

Design Knowledge and Cultural Continuity in Bidayuh *Kasah* Weaving: An Intangible Heritage Documentation Study

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ABSTRACT

Traditional Bidayuh *kasah* weaving represents a significant form of indigenous cultural heritage in Sarawak, embodying inherited design knowledge, symbolic motifs, and intergenerational craftsmanship. However, its sustainability is increasingly threatened by environmental change, material scarcity, and declining knowledge transmission. This study documents and analyses the intangible cultural heritage embedded in *kasah* weaving, focusing on techniques, motif structures, design logic, and cultural meanings. Guided by a heritage-centred framework, qualitative methods, including interviews and on-site observations with three experienced weavers, were employed. The study also includes contextual observations of locally available agro-waste materials, such as pineapple leaf fibre, not as substitutes but as reflections of changing material environments. Findings indicate that the cultural value of *kasah* weaving lies primarily in knowledge systems and weaving logic rather than raw materials. This study contributes to heritage safeguarding and offers insights for sustaining indigenous craft practices within evolving socio-environmental contexts.

KEYWORDS: Bidayuh *kasah* weaving, Intangible cultural heritage, Indigenous design knowledge, Weaving techniques, Cultural continuity

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1. INTRODUCTION AND RELATED LITERATURE

Weaving has long served as a vital cultural practice within Indigenous communities, functioning not only as a utilitarian craft but also as a medium for preserving cultural identity, transmitting intergenerational knowledge, and sustaining relationships between people, environment, and tradition (Mashman & Nayoi, 2012; Hwang & Huang, 2019). Through embodied skills, symbolic motifs, and culturally specific techniques, weaving practices encode histories, belief systems, and social values that define collective identity. As such, traditional weaving constitutes a significant form of intangible cultural heritage, where cultural meaning resides not merely in finished artefacts but in the processes, knowledge systems, and lived experiences of practitioners. Among the Dayak peoples, Indigenous groups native to Borneo, the Bidayuh community is recognised for its rich cultural traditions and skilled craftsmanship in basketry and weaving (Jalil & Alison, 2026). One of the most culturally significant Bidayuh woven forms is *kasah* (also known as *kelasah*), a traditional mat historically produced using rattan and tree bark (Jalil & Alison, 2026). Beyond its functional use, the *kasah* embodies ancestral knowledge, symbolic patterns, and distinctive weaving

logic that reflect Bidayuh cosmology, environmental understanding, and communal values. The practice of *kasah* weaving is traditionally learned through observation, participation, and oral transmission, making it a key site for intergenerational cultural continuity. In contemporary contexts, however, the continuity of traditional Bidayuh *kasah* weaving faces increasing challenges. Shifts in lifestyle, formal education pathways, and urban migration have reduced opportunities for younger generations to engage with traditional knowledge systems, including weaving practices and forest-based material gathering. At the same time, environmental pressures such as land-use change, logging, and agricultural expansion have significantly limited access to traditional raw materials, particularly rattan and tree bark (Jalil & Alison, 2026). These combined social and environmental changes have contributed to a widening gap in knowledge transmission, placing *kasah* weaving at risk of gradual decline. In response to these challenges, scholars have emphasised the importance of documenting Indigenous crafts to safeguard intangible cultural heritage, particularly in contexts where active practice is diminishing (Hwang & Huang, 2019). Documentation plays a critical role in preserving knowledge of

techniques, motifs, meanings, and cultural values that may otherwise be lost, while also providing a foundation for culturally respectful continuity (Jalil et al., 2024). Within heritage discourse, conservation is increasingly understood not as the preservation of artefacts alone, but as the safeguarding of cultural knowledge, skills, and practices that give meaning to material culture. At the same time, material scarcity and environmental change have prompted reflection on how traditional crafts can adapt without compromising cultural integrity. Although agricultural waste materials are increasingly discussed in sustainable textile literature, their relevance to Indigenous heritage practices remains underexplored. Within Bidayuh communities, such materials are not positioned as replacements but arise from shifting ecological and economic conditions. However, innovation that prioritises material substitution without cultural grounding risks undermining the intangible knowledge systems that define heritage practices. Despite growing interest in sustainable crafts, limited research has systematically documented Bidayuh *kasah* weaving as an intangible heritage practice, particularly in relation to design knowledge, symbolic motifs, and cultural logic. Therefore, there is a need for heritage-centred studies that foreground the voices of cultural custodians. This study addresses this gap by documenting weaving techniques, analysing symbolic motifs and design logic, and contextualising material challenges within contemporary environments.

1.1 Intangible Cultural Heritage and Indigenous Craft

Weaving plays a vital role in sustaining indigenous cultural identity, functioning as a medium for transmitting ancestral knowledge, social values, and embodied skills across generations (Mashman & Nayoi, 2012). Within the Bidayuh community of Sarawak, weaving constitutes an essential form of material culture closely tied to daily life, ritual practices, and agricultural activities. Among these woven artefacts, the *kasah*, a traditional mat woven, holds cultural significance, embodying collective memory, symbolic meaning, and intergenerational heritage (Shaik Hussain & Abdullah, 2022). Only one study provides a brief exploration of Bidayuh *kasah* (Shaik Hussain & Abdullah, 2022), and even this heritage is at risk of fading; no other study examines how material scarcity and environmental change affect the transmission of intangible knowledge within indigenous weaving traditions such as the Bidayuh *kasah*. Distinct from the weaving traditions of other Sarawakian ethnic groups, Bidayuh craftsmanship is characterised by wider warp strands combined with finer weft strands, forming a wicker-style weaving structure (Jalil & Alison, 2026). This distinctive structural logic not only defines the visual identity of Bidayuh woven artefacts but also reflects accumulated technical knowledge developed through long-term interaction with local environments (Mashman & Nayoi, 2012). Previous studies emphasise that cultural identity plays a significant role

in how traditional practices are valued, sustained, and adapted in contemporary contexts. In the field of textiles and crafts, research suggests that strong cultural attachment can reinforce ethical and environmentally conscious practices, linking sustainability with heritage and community values (Chakraborty & Sadachar, 2022; Larissa & Titisari, 2023).

Historically, craft and textile practices have served as powerful markers of identity, with the evolution of societies closely intertwined with their material cultures (Kalu et al., 2023). Studies on African and Asian craft traditions further demonstrate that weaving and related practices function not only as cultural expressions but also as repositories of indigenous knowledge systems (Kalu et al., 2023). These broader studies provide a comparative context for understanding *kasah* weaving as a culturally embedded knowledge system rather than merely a symbolic cultural artefact or as an economic resource. To tackle this issue, many designers have devised inventive strategies that involve breaking down, reshaping, and combining key aspects of Indigenous heritage with modern materials, updated manufacturing techniques, and current fashion trends. This approach generates new interpretations that respect traditional craftsmanship while catering to modern tastes (Jalil et al., 2024; Le et al., 2024). Recent studies have shown that traditional culture is not merely a backdrop; it is a significant source of inspiration for modern craft design (Hwui & Jalil, 2025). Recent studies highlight the growing role of digital technologies in preserving and promoting intangible cultural heritage. Jalil (2025a) demonstrates the potential of augmented reality (AR) to digitally document traditional fashion heritage, enabling wider access and engagement with cultural knowledge. Similarly, Jalil et al. (2025) showcase how artificial intelligence can be applied in graphic design to reinterpret Indigenous-inspired motifs in contemporary art, offering innovative avenues for cultural expression. Despite these advancements, research remains limited in systematically applying such digital tools to broader indigenous crafts, such as traditional weaving, basketry, and other material culture, pointing to a significant gap in strategies for sustainable documentation, preservation, and transmission of these heritage practices.

1.2 Natural-Based Agro-Waste Materials in Cultural Design Translation

In the context of Bidayuh *kasah* weaving, material selection is inseparable from cultural meaning, ecological knowledge, and environmental availability. Traditionally, *kasah* is woven using rattan and tree bark sourced from surrounding forests, materials that reflect long-standing relationships between the Bidayuh community and their local ecosystem (Shaik Hussain & Abdullah, 2022). However, increasing environmental pressures, resource scarcity, and changes in land

use have begun to affect the availability of these traditional materials, raising concerns about the continuity of *kasah* weaving practices (Jalil & Alison, 2026). Parallel to discussions on cultural heritage, increasing global attention has been directed towards environmental sustainability and waste management. Rapid population growth has led to a substantial increase in agricultural and organic waste, prompting scholars to explore alternative uses for underutilised natural resources (Ashokkumar et al., 2022; Provin et al., 2024; Jalil, 2025b). Agricultural residues, including fruit leaves, stems, and fibres, have been identified as potential resources for sustainable material exploration, offering environmental and socio-economic benefits when responsibly managed (Gupta et al., 2023). Within this discourse, pineapple leaf fibre (PALF) has attracted attention due to its availability as agricultural waste and its use in specific textile and craft applications (Muhammad Mifzal et al., 2023).

Existing studies mainly focus on the mechanical properties, processing methods, and environmental advantages of such fibres, positioning them as alternatives within sustainable textile development (Akatwijuka et al., 2022; Dana et al., 2023). However, less attention has been paid to their cultural implications. In indigenous contexts, materials are not neutral resources but are embedded within symbolic meanings, ecological knowledge, and traditional practices. As such, the exploration of agro-waste materials in relation to indigenous crafts should be understood not as direct material substitution but as a contextual response to environmental constraints that influence craft continuity (Jalil, 2025b). Malaysia's extensive pineapple cultivation generates a significant volume of agricultural waste in the form of discarded pineapple leaves. According to the Malaysian Pineapple Industry Board (MPIB), the country produced approximately 416,000 metric tons of pineapples in 2022 (MPIB, 2022). Moreover, the Sarawak government has formally committed to transforming pineapple waste, including leaves and stems, into value-added products through its "Waste to Wealth" initiative (Lorna, 2024). Studies collectively suggest that agricultural and other agro-waste materials can be explored not only for their technical performance but also for their compatibility with traditional weaving techniques and the cultural symbolism of indigenous crafts such as the Bidayuh *kasah*. This perspective positions agro-waste materials to maintain cultural continuity while promoting sustainable material use (Dana et al., 2023). Although PALF has been used in other craft contexts, its potential to support the cultural continuity of Bidayuh *kasah* weaving remains unexplored.

Previous studies demonstrate that alternative plant-based fibres can be integrated into traditional crafts when handled with cultural sensitivity (Jalil,

2025b). Research on *songket* weaving, for instance, illustrates how non-traditional fibres may support motif preservation and visual continuity without displacing symbolic meanings (Muhammad Mifzal et al., 2023). Similarly, Lin and Lin (2022) examine the use of banana fibre in Kavalan weaving, emphasising the importance of design-led adaptation guided by indigenous knowledge systems rather than purely technical considerations. This study highlights that agro-waste materials, when handled with cultural sensitivity, can reinforce cultural visibility and continuity (Lin & Lin, 2022). Studies also demonstrate that fibres derived from agricultural waste, such as pineapple leaves and banana pseudostem, can be processed into textiles with performance characteristics comparable to those of traditional textiles, such as cotton (Akatwijuka et al., 2022; Dana et al., 2023). These findings have positioned agricultural fibres as viable alternatives within sustainable textile production. This indicates a broader opportunity to repurpose locally available agro-waste materials to preserve cultural identity while contributing to sustainable craft practices. By repurposing locally available agricultural residues into usable fibres, material innovation can be aligned with indigenous knowledge systems that have historically relied on locally sourced natural materials (Jalil, 2022).

Moreover, local farmers are often unaware of the potential of agricultural waste fibres, leading to their waste being dumped or burned (Mondal et al., 2023). In this way, agrarian fibres may serve not only as sustainable alternatives, but also as culturally responsive materials capable of supporting the form, function, and material logic of traditional crafts such as *kasah*, without displacing their cultural significance. Importantly, in indigenous craft contexts such as *kasah* weaving, material exploration is not about replacing traditional materials outright, but about responding to environmental constraints in ways that preserve cultural identity, weaving logic, and symbolic meaning. Despite growing interest in sustainable fibres and indigenous crafts, research examining agro-waste materials through the lens of indigenous craft preservation remains limited (Jalil et al. 2024), particularly regarding the *kasah*'s form, function, and material symbolism. Furthermore, existing studies rarely adopt Indigenous-led or community-informed perspectives when exploring material adaptation. Drawing on the reviewed literature, this study identifies a critical gap at the intersection of indigenous craft preservation, sustainable material exploration, and culturally informed design. While existing studies highlight the technical and environmental potential of agro-waste fibres, limited attention has been given to how such materials may support the continuity of intangible cultural heritage within specific indigenous weaving traditions. Guided by this gap, the study is structured around four research objectives and corresponding research propositions

that examine cultural significance, material adaptation, sustainability, and ethical innovation in the context of Bidayuh *kasah* weaving.

In addition, positioned within the fields of indigenous craft studies, intangible cultural heritage, and cultural continuity, this research adopts a heritage-centred perspective rather than a material- or technology-driven approach. While existing literature on agro-waste fibres and sustainable materials provides important contextual insight, this study does not seek to evaluate material performance or propose direct material substitution for traditional *kasah* weaving. Instead, it foregrounds the documentation and interpretation of indigenous knowledge systems, weaving logic, symbolic meanings, and community perspectives that sustain the cultural identity of the Bidayuh *kasah*. By situating material exploration within environmental and cultural contexts rather than as an outcome of innovation, the study contributes to the heritage conservation discourse. It offers a culturally informed framework for understanding how traditional weaving practices negotiate continuity amid ecological and social change. To address this gap, this study adopts a heritage-oriented conceptual framework grounded in principles of intangible cultural heritage and culturally informed perspectives, as shown in **Figure 1**.

This research focuses on documenting and analysing the cultural knowledge embedded in traditional Bidayuh *kasah* weaving, including weaving techniques, symbolic motifs, cultural meanings, and modes of knowledge transmission. Qualitative fieldwork involving interviews and on-site observations with experienced Bidayuh weavers forms the core of the study. Reflections on locally available agricultural waste materials are included only as contextual observations related to material scarcity, rather than as a basis for technical material development. By prioritising documentation and cultural understanding over material replication or innovation, this study aims to contribute to the safeguarding of Bidayuh weaving heritage and to broader discussions on cultural continuity within Indigenous craft traditions facing contemporary change.

Figure 1 demonstrates the research framework of heritage-centred research that was used in this research. The framework is divided into two components that are interconnected and that jointly facilitate the documentation and interpretation of the intangible cultural knowledge in the Bidayuh *kasah* weaving. Phase One (**Figure 1**, left side) is about ethnographic recording, such as semi-structured interviews and direct observation of experienced weavers. This stage embodies fundamental aspects of cultural heritage intangible, such as weaving methods, structural reasoning, symbolic patterns, and cultural connotations.

It highlights the importance of practitioners as agents of cultural care and makes the documentation of embodied knowledge and lived experience a priority. Phase Two (**Figure 1**, right side) offers contextual material analysis through the evaluation of the availability and attributes of locally available materials in the modern community setting. This stage does not imply any material substitution but puts *kasah* weaving in a wider context of socio-environmental shifts, emphasizing how material circumstances affect but do not determine cultural practice. The two stages merge together with a qualitative analysis of data, where themes in knowledge transmission, cultural meaning, and design logic are identified and interpreted. The framework finally places cultural continuity as the product of maintaining knowledge systems as opposed to the material. The model advocates a culturally based approach to maintaining indigenous craft practices in changing environments by combining both the ethnographic and contextual knowledge. This study contributes to heritage-centred design research by repositioning material adaptation as a culturally negotiated process rather than a technical substitution strategy.

2. METHODOLOGY

This study adopted a qualitative, ethnographic, and interpretive design, supported by thematic analysis and methodological triangulation. Grounded in intangible cultural heritage documentation, the methodology emphasises the preservation of knowledge systems, weaving techniques, symbolic meanings, and cultural transmission. Fieldwork was conducted to capture the lived experiences of Bidayuh *kasah* weavers within their cultural and environmental contexts. As shown in **Figure 1**, the study comprises two interrelated phases. Phase One focuses on ethnographic documentation through interviews and on-site observations, while Phase Two contextualises material-related challenges and adaptive practices within contemporary environmental conditions. Ethical considerations guided all procedures, with approval obtained from the UNIMAS Human Research Ethics Committee (Non-Medical) [FACA-HREC(NM)/2025/01(12)].

2.1 Phase One: Ethnographic Documentation of *Kasah* Weaving

Phase One involved semi-structured interviews and direct observations of Bidayuh *kasah* weavers. Due to the limited number of active practitioners, purposive snowball sampling was employed to identify knowledgeable participants within the community (Patton, 2015). Three experienced weavers were selected as key cultural custodians. Although small, this sample is appropriate for qualitative ethnographic research, which prioritises depth and richness of data (Creswell & Poth, 2016). Interviews, conducted between May and September 2025, explored personal histories,

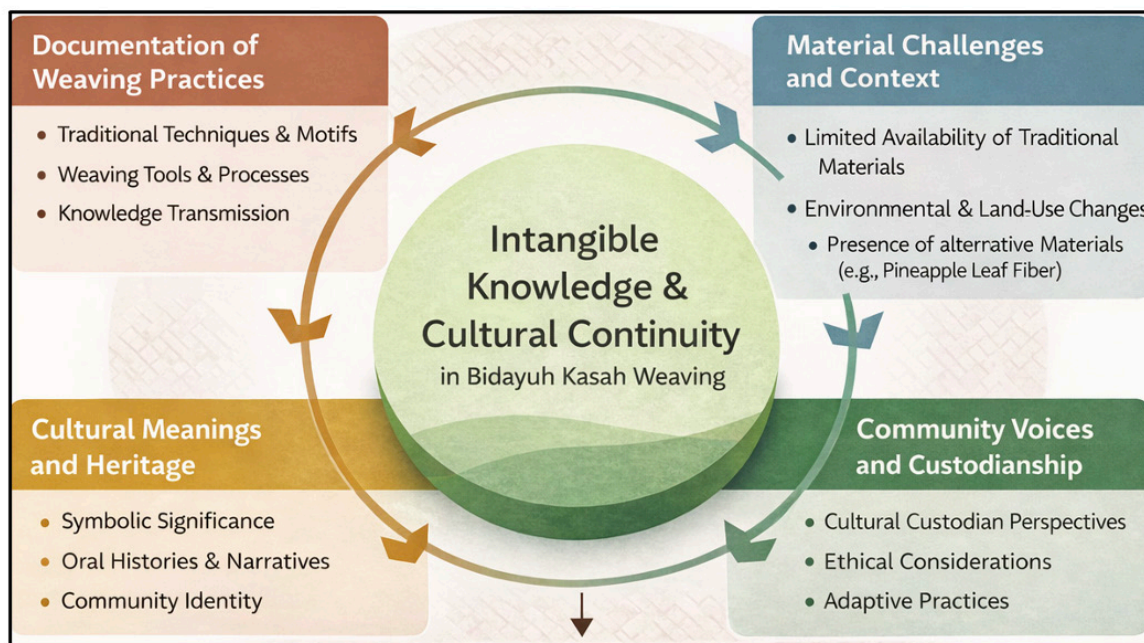


Figure 1: Conceptual framework

weaving techniques, symbolic motifs, cultural meanings, and perspectives on continuity. Each session lasted approximately 60 minutes and was audio-recorded and transcribed. To enhance data credibility, interviews were complemented by on-site observations lasting two to three hours. Observations focused on tools, materials, weaving processes, embodied techniques, and cultural practices. Data were documented through field notes, photography, and video recordings using a structured checklist. Triangulation was achieved through the integration of interview and observational data. Ethical protocols included informed consent, confidentiality, and permission for visual documentation, ensuring respect for cultural sensitivities and custodianship.

2.2 Phase Two: Contextual Documentation of Material Adaptation

Phase Two examined material-related challenges and adaptive practices to contextualise *kasah* weaving within changing environmental conditions. Observations focused on locally available resources, including agricultural waste such as pineapple leaves. Pineapple leaf fibre was documented as an example of material availability rather than as a substitute for traditional resources. Basic fibre extraction processes (retting, scraping, washing, and drying) were recorded to understand local perceptions of material suitability and cultural acceptance. This phase did not involve material experimentation. Instead, it aimed to document how weavers interpret material constraints, cultural boundaries, and the limits of adaptation, ensuring the study remains focused on heritage continuity rather

than technical development.

2.3 Data Analysis

Data were analysed using thematic analysis. Interview transcripts and field notes were coded to identify patterns related to weaving techniques, motif structures, symbolic meanings, and knowledge transmission. An inductive approach allowed themes to emerge from the data. Phase One data were analysed through iterative coding and categorisation, while Phase Two data were interpreted to identify themes related to material scarcity and environmental change. The analysis focused on participants' perspectives rather than material performance. By integrating findings from both phases, the study provides a holistic understanding of *kasah* weaving as an intangible cultural heritage practice within contemporary socio-environmental contexts.

3. RESULTS AND DISCUSSION

This section presents the study's findings across two phases. Phase One focuses on qualitative insights obtained through semi-structured interviews and direct observation with experienced Bidayuh *kasah* weavers, documenting the cultural significance, material knowledge, and technical processes embedded in *kasah* weaving. Phase Two presents contextual observations related to material availability, including pineapple leaf fibre as a locally present agro-waste resource, discussed in terms of environmental relevance rather than application. Together, the findings highlight how traditional knowledge, craftsmanship, and

symbolism are sustained within changing material and environmental contexts, supporting the continuity of *kasah* weaving knowledge transmission.

3.1 Phase One: Ethnographic Documentation of *Kasah* Weaving

Phase one of the study involved semi-structured interviews and observation with three experienced Bidayuh *kasah* weavers in Bau, Kuching, Sarawak, and Kota Padawan, Siburan, Sarawak. Thematic coding of the qualitative data produced the following significant themes.

3.1.1 Indigenous Cultural Knowledge: Documentation of *Kasah* Weaving Practices and Cultural Meanings

The findings show that *kasah* weaving is deeply intertwined with Bidayuh cultural identity. Weavers described the craft as a heritage symbol that embodies community values, traditional knowledge, and ancestral continuity. As one weaver explained, *kasah* has long been essential to everyday life, particularly in agricultural practices such as drying paddy where I1 stated that “if you had a lot of paddy, you needed to dry it under the sun, and you must have *kasah*.”, and it is also a cultural heritage where it is remembered as part of “our legend” and the way “our great grandparents, make a living” (I1). The *kasah* is recognised not only for its functional role in domestic and ceremonial contexts but also as a cultural emblem that signifies the Bidayuh people’s belonging and cultural identity. I1 noted that *kasah* incorporates various motifs, including *rantai* (chain-like motif) (Figure 2a), zigzag (Figure 2b), and *mata punai* (Figure 2c). According to I1, these motifs may carry symbolic meanings and operate as a form of visual storytelling rather than purely decorative elements. For instance, the zigzag motif represents an uphill road leading to the mountains, reflecting the historical settlement patterns of the Bidayuh people. Nevertheless, field observations and interview data indicate that the most produced *kasah* motif is shown in Figure 2d, suggesting a gradual narrowing of design variation in everyday practice, which will be used for this paper.

Preservation emerged as a strong concern among artisans. Participants highlighted the decline in the number of skilled weavers due to reduced interest among younger generations, who often pursue urban employment or formal education. I1 observed that younger people are “not interested” and are more engaged with “modern things.” In contrast, I3 similarly noted that many individuals, including some from older generations, no longer know how to produce the craft. These statements point to a weakening of intergenerational transmission pathways that traditionally sustained the practice of *kasah* weaving. *Kasah* weaving is a deeply rooted skill, often passed down informally through observation and practice

for generations within families. Thus, the absence of structured teaching systems limits the spread of the craft. This finding was evident across all participants: I1 and I2, each with over 20 years of experience, learned the craft from their mothers, while I3, with more than 40 years of experience, learned from his father. The reliance on familial transmission, while culturally significant, also limits the craft’s broader distribution in the absence of institutional or community-based learning frameworks. I2 explained that both rattan and *boyuh* (tree bark) have become increasingly difficult to obtain, requiring weavers to travel deep into forested areas. The slow regeneration cycle of these materials intensifies the issue, as rattan and trees to get the *boyuh* trees take decades to mature before harvesting. As I2 stated, although rattan can be planted, the question remains: “When are we going to harvest it?” Despite these constraints, the weavers expressed a strong commitment to safeguarding the *kasah* tradition. They acknowledged that material experimentation and product diversification could support the craft’s continuity, provided that cultural authenticity, weaving structure, and symbolic meaning are respected. Importantly, all three interviewees confirmed that there are no cultural taboos associated with weaving the *kasah*, suggesting openness to modern adaptations of the craft.

3.1.2 Material Scarcity and Sustainability Concerns: Community Voices and Custodianship

To weave a *kasah*, the two primary materials required are rattan and tree bark (*boyuh*). The two most common types of rattan used are *rotan segak emas* (Malay) / *uwi sogoh* (Bidayuh *Jagoi*, a sub-dialect of the Bidayuh Bau people) / *uwi segūh* (Bidayuh *Biatah*, a sub-dialect of the Bidayuh from the *Siburan* and *Padawan* sub-districts), which is naturally yellow (Figure 3a). The second type is *uwi sogā* (Bidayuh *Jagoi*) / *uwi smai* (Bidayuh *Biatah*), which has a paler colour (Figure 3b). In addition to rattan, tree bark (*boyuh*) is used as a binding material in the weaving structure (Figure 3c).

The materials require specialised harvesting and preparation methods, including slicing, flattening, smoothing, drying, and softening. A twine made from the tree bark (*boyuh*) is also used to reinforce the outer edges of the *kasah*. According to the weavers, the tree bark strips (*boyuh*) must be moistened with water before weaving to make it easier for the *boyuh* to be pushed down tightly into the weave. There are a few traditional tools identified to craft the *kasah*: 1) *Sosag* (Figure 4a), traditionally used to push the tree bark strip tightly into the weave, 2) *Sindak pait* (Figure 4b), a sharp blade for cutting, 3) *Kiru* (Figure 4c), a metal tool to untuck weaves. Furthermore, I2 demonstrated how the tree-bark twine she rolled up on the two sticks is tied together. However, the weaver is unsure of the tool’s name. The weaver explained that the tool (Figure 4d)

comes in pairs and is used to secure the edge of the *kasah* by interlocking at the finishing stage of the *kasah* weaving process. The weavers also emphasised during the demonstration that if the traditional tools are not readily available, any tool that has the same function as the conventional tools can be utilised for the *kasah* weaving process.

Observation of the weaving process revealed intricate techniques that demonstrate high craftsmanship. During the crafting process, the weaving structure alternates between long and short rattan strips, known in Bidayuh as *dari* and *dayung* (**Figure 5a**). In the final stage, the longer *dari* are looped inward to cover the shorter *dayung*, forming a secure structure (**Figure**

5b). A strip of tree bark is then inserted and interlaced between the loops and knots to reinforce the weave, and this process was repeated to create multiple rows of secure binding (**Figure 5c**). Once tightened, the loops are closed, tucked, and trimmed to produce a compact and durable edge (**Figure 5d**). The wicker weaving style, characterised by wider verticals and narrower horizontals, is unique to the Bidayuh. Variations in technique are evident among weavers, particularly in reinforcement methods, where additional wrapping of tree bark increases durability. If the tree bark is insufficient, new pieces are overlapped to continue the process. These variations highlight the technical expertise and deep material understanding required in *kasah* weaving.



Figure 2: a) Rantai (chain-like motif), b) Zig Zag, c) Mata Punai, d) wicker weave traditional kasah motif

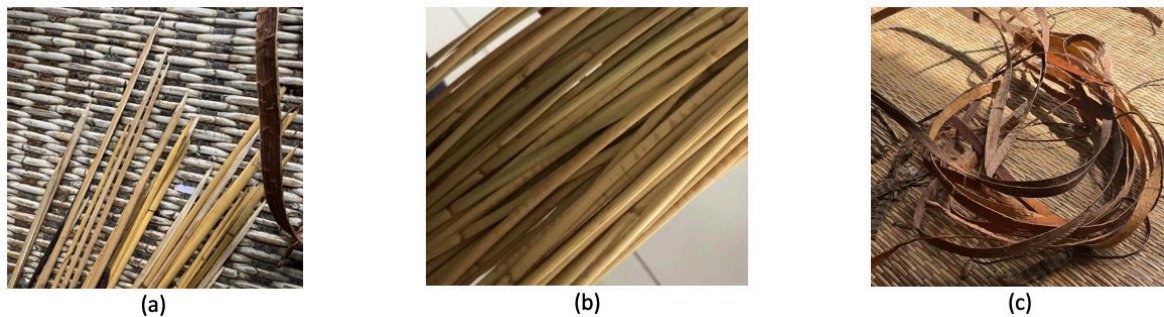


Figure 3: a) Rotan segak emas (Malay) / uwi sogoh (Bidayuh Jagoi) / uwi següh (Bidayuh Biatah) b) Uwi soga (Bidayuh Jagoi) / uwi smai (Bidayuh Biatah), c) Tree bark strip (boyuh)



Figure 4: a) Sosag, for pushing tree bark into the weaves, b) Sindak pait a sharp blade for cutting, c) Kiru, a metal tool to untuck the weaves, d) A pair of sticks to tie the edge of kasah



Figure 5: a) Rattan arranged alternately in long (*dari*) and short (*dayung*) pieces, b) Interlaced loops to secure the weave, c) Finished mat (front of *kasah*), d) Excess rattans tucked into existing weaves (backside of *kasah*)

Figure 6 shows the process of making *kasah* weaving, step by step, by a talented Bidayuh weaver. It shows that the tree bark (*boyuh*) must first be soaked to make it easier to push tightly into the weave. The rattan is alternately lifted to weave the tree bark into the weave, then pressed tightly into the weave. Once the tree bark is secured in the weaving arrangement, additional rattan strips are added until the desired length is achieved. The excess tree bark at the top of the weave loops twice around the supporting rattan piece to strengthen the weave, and then is tucked in the opposite direction, going downwards, to continue weaving. The exact process repeats until the weave is complete. Excess tree bark and rattan are cut off.

3.2 Phase Two: Agro-Waste Material Feasibility, Material Challenges, and Context

The second stage of the research provides a contextual material evaluation to understand how shifting environmental and material conditions influence the persistence of *kasah* weaving. Rather than focusing on experimental material development or structural substitution, this phase documents the presence, properties, and perceived relevance of locally available materials within Bidayuh communities. This phase does not replicate the traditional *kasah* weaving process or assess mechanical performance through laboratory testing, such as tensile strength or durability. Instead, it considers material characteristics, handling qualities, and visual compatibility of pineapple leaf fibres within culturally informed textile contexts. Field observations identified pineapple leaves as an accessible agricultural by-product in local farming settings. Two locally available variants were recorded: *Nanas Sawit*, characterised by long, narrow leaves with sharp edges, and *Nanas Paun*, with broader, shorter, and smoother-edged leaves. The leaves were collected from a Bidayuh-owned farm in *Siburan*, Sarawak, and processed into fibres to observe their physical characteristics. Fibre extraction processes, including water retting, hand scraping, washing, and drying (**Figure 7**), were documented to understand community handling and perception of these materials. The resulting fibres were long, flexible, and light in colour, resembling textile-like strands. In contrast to rattan,

which provides rigidity and structural strength essential for *kasah* weaving, pineapple leaf fibres are pliable and lack load-bearing capacity, making them unsuitable for direct structural substitution. However, their properties may inform culturally informed textile reinterpretations that translate *kasah* motifs and design logic into flexible applications. Importantly, this phase does not aim to redefine or reproduce traditional *kasah* using alternative materials. Instead, it situates material availability within broader socio-environmental change and highlights how communities engage with emerging material possibilities while maintaining cultural integrity. Findings indicate that continuity in *kasah* weaving is driven primarily by the preservation of design knowledge, symbolic meaning, and weaving logic, rather than material substitution alone.

A careful juxtaposition between conventional *kasah* material (rattan and tree bark) and pineapple leaf fibre is used to point out incompatibilities between the materials, as well as conceptual continuities, which underlie the differentiation between structural replication and cultural translation. Some of the results in Phase One include the fact that rattan has inherent rigidity, strength, and structural memory, which allows it to be formed in long-lasting, load-bearing woven forms, which constitute the functional identity of the *kasah*. Conversely, pineapple leaf fibre is flexible, soft, and behaves like a textile and therefore cannot be directly substituted in the traditional *kasah* structure without modifying its structure and functionality considerably. This contrast reflects key concerns expressed by weavers. The focus of I2 on the scarcity of materials and their harvesting challenge highlights the realistic constraints of using only traditional resources, and thus, encourages the consideration of other materials. But I1 emphasises symbolic meaning, and cultural narratives, indicating that material substitution has to be done carefully to ensure that visual and cultural language incorporated in *kasah* motives is not disturbed. Likewise, the fact that I3 is worried about the decrease in knowledge transmission is that anything developed as a material innovation has to be open and comprehensible in the current cultural systems of learning. Even with

these discrepancies, the comparison demonstrates an essential fact of convergence: both traditional and experimental materials can assist in the continuation of *kasah* knowledge when implemented in the proper structural and symbolic logic. Although pineapple fibre will not be as structurally stiff as rattan, it shows promise of visual and conceptual restructuring, specifically in its

use where the need to be load-bearing is not so crucial as the ability to be flexible, to be surface-based, and to be translated into a motif. This distinction is vital, and it focuses on the fact that instead of replacing materials, efforts of knowledge preservation are directed to adaptive design strategies.



Figure 6: Weaving one of the significant Bidayuh cultural heritages *kasah*, step by step, by a talented weaver

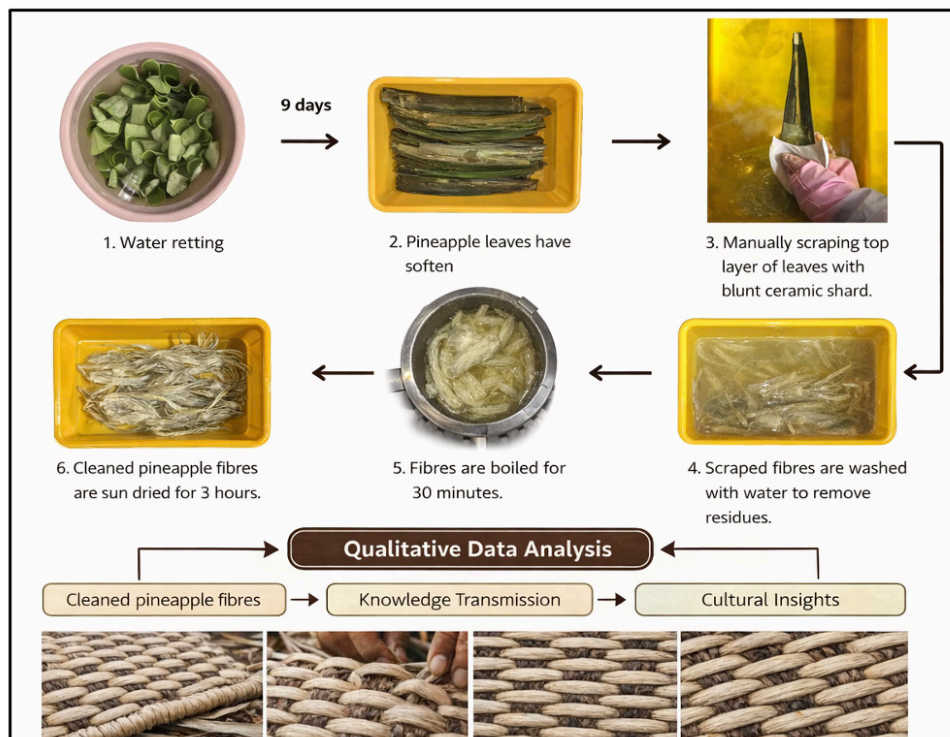


Figure 7: Pineapple leaf fibre extraction process documented as a contextual agro-waste material

Moreover, the comparison underscores a larger conflict of authenticity and adjustment. The basis of traditional *kasah* weaving lies in material-specific knowledge, in which the behaviour of rattan is directly used to shape weaving processes and structural results. This opposition confirms the observations of Phase One, when weavers stressed that the identity of *kasah* weaving is rooted not only in the material exploitation but also in the logic of structure, in the symbolic motifs, and in the cultural meaning of *kasah* weaving. The direct transfer is not necessary; instead, different techniques must be reinterpreted to use a materially different fibre like pineapple leaf. Failure to adapt to this means that artefacts that are structurally viable and culturally meaningful might be produced. Thus, the results indicate that pineapple leaf fibre cannot be perceived as an analog to rattan, although it is the complementary substance that can allow transferring *kasah*-related knowledge into new situations. Such a material experimentation, emphasized by the knowledge of cultural actors and based on the maintenance of the logic and symbolism of weaving, can help to sustain the continuity of intangible cultural heritage, but not to weaken it. This confirms that material adaptation in *kasah* weaving must prioritise cultural logic over structural imitation.

4. DISCUSSION

This study highlights the relevance of a heritage-centred framework for understanding how intangible cultural knowledge in Bidayuh *kasah* weaving can be sustained amid environmental and social change. The findings confirm that *kasah* identity is primarily embedded in knowledge systems, such as weaving techniques, structural logic, motifs, and symbolic meanings, rather than in raw materials. Four key themes emerged: (1) material scarcity and cultural negotiation, (2) structural knowledge as ancestral craft logic, (3) preservation of symbolism through weaving practice, and (4) challenges in intergenerational knowledge transmission. These themes demonstrate that *kasah* weaving is a dynamic practice shaped by environmental conditions and cultural knowledge systems. Findings show increasing scarcity of rattan and tree bark due to deforestation, plantation expansion, and ecological change, directly affecting access to traditional materials. Rather than treating alternative materials as replacements, weavers emphasise that *kasah* must remain consistent in form, logic, and meaning. Pineapple leaf fibre was documented as a locally available agro-waste material within Bidayuh villages, not as a substitute but as contextual evidence of shifting material environments.

Two variants were observed, *Nanas Sawit* (long, narrow leaves) and *Nanas Paun* (broader, shorter leaves), collected from a farm in *Siburan*, Sarawak. Basic fibre extraction processes (retting, scraping, washing, drying)

were recorded (**Figure 7**) to understand local handling and perception. The fibres produced were flexible and lightweight, contrasting with rattan's structural rigidity, required in *kasah* weaving. While unsuitable for direct substitution, they may inform culturally sensitive textile reinterpretations that preserve weaving logic and symbolic structure. This aligns with prior research on agricultural fibre utilisation (Ashokkumar et al., 2022; Lin & Lin, 2022; Gupta et al., 2023), which focuses mainly on material performance and innovation. In contrast, this study situates material adaptation within a cultural framework, emphasising that innovation must be guided by custodianship and heritage continuity rather than technical substitution. Material change is therefore understood as a negotiated cultural process rather than a functional replacement strategy.

Kasah durability is achieved through inherited structural principles, including alternating *dari* (long) and *dayung* (short) strips, wicker-style weaving, and reinforced edge looping. These are not only technical methods but also expressions of transmitted cultural knowledge. The findings suggest that adaptation should translate structural logic rather than replicate form. While pineapple leaf fibres lack rattan's rigidity, they may be reconfigured through layered weaving strategies that reflect *kasah* construction principles. This reinforces the argument that structural integrity and cultural continuity are inseparable. Material substitution must therefore align with weaving logic, ensuring that adaptation remains culturally grounded rather than purely functional or material-driven. Data indicate that cultural continuity in *kasah* weaving is maintained primarily through correct construction techniques rather than decorative motifs. The wicker-style structure is a key cultural marker among Bidayuh communities. Thus, meaning in *kasah* is embedded in making processes rather than surface ornamentation. Within this study, *kasah* is interpreted not as a literal artefact to be reproduced, but as a set of transferable weaving principles for textile adaptation. Phase Two observations suggest that pineapple leaf fibres can support *kasah*-inspired textile translation when structural logic is preserved. This challenges material-centred innovation approaches, which often overlook embodied knowledge and craft transmission.

A decline in intergenerational transmission was consistently reported, driven by reduced access to materials, labour-intensive processes, and socio-economic change (Mashman & Nayoi, 2012; Shaik Hussain & Abdullah, 2022). While material scarcity affects traditional production, weavers emphasised that knowledge continuity is the primary concern. Participants expressed openness to material adaptation, provided that weaving techniques and structural principles are maintained. This indicates that cultural continuity depends more on knowledge transmission than material preservation. Importantly, adaptation is

viewed as acceptable when it supports the continuation of weaving practice in changing environmental conditions, rather than replacing traditional systems. As shown in **Figure 1**, the proposed framework integrates ethnographic documentation and contextual material understanding, positioning design knowledge as the core carrier of cultural identity. Material conditions are treated as contextual influences rather than drivers of change. The findings suggest that culturally informed adaptation can support the relevance of *kasah* weaving within contemporary creative contexts without compromising authenticity. Rather than prioritising material innovation, the framework emphasises documentation of weaving knowledge, symbolic systems, and practitioner perspectives as essential to cultural continuity. This contributes to heritage-centred approaches for sustaining indigenous craft practices under environmental change.

While this study provides valuable documentation of the intangible cultural heritage embedded in traditional Bidayuh *kasah* weaving, several limitations should be acknowledged. These limitations arise primarily from the cultural context of the craft, the scope of the research, and the methodological choices made to prioritise ethical heritage documentation over technical experimentation. As *kasah* weaving is increasingly endangered, only a small number of experienced artisans remain actively practising within the Bidayuh community. Nevertheless, this limitation constrains the generalisability of findings across all Bidayuh subgroups or geographic regions. The study, therefore, represents in-depth, context-specific documentation rather than a comprehensive survey of all *kasah* weaving traditions. Another limitation concerns the focus on qualitative documentation rather than on longitudinal observation. The study captures *kasah* weaving practices at a specific moment in time and does not examine changes in techniques, material access, or knowledge transmission over extended periods. As cultural practices are dynamic, future studies would benefit from longitudinal ethnographic approaches to trace how *kasah* weaving evolves across generations, particularly in response to environmental change and shifting socio-economic conditions. Additionally, while the study includes contextual documentation of locally available agro-waste materials, it does not undertake systematic experimental testing, mechanical analysis, or large-scale material trials. This decision was deliberate, as the primary aim of the research was to document intangible cultural knowledge rather than to develop or validate alternative materials. As a result, conclusions regarding material suitability remain exploratory and illustrative rather than technical or performance-based.

Future studies could expand on this work by conducting practice-based experimental investigations into a broader range of local natural and agro-waste

materials to bring a new look to the *kasah*. Such studies may incorporate laboratory testing, durability assessment, and structural analysis to evaluate material performance while remaining guided by culturally informed principles. Moreover, the framework proposed in this study offers significant potential for broader application. Future research may apply this heritage-centred framework to other indigenous weaving traditions, enabling comparative analysis of how intangible cultural knowledge, material conditions, and community values interact in different cultural contexts. The framework may also be adapted for educational, curatorial, or community-based heritage programmes aimed at revitalising endangered crafts through documentation, co-creation, and intergenerational learning. Finally, the study is limited by the broader reality that intangible cultural heritage is inherently vulnerable to loss, particularly when dependent on oral transmission and embodied practice. As elder weavers age and fewer younger practitioners emerge, opportunities for documentation become increasingly scarce. This underscores the urgency of heritage-focused research and highlights the need for sustained institutional support, archival initiatives, and community-led safeguarding strategies. In conclusion, while this study is intentionally limited to a documentary scope, it establishes a critical foundation for future research that integrates cultural documentation, ethical material exploration, and participatory heritage safeguarding.

5. CONCLUSION

This paper demonstrated that Bidayuh *kasah* weaving is a knowledge-based cultural practice in which identity is sustained through design logic, symbolic motifs, and embodied techniques rather than material components alone. The research showed that the persistence of *kasah* weaving can be traced back to the passing of the principles of structure, system of patterns, and embedded meaning of the culture by recording the experiences of practising weavers using qualitative interviews and on-site observation. The results repositioned *kasah* weaving into the context of intangible cultural heritage by highlighting that its worth is not its material permanence, but the maintenance of knowledge and cultural interpretation as practiced. In this framework, the observations of materials that are locally found, including the pineapple leaf fibre, are presented as the reflections of the changing environmental conditions instead of the causes of material substitution. This difference highlighted how adaptation should be done using culturally informed design translation instead of direct substitution of the traditional materials. The paper also emphasized the importance of weavers as cultural custodians whose body of knowledge supports the practice. With the ongoing environmental stresses and the changing socio-economic status around access to traditional resources,

the sustainability of *kasah* weaving in the long-term relies on sustaining access to intergenerational flow and cultural authority of the practice. The study has weaknesses regarding the small sample size and is based on documentation, as opposed to longitudinal or practice-based experimentation, but it provided a valuable basis on which future research can be conducted. Future research can build on this work by considering participatory and community-led strategies to protect and studying how culturally based adaptation strategies can serve to make the relevance of traditional crafts in more modern contexts. In general, the study is relevant to the heritage and design debate by helping to develop a heritage-driven approach, where knowledge continuity is given greater priority than material preservation. It shows that to preserve the practice of indigenous crafts, it is necessary not only to document but also to have a critical interpretation of the interactions between cultural meaning, design logic, and community involvement in changing environmental and social environments.

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DECLARATION OF COMPETING INTERESTS

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

MHJ: Conceptualization, Methodology, Data curation, Visualization, Writing – original draft, Supervision, Funding acquisition, Reviewing and Editing, Project administration. **AIAR:** Conceptualization, Investigation, Resources, Formal analysis, Writing – original draft.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the author used ChatGPT as a language assistant to rephrase and refine the text. After using this tool, the author reviewed and edited the content as necessary, taking full responsibility for the publication's accuracy.

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