducted in a manner that minimised disruption to community routines and upheld local norms (Baxter & Jack, 2015).

By combining purposive sampling, in-depth interviews, observational documentation, and interactive qualitative analysis, the methodology ensures that the tradition of *berlari di atas tual sagu* is rigorously examined both culturally and scientifically. The structured reconstruction of indigenous knowledge, as presented in Table 1, allows the translation of empirical practices into formal scientific principles, creating a bridge between local wisdom and contemporary science education. This methodological framework aligns with the goals articulated in the introduction, facilitating the integration of contextualised cultural practices into pedagogy while preserving intangible heritage.

Overall, the methodology establishes a comprehensive qualitative framework that captures the multidimensional nature of indigenous knowledge. By adhering to case study principles and interactive data analysis, the study produces robust, interpretable, and educationally relevant findings. The methodological rigour demonstrated here serves not only to document a unique cultural practice but also to provide a replicable approach for future research seeking to link ethnoscience with formal education curricula in diverse cultural settings.

RESULTS AND DISCUSSION

Contextual Background and Cultural Significance of Sago Practices

The Meranti Islands, located in Riau Province, Indonesia, are a region where sago cultivation underpins both the local economy and cultural identity (Mulyani, 2020). Sago, derived from the trunk of *Metroxylon sagu* Rottb., thrives in the region's peat-rich soils, which retain water, support plant growth, and provide critical carbon sequestration (Ratmini, 2012). Within this ecological context, the tradition of *berlari di atas tual sagu*, or running on sago logs, has emerged as both a practical and cultural practice. Historically, the method was used to expedite the counting of sago logs transported from plantations to rivers and, subsequently, to processing facilities. Interviews with local informants revealed that this practice has been transmitted intergenerationally, reflecting both functional necessity and community identity. Observational data confirmed that the practice involves running across floating sago logs in a coordinated manner to assemble and count logs efficiently before rafting them downstream to mills. The cultural embeddedness of this practice not only preserves indigenous knowledge but also embodies a tacit understanding of mechanical and physical principles, positioning it as a rich subject for ethnoscience inquiry (Ilhami et al., 2018).

The findings indicate that the tradition integrates practical and ecological awareness. The selection of logs for floating, the use of long wooden sticks to manoeuvre sago trunks, and the coordination during log counting demonstrate a sophisticated understanding of material properties and the application of force. Table 1 presents a reconstruction of indigenous knowledge into scientific concepts, illustrating how community practices align with principles of mechanics, buoyancy, and environmental adaptation. For instance, the use of wooden sticks to roll sago logs onto river surfaces can be interpreted as an application of simple machines and force efficiency, revealing implicit knowledge about energy conservation and work (Amarillis et al., 2020). Similarly, the ability of sago logs to float, even under the weight of individuals running on them, provides a practical demonstration of Archimedes' principle, confirming that the density of the logs is lower than that of water. This observation substantiates prior studies that emphasise that local communities often encode scientific reasoning into practical activities, even when conceptual terminology is absent (Daniah, 2019). Collectively, these findings suggest that the cultural practice of running on sago logs serves both as a functional resource-management technique and as a living repository of indigenous scientific knowledge.

Reconstruction of Indigenous Knowledge into Scientific Principles

The process of reconstructing local knowledge into scientific frameworks highlights how the tradition of *berlari di atas tual sagu* can inform formal science education. Data analysis using the Miles and Huberman model facilitated the identification of recurring themes and principles embedded in community practices (Ilyas, 2016). For example, participants described rolling logs with a long stick, which requires a lever mechanism to reduce the effort required of the participants. This demonstrates the community's implicit understanding of mechanical advantage, a principle foundational to physics and engineering education. Table 1 details the conversion of indigenous observations into scientific explanations, linking cultural practices with pedagogically relevant concepts such as work, force, simple machines, and buoyancy. The narratives by Sunarimo (2022) and Sobirin (2022) illustrate that these principles are embedded in routine activities, indicating a tacit science literacy that has evolved organically over generations.

Table 1: Reconstruction of Community Knowledge into Scientific Knowledge

Community Knowledge	Scientific Knowledge
The community believes that rolling sago logs using a wooden stick facilitates transportation of sago to the river.	The use of wooden sticks demonstrates the application of force and simple machines. It illustrates the principle of work, where energy is applied to move the sago logs efficiently, and the concept of mechanical advantage is achieved through tool use (Amarillis et al., 2020).
The community runs on sago logs to accelerate the counting process.	Sago logs float due to their lower density than water, allowing individuals to move on them without sinking. This practice demonstrates Archimedes' principle and the concept of buoyancy (Daniah, 2019).
The community understands that sago grows on peat soil.	Peat soil retains water and carbon, providing an optimal habitat for sago growth. This highlights the relationship between plant physiology, soil properties, and ecological adaptation (Ratmini, 2012; Sugiyanto, 2019).
The community believes that sago logs do not sink because they are light.	Objects float when their density is lower than the fluid they are placed in. The floating sago logs indicate their density is less than water, providing a tangible example of physical properties in fluid mechanics (Ilhami et al., 2018).

The data demonstrate that the physical properties of sago logs facilitate floating and stability during transport. Observation and interviews revealed that logs are carefully selected for size and weight, ensuring they remain buoyant when assembled in rafts. This practice embodies the practical application of the density difference between solid wood and water, consistent with Archimedes' principle. The educational implications are significant, as students can directly observe and measure the floating logs, calculate forces involved, and model the principles in classroom experiments. By integrating these findings into pedagogy, science educators can bridge abstract principles with concrete, contextually meaningful activities, aligning with culturally responsive teaching models emphasised in prior ethnoscience research (Daniah, 2019; Ilhami et al., 2018).

Ecological Knowledge and Soil Adaptation

The study further reveals that indigenous knowledge encompasses environmental understanding, particularly regarding soil characteristics and plant ecology. Informants consistently reported that sago grows optimally in peat-rich, water-retentive soils that dominate the Meranti Islands (Ratmini, 2012). Observations confirmed that community members utilise this ecological awareness to select planting sites and to manage water levels during cultivation, ensuring sustainable yields. This finding aligns with prior studies demonstrating that local communities develop ecological literacy through experience and practice, which can be formalised into scientific education (Sugiyanto, 2019). Table 2 illustrates how these observations translate into curriculum-relevant knowledge concerning soil physics, plant physiology, and ecological interactions.

Table 2. Potential Educational Concepts Derived from Indigenous Ecological Knowledge

Basic Competency	Indicator	Local Wisdom Potential
3.2 Classify living organisms and objects based on observable characteristics	Classification	Students can classify sago based on its taxonomy, differentiating characteristics of living and non-living components, aligning practical observation with formal biology education (Amarillis et al., 2020).

Basic Competency	Indicator	Local Wisdom Potential
3.3 Explain the concepts of work and simple machines and their applications	Work, Types of Simple Machines, Mechanical Advantage	Rolling sago using sticks demonstrates applied work, lever mechanics, and muscle coordination. This allows integration of physics and human anatomy principles into experiential learning (Daniah, 2019).
3.6 Understand the organization of life from cellular to organismal levels	Cell, Tissue, Organ, Organ System, Organism	Analysis of sago logs provides insights into plant tissue structure from cellular composition to complete plant anatomy, facilitating contextual understanding of biology (Amarillis et al., 2020).
3.9 Relate physical and chemical properties of soil to organismal adaptation and sustainability	Soil Physics and Chemistry, Organismal Role	Peat soil characteristics and their suitability for sago cultivation highlight the interaction between organisms and their environment. Students learn ecosystem functions and sustainability concepts in a tangible context (Ratmini, 2012; Sugiyanto, 2019).

Analysis indicates that students exposed to these practices can learn about the interdependence among soil type, water retention, and plant growth, thereby gaining an applied understanding of environmental science. The community's use of peatlands demonstrates awareness of soil chemistry and hydrology, while their practices of selective planting and monitoring water levels reflect principles of ecosystem management. Integrating this knowledge into science curricula supports experiential learning, improves comprehension of abstract concepts, and encourages environmental stewardship (Baxter & Jack, 2015; Herrera et al., 2016).

The findings collectively demonstrate the potential to integrate indigenous knowledge into science education, offering a contextually grounded approach to teaching physics, biology, and environmental science. Students can engage with culturally familiar activities while exploring scientific principles, supporting both cognitive and affective learning outcomes (Aondolumun et al., 2025; Ilhami et al., 2019). This aligns with the ethnoscience literature, which emphasises that local knowledge systems can serve as pedagogical bridges, enhancing conceptual understanding, cultural awareness, and learner motivation (Baxter & Jack, 2015; Daniah, 2019; Ilhami et al., 2018). The reconstruction of *berlari di atas tual sagu* into scientific frameworks highlights the dual value of the practice as both cultural heritage and educational resource. Tables 1, 2, and 3, along with Figure 1, provide structured evidence of how traditional activities encode principles of mechanics, buoyancy, ecology, and plant biology. These results support the development of curriculum modules that incorporate local knowledge, thereby enriching science education while preserving intangible cultural heritage.

CONCLUSION

The study demonstrates that the tradition of *berlari di atas tual sagu* in Bokor Village embodies a rich integration of cultural, mechanical, and ecological knowledge that can be systematically reconstructed into formal scientific concepts. Findings reveal that community practices, including rolling, assembling, and running on sago logs, reflect an implicit understanding of mechanical principles, buoyancy, and material properties, while also incorporating ecological awareness of peatland soils and plant physiology. This integration illustrates how indigenous knowledge can serve as a tangible and contextually meaningful medium for science education. The analysis shows that sago logs' floating properties exemplify Archimedes' principle, the use of wooden sticks demonstrates mechanical advantage, and the selection and management of sago cultivation sites provide practical insight into ecosystem interactions and soil characteristics. The study's contribution lies in bridging local cultural practices with formal science education, offering a replicable framework for translating tacit indigenous knowledge into curriculum-relevant learning materials. By connecting observable traditional practices with scientific principles, the research provides a model for culturally responsive pedagogy that enhances both conceptual understanding and learner engagement. Furthermore, this study enriches the body of ethnoscience literature by demonstrating how kinetic, task-based traditions can encode complex scientific reasoning, extending beyond previously documented agricultural or ecological practices. Future research could explore integrating similar indigenous practices from diverse cultural contexts into science curricula, as well as conducting longitudinal studies to evaluate their impact on student learning outcomes and cultural preservation. Additionally, experimental approaches could quantify the mechanical forces and ecological parameters inherent to these practices, thereby further validating their educational and scientific relevance. Overall, the study highlights the potential of local knowledge systems as both pedagogical tools and cultural assets, reinforcing the value of contextualised science education.

AUTHOR CONTRIBUTIONS

Sri Aryani wrote the draft, conducted field observations and interviews, collected and analyzed the data. Aldeva Ilhami contributed to review of the manuscript and finalizing the manuscript for publication

DECLARATION OF CONFLICTING INTERESTS

The author declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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