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Evaluating the Circular Potential of Indigenous Indian Cotton
Textiles: ISO-Validated Scientific Testing and Design Integration

Faculty of Engineering and Applied Science
Design Engineering

MSc by Research
Academic Year: 2024- 2025

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This thesis is submitted in partial fulfilment of the requirements for
the degree of MSc by Research

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Academic integrity declaration

I declare that:

1. the thesis submitted has been written by me alone.
2. the thesis submitted has not been previously submitted to this university or any other.
3. that all content, including primary and/or secondary data, is true to the best of my knowledge.
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Abstract

The fashion industry is under scrutiny for the high emissions and growing textile waste associated with fast fashion. Although Indian handloom textiles are durable and produced with low energy, they are often excluded from global circular economy frameworks because they lack scientific validation. This thesis addresses this gap by introducing the Converging Pillars Framework, which combines ISO-standard textile testing with human-centred Design Thinking analysis.

Four Indian cotton textiles: Khadi, Kala Cotton, Jamdani, and Ikat were analysed. Laboratory tests were conducted to measure tensile strength, tear resistance, wash shrinkage, and biodegradability, utilizing relevant ISO standards. Khadi showed the highest biodegradability and strong dimensional stability. Kala Cotton and Ikat demonstrated superior mechanical durability. Jamdani, although culturally important, had lower resilience and slower degradation, which limited its technical applications.

The findings informed a Circularity Suitability Matrix, which supports modular design strategies such as Differential Lifecycle Fastening. This approach enables the combination of textiles with different end-of-life pathways in a single product, allowing for their separation for proper disposal or recycling.

This research provides a validated dataset for indigenous handlooms, introduces a replicable hybrid methodology, and shows that craft-based materials can be integrated into global sustainability frameworks. It provides practical tools for designers, policymakers, and certification bodies to mitigate greenwashing, enhance certification standards, and enhance the socio-economic resilience of artisan communities.

Keywords:

Indian handloom textiles; ISO textile testing; Biodegradability assessment; Circularity evaluation framework; Circular design integration; Design Thinking methodology

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Table of Contents

Academic integrity declaration.....	i
Abstract	ii
Acknowledgements	iii
List of Figures.....	vi
List of Tables	vii
List of Abbreviations	viii
1 Introduction.....	1
1.1 Introduction and Problem Statement.....	1
1.2 Significance of the Study	2
1.3 Research Gap.....	4
1.4 Aim and Objectives	4
1.5 Methodological Approach: Design Thinking Integration	5
1.6 Thesis Structure.....	7
2 Defining Circularity in Fashion and Framework Development.....	8
2.1 Introduction	8
2.2 Understanding Circularity in Fashion	9
2.3 The Circular Potential of Indian Textiles	10
2.4 Theoretical and Literature Foundations	10
2.5 Framework Development Approach.....	12
2.6 Methodology: Design Thinking Phases - Empathise and Define	14
2.7 Contributions and Implications	14
2.7.1 Academic Contribution	14
2.7.2 Practical Implications.....	15
2.8 Conclusion	15
3 Material Selection and Contextual Mapping	17
3.1 Introduction	17
3.2 Contextual Mapping of Indian Textiles.....	19
3.2.1 Khadi: The Fabric of Self-Reliance.....	19
3.2.2 Kala Cotton: An Indigenous and Resilient Model	20
3.2.3 Jamdani: The Art of Circularity	20
3.2.4 Ikat: Craftsmanship and Regional Identity	21
3.3 Summary of Material Selection	22
3.4 Conclusion	24
4 Experimental Testing and Evaluation	25
4.1 Introduction	25
4.2 Methodological Overview: Test Procedures.....	25
4.2.1 Tensile Strength (ISO 13934-1)	26
4.2.2 Tear Strength Test (ISO 13937-2).....	26
4.2.3 Wash and Shrinkage Test (ISO 6330).....	27

4.2.4 Biodegradation Test (ISO 11721-1)	27
4.3 Test Results and Comparative Analysis	28
4.3.1 Tensile Properties	28
4.3.2 Tear Properties	31
4.3.3 Dimensional Stability	33
4.3.4 Biodegradation Properties	35
4.4 Synthesis of Overall Fabric Performance.....	37
4.5 Conclusion	39
5 Comparative Analysis and Design Integration.....	40
5.1 Introduction	40
5.2 Operationalising Circularity: Linking Data to Metrics.....	40
5.2.1 Mechanical Durability: Longevity in the Technical Cycle	40
5.2.2 Dimensional Stability and Interoperability.....	41
5.2.3 End-of-Life and Biological Integrity.....	41
5.3 The Circularity Suitability Matrix and Prioritisation	42
5.3.1 Application of the Converging Pillars Framework.....	42
5.3.2 Prioritisation of Indigenous Textiles.....	44
5.4 Design Strategies: Integrating Performance and Cultural Value.....	45
5.4.1 Principles of Performance-Driven Modularity	45
5.4.2 Fabric-Specific Modular Integration Proposals.....	46
5.5 Conclusion	47
6 Discussion and Implementation.....	48
6.1 Introduction	48
6.2 Discussion of Core Findings and Contributions	48
6.2.1 Validating the Hybrid Evaluation Framework.....	48
6.2.2 Rethinking Circularity: Beyond Industrial Recycling	49
6.2.3 Mitigating Constraints for Scalability	49
6.3 Implementation and Policy Implications.....	50
6.3.1 Implications for Sustainable Design Practice	50
6.3.2 Recommendations for Certification and Policy	51
6.4 Broader Socio-Cultural and Ethical Impact	52
6.4.1 Preserving Intangible Cultural Heritage.....	52
6.4.2 Ethical Sourcing and Community Resilience.....	52
6.5 Limitations and Future Work	53
6.6 Conclusion	54
7 Conclusion and Further Research.....	56
7.1 Introduction	56
7.2 Summary of Key Contributions	56
7.2.1 Empirical Validation and Framework Innovation	56
7.2.2 Design Solution: Modular Integration	57
7.3 Broader Academic and Practical Impact.....	57
7.3.1 Academic Contribution and Policy Mandates	57

7.3.2 Design and Systemic Integration.....	58
7.4 Directions for Future Research and Development	58
7.4.1 Prototype and Tool Development	58
7.4.2 Academic Expansion and Methodological Refinement	59
7.5 Conclusion	60
References	61
Appendix A	68
Appendix B : Detailed Experimental Protocols.....	70
Appendix C : Raw Data Tables.....	78
Appendix D : Supplementary Figures	86
Appendix E : Extended Literature / Frameworks.....	95
Appendix F : Extended Cotton Descriptions	102

List of Figures

Figure 1-1 Contrasting Fast Fashion Waste and Indian Heritage Textiles	2
Figure 1-2 Product Examples of Selected Indian Textiles.	3
Figure 1-3 Application of the Design Thinking Process for Evaluating the Circular Potential of Indian Handmade Cotton Textiles	6
Figure 2-1 The Ellen MacArthur Foundation's Circular Economy Systems Diagram (The Butterfly Diagram).....	9
Figure 2-2 The Converging Pillars Framework.....	13
Figure 3-1 Map of India Showing Origins of Selected Textiles.	18
Figure 3-2 Khadi: Production to Product	19
Figure 3-3 Kala Cotton: Production to Product.	20
Figure 3-4 Jamdani: Production to Product.	21
Figure 3-5 Ikat: Production to Product.....	22
Figure 3-6 Comparative Swatch Plate of Tested Materials (A-D).....	23
Figure 4-1 Mean Breaking Force (N) of Fabrics (Warp vs. Weft)	29
Figure 4-2 Mean Elongation at Break (%) of Fabrics (Warp vs. Weft).....	30
Figure 4-3 Comparative Mean Tensile Stress (N/mm ²) of Handloom Fabrics .	30
Figure 4-4 Mean Tear Force (N) of Handloom Fabrics (Warp vs. Weft)	32
Figure 4-5 Mean Dimensional Stability (Shrinkage %) After Standardized Laundering	34
Figure 4-6 Mean Biodegradation Rate (Weight Loss %) Over 63 Days (Soil Burial Test).....	35
Figure 5-1 Comparative Circular Performance Profiles of Textiles.....	44

List of Tables

Table 1-1 Linkage between Objectives and Chapters	5
Table 2-1 A comparative analysis of existing sustainability frameworks and the proposed circularity framework. Cells with (✓) indicate that the framework addresses the metric, while blank cells indicate that it does not.	11
Table 3-1 Comparative Attributes of Selected Textiles.....	23
Table 4-1 Mean Breaking Force, Mean Elongation at Break, and Mean Tensile Stress of Tested Handloom Fabrics (n=5 per direction).....	29
Table 4-2 Mean Tear Force of Tested Handloom Fabrics (n = 5 per direction).....	31
Table 4-3 Mean Shrinkage in Length and Width of Handloom Fabrics (n = 5)	33
Table 4-4 Mean Weight Loss (%) of Tested Handloom Fabrics Over Time (n = 3 per time point)	35
Table 4-5 Overall Performance Ranking of Handloom Textiles.....	38
Table 5-1 Circularity Suitability Matrix of Handloom Textiles based on ISO Performance and Framework Alignment.	43
Table 5-2 Fabric-Specific Design Mandates for Modular Integration	46

List of Abbreviations

BD	Biodegradability
C2C	Cradle to Cradle
CRE	Constant Rate of Extension
DfD	Design for Disassembly
EMF	Ellen MacArthur Foundation
EU	European Union
GOTS	Global Organic Textile Standard
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
OEKO- TEX®	International Association for Research and Testing in the Field of Textile and Leather Ecology
SDG	Sustainable Development Goals
TS	Tensile Strength
TR	Tear Resistance
UNESCO	United Nations Educational, Scientific and Cultural Organization
WS	Wash Shrinkage

1 Introduction

1.1 Introduction and Problem Statement

The fashion industry is subject to increasing scrutiny for its environmental and social impacts, particularly within the fast-fashion segment. This segment accounts for approximately 10% of annual global carbon emissions, surpassing the combined emissions from international flights and maritime shipping (UN Environment Programme, 2023). Additionally, it consumes an estimated 93 billion cubic meters of water each year (United Nations, 2019). The prevailing linear production model promotes disposability, resulting in a projected global textile waste volume exceeding 120 million metric tons by 2025. Less than 1% of this waste is recycled into new fibers (Loo, Yu, and Hu, 2023).

Although sustainable alternatives have been developed, greenwashing remains widespread and frequently diverts attention from the fundamental issue of overproduction (Gurova, 2015). Recent research has challenged the anticipated economic benefits of circular economy models, suggesting that current frameworks often prioritise consumer behaviour over structural transformation (Hussain, Kuzmina, and Korja, 2025). This situation highlights a critical gap: the lack of a comprehensive framework with clear indicators of circularity that address systemic inefficiencies and validate non-industrial production systems.

India's heritage textiles represent a promising yet insufficiently explored alternative. These handlooms are produced using traditional, resource-efficient methods, exemplifying principles such as repairability, reuse, biodegradability, and low-energy production (Choudhury, 2023). The Indian handloom sector makes a significant contribution to the economy, employing over 4.33 million artisans, and its practices hold substantial cultural importance (Chakraborty, 2024). However, traditional production methods are largely excluded from scientific evaluation frameworks and international certification programs. The absence of scientific validation restricts their acceptance and integration into global circular design systems (Niinimäki et al., 2022). Without systematic testing

and validation, the full circular potential of these practices remains unrecognised by policymakers and brands.

This research aims to address this gap by examining four representative Indian cotton textiles: Khadi, Kala Cotton, Jamdani, and Ikat. The primary objective is to develop a verifiable, ISO-standardised framework that integrates traditional production methods with contemporary circular design principles.



Figure 1-1 Contrasting Fast Fashion Waste and Indian Heritage Textiles- The juxtaposition highlights the destructive linear model of fast fashion (left) and the regenerative, culturally rooted practices of Indian handloom weaving (right).

Source: [Vogue \(2020\)](#) and [Ruri Ethnic \(2023\)](#)

1.2 Significance of the Study

The transition to circular systems in the fashion industry advances global sustainability objectives, particularly Sustainable Development Goals 12 (Responsible Consumption and Production) and 13 (Climate Action), as defined by the United Nations (2015). The present study aims to develop a verifiable framework that directly contributes to achieving these goals.

India's diverse handwoven traditions position the country as a significant contributor to the global sustainability agenda. This research examines four

representative cotton textiles, each selected for distinct ecological, technical, and cultural characteristics.

- Khadi is recognised for low-energy production processes and its role in supporting rural employment (Chowdhury and Chowdhury, 2025)
- Kala Cotton is an indigenous, rain-fed cotton variety cultivated without the use of chemical inputs (Ali and Sarfraz, 2018).
- Jamdani, designated as an Intangible Cultural Heritage by UNESCO, integrates artistic techniques with the use of biodegradable materials (Chakraborty, 2017).
- Ikat is a resist-dyeing tradition that exemplifies complex craftsmanship and utilises plant-based dyeing techniques.

These textiles were selected to ensure broader applicability of the framework by evaluating materials that represent the ecological diversity, cultural richness, and technical variation characteristic of the non-industrial textile sector.



Figure 1-2 Product Examples of Selected Indian Textiles- Examples of products made from the four selected textiles: Khadi Cotton (saree), Kala Cotton (scarf), Jamdani (suit), and Ikat (lampshade). These illustrate both the cultural relevance and contemporary applications of each textile.

Source: *Vogue* (2020); *Pisces London* (n.d.); *Charkha Tales* (2023); *Pooky* (2023).

1.3 Research Gap

Although circularity is acknowledged as a global concern, most established frameworks and certifications prioritise industrialised textiles and Western-centric models (Fashion Law & IP Blog, 2025). Indian handloom systems, which inherently embody circular practices, often lack scientific validation and are frequently excluded from internationally recognised standards (Fibre2Fashion, 2024).

This omission results in two major consequences:

1. First, it limits both the market access and valuation of heritage textiles.
2. Second, it prevents the scalable integration of these textiles into global brand supply chains that require certified, data-backed materials (Zhang, Li, and Kumar, 2025).

This study addresses this gap by applying a focused and representative methodology to generate rigorous, ISO-compliant data on key circularity indicators, including durability, biodegradability, and shrinkage, for these undervalued textiles. The resulting data provide a foundation for their inclusion in contemporary circular policy and design.

1.4 Aim and Objectives

This research aims to develop a scientific framework for evaluating the circular potential of Indian cotton textiles using ISO standards and Design Thinking.

The study is structured around the following objectives:

- **O1:** To define circularity within the context of sustainable fashion, focusing on measurable parameters such as durability, biodegradability, and recyclability.
- **O2:** To identify and select handmade cotton textiles that are culturally significant and representative of diverse production techniques.

- **O3:** To conduct empirical testing of the selected textiles using relevant ISO standards to assess physical durability, wash-related shrinkage, and biodegradability.
- **O4:** To analyse and compare the test results based on key circularity indicators to evaluate their suitability for circular fashion systems.
- **O5:** To propose design strategies informed by the findings, enabling the integration of traditional textiles into contemporary circular design practices.

Table 1-1 Linkage between Objectives and Chapters

Objective	Focus	Chapter Fulfilment
O1	Define Circularity & Metrics	Chapter 2
O2	Identify & Select Materials	Chapter 3
O3	Conduct Empirical Testing (ISO)	Chapter 4
O4	Analyse & Compare Results	Chapter 4
O5	Propose Modular Design Strategies	Chapter 5

1.5 Methodological Approach: Design Thinking Integration

The Stanford d.school's five-stage Design Thinking process serves as a meta-methodology to systematically assess the circular potential of Indian handmade cotton textiles (Hasso Plattner Institute of Design at Stanford, 2018). This methodology offers a human-centred, repeatable framework that integrates cultural context with scientific testing and sustainable design principles.

- **Empathise:** Cultural practices and secondary sources were examined to understand producer traditions and sustainability knowledge, thereby identifying a research problem grounded in real-world practice.
- **Define:** The core problem was articulated as the absence of a standardised, scientifically grounded evaluation method. Selection criteria and measurable parameters, including durability, biodegradability, and shrinkage resistance, were established.

- **Ideate:** Four culturally significant textiles- Kala Cotton, Khadi, Jamdani, and Ikat- were selected. The research was aligned with ISO testing standards and circularity indicators to support sustainable outcomes.
- **Prototype:** ISO-standardised textile tests were conducted to generate empirical data on performance. The key tests included:
 1. Tensile Strength (ISO 13934-1)
 2. Tear Strength (ISO 13937-2)
 3. Wash Shrinkage (ISO 6330)
 4. Biodegradability (ISO 11721-1)
- **Test:** Test outcomes were analysed, and textile performance was compared. A preliminary scoring framework was developed to evaluate suitability for modular and circular fashion systems.

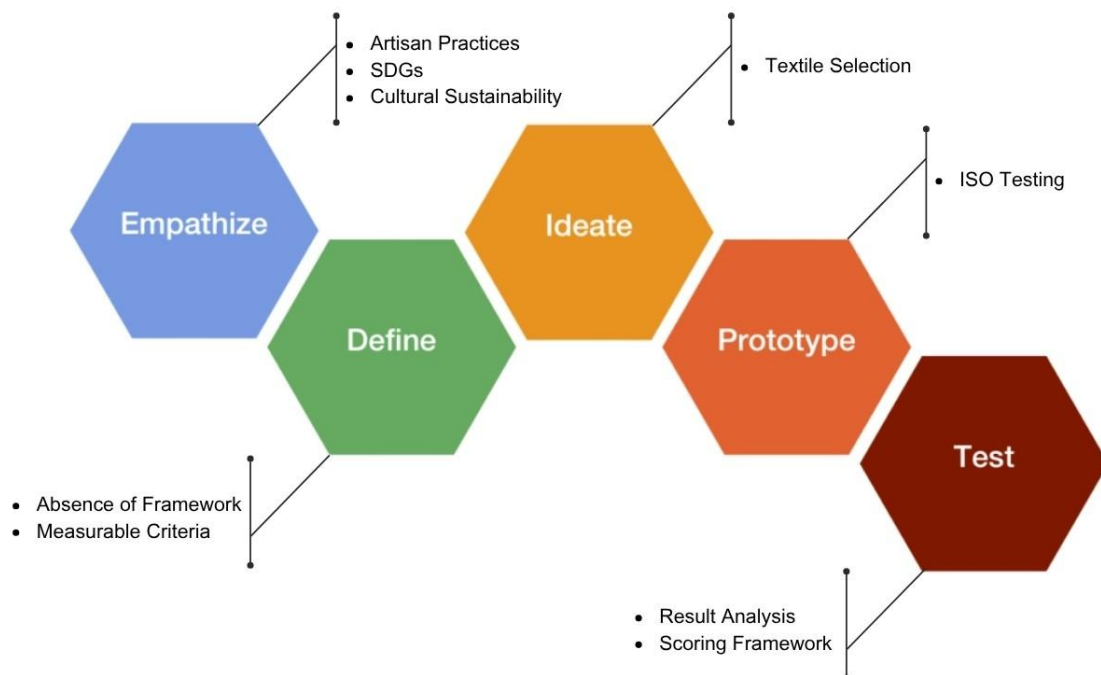


Figure 1-3 Application of the Design Thinking Process for Evaluating the Circular Potential of Indian Handmade Cotton Textiles

Source: Adapted from [d.school \(2018\)](#), developed by the author (2025)

1.6 Thesis Structure

The thesis adopts a paper-based format, with Chapters 2 to 5 each constituting a stand-alone research paper. Together, these chapters form a comprehensive framework for evaluating textile circularity as a unified research program.

- **Chapter 1:** Introduction - Provides the background, significance, research gap, aims, objectives, and methodology.
- **Chapter 2:** Defining Circularity and Framework Development - Establishes the theoretical foundation for circularity and introduces the proposed evaluation framework (Fulfil O1).
- **Chapter 3:** Material Selection and Contextual Mapping - Justifies the selection of four handmade textiles and examines their attributes (Fulfil O2).
- **Chapter 4:** Experimental Testing and Evaluation - Details empirical ISO testing, presents comparative results, and evaluates suitability for circular systems (Fulfil O3 and O4).
- **Chapter 5:** Comparative Analysis and Design Integration - Synthesises test results and proposes design strategies aligned with circular values (Fulfil O5).
- **Chapter 6:** Discussion and Implementation - Examines the broader implications of the research for design practice, policy, and the handloom sector.
- **Chapter 7:** Conclusions and Further Research - Summarises key findings and outlines recommendations for future research.

2 Defining Circularity in Fashion and Framework Development

2.1 Introduction

The transition of the fashion industry toward a circular economy is a central focus in both policy and academic research. Existing models often demonstrate conceptual ambiguity, insufficient scientific rigour, and a tendency to neglect culturally significant materials, such as India's handloom textiles (Das, 2025). Hand-spun and hand-woven textiles embody essential principles of circularity, including durability, biodegradability, and low energy consumption. Excluding these materials from standard evaluation frameworks leads to systemic oversight and marginalisation within the global sustainability discourse and certification systems (Venkatesh et al., 2024).

This chapter addresses this gap by proposing a definition of circularity that is scientifically rigorous and culturally inclusive. The Converging Pillars Framework is introduced as a hybrid model that combines human-centred insights from Design Thinking with empirical validation using International Organisation for Standardisation (ISO)-standardised textile testing. This methodology facilitates the assessment of circularity through verifiable laboratory data and acknowledges the cultural and ecological significance of handmade textiles.

The remainder of the chapter is structured as follows: Section 2.2 establishes a clear, measurable definition of circularity. Section 2.3 explores the under recognised potential of Indian textiles. Section 2.4 critically assesses existing sustainability frameworks and introduces the theoretical foundations of the new model. Section 2.5 details the components of the new framework, and Section 2.6 outlines the methodological rationale.

2.2 Understanding Circularity in Fashion

Circularity in fashion represents a transformative systems-thinking approach designed to extend the lifecycle of materials and products. Its core principles are longevity, durability, the use of renewable and safe inputs, facilitation of safe biodegradation, and the establishment of closed-loop systems for material recovery (Ellen MacArthur Foundation, n.d.).

Although these principles are frequently referenced, their implementation often lacks quantifiable standards. In this study, circularity is defined as the maximisation of material longevity, encompassing durability, dimensional stability, and safe end-of-life biodegradability, as validated by ISO standards. This definition is especially pertinent to natural and handmade textiles, since industrial frameworks typically emphasise scalability and may overlook longstanding regenerative traditions. The framework developed in this research introduces measurable indicators for these underrepresented qualities.

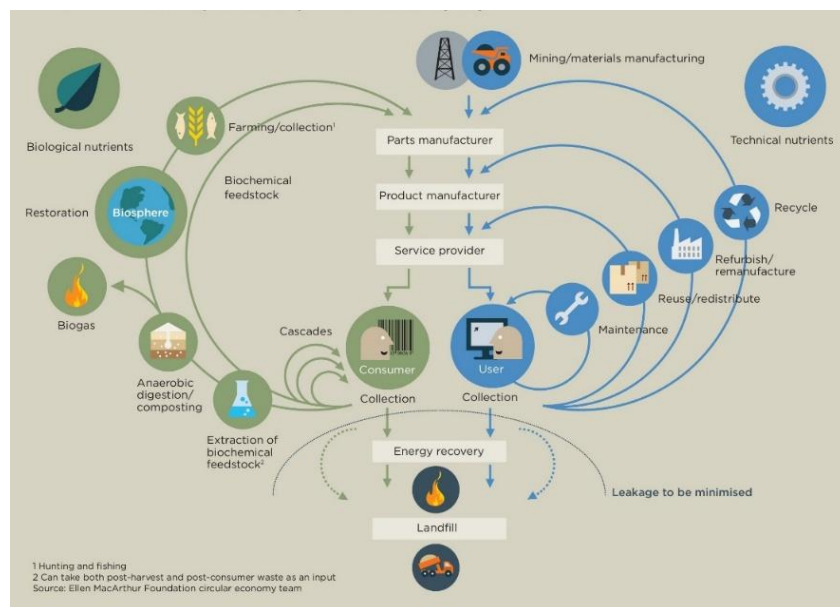


Figure 2-1 The Ellen MacArthur Foundation's Circular Economy Systems Diagram (The Butterfly Diagram)- Illustrating the two main cycles: the biological cycle for biodegradable materials (left) and the technical cycle for non-biodegradable materials (right).

Source: Ellen MacArthur Foundation, Towards the Circular Economy, Vol. 1 (2013).

2.3 The Circular Potential of Indian Textiles

India's textile ecosystem presents an important yet underexplored opportunity for applying circular design principles. Fabrics like Kala Cotton, Khadi, Jamdani, and Ikat represent an alternative circular model, reflecting resource efficiency that predates modern industrial practices. Their primary benefits include natural biodegradability, freedom from synthetic fibers and chemical finishes, and regional sourcing, which reduces transportation emissions. These fabrics also support indigenous knowledge systems and community livelihoods, often being made in closed-loop, low-waste village economies (Hussain and Seth, 2022).

Despite these advantages, these fabrics often fail to meet the quantitative validation required by contemporary international standards, leading to their frequent exclusion from formal certification systems and mainstream design processes (Indian Textile Journal, 2023). By generating ISO-standardised data, this study positions these materials within global frameworks, bridging traditional wisdom and contemporary design demands.

2.4 Theoretical and Literature Foundations

The proposed circularity evaluation framework draws upon five key areas of literature that collectively address the scientific, methodological, and cultural dimensions of sustainable textiles.

1. **Circular Economy Models:** The framework is grounded in circular economy and performance economy models, as articulated by the Ellen MacArthur Foundation (2017) and Walter Stahel (2019), which emphasise waste elimination and material retention.
2. **Critique of Existing Sustainability Frameworks:** Prevailing models in fashion, such as Life Cycle Assessment (LCA) and Cradle-to-Cradle (C2C) (Fletcher and Tham, 2019), primarily address industrial materials. These frameworks often overlook decentralised, craft-based systems, resulting in a notable gap in evaluating handloom textiles. The proposed

framework seeks to address this gap by incorporating additional, context-specific metrics.

The most widely standardised lifecycle tool, ISO 14040/14044-compliant LCA, requires upstream inventory data unavailable for decentralised artisan production (ISO, 2006). The GREET model (Argonne National Laboratory, Wang et al., 2023), while rigorous for energy and carbon accounting, was designed for transport systems and does not address textile biodegradation pathways. The Converging Pillars Framework addresses this gap by substituting ISO-validated performance data for full upstream inventory, generating verifiable circularity indicators where complete LCA is not currently feasible.

Table 2-1 A comparative analysis of existing sustainability frameworks and the proposed circularity framework. Cells with (✓) indicate that the framework addresses the metric, while blank cells indicate that it does not.

Framework	CO ₂ <i>Emissions</i>	Toxicity	Recyclability	Durability	Cultural Value
Life Cycle Assessment	✓	✓			
Cradle-to-Cradle		✓	✓		
Proposed Framework		✓	✓	✓	✓

Note: CO₂ Emissions' refers to CO₂-equivalent greenhouse gas emissions; energy data is excluded, as standardised figures are unavailable for artisan handloom production. 'Cultural Value' refers to the explicit inclusion of artisan, heritage, or community production criteria. The LCA row is blank here because standard LCA does not treat heritage as a formal impact category.

3. **Design Thinking Methodologies:** Integrating design thinking (Brown, 2008; Liedtka, 2015) introduces a user-centred process that combines

qualitative insights with quantitative methods. This approach enhances both the scientific rigour and cultural relevance of the framework.

4. **Critiques of Greenwashing:** Scholars have identified that ambiguous and unverifiable sustainability claims contribute to consumer distrust (Niinimäki and Hassi, 2011; Shen, 2014). The present research addresses this issue by incorporating ISO standards to ensure scientific validation and transparent communication.
5. **Craft and Cultural Sustainability:** Studies highlight that traditional Indian textile systems embody ecological knowledge and cultural resilience (Scrase, 2003). Incorporating this perspective is essential for developing inclusive and culturally relevant circular fashion models.

Together, these five areas create the intellectual base for the circularity evaluation framework, positioning traditional Indian cotton textiles as important contributors to the future of sustainable fashion.

2.5 Framework Development Approach

To address the absence of robust tools for evaluating the circular potential of handmade textiles, this chapter presents the Circularity Evaluation Framework. This framework combines scientific testing, design thinking, and cultural knowledge to ensure that quantitative data is both contextually relevant and informed by stakeholder perspectives.

The framework is built on three pillars:

1. **Core Indicators and ISO Scientific Tests:** Standardised textile tests were selected to objectively evaluate physical and environmental performance according to factors essential for product longevity and environmentally responsible end-of-life outcomes:
 - **Durability:** Evaluated using tensile and tear strength tests (ISO 13934-1, ISO 13937-2).

- **Biodegradability:** Determined through the soil burial test (ISO 11721-1).
 - **Shrinkage Resistance:** Assessed using a domestic wash simulation (ISO 6330).
2. **Design Thinking Integration:** The Design Thinking process serves as the contextual foundation, ensuring that scientific inquiry addresses practical needs. The Empathise and Define phases informed the formulation of the research question and the selection of testing methods to align with stakeholder expectations.
 3. **Cultural Embeddedness:** Scientific performance indicators are complemented by qualitative narratives that document the social and cultural dimensions of handloom textiles, offering a comprehensive perspective that acknowledges local production methods and artisan communities.

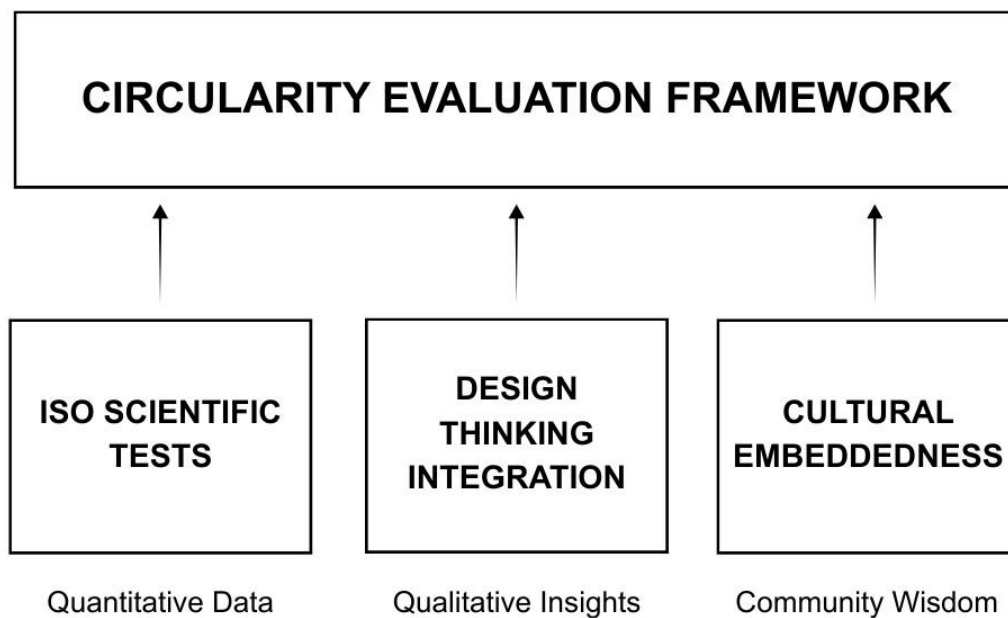


Figure 2-2 The Converging Pillars Framework

Source: Created by the author (2025).

2.6 Methodology: Design Thinking Phases - Empathise and Define

The research methodology utilises the initial stages of the Design Thinking process to position the study within real-world contexts and incorporate stakeholder perspectives.

In the Empathise phase, a comprehensive literature review documented cultural practices and traditional knowledge systems associated with Indian handmade textiles. This review revealed a significant gap between the qualitative values of these materials and the quantitative criteria applied in current sustainability frameworks. These findings provided a basis for developing a research question that addresses both cultural sensitivity and scientific rigour.

Insights from the Empathise phase informed the Define phase, resulting in the formulation of the primary research question and the selection of four

representative textiles: Kala Cotton, Khadi, Jamdani, and Ikat. This stage increased the relevance of the empirical research by aligning specific International Organisation for Standardisation (ISO) tests with the physical properties of each textile.

2.7 Contributions and Implications

This research offers significant contributions to both academic discussion and practical applications within the fields of sustainable fashion and materials science.

2.7.1 Academic Contribution

The primary academic contribution is the framework's integration of ISO textile testing with a human-centred design thinking approach. By linking scientific validation to cultural and community knowledge, this study addresses a critical gap in circularity research, which has frequently overlooked non-Western, handmade materials. The resulting research model is comprehensive and

culturally informed, extending beyond technical evaluation to encompass broader social and cultural contexts

2.7.2 Practical Implications

The framework converts academic insights into actionable tools. By providing a clear and reliable evaluation method, it enables designers, materials scientists, and researchers to assess the circular potential of handmade fabrics with confidence. This framework supports data-driven decision-making throughout the supply chain and establishes a foundation for developing and implementing modular design strategies using validated circular textiles.

2.8 Conclusion

This chapter establishes the theoretical and methodological foundation for the thesis by defining circularity in the context of fashion and introducing a hybrid evaluation framework for handmade Indian cotton textiles. Unlike prevailing models, which are often broad or abstract, the presented framework translates circularity into measurable and verifiable indicators based on ISO standards and contextualised within specific cultural and ecological contexts.

The chapter made several key contributions. First, it clarified that circularity requires integrating durability, safe biodegradability, and cultural resilience. Second, it reviewed the limitations of existing frameworks (LCA, C2C), demonstrating their inadequacy in capturing decentralised systems. In response, the proposed Converging Pillars Framework combines the rigour of ISO-standardised textile tests with the iterative, human-centred process of Design Thinking.

The methodology presented establishes a clear foundation for empirical analysis. By selecting relevant ISO tests, the framework ensures that laboratory results directly reflect key circularity principles. Simultaneously, the analysis preserves cultural narratives, resulting in findings that are both scientifically valid and socially meaningful. This chapter offers a replicable model that positions Indian

handloom fabrics as central contributors to the transition toward circular fashion systems.

The following chapter builds upon this theoretical foundation by shifting focus from the framework to the materials. Chapter 3 provides a contextual mapping of Kala Cotton, Khadi, Jamdani, and Ikat, examining their ecological attributes, production processes, and cultural legacies. This step is essential to ensure that empirical testing in Chapter 4 is interpreted with full consideration of the textiles' historical and social significance.

3 Material Selection and Contextual Mapping

3.1 Introduction

This chapter extends the theoretical and methodological foundation established in Chapter 2 by addressing the practical application of material selection. With the Converging Pillars Framework for evaluating circularity established, the focus shifts to identifying representative case studies that exemplify both technical performance and cultural significance. The deliberate selection of materials defines the empirical scope of the research and ensures that subsequent evaluation is grounded in real-world practices rather than abstract models.

The selection of four case studies: Khadi, Kala Cotton, Jamdani, and Ikat is guided by two primary considerations. First, these textiles are among the most recognisable and historically significant Indian handlooms, each strongly linked to regional identity and national narratives. Their prominence ensures that the findings from their evaluation will be highly relevant for broader policy and industry integration. Second, these textiles display distinct ecological and technical characteristics, such as the contrast between the loose hand-spun texture of Khadi and the fine, labour-intensive structure of Jamdani, or the difference between the low-input cultivation of Kala Cotton and the dye-intensive process of Ikat. This technical diversity provides a robust foundation for testing the framework's capacity to assess a range of handloom production systems and their unique circular pathways.

Prioritising these materials enables the research to generate empirical data while also highlighting alternative models of sustainability rooted in indigenous practices. Mainstream circular economy frameworks often emphasise metrics such as energy efficiency and recyclability, yet rarely address decentralised economies, artisanal knowledge transfer, or low-input farming traditions. This material-centric approach directly supports the thesis objective of establishing a scientifically validated and culturally responsive framework for evaluating circular textiles. Accordingly, this chapter provides a contextual mapping of the four

selected textiles, examining their history, production processes, and ecological attributes.

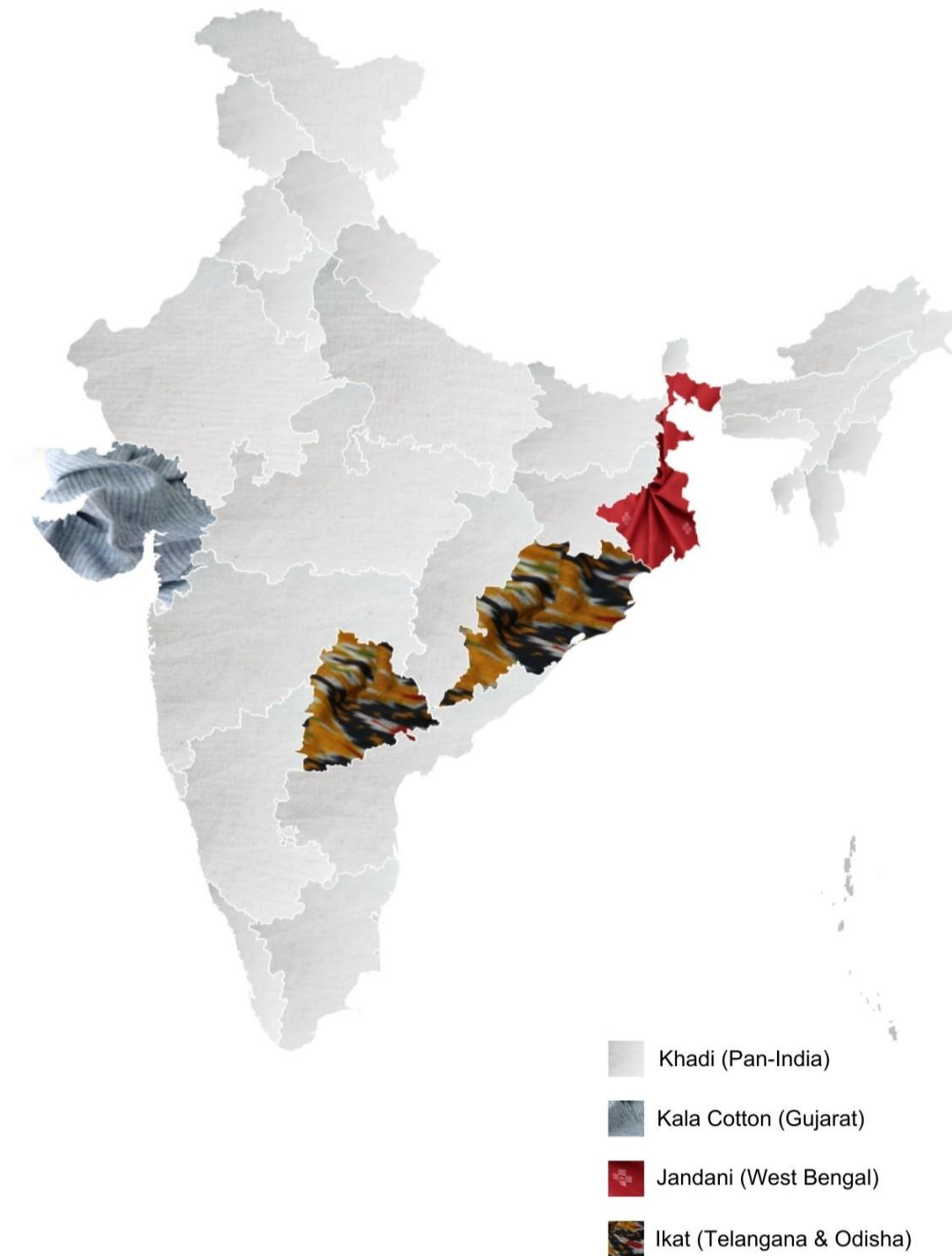


Figure 3-1 Map of India Showing Origins of Selected Textiles- Origins of Kala Cotton (Gujarat), Jamdani (West Bengal), Ikat (Telangana & Odisha), and Khadi (Pan-India).

Source: Author's illustration (2025)

3.2 Contextual Mapping of Indian Textiles

The choice of these four textiles is critical, as each represents a different model of circularity and offers distinct technical variables that directly influence their subsequent performance in empirical testing (Chapter 4).

3.2.1 Khadi: The Fabric of Self-Reliance

- **History and Cultural Significance:** Khadi embodies the principles of self-reliance and resistance (Gandhi, 1938), serving as a decentralised economic model that employs millions of rural artisans (Press Information Bureau, Government of India, 2022). The cultural significance of khadi stems from its hand-spun and hand-woven production methods, which directly oppose industrial overproduction.
- **Production Process and Ecological Attributes:** Khadi production is a low-energy, zero-electricity process that relies on human power (charkha and handloom), notably reducing carbon emissions and water use compared to industrial textile production. This resource-efficient, handmade method offers a strong example of a regenerative, non-industrial system (Mishra, 2015).

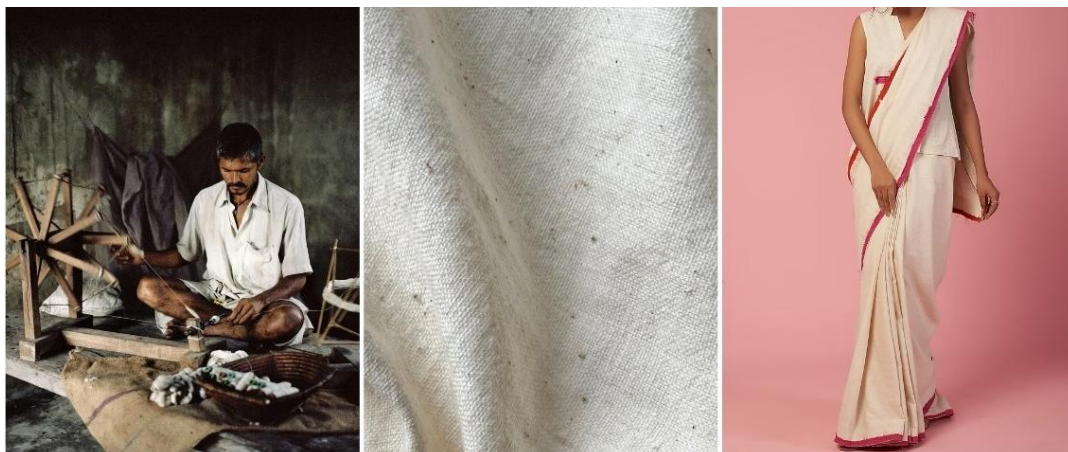


Figure 3-2 Khadi: Production to Product- Khadi production on the charkha (left), plain weave cotton fabric swatch (centre), and saree as a cultural product (right), symbolising self-reliance and Gandhian legacy.

Source: Sukkha Citta (2023); Author's photograph (2025); Pernia's Pop-Up (2023).

3.2.2 Kala Cotton: An Indigenous and Resilient Model

- **History and Cultural Significance:** Indigenous to the dry Kutch region, Kala Cotton is one of the oldest varieties cultivated in India. Its revival honours traditional farmers and demonstrates the resilience of local communities and indigenous knowledge (Ali and Sarfraz, 2018).
- **Production Process and Ecological Attributes:** This crop variety requires minimal external inputs and is cultivated solely with rainwater, which eliminates the need for irrigation. Its natural resistance to pests and diseases reduces dependence on synthetic chemicals. This approach exemplifies a sustainable and regenerative agricultural system. The resulting coarse fabric is typically unbleached and lacks chemical finishes, thereby facilitating an environmentally responsible end-of-life cycle.



Figure 3-3 Kala Cotton: Production to Product- Kala Cotton farming (left), coarse weave swatch (centre), and scarf as a contemporary application (right), representing rain-fed indigenous resilience.

Source: Khamir (n.d.); Author's photograph (2025); Kuttons (n.d.).

3.2.3 Jamdani: The Art of Circularity

- **History and Cultural Significance:** Jamdani, recognised by UNESCO as Intangible Cultural Heritage, is a fine muslin weaving tradition originating in Bengal. Its cultural significance derives from intricate handwoven

designs produced through the discontinuous supplementary weft technique, which exemplifies a commitment to craftsmanship and quality rather than production speed (UNESCO, 2013).

- **Production Process and Ecological Attributes:** The Jamdani weaving process is entirely manual and labour-intensive, resulting in a minimal environmental footprint. Supplementary motifs are dyed in small batches, which reduces water usage and chemical waste compared to large-scale industrial dyeing. The finished fabric is lightweight, breathable, and fully biodegradable, aligning with the principles of circularity (Chakraborty, 2017).

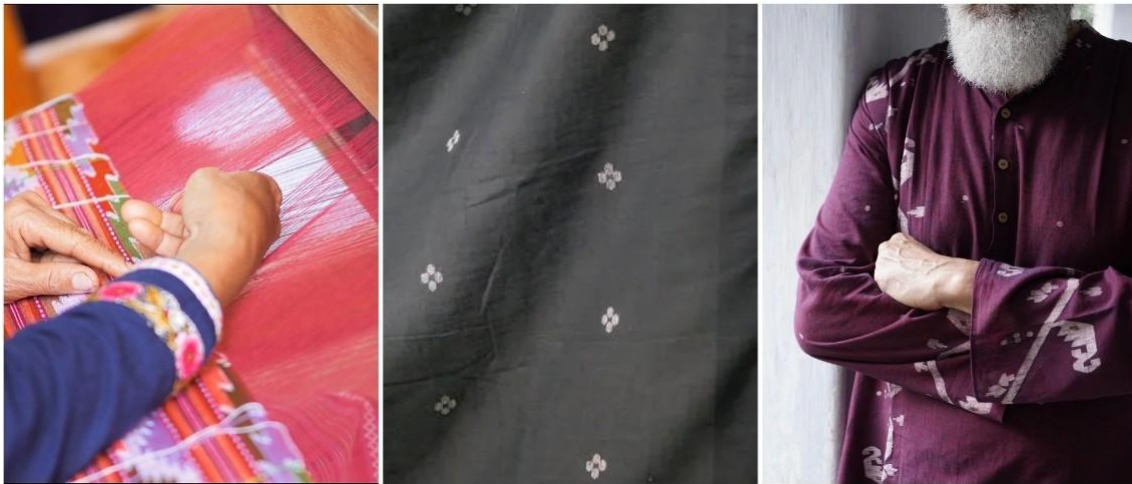


Figure 3-4 Jamdani: Production to Product- Jamdani weaving on a handloom (left), fine muslin swatch (centre), and kurta as a product (right), recognised as UNESCO Intangible Cultural Heritage.

Source: Swadesh Online (n.d.); Author's photograph (2025); Parama Calcutta (n.d.).

3.2.4 Ikat: Craftsmanship and Regional Identity

- **History and Cultural Significance:** Ikat is a sophisticated resist-dyeing tradition that originated in regions such as Telangana and Odisha. The geometric motifs characteristic of Ikat serve as markers of regional identity and demonstrate the precision of artisans. This craft represents the intergenerational transmission of advanced technical and artistic expertise (Reddy and Reddy, 2023).

- **Production Process and Ecological Attributes:** The Ikat production process involves dyeing yarns before weaving, using a resist-dyeing method that consumes less water compared to conventional fabric printing. Artisans often use natural, plant-based dyes, which decreases dependence on synthetic chemicals and reduces water pollution. This method aligns with circular design principles by minimising toxic inputs (Saha and Majumdar, 2019).



Figure 3-5 Ikat: Production to Product- Ikat yarn tie-dyeing process (left), zig-zag patterned swatch (centre), and lampshade as a cultural product (right), highlighting regional identity and craftsmanship.

Source: Ock Pop Tok (n.d.); Author's photograph (2025); Pooky (n.d.).

3.3 Summary of Material Selection

The following table summarises the principal attributes of the selected materials, which serve as the key independent variables for the empirical analysis presented in Chapter 4.

Table 3-1 Comparative Attributes of Selected Textiles

Textile	Region	Cultural Significance	Ecological Traits
Khadi	Pan-India	Gandhian legacy, rural employment	Low energy, zero-electricity, hand-spun
Kala Cotton	Kutch, Gujarat	Tribal heritage, rain-fed revival	Organic, rain-fed, low-input farming
Jamdani	West Bengal	UNESCO Intangible Cultural Heritage	Lightweight, low dye load, minimal environmental footprint
Ikat	Telangana / Odisha	Tie-dye heritage, geometric motifs	Plant dyes are a low-water-resistant dye technique

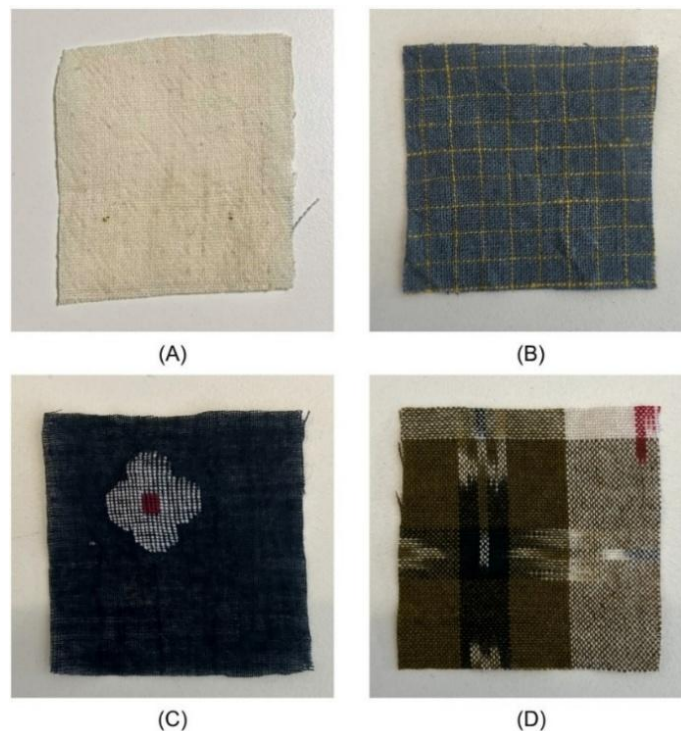


Figure 3-6 Comparative Swatch Plate of Tested Materials (A-D)- A composite plate of the four test textiles, visually summarising the material variables (A) Khadi, (B) Kala Cotton, (C) Jamdani, and (D) Ikat used in the empirical tests of Chapter 4.

Source: Author's photograph (2025)

3.4 Conclusion

This chapter established the rigorous rationale for focusing on four representative Indian handloom cotton textiles: Khadi, Kala Cotton, Jamdani, and Ikat. It systematically mapped their cultural, ecological, and technical characteristics, demonstrating that material selection in circular design research must be grounded in historical legacies and community-based economies.

The contextual mapping demonstrates that each textile represents a distinct pathway of circularity, offering the technical diversity required for effective comparative testing. This approach ensures that the subsequent empirical analysis is both culturally informed and ecologically situated. Laboratory results on durability, shrinkage, and biodegradability presented in Chapter 4 will gain significance when interpreted in relation to these broader narratives of resilience, heritage, and sustainability.

This chapter addressed Objective 2, which is to identify and select handmade cotton textiles. The following chapter builds on this foundation by transitioning from contextual mapping to empirical validation. Chapter 4 presents results from ISO-standardised tests, generating quantitative data on durability, stability, and biodegradability. These results will be integrated into the research framework through analysis in relation to the contextual profiles established in this chapter.

4 Experimental Testing and Evaluation

4.1 Introduction

This chapter extends the theoretical framework established in Chapter 2 and the material context described in Chapter 3 to present the empirical core of the research. The discussion transitions from the general imperative for circularity to a quantitative evaluation of traditional Indian textiles. The primary objective is to empirically assess the performance of four handloom cotton textiles: Khadi, Kala Cotton, Jamdani, and Ikat, using key circularity metrics including durability, dimensional stability, and biodegradability. The resulting verifiable data (Objective O3) will form the basis for the comparative analysis and design integration strategies discussed in Chapter 5.

The chapter initially details the testing methodology, then presents and analyses the results for each ISO standard and finally synthesises the findings to evaluate the central performance profiles of the textiles.

4.2 Methodological Overview: Test Procedures

The four handloom textiles were subjected to standardised laboratory tests, following the protocols of the International Organisation for Standardisation (ISO), to ensure the accuracy and reproducibility of the data. All fabric specimens were conditioned for a minimum of 24 hours at standard atmospheric conditions ($20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $65\% \pm 4\%$ relative humidity, as specified in ISO 139:2005). Specimens were consistently prepared in both the warp and weft directions to account for the inherent anisotropic properties of handloom textiles.

Tensile and tear strength were selected to quantify structural integrity under the mechanical demands of everyday wear, tensile forces concentrate at seams during bodily movement, while tear resistance addresses snagging and point-stress failure (Mukhopadhyay, Ghosh and Bhaumik, 2006); wash shrinkage was included because dimensional instability is a leading cause of garment rejection during repeated laundering and directly affects circular use cycles; and biodegradation was tested to evaluate end-of-life material recovery potential, a

prerequisite for biological cycle alignment within the proposed circularity framework.

4.2.1 Tensile Strength (ISO 13934-1)

Tensile strength was evaluated using the strip method as specified in ISO 13934-1:2013. This method measures the maximum force (N) and elongation at break (%) under uniaxial tension. The test is crucial for determining the mechanical durability and structural integrity of fabrics intended for long-term and repeated use in circular applications.

- **Procedure Detail:** Specimens measured 50 ± 0.5 mm in width and were mounted with a gauge length of 200 mm. Testing was conducted on a constant-rate-of-extension (CRE) machine at a separation rate of 100 mm/min until rupture. Five replicates were tested for each fabric direction.
- **Metric:** The primary metrics included maximum breaking force (N), elongation at break (%), and derived tensile stress (N/mm²), enabling comparison independent of fabric thickness.

4.2.2 Tear Strength Test (ISO 13937-2)

Tear strength was evaluated using the single-tear trouser method (ISO 13937-2:2000). This test quantifies the force necessary to propagate an existing tear, providing a key indicator of mechanical resilience against accidental damage and long-term wear.

- **Procedure Detail:** Rectangular specimens measuring 200 mm by 50 mm were prepared with a central 100 mm slit to form a trouser-shaped configuration. The two legs of each specimen were clamped and separated at a constant rate of 100 mm/min. The mean tear force was determined by analysing the peaks in the force-extension curve, with initial anomalies excluded from the analysis.
- **Metric:** Mean Tear Force (N).

4.2.3 Wash and Shrinkage Test (ISO 6330)

Dimensional stability of the fabrics was assessed according to ISO 6330, the standard method for evaluating fabric shrinkage due to domestic laundering. This method quantifies changes in length and width after a standard wash and tumble-dry cycle at 40°C using the Normal Cotton Cycle. The resulting data provide critical information on longevity and shape retention relevant to modular fashion systems.

- **Procedure Detail:** Square specimens measuring 300 mm by 300 mm were marked with 25 cm reference lines. After conditioning, initial and final measurements were compared to calculate percentage shrinkage.
- **Metric:** Mean Shrinkage in Length and Width (%).

4.2.4 Biodegradation Test (ISO 11721-1)

The biodegradability of cellulosic textiles was evaluated according to ISO 11721-1:2018, which outlines the soil burial test method. This approach provides a direct measure of environmental performance and material suitability for regenerative end-of-life cycles.

Cotton textiles are cellulosic materials in which glucose units are linked by beta-1,4-glycosidic bonds. In microbially active soil, cellulolytic microorganisms, predominantly fungi including *Trichoderma* and *Aspergillus* species, and bacteria including *Cellulomonas* species, secrete cellulase enzymes that hydrolyse these bonds, breaking the cellulose chain into glucose monomers (Datta, 2024). The glucose is then metabolised through aerobic respiration, producing carbon dioxide, water, and microbial biomass as end products. The rate of degradation is governed by fibre accessibility: lower yarn crystallinity, looser weave structures, and the absence of chemical finishes all enhance microbial enzyme access to the cellulose substrate (Hubbe et al., 2025).

- **Procedure Detail:** Specimens were buried in microbially active soil at a depth of 5 to 10 cm and maintained at optimal moisture content. Samples were collected at 21, 42, and 63 days, then cleaned and weighed.
- **Metric:** Percentage Weight Loss over time (%).

Note: Detailed technical specifications, including sample dimensions, equipment calibration data, and all calculation formulae used for deriving results (e.g., Tensile Stress and Tear Peak Selection), as well as a visual record of the complete experimental setup and specimen preparation, are fully documented in Appendix B: Detailed Testing Protocols.

4.3 Test Results and Comparative Analysis

This section reports the empirical results of performance testing on four traditional Indian textiles. Each fabric was assessed in both warp and weft directions using standardised laboratory methods. The experimental parameters included tensile strength, tear resistance, dimensional stability through wash and shrinkage tests, and biodegradation behaviour. These findings provide a basis for the comparative analysis and design integration presented in Chapter 5, which examines the implications for modular construction and circular fashion systems.

4.3.1 Tensile Properties

The tensile properties of each textile were evaluated to assess resistance to breaking and deformation under uniaxial stress. Key performance metrics included Mean Breaking Force (N), Mean Tensile Stress (N/mm²), and Mean Elongation at Break (%), all obtained through empirical testing. For each fabric, five replicate samples ($n = 5$) were tested in both the warp and weft directions. The average values from these replicates are presented in Table 4.1.

Table 4-1 Mean Breaking Force, Mean Elongation at Break, and Mean Tensile Stress of Tested Handloom Fabrics (n=5 per direction).

Fabric	Mean Force Warp (N)	Mean Force Weft (N)	Mean Elongati on Warp (%)	Mean Elongati on Weft (%)	Mean Stress Warp (N/mm ²)	Mean Stress Weft (N/mm ²)
Khadi	195.54	171.97	32.41	45.39	57.51	50.58
Kala Cotton	216.89	233.91	39.91	39.95	54.91	59.22
Jamdani	104.96	85.31	34.77	41.48	55.68	45.26
Ikat	208.19	194.61	33.27	38.81	52.71	49.27

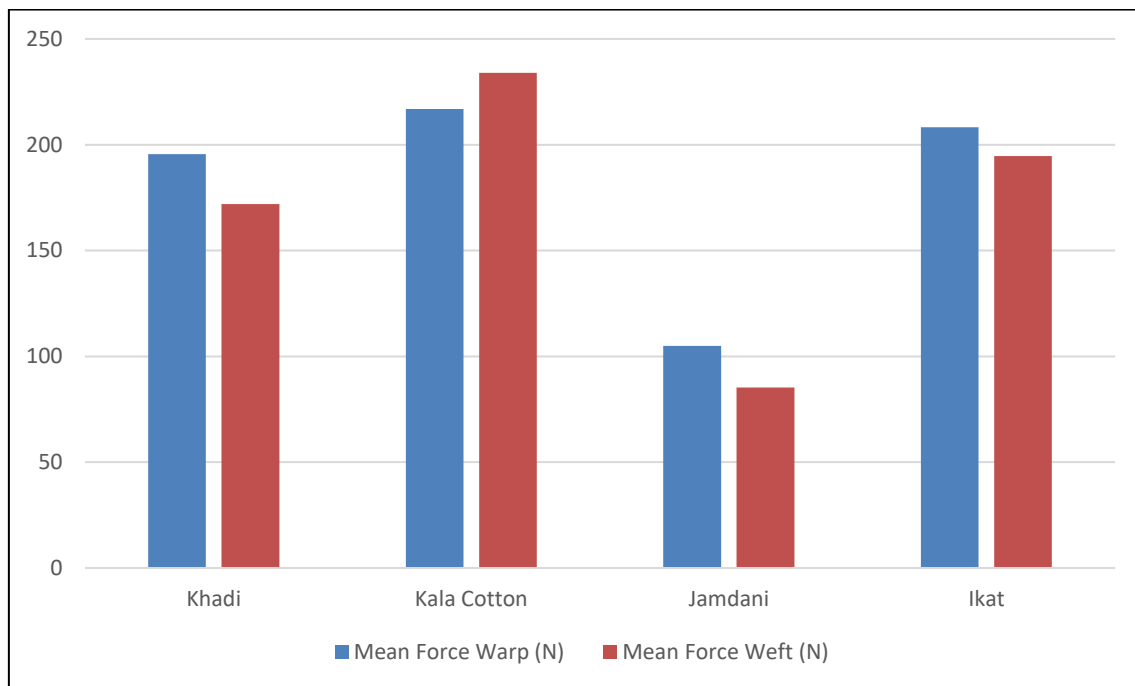


Figure 4-1 Mean Breaking Force (N) of Fabrics (Warp vs. Weft)

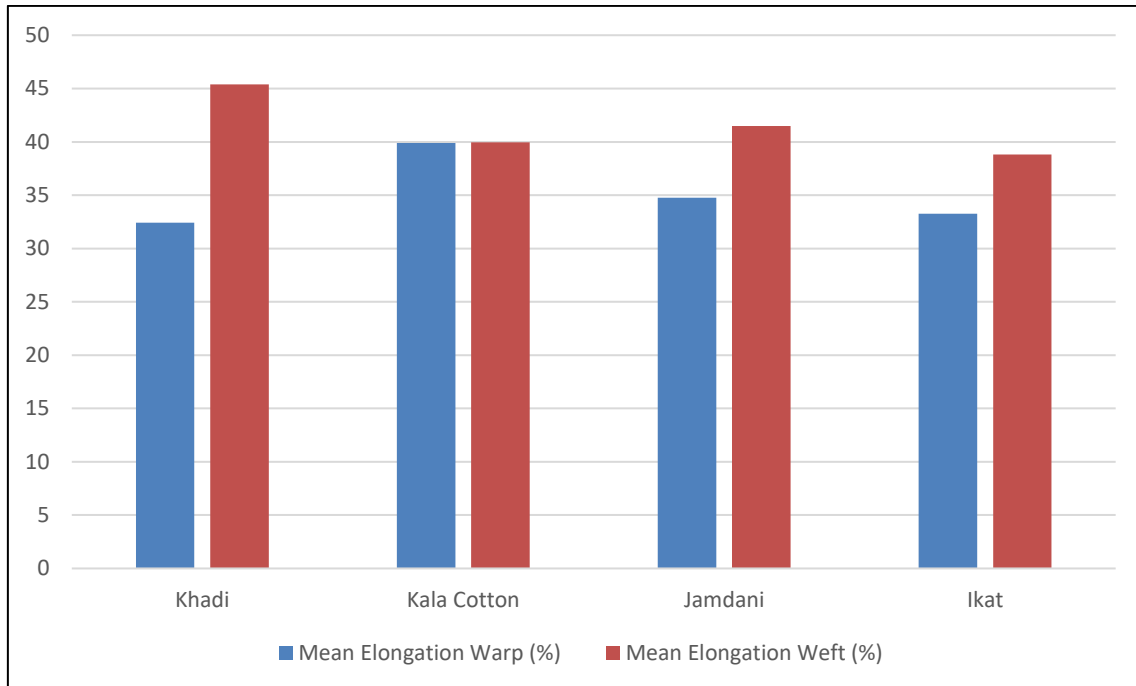


Figure 4-2 Mean Elongation at Break (%) of Fabrics (Warp vs. Weft)

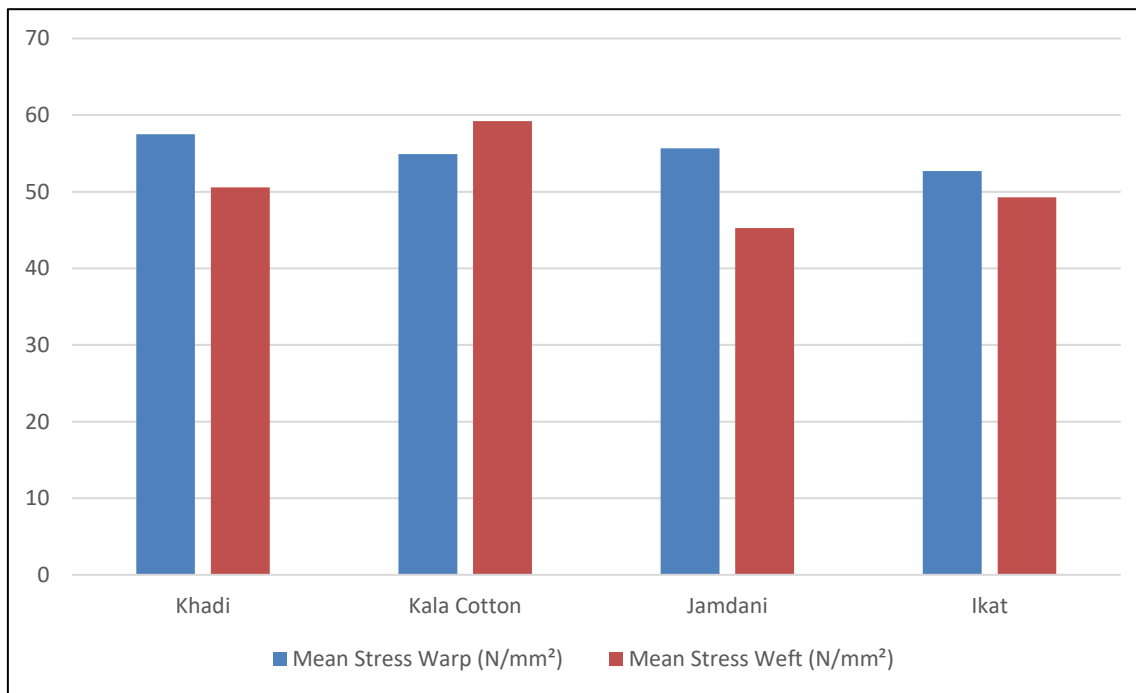


Figure 4-3 Comparative Mean Tensile Stress (N/mm²) of Handloom Fabrics

Observations:

The handloom fabrics demonstrated pronounced anisotropic properties, with mechanical performance differing notably between the warp and weft directions.

Kala Cotton exhibited the highest overall strength, achieving maximum values in the weft direction (Force: 233.91 N; Stress: 59.22 N/mm²). While the mean values in Figure 4-1 appear close in visual scale, the raw replicate data in Table C-2 (Appendix C) confirm that all five Kala Cotton weft specimens consistently exceeded 210 N, ranging from 210.00 N to 252.20 N, a range that does not overlap with Khadi's weft values of 151.60 N to 187.29 N, confirming a clear and consistent performance separation between these two fabrics. Khadi exhibited the highest mean warp stress (57.51 N/mm²) and the greatest elongation at break (45.39% in the weft), indicating enhanced resilience. Although Jamdani had the lowest breaking force, it maintained a high stress value in the warp direction, reflecting its extremely fine cross-sectional area rather than structural strength. Ikat displayed the most balanced performance between warp and weft directions. Chapter 5 provides a more detailed comparative analysis of these anisotropic properties and discusses their relevance to circular and modular design strategies.

4.3.2 Tear Properties

The tear properties of each textile were evaluated to determine its resistance to tear propagation from a pre-initiated slit under uniaxial stress. The primary performance metric, Mean Tear Force (N), was measured through empirical testing following ISO 13937-2 using the single-tear trouser method. For each fabric, five replicate samples (n = 5) were tested in both the warp and weft directions. The mean values from these replicates are reported in Table 4.2

Table 4-2 Mean Tear Force of Tested Handloom Fabrics (n = 5 per direction)

Fabric	Mean Tear Force Warp (N)	Mean Tear Force Weft (N)
Khadi	13.43	15.81
Kala Cotton	18.78	20.79
Jamdani	5.66	6.26
Ikat	22.35	23.38

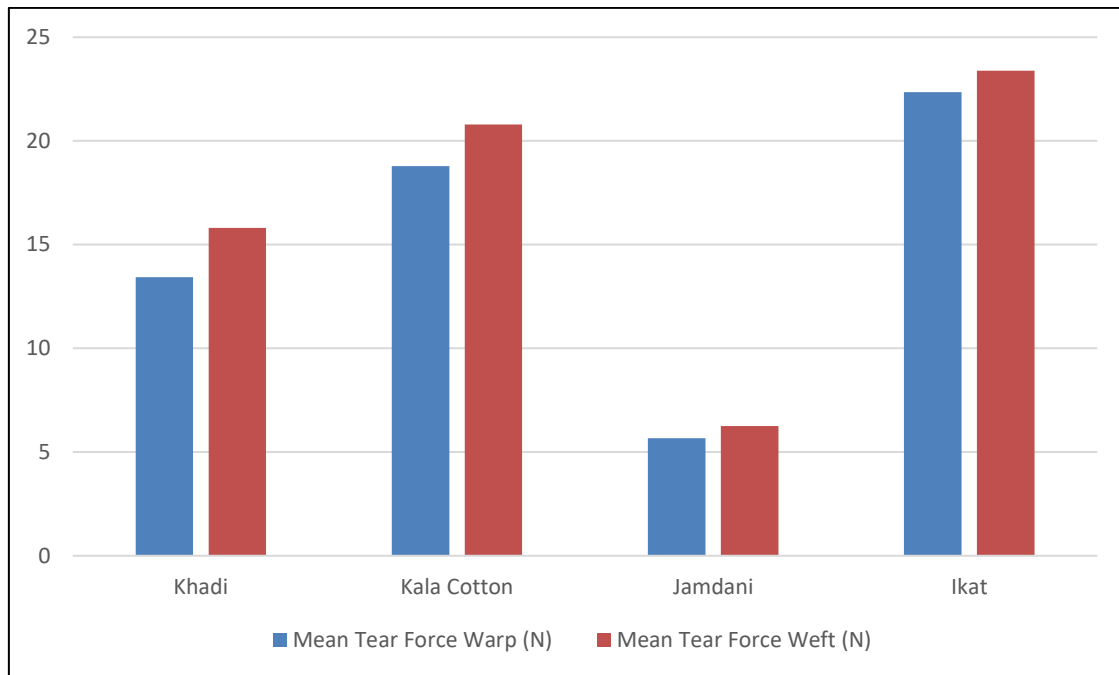


Figure 4-4 Mean Tear Force (N) of Handloom Fabrics (Warp vs. Weft)

Observations:

Directional differences in tear resistance were observed among the handloom fabrics, with most samples demonstrating greater strength in the weft direction. Ikat exhibited the highest overall tear strength, measuring 22.35 N in the warp and 23.38 N in the weft, indicating a balanced and durable structure. The consistency of Ikat's tear resistance is confirmed by the raw replicate data in Table C-8 (Appendix C), where warp values ranged from 20.81 N to 23.90 N and weft values from 20.73 N to 25.95 N, a narrow spread indicating structural uniformity across specimens, in contrast to Khadi's warp tear data (Table C-5), which ranged from 5.41 N to 18.21 N, reflecting the inherent irregularity of hand-spun yarn construction. Kala Cotton also showed superior performance in the weft direction. Khadi displayed moderate tear strength in both directions, whereas Jamdani had the lowest resistance, particularly in the warp direction. These results suggest that Ikat and Kala Cotton are most suitable for applications requiring mechanical durability, while Khadi and Jamdani are more appropriate for low-stress or decorative purposes. Chapter 5 presents a comparative synthesis of these findings within the frameworks of modular and circular design.

4.3.3 Dimensional Stability

Dimensional stability for each fabric was evaluated according to ISO 6330, quantifying the percentage of shrinkage in both length and width after standardised domestic laundering. This assessment is essential for determining fabric performance during actual use cycles, especially within modular and circular fashion systems that require consistent fit, precise panelling, and reliable repeatability.

Samples were cut to 30 by 30 centimetres and marked with a 25-centimetre reference line in both length and width. Five replicate specimens ($n = 5$) were tested per fabric type. Shrinkage was determined by comparing initial and final dimensions, and mean values are presented in Table 4.3.

Table 4-3 Mean Shrinkage in Length and Width of Handloom Fabrics ($n = 5$)

Fabric	Mean Length Shrinkage (%)	Mean Width Shrinkage (%)
Khadi	7.33	8.00
Kala Cotton	10.33	9.33
Jamdani	8.66	6.00
Ikat	9.00	9.00

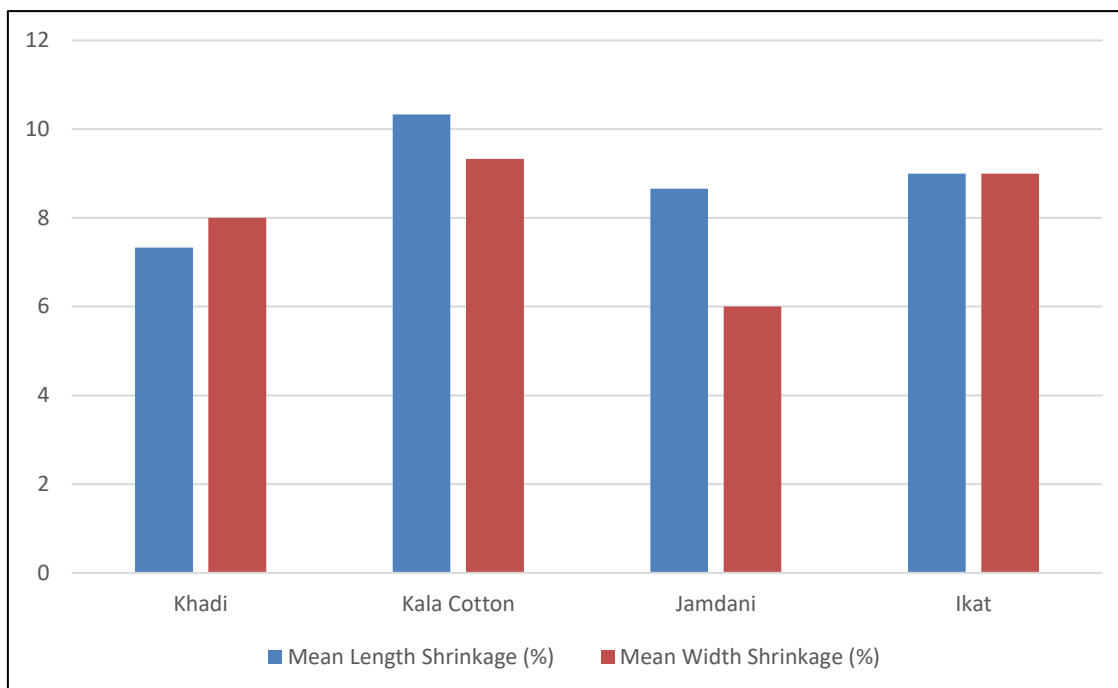


Figure 4-5 Mean Dimensional Stability (Shrinkage %) After Standardized Laundering

Observations:

The tested fabrics demonstrated differences in dimensional stability following washing. Kala Cotton exhibited the highest average shrinkage, with 10.33% in length and 9.33% in width, which is consistent with the structural yarn crimp relaxation characteristic of unprocessed rain-fed cotton during wet processing. Ikat displayed balanced shrinkage of 9.00% in both directions. In contrast, Khadi showed the lowest lengthwise shrinkage at 7.33% and maintained good width stability at 8.00%, indicating comparatively stable performance.

Jamdani exhibited the lowest width shrinkage at 6.00%. However, it experienced visible deformation after washing, with side extension likely resulting from its open weave and decorative structure. These findings underscore the need to consider both quantitative measurements and structural responses in practical applications. For modular applications that require fit retention, Khadi and Ikat are identified as more suitable options. A comprehensive comparison of mechanical and dimensional properties is provided in Chapter 5.

4.3.4 Biodegradation Properties

The biodegradability of the handloom fabrics was assessed by determining the percentage weight loss following soil burial at intervals of 21, 42, and 63 days. The procedure adhered to ISO 11721-1, which replicates natural decomposition in microbially active soil. For each fabric and time interval, three replicate specimens ($n = 3$) were analysed, and mean weight loss was calculated to quantify biological degradation. Table 4.4 presents the summarised results.

Table 4-4 Mean Weight Loss (%) of Tested Handloom Fabrics Over Time ($n = 3$ per time point)

Fabric	21 Days	42 Days	63 Days
Khadi	27.42%	34.38%	60.15%
Kala Cotton	17.67%	24.87%	36.71%
Ikat	14.99%	23.19%	36.02%
Jamdani	6.21%	7.34%	22.55%

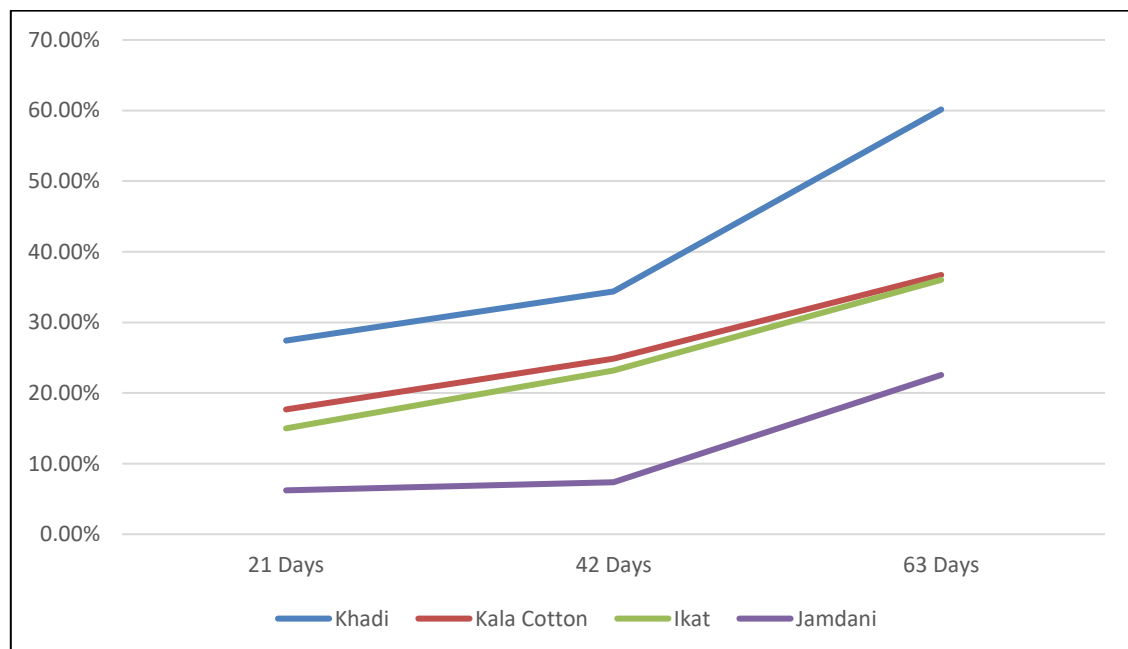


Figure 4-6 Mean Biodegradation Rate (Weight Loss %) Over 63 Days (Soil Burial Test)

Observation:

The biodegradation behaviour of handloom fabrics varied notably by material type and over time. Khadi showed the highest biodegradability, with a 60.15% weight loss after 63 days, attributed to its handspun yarn structure and lack of chemical finishes. Kala Cotton and Ikat exhibited moderate degradation, each exceeding 36% weight loss by the end of the test period. Kala Cotton decomposed more rapidly in the early stages, whereas Ikat's degradation rate increased later, likely due to delayed microbial access through its dyed and compact yarn structure. Jamdani, although lightweight, exhibited the lowest degradation at all time points, which may be explained by its tight weave, supplementary weft motifs, and potential residual finishing agents. The progressive nature of Jamdani's biodegradation is confirmed at the replicate level in Table C-15 (Appendix C), which shows biological degradation occurring consistently across all three replicates at each time point, but at a rate notably slower than Khadi (Table C-13 replicates: 52.74%, 72.67%, and 55.04% at 63 days). Jamdani's slower rate is attributable to structural factors, tight weave, supplementary weft motifs, rather than any difference in base cellulosic composition. The differential degradation rates across the four fabrics are directly attributable to structural and processing variables rather than any difference in cellulosic fibre composition: Khadi's rapid 60.15% weight loss reflects its hand-spun open yarn structure and the absence of chemical finishes, both of which enhance microbial enzyme access to the cellulose substrate, whereas Jamdani's comparatively limited degradation of 22.55% is consistent with its tighter weave density and supplementary weft motifs, which restrict enzyme penetration regardless of equivalent fibre-level biodegradability. These results indicate that biodegradability depends on structural porosity, yarn type, and surface treatments, rather than solely on weight or thickness. Chapter 5 presents a comparative analysis of biodegradation performance to inform sustainable material selection and end-of-life strategies in circular fashion design.

4.4 Synthesis of Overall Fabric Performance

The combined results from tensile, tear, shrinkage, and biodegradation tests provide a comprehensive performance profile for each handloom fabric. This analysis identifies the relative strengths and limitations of the materials and offers a comparative assessment of their appropriateness for circular use cycles.

Khadi exhibited a unique profile characterised by high biodegradability and flexibility. It achieved the highest elongation at break, moderate tensile and tear strengths, and the fastest degradation rate, with over 60.15% weight loss after 63 days. Its dimensional stability was the highest, as indicated by the lowest length shrinkage in the group (7.33%). This stability provides a strong basis for managing sizing in modular applications while maintaining adequate usability throughout its service life.

Kala Cotton and Ikat demonstrated similar profiles, marked by high mechanical durability and moderate biodegradability. Both fabrics performed well in tensile and tear tests, with Ikat recording the highest tear resistance (23.38 N) and Kala Cotton achieving superior tensile force and stress values. Both exhibited the highest and most pronounced shrinkage in the group. Biodegradation proceeded at a moderate rate, with both fabrics exceeding 36% weight loss after 63 days. These findings indicate that Kala Cotton and Ikat are the most mechanically resilient textiles evaluated, making them suitable for applications involving repeated, high stress use cycles.

Jamdani exhibited the weakest overall performance, characterized by low durability and limited biodegradability. It recorded the lowest tensile strength (85.31 N) and tear resistance (5.66 N). Although width shrinkage was minimal, the fabric showed visible deformation after laundering, likely due to its open weave. This combination indicates that Jamdani is delicate in structure and slow to decompose in natural environments.

The full replicate dataset in Appendix C further reveals that Jamdani's variability across replicates was the highest in the study group: warp tear force ranged from 5.15 N to 6.11 N across five replicates (Table C-7), proportionally greater

variation than Ikat's tighter range of 20.81 to 23.90 N (Table C-8). This replicate-level variability reflects the structural complexity introduced by Jamdani's supplementary weft motifs, which create localised inconsistencies in yarn density and weave compactness that the mean values alone do not fully convey, and which reinforce its designation as a cultural accent fabric rather than a structural material.

In summary, the comparative performance ranking indicates:

Table 4-5 Overall Performance Ranking of Handloom Textiles

Performance Criterion	Best Fabric(s)	Key Data Point
Biodegradability	Khadi	60.15% Weight Loss
Mechanical Durability	Ikat / Kala Cotton	Ikat: 23.38 N Tear
Dimensional Stability	Khadi	Lowest Length Shrinkage (7.33%)
Lowest Performance	Jamdani	Lowest Breaking Force (85.31 N)

This synthesis provides an empirical foundation for Chapter 5, which examines the influence of differentiated performance profiles on the potential of each fabric within circular and modular design frameworks.

Mukhopadhyay, Ghosh and Bhaumik (2006) reported weft-direction tear forces of 31.6 N for finished ring-spun military khaki cotton twill in the sanforized state, and 51.1 N for the same fabric unprocessed. Against these reference points, Ikat (23.38 N weft) and Kala Cotton (20.79 N weft), tested without any industrial finishing, demonstrate meaningful structural durability relative to unfinished commercial equivalents. Khadi and Jamdani fall below both reference points, confirming their low-stress and cultural-accent positioning. Tensile data from that study are reported in kN/m and cannot be directly compared to the N values in

Table 4-1; a co-tested commercial control fabric is recommended as a future research priority (Section 6.5).

4.5 Conclusion

This chapter establishes the empirical foundation of the study by quantifying the performance of four traditional handloom textiles across key parameters: durability, dimensional stability, and biodegradability (Objective O3). Standardised ISO testing methods yielded reliable and reproducible data, leading to validated performance profiles for Khadi, Kala Cotton, Jamdani, and Ikat. The results identify both the inherent strengths and practical limitations of these materials, providing a robust evidence base that addresses the research hypothesis.

The findings demonstrate that the core experimental objective has been achieved, generating a systematic dataset that precisely characterises the mechanical, dimensional, and biological behaviour of the selected fabrics under controlled conditions. This dataset serves as a critical quantitative reference for evaluating the suitability of indigenous cotton textiles in future-oriented design strategies.

Chapter 5 will build on these results by undertaking a comprehensive comparative analysis. It will integrate the established performance profiles with the principles of modularity and the circular economy, linking material behaviour to broader design and sustainability implications.

5 Comparative Analysis and Design Integration

5.1 Introduction

This chapter extends the empirical dataset presented in Chapter 4. Laboratory results are translated into actionable insights by linking each fabric's performance profile to the circular economy principles introduced in Chapter 2. The analysis operationalises circularity by situating the fabrics within the technical and biological cycles, thereby demonstrating how their inherent properties can be strategically aligned with system-level sustainability outcomes.

Textiles are not treated as isolated artefacts in this discussion. Instead, they are analysed as interdependent elements within a modular evaluation framework. Here, modularity refers to a systematic classification in which each fabric occupies a functional role within a broader circular system, rather than to physical garment components.

5.2 Operationalising Circularity: Linking Data to Metrics

5.2.1 Mechanical Durability: Longevity in the Technical Cycle

Durability is a defining feature of the technical cycle, where materials are kept in circulation through reuse and repair (Ellen MacArthur Foundation, n.d.).

Ikot, which exhibited the highest tear resistance (23.38 N), and Kala Cotton, which demonstrated the highest tensile force (up to 233.91 N), both display significant resilience. These superior mechanical properties, attributed to indigenous yarn characteristics and compact weaves, render them appropriate for the technical cycle and support prolonged service life in demanding applications. All fabrics exhibited anisotropy, with performance varying between the warp and weft directions. This structural feature, likely resulting from variations in yarn preparation and tensioning during hand-weaving, highlights the importance of proper orientation and application in systems that prioritise longevity and resilience. In contrast, Jamdani exhibited the lowest breaking force

(85.31 N), indicating limited suitability for high-resilience contexts and a more restricted role within the technical cycle.

5.2.2 Dimensional Stability and Interoperability

Dimensional stability is crucial for interoperability across systems that require reliability over multiple cycles of use and maintenance (Nayak et al., 2022).

Kala Cotton exhibited the highest shrinkage (10.33% in length and 9.33% in width), a typical property of untreated indigenous cottons that complicates applications requiring consistent dimensional accuracy. This instability highlights the necessity of pre-treatment before modular use. Khadi demonstrated the most favourable shrinkage profile (7.33% in length and 8.00% in width), establishing it as the most reliable fabric regarding dimensional stability. Jamdani, despite its low width shrinkage (6.00%), experienced visible deformation due to its open weave structure. This result indicates that qualitative deformation can be more significant than quantitative shrinkage in assessing dimensional reliability. Overall, these results suggest that dimensional stability depends on both structural integrity and measured contraction, which directly influence suitability for modular interchangeability.

5.2.3 End-of-Life and Biological Integrity

The biological cycle requires a safe return to the biosphere through biodegradation (Ellen MacArthur Foundation, n.d.).

Khadi exhibited the highest biodegradation, with a 60.15% weight loss after 63 days. This result demonstrates its compatibility with the biological cycle and highlights its potential as a benchmark for safe reintegration into natural systems, attributed to its hand-spun structure and absence of chemical finishes. Kala Cotton and Ikat experienced moderate degradation, with 36.71% and 36.02% weight loss, respectively. These slower degradation rates indicate extended utility during use and underscore the need for tailored end-of-life management, potentially due to denser yarn structures or the presence of natural dyeing agents. Jamdani, with only 22.55% degradation, was the least suitable for biological

reintegration, likely due to its supplementary weft motifs and compact weave. Its primary value remains in its cultural and decorative significance.

Beyond the aerobic soil burial conditions replicated under ISO 11721-1, it is important to consider the two most prevalent real-world textile disposal pathways: landfill and incineration. In landfill, cellulosic textiles undergo anaerobic degradation, a process that generates methane, a greenhouse gas with a 100-year global warming potential approximately 28 times that of carbon dioxide (IPCC, 2021). Despite this, unfinished natural cotton fibres present a substantially lower environmental burden in landfill than synthetic textiles, which resist biological breakdown entirely (Cooper and Claxton, 2022). In incineration, natural cotton fibres combust without releasing synthetic polymer microparticles or persistent halogenated compounds, and energy is recoverable through waste-to-energy systems. In all three end-of-life scenarios, composting, landfill, and incineration, natural cellulosic handlooms demonstrate a substantially lower environmental burden than synthetic or chemically finished alternatives, further reinforcing the biological cycle alignment established in Table 5-1. The biodegradation data in this chapter therefore represent best-case performance under optimal conditions, and underscore the importance of developing appropriate composting and collection infrastructure alongside the material validation work undertaken here.

5.3 The Circularity Suitability Matrix and Prioritisation

5.3.1 Application of the Converging Pillars Framework

The Converging Pillars Framework, as outlined in Chapter 2, integrates quantitative ISO data with cultural and ecological values. This functional differentiation is visually captured in the holistic performance profiles established by the Radar Chart (Figure 5-1), which graphically represents the trade-offs between durability and biological integrity for each fabric.

For example, Khadi demonstrates superior biodegradability, with a 60.15% weight loss, which supports its low-energy, decentralised production model and confirms its function as a key component in the biological cycle. In contrast, the

high tear strength of Ikat substantiates the traditional artisan practice of compact weaving as an effective strategy for enhancing material longevity within the technical cycle.

Table 5-1 Circularity Suitability Matrix of Handloom Textiles based on ISO Performance and Framework Alignment.

Fabric	Durability Score	Dimensional Stability Score	Biological Loop Score	Circular Role/Alignment Goal
Khadi	Moderate	Best in Group	Excellent	Biological Cycle Anchor
Kala Cotton	High	Lowest in Group	Good	Technical Cycle Durable Option
Ikat	High	Low	Good	Technical Cycle Resilient Option
Jamdani	Lowest	Poor/ Unreliable	Limited	Cultural Accent / Limited Circular Role

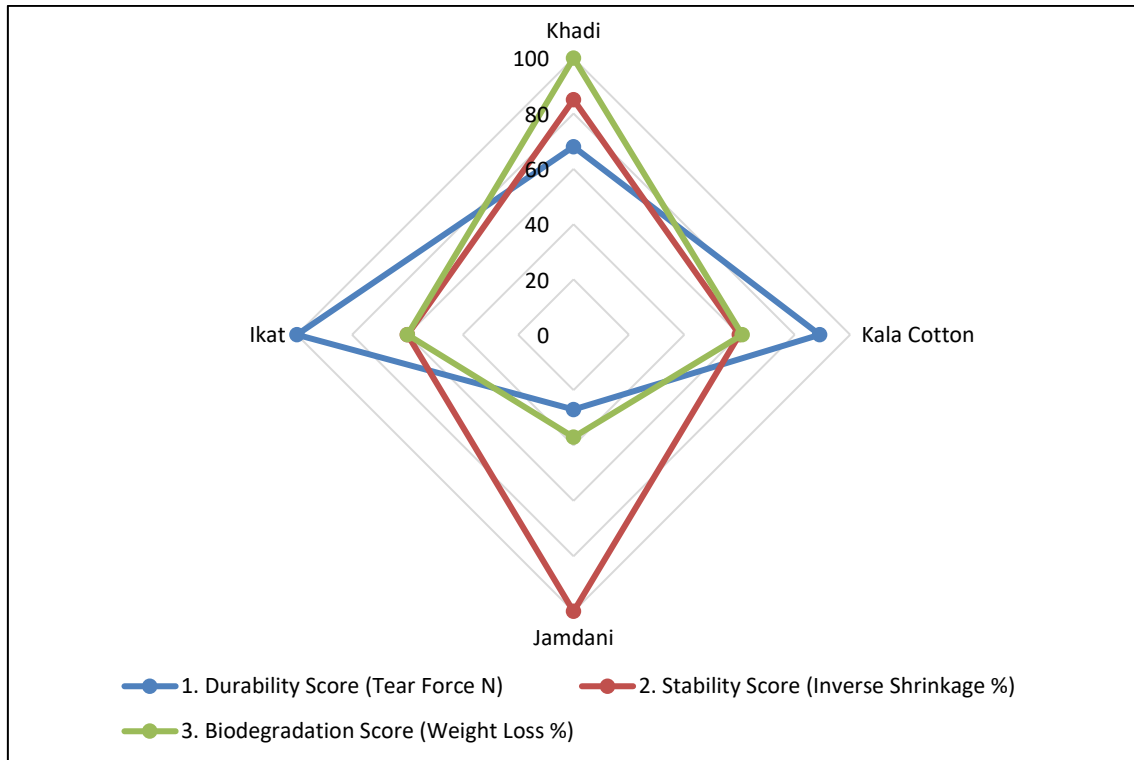


Figure 5-1 Comparative Circular Performance Profiles of Textiles.

5.3.2 Prioritisation of Indigenous Textiles

The prioritisation process identifies three fabrics of significant circular relevance, each fulfilling a specific functional role.

- Khadi functions as the primary material within the biological cycle.
- Kala Cotton and Ikat are identified as durable materials suitable for the technical cycle.
- Although Jamdani demonstrates limited technical and biological performance, it maintains cultural significance and may serve as a low-impact, symbolic component in system design.

Khadi, Kala Cotton, and Ikat are suitable for regular wear applications due to their durability profiles, whereas Jamdani is better positioned as an occasion or heirloom textile because of its cultural value and comparatively lower mechanical performance (breaking force: 85.31 N; visible deformation after laundering). This distinction is important for interpreting the circularity data: heirloom use inherently

involves fewer wear and laundering cycles, which reduces the relevance of dimensional stability limitations and repositions cultural retention as the primary circular mechanism.

These findings support the research hypothesis that ISO testing, integrated with contextual evaluation, uncovers the underexplored potential of Indian handloom textiles within circular systems. The resulting matrix provides the design input for developing modular strategies in the following section.

5.4 Design Strategies: Integrating Performance and Cultural Value

This section applies the Circularity Suitability Matrix to develop fabric-specific modular design mandates. These mandates aim to align each textile with either the technical or biological cycle. The proposed strategies utilise the inherent strengths of each fabric and require design interventions to address identified empirical limitations.

5.4.1 Principles of Performance-Driven Modularity

Three core principles, identified through data analysis, guide the integration strategies:

1. **Differential Lifecycle Fastening:** Modules should be connected using fasteners such as stitching, zippers, or snaps that enable disassembly. This approach ensures that materials with different end-of-life pathways, such as highly biodegradable Khadi and durable Kala Cotton, can be efficiently sorted and managed, a concept central to Design for Disassembly (DfD) principles (Ellen MacArthur Foundation, 2023).
2. **Mitigation of Dimensional Instability:** To maintain structural integrity and interchangeability, the high shrinkage observed in all handloom samples, reaching up to 10.33%, must be addressed. This can be achieved through mandatory pre-treatment or by incorporating standardised shrinkage allowances in the design process (ISO 6330 standards for washing practices).

3. **Cultural Value Maximisation:** Low-resilience fabrics should be incorporated exclusively in areas where their symbolic, aesthetic, and cultural value is maximised, provided that the structural longevity of the garment's technical cycle is not compromised.

5.4.2 Fabric-Specific Modular Integration Proposals

Table 5-2 Fabric-to-Product-to-End-of-Life Pathway Summary

Fabric	Suitable Product Category	End-of-Life Route
Khadi	Sarees, kurtas, stoles — primary visible garments	Composting — biological cycle
Kala Cotton	Outerwear, structured garments, load-bearing panels	Repair and reuse — technical cycle
Ikat	Outerwear, structured garments, high-stress zones	Repair and reuse — technical cycle
Jamdani	Sarees, occasion wear, ceremonial garments	Cultural retention, intergenerational transfer

The design mandates in Table 5.2 validate the circular credentials of these textiles in the cultural forms they already occupy, they do not prescribe new garment typologies. Jamdani in its saree form already demonstrates circular behaviour through intergenerational retention, repair, and natural end-of-life decomposition; no structural redesign is required or appropriate for a UNESCO Intangible Cultural Heritage textile. Khadi garments in their existing forms, kurtas, sarees, stoles, already embody the biological cycle through verified biodegradability, and their circular value is maximised precisely when they remain visible and culturally foregrounded rather than hidden as interior components. The framework's practical contribution is to provide ISO-validated material evidence confirming these existing practices are empirically grounded, and to identify Kala Cotton and Ikat as the appropriate candidates for structural garment

components in contemporary applications where tear resistance above 20 N is a functional requirement. Translation into specific garment prototypes tested across repeated use cycles is identified as a future research priority in Section 7.4.

5.5 Conclusion

This chapter completes the comparative analysis and design integration, operationalising circularity by linking empirical performance data to system-level indicators for both technical and biological cycles. The Circularity Suitability Matrix (Table 5.1) demonstrates that each indigenous fabric occupies a distinct yet complementary role within a modular evaluation framework.

The key analytical outcome is the validation of the hybrid evaluation framework (Chapter 2), which successfully translated ISO-standard data into culturally and ecologically relevant design mandates. Specifically:

- Khadi serves as a robust anchor for the biological cycle, most authentically realised in its existing garment forms where cultural visibility and verified biodegradability operate together.
- Kala Cotton and Ikat are identified as durable and resilient options for the technical cycle, provided that dimensional stabilisation is implemented.
- Jamdani is designated as a valuable cultural accent, necessitating non-structural integration.

This synthesis demonstrates that the core research objective has been achieved. The systematic evaluation provides an empirical foundation for integrating these traditional textiles into future-oriented circular fashion systems.

Chapter 6 broadens the discussion by examining the ethical, industrial, and policy implications of integrating these validated findings into global sustainable fashion systems.

6 Discussion and Implementation

6.1 Introduction

Chapter 5 synthesised the empirical dataset into a Circularity Suitability Matrix, demonstrating the alignment of each textile with the technical or biological cycle of the circular economy. The present chapter extends this analysis by contextualising the findings within the broader domains of sustainable design, policy, and cultural practice. Its objectives are to interpret the factors influencing fabric performance, critically compare these results with existing literature, and evaluate the implications for design practice, certification systems, and the socio-economic resilience of the handloom sector.

6.2 Discussion of Core Findings and Contributions

6.2.1 Validating the Hybrid Evaluation Framework

The results confirm that integrating ISO-standardised tests with a cultural and ecological perspective, as outlined in the Converging Pillars Framework (Chapter 2), offers a robust approach for assessing the circular potential of indigenous textiles. For example, Khadi's 60.15 per cent biodegradation after 63 days (Table 4-4) demonstrates its alignment with the biological cycle, a material property that is rarely quantified for artisanal textiles. In addition, Ikat's tear resistance of 23.38 N (Table 4-2) indicates technical durability comparable to industrial cottons reported in the literature (Mukhopadhyay, Ghosh and Bhaumik, 2006).

Grounding the results in replicable laboratory methods, this framework directly addresses critiques of greenwashing in the fashion industry (Niinimäki & Hassi, 2011). While handloom fabrics have historically been dismissed as unverified, the present study provides empirical evidence to support credible, data-driven sustainability claims and facilitate broader market access.

6.2.2 Rethinking Circularity: Beyond Industrial Recycling

The current discourse on circularity, largely shaped by Western-centric frameworks, focuses predominantly on the technical cycle of recycling and fibre-to-fibre regeneration (Ellen MacArthur Foundation, 2017). Empirical results from this study demonstrate an alternative, more holistic model: biological circularity inherent in traditional systems.

Khadi's high biodegradability (60.15%) combined with its low-energy, decentralised production (see Chapter 3) exemplifies a circularity model based on safe reintegration into the biosphere. This contrasts with the energy-intensive processes required for industrial recycling. Kala Cotton, which demonstrates moderate biodegradability (36.71 %) and high tensile strength (233.91 N in the weft), represents a dual pathway: durability during use and eventual compatibility with the biological cycle. These findings support critiques by Fletcher and Tham (2019) that industrial recycling often sustains linear overproduction. Handloom systems, by contrast, demonstrate circularity at the source using renewable inputs, minimal processing, and the preservation of end-of-life integrity.

Studies indicate that garments are most commonly discarded due to perceived loss of style, poor fit, or declining quality rather than complete material failure (Laitala, 2014). Durable artisan textiles may therefore contribute to circularity not only through physical longevity but also through emotional durability, cultural attachment, and repairability, qualities that encourage longer use periods and reduce premature disposal. Handloom textiles such as Khadi and Jamdani, which carry strong cultural identity, are particularly well positioned to benefit from this dynamic, and this socially embedded lifecycle extension is explicitly acknowledged within the Cultural Embeddedness pillar of the Converging Pillars Framework.

6.2.3 Mitigating Constraints for Scalability

Despite their potential, the results revealed constraints that establish the boundary conditions for large-scale integration. Dimensional instability emerged as the most pronounced issue, with Kala Cotton exhibiting a 10.33% reduction in

length (Table 4-3). This finding raises concerns about the reliability of size during repeated laundering cycles. Such instability aligns with previous reports on unprocessed cottons. If not addressed, this substantial dimensional variance may lead to increased material waste and consumer dissatisfaction at the industrial scale, ultimately impeding market acceptance and the sustainability of artisan livelihoods.

Anisotropy was also consistently observed, as tensile and tear properties varied notably between the warp and weft directions across all fabrics (Tables 4-1, 4-2). This variation limits the achievement of uniform mechanical performance.

These constraints, however, are not prohibitive. Instead, they indicate the necessity for boundary conditions such as pre-shrinkage finishing and mandatory design alignment with the grain direction. Comparable mitigation strategies have historically enabled organic cottons to achieve acceptance in apparel markets despite similar processing challenges (Textile Exchange, 2023). The present findings, therefore, provide clear and measurable insights for industrial partners seeking to bridge the gap between craft production and global scalability.

6.3 Implementation and Policy Implications

6.3.1 Implications for Sustainable Design Practice

The Circularity Suitability Matrix (Table 5-1) serves as an essential tool for material selection. It enables designers to make decisions based on quantifiable indicators, such as choosing Ikat for its high tear strength (greater than 23 N) or Khadi for its superior compostability (biodegradation exceeding 60%). This approach advances design practice from reliance on anecdotal eco-claims to evidence-based decision-making.

Additionally, the system-level integration strategies outlined in Chapter 5 illustrate how textiles with distinct circular profiles can be incorporated within a single product system. This supports the application of Differential Lifecycle Fastening (Section 5.4.2), which intentionally combines Khadi as a Biological Anchor with Ikat or Kala Cotton in the Technical Cycle to create a differentiated garment. The

framework thus promotes the assignment of specialised and efficient functions to materials within the technical and biological cycles, rather than seeking a single ideal sustainable fabric.

ISO performance standards validate material output rather than production method, which creates a viable pathway for integrating cultural value within commercial systems. Physical performance can be certified through ISO testing, while cultural attributes can be incorporated through complementary mechanisms including geographical indications, artisan attribution labels, heritage documentation, and traceability systems such as the India Handloom Mark (Hussain, Kuzmina and Koria, 2025). This layered approach allows handloom textiles to satisfy supply chain compliance requirements without standardising the production process itself, thereby preserving the craft knowledge and community identity that define their cultural value.

6.3.2 Recommendations for Certification and Policy

A key finding from Chapter 2 is the systemic exclusion of handloom textiles from global certification schemes. Although these textiles offer ecological advantages, they often fail to meet industrial criteria such as uniformity and large-scale supply chains (Save Handloom Foundation, n.d.). The results suggest that ISO-validated performance data may offer a viable alternative to traditional supply-chain audits (Zimon, Madzík and Sroufe, 2020).

- **Certification Reform:** Global organisations, such as the Global Organic Textile Standard (GOTS) and EU Eco-labels, should formally recognise the performance-based validation of craft-based textiles. For example, accepting 60.15% biodegradability as evidence of safe end-of-life would shift the focus from supply-chain volume to verifiable material integrity.
- **Policy Leverage:** The Ministry of Textiles in India could incorporate this framework into its official sustainability branding. This approach would enable Khadi, Kala Cotton, Ikat, and Jamdani to compete in global markets using scientifically verifiable claims.

These measures are directly aligned with the Sustainable Development Goals, specifically SDG 12.5 (Responsible Consumption and Production), which aims to reduce waste, and SDG 9.4 (Industry, Innovation and Infrastructure), which seeks to upgrade industries for sustainability (United Nations, 2015).

6.4 Broader Socio-Cultural and Ethical Impact

6.4.1 Preserving Intangible Cultural Heritage

Validating the properties of Jamdani, even when performance metrics are limited (breaking force of 85.31 N and biodegradation of 22.55%), reinforces its UNESCO-recognised heritage value (UNESCO). Integrating Jamdani within a circular framework ensures that artisans are included in sustainability transitions, regardless of differences in textile performance compared to industrial materials. The framework recognises Jamdani as a high-value cultural accent and guarantees the continued economic viability of the specialised skills and cultural heritage required for its production. Consequently, sustainability initiatives are positioned to support, rather than diminish, intangible cultural capital.

6.4.2 Ethical Sourcing and Community Resilience

The empirical results substantiate Gandhi's assertion that Khadi supports an ethical economy. Khadi's demonstrated biodegradability rate of 60.15 per cent reinforces the viability of decentralised, low-energy, and community-based production systems as alternatives to industrial efficiency (Mukherjee, 2021). Demonstrating the ecological integrity of these processes supports ethical sourcing models that foster local economic resilience and ensure fair wages. Nevertheless, there is a risk that global brands may appropriate these scientific sustainability claims without ensuring equity for artisans. Consequently, effective ethical implementation necessitates certification schemes that prioritise both verifiable community benefits and environmental performance (as discussed in Section 6.3.2, Fletcher and Tham, 2019).

6.5 Limitations and Future Work

The study provides a foundational dataset and a validated framework for four indigenous handlooms, yet several methodological and practical limitations remain.

- **Material Scope and Representativeness:** The study tested only four cotton-based handlooms. Applying the framework to additional fibre types such as indigenous silk, wool, or blended fibres would enhance its relevance across India's diverse textile ecology. Moreover, these four textiles do not capture the full cultural and regional diversity of India's handloom sector.
- **External Validity versus Laboratory Testing:** The ISO tests simulate controlled and accelerated conditions, offering comparative rigour. However, these tests do not replicate the stresses associated with long-term consumer use and repeated washing cycles. Longitudinal wear trials of garments produced using the modular strategy are necessary for comprehensive validation of this approach.
- **Absence of Industrial Benchmark:** The study intentionally focused on indigenous textiles and did not include a widely recognised industrial control fabric, such as standard, conventional, or organic cotton. This omission restricts the ability to make direct empirical claims regarding global competitiveness. For contextual reference, tear force values for finished and grey-state ring-spun military khaki cotton twill (Mukhopadhyay, Ghosh and Bhaumik, 2006) were used to situate the handloom tear resistance data in Section 4.4. Tensile benchmarking was not possible as that study reports breaking strength in kN/m, which is not directly comparable to the absolute N values recorded in the present study. A more rigorous benchmark requires side-by-side ISO testing of a certified commercial cotton fabric under identical specimen dimensions and testing conditions, identified as a priority for future experimental work.

- **Framework Quantifiability:** The primary limitation of the Converging Pillars Framework is the challenge of weighing and quantifying the cultural and ethical pillars in relation to the precise technical data provided by ISO standards. While the framework provides qualitative context, it requires further development to integrate socio-economic impact metrics, such as livelihood security indices, with technical data in a balanced quantitative model.

Future research should focus on expanding the range of fabrics studied, incorporating longitudinal wear trials, developing industrial benchmarks, and refining the Converging Pillars Framework to include measurable socio-economic indicators. These steps will support the development of an actionable prototype for sustainable industry adoption.

6.6 Conclusion

This chapter critically evaluates the findings of Chapters 4 and 5, situating them within broader debates on circularity and sustainability. Three principal contributions are identified:

- **Empirical Validation:** ISO-standardised testing demonstrates that indigenous handloom cottons possess measurable circularity properties, including high biodegradability in Khadi (60.15% loss) and notable durability in Ikat (23.38 N tear resistance).
- **Framework Innovation:** The Converging Pillars Framework introduces a novel methodological tool that integrates scientific, cultural, and ecological dimensions, addressing a significant gap in sustainability assessment.
- **Practical Pathways:** The Circularity Suitability Matrix and the resulting modular design mandates offer actionable guidance for designers, certification bodies, and policymakers, supporting environmental integrity and socio-cultural sustainability.

Collectively, these contributions demonstrate that Indian handloom textiles are scientifically validated contributors that can support the global transition to a

circular economy. This work provides an evidence base that bridges the gap between traditional craft and future-oriented industrial sustainability.

The final chapter will conclude the thesis by summarising these contributions, highlighting their academic and practical impact, and outlining directions for further development of prototypes and research.

7 Conclusion and Further Research

7.1 Introduction

This thesis addressed the persistent lack of empirical data and the systemic exclusion of environmentally superior, craft-based Indian handloom textiles from global circular economy models. Although these materials possess inherently low environmental impact, they remain under-recognised within established sustainability frameworks.

The primary objective was to scientifically validate the circular properties of four indigenous handlooms: Khadi, Kala Cotton, Ikat, and Jamdani. Additionally, a data-driven framework was developed to facilitate their integration into circular design systems. This objective was accomplished through the application of ISO-standard testing and the creation of the Converging Pillars Framework, which integrates empirical performance data with cultural and ecological context.

This chapter concludes the thesis by summarising the key contributions, outlining the academic and practical significance of the findings, and proposing directions for future research and tool development.

7.2 Summary of Key Contributions

7.2.1 Empirical Validation and Framework Innovation

The Converging Pillars Framework was validated as a robust hybrid methodology that integrates ISO-standard performance metrics with essential cultural and ecological context. This methodology addresses a critical gap in sustainability assessment.

The experimental program produced the first systematic and quantifiable dataset for these handloom textiles.

- Khadi served as the benchmark for the biological cycle, achieving 60.15% weight loss in the soil burial test and demonstrating rapid and safe biodegradability.

- Kala Cotton and Ikat exhibited superior durability, with tensile forces reaching 233.91 N and tear resistance of 23.38 N. These results confirm their suitability for longevity-focused technical cycles.
- The primary technical limitation was dimensional instability, particularly in Kala Cotton, which exhibited shrinkage up to 10.33%. This limitation was reframed as a design mandate, necessitating stabilisation measures for successful market integration.

7.2.2 Design Solution: Modular Integration

This research introduced the Circularity Suitability Matrix and related integration strategies, forming the first data-driven framework that explicitly connects craft-based textiles with contemporary product systems.

A key innovation was the development of Differential Lifecycle Fastening. This strategy allows textiles with different life spans, such as those in the Technical Cycle and Biological Cycle, to coexist within a single product system and remain easily separable at the end-of-life stage. These findings demonstrate that achieving circularity depends on defining differentiated, complementary roles throughout the product lifecycle rather than identifying a single optimal sustainable material.

7.3 Broader Academic and Practical Impact

7.3.1 Academic Contribution and Policy Mandates

This research identifies two principal areas of contribution.

- **Data Novelty:** The study presents the first ISO-validated dataset for Khadi, Kala Cotton, Ikat, and Jamdani. This dataset provides an empirical foundation for future materials science research and serves as a verifiable benchmark for evaluating the circular potential of indigenous textiles.
- **Methodological Blueprint:** The Converging Pillars Framework offers a replicable model for evaluating craft-based or regionally specific materials

that lack formal certification. This framework facilitates broader application of the methodology at a global level.

The findings support specific policy recommendations.

- **Certification Reform:** The results indicate that global certification bodies such as GOTS and EU Eco-labels should adopt performance-based indicators, including biodegradability and durability, as essential complements to traditional supply chain audits. This approach reinforces the scientific integrity of craft-based production systems.
- **Ethical Mandate:** The findings highlight the socio-economic benefits of decentralised, community-based production systems such as Khadi. These systems can support sustainable livelihoods, strengthen community resilience, and advance environmental objectives.

7.3.2 Design and Systemic Integration

- **Design Tool:** The Circularity Suitability Matrix serves as a validated, data-driven tool for material selection by designers. This approach prioritises evidence-based product development and risk assessment over anecdotal eco-claims.
- **Systemic Solution:** The concept of Differential Life-Cycle Fastening demonstrates that complex circularity, such as combining fabrics with distinct end-of-life pathways in the technical and biological cycles, is feasible. This provides a practical method for manufacturers to incorporate verified indigenous textiles into mainstream product lines.

7.4 Directions for Future Research and Development

7.4.1 Prototype and Tool Development

Immediate efforts are required to translate the validated framework into market-ready tools and rigorously tested products.

- **Digital Tool Mandate:** The primary next step is the development of an open-access digital database or application based on the Circularity Suitability Matrix. This tool should enable designers and policymakers to search and filter fabrics according to the validated sustainability indicators identified in this research, such as filtering by biodegradation greater than 50% or tensile strength exceeding 200 newtons.
- **Prototype Validation:** To advance beyond laboratory findings, longitudinal wear trials of garment prototypes designed with the Differential Lifecycle Fastening framework are essential. These trials should assess real-world durability, clean separability, and overall interoperability of fabric combinations during actual consumer use cycles.

7.4.2 Academic Expansion and Methodological Refinement

The study should be expanded to enhance its scope, relevance, and methodological rigour.

- **Socio-Economic Metrics Integration:** Refining the Cultural and Ethical Pillars by establishing quantifiable measures is essential. Future research should incorporate metrics such as livelihood security, equitable job creation, and value distribution to evaluate human impact in parallel with technical performance.
- **Benchmarking for Global Relevance:** Incorporating industrial reference textiles such as conventional, GOTS-certified, or Supima cotton is necessary to establish benchmarks that support empirical claims of competitiveness and position indigenous performance within global supply chains.
- **Scaling Handloom Production:** Future research should develop a technical interface translating ISO-validated performance data into commercial procurement specifications, enabling handloom textiles to be sourced with the same confidence as certified industrial cottons. The sector's demonstrated survival against industrial competition — rooted in

embodied cultural knowledge and community identity (Mamidipudi, Syamasundari and Bijker, 2012) — suggests these systems can scale with the right institutional and technical frameworks, as partially established through the Handloom Mark scheme (Chakraborty, 2024; Reddy and Reddy, 2023).

- **Material Expansion:** The scope of empirical testing should be extended beyond cotton to include additional indigenous materials, such as handloom silk and wool, as well as common blended fibres, to broaden the framework's applicability.

7.5 Conclusion

This thesis demonstrates that indigenous Indian handloom textiles are scientifically viable, ethically robust, and essential contributors to the transition to a circular economy. Validation of their durability, stability, and biodegradability according to ISO standards, contextualised through the Converging Pillars Framework, provides empirical evidence to bridge the gap between traditional craft and modern sustainability frameworks.

The Circularity Suitability Matrix and its associated integration strategies present concrete pathways for designers, policymakers, and certification bodies to responsibly incorporate these materials into global systems.

The success of this research depends on the willingness of industry and policy actors to adopt evidence-based practices that prioritise both ecological integrity and cultural resilience. Application of this validated framework enables handloom textiles to transition from the margins to the center of sustainable design, providing a credible and scalable model for resource-efficient fashion.

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Appendix A

A.1 Ethics approval letter



16 January 2025

Dear Miss Tom ,

Reference: CURES/24148/2025

Project ID: 27455

Title: Modular Fashion For a Circular Future: Sustainable Design Solutions

Thank you for your application to the Cranfield University Research Ethics System (CURES).

We are pleased to inform you your CURES application, reference CURES/24148/2025 has been reviewed. You may now proceed with the research activities you have sought approval for.

If you have any queries, please contact CURES Support.

We wish you every success with your project.

Regards,

CURES Team

A.2 Title change confirmation



14 August 2025

Dear Miss Tom ,

Reference: CURES/26292/2025

Project ID: 27455

Title: Modular Fashion for a Circular Future: Evaluating the Circularity of Indigenous Indian Cotton Textiles through Scientific Testing and Design Integration

Thank you for your application to the Cranfield University Research Ethics System (CURES).

We are pleased to inform you your project title change request has been actioned and has been amended as shown in the table below.

Submitted Form Reference	Status Date	Short_Title	full_title
Cranfield University Research Ethics System (CURES)	15/01/2025	Modular Fashion For a Circular Future:Sustainable Design Solutions	Modular Fashion For a Circular Future: Sustainable Design Solutions
Project title change	13/08/2025	Modular Fashion for a Circular Future: Evaluating the Circularity of Indigenous Indian Cotton Textiles through Scientific Testing and Design Integration	Modular Fashion for a Circular Future: Evaluating the Circularity of Indigenous Indian Cotton Textiles through Scientific Testing and Design Integration

If you have any queries, please contact CURES Support.

Regards,

CURES Team

Appendix B : Detailed Experimental Protocols

This appendix outlines the ISO-standard procedures implemented in the empirical testing program. Each subsection describes specimen preparation, testing parameters, and calculation methods to ensure transparency and reproducibility.

B.1 Tensile Strength Test (ISO 13934-1)

B.1.1 Specimen Preparation

- Dimensions: 50 ± 0.5 mm width, 200 mm gauge length.
- Replicates: Five per fabric, prepared in both warp and weft directions.
- Conditioning: 24 hours at $20 \pm 2^\circ\text{C}$ and $65 \pm 4\%$ relative humidity (ISO 139:2005).
- Thickness Measurement: Fabric thickness was measured using a digital thickness gauge according to ISO 5084; ten measurements were averaged to determine the cross-sectional area (A).

B.1.2 Testing Parameters

- Equipment: Stable Micro Systems Universal Testing Machine.
- Crosshead Speed: 100 mm/min until rupture.
- Calibration: Equipment was verified as fully calibrated by the testing laboratory before use.

B.1.3 Outputs

- Maximum Breaking Force (N).
- Elongation at Break (%).
- Tensile Stress (N/mm^2).

B.1.4 Calculations

Maximum Force:

$$F_{\max} = \text{Peak force (N) recorded at rupture}$$

Represents the ultimate load the fabric can sustain before breaking.

Elongation at Break (%):

$$\left(\frac{L_f - L_o}{L_o} \right) \times 100$$

Where:

- L_f : Final length at rupture
- L_o : Original gauge length

Elongation at break expresses how much the fabric stretches before rupture and is a measure of its flexibility.

Tensile Stress:

$$\sigma = \frac{F_{\max}}{A}$$

where A =width x thickness (mm²)

Tensile stress provides a measure of the fabric's intrinsic strength per unit area, allowing for a comparison of material performance regardless of thickness or weight.

Mean Value:

Used to calculate the average performance across five replicates for each fabric in both warp and weft directions.

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

Where:

- $\bar{X}$ = Average value of the tensile parameter (force or elongation)
- X_i = Individual test value (force or elongation)
- n = Number of specimens

B.2 Tear Strength Test (ISO 13937-2)

B.2.1 Specimen Preparation

- Dimensions: 200×50 mm rectangles with a central slit of 100 mm (single-rip method).
- Replicates: Five per fabric per direction (warp/weft).
- Conditioning: 24 hours at 20±2°C and 65±4% relative humidity (ISO 139:2005).

B.2.2 Testing Parameters

- Equipment: Stable Micro Systems Universal Testing Machine.
- Crosshead Speed: 100 mm/min.
- Calibration: Equipment calibration was verified before testing as per laboratory protocol.
- Data: Force-extension curves were recorded; anomalies were removed as per ISO guidance.

B.2.3 Outputs

- Mean Tear Force (N), calculated as the arithmetic mean of five replicates.

B.2.4 Calculations

The mean tear force was calculated based on the ISO 13937-2 tear peak selection method, which specifies a refined analysis of the force-extension graph:

Quartering the Tear Curve:

- The graph of the tearing process (from first peak to last) was divided into four equal sections (quarters) based on the extension (mm).
- The first quarter was excluded from analysis to remove anomalies at the start of the tearing.

Peak Selection:

- From each of the remaining three quarters (Q2, Q3, Q4), the two highest and two lowest force peaks were selected.
- This resulted in 12 force values per specimen, capturing both resistance extremes and average force characteristics.

Mean Tear Force per Specimen:

The arithmetic mean of the 12 selected peaks was calculated using:

$$F_{mean(specimen)} = \frac{1}{12} \sum_{i=1}^{12} F_i$$

Where:

- F_i = Each selected peak force (in Newtons)

Mean Tear Force per Direction:

$$F_{mean(direction)} = \frac{1}{n} \sum_{j=1}^n F_{mean}$$

Overall Mean:

Applied across replicates to represent tear resistance in both directions.

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

Where:

- $\bar{X}$ = Mean tear force(N)

- X_i = Individual force values
- n = Number of specimens

B.3 Wash and Shrinkage Test (ISO 6330)

B.3.1 Specimen Preparation

- Dimensions: 300×300 mm squares.
- Markings: 25 cm reference lines in warp and weft using indelible textile
- Replicates: Five per fabric.
- Conditioning: 24 hours at 20±2°C and 65±4% relative humidity (ISO 139:2005)

B.3.2 Testing Parameters

- Equipment: Automatic Front Load Washing Machine.
- Cycle: Normal Cotton Cycle, 40°C, 1000 rpm spin setting.
- Detergent: Ariel Bio (50 g).
- Drying: Tumble dry at 60°C.

B.3.3 Outputs

- Shrinkage (%) in length and width.

B.3.4 Calculations

The initial length and width were recorded before washing. Final measurements were obtained after drying at the same marked points. Shrinkage in each direction was then calculated using the standard equation:

$$\text{Shrinkage \%} = \left(\frac{\text{Initial Dimension} - \text{Final Dimension}}{\text{Initial Dimension}} \right) \times 100$$

This formula was applied separately for the length and width directions of each specimen.

Mean Shrinkage:

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

Where:

- $\bar{X}$ = Mean shrinkage (%)
- X_i = Shrinkage value for each specimen
- n = Number of specimens

The average shrinkage percentage was calculated across five replicates for each fabric.

B.4 Biodegradation Test (ISO 11721-1)

B.4.1 Soil Preparation

- Soil Type: Loamy topsoil, pH 6.5.
- Moisture: 60–65% water-holding capacity maintained (measured via a soil moisture meter).
- Volume: ~5 L per tray, refreshed weekly.
- Conditioning: 24 hours at $20 \pm 2^\circ\text{C}$ and $65 \pm 4\%$ relative humidity (ISO 139:2005)

B.4.2 Specimen Preparation

- Dimensions: 50×50 mm.
- Protection: Enclosed in nylon mesh bags.
- Replicates: Three per fabric per time point (n=3).

B.4.3 Burial Protocol

- Depth: 5–10 cm below soil surface.
- Layout: Specimens were arranged in 15-compartment trays for systematic retrieval (see Figure B.4 in Appendix B).
- Sampling: Days 21, 42, and 63.

B.4.4 Outputs

- Weight loss (%) after oven-drying retrieved specimens.

B.4.5 Calculations

Weight Loss (%):

The extent of biodegradation was determined by calculating the percentage of weight loss using the following formula:

$$\text{Weight Loss}(\%) = \left(\frac{W_i - W_f}{W_i} \right) \times 100$$

Where:

- W_i = Initial dry weight of the specimen (g)
- W_f = Final dry weight of the specimen after burial (g)

Mean Weight Loss (%):

For each fabric and time point, three replicate samples were tested. The mean percentage weight loss was calculated to represent the average degradation behaviour, using the formula:

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

Where:

- $\bar{X}$ = Mean weight loss (%)
- X_i = Individual weight loss value for each specimen
- n = Number of replicates

This value provides a representative degradation rate for each fabric type over time and is suitable for comparative analysis.

Appendix C : Raw Data Tables

This appendix presents the complete datasets generated from ISO-standardised testing of Khadi, Kala Cotton, Jamdani, and Ikat. Unlike the summary results presented in Chapter 4, these tables contain the raw replicate values for each specimen in warp and weft directions.

Data are organised by test type (tensile, tear, shrinkage, biodegradation) and fabric.

C.1 Tensile Strength Test (ISO 13934-1)

For each fabric:

- Warp direction (n = 5 replicates).
- Weft direction (n = 5 replicates).
- Metrics recorded: Breaking Force (N), Elongation at Break (%), Tensile Stress (N/mm²).

Table C-1 Raw Tensile Data for Khadi (Warp and Weft, n=5)

Replicate	Force Warp (N)	Elongati on Warp (%)	Stress Warp (N/mm ²)	Force Weft (N)	Elongati on Weft (%)	Stress Weft (N/mm ²)
1	171.32	38.99	50.39	178.81	42.24	52.59
2	178.11	24.21	52.38	187.29	52.10	55.08
3	200.32	29.72	58.91	155.89	39.07	45.85
4	220.08	30.05	64.73	151.60	40.58	44.58

5	207.82	39.07	61.12	186.23	52.93	54.77
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Table C-2 Raw Tensile Data for Kala Cotton (Warp and Weft, n=5)

Replicate	Force Warp (N)	Elongati on Warp (%)	Stress Warp (N/mm ²)	Force Weft (N)	Elongati on Weft (%)	Stress Weft (N/mm ²)
1	211.96	35.98	53.66	229.99	39.82	58.22
2	221.43	37.24	56.05	210.00	51.68	53.16
3	224.08	45.25	56.73	239.75	27.63	60.69
4	206.42	37.74	52.25	237.60	38.32	60.15
5	220.52	43.33	55.82	252.20	42.24	63.84

Table C-3 Raw Tensile Data for Jamdani (Warp and Weft, n=5)

Replicate	Force Warp (N)	Elongati on Warp (%)	Stress Warp (N/mm ²)	Force Weft (N)	Elongati on Weft (%)	Stress Weft (N/mm ²)
1	114.41	32.81	60.69	91.53	47.84	48.55
2	96.51	38.40	51.20	75.17	50.34	39.88
3	104.853	30.22	55.62	86.83	41.08	46.06

4	102.46	38.74	54.35	78.48	38.91	41.637
5	106.56	33.64	56.53	94.54	29.22	50.15

Table C-4 Raw Tensile Data for Ikat (Warp and Weft, n=5)

Replicate	Force Warp (N)	Elongati on Warp (%)	Stress Warp (N/mm ²)	Force Weft (N)	Elongati on Weft (%)	Stress Weft (N/mm ²)
1	194.38	38.24	49.21	234.60	34.73	59.39
2	179.88	30.89	45.53	198.74	34.98	50.31
3	239.22	28.80	60.56	175.58	36.23	44.45
4	220.35	32.56	55.78	199.73	48.17	50.56
5	207.09	35.82	52.42	164.40	39.91	41.62

C.2 Tear Strength Test (ISO 13937-2)

For each fabric:

- Warp direction (n = 5).
- Weft direction (n = 5).
- Metric: Tear Force (N).

Table C-5 Raw Tear Data for Khadi (Warp and Weft, n=5)

Replicate	Warp Tear Force (N)	Weft Tear Force (N)
1	5.41	16.89
2	13.81	9.31
3	13.79	17.27
4	18.21	17.89
5	15.94	17.68

Table C-6 Raw Tear Data for Kala Cotton (Warp and Weft, n=5)

Replicate	Warp Tear Force (N)	Weft Tear Force (N)
1	18.37	20.86
2	17.72	21.01
3	21.82	13.65
4	18.27	25.29
5	17.73	23.16

Table C-7 Raw Tear Data for Jamdani Cotton (Warp and Weft, n=5)

Replicate	Warp Tear Force (N)	Weft Tear Force (N)
1	6.11	9.01
2	5.57	7.44
3	5.58	3.48
4	5.89	4.44
5	5.15	6.93

Table C-8 Raw Tear Data for Ikat Cotton (Warp and Weft, n=5)

Replicate	Warp Tear Force (N)	Weft Tear Force (N)
1	20.86	21.26
2	22.93	20.73
3	23.9	23.73
4	23.26	25.95
5	20.81	25.21

C.3 Wash & Shrinkage Test (ISO 6330)

For each fabric:

- Length shrinkage % (n = 5).
- Width shrinkage % (n = 5).

Table C-9 Raw Shrinkage Data for Khadi (n=5)

Replicate	Length Shrinkage (%)	Width Shrinkage (%)
1	8.33%	6.67%
2	8.33%	8.33%
3	8.33%	6.67%
4	6.67%	10.00%
5	5.00%	8.33%

Table C-10 Raw Shrinkage Data for Kala Cotton (n=5)

Replicate	Length Shrinkage (%)	Width Shrinkage (%)
1	6.67%	8.33%
2	6.67%	6.67%
3	13.33%	10.00%

4	11.67%	11.67%
5	13.33%	10.00%

Table C-11 Raw Shrinkage Data for Jamdani (n=5)

Replicate	Length Shrinkage (%)	Width Shrinkage (%)
1	10.00%	6.67%
2	8.33%	3.33%
3	8.33%	6.67%
4	8.33%	6.67%
5	8.33%	6.67%

Table C-12 Raw Shrinkage Data for Ikat (n=5)

Replicate	Length Shrinkage (%)	Width Shrinkage (%)
1	13.33%	11.67%
2	5.00%	3.33%
3	10.00%	11.67%
4	6.67%	6.67%
5	10.00%	11.67%

C.4 Biodegradation Test (ISO 11721-1)

For each fabric:

- Time points: 21, 42, 63 days.
- Replicates: n = 3 per time point.
- Metric: Weight Loss (%).

Table C-13 Raw Biodegradation Data for Khadi (n=3 per time)

Time Point	Replicate	Initial Weight (g)	Final Weight (g)	% Weight Loss
21 days	1	0.28	0.21	25.06%
	2	0.27	0.19	29.12%
	3	0.27	0.20	28.08%
42 days	1	0.29	0.19	33.31%
	2	0.29	0.23	21.64%
	3	0.28	0.14	48.18%
63 days	1	0.28	0.13	52.74%
	2	0.27	0.07	72.67%
	3	0.28	0.12	55.04%

Table C-14 Raw Biodegradation Data for Kala Cotton (n=3 per time)

Time Point	Replicate	Initial Weight (g)	Final Weight (g)	% Weight Loss
21 days	1	0.33	0.27	17.27%
	2	0.33	0.26	20.85%
	3	0.34	0.29	14.90%
42 days	1	0.33	0.26	23.38%
	2	0.34	0.27	21.46%
	3	0.33	0.23	29.77%
63 days	1	0.31	0.21	34.21%
	2	0.32	0.19	39.73%
	3	0.33	0.21	36.18%

Table C-15 Raw Biodegradation Data for Jamdani (n=3 per time)

Time Point	Replicate	Initial Weight (g)	Final Weight (g)	% Weight Loss
21 days	1	0.17	0.16	4.65%
	2	0.17	0.16	6.43%
	3	0.15	0.14	7.55%
42 days	1	0.17	0.16	5.53%
	2	0.17	0.15	7.47%
	3	0.17	0.15	9.01%
63 days	1	0.17	0.12	27.39%
	2	0.17	0.14	16.11%
	3	0.20	0.15	24.15%

Table C-16 Raw Biodegradation Data for Ikat (n=3 per time)

Time Point	Replicate	Initial Weight (g)	Final Weight (g)	% Weight Loss
21 days	1	0.34	0.30	12.82%
	2	0.33	0.28	16.22%
	3	0.33	0.28	15.93%
42 days	1	0.34	0.27	20.16%
	2	0.34	0.26	22.91%
	3	0.33	0.24	26.49%
63 days	1	0.35	0.23	34.58%
	2	0.34	0.22	33.79%
	3	0.31	0.19	39.70%

Appendix D : Supplementary Figures

This appendix contains visual evidence that supports the experimental methods and results presented in Chapters 3–5. It includes pre- and post-test swatch photography, time-series biodegradation images, representative instrument setups, additional charts and graphs not included in the main body. All images are original unless stated otherwise.

D.1 Tensile Strength Test Setup (ISO 13934-1)

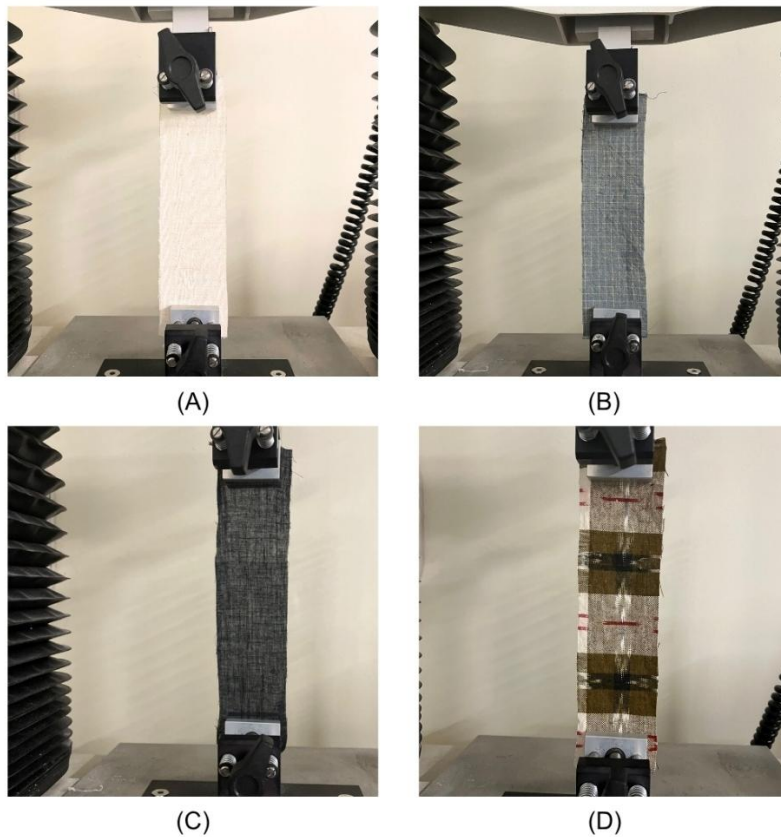


Figure D-1 Instron tensile test set-up for four handloom fabrics under ISO 13934-1 strip method: (A) Khadi, (B) Kala Cotton, (C) Jamdani, and (D) Ikat.

Source: Author (2025)

D.2 Tear Strength Test (ISO 13937-2)

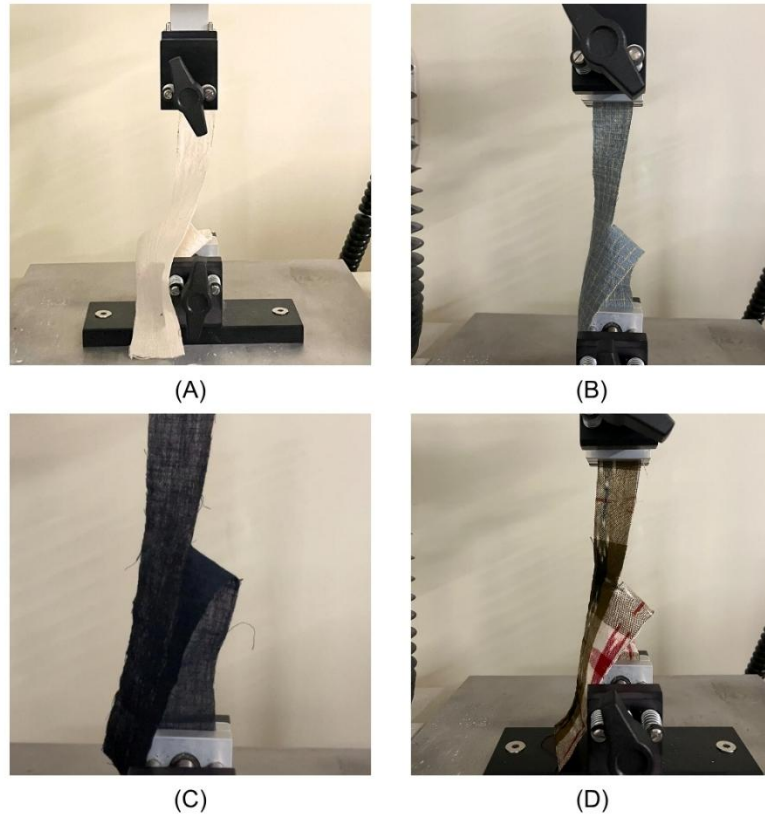


Figure D-2 Instron tear test set-up for four handloom fabrics under ISO 13937-2 (single-tear trouser method): (A) Khadi, (B) Kala Cotton, (C) Jamdani, and (D) Ikat.

Source: Author (2025)

D.3 Wash and Shrinkage Test (ISO 6330)



Figure D-3 After-wash specimens of Khadi following ISO 6330 (40 °C wash cycle)- Quantitative shrinkage data are provided in Appendix C -Tables C-9

Source: Author (2025)



Figure D-4 After-wash specimens of Kala Cotton following ISO 6330 (40 °C wash cycle)-Quantitative shrinkage data are provided in Appendix C -Tables C-10

Source: Author (2025)



Figure D-5 After-wash specimens of Jamdani following ISO 6330 (40 °C wash cycle)-Quantitative shrinkage data are provided in Appendix C -Tables C-11

Source: Author (2025)

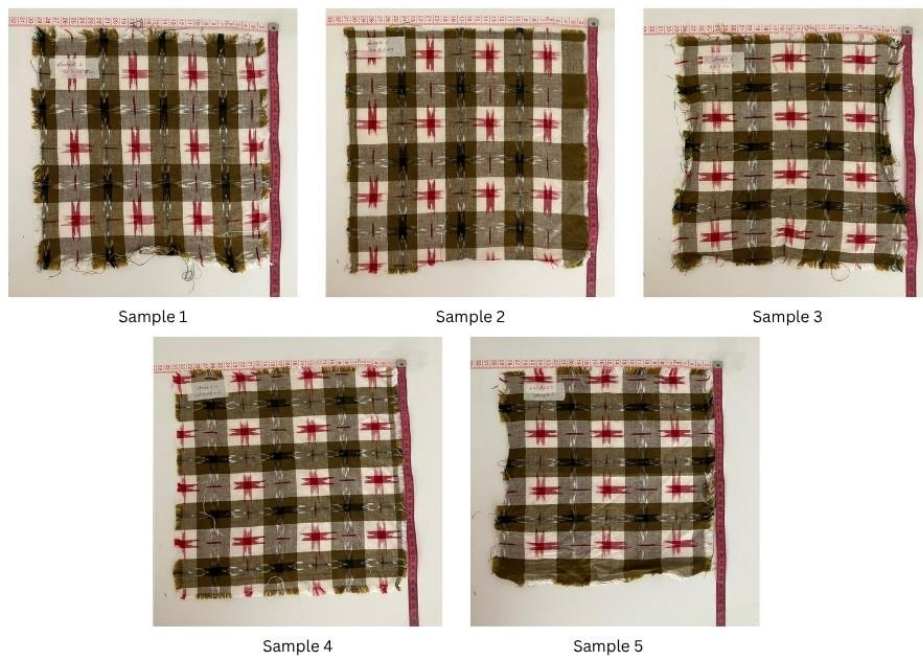


Figure D-6 After-wash specimens of Ikat following ISO 6330 (40 °C wash cycle)-Quantitative shrinkage data are provided in Appendix C -Tables C-12

Source: Author (2025)

D.4 Biodegradation Test (ISO 11721-1)



Figure D-7 Soil burial tray setup for ISO 11721-1 biodegradation test. Handloom cotton specimens (Khadi, Kala Cotton, Jamdani, Ikat) were enclosed in nylon mesh bags and buried at 5–10 cm depth in loamy topsoil (pH 6.5, 60–65% water-holding capacity).

Source: Author (2025)



(A) 21 Day



(B) 42 Day



(c) 63 Day

Figure D-8 Biodegradation of Khadi (ISO 11721-1, soil burial): (A) Day 21, (B) Day 42, (C) Day 63. Progressive material loss is visible across intervals; baseline swatch provided in Appendix D-1.

Source: Author (2025)



(A) 21 Day



(B) 42 Day



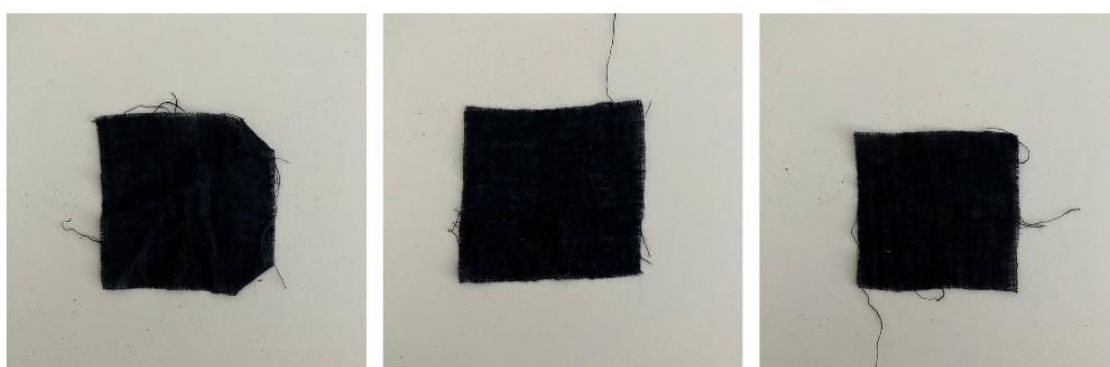
(c) 63 Day

Figure D-9 Biodegradation of Kala Cotton (ISO 11721-1, soil burial): (A) Day 21, (B) Day 42, (C) Day 63. Progressive fibre breakdown and surface deterioration are evident compared to baseline in Appendix D-1.

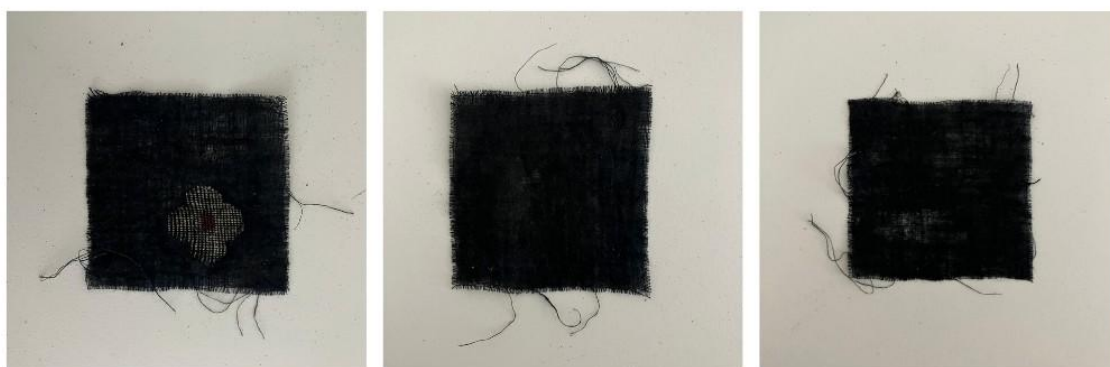
Source: Author (2025).



(A) 21 Day



(B) 42 Day



(c) 63 Day

Figure D-10 Biodegradation of Jamdani (ISO 11721-1, soil burial): (A) Day 21, (B) Day 42, (C) Day 63. Progressive material loss is visible across intervals; baseline swatch provided in Appendix D-1.

Source: Author (2025)



(A) 21 Day



(B) 42 Day



(c) 63 Day

Figure D-11 Biodegradation of Ikat (ISO 11721-1, soil burial): (A) Day 21, (B) Day 42, (C) Day 63. Progressive material loss is visible across intervals; baseline swatch provided in Appendix D-1.

Source: Author (2025)

Appendix E : Extended Literature / Frameworks

This appendix provides extended material that supports the theoretical and methodological foundations of the study. It includes (i) a comparative matrix of circularity frameworks, (ii) the full selection rubric used to identify case-study textiles, and (iii) reference tables of global textile certification and policy criteria.

E.1 Comparative Matrix of Circularity Frameworks

Table E-1 Comparative matrix of circularity frameworks referenced in this study.

Dimension	Life Cycle Assessment (LCA)	Cradle to Cradle (C2C)	Circular Economy Guidance (e.g., EMF-aligned)	Converging Pillars Framework (this study)
Primary Aim	Quantify environmental impacts across a product's life cycle	Certify products/materials against set circular criteria	Provide pathways and strategies for design/business models	Integrate measured ISO textile data with cultural/ecological context and design integration
System Boundary	Cradle-to-grave or cradle-to-gate	Product/material scope	System or organisation level	Material-to-design role mapping (lab test → garment module)

Functional Comparability	Requires a functional unit definition	Certification categories	Often qualitative/roadmap	Uses empirical, ISO-validated indicators (durability, biodegradability) mapped directly to design roles
Data Demands	High (inventories, datasets, databases)	Disclosure of chemicals and supply chain	Evidence of policies, metrics, or strategies	ISO performance tests + contextual notes + cultural narratives
Circularity Signal	Hotspot impacts: reductions vs baseline	Achieved certification levels (Basic–Platinum)	Adoption of reuse, repair, and recycling strategies	Role-specific suitability (Core/Consumable/Aesthetic); disassembly-ready
Social/Cultural Fit	Often excluded	Partly included via program criteria	Limited to reporting	Central – handloom heritage, craft knowledge, livelihoods

Verification	Methodological standards (ISO 14040/44)	Third-party certification	Varies	Internal reproducibility (ISO data), traceable sourcing
Strengths	Quantitative, robust	Recognised certification, consumer label	Broad strategy language, policy-friendly	Bridges lab evidence → design action
Limitations	Data-heavy, abstract for design	Costly, restrictive, scope limits	Often generic or high-level	

E.1.1 Notes

- LCA was referenced to highlight life-phase trade-offs.
- Cradle-to-Cradle (C2C) was used as a comparator for how circular certification frames textiles.
- EMF guidance was used for system-level alignment (biological vs technical cycle).
- The Converging Pillars Framework developed here integrates ISO testing, cultural value, and design readiness, operationalized through Differential Lifecycle Fastening (assigning different fasteners to biological vs technical modules for end-of-life separation).

E.2 Textile Selection Criteria

Table E-2 Criteria and weights for textile selection.

Criterion	Description	Weight (%)
Durability potential	Anticipated strength and resilience in tensile/tear tests	20
Biodegradation potential	Natural fibre, minimal finishing, expected soil decay	20
Dimensional stability	Manageability of shrinkage under ISO 6330	10
Cultural significance	Heritage value, UNESCO status, or national identity link	20
Availability/traceability	Reliable sourcing, adequate sample yardage	15
Role diversity	Potential to represent Core, Consumable, or Aesthetic role	15

Table E-3 Decision log for selected textiles.

Fabric	Khadi	Kala Cotton	Jamdani	Ikat
Durability	Moderate	High	Low	High
Biodegradation	Very High	Moderate	Low	Moderate
Stability	Good	Low (shrinkage 10%)	Variable	Moderate

Cultural	Pan-Indian legacy	Regional heritage (Kutch)	UNESCO Intangible Heritage	Regional identity (Odisha/Telangana)
Availability	Excellent	Good	Limited	Good
Role Diversity	Moderate	Strong	High aesthetic	Strong
Selected Role	Consumable Module	Structural Shell (Core)	Aesthetic Overlay	Alternative Core Module

E.3 Policy and Certification Criteria

Table E-4 Global Organic Textile Standard (GOTS) criteria overview.

Category	Requirement	Scope
Fibre content	Minimum % organic certified fibre	Product
Chemical management	Prohibited substances, wastewater rules	Processing
Traceability	Chain of custody, transaction certificates	Supply chain
Social criteria	ILO standards for workers	Facilities
Labelling/claims	Controlled logo/label use	Product
Verification	Third-party audits	Annual

Table E-5 EU Ecolabel criteria for textiles.

Category	Requirement	Scope
Fibre criteria	Specific fibre-based restrictions	Product
Chemical restrictions	Auxiliaries, dyes, finishes, limited	Processing
Quality	Colour fastness, shrinkage, and durability	Product
Environmental mgmt.	Energy, emissions, wastewater	Facility
Labelling	EU Ecolabel logo use	Product
Verification	Dossier review + audits	Pre-market

Table E-6 OEKO-TEX® Standard 100 criteria overview.

Category	Requirement	Scope
Human-ecological safety	No harmful residues in finished textiles	Product
Product classes	Class I–IV (baby to decor)	Product
Testing updates	Annual updates to chemical limits	Product
Labelling	Hangtags, approved logo use	Product
Verification	Testing + spot audits	Product/site

E.3.1 Notes

- These certification schemes were reviewed for context but were not directly applied in the validation of the handloom textiles.
- They highlight the gap that this thesis addresses: cultural and small-scale heritage textiles often cannot access these certifications due to scope, cost, or standardisation barriers.
- The **Converging Pillars Framework** complements rather than replaces existing certification, offering a scientific and culturally sensitive validation pathway.

Appendix F : Extended Cotton Descriptions

This appendix provides a comprehensive catalogue of 37 Indian cotton textiles reviewed during the scoping stage of the research. Each table describes the fabric's physical attributes, weaving techniques, socio-cultural background, applications, environmental considerations, and design potential. While only four textiles (Khadi, Kala Cotton, Jamdani, Ikat) were selected for detailed ISO-standard evaluation, the extended dataset contextualises their place within India's diverse cotton heritage.

Table F-1 Extended catalogue of 37 Indian cotton textiles, with attributes including content, weave, process, applications, and environmental considerations.

Category	Description	Image
Fabric Name	Karunganni Cotton	
Fabric Content	100% Cotton	
Fabric Weight	80 GSM-100 GSM	
Thread Count	60 to 80 threads per square inch	
Weave Types	Plain Weave	
Texture	Coarse yet softens over time, with a natural, rustic finish due to the handspinning process.	
Introduction	Karunganni cotton is a traditional cotton fabric originating from the Karunganni region of Tamil Nadu, India. Known for its durability and breathable qualities, Karunganni cotton is primarily used for daily wear and functional clothing.	
Manufacturing Process	Cotton is harvested and spun into yarn → Yarn is dyed using basic synthetic or natural dyes → Handwoven or machine-woven using traditional methods → The fabric is finished with minimal processing to maintain its natural texture.	
Applications	<ul style="list-style-type: none"> Lungi, dhotis, sarees, and salwar suits, especially for daily wear in rural areas. Casual shirts, kurta-pajamas, casual dresses, and home textiles like bedsheets, pillow covers, and tablecloths. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon Footprint is low as the production mainly uses handlooms or local weaving methods with little reliance on large-scale industrial processes. Moderate to high water usage due to the dyeing process. Provides employment to rural artisans and weavers, supporting local economies and traditional craftsmanship. 	
Quality	<ul style="list-style-type: none"> Karunganni cotton is durable, soft, and breathable, making it suitable for hot climates. The fabric is thick yet comfortable, offering excellent moisture absorption and easy care. 	
Design Opportunities	<ul style="list-style-type: none"> The fabric's durability and natural texture offer design opportunities for everyday wear and casual fashion. Ideal for creating functional garments such as workwear, casual dresses, and unisex clothing. The simplicity of the fabric allows for experimentation with dyeing techniques, prints, and embroidery. 	
Considerations	<ul style="list-style-type: none"> The fabric is quite sturdy but may require care to avoid rough handling. Pre-washing is recommended to minimize shrinkage. Affordable, making it ideal for budget-conscious consumers seeking sustainable and functional cotton fabrics. 	

Category	Description	Image
Fabric Name	Chirala Cotton	
Fabric Content	100% Cotton	
Fabric Weight	80 GSM-120 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft and smooth, with a luxurious yet natural feel, perfect for warm climates.	
Introduction	Chirala cotton is a handwoven fabric originating from Chirala, a town in Andhra Pradesh, India. Known for its smooth texture, lightness, and durability, Chirala cotton is primarily used for making sarees, shirts, and other garments. The fabric is produced using traditional handloom techniques, making it an eco-friendly option.	
Manufacturing Process	Cotton is spun into yarn → Yarns are dyed using natural or synthetic dyes → Handwoven using traditional looms → Fabric is finished with basic finishing techniques to retain its natural texture.	
Applications	<ul style="list-style-type: none"> Sarees, dhotis, and other ethnic wear, particularly in southern India. Casual shirts, tunics, dresses, and home textiles such as bedsheets, cushion covers, and tablecloths. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon Footprint is low due to the handwoven nature of the fabric, with minimal industrial processing. Moderate water usage due to the dyeing and finishing processes. Provides livelihood to local weavers and artisans in Chirala, supporting traditional handloom industries and rural economies. 	
Quality	<ul style="list-style-type: none"> Chirala cotton is lightweight, breathable, and soft, offering excellent comfort in hot and humid climates. Its smooth texture and fine weave make it suitable for both formal and casual wear, with a crisp, fresh finish. 	
Design Opportunities	<ul style="list-style-type: none"> Chirala cotton's smooth texture and lightness offer opportunities for designing casual wear, office wear, and summer collections. Its simplicity allows for creative use in modern and traditional fusion garments, making it versatile for different styles. 	
Considerations	<ul style="list-style-type: none"> While durable, Chirala cotton should be handled gently to avoid wear and tear. Pre-washing is recommended to minimize shrinkage. Chirala cotton is typically positioned in the mid-market, offering affordable, sustainable options for consumers seeking traditional yet comfortable fabrics. 	

Category	Description	Image
Fabric Name	Baluchari Cotton	
Fabric Content	100% Cotton	
Fabric Weight	100 GSM-150 GSM	
Thread Count	80 to 120 threads per square inch	
Weave Types	Tissue Weave, a distinctive extra-weft weaving technique for intricate designs and motifs.	
Texture	Smooth, soft, and fine, with a lustrous finish due to the traditional weaving method.	
Introduction	Baluchari cotton is a traditional handwoven fabric from West Bengal, India, known for its rich history and elaborate designs. The fabric is made from fine cotton and is often embellished with intricate motifs, inspired by mythological themes, animals, and nature.	
Manufacturing Process	Cotton is spun into fine yarn → Yarns are dyed using natural or synthetic dyes → Handwoven using traditional Jacquard looms to create intricate patterns → Designs are often inspired by folk art and mythology, incorporating detailed thread work for embellishment.	
Applications	<ul style="list-style-type: none"> Sarees, dupattas, stoles, and shawls, particularly for weddings and festive occasions. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon Footprint is low as it is primarily handwoven using traditional techniques with minimal industrial input. The use of traditional methods ensures minimal environmental impact. Moderate water usage due to the dyeing and finishing processes. Provides livelihood to artisans in rural Bengal, supporting traditional craftsmanship and promoting cultural heritage. 	
Quality	<ul style="list-style-type: none"> Baluchari cotton is known for its fine texture and durability. The fabric is soft, smooth, and breathable, making it comfortable to wear for long durations. Its unique and intricate designs add a luxurious touch, making it ideal for ceremonial and festive wear. 	
Design Opportunities	<ul style="list-style-type: none"> The rich texture and intricate designs offer numerous opportunities for creating high-end fashion collections, focusing on luxury and heritage. 	
Considerations	<ul style="list-style-type: none"> While durable, the intricate patterns require careful handling to avoid damage. Pre-washing is recommended to prevent shrinkage. Positioned as a premium fabric, Baluchari cotton appeals to consumers looking for luxury, heritage, and elegance, especially in the ceremonial wear segment. 	

Category	Description	Image
Fabric Name	Sualkuchi Cotton	
Fabric Content	100% Cotton	
Fabric Weight	90 GSM- 110 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft and slightly textured, with a natural, handcrafted feel.	
Introduction	Sualkuchi cotton is a handwoven fabric from the Sualkuchi village in Assam, India. Known as the "Manchester of the East," Sualkuchi is famous for producing high-quality cotton textiles.	
Manufacturing Process	Cotton is spun into fine yarn → Yarns are dyed using natural or synthetic dyes → Handwoven on traditional looms, often incorporating designs through the Jacquard or dobby weaving technique → The fabric is finished with minimal chemical processing to retain its natural texture.	
Applications	<ul style="list-style-type: none"> Mekhela chadar, sarees, shawls, and dupattas. Dresses, kurtas, tunics, stoles, and home décor items such as tablecloths and cushion covers. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon Footprint is low as Sualkuchi cotton is handmade with minimal industrial intervention, relying on traditional handlooms. The reliance on handloom weaving contributes to a minimal ecological footprint. Moderate water usage, due to dyeing and finishing processes. Supports rural employment and local artisans in Sualkuchi, preserving traditional weaving techniques and promoting local craftsmanship. 	
Quality	<ul style="list-style-type: none"> Sualkuchi cotton is lightweight, soft, and breathable, making it ideal for the hot and humid climate of Assam. The fabric is smooth, with a natural sheen, and is durable for both daily wear and ceremonial occasions. Its crisp drape adds elegance to the garments. 	
Design Opportunities	<ul style="list-style-type: none"> The handwoven texture and unique designs of Sualkuchi cotton provide opportunities to create stylish, traditional, and contemporary fusion wear. The fabric's intricate motifs and natural colors make it perfect for crafting garments that showcase Indian heritage in modern fashion. 	
Considerations	<ul style="list-style-type: none"> Sualkuchi cotton is durable but should be handled carefully to preserve the intricate handwoven designs. Pre-washing is recommended to prevent shrinkage. Sualkuchi cotton is a premium fabric, often marketed for traditional wear, appealing to those who value heritage, craftsmanship, and sustainable practices. 	

Category	Description	Image
Fabric Name	Chanderi Cotton	
Fabric Content	Primarily 100% Cotton, though traditionally woven with a blend of cotton and silk for added sheen and durability.	
Fabric Weight	80 GSM-120 GSM	
Thread Count	100 to 150 threads per square inch	
Weave Types	Plain Weave	
Texture	Sheer, lightweight, and smooth, with a glossy finish due to the silk content.	
Introduction	Chanderi cotton originates from the town of Chanderi in Madhya Pradesh, India. Known for its fine texture, lightweight feel, and rich historical significance, Chanderi cotton is characterized by its subtle sheen and delicate weave.	
Manufacturing Process	Cotton fibers are spun into yarn → Yarns are dyed using natural or synthetic dyes → The yarns are handwoven using a traditional Chanderi weaving technique on handlooms → The weaving process creates the characteristic sheer texture and subtle patterns.	
Applications	<ul style="list-style-type: none"> Sarees, dupattas, stoles, and other traditional garments. Dresses, kurtas, tunics, stoles, and home décor items such as tablecloths and cushion covers. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon Footprint is low. Its lightweight nature also promotes energy savings in production and transportation. Moderate water usage. Promotes rural employment and supports local artisans, helping to preserve traditional weaving techniques in the Chanderi region. 	
Quality	<ul style="list-style-type: none"> Chanderi cotton is known for its lightweight, soft, and breathable texture. The fabric offers a sheer, elegant appearance with a subtle sheen, which gives it a luxurious feel. It has a crisp drape and is perfect for warm weather due to its breathable qualities. The fine, intricate weaving also makes it durable while retaining its delicate look. 	
Design Opportunities	<ul style="list-style-type: none"> The fine texture and shimmering quality of Chanderi cotton open up opportunities for high-end fashion, especially for wedding collections, fusion wear, and contemporary reinterpretations of traditional attire. 	
Considerations	<ul style="list-style-type: none"> While Chanderi cotton is relatively durable, the fine weaving and delicate sheen require careful handling. Pre-washing is recommended to prevent shrinkage. Chanderi cotton is a premium fabric, often sought after for its luxurious texture and heritage, appealing to both traditional and contemporary markets. 	

Category	Description	Image
Fabric Name	Maheshwari Cotton	
Fabric Content	Primarily a blend of cotton and silk.	
Fabric Weight	80 GSM-120 GSM	
Thread Count	100 to 150 threads per square inch	
Weave Types	Plain Weave	
Texture	Sheer, lightweight, and smooth, with a glossy finish due to the silk content.	
Introduction	Maheshwari cotton originates from the Maheshwar region in Madhya Pradesh, India. Known for its fine, light, and durable texture, Maheshwari cotton is often characterized by its intricate borders, zari work (gold or silver threads), and rich patterns.	
Manufacturing Process	Cotton and silk threads are spun into yarn → Yarns are dyed using natural or synthetic dyes → Handwoven on traditional looms using a blend of cotton and silk → Intricate zari or thread work is incorporated for detailing. The weaving process requires precision to balance the delicate combination of cotton and silk fibers.	
Applications	<ul style="list-style-type: none"> Sarees, dupattas, and shawls, especially for ceremonial and festive occasions. Dresses, blouses, kurtas, tunics, stoles, scarves, and home décor. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon Footprint is low. The blend of cotton and silk may involve more resource use compared to pure cotton fabrics. Moderate water usage due to the dyeing and zari processes. Promotes rural employment, particularly in the Maheshwar region, and supports traditional artisans, preserving age-old weaving techniques. 	
Quality	<ul style="list-style-type: none"> Maheshwari cotton is lightweight, smooth, and durable. Its distinctive texture and sheen make it ideal for both traditional and contemporary wear. The fabric offers a subtle, elegant finish with a crisp drape, making it suitable for formal and festive occasions. 	
Design Opportunities	<ul style="list-style-type: none"> The versatility of Maheshwari cotton, with its blend of cotton and silk, allows for experimentation with modern styles while preserving its traditional aesthetic. 	
Considerations	<ul style="list-style-type: none"> While durable, the zari work and blend of fibers require delicate handling. Pre-washing is necessary to avoid shrinkage. Positioned as a premium fabric, Maheshwari cotton is valued for its elegant finish and heritage, appealing to both traditional and contemporary markets. 	

Category	Description	Image
Fabric Name	Patola Cotton	
Fabric Content	100% pure cotton or a blend of cotton and silk	
Fabric Weight	90 GSM-120 GSM	
Thread Count	80 to 120 threads per square inch	
Weave Types	Double Ikat Weave	
Texture	Smooth, soft, and vibrant, with a slightly crisp feel due to the tight weaving technique.	
Introduction	Patola cotton is a handwoven textile originating from Gujarat, India, inspired by the intricate double ikat technique used in Patola silk.	
Manufacturing Process	Cotton yarn is spun and dyed using natural or synthetic dyes→ Yarn is carefully resist-dyed to create intricate patterns (single ikat technique is used more commonly for Patola cotton)→ Handwoven on looms with precision to maintain pattern alignment, creating vibrant, geometric designs with cultural motifs.	
Applications	<ul style="list-style-type: none"> Sarees, dupattas, and shawls featuring vibrant colors and intricate motifs. Dress materials, kurtas, home décor items like cushion covers, table runners, and wall hangings. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon Footprint is low. The blend of cotton and silk may involve more resource use compared to pure cotton fabrics. Moderate water usage due to the dyeing and zari processes. Supports traditional artisans and preserves the cultural heritage of Gujarat. Encourages sustainable employment in rural weaving communities. 	
Quality	<ul style="list-style-type: none"> Patola cotton is lightweight, breathable, and durable. It features crisp textures and bold, symmetrical patterns. The fabric is known for its vibrant colors, making it suitable for both casual and semi-formal wear. 	
Design Opportunities	<ul style="list-style-type: none"> The intricate geometric patterns and bright colors of Patola cotton provide a unique design canvas for contemporary fashion. Suitable for fusion wear like tunics, skirts, and palazzos while maintaining its cultural essence. 	
Considerations	<ul style="list-style-type: none"> Handwoven fabric may require delicate handling and care. Pre-washing is recommended to prevent shrinkage. Positioned as a premium fabric due to its craftsmanship and cultural significance. It appeals to customers seeking traditional textiles with a modern touch. 	

Category	Description	Image
Fabric Name	Bhilwara Cotton	
Fabric Content	100% cotton or blended with polyester	
Fabric Weight	120 GSM -250 GSM	
Thread Count	60 to 120 threads per square inch	
Weave Types	Plain Weave, Twill Weave, Satin Weave	
Texture	Smooth to slightly coarse, depending on the weave and weight, with a focus on durability.	
Introduction	Bhilwara cotton originates from Bhilwara, Rajasthan, a prominent textile hub in India known for its high-quality cotton fabric production. The region specializes in producing both traditional and industrial cotton textiles, including shirting, suiting, and dress materials.	
Manufacturing Process	Raw cotton is processed to remove impurities → Cotton is spun into yarn using advanced spinning machinery → Yarns are dyed using natural or synthetic dyes → The fabric is woven on modern power looms or traditional handlooms depending on the application.	
Applications	<ul style="list-style-type: none"> Sarees, dhotis, and turbans. Shirting, suiting, dress materials, bed linen, upholstery, and industrial textiles. 	
Environmental Impact	<ul style="list-style-type: none"> Moderate carbon footprint, as Bhilwara is known for industrial-scale production. High water usage, due to dyeing and finishing processes. Bhilwara's textile industry provides significant employment opportunities in Rajasthan, supporting both skilled and unskilled labor. 	
Quality	<ul style="list-style-type: none"> Bhilwara cotton is known for its durability, fine texture, and versatility. Fabrics from this region often exhibit excellent dye absorption and a smooth finish, making them suitable for both traditional and contemporary applications. 	
Design Opportunities	<ul style="list-style-type: none"> Bhilwara cotton's versatility allows for creating a wide range of products, from traditional garments to modern industrial textiles. The fabric's adaptability makes it ideal for experimenting with new finishes, colors, and patterns to cater to diverse markets. 	
Considerations	<ul style="list-style-type: none"> Highly durable but requires quality control due to its large-scale production. Pre-washing is recommended to prevent shrinkage. Positioned as a versatile fabric catering to both budget and premium markets, Bhilwara cotton appeals to domestic and international buyers. 	

Category	Description	Image
Fabric Name	Gadwal Cotton	
Fabric Content	A blend of pure cotton body with silk or zari borders (commonly a mix of cotton and silk).	
Fabric Weight	80 GSM- 120 GSM	
Thread Count	80 to 120 threads per square inch	
Weave Types	Interlock Weave (Kuttu technique)	
Texture	Soft and breathable, with a luxurious and slightly crisp feel due to zari and silk embellishments.	
Introduction	Gadwal cotton originates from Gadwal, Telangana, India. Renowned for its lightweight texture, intricate zari borders, and vibrant patterns, it is traditionally woven into sarees with a distinctive cotton-silk combination. Known as "weave of grace," Gadwal sarees are easily foldable and highly cherished for their comfort and elegance.	
Manufacturing Process	High-quality cotton threads are spun into yarn → Yarn is dyed using natural or synthetic dyes → The cotton body is handwoven on pit looms, often with a contrasting silk or zari border → Pallu and borders are intricately designed with traditional motifs. The process often includes interlocking the cotton and silk to ensure seamless blending.	
Applications	<ul style="list-style-type: none"> Sarees, dhotis, and temple attire. Dress materials, kurtas, tunics, dupattas, and home décor items like table runners. 	
Environmental Impact	<ul style="list-style-type: none"> Low carbon footprint due to the manual handloom weaving process. Moderate water usage due to dyeing processes. Supports rural artisans and preserves traditional handloom weaving techniques, contributing to the livelihood of local weavers. 	
Quality	<ul style="list-style-type: none"> Gadwal cotton is lightweight, durable, and soft. Its fine weave ensures breathability, while the silk or zari borders enhance its aesthetic appeal, making it suitable for festive and formal occasions. 	
Design Opportunities	<ul style="list-style-type: none"> The contrast between the cotton body and silk/zari borders offers a versatile design canvas for both traditional and contemporary fashion. 	
Considerations	<ul style="list-style-type: none"> Durable but requires careful handling of the zari and silk elements. Pre-washing is necessary to avoid shrinkage. Positioned as a premium handloom fabric, Gadwal cotton appeals to both traditional buyers and modern consumers valuing heritage. 	

Category	Description	Image
Fabric Name	Eri Cotton	
Fabric Content	Blended Cotton and Eri Silk, typically 50-70% Cotton mixed with 30-50% Eri Silk. Pure cotton versions are also crafted in some regions.	
Fabric Weight	100 GSM-150 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Plain Weave, Twill Weave	
Texture	Soft and slightly coarse, with a subtle sheen from the Eri silk content.	
Introduction	Eri cotton, originating from the northeastern regions of India (notably Assam and Meghalaya), combines the softness of cotton with the natural sheen and durability of Eri silk. Known as "the fabric of peace," Eri is ethically produced, as the silkworms are not harmed during the process.	
Manufacturing Process	Cotton fibers are spun into yarn → Eri silk is spun (if blended) using traditional hand-spinning techniques → Fibers are dyed using natural or synthetic dyes → The cotton or cotton-Eri blend is handwoven on traditional looms → Finished products may feature traditional motifs inspired by northeastern culture	
Applications	<ul style="list-style-type: none"> Shawls, stoles, sarees, and dhotis. Dresses, tops, jackets, scarves, and home furnishings such as cushions and table runners. 	
Environmental Impact	<ul style="list-style-type: none"> Low carbon footprint as production involves traditional hand-spinning and weaving techniques. High sustainability due to ethical and eco-friendly practices. Minimal water use compared to industrialized processes. Supports rural artisans and promotes sustainable livelihoods in northeastern India, preserving traditional weaving and spinning techniques. 	
Quality	<ul style="list-style-type: none"> Eri cotton is soft, breathable, and durable. It has excellent moisture-absorbing properties, making it comfortable in all seasons. Its unique combination of warmth and lightness ensures suitability for a wide range of applications. 	
Design Opportunities	<ul style="list-style-type: none"> Promising for activewear or loungewear due to its moisture-wicking and breathable qualities. 	
Considerations	<ul style="list-style-type: none"> Highly durable but requires proper care to maintain texture and color. Pre-washing recommended to prevent shrinkage. Appeals to eco-conscious consumers and those valuing ethical production. Positioned as a premium sustainable fabric. 	

Category	Description	Image
Fabric Name	Kutch Cotton	
Fabric Content	100% cotton, often used in combination with traditional embellishments like mirror work or embroidery.	
Fabric Weight	100 GSM-150 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Plain Weave, Twill Weave, Jacquard Weave	
Texture	Soft with a slightly coarse feel, depending on the weave, and often enhanced by intricate embroidery or mirror work.	
Introduction	Kutch cotton originates from the Kutch region in Gujarat, India. Known for its vibrant colors and intricate hand-embroidered patterns, Kutch cotton is traditionally used in garments such as sarees, kurtas, and dupattas.	
Manufacturing Process	Cotton yarn is spun → The fabric is handwoven on traditional looms → The fabric is dyed using natural or synthetic dyes → Embroidery work, mirror work, or beadwork is added by skilled artisans, often using traditional techniques like 'Kantha,' 'Banni,' or 'Teri,' which are characteristic of the Kutch region.	
Applications	<ul style="list-style-type: none"> Sarees, dupattas, cholis, and kurtas, particularly for weddings, festivals, and cultural events. Dresses, tunics, tops, shawls, stoles, and home décor items. 	
Environmental Impact	<ul style="list-style-type: none"> Low carbon footprint due to the handloom weaving process and minimal reliance on industrial machinery. The handcrafting process is sustainable, but the addition of synthetic embellishments may increase environmental impact. Moderate to high water usage due to dyeing processes, especially when synthetic dyes are used. Provides significant employment to local artisans. 	
Quality	<ul style="list-style-type: none"> Kutch cotton is soft, breathable, and lightweight, with a smooth texture. Kutch cotton is soft, breathable, and lightweight, with a smooth texture. The addition of intricate embroidery and mirror work elevates its aesthetic appeal, making it ideal for special occasions. 	
Design Opportunities	<ul style="list-style-type: none"> The rich tradition of embroidery and mirror work offers ample opportunity for experimentation in contemporary fashion. 	
Considerations	<ul style="list-style-type: none"> While durable, the embellishments such as mirror work and embroidery can be delicate and require careful handling. Pre-washing is recommended to prevent shrinkage. Popular in both traditional and contemporary markets, Kutch cotton appeals to those seeking sustainable, artisanal, and culturally significant textiles. 	

Category	Description	Image
Fabric Name	Dharwad Cotton	
Fabric Content	100% cotton	
Fabric Weight	120 GSM- 200 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Plain Weave, Twill Weave	
Texture	Soft and smooth, but with a slight crispness that gives the fabric structure, making it comfortable to wear.	
Introduction	Dharwad cotton is grown in the Dharwad region of Karnataka, India. Known for its high quality and fine texture, it is often used in making a variety of fabrics for both traditional and modern wear.	
Manufacturing Process	Cotton fibers are harvested → Spun into yarn → Yarn is dyed using either natural or synthetic dyes → Handwoven or machine-woven into fabric using traditional or industrial looms. The fabric is often finished using methods that enhance its smoothness and comfort.	
Applications	<ul style="list-style-type: none"> Sarees, kurtas, dhotis, and traditional garments worn in various cultural ceremonies. Shirts, dresses, tops, trousers, and home décor such as bed linens, tablecloths, and cushion covers. 	
Environmental Impact	<ul style="list-style-type: none"> Moderate carbon footprint, as cotton farming and processing require energy inputs, but the fabric is often woven using traditional methods that reduce reliance on industrial machinery. Moderate to high water usage. Supports local farmers and artisans in the Dharwad region, providing rural employment and sustaining the local economy. 	
Quality	<ul style="list-style-type: none"> Dharwad cotton is soft, smooth, and breathable. Its high-quality texture makes it comfortable for wear in warm climates, while its durability ensures long-lasting use. The fabric is lightweight yet sturdy, ideal for creating garments that are both stylish and practical. 	
Design Opportunities	<ul style="list-style-type: none"> Ideal for creating both casual wear and more refined clothing, offering versatility for designers. Opportunities to blend Dharwad cotton with other fabrics for unique textures and finishes. 	
Considerations	<ul style="list-style-type: none"> While durable, the fabric may require delicate handling to avoid wear and tear over time, especially with regular washing. Pre-washing is recommended to prevent shrinkage after the first wash. Positioned as a fabric suitable for both traditional and modern markets, appealing to eco-conscious consumers. 	

Category	Description	Image
Fabric Name	Karvati Cotton	
Fabric Content	100% cotton	
Fabric Weight	150 GSM- 250 GSM	
Thread Count	60 to 120 threads per square inch	
Weave Types	Plain Weave, Twill Weave	
Texture	Soft and sturdy, with a slightly coarse texture, often smoothened during finishing for comfort.	
Introduction	Karvati cotton is a traditional fabric woven in the Karvati region of India. Known for its strong and durable texture, Karvati cotton is used in both traditional and modern garment making. The fabric is highly breathable, making it suitable for warm climates.	
Manufacturing Process	Cotton is harvested → Spun into yarn → Yarn is woven into fabric on handlooms or power looms, with the fabric often undergoing dyeing and finishing processes to improve texture and appearance. The fabric can be dyed using both natural and synthetic dyes, depending on production methods.	
Applications	<ul style="list-style-type: none"> Sarees, dupattas, and kurta sets, especially for rural and ceremonial occasions. Shirts, trousers, casual dresses, and home furnishings such as curtains, bed sheets, and tablecloths. 	
Environmental Impact	<ul style="list-style-type: none"> Moderate carbon footprint. Moderate to high water usage, as cotton farming is water-intensive, though sustainable farming practices can help reduce this impact. Provides employment in rural areas, particularly for artisans involved in the weaving and finishing processes, preserving traditional skills and supporting local economies. 	
Quality	<ul style="list-style-type: none"> Karvati cotton is known for its coarse texture and strength. While it is less soft than finer cotton fabrics, it is highly durable, breathable, and comfortable, making it ideal for hot climates and everyday wear. The fabric becomes softer with washing, enhancing its comfort over time. 	
Design Opportunities	<ul style="list-style-type: none"> The durable texture of Karvati cotton makes it ideal for creating casual, rustic clothing as well as home décor items. 	
Considerations	<ul style="list-style-type: none"> The fabric is strong and long-lasting, but its coarseness may not suit all consumers, especially for delicate or formal wear. Pre-washing is advisable to avoid shrinkage. Suitable for both rural and urban markets, especially for consumers interested in sustainable, eco-friendly textiles. 	

Category	Description	Image
Fabric Name	Channapatna Cotton	
Fabric Content	100% cotton	
Fabric Weight	120 GSM-180 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Plain Weave, Twill Weave	
Texture	Smooth and soft, with a natural sheen and slightly crisp feel, suitable for warm climates.	
Introduction	Channapatna cotton is traditionally woven in the Channapatna region of Karnataka, India. This cotton is renowned for its softness, smooth texture, and breathability, making it ideal for warm weather.	
Manufacturing Process	Cotton fibers are harvested → Spun into yarn → Yarn is dyed with natural or synthetic dyes → Woven on traditional handlooms or power looms to produce fabric.	
Applications	<ul style="list-style-type: none"> Sarees, dupattas, and other traditional garments for ceremonies and festivals. Casual wear including shirts, dresses, and tunics. It is also used in home décor such as bed linens, cushion covers, and tablecloths. 	
Environmental Impact	<ul style="list-style-type: none"> Moderate carbon footprint as the fabric is handwoven or power-loomed, reducing reliance on industrial machinery but still requiring energy inputs for processing and dyeing. Moderate water usage. Supports local artisans and weavers, providing employment in rural communities, and preserving the traditional weaving craft. 	
Quality	<ul style="list-style-type: none"> Channapatna cotton is soft, smooth, and highly breathable. It has a lightweight texture, making it ideal for use in warm weather. While not as strong as some other cotton fabrics, it is still durable and long-lasting with proper care. The fabric is smooth to the touch, making it comfortable for both everyday wear and more formal attire. 	
Design Opportunities	<ul style="list-style-type: none"> The fabric's smooth texture and vibrant colors offer opportunities for creating eye-catching contemporary garments and accessories. 	
Considerations	<ul style="list-style-type: none"> While soft and smooth, the fabric is not as tough as coarser cottons and may require more delicate handling. Pre-washing is recommended to prevent shrinkage. Positioned as a versatile, lightweight fabric suitable for both traditional and modern markets, especially appealing to eco-conscious consumers. 	

Category	Description	Image
Fabric Name	Wangkhei Phee	
Fabric Content	100% cotton, typically handwoven	
Fabric Weight	80 GSM-120 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft and smooth, with a fine finish that feels delicate yet durable.	
Introduction	Wangkhei Phee is a traditional cotton fabric from the state of Manipur, India. The fabric is renowned for its intricate handwoven patterns, often in geometric or floral designs. It is typically used for making Phanek (a traditional Manipuri skirt) and other ceremonial wear.	
Manufacturing Process	Cotton fibers are sourced locally → Spun into yarn → Dyed using natural or synthetic dyes → Handwoven on traditional looms by skilled artisans, resulting in intricate patterns. The process involves significant handcraft, and the quality depends on the weaver's expertise.	
Applications	<ul style="list-style-type: none"> Primarily used to make Phanek, which is a traditional garment worn by Manipuri women. It is also used in making shawls, wraps, and skirts. 	
Environmental Impact	<ul style="list-style-type: none"> Low carbon footprint, as it is handwoven using traditional methods with minimal machine involvement. Moderate water usage. Promotes local artisans and supports the preservation of traditional weaving practices in Manipur, providing livelihoods to rural communities. 	
Quality	<ul style="list-style-type: none"> Wangkhei Phee is soft, lightweight, and breathable. Its texture is smooth yet durable, making it suitable for both casual and formal wear. The handwoven quality ensures each piece is unique, with a high degree of craftsmanship reflected in its intricate patterns. 	
Design Opportunities	<ul style="list-style-type: none"> The delicate handwoven patterns allow for a wide range of design possibilities, from traditional garments to contemporary fashion. The traditional patterns offer unique opportunities for designers to incorporate regional heritage into modern collections. 	
Considerations	<ul style="list-style-type: none"> As a handwoven fabric, Wangkhei Phee can be less durable than machine-woven fabrics. Careful handling is required to preserve the integrity of the fabric. Pre-washing is advised to minimize shrinkage after the first wash. Primarily targets consumers interested in traditional, handwoven textiles, with growing appeal in contemporary and fusion fashion markets. 	

Category	Description	Image
Fabric Name	Arni Cotton	
Fabric Content	100% cotton	
Fabric Weight	150 GSM- 250 GSM	
Thread Count	80 to 120 threads per square inch.	
Weave Types	Plain Weave	
Texture	Soft yet sturdy, with a slightly crisp feel, making it comfortable for both casual and formal wear.	
Introduction	Arni Cotton is a traditional fabric originating from the Arni region in Tamil Nadu, India. Known for its fine texture and durability, Arni cotton is woven using local techniques, often with intricate patterns and borders.	
Manufacturing Process	Cotton is cultivated locally → The fibers are spun into yarn → Yarn is dyed using either natural or synthetic dyes → The yarn is handwoven or machine-woven on traditional looms to create fine fabric with distinctive patterns. The weaving process often incorporates borders or checks, which are traditional in Arni cotton weaving.	
Applications	<ul style="list-style-type: none"> Mainly used for sarees, lungis, and dupattas. Contemporary applications include casual wear, dresses, tunics, and home décor items like cushion covers, tablecloths, and curtains. 	
Environmental Impact	<ul style="list-style-type: none"> Moderate to low carbon footprint, as it is typically handwoven. Moderate water usage. Supports local artisans and contributes to the preservation of traditional weaving techniques, providing livelihoods in rural regions. 	
Quality	<ul style="list-style-type: none"> Arni cotton is soft, lightweight, and breathable, with a smooth texture. It has a slight crispness to it, which makes it comfortable to wear in hot climates. The fabric is durable and suitable for everyday use as well as festive occasions. 	
Design Opportunities	<ul style="list-style-type: none"> The fine texture and traditional patterns of Arni cotton make it ideal for creating modern adaptations of traditional garments, including sarees, dresses, and tunics. It is an excellent choice for creating lightweight summer wear, including dresses, blouses, and scarves. 	
Considerations	<ul style="list-style-type: none"> While soft and comfortable, Arni cotton may not be as durable as coarser fabrics and may require delicate care. Pre-washing is recommended to minimize shrinkage. 	

Category	Description	Image
Fabric Name	Dharmavaram Cotton	
Fabric Content	100% Cotton	
Fabric Weight	150 GSM-200 GSM	
Thread Count	80 to 120 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft and smooth, with a crisp feel that becomes softer with use and washing.	
Introduction	Dharmavaram Cotton originates from the town of Dharmavaram in Andhra Pradesh, India. Known for its smooth texture and elegant finish, it is traditionally used for weaving sarees. The fabric is characterized by its lustrous quality, which is a result of the fine quality cotton yarns used and the skillful weaving techniques.	
Manufacturing Process	The cotton fibers are carefully selected and spun into fine yarn → The yarn is dyed using either natural or synthetic dyes → The yarn is handwoven on traditional or modern looms, with fine weaving techniques to produce the smooth, lustrous texture and beautiful patterns, often featuring contrasting borders and zari work.	
Applications	<ul style="list-style-type: none"> Primarily used for sarees, dupattas, and shawls. The fabric is also used in creating contemporary garments like dresses, tunics, blouses, and home décor items such as cushion covers, table runners, and curtains. 	
Environmental Impact	<ul style="list-style-type: none"> Moderate carbon footprint, as it involves both handwoven and machine weaving processes. Moderate to high water usage, primarily from dyeing and cotton cultivation. Dharmavaram cotton supports local weavers and artisans, contributing to the preservation of traditional weaving techniques and providing livelihood opportunities. 	
Quality	<ul style="list-style-type: none"> Dharmavaram cotton is known for its soft, smooth, and lustrous texture. It has a fine finish, offering comfort and elegance. The fabric is lightweight yet durable, making it suitable for both everyday wear and formal occasions. 	
Design Opportunities	<ul style="list-style-type: none"> The smooth texture and glossy finish of Dharmavaram cotton lend themselves well to creating luxurious sarees and formal wear. 	
Considerations	<ul style="list-style-type: none"> Handwoven varieties require delicate handling to maintain their quality. Pre-washing is recommended to reduce shrinkage. Appeals to consumers interested in eco-friendly, artisanal textiles, as well as those seeking traditional and festive attire. 	

Category	Description	Image
Fabric Name	Surat Cotton	
Fabric Content	100% cotton or cotton blends with silk and synthetic fibers (varied depending on use).	
Fabric Weight	120 GSM-250 GSM.	
Thread Count	60 to 120 threads per square inch	
Weave Types	Plain Weave, Satin Weave, Twill Weave	
Texture	Smooth and soft, often with a slight sheen for certain weaves.	
Introduction	Surat Cotton originates from Surat, Gujarat, a city renowned for its rich textile heritage. Known for its fine quality and affordability, Surat Cotton encompasses a variety of cotton fabrics, including plain weaves, prints, and blends with silk or synthetic fibers.	
Manufacturing Process	Locally grown cotton is harvested and spun into yarn → Yarns are dyed using synthetic or natural dyes → Fabric is woven using power looms or handlooms → Printing, embroidery, or other embellishments are added for design variation.	
Applications	<ul style="list-style-type: none"> Sarees, salwar suits, and blouses featuring intricate designs or embroidery. Dresses, shirts, kurtis, casual wear, bed linens, curtains, and upholstery. 	
Environmental Impact	<ul style="list-style-type: none"> Moderate carbon footprint, as many Surat cotton products are produced using power looms and industrial dyeing methods. High water usage due to dyeing and finishing processes. Contributes significantly to employment in the Surat region, supporting both traditional artisans and modern textile industries. 	
Quality	<ul style="list-style-type: none"> Surat Cotton is soft, lightweight, and breathable. It can range from simple, affordable weaves to luxurious blends with silk or embellishments. Known for its versatility, the fabric caters to both everyday wear and festive occasions. 	
Design Opportunities	<ul style="list-style-type: none"> High potential for incorporating innovative prints and patterns. Can experiment with blends, including silk and synthetics, to cater to diverse market needs. 	
Considerations	<ul style="list-style-type: none"> Dependent on the blend; pure cotton versions are durable but prone to wrinkling, while blends may offer more resilience. Requires pre-washing to prevent shrinkage, especially in pure cotton variants. Positioned as a versatile fabric, appealing to a broad spectrum of consumers, from budget-conscious buyers to premium textile markets. 	

Category	Description	Image
Fabric Name	Malda Cotton	
Fabric Content	100% cotton or a blend of cotton with silk.	
Fabric Weight	100 GSM-150 GSM	
Thread Count	60 to 100 threads per square inch.	
Weave Types	Plain Weave	
Texture	Soft and airy, with a slightly crisp feel that becomes smoother with washing.	
Introduction	Malda Cotton originates from the Malda district in West Bengal, India. Known for its fine, soft texture and lightweight nature, it is traditionally handwoven, reflecting the rich cultural heritage of the region.	
Manufacturing Process	Locally sourced cotton is spun into yarn → Yarns are dyed using natural or synthetic dyes → Handwoven on traditional looms → Simple motifs or patterns are added to enhance the fabric's aesthetic. Malda Cotton often retains an earthy and natural look, aligning with its traditional roots.	
Applications	<ul style="list-style-type: none"> Sarees, dhotis, and stoles with simple patterns or minimalistic designs. Dresses, shirts, kurtis, scarves, and home décor items like tablecloths and cushion covers. 	
Environmental Impact	<ul style="list-style-type: none"> Low carbon footprint, as it is primarily handwoven and relies minimally on industrial processes. Moderate water usage, mainly during the dyeing process. Supports rural artisans and promotes traditional weaving techniques, contributing to the preservation of local craftsmanship. 	
Quality	<ul style="list-style-type: none"> Malda Cotton is lightweight, breathable, and soft to the touch. It is suitable for warm climates due to its excellent moisture-wicking properties. The fabric is durable, making it an excellent choice for everyday wear and casual attire. 	
Design Opportunities	<ul style="list-style-type: none"> Scope for incorporating contemporary prints and designs to appeal to modern consumers. Ideal for sustainable and ethical fashion lines due to its handwoven nature and eco-friendly potential. 	
Considerations	<ul style="list-style-type: none"> Generally strong but requires proper care to maintain its softness. Pre-washing is recommended to prevent shrinkage. Positioned as an artisanal fabric, Malda Cotton appeals to customers seeking eco-friendly and culturally rooted textiles. 	

Category	Description	Image
Fabric Name	Golconda Cotton	
Fabric Content	100% organic cotton	
Fabric Weight	80 GSM-120 GSM	
Thread Count	80 to 150 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft, smooth, and luxurious, with a silky finish due to the high-quality cotton fibers.	
Introduction	Golconda Cotton originates from the region surrounding the Golconda fort in Telangana, India. Renowned for its fine texture, superior quality, and eco-friendly production, it was historically linked to the global trade of Indian cotton.	
Manufacturing Process	Organic cotton is grown without synthetic fertilizers or pesticides → Handpicked to ensure fiber quality → Spun into yarn using traditional spinning methods → Dyed using natural dyes or left undyed → Handwoven on looms to create soft, durable fabric.	
Applications	<ul style="list-style-type: none"> Sarees, dhotis, and turbans with simple, elegant designs. Shirts, dresses, scarves, bed linens, and cushion covers, particularly in sustainable fashion collections and home décor. 	
Environmental Impact	<ul style="list-style-type: none"> Low carbon footprint, as it relies on organic farming and manual weaving processes. Highly sustainable, with a focus on organic cultivation and natural dyeing. Reduced water usage compared to conventional cotton farming, particularly in the dyeing stage when natural dyes are used. Provides employment to rural communities, sustains traditional weaving crafts, and promotes fair trade practices. 	
Quality	<ul style="list-style-type: none"> Golconda Cotton is lightweight, breathable, and durable. It offers a smooth finish and excellent drape, making it suitable for both casual and formal wear. Its organic nature ensures comfort, even for sensitive skin. 	
Design Opportunities	<ul style="list-style-type: none"> Versatile fabric for creating modern sustainable clothing lines. Ideal for experimenting with natural dyes and traditional motifs. 	
Considerations	<ul style="list-style-type: none"> High durability, but requires gentle care to preserve its organic properties. Pre-washing is essential to avoid shrinkage. Appeals to conscious consumers and niche markets seeking handcrafted and eco-friendly textiles. 	

Category	Description	Image
Fabric Name	Bastar Cotton	
Fabric Content	100% pure handspun cotton, sometimes blended with natural fibers like silk or jute for added texture.	
Fabric Weight	150 GSM-200 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Plain Weave	
Texture	Rough and coarse, with a rustic and earthy feel, gradually softening over time with use.	
Introduction	Bastar Cotton originates from the Bastar region in Chhattisgarh, India. Renowned for its coarse yet soft texture, it is primarily handwoven by tribal artisans using traditional techniques. The fabric reflects the region's cultural and artisanal heritage and is often decorated with tribal motifs or natural patterns.	
Manufacturing Process	Locally sourced cotton is handpicked → Cotton is handspun into yarn using traditional spinning wheels → Yarns are dyed with natural dyes (derived from bark, leaves, or minerals) → Handwoven on looms by tribal artisans, often incorporating distinctive tribal patterns.	
Applications	<ul style="list-style-type: none"> Sarees, lungis, dhotis, and ethnic wear. Home furnishings like cushion covers, curtains, and table linens; contemporary apparel such as shirts, dresses, and stoles. 	
Environmental Impact	<ul style="list-style-type: none"> Very low carbon footprint, as the entire process is manual with minimal reliance on machinery. Highly sustainable, due to the use of organic materials and natural dyes. Low water usage, as natural dyeing methods typically use less water compared to industrial processes. Significant, as it supports the livelihood of tribal artisans and sustains traditional crafts. 	
Quality	<ul style="list-style-type: none"> Bastar Cotton is breathable, durable, and naturally textured. Its slightly coarse weave makes it robust and suitable for everyday use, while its unique handwoven patterns enhance its aesthetic appeal. 	
Design Opportunities	<ul style="list-style-type: none"> Ideal for eco-friendly and sustainable fashion lines. Can be combined with other natural fibers to create textured, multi-purpose fabrics. 	
Considerations	<ul style="list-style-type: none"> High durability, but requires gentle care to preserve the natural dyes and patterns. Pre-washing is recommended. Appeals to eco-conscious consumers and those who value indigenous art and craftsmanship. 	

Category	Description	Image
Fabric Name	Kurnool Cotton	
Fabric Content	100% handspun organic cotton, occasionally blended with silk or natural fibers for varied textures.	
Fabric Weight	120 GSM-180 GSM	
Thread Count	60 to 80 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft and smooth, with a slight crispness that softens over time with use and washing.	
Introduction	Kurnool Cotton originates from the Kurnool district of Andhra Pradesh, India. Known for its organic and eco-friendly production methods, it is handspun and handwoven by local artisans, embodying traditional weaving techniques.	
Manufacturing Process	Locally grown organic cotton is harvested → Cotton fibers are handspun into yarn using traditional spinning methods → Yarns are dyed with natural or organic dyes → The fabric is handwoven on looms, often incorporating simple, elegant patterns.	
Applications	<ul style="list-style-type: none"> Sarees, dhotis, and lungis. Casual wear, shirts, dresses, home décor items like tablecloths, and curtains. 	
Environmental Impact	<ul style="list-style-type: none"> Minimal carbon footprint, as the process relies heavily on manual labor and traditional techniques. Low water usage. Highly sustainable. Supports rural artisans, promotes sustainable livelihoods, and helps preserve traditional weaving methods. 	
Quality	<ul style="list-style-type: none"> Kurnool Cotton is soft, breathable, and lightweight. Its natural texture and durability make it ideal for both traditional and contemporary uses. It offers comfort and adaptability in hot climates. 	
Design Opportunities	<ul style="list-style-type: none"> Suitable for lightweight and breathable garments such as summer dresses and casual shirts. The simplicity of the fabric allows for embellishments or block prints to enhance its appeal. 	
Considerations	<ul style="list-style-type: none"> High durability but may require proper care to maintain texture. Pre-washing is advisable. Appeals to eco-conscious buyers and those seeking lightweight, breathable, and affordable fabrics. 	

Category	Description	Image
Fabric Name	Khadi Cotton	
Fabric Content	100% Cotton	
Fabric Weight	80 GSM -200 GSM	
Thread Count	40 to 80 threads per square inch	
Weave Types	Plain Weave, Twill Weave	
Texture	Coarse and irregular due to handspinning; softens over time and with washing.	
Introduction	Khadi cotton is a handspun and handwoven fabric, deeply rooted in Indian tradition. It symbolizes self-reliance and sustainable practices, originally promoted during India's independence movement by Mahatma Gandhi. Today, it represents eco-conscious, artisanal craftsmanship.	
Manufacturing Process	Cotton is manually harvested → Cleaned and carded → Handspun into yarn using a charkha → Handwoven on a loom → Washed and finished to achieve the final texture.	
Applications	<ul style="list-style-type: none"> Traditional and contemporary apparel (kurtas, sarees, and jackets). Accessories (bags, scarves). Home furnishings (cushion covers, curtains). 	
Environmental Impact	<ul style="list-style-type: none"> Minimal carbon footprint, as the production process is manual and energy-efficient. Uses natural fibers, biodegradable, and avoids synthetic inputs. Requires significantly less water compared to conventional fabrics. Promotes rural employment, particularly among women, and ensures fair wages. 	
Quality	<ul style="list-style-type: none"> Breathable, durable, and comfortable nature. Fabric's natural texture, with slight irregularities, adds an authentic, rustic charm. Khadi cotton is temperature-regulating : it keeps the wearer cool in summer and warm in winter, making it ideal for diverse climates. 	
Design Opportunities	<ul style="list-style-type: none"> Highly versatile for natural dyeing, hand block printing, embroidery, and patchwork. Its unique texture and artisanal appeal make it a favorite for sustainable and luxury designs. 	
Considerations	<ul style="list-style-type: none"> Production is time-intensive and depends on skilled artisans. May shrink and wrinkle if not pre-treated. Premium pricing limits accessibility to mass markets. 	

Category	Description	Image
Fabric Name	Mulmul Cotton (Muslin)	
Fabric Content	100% Cotton	
Fabric Weight	50GSM- 80 GSM	
Thread Count	50 to 100 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft, airy, and breathable, with a fine texture due to the use of combed cotton fibers. It has a slightly crisp feel but softens with washing.	
Introduction	Mulmul cotton, also known as muslin, is a lightweight, finely woven cotton fabric with a soft and smooth texture. Originating in Bengal, India, it was historically prized for its sheer quality and luxurious feel. Mulmul has regained popularity in modern fashion for its versatility and comfort.	
Manufacturing Process	Cotton is harvested → Cleaned and carded → Spun into fine yarns → Woven into a lightweight fabric → Finished for softness and uniformity. Advanced processes may include pre-washing for shrinkage control.	
Applications	<ul style="list-style-type: none"> Primarily used in summer wear (tunics, sarees, dresses), baby clothing, bedding, curtains, and soft furnishings. Favored for block printing, embroidery, and dyeing 	
Environmental Impact	<ul style="list-style-type: none"> Relatively low carbon footprint if produced traditionally, though industrial production may increase emissions. Fully biodegradable and recyclable when untreated. Water usage is moderately high during cotton farming. Supports traditional weavers and artisanal communities. 	
Quality	<ul style="list-style-type: none"> Renowned for its softness, breathability, and delicate texture. Mulmul cotton is ideal for warm climates, offering lightweight comfort. It is gentle on the skin, making it suitable for sensitive applications like baby clothes and luxury bedding. 	
Design Opportunities	<ul style="list-style-type: none"> Excellent for layering, draping, and embellishments fine weave allows intricate handwork, such as embroidery and block printing Adaptability makes it suitable for minimalist and intricate design styles. 	
Considerations	<ul style="list-style-type: none"> Prone to wear and tear due to its delicate weave. Requires pre-washing to prevent shrinkage. Affordable yet luxurious. 	

Category	Description	Image
Fabric Name	Kotta Doria Cotton	
Fabric Content	100% Cotton	
Fabric Weight	80 GSM-120 GSM	
Thread Count	40 to 80 threads per square inch, giving it a fine yet slightly textured feel.	
Weave Types	Plain Weave	
Texture	Light, soft, and slightly transparent with a delicate, crisp finish. It has a refined texture due to its fine yarns and open weave.	
Introduction	Kotta Doria is a traditional handwoven cotton fabric, known for its fine texture, lightweight feel, and intricate checkered patterns. Originating from the town of Kottapalli in Andhra Pradesh, India, Kotta Doria was historically used for making sarees and household textiles.	
Manufacturing Process	Cotton is harvested → Cleaned and carded → Handspun into yarn → Woven using traditional pit looms into a fine checkered pattern → Washed and finished for softness.	
Applications	<ul style="list-style-type: none"> Primarily used in sarees, dupattas, shawls, and other traditional wear. Home textiles like bed covers, curtains, and cushion covers due to its lightweight and breathable nature. 	
Environmental Impact	<ul style="list-style-type: none"> Low carbon footprint, as production is handwoven and energy-efficient. Biodegradable, and avoids synthetic fibers Water usage is moderate; the cotton farming process requires water but not as much as industrial cotton. Supports local artisans and traditional craftsmanship, fostering rural employment and economic sustainability. 	
Quality	<ul style="list-style-type: none"> Known for its softness, smooth texture, and the distinctive checkered pattern. Its lightweight and breathable nature make it ideal for hot climates. The fabric's durability can vary depending on the hand weaving technique. 	
Design Opportunities	<ul style="list-style-type: none"> The checkered pattern provides a unique visual appeal, making it suitable for traditional and contemporary fusion designs. The fabric can be used for block printing, embroidery, and dyeing. 	
Considerations	<ul style="list-style-type: none"> Delicate weave can result in wear and tear with frequent use. Requires careful washing to prevent shrinkage. Niche market focused on traditional and heritage textiles; not as widely accessible in mass markets. 	

Category	Description	Image
Fabric Name	Jamdani Cotton	
Fabric Content	100% Cotton	
Fabric Weight	80 GSM-120 GSM	
Thread Count	80 to 200 threads per square inch	
Weave Types	Plain Weave Base- Patterns are woven using an additional weft thread over the plain weave base.	
Texture	Soft, sheer, and delicate, often featuring raised motifs or patterns that add texture	
Introduction	Jamdani is a traditional handwoven cotton fabric that originates from Bengal, India. Known for its intricate patterns and fine quality, Jamdani cotton is one of the most famous traditional textiles in South Asia.	
Manufacturing Process	Cotton is harvested → Cleaned and carded → Spun into yarn → Handwoven on traditional pit looms using intricate designs woven into the fabric. The weaving process is labor-intensive and can take several days or weeks depending on the complexity of the design.	
Applications	<ul style="list-style-type: none"> Primarily used in sarees, dupattas, scarves, and other ethnic wear. It is also used in modern garments like blouses, tunics, and dresses. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon footprint is relatively low due to the handwoven process and minimal use of energy-intensive machinery. Fully biodegradable and free from synthetic fibers. Water usage is moderate Supports local artisans, preserves heritage craft, and generates rural employment. 	
Quality	<ul style="list-style-type: none"> Jamdani cotton is known for its soft texture, breathability, and luxurious feel. The fabric is lightweight but durable, with a dense texture due to the handwoven techniques. 	
Design Opportunities	<ul style="list-style-type: none"> The fine quality and flexibility of Jamdani cotton allow for intricate designs, including floral, geometric, and nature-inspired patterns. 	
Considerations	<ul style="list-style-type: none"> While durable, Jamdani cotton is delicate compared to machine-made cotton due to the intricacy of its weave. Can shrink if not properly washed or pre-washed. Considered a luxury fabric, often expensive due to the labor-intensive weaving process. 	

Category	Description	Image
Fabric Name	Mangalagiri Cotton	
Fabric Content	100% Cotton	
Fabric Weight	80GSM-120 GSM	
Thread Count	60 to 80 threads per square inch	
Weave Types	Plain Weave	
Texture	Smooth, crisp, and slightly stiff due to the starched finish, which softens with use and washing.	
Introduction	Mangalagiri cotton originates from Mangalagiri, Andhra Pradesh, India. Renowned for its durability, fine texture, and vibrant colors, this fabric is traditionally handwoven and is known for its plain or striped designs with zari borders.	
Manufacturing Process	Cotton is harvested → Cleaned and spun into yarn → Dyed using traditional or natural dyes → Handwoven on pit looms with distinctive zari borders. The fabric is often starched for a crisp finish.	
Applications	<ul style="list-style-type: none"> Sarees, salwar suits, and kurtas. Also used in Shirts, dresses, and home textiles like cushion covers and curtains. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon footprint is relatively low due to the handwoven process. Biodegradable and eco-friendly. Water usage is moderate Supports local weavers and preserves traditional craftsmanship, fostering rural employment and cultural heritage. 	
Quality	<ul style="list-style-type: none"> Mangalagiri cotton is known for its strength, smooth texture, and versatility. Its tightly woven structure makes it durable and resistant to wear. The vibrant colors and zari borders enhance its aesthetic appeal. 	
Design Opportunities	<ul style="list-style-type: none"> Ideal for block printing, embroidery, and dyeing. Unique for its blend of tradition and modernity, appealing to diverse markets. 	
Considerations	<ul style="list-style-type: none"> Durability is high, but the fabric requires proper care to maintain its starch finish and color vibrancy. Needs pre-washing to avoid shrinkage. Positioned as an affordable, durable fabric with traditional appeal, gaining popularity in both domestic and global markets. 	

Category	Description	Image
Fabric Name	Chettinad Cotton	
Fabric Content	100% Cotton	
Fabric Weight	90GSM- 120 GSM	
Thread Count	60 to 80 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft, sturdy, and slightly coarse, often enhanced with traditional starching for a crisp finish.	
Introduction	Chettinad cotton originates from the Chettinad region of Tamil Nadu, India. Known for its vibrant colors, bold patterns, and sturdy weave, this traditional fabric has been a staple of South Indian heritage, especially for sarees.	
Manufacturing Process	Cotton is harvested → Cleaned and spun into yarn → Dyed using natural or chemical dyes → Handwoven on looms with intricate patterns. Traditional Chettinad sarees are woven in shorter lengths for convenience.	
Applications	<ul style="list-style-type: none"> Sarees with bold checks, stripes, and geometric patterns. Dresses, skirts, kurtas, shirts, and home furnishings like tablecloths and cushion covers. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon footprint is relatively low due to handweaving processes and minimal reliance on machinery. Biodegradable and eco-friendly. Water usage is moderate Supports local weavers and preserves traditional craftsmanship, fostering rural employment and cultural heritage. 	
Quality	<ul style="list-style-type: none"> Chettinad cotton is recognized for its sturdy texture, lightweight feel, and breathability It is ideal for hot climates due to its moisture-absorbing properties and durability. 	
Design Opportunities	<ul style="list-style-type: none"> Known for bold checks, stripes, and earthy tones that offer scope for modern reinterpretations. Suitable for experimenting with embroidery, block printing, and patchwork. Ideal for fusion wear, blending traditional aesthetics with contemporary designs. 	
Considerations	<ul style="list-style-type: none"> Highly durable, but requires proper washing techniques to retain color and texture. Pre-washing is necessary to prevent shrinkage. Positioned as an affordable yet stylish fabric, appealing to both traditional and modern fashion markets. 	

Category	Description	Image
Fabric Name	Pochampally Ikat Cotton	
Fabric Content	100% Cotton	
Fabric Weight	80 GSM-120 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Ikat Weave	
Texture	Soft, smooth, and slightly crisp, with a lightweight feel that softens with use and washing.	
Introduction	Pochampally Ikat cotton originates from the Pochampally region of Telangana, India. It is renowned for its intricate ikat patterns, created through a unique tie-and-dye technique applied to the yarn before weaving. This traditional craft has earned a Geographical Indication (GI) tag.	
Manufacturing Process	Cotton is harvested → Cleaned and spun into yarn → Yarns are tied in specific patterns and dyed (ikat process) → Dyed yarns are aligned on the loom → Handwoven into fabric. The process is labor-intensive and requires precision to achieve intricate designs.	
Applications	<ul style="list-style-type: none"> Sarees, dupattas, and kurtas. Dresses, shirts, home textiles like cushion covers, table runners, and bags. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon footprint is relatively low due to handweaving processes and minimal reliance on machinery. Biodegradable and eco-friendly. Biodegradable and eco-friendly, especially when natural dyes are used. Water usage is high due to the dyeing process. Provides employment to local artisans, preserving a traditional craft and contributing to rural economies. 	
Quality	<ul style="list-style-type: none"> Pochampally Ikat cotton is lightweight, breathable, and durable. The fabric's fine texture and vibrant patterns make it suitable for various climates and occasions. 	
Design Opportunities	<ul style="list-style-type: none"> The intricate ikat patterns offer opportunities for creating contemporary fashion that blends traditional and modern aesthetics. Ideal for customization through embroidery and embellishments. 	
Considerations	<ul style="list-style-type: none"> Durable with proper care but can lose vibrancy if not washed correctly. Requires pre-washing to prevent shrinkage. Positioned as a premium fabric due to its labor-intensive production and intricate craftsmanship, appealing to niche markets for both traditional and contemporary styles. 	

Category	Description	Image
Fabric Name	Sambalpuri Cotton	
Fabric Content	100% Cotton	
Fabric Weight	90 GSM-120 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Ikat Weave	
Texture	Soft and smooth, with a slightly crisp finish due to traditional starching.	
Introduction	Sambalpuri cotton originates from Sambalpur, Odisha, India. It is famous for its intricate handwoven patterns created using the ikat technique, where the yarn is tie-dyed before weaving. Sambalpuri fabrics often feature traditional motifs inspired by nature, mythology, and cultural heritage. This craft holds a Geographical Indication (GI) tag.	
Manufacturing Process	Cotton is harvested → Spun into yarn → Yarn is tie-dyed with natural or chemical dyes (ikat technique) → Yarns are aligned precisely for patterns → Handwoven on traditional looms. The process is meticulous, requiring expertise to achieve symmetrical and vibrant designs.	
Applications	<ul style="list-style-type: none"> Sarees, dupattas, and kurtas. Dresses, shirts, home textiles like cushion covers, table runners, and bags. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon footprint is low due to reliance on manual labor and traditional weaving techniques. Moderate water usage, but dyeing practices can increase usage. Promotes rural employment and sustains traditional craftsmanship, benefiting local weavers and preserving a centuries-old art form. 	
Quality	<ul style="list-style-type: none"> Sambalpuri cotton is lightweight, breathable, and comfortable. It is prized for its durability and the sharpness of its designs. The fabric's natural drape and vibrant colors enhance its appeal. 	
Design Opportunities	<ul style="list-style-type: none"> The unique ikat patterns and cultural motifs offer potential for modern reinterpretations in both ethnic and fusion fashion. 	
Considerations	<ul style="list-style-type: none"> Durable with proper care but prone to fading if exposed to harsh detergents or sunlight. Requires pre-washing to prevent shrinkage. Positioned as a premium artisanal fabric, appealing to consumers interested in sustainable and culturally rich textiles. 	

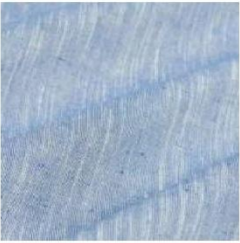
Category	Description	Image
Fabric Name	Bengal Tant Cotton	
Fabric Content	100% Cotton	
Fabric Weight	80 GSM-100 GSM	
Thread Count	40 to 80 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft, airy, and crisp, with a slightly coarse finish that softens with use and washing.	
Introduction	Bengal Tant cotton is a traditional handwoven fabric from West Bengal, India, known for its lightweight, airy texture and elegant simplicity. It is traditionally used for sarees and is a staple in Bengali cultural attire, celebrated for its intricate borders and pallus.	
Manufacturing Process	Cotton is harvested → Spun into yarn → Dyed with natural or synthetic dyes → Handwoven on traditional looms. The weaving involves creating intricate patterns on borders and pallus, often inspired by nature and folklore. The process is time-intensive, requiring skilled artisans.	
Applications	<ul style="list-style-type: none"> Sarees with intricate motifs and borders. Blouses, tunics, dresses, shirts, dupattas, and home décor items like curtains and table runners. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon footprint is low due to reliance on manual labor and traditional weaving techniques. Moderate water usage, but dyeing practices can increase usage. Promotes rural employment and sustains traditional craftsmanship, benefiting local weavers and preserving a centuries-old art form. 	
Quality	<ul style="list-style-type: none"> Bengal Tant cotton is lightweight, breathable, and soft. It is ideal for hot and humid climates. The fabric is durable with proper care and offers a crisp texture that enhances its elegance. 	
Design Opportunities	<ul style="list-style-type: none"> The lightweight nature and intricate borders make it versatile for contemporary fashion like dresses, skirts, and scarves. Can be reinterpreted with modern prints and embellishments to appeal to a wider audience. Suitable for layering, combining with other textiles, and designing fusion wear. 	
Considerations	<ul style="list-style-type: none"> Delicate and may tear with rough handling but retains quality with proper care. Pre-washing is necessary to avoid shrinkage. Affordable and accessible, appealing to both traditional and modern markets for its comfort and elegance. 	

Category	Description	Image
Fabric Name	Venkatagiri Cotton	
Fabric Content	100% Cotton	
Fabric Weight	90 GSM-120 GSM	
Thread Count	60 to 80 threads per square inch.	
Weave Type	Plain Weave	
Texture	Soft, smooth, and slightly crisp, with a fine finish that softens after washing.	
Introduction	Venkatagiri cotton originates from Venkatagiri, a town in Andhra Pradesh, India. Known for its fine weave, lightness, and intricate zari (gold or silver thread) work, this fabric has been a staple in traditional South Indian textiles for centuries..	
Manufacturing Process	Cotton is harvested → Spun into yarn → Dyed using natural or synthetic dyes → Handwoven on traditional pit looms. The weaving process includes the incorporation of zari, enhancing the fabric's aesthetic appeal. The art requires precision and skill to achieve its signature lightweight and smooth texture.	
Applications	<ul style="list-style-type: none"> Sarees, especially for festive and casual wear, featuring delicate borders and pallus. Dresses, skirts, kurtas, dupattas, stoles, and home furnishings like cushion covers and table linens. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon footprint is low due to handloom weaving and minimal reliance on industrial machinery. Moderate water usage. Supports rural artisans and preserves a traditional craft, contributing to sustainable livelihoods and cultural heritage. 	
Quality	<ul style="list-style-type: none"> Venkatagiri cotton is lightweight, breathable, and soft. The fine weave and incorporation of zari add a touch of sophistication. The fabric is durable yet delicate, making it suitable for both daily and special occasions. 	
Design Opportunities	<ul style="list-style-type: none"> The fabric's fine texture and subtle sheen make it ideal for high-end fashion, including evening wear and fusion designs. Suitable for blending with other materials like silk or organza to create unique, contemporary designs. 	
Considerations	<ul style="list-style-type: none"> May require gentle handling due to its fine weave and zari work. Pre-washing is essential to prevent shrinkage. Positioned as an artisanal fabric, appealing to consumers seeking heritage textiles with a luxurious touch. 	

Category	Description	Image
Fabric Name	Kasavu Cotton	
Fabric Content	100% Cotton	
Fabric Weight	90 GSM-120 GSM	
Thread Count	60 to 80 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft, crisp, and smooth, with a slightly coarse feel that softens with repeated use and washing.	
Introduction	Kasavu cotton is a traditional fabric from Kerala, India, primarily used for the famous Kasavu sarees. It is known for its crisp texture, elegance, and golden zari borders.	
Manufacturing Process	Cotton is spun into yarn → Yarn is dyed with natural or synthetic dyes → Handwoven or machine-woven → Gold or silver zari is added to create the signature border patterns.	
Applications	<ul style="list-style-type: none"> Kasavu sarees, usually worn during festivals, weddings, and cultural events, especially in Kerala. Blouses, kurtas, dupattas, dresses, and accessories like stoles and scarves. 	
Environmental Impact	<ul style="list-style-type: none"> Has a lower carbon footprint compared to machine-made fabrics due to its minimal reliance on industrial machinery. Moderate water usage. Supports local artisans and weavers in Kerala, preserving traditional craftsmanship and promoting rural employment. The fabric is part of Kerala's cultural heritage, and its production helps sustain local economies. 	
Quality	<ul style="list-style-type: none"> Kasavu cotton is light yet durable, with a smooth, crisp texture. The fabric offers comfort and breathability, making it suitable for both warm and cool weather. The zari border adds a touch of luxury, elevating its aesthetic appeal. The quality of the fabric is greatly influenced by the weaving process, with handwoven versions being more prized for their craftsmanship. 	
Design Opportunities	<ul style="list-style-type: none"> The contrast between the simple cotton body and the intricate zari borders creates opportunities for elegant, minimalist designs.. 	
Considerations	<ul style="list-style-type: none"> Kasavu cotton is durable, but the zari work may require careful handling to avoid damage. Pre-washing is recommended to minimize shrinkage. Kasavu cotton is often marketed as a premium fabric, appealing to consumers seeking cultural and traditional elegance, especially during wedding and festival seasons. 	

Category	Description	Image
Fabric Name	Ponduru Khadi	
Fabric Content	100% Cotton	
Fabric Weight	80 GSM-120 GSM	
Thread Count	60 to 100 threads per square inch	
Weave Types	Plain Weave	
Texture	Slightly coarse but softens with use, with a unique, natural finish owing to the handspinning process.	
Introduction	Ponduru Khadi is a handspun, handwoven cotton fabric originating from Ponduru, a small town in Andhra Pradesh, India. Known for its unmatched softness and fine texture, it is crafted using indigenous short-staple cotton varieties like hill cotton and desi cotton. This eco-friendly fabric holds a special place in Indian heritage and was favored by Mahatma Gandhi for its simplicity and sustainability.	
Manufacturing Process	Cotton is hand-picked and cleaned → Spun into yarn on traditional charkhas → Woven on handlooms using intricate techniques	
Applications	<ul style="list-style-type: none"> Sarees, dhotis, kurtas, and angavastram. Shirts, dresses, tunics, stoles, scarves, and home décor items like tablecloths and cushion covers. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon Footprint is very low, as the entire process is manual and non-industrial. Highly sustainable due to the use of organic cotton and minimal environmental impact. Minimal water use, with limited reliance on water-intensive dyeing processes. Provides employment to rural artisans, empowering local communities and preserving traditional craftsmanship. 	
Quality	<ul style="list-style-type: none"> Ponduru Khadi is lightweight, soft, and breathable. It is valued for its durability, comfort, and natural texture, making it suitable for both summer and winter wear. 	
Design Opportunities	<ul style="list-style-type: none"> The organic and natural appeal of Ponduru Khadi makes it ideal for eco-conscious fashion. Its fine texture allows for intricate hand embroidery and printing, making it versatile for both traditional and contemporary designs. Suitable for minimalist and sustainable fashion collections. 	
Considerations	<ul style="list-style-type: none"> Requires gentle handling to maintain its softness and texture. Pre-washing is necessary to avoid shrinkage. Appeals to consumers looking for authentic, eco-friendly, and high-quality handmade textiles. 	

Category	Description	Image
Fabric Name	Kanjeevaram Cotton	
Fabric Content	100% Cotton, handwoven, sometimes blended with silk to enhance the richness and sheen.	
Fabric Weight	100 GSM-150 GSM	
Thread Count	80 to 120 threads per square inch	
Weave Types	Plain Weave, Warp Weave	
Texture	Soft and smooth, with a slightly crisp feel that softens with use and washing.	
Introduction	Kanjeevaram cotton originates from Kanchipuram, Tamil Nadu, a region renowned for its handwoven textiles. Known for its lightweight texture and elegant patterns, Kanjeevaram cotton features traditional motifs inspired by temples, nature, and Indian culture. While less opulent than its silk counterpart, it retains a classic appeal with zari or threadwork for added elegance.	
Manufacturing Process	Pure cotton yarn is spun and dyed using natural or synthetic dyes → Woven on traditional handlooms → Intricate motifs and zari borders are incorporated, showcasing the region's rich weaving heritage.	
Applications	<ul style="list-style-type: none"> Sarees for festivals, weddings, and formal events. Dresses, tunics, blouses, stoles, dupattas, and home décor items like cushion covers. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon Footprint is low as it is handcrafted with minimal reliance on industrial processes. Minimal water usage. Supports local weavers in Kanchipuram, preserving traditional handloom techniques and fostering rural employment. 	
Quality	<ul style="list-style-type: none"> Kanjeevaram cotton is soft, breathable, and durable, making it ideal for both casual and festive wear. Its fine weave and intricate designs reflect the craftsmanship of skilled artisans. 	
Design Opportunities	<ul style="list-style-type: none"> The fabric's ability to blend tradition with modern aesthetics makes it versatile for contemporary and fusion wear. Its lightweight texture makes it suitable for summer collections and resort wear. 	
Considerations	<ul style="list-style-type: none"> Requires gentle care to preserve intricate zari or threadwork. Pre-washing is recommended to prevent shrinkage. Appeals to consumers seeking a balance between traditional elegance and modern comfort. 	

Category	Description	Image
Fabric Name	Dindigul Cotton	
Fabric Content	100% Cotton	
Fabric Weight	80 GSM-120 GSM	
Thread Count	60 to 80 threads per square inch	
Weave Types	Plain Weave	
Texture	Slightly coarse and sturdy, softens with repeated use and washing.	
Introduction	Dindigul cotton originates from the Dindigul region of Tamil Nadu, India, renowned for producing high-quality cotton fabrics. Known for its durability, softness, and breathability, Dindigul cotton is widely used in traditional and everyday wear. The region's handloom weaving tradition ensures sustainable and artisanal textile production.	
Manufacturing Process	Locally grown cotton is harvested → Spun into yarn → Yarn is dyed with natural or synthetic dyes → Handwoven on traditional looms to create fine cotton fabric → Final product undergoes finishing processes to enhance texture and durability.	
Applications	<ul style="list-style-type: none"> Sarees, dhotis, and salwar suits. Shirts, dresses, casual wear, tote bags, and home furnishings like bedsheets, curtains, and tablecloths. 	
Environmental Impact	<ul style="list-style-type: none"> Low carbon foot print, as production relies on handlooms with minimal industrial intervention. Moderate water usage, primarily during dyeing processes. Supports local weavers and artisans, contributing to rural employment and preserving traditional handloom weaving techniques. 	
Quality	<ul style="list-style-type: none"> Dindigul cotton is lightweight, durable, and breathable, making it ideal for hot and humid climates. Its fine texture and sturdy weave ensure comfort and longevity. 	
Design Opportunities	<ul style="list-style-type: none"> Offers versatility for contemporary and fusion fashion, including casual and formal wear. Ideal for experimenting with natural dye patterns, block prints, and embroidery. 	
Considerations	<ul style="list-style-type: none"> Durable fabric but requires care to prevent fading or damage during washing. Pre-washing is essential to prevent shrinkage. Attracts eco-conscious consumers and those seeking affordable yet high-quality handloom textiles. 	

Category	Description	Image
Fabric Name	Shantipur Cotton	
Fabric Content	100% Cotton	
Fabric Weight	80 GSM-100 GSM	
Thread Count	80 to 120 threads per square inch	
Weave Types	Plain Weave	
Texture	Soft, smooth, and delicate, with a refined finish that improves with washing.	
Introduction	Shantipur cotton is a traditional handwoven fabric originating from Shantipur, West Bengal, India. Known for its fine texture, smooth finish, and intricate patterns, this fabric is often used in the making of sarees, dupattas, and other ethnic wear. The fabric is woven with a blend of cotton and silk, giving it a slight sheen while maintaining the softness of cotton.	
Manufacturing Process	Cotton yarn is spun → Yarn is dyed using natural or synthetic dyes → Handwoven on traditional looms to create a fine, smooth fabric → Decorative motifs and borders are incorporated using delicate weaving techniques.	
Applications	<ul style="list-style-type: none"> Sarees, dupattas, and shawls, primarily for festive and ceremonial occasions. Dresses, kurtas, blouses, tunics, stoles, and home décor items like tablecloths, cushion covers, and bedspreads. 	
Environmental Impact	<ul style="list-style-type: none"> Carbon Footprint is low as the fabric is handwoven with minimal reliance on machines. Water usage is moderate due to dyeing processes. Provides employment to local artisans, preserving traditional weaving techniques and contributing to the local economy. 	
Quality	<ul style="list-style-type: none"> Shantipur cotton is soft, breathable, and lightweight, making it suitable for year-round wear. Its fine weave gives it a smooth texture, and the blend of cotton and silk adds a subtle shine, making it suitable for both casual and formal wear. 	
Design Opportunities	<ul style="list-style-type: none"> Shantipur cotton offers design flexibility, allowing for experimentation with modern patterns, embroidery, and sustainable dyeing techniques. 	
Considerations	<ul style="list-style-type: none"> Requires gentle handling to preserve the fine weave and prevent damage. Pre-washing is recommended to prevent shrinkage. Shantipur cotton appeals to consumers looking for premium handwoven fabrics that combine traditional artistry with modern style. 	