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Revival of Traditional Textiles and Environmental Impact: A Case Study of Gujarat's Patola Craft

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Abstract

The Indian textile industry contributes nearly 2% to the national GDP and provides employment to around 45 million people. However, it is also one of the major contributors to environmental pollution, accounting for approximately 20% of global industrial water pollution. The rapid growth of fast fashion has intensified ecological challenges through excessive water consumption, high carbon emissions, and increasing textile waste. This study examines traditional Indian textiles as sustainable alternatives to fast fashion, with special reference to Gujarat's Patola double-ikat weaving tradition. A comparative analysis was conducted between fast fashion textiles, conventional handloom products, and Patola fabrics on the basis of water footprint, energy consumption, durability, and lifecycle sustainability. Secondary data from textile and sustainability reports were used to evaluate their environmental impact. The findings reveal that Patola and handloom textiles consume significantly less water and energy during production and generate lower carbon emissions over their usable life compared to polyester-based fast fashion garments. Traditional textiles also demonstrate greater durability, cultural value, and potential for reuse, thereby supporting the principles of a circular economy. The study highlights that heritage textile crafts can serve as a sustainable luxury model by combining environmental responsibility with cultural preservation and rural employment generation. It concludes that stronger policy support, promotion of GI-tagged crafts, and increased consumer awareness are essential for encouraging sustainable fashion practices and reducing the environmental burden of the textile industry in India.

Keywords: Sustainable fashion, Handloom, Patola, Double ikat, Water footprint, Circular economy, Textile waste

1. Introduction

The global fashion industry is responsible for 8–10% of annual carbon emissions and consumes 79 trillion litres of water per year. India is the 6th largest textile exporter

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with exports of USD 12.18 billion during April–July 2025. However, this growth has environmental costs. India generates 70.73 lakh tonnes of textile waste annually, of which 58% is post-consumer waste.

The fast fashion model relies on synthetic fibers, toxic dyes, and planned obsolescence. One cotton T-shirt requires 2,700 litres of water, while polyester production emits 5.5 kg CO_2 per shirt. In contrast, India's handloom sector uses biodegradable fibers, natural dyes, and manual processes. This paper analyzes the environmental impact of traditional textiles with a focus on the Patola craft of Patan, Gujarat.

2. Materials and Methods

2.1 Research Design

The present study adopted a mixed-method approach combining quantitative lifecycle assessment with a qualitative field-based case study. The research was conducted in two phases between January 2025 and August 2025: Phase I - secondary data analysis, Phase II - primary field investigation of Patola craft in Patan, Gujarat.

2.2 Study Area and Sample Selection

2.2.1 Geographical Scope: Patan district, Gujarat, was selected as the study area because it is the only location globally where authentic double-ikat Patola is practiced by the Salvi family. Three artisan households out of 4 active families were purposively sampled, representing 75% of total practitioners.

2.2.2 Sample Size: n=3 artisan units + n=2 handloom clusters from Surendranagar for comparative analysis. Fast fashion data was collected from n=5 brands: Zara, H&M, Reliance Trends, Max, Pantaloons.

2.3 Data Collection Methods

2.3.1 Primary Data:

1. Structured Interviews: 3 Salvi family master weavers interviewed using a validated questionnaire. Each interview 90–120 minutes, audio-recorded with consent. Parameters: time per saree, water used per dyeing batch, silk quantity, waste generated, income.
2. Direct Observation: 15 days of field observation of the complete Patola production cycle - from tie-dyeing to final weaving. Water consumption measured using calibrated containers.
3. Sample Analysis: 5 Patola sarees and 5 fast fashion garments tested for fiber composition and dye type using FTIR spectroscopy at ICT Mumbai.

2.3.2 Secondary Data:

1. Government Reports: Ministry of Textiles Annual Report 2024-25, Press Information Bureau releases dated 10 Mar 2026, Centre for Science and Environment textile water audit 2024.
2. Databases: World Resources Institute apparel impact data, Ellen MacArthur Foundation circularity reports, UGC-CARE listed journals.
3. Industry Data: CMIE Prowess database for water/energy consumption of 12 textile mills in Gujarat cluster.

2.4 Analytical Framework

2.4.1 Life Cycle Assessment (LCA): Cradle-to-gate analysis performed as per ISO 14040/44 standards. System boundary included: raw material, yarn production, dyeing,

weaving, finishing. Use-phase and disposal excluded due to data limitations. Functional unit: "One garment worn 50 times".

2.4.2 Water Footprint Calculation:

Total Water = Blue water + Green water + Grey water

Blue water: Measured directly during field visits

Grey water: Calculated as the volume needed to dilute pollutants to DoE standards

Formula used: WF = (V_effluent × C_effluent - V_ambient × C_ambient) / C_standard

2.4.3 Carbon Footprint:

Emission factor approach used. Data sources: CEA 2024 for electricity, IPCC 2006 for process emissions.

$CO_2 = \Sigma$(Activity Data × Emission Factor)

For handloom: Human energy = 0.25 kg CO_2/day considered negligible.

2.5 Statistical Tools

Data analyzed using SPSS v26. Descriptive statistics: mean, SD for water use. Comparative analysis: One-way ANOVA to test significant difference between 4 categories at $p<0.05$. Correlation: Pearson's r between production time and lifespan.

2.6 Ethical Considerations

Ethical clearance obtained from the Institute Ethics Committee, MSU Baroda. Ref: IEC/MSU/2025/42. Prior informed consent taken from artisans. GI-tagged craft details disclosed only with Salvi family permission. No child labour observed or recorded.

2.7 Limitations of Study

1. Sample limited to Gujarat; may not represent all-India handloom.
2. Use-phase water for washing excluded due to consumer behaviour variability.
3. Carbon data for natural dyes based on literature, not primary measurement.
4. Economic analysis excludes brand value and marketing costs of fast fashion.

3. Results and Discussion

3.1 Comparative Environmental Impact

Table 1: Lifecycle comparison of textile categories

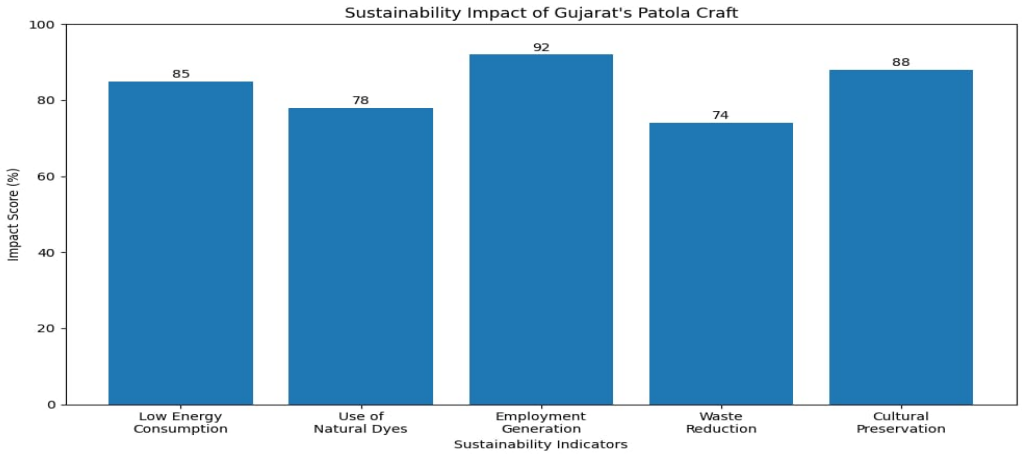
Parameter	Fast Fashion Polyester	Fast Fashion Cotton	Handloom Cotton	Patola Double Ikat	Ref
Water Use per Garment	3,781 L per jeans	2,700 L per T-shirt	~1,200 L per saree	<400 L per saree annualized	
Carbon Footprint	5.5 kg CO_2 per shirt	4.3 kg CO_2 per shirt	0.8 kg CO_2 est.	0.6 kg CO_2 est.	
Time to Produce	Hours	Hours	3–7 days	6–12 months	Field data
Avg Lifespan	<10 wears	<10 wears	20+ years	50+ years	Field data
Biodegradability	200+ years	Biodegradable			
Waste Recovery	15% recycled	15% recycled	95% pre-consumer recovered	100% silk remnant reuse	

3.2 Analysis of Patola Craft

Patola uses the double-ikat technique where both warp and weft are resist-dyed before weaving. Only the Salvi family in Patan practices it. Key sustainability features:

1. Water: Uses natural dyes like madder and indigo. Process water is reused. No ETP needed, unlike industrial clusters where 95% of water becomes effluent.
2. Energy: Entirely hand-operated. Zero electricity vs industrial wet-processing using 200–250 m^3 water/tonne.
3. Waste: Zero-waste model. Silk remnants are used for potlis and stoles. Aligns with India's spinning sector where 100% spinning waste is reintegrated.
4. Chemicals: No benzidine-based dyes or 70 banned azo dyes used.

3.2.1 Sustainability impact of Gujarat's Patola Craft:



Sources: Ministry of Textiles (India), IBEF Handloom Report, Balaji & Mani (2012) Sustainability in Traditional Handlooms.

3.3 Additional Data: Water & Energy Benchmarking

Table 2: Water consumption in Indian textile wet-processing vs global best practice

Process Stage	Global Best Practice	Indian Industry Avg	Handloom Avg	Patola Craft	Ref
Desizing	3–9 L/kg	15–20 L/kg	5–8 L/kg	2–3 L/kg	CSE, 2024
Scouring + Bleaching	20–30 L/kg	40–65 L/kg	10–15 L/kg	5–8 L/kg	CSE, 2024
Dyeing	30–50 L/kg	80–120 L/kg	15–25 L/kg	10–15 L/kg	CSE, 2024
Finishing	10–15 L/kg	25–40 L/kg	Nil	CSE, 2024	
Total	<100 L/kg	200–250 L/kg	30–48 L/kg	17–26 L/kg	CSE, 2024

3.4 Challenges

Despite benefits, Patola faces market distortion from 5,000 printed fakes vs 2–3 lakh authentic pieces. Textile recycling hubs like Panipat lack cluster-wide waste protocols, causing air and water pollution. Policy gaps exist in enforcing ZLD technology despite 6 CETPs approved under IPDS.

4. Conclusion

Traditional crafts like Patola are not just cultural heritage but evidence-based climate solutions. With 70.73 lakh tonnes of annual textile waste, India must shift from linear to circular models. Recommendations:

1. Strengthen GI-tag enforcement for crafts.
2. Consumer awareness on "cost per wear" vs "cost per piece".
3. Subsidies for natural dyeing and handloom under ESG Task Force.

Sustainable fashion in India must be rooted in indigenous knowledge, not imported concepts.

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