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PHULKARI IN THE DIGITAL AGE: BLENDING TRADITION WITH TECHNOLOGY, ONLINE MARKETS, AND DIGITAL NARRATIVES

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Abstract
Phulkari, the traditional embroidery of Punjab, has long been admired for its beautiful artistry and cultural value. However, there is an opportunity to reimagine this age-old craft in the digital era by utilizing contemporary technology like digital printing and laser cutting. This study explores how modern techniques might enhance Phulkari's design possibilities, production efficiency, and sustainability while preserving its traditional core. By examining case studies and experimental applications, the study highlights how digital tools can be used to revolutionize stitching processes, reduce labor intensity, and improve creative expression. Additionally, discussed are how the fashion industry, craftspeople, and cultural preservation are affected by technology adaptation. The results show that by striking a balance between tradition and innovation, Phulkari's artistic heritage may be preserved while retaining its relevance in global markets. This study contributes to broader discussions about how traditional crafts might be revived through digital transformation.

INTRODUCTION

Punjab's Phulkari Embroidery: Tradition and Digital Innovation

Long praised as a cultural icon that captures the artistic heritage of rural Indian and Pakistani women, Punjab's vibrant and intricate Phulkari embroidery tradition (Dhawan, 2017; Sandhu, 2018).

Phulkari is a traditional handcrafted art style that adorns fabrics with natural, folkloric, and spiritual themes through elaborate threadwork (Bhandari, 2018).However, the slow, laborintensive nature of traditional needlework, dwindling artisan participation, and competition from machinemade textiles have all contributed to the craft's difficulties in recent decades (Bains & Kaur, 2019; Kaur, 2020).

There is a chance to redesign Phulkari while maintaining its cultural value thanks to the development of digital fabrication technologies like laser cutting and digital printing (Ahmed, 2020; Joshi, 2018).

While laser cutting makes it possible to create delicate details that could be challenging to do by hand, digital printing allows for the precise duplication of traditional patterns with minimum waste (Chakraborty & Datta, 2021; Grover & Khan, 2021).

These developments are in line with more general patterns in sustainable fashion and textile digitization, where technology improves productivity without sacrificing creative integrity (Fletcher, 2019; Patel, 2020).

Research Gaps and Questions

Digital technologies have great potential, but little is understood about how they may be integrated with traditional crafts like Phulkari.

Among the main research gaps are:

1. How may Phulkari patterns be innovated or replicated using digital printing and laser cutting while preserving cultural authenticity?

2. What are the economic and environmental benefits of digitizing Phulkari production compared to traditional methods?
3. How does **technology-assisted Phulkari** impact craft preservation, and how do artisans and consumers perceive it?

To address these questions, this study examines experimental applications of digital techniques in Phulkari and evaluates their feasibility, sustainability, and cultural impact.

Significance of the Study

This research holds critical importance for multiple stakeholders:

- **Artisans & Craft Revival:** Digital technologies may improve the economic viability of Phulkari by reducing labor intensity and production time (Garg & Singh, 2020; Mehta, 2019).

- **Sustainable Fashion:** Digital methods can minimize material waste and energy consumption, supporting eco-friendly textile production (Kumar & Pandit, 2022; Nayak & Padhye, 2021).

- **Cultural Preservation:** Balancing innovation with tradition ensures Phulkari remains relevant in global markets without losing its heritage value (Rai & Sharma, 2021; Wilson, 2021).

- **Academic Contribution:** The study fills gaps in craft digitization literature, offering insights applicable to other endangered textile traditions (Das, 2022; Thakur, 2021).

By exploring the intersection of tradition and technology, this study aims to redefine Phulkari's future, ensuring its survival as both a cultural artifact and a contemporary design medium.

Review of Literature

Phulkari: A Craft Tradition in Transition

Numerous studies have documented Punjab's rich Phulkari embroidery legacy as a form of artistic expression and cultural heritage (Dhawan, 2017; Sandhu, 2018).

With motifs that reflected agrarian life and spiritual symbolism, Phulkari was traditionally a domestic craft for women (Bhandari, 2018).

Recent research, however, shows that the craft faces many difficulties.

Economic pressures from massproduced alternatives are cited by Kaur (2020) as a major danger, while Bains and Kaur (2019) highlight the decline in intergenerational knowledge transfer.

These worries are quantified by Garg and Singh (2020), who point out that the 200–300 hours needed to handcraft a single Phulkari shawl compromises its commercial viability in contemporary markets.

Digitalization of Textile Manufacturing

Traditional crafts like Phulkari may find answers in the digital change of the textile industry.According to Ahmed (2020), digital printing ensures accurate pattern reproduction while reducing material waste by up to 30%.

In a similar vein, Chakraborty and Datta (2021) showed that laser cutting outperforms human methods in fabric manipulation, achieving 0.1mm precision.

Fletcher's (2019) sustainable design paradigm, which promotes technology-driven reductions in water and chemical usage (up to 75%) in textile production, is in line with these developments.

Theoretical Frameworks for Craft Innovation

Three theoretical perspectives inform the intersection of tradition and technology in Phulkari's revival:

1. **Craft Innovation Theory (Mehta, 2019):** Positions technological adaptation as an evolutionary process that enhances—rather than erodes—craft traditions.

2. **Sustainable Fashion Principles (Fletcher, 2019):** Provides environmental criteria for evaluating digital production methods.

3. **Cultural Hybridity Model (Wilson, 2021):** Offers a critical lens for balancing authenticity with innovation in cultural crafts.

Identified Research Gaps

Despite these foundational studies, significant gaps persist in the literature. Jain and Sharma's (2021) systematic review revealed that less than 5% of textile digitization research examines South Asian crafts. Thakur (2021) highlighted a critical lack of artisan

perspectives, noting that only 2 out of 87 relevant studies incorporated interviews with practitioners. Additionally, quantitative comparisons remain scarce: While Verma and Kapoor (2020) analyzed the efficiency of digital stitching broadly, no study has specifically measured time/cost metrics for Phulkari production. Furthermore, although Islam and Ahmed (2020) found that 68% of craft consumers consider production methods when purchasing, research on consumer perceptions of digitally adapted Phulkari is virtually absent.

Research Direction and Synthesis

Existing studies underscore both the urgency of preserving Phulkari and the potential of digital solutions, yet fail to address key gaps. This review identifies four critical deficiencies:

1. **Application-specific research** on digital Phulkari production techniques;

2. Inclusion of **artisan voices** in technological adaptation studies;

3. **Empirical efficiency comparisons** between traditional and digital methods;

4. **Consumer perception studies** regarding digitally produced Phulkari.

The present study addresses these gaps through technical experimentation, artisan interviews, and market analysis. Grounded in Craft Innovation Theory (Mehta, 2019) and applying Fletcher's (2019) sustainability framework, this research advances both theoretical and practical understanding of heritage craft preservation in the digital age.

Methodology: Phulkari Digitization in Punjab, Pakistan

Research Approach

This study employed a place-based mixed-methods strategy to examine the digitalization potential of Phulkari embroidery across key districts of Pakistani Punjab (Lahore, Faisalabad, Jhang, Toba Tek Singh, Kasur, and Chiniot). The sequential exploratory design comprised two phases:

Qualitative Phase

1. **In-Depth Interviews**

o Conducted with Phulkari artisans from:

▪ Lahore: Historic urban center with craft markets (Liberty Market, Anarkali)

▪ Faisalabad: Industrial textile zone combining machine and traditional production

▪ Jhang & Toba Tek Singh: Rural craft clusters with lesser-known artisan communities

2. **Focus Group Discussions (FGDs)**

o Held at:

▪ Punjab Council of Arts, Lahore (policy perspectives)

▪ National Textile University, Faisalabad (technical expertise)

Quantitative Phase

1. **District-Wise Surveys**

o Compared:

▪ Production efficiency (home-based artisans in Jhang vs. commercial enterprises in Lahore)

▪ Consumer demand (urban Lahore vs. semi-urban Toba Tek Singh markets)

Sampling Strategy

1. Artisan Recruitment

District	Sample Size	Specialization	Selection Criteria
Lahore	10-12	Commercial/urban Phulkari	Supply brands like Khaadi; use hybrid techniques
Faisalabad	8-10	Industrial integration	Connected to textile factories; digital knowledge
Jhang	6-8	Traditional Chope/Bagh styles	Home-based female artisans; limited digital exposure
Toba Tek Singh	5-7	Cotton-based rural production	Members of local cooperatives (Toba Craft Association)

2. Stakeholder Engagement

- Lahore:

o Designers: Bareeze, ChenOne (luxury adaptations)
o Policymakers: Punjab Small Industries Corporation (PSIC)
• Faisalabad:
o Textile engineers: National Textile University
• Jhang/Toba Tek Singh:
o NGOs: Hunar Foundation (rural training programs)

3. Consumer Research
• Urban (Lahore/Faisalabad): shopping malls (Emporium Mall), online platforms (Daraz.pk)
• Rural (Jhang/Toba): Local craft fairs (Jhang Mela)

Data Collection Methods
Primary Data
1. **Interviews**
o Languages: Urdu + regional Punjabi dialects (Majhi in Lahore, Jhangvi in Jhang)
o Themes:
▪ Lahore: Competitiveness of machine-made vs. handmade Phulkari
▪ Jhang: Preservation of traditional Chope motifs in digitization

2. **Focus Groups**
o Faisalabad: Bridging industrial technology with artisan skills
o Toba Tek Singh: Cost comparison of cotton vs. silk Phulkari

3. **Case Studies**
o Lahore: Pakistan Craft Council's digital pilot programs
o Faisalabad: Interloop Limited's Phulkari experiments

Secondary Data
• Punjab Skills Development Fund (PSDF) training reports
• Lahore Chamber of Commerce export statistics
• Punjab EPA environmental impact data

Data Analysis
Qualitative Analysis
1. Thematic Mapping
o District-level digitization readiness (e.g., Lahore = high, Jhang = low)
2. SWOT Analysis
o Example: Faisalabad's industrial strengths vs. artisan wage suppression

Quantitative Analysis
1. District-Wise ANOVA
o Production time/cost comparisons (urban vs. rural)
2. Spatial Regression
o Correlation between district GDP and Phulkari demand

Key Regional Insights

District	Opportunities	Challenges
Lahore	Luxury digital exports	Artisan exploitation risks
Faisalabad	Bulk production capabilities	Loss of handmade authenticity
Jhang	Rare motif preservation	Limited technology infrastructure
Toba Tek Singh	Affordable cotton products	Competition from Indian imports

Policy and Practical Implications
1. **Government Action**
o Targeted digitization grants (e.g., PSIC subsidies for Jhang artisans)

2. **Industry Innovation**
o Hybrid production models combining:
▪ Laser precision (Faisalabad)
▪ Hand embroidery (Jhang)

3. **Cultural Preservation**
o Digital archiving of traditional motifs:
▪ Chope patterns (Jhang)
▪ Bagh styles (Toba Tek Singh)

Findings: Digital Transformation of Phulkari Embroidery in Punjab, Pakistan

1. Artisan Perspectives on Digital Adoption

A. Challenges in Traditional Phulkari Production

- **Time-Intensive Process**:
  - 92% of artisans reported requiring 200-350 hours to create a single Phulkari shawl by hand (Jhang, Toba Tek Singh)
  - Only 18% of artisans under 35 in Faisalabad planned to continue traditional methods due to low wages (PKR 500-1,000/day)

- **Health Impacts**:
  - 78% of female artisans in Lahore and Kasur reported chronic joint pain and eye strain from prolonged stitching

- **Intergenerational Decline**:
  - 65% of parents in rural Jhang indicated their children refused to learn hand embroidery

B. Willingness to Adopt Digital Methods

- **Mixed Responses**:
  - 58% acceptance in Lahore and Faisalabad if design authenticity was maintained
  - 32% resistance in Jhang and Chiniot ("loss of craft soul")
  - 10% uncertain but interested in training (Toba Tek Singh)

- **Key Concerns**:
  - "Will digital Phulkari still be considered our cultural heritage?" (Jhang artisan)
  - "How will we support our families if machines replace our work?" (Toba Tek Singh self-help group member)

2. Production Efficiency Comparison

Parameter	Handmade (Lahore, Jhang)	Digital Printing (Faisalabad)	Laser Cutting (Lahore Industrial Zone)
Time per Shawl	200-350 hours	4-6 hours	2-3 hours
Production Cost	PKR 15,000-25,000	PKR 5,000-8,000	PKR 3,500-6,000
Fabric Waste	15-20%	<5%	3-7%
Energy Use	Low (manual)	Moderate	High

Key Findings:

- Digital methods reduced production time by 95% and costs by 60-75%
- Laser cutting enabled intricate micro-patterns impossible by hand (Faisalabad Textile University trials)
- Trade-off: Digital outputs lacked tactile quality valued by purists (Lahore markets)

3. Industry and Designer Perspectives

A. Case Studies

- **The Phulkari Collective (Lahore)**:
  - Achieved 40% faster market delivery through digital printing
  - Premium prices 25% lower than handmade equivalents.

- **Punjab Digital Craft (Faisalabad)**:
  - Hybrid technique increased urban millennial sales by 30% (Emporium Mall)

B. Sustainability Benefits

- 70% water reduction in digital printing (National Textile University)
- Laser cutting aligned with zero-waste objectives (Punjab EPA)

4. Consumer Perceptions (N=220)

A. Product Preference

- 62% preferred handmade for weddings/gifts (Lahore, Jhang)
- 28% favored digital for affordability (Faisalabad urban centers)
- 10% indifferent if aesthetics maintained (Karachi sample)

B. Price Sensitivity

Product Type	Price Range (PKR)	Market Acceptance
Handmade Phulkari	25,000-50,000	Traditional buyers
Digital Printing	7,000-14,000	Budget-conscious
Hybrid Production	12,000-25,000	45% of respondents

5. Cultural Impact Analysis

Emerging Themes:

1. **Tradition vs. Innovation**:
   - Designers (Lahore): Technology as evolution
   - Master artisans (Jhang): Craft as cultural identity
2. **Economic Anxiety**:
   - Rural artisans (Toba Tek Singh) feared automation displacement
3. **Youth Engagement**:
   - Digital-native artisans proposed Instagram marketing (Lahore Design School)

Regional Highlights

District	Key Finding	Policy Implication
Lahore	High hybrid model adoption	Luxury market development
Faisalabad	Industrial efficiency leader	Technology subsidies
Jhang	Cultural resistance/design preservation	GI tag protection
Toba Tek Singh	Rural digitization challenges	Infrastructure investment

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Academic Contribution:

- First cross-district study of Phulkari digitization in Pakistani Punjab
- Provides comparative data with Indian Punjab (Craft Revival Trust)

Policy Recommendations:

1. **Punjab Skills Development Fund**: Prioritize digitization training.
2. **Punjab Small Industries Corporation**: Subsidize laser-cutting equipment
3. **Cultural Preservation**: Digital archives for traditional motifs

Discussion: Digital Transformation of Phulkari in Punjab, Pakistan

1. Technological Adaptation and Cultural Preservation

Our findings reveal a complex interplay between technological advancement and cultural preservation in Phulkari digitization. The 95% reduction in production time and 60-75% cost savings (Faisalabad industrial trials) confirm digital technologies' economic viability (Ahmed, 2020). However, the 32% resistance rate among Jhang and Toba Tek Singh artisans substantiates Mehta's (2019) Craft Innovation Theory, highlighting technology's dual capacity to both disrupt and revitalize traditional crafts. This tension manifests most acutely in:

- **Urban-Rural Divide**: While Lahore designers view digitization as evolutionary progress, Jhang artisans perceive it as cultural erosion (Dhawan, 2017).
- **Generational Shift**: The preference for hybrid models (45% consumer acceptance) aligns with Wilson's (2021) cultural hybridity model, suggesting a middle path for craft evolution

2. Sustainability Trade-offs

The environmental data presents both opportunities and challenges:

Sustainability Metric	Digital Printing	Laser Cutting	Traditional
Water Consumption	70% reduction*	-	Baseline
Energy Use	Moderate	High**	Low
Material Waste	<5%	3-7%	15-20%

*Faisalabad Textile University data
**Lahore industrial zone measurements

While digital methods significantly reduce water usage (Fletcher, 2019), the high energy demands of laser cutting (Kumar & Pandit, 2022) necessitate renewable energy solutions, particularly in Faisalabad's industrial clusters.

3. Economic and Social Implications

A. Artisan Livelihoods

The 50-70% income reduction in hybrid models (Thakur, 2021) underscores the need for:

- **Upskilling Programs**: CAD training at Hunar Foundation, Toba Tek Singh.
- **Equitable Pricing**: 30-40% profit margins for artisans (Punjab Small Industries Corporation)

B. Market Dynamics

The PKR 12,000-25,000 price range for hybrid Phulkari reflects consumers' willingness to pay for:

- Authenticity (hand-embroidered elements)
- Technological precision (laser-cut bases)

4. Policy and Implementation Challenges

Key Recommendations:

1. **Cultural Protection**:
   - Expanded GI tags to differentiate digital/handmade variants
   - Digital archives for Jhang's Chope motifs
2. **Sustainable Implementation**:
   - Solar-powered laser units in Faisalabad
   - Water recycling systems for digital printing
3. **Regional Development**:
   - Toba Tek Singh: Rural digitization hubs
   - Lahore: Luxury hybrid production centers

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5. Study Limitations and Future Directions

Current Constraints:

1. **Geographic Focus**: Excluded Sindh/KPK variants
2. **Temporal Scope**: Lacks longitudinal data on skill erosion.
3. **Sample Bias**: Urban-dominated consumer data (70% Lahore/Faisalabad)

Research Priorities:

1. **Longitudinal Studies**: 5-year impact assessment in Jhang.
2. **Cross-Border Analysis**: Comparison with Indian Punjab's GI-tagged Phulkari.
3. **Technological Innovation**:
   - AI-assisted design (MidJourney pattern generation)
   - Blockchain for craft authentication

Conclusion

This study illustrates how Punjab, Pakistan's digital transformation of phulkari embroidery offers both r egionally specific benefits and constraints.

While qualitative research indicates considerable cu ltural opposition in rural settings (32% adoption vs. 58% urban), quantitative data indicates that digital approaches cut production time by 95% (from 275 to 5 hours per shawl) and expenses by 60-75%.

Hybrid models are a good middle ground, costing 2 5–40% more than digital-
only products while still being 35-
50% less expensive than handmade goods.

Three essential conditions for successful digitizatio n are highlighted by the study:

1) Implementation strategies tailored to the local co ntext,
2) Enhanced protections for intellectual property, a nd
3) Integrated protections for artisan livelihoods.

The results highlight the need to strike a balance be tween innovation and cultural
preservation, especially when it comes to safeguardi ng traditional knowledge and guaranteeing fair ben efits for artisans in both urban and rural communiti es, even as they show how
digital technology can improve sustainability, productivity and sales. Online platforms have provided new markets, allowing artisans to reach an expanded audience, work more efficiently and increase their global presence. Longterm effects on knowledge transfer between ge nerations and comparisons with other
digitized craft traditions should be the focus of futu re research.

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