

Translating Sindhi Textile Heritage (Ajrak and Rilli) onto Banana-Fibre Sustainable Fabric for Contemporary Apparel Design

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Abstract

The growing dependency of the global fashion industry on the use of high-resource fibres has caused great interest in alternative fibre sources made from agricultural waste, including banana fibre. This study investigated the potential to translate Ajrak block-printing and Rilli patchwork into modern apparel fabrics constructed from banana fibre. Ajrak is a textile tradition from the province of Sindh, Pakistan, where it is typically printed onto cotton fabric. Similarly, Rilli is also a textile tradition from Sindh but involves sewing together pieces of fabric, which are traditionally cut from a single piece of cloth. The study was conducted within an interpretivist paradigm and utilized a qualitative multiple case study approach (two textile traditions - Ajrak and Rilli). Fieldwork occurred in the cities of Hyderabad, Hala and Bhit Shah. Purposive sampling along with snowball sampling resulted in sixteen total participants: three Ajrak artisans, three Rilli artisans, five fashion designers and five textile experts and academics. Interviews were triangulated with data collected during field observations and a literature review. Braun and Clarke's thematic analysis technique was employed to analyze all data. Results indicated six major themes: motif as cultural memory; embodied craft knowledge at risk due to lack of transmission to younger generations; cautious acceptance toward incorporating new materials; technical challenges when translating traditional dyes and stitches onto banana fibre; artisan-centered collaboration will provide legitimacy; and sustainability provides an opportunity for the revitalization of intangible cultural heritage. The findings suggest participants consider banana fibre to be a viable - possibly advantageous - substrate for both Ajrak and Rilli textiles provided their absorbency, hand feel and ability to accept stitching can be thoroughly evaluated. Additionally, participants noted artisans should continue to play a central role in the adaptation process instead of being bypassed by designers.

Keywords: sustainable fashion; banana fibre; textile heritage; Ajrak; Rilli; craft sustainability; reflexive thematic analysis

Introduction

The global textile and clothing industry is known to be an environment polluting sector, with considerable amounts of energy being used for fibre production and dyeing, also causing large amounts of chemical pollutants into rivers and oceans, and creating huge volumes of post-consumer textile waste (Niinimäki et al., 2020) leading to sustainability being at the forefront of modern design research. The discourse on the 'circular textile economy' has become increasingly prominent promoting the move from linear 'take-make-dispose' processes towards more cyclical production processes which allow materials, garments and cultural values to remain in circulation for longer periods (Ellen MacArthur Foundation, 2017; Grossi & Mortensen, 2022).

Banana fibre has such great potential for sustainable fashion, that the pseudostem is often left behind after bananas are harvested. Therefore, turning the pseudostem into clothing creates a new opportunity to utilize what would otherwise become waste without needing to grow another crop using additional water, pesticides, etc. (Khan et al., 2024). When comparing the energy needed to produce banana fibre versus cotton fibre, banana fibre requires significantly less spun into yarn and woven into fabrics. However, depending on the type of banana fibre being used, some blending may be required. Studies show that even though there is no difference in cost per unit of energy consumed between producing banana fibre and cotton fibre, banana fibre uses significantly less energy than cotton fibre (Ortega et al., 2016; Khan et al., 2024).

Sindh is one of Pakistan's provinces located on the south side of Pakistan. In this area there are two traditions that have been preserved using traditional techniques. The first is AJRAK which is a resist-and-block-printed cotton fabric. The fabric was produced using a multi-step technique where traditional Indigo dye and Madder were used as colorants. Additionally the use of specialized hand carved wooden printing blocks and specific sequential steps involved in producing the print and inherited technical expertise all had to be followed during each step. This type of printing technique has been used in this area for longer than a thousand years. It continues to serve as a marker of identity for Sindhis both in their everyday lives and in ceremonies (Iqbal et al., 2025).

The second tradition is called RILLI also known as RALLI. It is a type of hand stitched appliqué and embroidery technique practiced primarily by women. Women use remnant fabrics, mostly pieces of clothing that no longer fit, to create large geometric patterns. Rilli is a form of domestic craft and an economic source of income for many rural families. Furthermore, Rilli is considered to be an innovative low waste textile manufacturing method long before “Zero Waste Design” became popular among designers and students in western design schools (Stoddard, 2003; Shen & Sethi, 2021).

Both crafts are facing similar challenges. Younger generations of artisans are becoming less interested in labor intensive apprenticeships. Artificially colored dyes and mechanized printing processes are being increasingly introduced to replace traditional methods of creating these designs. Moreover, artisans who produce handmade textiles are often finding it difficult to gain consistent support and acknowledgment of the time, effort, and skills required to produce these types of materials (Shen & Sethi, 2021; Iqbal et al., 2025).

Scholars have now documented ways in which intangible cultural heritage could be transferred into contemporary design languages without being reduced to simply decorative motifs — i.e. through semiotic reinterpretations of traditional Chinese velvet-flower crafts for the context of modern fashion (Jiang, 2025), or ways in which regional block-printed textiles like Ajrak are gaining global circulation within media & fashion systems — creating opportunities for local economies to be revitalized while also exposing potential threats of commercialization and cultural flattening (Afridi & Haider, 2025). However, there has been an empirical lack of artisanship inclusive research that questions how people with actual practice and knowledge of the Sindhi textile heritage will receive, test and adapt a particular sustainable material — banana fibre.

The study aims to address following research questions:

- (1) How do artisans, fashion designers, and textile experts perceive the adaptation of Ajrak and Rilli heritage onto banana-fibre fabric?
- (2) What opportunities and challenges exist for integrating banana-fibre fabric into contemporary apparel while preserving Sindhi textile heritage?

Literature Review

Mechanical and chemical extraction of ligno-cellulosic fibre type, known as banana fibre, occurs from the pseudostem of the banana plant, a part that would normally be disposed of after harvesting bananas. A number of comparative studies on fibres have shown that banana fibre production uses far less energy than producing conventional cotton; and has similar tensile strength, wicking ability and durability to cotton when combined with cotton, or other regenerative cellulosic fibres, such as Tencel (Khan et al., 2024). Tri-Blend Yarns made using banana-Cotton-Tencel had improved tensile strength, elongation, and yarn quality compared to Cotton Yarn (Khan et al., 2024); whereas Enzyme treated banana Fibre Yarns were shown by Ortega et al . (2016), could also offer potential for technical textile reinforcement. From a Systems perspective Provin & Leal Vieira Cubas (2024) suggest that banana waste produced during farming, can be considered an example of how agricultural waste can be incorporated into circular economies of the Textile Industry. The two most relevant factors in this research are: The relatively stiff and coarse hand feel of banana fibre compared to Cotton, which will need to be 'softened' prior to being suitable for use against skin, either through some form of mechanical/chemical treatment; And the variability in dye affinity of banana fibre, which will not allow for predictable dye behaviour in natural dyeing processes, and therefore may require alternative methods.

Ajrak is a perfect example for cultural sustainable research to show how the craftsmanship of heritage crafts are a "living system" of knowledge, techniques and meanings created by each artisan (Fletcher, 2013) The specific craft process of Ajrak is an important part of what makes it so unique - and that includes the fact that the resist application, mordanting, dyeing with Indigo and Madder, aligning the blocks of design, washing and drying the fabric in sunlight - all of which are necessary steps to create the traditional geometric and floral designs found in Ajarak, which represent balance, protection and Sindhi identity; but also serve a purpose other than just decoration (Iqbal et al., 2025).

Rilli fits within Sindhi textile art as both a unique craft practice, yet one that complements other craft practices. Rilli is a fabric construction practice based on patches of discarded materials, which has been primarily constructed by women and utilizes zero waste as a core principle. Therefore, the zero waste philosophy demonstrated through Rilli can be stated to have occurred for at least two generations prior to the development of this philosophy in Western sustainable design literature. The documentation provided by Stoddard (2003), regarding the Ralli quilts made throughout Sindh and adjacent areas of India and Pakistan, identified both geographical variations of this craft form and how it was used as a means of transmitting the craft formally from mothers to daughters. Furthermore, Shen and Sethi (2021) argue that Ralli quilt forms hold the potential to be utilized in informing sustainable fashion due to the inherent nature of its composition.

In addition to its impact on intangible cultural heritage, there has been an ongoing body of research focused upon how the intangible cultural heritage can be used by contemporary designers in a manner that does not simply transform it into shallow decoration. Jiang's (2025) semiotic analysis of the art of crafting Chinese Velvet-flowers proposed a three-step logic for translating heritage—cultural meaning refinement, emotional/semantic reorganization, and visual language reconstruction—and treated heritage motifs as narrative media that carry identity rather than as a static set of patterns to be applied or printed onto new materials. The above is instructional to our own discussion: multiple participants described a distinction between designers that “copies” traditional motifs and designers that “involves artisans in the entire design process,” and this distinction clearly maps to Jiang's (2025) argument that a proper transformation of heritage cannot take place through solely reconstructing the meaning of heritage but through being actively engaged with that meaning.

This body of research has been organized into three largely independent dialogues: one around the technical/circular economy aspects of banana fibre; a second dialogue focusing on the documentation of Ajrak and Rilli as living craft systems and their respective, intersecting generational and economic pressures; and a third dialogue focused on theoretical work around how traditional designs/motifs could be reconstructed in ways that would maintain/retain cultural legitimacy. While there is no existing study that brings together the perspectives of artisans, designers, and academics to understand how a sustainable material (in this case, a specific sustainable fibre) may be accepted within an established, living, two-legacy craft heritage system. Drawing from Grossi and Mortensen's (2022) triad and Jiang's (2025) logic of translation, this study will propose an initial conceptual model — Material Translation of Heritage — for the effective transfer/adaptation of a textile heritage design/motif onto a newly developed sustainable fabric, based upon the simultaneous fulfillment of three key criteria: Technical Compatibility (fibre/dye interactions; hand feel; stitch ability); Symbolic Continuity (the continued recognition/value of motifs in terms of their original meaning); Process Legitimacy (the participation/input of the artisans involved in the production process and the fair distribution of benefits.)

Research Methodology

This study is based on a qualitative case study methodology (Yin, 2018). Here, Ajrak and Rilli are regarded as two sub-cases contained within the overall subject of Sindh's textile heritage. multi-case design is used because the two crafts are different in terms of technical approach, gender-based division of labor and logical form of materials. Field work was conducted in three locations: Hyderabad (the primary city in Sind and an important center for trade of crafts) Hala (well known for having many Ajrak block printing workshops); and Bhit Shah (a location with Rilli patchwork production and associated with larger aspects of Sindhi culture), in order to observe both crafts at their main points of production.

The sample size included sixteen participants: 3 Ajrak craftsmen, 3 Rilli craftsmen, 5 fashion designers and 5 textile experts/academic scholars (see Table 1), in order to have access to all elements of the transformation process from hands-on craftsmanship, into design intervention, and into academic perspectives. Participants were selected using purposeful sampling who had extensive experience working in Ajrak or Rilli production; sustainable fashion design; or in research related to Sindhi textiles (Guba and Lincoln, 1994).

Table 1. Participants' Profile

Group	Codes	N
Ajrak Artisans	A1–A3	3
Rilli Artisans	RA-01–RA-03	3
Fashion Designers	FD-01–FD-05	5
Textile Experts/Academics	TE-01–TE-05	5

The research triangulated the data from both field study and interviews: Field studies of how both Ajrak and Rilli are made and what techniques, tools, dyes and patterns are used; also how they develop their designs, the significance of the design and their work place. Semi-structured interviews with all sixteen participants about traditional skills; integrating banana fibres into the fabric; future developments; and sustainability implications beyond their immediate context. Interviews were carried out in the language that each participant preferred (Tong et al., 2007). Field observations were written down immediately after each visit as reflective/ structured descriptive notes. Thematic analysis strategy developed by Braun and Clarke (2006) was employed because it views the researcher's judgment as a useful tool for analysis, rather than a means of introducing bias, which fits well with the interpretative perspective.

The limitations of the present study can be summarised under three headings. Firstly, although there is sufficient justification for sampling purposively, the number of participants sampled (i.e., $n = 16$) is limited and geographically localised (Lincoln and Guba, 1985). Therefore, whilst findings provide insight into depth, they do not relate to the wider population statistically. Secondly, prior to conducting this study, most artisan participants would not have worked with banana fibre fabrics directly; therefore, findings reflect anticipations of artisans relating to how they perceive materials will translate rather than actual experiences related to translating materials. Thirdly, due to its interpretivist nature, this study has constructed an analytic account of participant interpretations and researcher interpretations collectively (Tong et al., 2007).

Findings

Reflexive thematic analysis generated six major themes, summarised in Table 2 and detailed below with representative quotations and corroborating field-observation evidence.

Table 2: Themes and Sub-Themes

Theme	Sub-themes
1. Motif as Cultural Memory and Identity Marker	Motif symbolism; recognisability as authenticity marker
2. Embodied Craft Knowledge Under Generational Strain	Tacit skill transmission; youth disengagement
3. Cautious Openness to Material Innovation	Curiosity without direct experience; conditional acceptance
4. Technical Friction in Material Translation	Dye absorption; hand-feel and stitchability; block-printing pressure
5. Artisan-Centred Collaboration as Precondition for Legitimacy	Co-design vs. extraction; fair recognition

Theme	Sub-themes
6. Sustainability as Revitalisation Opportunity	New markets; export potential; youth engagement pathways

Motif as Cultural Memory and Identity Marker

Participants in all two instances articulated Ajrak and Rilli motifs as a means to carry shared cultural meanings. The artisans, who create Ajrak, identified the designs and colors used in their work with stories of their Sindhi culture. Both AJRAK ARTISANS (A1) and AJRAK ARTISAN (A2) referenced that it is their customer's expectation that Ajrak patterns will continue to be part of an extended family member's past or future due to the continued use of the same pattern. Similarly, Rilli artisans also made a similar argument using identical logic; RA-03 stated that sun, star, and geometric border motifs are representative of blessings and protection and have been transmitted directly from mother-to-daughter. This was confirmed by field observations when customers could recognize genuine Sindhi textiles based on unique patterns instead of just the type of fibre used. Therefore, this provides a direct relationship between translating materials into different fibres while maintaining the original motif system and the perceptions of legitimacy among consumers. In other words, as long as the motif system remains intact and can be understood by participants, they feel a substantial amount of authenticity is maintained. Conversely, if a simplified version of the motifs is produced, then participants felt that there is a greater disconnection.

Embodied Craft Knowledge Under Generational Strain

The major cross-cutting theme (of the three) concerns the vulnerability of non-explicit, apprenticeship based skills. As A3 mentioned, due to increasing difficulty in locating experienced artisans with skill knowledge, younger individuals are increasingly electing to pursue other careers. Similarly, A1 and A2 both specifically identified natural dye preparation as the most vulnerable "sub-skill" since it has been transmitted primarily by means of experience instead of technical formulae. The Rilli artisans supported these claims; RA-01 noted that many young individuals would opt for sewing machines as they produce goods much quicker and traditional hand-stitching is diminishing. At the systemic level, TE-02 attributed this trend to labour intensive production which encourages younger artisans to pursue alternate occupation.

Cautious Openness to Material Innovation

Both craft groups displayed a consistent opinion regarding banana fibre: They were intrigued but cautiously optimistic about trying it. Although most artisan respondents had never used banana fibre, they did not reject the idea entirely. The majority of respondents were conditionally accepting (i.e., "if... then") with regards to banana fibre's potential. For example, A3 said that banana fibre could be viable as long as it was soft, durable, and compatible with natural dye processes. Likewise, RA-03 also expressed a nearly identical formula of conditions for use when sewing. Those who are designers or academics have been exposed to other plant-based alternatives to traditional fibres and therefore expressed more confidence in their opinions. For instance, TE-01 described banana fibre as particularly promising due to its relative strength, biodegradable nature, and compatibility with sustainable textile practice. This pattern - direct producers cautiously and conditionally acceptative vs. design/academic actor(s) more confident in their acceptance - is

repeated throughout the data set. It will be explored further in the Discussion section in terms of how different levels of risk exposure by participant group may contribute to these varying opinions.

Technical Friction in Material Translation

Ajrak and Rili both had similar issues related to translation mechanics but separately. Both sets of participants for Ajrak had their own particular concerns regarding dye absorption and how they thought the surface of the printing material would react. The first participant for Ajrak (A1) stated that he believed there would be potential problems within the wash-dye-absorb-dry stages of the Ajrak making process. The second participant for Ajrak (TE-01), indicated that dyeing (the amount of time the fabric is exposed to color) and pressure (from the blocks used to apply the design) would have to be tested due to the fact that banana fibre absorbs dyes differently than cotton. This issue was found to be valid based upon literature that addresses how fibres interact with dyes (Khan et al., 2024). The primary concern regarding Rili was whether or not the banana fibre would be suitable for use as a textile. Participants (RA-01) indicated that they believed the needle size and thread tension may need adjustments if it were determined that the banana fibre is thicker than cotton. Another participant (RA-02), requested training on cutting, sewing and washing techniques. A concern that designers felt was important and one that was relatively absent from the artisans' perspectives was colour fastness (how colours will hold up over repeated washings) and shrinkage at large-scale manufacturing. Observations in the field suggested why these friction points are so significant; when working with a familiar fibre, the precise application of dye and accurate placement of prints on fabric requires great deal of precision. It can be inferred that using a new type of substrate will increase the complexity of this labour-intensive process rather than decreasing it.

Artisan-Centered Collaboration as a Precondition for Legitimacy

A fifth consistent concern across all three communities (artisan, designer, academic) is a focus on the process - who has authority to decide when, how and if translations occur. RA-03 suggests that designers need to be working with artisans in co-designing rather than unilaterally altering traditional textile designs. The two are saying the same thing; A2 suggests that an understanding of the traditional processes prior to designing new contemporary textiles is critical. Designers were largely in agreement: FD-04 indicates that collaborative design approaches can protect cultural heritage while at the same time responding to current market needs. Academics were far more explicit regarding the theoretical framing: TE-04 states that perhaps the greatest challenge is ensuring both innovation and authenticity are balanced; TE-02 concludes that the next generation of researchers must incorporate artisans into the entire design process. This theme works as a bridge between technical openness/friction and opportunity: Participants' optimism for banana fibre is always contingent upon resolving technical issues related to its performance as well as establishing a governance structure where artisans have interpretive authority over how they would like their heritage translated.

Sustainability as a Revitalization Opportunity

All of the participant groups identified banana fibre as both a means of advancing the economy and culture, as well as a method of improving environment. As such, A1 believed that success could be used to open up Ajrak to new international markets. However, FD-05 presented one of

the most integrated statements within the entire data set; by suggesting that governmental assistance, artist training, research, and designer collaboration were equally important to its success. TE-05 further emphasized this with reference to Rilli's inherent logic of producing on a zero waste basis. By stating that banana fibre will allow for contributions toward circular fashion systems when production costs decrease sufficiently, he demonstrated how the use of banana fibres could provide additional benefits for consumers in terms of sustainable materials. Several participants referred to this as a solution to the generational continuity issue. For example RA-02 stated that "younger people" (who are learning how to stitch) should utilize social media to "promote" their craft.

Discussion

Technical concerns regarding dye absorption, hand feel, and stitch ability have been cited frequently among participants, which has a close correlation with research in material science concerning banana fibre, which demonstrates its rougher and more absorbent nature compared to cotton. Therefore, there should be an evaluation of how to address these issues as opposed to using the fibres interchangeably (Ortega et al., 2016; Khan et al., 2024). The convergence of artisan experience-based knowledge and lab-tested fibre characteristics further establishes that artisans can provide an accurate representation of the true physical attributes of natural fibres. Thus, Grossi & Mortensen's (2022) model of a circular business model triad is extended to demonstrate that "technical innovation" cannot simply be treated as solely dependent upon materials engineering within the context of living heritage, and is instead jointly developed with the knowledge of artisans from inception.

Further, motifs serve as anchors to establish perceived authenticity (Theme 1), validates the work of Iqbal et al. (2025) and Shen & Sethi (2021) who characterized Ajrak and Rilli as systems of meaning versus systems of material objects. Additionally, the empirical evidence supports that artisans differentiate between the use of alternative fibres for textile production (subject to technical validation) and alterations to the motif design (perceived as a greater threat to authenticity). Jiang's (2025) position that legitimate translations of heritage occur through culturally relevant reconstructions of meaning rather than superficial extractions of meaning, parallels the reasoning behind artisans' reliance on the involvement of artisans in both design development and/or production processes (Theme 5).

Artisan producers' more experientially based cautions relative to designers/academics (Theme 3) merit a separate consideration rather than grouping them under a single category such as "openness." Artisans rely on the success of each individual production batch for their livelihoods. Consequently, a failed dye trial may represent lost revenue for artisan producers whereas designers/academics conceptualizing strategic approaches to sustainability may view lost revenue as less tangible. This difference in impact provides insight as to why Theme 5's reliance on artisan centered processes as a means to mitigate risks associated with commercialization is commensurate with the commercialization-risks identified by Afridi and Haider (2025) related to Ajrak's global-market distribution.

Conclusion

This study used data from sixteen semi-structured interviews and field observations to consider how traditional textiles (Ajrak and Rilli) of Sindh province in Pakistan may be adapted to banana-fibre fabric — a sustainable alternative substrate. Using thematic analysis, it identified six key themes illustrating how participants are likely to define authentic versions of these textiles in terms of motifs, have expressed positive, albeit cautious, views about the possibility of using banana fibre, and can specify craft-specific technical uncertainties related to banana fibre, emphasize the necessity for artisans to collaborate together as part of a collaborative process in order to translate their crafts appropriately, and believe that translating their crafts successfully will create a potential vehicle for both economic and cultural revival. The results provide empirical evidence supporting the proposed "Material Translation of Heritage" framework. The framework proposes that technical compatibility and symbolic continuity serve as threshold criteria for determining whether material sustainability innovations strengthen or weaken living craft heritage by providing a conditionality for determining the legitimacy of the material sustainability innovation. As such, while the study's findings are based on a relatively small and geographically bounded sample size of artisan participants who have not had direct experience working with banana-fibre fabrics, it is recommended that future studies conduct controlled artisan-led trials using dyeing and stitching techniques that mimic those utilized in creating Ajrak and Rilli designs on banana-fibre fabrics; longitudinally study the development of any initial pilot collaborations; and comparatively evaluate whether the framework applies to other heritage-craft contexts outside of Sindh. Since companies operating within industries that focus on circular economy practices are looking at ways they can create long-term innovations, the study demonstrates that some of the most sustainable innovations in the industry today are those that address sustainability and heritage as complementary conditions for establishing design legitimacy as opposed to competitive limitations.

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