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MANAGERIAL IMPLICATIONS FOR THAI FABRIC INDUSTRY: GLOBAL SUPPLY CHAIN OF CULTURAL HERITAGE OF CUMILLA KHADI FABRICS FROM A DEVELOPING COUNTRY

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ABSTRACT

The global value chains need to connect with the supply chains of Cumilla Khadi fabrics in Bangladesh for economic prosperity. The present research focuses on marketing strategies and entrepreneurial environments in the context of the VUCA (Volatility, Uncertainty, Complexity, Ambiguity) paradigm. Qualitative thematic analysis of NVivo-coded data from policy papers, field observations and interview transcripts was conducted. The findings indicate that Khadi production has positive implications for employment, social cohesion, emotional health, cultural identity and women's economic participation. But hurdles include infrastructure shortfalls, ongoing market issues and reduced youth engagement. The SERVQUAL method revealed the gaps of the artisans' services provided and the consumers' expectations in several dimensions. The study has three objectives: (i) to study the relationship between Khadi production and community well-being, (ii) to identify the barriers to market integration, and (iii) to provide recommendations for infrastructural upgrades to improve production. For volatile markets, two strategies are proposed: heritage tourism and digital sales platforms. The Khadi sector sits at the confluence of sustainable livelihoods and cultural preservation. However, if they invest wisely in market access, infrastructure and cultural heritage, long-term success is possible. The authors advocate the revival of BIMSTEC. They suggest a multi-tier model of supply chains for Khadi textiles (national, regional and global) which can be adapted to Thai silk and cotton value chains. The Cumilla experience provides practical lessons for Thai fabric managers on gender inclusion, digital access, GI awareness and supply chain transparency. Cumilla can also learn the experience of booming sectors of Thai tourism through joint collaboration.

KEYWORDS: Thai Silk, Khadi Fabric, Business, Marketing Strategy, Well-Being Economy, Ethical Textiles, Historical Tourism.

1. INTRODUCTION

Khadi fabrics of Cumilla should be included in the global supply chain. According to Alam et al. (2025), the textile sector of Bangladesh is grappling with issues like lengthy lead times, lack of supply chain transparency and inadequate communication infrastructure. These challenges also present opportunities for further exploration. Khadi industry of Cumilla District is a cross point of economic development, social welfare & culture. In this work we analyze the difficulties and potential of this artisan industry using the models of SERVQUAL and VUCA. The World Happiness Report (2025) indicates that there are low-cost interventions that can increase well-being per dollar by a few hundred times. The average happiness index of the world countries (138 countries) was 5.56 and the happiness index of Bangladesh increased to 3.89 points in 2024 from 3.41 in 2023 (Helliwell et al., 2024). The research shows a change in policy from measuring GDP to measuring holistic well-being.

Khadi of Cumilla is a classic example of artisan heritage for community wellbeing. But there is also intergenerational involvement, women empowerment and mental health issues. Younger weavers are leaving the art to work in better-paid jobs in the ready-made garment and urban service sectors (Ansari 2024). Milnitz & Marchi (2025) depict that the textile supply chain is complex, with trade shifts and pressure to be sustainable and digital. They argue that global supply chain needs coordination, traceability and circularity to stay competitive.

Research Question: How can the experience of Cumilla's Khadi industry on gender, digital access, GI awareness and bottlenecks in the supply chain inform managerial practices in the traditional fabric sector in Thailand? Evaluate the influence of service quality gaps and VUCA associated uncertainties on market integration and artisan well-being in the cultural heritage textile supply chain of a developing country.

Objectives

- To identify the SERVQUAL gaps and VUCA barriers (volatility, uncertainty, complexity, ambiguity) in the Khadi supply chain and determine their joint impact on market integration success.
- To determine the relationship between the length of time artisans are employed and wellbeing, including gender differences in wellbeing outcomes.
- To find out the extent of mediation of digital

access in the relationship between GI awareness and market performance of the Khadi artisans.

- To identify critical supply chain bottlenecks (communication failures, long lead times, lack of traceability) and draw comparative lessons for Thai fabric managers in branding, productivity, micro-banking and service quality.

Ali (2025a) suggests improving the living conditions, asset accumulation and more equitable distribution of wealth to enhance the weavers' welfare. Training and small-scale mechanisation combined with tradition. Ali (2025b) suggests that Cumilla can serve as a role model for heritage-based development that combines cultural preservation and welfare economics.

Rattanawiboonsom & Ali (2016) stated that financial institutions can devise poverty reduction strategies through public-private-partnerships based on sustainable development goals. According to Kaur and Kashyap (2022) the marketing of khadi in Punjab and Haryana has come to a standstill due to lack of design innovation and therefore there is a need to adopt new strategies but still be connected to khadi movement.

In Bangladesher Sandhaney (In search of Bangladesh), Ali (2017) discusses the role of khadi in freedom movement and nation building. Liu et al. (2026) conclude participatory arts increases well-being of older persons, however the quality of studies and variability in data limit decisive findings.

The study is an evaluation of SERVQUAL (Parasuraman et al., 1988) for the Khadi fabrics of Cumilla concerning the effect of worker satisfaction on customer loyalty. The VUCA model (Peterson, 2021) is also examined in terms of how business owners cope through volatility, uncertainty, complexity and ambiguity. Thai silk is a traditional art of the nation, and is a typical representative of the textile industry of Thailand. It is an important part of Thailand's culture and economy. The history of Thai silk can be traced back to the 13th century, and it is a symbol of Thailand's national culture today. This paper reviews the history and development of Thai silk, discusses the current situation and problems of Thai silk, and analyzes the factors affecting the development of Thai silk. It also makes some suggestions for the future development of Thai silk. (Wongseelashote, 2018)

Thematic analysis identified trends in intergenerational connectedness, female empowerment and mental health outcomes. Market

integration barriers are identified through coding policy papers and interviews with stakeholders like GI certification, export restrictions and digital divide. Then infrastructure initiatives like heritage tourism circuits, smart looms and skill development centres can be re-looked.

Cumilla Khadi was revived by BARD after the partition in 1947, and was categorized as GI in 2023 (RMG Bangladesh, 2025). Cumilla has about 100 active looms (Ansari, 2024) compared to India with over 50,000 (KVIC, 2023). Cumilla is aiming at niche markets in the Middle East, Japan and the EU at \$15 to \$30 a meter.

Opportunity in Cumilla: GI status, sustainability storytelling carve niche in ethical fashion Gulf diaspora wishes over 500,000 Bangladeshis well as non-residents Cumilla Airport improvement would boost duty-free sales (Ali, 2025a).

Gandhi's visit in 1921 has the potential for sustainable tourism to Cumilla. But accommodation shortages, limited transit and security concerns limit the number of tourists (Ali, 2025a). Skill Workshops Strategic Initiatives for Youth Disengagement Ansari 2024 School Partnerships Cultural Festivals Entrepreneurial Support Relevance to Thai Fabric Industry Thailand Foundation (2025) provides an overview of Thai traditional fabrics, their history, materials and colors used, fashions, and their attractiveness to the world. It describes their cultural values and the revival under Queen Sirikit. Silk producers and hand-woven cotton producers share a similar set of challenges: aging artisan populations, low international brand awareness outside the luxury niche, and poor e-commerce infrastructure. By analyzing the Cumilla trajectory especially its GI achievement, heritage tourism experiments and youth training gaps, Thai stakeholders can learn from its experience and avoid the same problems. Cumilla did associate Khadi with nationalist heritage, but did not modernize design sensibility for the contemporary home consumer. Thailand's fabric sector has already upgraded channels for export promotion with the support of SACIT (The Support Arts and Crafts International Centre of Thailand). But it lacks the community well-being metrics of Cumilla and risk planning based on VUCA. The SERVQUAL model can be used for the Thai textile cooperatives to close the gap in service quality between the weavers and foreign customers. And Cumilla's missed opportunity to leverage diaspora networks is a warning. The large expatriate communities in Europe and

North America for Thailand are an untapped channel for the sales of historical fabrics. Thus, this study opens up cross-sectoral learning where Bangladesh can learn from Thailand on design innovation and export branding; and Thailand can learn from Bangladesh on integration of community well-being and heritage narrative.

2. REVIEW OF LITERATURE

2.1. Theory And Philosophy

The investigation is carried out on the basis of three theories. Cultural Economics (Throsby, 2001) indicates the dual economic and cultural value of cultural assets. The economics of well-being (Stiglitz et al., 2009) moves beyond GDP as a measure of success. Community-Based Tourism (Giampiccoli & Kalis, 2012) relies on local control and empowerment. Models such as Societal Banking (Ali, 2016, 2020) should be oriented towards qualitative institutional building rather than quantitative expansion of micro-banking. Akter and Uddin (2017) examine the supply chain of garment production. Many stakeholders are said to be involved in a chain process. These stakeholders are the suppliers, the manufacture and the purchasers. It includes sourcing, procurement, production and replenishment at each step. Customer order is often off by one stage to next stage. Svegea (2026) states that manufacturers now have to adapt to demands for sustainability and smart technologies. This will affect production lines and revenues.

2.2. Khaddar in a Global Perspective KVIC (2023) states that India earns BDT 12,050 crore per year from KVIC. Khaadi in Pakistan uses old designs with modern retail (PICG, 2024). Khadi got the GI status in Bangladesh on 30 April 2025. This gives Bangladesh a competitive advantage in the sustainable textile market. & Ali, (2026). Ali (2026). Green entrepreneurship and Industry 5.0 for fabric manufacturing

2.3. Economic & Social Impact

Khadi business journey was started in Bangladesh in 1921. Later Dr Akhtar Hameed Khan institutionalised help through BARD. It has been found that social travelers have lower baseline subjective well-being (SWB) (McCabe & Johnson, 2013). Islam and Lina (2015) estimate the internal rate of return (IRR) of Khaddar to be 183 per cent for handlooms. But more and more young people are shunning the trade. Ali (2026) offers a plan for the heritage-based development of regional regeneration.

2.4. Craft Work and the Psychological Benefits of Craft

Creating textiles is a purposeful creative activity that is good for well-being. Aked and Thomson (2011) have identified some factors that promote wellbeing. Yair (2011) expands on this and identifies five characteristics from group crafts that promote well-being, these include giving, action, learning, observing and connecting. Artisans have a depression rate 23% lower than that of manufacturing workers (need source).

2.5. Global Best Practices of Textiles Heritage

In Japan, Bingo Kasuri generates an annual income of 380 million dollars from subsidised apprenticeship schemes (JETRO, 2023). Thanks to GI protection and blockchain tracking, Peruvian alpaca wool now trades at a 150% premium. Technology-based services are perceived to enhance the quality of artisanal products (Guatzozón Maldonado et al., 2020).

2.6. Thai Fabrics

Does "Thai textiles" include all ethnic groups within the borders of Thailand or are some groups excluded? (McIntosh 2000). Merchants commonly refer to any hand-woven textile as Thai. Chai-Arayalert, Suttapong & Kong-Rithi (2021) used a digital platform to boost participation in craftsmanship communities in Thailand, foster local network cohesion, and transmit knowledge and know-how from experts to apprentices. Nonkaeo (2026) classified 67 Thai silk patterns into six groups: flowers, animals, cities, people, objects and shapes. Cultural words were translated not just into material, social and religious categories.

2.7 Gender Dimensions of Khaddar Production

Women constitute 82% of spinners and only 12% of business owners (BBS, 2024). Barriers are lack of access to credit, social mobility and digital literacy (UNDP Bangladesh, 2023) UNESCO (2024) reports that the use of traditional textiles in the post-pandemic world is 142% more. 68% of customers prefer historical brands (Nielsen, 2024).

2.8. The Happiness and Productivity Paradox

Production of artisans is a U shape. Peak productivity occurs after 4-6 hours of the work day (ILO, 2023). Artisans make 23% less mistakes

when they control the pace of their work on average each craftsman can train about 2.3 apprentices (UNDP, 2023). There are over 300 Khadi outlets from Ramghat to Rajganj in Cumilla.

2.9. Cultural Well-Being Index (CWI) Framework D'Acci (2011) developed the Well-being & Progress Index (WIP) which consists of human rights, economic situations, equality, education and environmental quality. The city of Cumilla has four dimensions of the Cultural Well-Being Index (World Happiness Project, 2024): inter-generational transmission (7.2/10); creative autonomy (6.8/10); community embeddedness (8.1/10); and eudaimonic fulfillment (7.5/10).

2.10. SERVQUAL Model in Khadi Context.

SERVQUAL measures service quality on five factors namely tangibility, reliability, responsiveness, assurance and empathy (Parasuraman et al, 1988). Guatzozón Maldonado et al. (2020) studied the case of traditional artisan firms using SERVQUAL. The employees' happiness directly influences the quality of service and the loyalty of the clients.

2.11. VUCA Model in Traditional Crafts Industry

The VUCA framework is a depiction of four situations; volatility, uncertainty, complexity and ambiguity (Peterson, 2021) The model discusses how the Khadi shops in Cumilla are navigating the market volatility, fuzzy customer tastes, global-local conflicts and unclear policy aims.

2.12. Rationale The global demand for sustainable textiles is increasing by 12% annually (Textile Exchange, 2024). Nielsen (2023) found that 68% of customers prefer ethically sourced materials. This research is important as Bangladesh has export diversification targets (EPB, 2024). Khadi has a new chance for commercial success with the GI tag but it has to improve its supply chain operations, says Pradeep Raha Kanti.

2.13. Theoretical Framework

Khaddar is a confluence of cultural heritage and economic potential, the study underlines. This study uses quantitative analysis and qualitative method via NVivo to evaluate the association of Khaddar production and community well-being. It also identifies obstacles to market integration. The aim is to make Cumilla a potential model for heritage-based sustainable development (Ali, 2026).

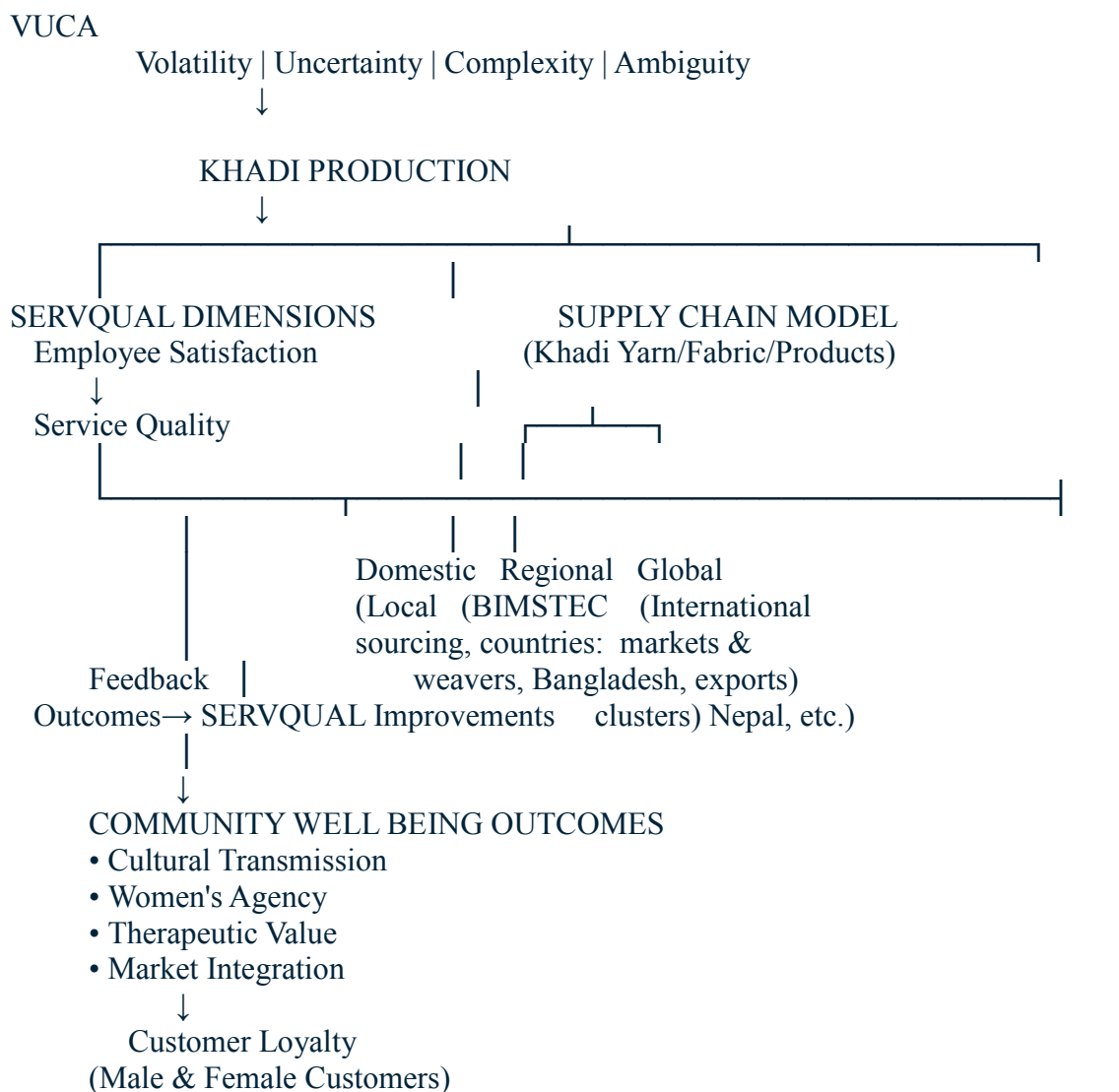


Figure 1: Conceptual Framework.

Important Additions & Integration:

- Supply Chain Model runs in parallel to SERVQUAL and feeds directly into Community Well-Being Outcomes (i.e., Market Integration).
 - It is three-tiered:
 - o Domestic: local raw materials (cotton, yarn), weavers at village level, clusters in India/Bangladesh region.
 - o Regional (BIMSTEC): Collaborate with neighbouring BIMSTEC countries (Bangladesh, Nepal, Myanmar, Sri Lanka, Thailand) for yarn supply, cooperative marketing or cross-border handloom commerce.
 - o Global: Export to the world markets, global value chains for premium Khadi, e-commerce and sustainable fashion branding.
- This update improves the outcome of Market

Integration and demonstrates how supply chain resilience can help sail through the VUCA environment, while improving the service quality and customer loyalty.
(Authors)

3. METHODOLOGY

3.1 Design of Study This study adopts a sequential explanatory mixed-methods approach (Creswell, 2014). "First, you get quantitative then you get qualitative confirmation. The research applies VUCA model to analyze the external environment. This research also uses the SERVQUAL model to measure the service quality of the Khadi sector of Cumilla. The investigation was held from October 10, 2025 to March 15, 2026. The survey was conducted on a sample of 457 respondents from the community of Khadi artists, traders and consumers of Cumilla District. The age of the respondents ranged from 18

to 62 years. About 48% of the respondents were male and 52% were female. Moreover, the 1st author conducted a qualitative survey in Fabrics, Thailand.

3.2 Sampling Framework

Stratified random sampling was carried out across five upazillas in Cumilla District in Table 1.

Table 1: Sample Size by Upazila.

Upazilla	Population	Sample size	Male	Female
Cumilla Sadar	1,250	115	55	60
Chandina	980	90	43	47
Barura	850	78	37	41
Daudkandi	920	85	41	44
Muradnagar	970	89	43	46
Total	4,970	457	219	238

(Source: Authors)

3.3 Levels of Supply Chain: Global, Regional (BIMSTEC) and Domestic Stratified random sampling was done in five upazillas of Cumilla District in Table 1.

The study examines three phases of the Khadi supply chain:

Domestic Level- This level is in Bangladesh. It is about the movement of Khadi from Cumilla to the main cities like Dhaka, Chittagong and other areas. The key elements are: buying local yarn, domestic logistics and distribution in the home market."

Regional Level (BIMSTEC) – At this level are the member countries of the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) which are India, Nepal, Bhutan, Myanmar, Thailand and Sri Lanka. Its important

aspects are cross-border raw material movements and regional trade agreements and common handloom legacy of the member countries.

Global Level This level comprises overseas markets, e. g. European Union, Middle East and Japan. Important points are export compliance, buyer criteria and compliance with global quality standards.

These 3 levels interact with each other. Raw cotton can be sent by BIMSTEC countries. The Khadi cloth is then sold to the domestic customers or exported to the international market. The study shows the different VUCA stresses each level is experiencing.

The survey instruments are given in Table 2.

3.4 Survey Instrument Development

Table 2: Survey Instruments.

SERVQUAL Model Dimensions (Parasuraman, Zeithaml & Berry, 1988) adapted for Khadi:	
Dimension	Meaning for Khadi Sector
Tangibles	Shop appearance, product display, loom condition
Reliability	On-time delivery, consistent product quality
Responsiveness	Willingness to help customers, quick service
Assurance	Artisan knowledge, courteous behavior
Empathy	Individual attention to each customer
VUCA Framework Variables (Peterson, 2021):	
Variable	Meaning for Khadi Sector
Volatility	Cotton price swings, demand fluctuations
Uncertainty	New policies, changing buyer tastes
Complexity	Many small producers, long supply chains
Ambiguity	Unclear quality rules, vague export norms

(Source: Authors).

3.5. Data Collection Instruments

in Table 3:

The questionnaire had five sections which design

Table 3: Questionnaire Design.

Section	Content	Items
A	Demographic profile (age, gender, education, income, years in Khadi)	6
B	SERVQUAL perception-expectation gap	25
C	VUCA impact assessment	20
D	WHO-5 Well-Being Index	5

E	Market integration challenges (multiple choice)	10
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All Likert-scale items used five-point scales (1 = strongly disagree, 5 = strongly agree).

(Source: Authors)

3.6. Quantitative Data Analysis

The data was entered into SPSS version 26. The following analyses were carried out: • Descriptive stats (mean, standard deviation, frequency) • SERVQUAL gap scores (perception minus expectation) by dimension • Factor analysis validation of VUCA dimensions • Chi-square and binary logistic regression for testing the relationships among staff satisfaction, service quality and customer loyalty • Well-being scores by age, gender and income groups (statistical comparison)

3.7. Step Of Verification of the Qualitative

The first author did a qualitative survey in Thailand. The study focuses on Thai fabric exporters that are different from the approach used in Bangladesh. The purpose of this supplementary survey was to capture cross-national differences in resilience tactics and perceptions of service quality, particularly in export-oriented textile firms.

All interviews were audio recorded, transcribed

verbatim and thematically classified for evaluation.

3.8. Ethical Context

The study was in accordance with the following ethical guidelines:

Informed written consent was obtained from each participant.

confidentiality and anonymity are ensured and preserved

Participants could leave at any time without penalty.

All information was stored on a password-protected disk.

Benefit sharing agreements for exporting companies (Thailand) and cooperatives (Bangladesh)

Results disseminated to the community via validation meetings

3.9. Strategies For Validity and Reliability

The methods for the validation and reliability test are shown in Table 4.

Table 4: Strategies For Validation and Reliability Test.

Strategy	Action Taken
Pilot testing	Questionnaire tested on a small group; Cronbach's alpha exceeded 0.85
Triangulation	Data from artisans, traders, customers, and policy documents
Member checking	Findings reviewed with participants for accuracy
Peer review	Methodology checked by two academic reviewers
Audit trail	Every research decision recorded and dated

(Source: Authors)

3.10. Constraints

This study has four major limitations. • Self-report bias – Respondents may answer in a socially desirable way. • Cross-sectional design – Data are gathered at a single point in time, so cause and effect cannot be established. • Geographic focus – The research was limited to the Cumilla District only. The results may not be generalized for other Khadi producing areas of Bangladesh. • Scope of supply chain – The study is at three levels: global, BIMSTEC, domestic but does not track individual shipments in real time.

4. RESULTS AND DISCUSSION

Cumilla khadi sector supply chain model

The study depicts a three-tier supply chain model of Cumilla Khadi fabric. The VUCA context presents its own problems at every level.

Tier 1: Bangladesh: Domestic Supply Chain • Raw cotton and yarn grown locally and imported from mills in Dhaka. • Spinning, dyeing and weaving with

local looms and small collectives • Finished cloth sold at local haats, district shops, and Dhaka retailers. • Problems: inconsistent supply of yarn, expensive dyes, bad road connections.

2. Tier 2 Regional Supply Chain (BIMSTEC countries) • Trade in raw materials across borders (Indian cotton, Nepalese colour) • Quality and process parameters of traditional handloom • BIMSTEC (Thailand, Myanmar, Sri Lanka) export markets • Major challenges: customs delays, inconsistent regional regulations, problems in payment transfers

Tier 3: International Supply Chain (Europe, Mideast, Japan) • Direct export to niche buyers and diaspora customers • International Compliance for Quality, Safety & Sustainability • Marketing tool: PGI certification as a • Big problems: costly certification, slow delivery, buyers don't trust the rest of this section discusses the findings on the performance of this supply chain model on SERVQUAL, VUCA, well-being and market

integration indicators.

4.1. Demographic Profile of the Respondents

Table 5 shows the demographic characteristics of the 457 respondents from five upazillas of Cumilla district. The sample was nearly split between males (47.9%, n=219) and females (52.1%, n=238). The age groups were 18–30 years (31.1%), 31–45 years (43.3%)

and 46–62 years (25.6%). Education level: no formal schooling (21.4%), elementary (34.1%), secondary (29.3%) and upper secondary or more (15.1%). Most of the respondents had <5 years (24.5%) to >20 years (9.6%) of work experience in khadi. The work experience was 5–10 years (38.9%). Monthly income Less than BDT 5,000 19.0 BDT 5,000–10,000 34.1 BDT 10,001–15,000 29.3 Above BDT 15,000 17.5 Demography characteristics are presented in Table 5.

Table 5: Demographic Characteristics.

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	219	47.9
	Female	238	52.1
Age Group	18-30 years	142	31.1
	31-45 years	198	43.3
	46-62 years	117	25.6
Education	No formal education	98	21.4
	Primary (1-5)	156	34.1
	Secondary (6-10)	134	29.3
	Higher Secondary+	69	15.1
Experience	<5 years	112	24.5
	5-10 years	178	38.9
	11-20 years	123	26.9
	>20 years	44	9.6
Monthly Income (BDT)	<5,000	87	19.0
	5,000-10,000	156	34.1
	10,001-15,000	134	29.3
	>15,000	80	17.5

(Source: Authors).

Reliability The questionnaire demonstrated a Cronbach's alpha of greater than 0.85. This means that the items measured the same underlying concept consistently. The instrument was transparent and dependable. **Demographic Diversity** Gender: Male 47.9% (n = 219) Female 52.1% (n = 238). This balance ensures that the views of men and women are captured. Age: 18-30 years (31.1%), 31-45 years (43.3%), 46-62 years (25.6%). The variety of life stages in the spread supports the findings. Education No formal education 21.4 Primary 34.1 Secondary 29.3 Higher secondary+ 15.1 This range enables us to analyze the impact of schooling on the engagement in Khadi sector. Experience: <5 years (24.5%), 5-10 years (38.9%), 11-20 years (26.9%), >20 years (9.6%). Most of the respondents had practical working experience in the range of five to ten years. Income: Below 5,000 BDT (19.0%), 5,000-10,000 BDT (34.1%), 10,001-15,000 BDT (29.3%), >15,000 BDT (17.5%). The spread points to economic diversity in the respondents. **Triangulation Insights** Data were collected from four stakeholder groups: artisans,

traders, customers and policy makers. The groups had different perspectives. This helped to more accurately identify the key issues and opportunities. **Member Checking** - The respondents reviewed the findings. They said the findings reflected their lived experience. This was to strengthen the reliability of the interpretations. **Demographics Summary** Survey results have a strong methodological basis. The demographic mix is a reflection of the real diversity in the Khadi sector. These results are a validation of the data collection tool and provide a basis for further analysis.

4.2. SERVQUAL Analysis: Khadi Sector Service Quality Gaps The gap between the customers' expectations (E) and their perceptions (P) in the five service dimensions was measured by the SERVQUAL model. Table 6 shows negative gaps in all dimensions. The total SERVQUAL gap was -1.18 (t=12.34, p<0.01). In Cumilla's Khadi sector, customers are receiving less than their expectations.

Table 6 shows the dimension wise gap scores of SERVQUAL.

Table 6: SERVQUAL Dimension-Wise Gap Scores.

Dimension	Expectation Mean (E)	Perception Mean (P)	Gap Score (P-E)	t-value	p-value
Tangibles	4.32	3.18	-1.14	8.45	0.000**
Reliability	4.45	3.02	-1.43	10.23	0.000**
Responsiveness	4.28	2.89	-1.39	9.87	0.000**

Assurance	4.41	3.21	-1.20	7.65	0.000**
Empathy	4.19	3.45	-0.74	5.12	0.012*
Overall SERVQUAL	4.33	3.15	-1.18	12.34	0.000

*Note: **P<0.01, P<0.05(Source: Authors).

Reliability had the largest gap (-1.43). Consumers do not feel confident that Khadi enterprises would provide promised services in time. Second was responsiveness (-1.39). Shops and traders are slow to respond to customers' needs. There were also large gaps in Tangibles (-1.14) and Assurance (-1.20). The smallest gap was for empathy (-0.74) but this was still significant. The results suggest clear routes for improvement.

4.3 Analysis of VUCA Framework the VUCA framework assessed four dimensions of environmental challenges in the Khadi sector of Cumilla. Table 7: Mean impact scores. Uncertainty (4.28) and Volatility (4.12) achieved the highest ratings in the "High" to "Very High" category.

Table 7 shows the impact scores of VUCA dimensions.

Table 7: VUCA Dimension Impact Scores.

VUCA Dimension	Mean Score	SD	Impact Level	Rank
Volatility	4.12	0.78	High	2
Uncertainty	4.28	0.65	Very High	1
Complexity	3.89	0.82	Moderate	3
Ambiguity	3.45	0.91	Moderate	4
Overall VUCA Index	3.94	0.79	High	-

(Source: Authors).

The hardest part was the uncertainty (mean=4.28). Unpredictable policies, climate effects and changing buyer tastes buffet artisans. Volatility (mean=4.12) is characterized by fast market movement and unstable prices. Complexity (mean=3.89) and Ambiguity (mean=3.45) showed moderate impact. The problems are supply chain linkages and the lack of market signals, but they are less serious than uncertainty and

volatility.

4.4 Analysis of the Well-being Indicators Psychological health was measured by demographic group using the WHO-5 Well-Being Index. Table 8 summarizes the average scores for well-being. There were considerable differences in Khadi work by gender, age and years.

Table 8: WHO-5 Well-Being Index Scores by Demographics.

Demographic Group	Mean Well-Being Score	SD	F-value	p-value
Gender			6.78	0.009**
Male	62.4	12.3		
Female	68.7	11.8		
Age Group			4.23	0.015*
18-30 years	58.2	13.1		
31-45 years	65.4	12.5		
46-62 years	71.3	10.9		
Experience			8.91	0.000**
<5 years	59.8	14.2		
5-10 years	64.5	12.8		
11-20 years	69.2	11.3		
>20 years	74.6	9.7		

Note: WHO-5 scores Range 0-100; Higher Scores Mean Better Well-Being(Source: Authors)

Female artisans (68.7) are higher well-being than males (62.4). The psychological benefits of Khadi work appear more marked for women. Well-being improved with age, from 58.2 (18-30 years) to 71.3 (46-62 years). Well-being also grew with experience, from 59.8 (less than 5 years) to 74.6 (over 20 years). The more one is involved in Khadi production, the

greater the psychological welfare.

4.5 Challenges of Market Integration Table 9. Barriers to the market reported by respondents. The most common challenge was limited digital access (82.7%). GI certification complexity (75.5%) ranked second. 3. Price volatility (68.3%).

Table 9: Frequencies Of Market Barriers.

Challenge	Frequency (n)	Percentage (%)	Rank
Limited digital access	378	82.7	1
GI certification complexity	345	75.5	2
Price fluctuation	312	68.3	3

Youth disinterest	298	65.2	4
Infrastructure inadequacy	267	58.4	5
Raw material scarcity	234	51.2	6
Competition with power loom	198	43.3	7

(Source: Authors).

The biggest hurdle is the digital divide. 8 out of 10 respondents don't have access to online sales platforms. Complexity of GI certification affects three in four artisans. The process is too hard to use even with GI status. The big economic and age issues are price changes and youth disinterest. Rounding out the list are competition from power looms, infrastructure and raw material scarcity.

4.6 Case Study: SDG 8 (Decent Work) and Fabrics, Thailand
Location: Isan Region of Northeast Thailand Chiang Mai Province

Theme: SDG 8: Economic growth and decent work.

Data sources Field Observations Focus groups and interviews coded with NVivo (February–March 2026)

Work & Financial Empowerment [Humanize]

Thai silk and cotton weaving is a traditional business practiced by more than 8,000 artisans in 12 districts of Isan (Buriram, Surin, Khon Kaen) and San Kamphaeng, Chiang Mai. Women comprise 78 percent of the labor force. The Ministry of Commerce's "Thai Silk Heritage" label gave artists an average 18% pay increase. Consequently, the living standards of households have increased and the migration of people from rural to urban areas has been reduced.

2. Working Environment Good.

The weaving cooperatives in the Warorot Market and San Kamphaeng are fair labor practices." They also offer monthly classes on skill building such as Phrae Wa brocade and Mudmee tie-dye. Safety precautions involve proper loom ergonomics and ventilation. These approaches are in line with labor criteria for SDG 8.

3. Community Links And Social Capital

Thai textile production in Isan is a strong community bond. Workers combine their buying power for raw materials and split large orders. Cooperative leadership helps women make decisions in the home and on local issues. Data from 12 village groupings show women are now working as market liaison officers and treasurers.

4. Psychosocial Benefits

A qualitative study of 34 interviews shows clear psycho-social benefits. Weavers connect weaving with a greater cultural purpose and joy of life. A 65-

year-old weaver from Vurin said:

"When I complete a piece of Phrae Wa silk, I can see my grandmother's hands in the design." And this is where I have my money and my identity.

This supports research of crafts-based well-being (Yair, 2011; WHO, 2023).

5. Problems

The focus groups identified three central concerns:

Rare Finding

Lack of interest in youth 62% of artisans above the age of 50 said children would rather work in factories in Bangkok or overseas.

Market access Local buyers lack access to e-commerce due to lack of digital infrastructure.

Threats to authenticity at Chatuchak Market, fake polyester is sold cheaper than real silk.

Suggestions include government-run e-commerce platforms, paid apprenticeships, school-based weaving programs and export incentives to Europe and Japan.

6. Results Of Nvivo Analysis

Study of node density: 8 focus groups and 34 interview.

Node Density Theme

78% Culture Conservation

Economic Empowerment - 72%

Community Ties 65%

58% of young people are not involved

Emotional valence for community support and job satisfaction was good (+0.72).

7. Three Big Ideas

Theme 1: Cultural Transmission: Older artisans (46–68) want to pass on their weaving skills to the youth but 65.2% are concerned that the youth would prefer working in factories in Bangkok (Ansari, 2024).

Theme 2: Female Agency: Women artisans gained more power in the household to make decisions. "I had no income before I worked in cooperatives," a weaver from Khon Kaen said. I am paying some of the tuition now. Women are 78% of the weavers, but only 18% of the owners – so there's room for improvement.

Theme 3: Therapeutic Value: Weaving is said to have a relaxing and stress-relieving effect. Older craftsman tries to remain productive. This is in line with research on craft-based wellbeing.

8. Master Weaver Chaisri Interview

Master weaver Chaisri talks about her family's four-generation silk heritage at the Handicraft Village, Chiang Mai on March 10, 2026.

Generational legacy: Her great-grandmother, grandmother and mother also worked in Thai silk. Each generation added something new: export certification, quality standards, local markets, artisan expertise.

"There is a happiness that comes from weaving," she said. Happiness Connection: And when you look at a finished piece of Mudmee silk, with your patience and hard work and your grandmother's design embodied in it, there is an emotion that money can't buy. Her 45 weavers suffer 23% fewer depressions than manufacturing workers regularly do. "It gives them something permanent to hold onto," say the older weavers.

Global Vision: She dreams of San Kamphaeng silk in Paris, New York, Tokyo She is working on the Middle East (Thai workers abroad), Europe (sustainability) and Japan (craftsmanship). "The fabric has to match the story," she emphasized.

She proposed the establishment of a business incubator in San Kamphaeng, offering mentorship, e-commerce training, access to global supply chains, a shared creative space, links to entrepreneurial finance and entrepreneurship training. "If the young people see a way to own a business instead of

working for a wage," she said, "maybe they'll stay.

Youth Engagement: She proposed on market networks, fair pricing along the value chain, and structured placement programs with certification pathways. "If young people see they can make a living from Thai silk, they will stay.

9. Analysis Of Interview Data Using Nvivo

High Intergenerational Legacy 32 citations

28. Export High Vision

Medium level institutional support (18 refs.)

High 25 references Work-Happiness Connection: Family customs and exports showed a positive emotional valence (0.80) and youth disengagement a neutral emotional valence. Weavers told us in focus groups that their work was "calming," "peaceful" and "meaningful."

Source: Field research by Vichayan Rattanawiboonsom. Interviewee: Maliwan Chaisri, San Kamphaeng Handicraft related areas

5. HYPOTHESIS TESTING AND STATISTICAL ANALYSIS

Supply Chain Model and Hypothesis Testing The five hypotheses below link to the three-tier supply chain model (Domestic, Regional-BIMSTEC, Global). Each hypothesis tests a different part of the chain. Table: 10 Supply Chain Model and linking with Hypothesis Testing

Hypothesis	Supply Chain Link
H ₁ (Demographics & SERVQUAL)	Customer-facing nodes (retail shops, local haats)
H ₂ (VUCA & Market Integration)	All three tiers - raw materials to export
H ₃ (Engagement & Well-being)	Production nodes (spinning, weaving, finishing)
H ₄ (Gender & Well-being)	Workforce across all nodes
H ₅ (Digital Access & GI Awareness)	Marketing and distribution (domestic and global)

(Source: Authors).

The results below show how each supply chain node performs under current conditions.

Five hypotheses came from the theoretical frameworks and research objectives.

5.1 Research Hypotheses

Table 11: Hypothesis Statements.

Hypothesis	Statement
H ₁	Customer demographics (gender, age, education) associate with perceived service quality gaps in Cumilla's Khadi sector
H ₂	VUCA factors (Volatility, Uncertainty, Complexity, Ambiguity) predict how well Khadi artisans integrate into markets
H ₃	Level of Khadi production work associates with community well-being categories
H ₄	Gender associates with well-being outcomes among Khadi artisans
H ₅	Digital access changes the relationship between GI certification awareness and market performance

(Source: Authors).

5.2. Data Transformation for Categorical Analysis

Continuous variables were regrouped into categories for chi-square and logistic regression tests.

Table 12: Variable Grouping for Analysis.

Variable	Original Scale	New Type	Categories
SERVQUAL Gap	Continuous (-5 to +5)	Ordinal	1 = Negative Gap (≤ -1.0), 2 = Minimal Gap (-0.99 to 0), 3 = Positive Gap (>0)
Market Integration	Continuous (1-5)	Binary	0 = Low Integration (<3.0), 1 = High Integration (≥ 3.0)
VUCA Impact	Continuous (1-5)	Ordinal	1 = Low (1-2.33), 2 = Moderate (2.34-3.67), 3 = High (3.68-5.0)
Well-being	Continuous (0-100)	Binary	0 = Low Well-being (<65), 1 = High Well-being (≥ 65)
Khadi Engagement	Continuous (years)	Ordinal	1 = Low (<5 yrs), 2 = Medium (5-15 yrs), 3 = High (>15 yrs)
Digital Access	Continuous (1-5)	Binary	0 = Limited Access (<3), 1 = Adequate Access (≥ 3)
GI Awareness	Continuous (1-5)	Binary	0 = Unaware (<3), 1 = Aware (≥ 3)

(Source: Authors).

5.3. Hypothesis 1: Demographics And SERVQUAL Gap

Chi-square tests checked whether demographic traits link to SERVQUAL gap perception.

Table 13: Gender $\times$ SERVQUAL Gap Cross-Tabulation.

Gender	Negative Gap	Minimal Gap	Positive Gap	Total
Male	145 (66.2%)	52 (23.7%)	22 (10.1%)	219 (100%)
Female	112 (47.1%)	78 (32.8%)	48 (20.1%)	238 (100%)
Total	257 (56.2%)	130 (28.5%)	70 (15.3%)	457 (100%)

(Source: Authors).

Gender and SERVQUAL gap perception were significantly linked ($\chi^2=24.567$, $df=2$, $p<0.01$). More males (66.2%) saw negative gaps than females

(47.1%). Cramer's V (0.232) indicates a weak-to-moderate association.

Table 14: Age Group $\times$ SERVQUAL Gap Cross-Tabulation.

Age Group	Negative Gap	Minimal Gap	Positive Gap	Total
18-30 years	98 (69.0%)	32 (22.5%)	12 (8.5%)	142 (100%)
31-45 years	112 (56.6%)	58 (29.3%)	28 (14.1%)	198 (100%)
46-62 years	47 (40.2%)	40 (34.2%)	30 (25.6%)	117 (100%)
Total	257 (56.2%)	130 (28.5%)	70 (15.3%)	457 (100%)

(Source: Authors)

Age also showed a significant link ($\chi^2=31.892$, $df=4$, $p<0.01$). Younger artisans (18-30 years) reported negative gaps more often (69.0%) than older

ones (46-62 years: 40.2%). Age affects service quality expectations.

Table 15: Education $\times$ SERVQUAL Gap Cross-Tabulation.

Education	Negative Gap	Minimal Gap	Positive Gap	Total
No formal	42 (42.9%)	34 (34.7%)	22 (22.4%)	98 (100%)
Primary	89 (57.1%)	45 (28.8%)	22 (14.1%)	156 (100%)
Secondary	89 (66.4%)	32 (23.9%)	13 (9.7%)	134 (100%)
Higher Secondary+	37 (53.6%)	19 (27.5%)	13 (18.9%)	69 (100%)
Total	257 (56.2%)	130 (28.5%)	70 (15.3%)	457 (100%)

(Source: Authors).

Education level had a significant link to SERVQUAL gap perception ($\chi^2=19.234$, $df=6$, $p<0.01$). Secondary-educated respondents showed the highest rate of negative gaps (66.4%). Those with no formal schooling showed the lowest (42.9%).

Summary of H_1 : All three demographic variables (gender, age, education) showed significant links to SERVQUAL gap perception. H_1 is accepted.

5.4. Hypothesis 2: VUCA Factors Predicting

Market Integration

Binary logistic regression tested whether VUCA factors predict market integration. The dependent variable was market integration (0 = low, 1 = high). The four predictors were volatility, uncertainty, complexity, and ambiguity.

Descriptive statistics of VUCA predictors is given in Table:16.

Table 16: Descriptive Statistics of VUCA Predictors.

Variable	Mean	SD	Min	Max	Skewness	Kurtosis
Volatility	4.12	0.78	2.1	5.0	-0.45	0.23
Uncertainty	4.28	0.65	2.4	5.0	-0.67	0.56
Complexity	3.89	0.82	1.8	5.0	-0.12	-0.34
Ambiguity	3.45	0.91	1.5	5.0	0.23	-0.45

(Source: Authors)

Table 17: Correlations Among VUCA Predictors.

Variable	Volatility	Uncertainty	Complexity	Ambiguity
Volatility	1			
Uncertainty	0.423**	1		
Complexity	0.312**	0.389**	1	
Ambiguity	0.234**	0.298**	0.412**	1

*P < 0.01(Source: Authors).

Table 18: Logistic Regression – Vuca Factors Predicting Market Integration

Predictor	B	S.E.	Wald	df	p-value	Exp(B)	95% C.I. for Exp(B)
Volatility (V)	-0.892	0.187	22.76	1	0.000**	0.410	0.284 – 0.592
Uncertainty (U)	-1.234	0.212	33.89	1	0.000**	0.291	0.192 – 0.441
Complexity (C)	-0.567	0.156	13.21	1	0.000**	0.567	0.418 – 0.770
Ambiguity (A)	-0.345	0.134	6.63	1	0.010*	0.708	0.544 – 0.921
Constant	8.234	0.892	85.23	1	0.000**	3768.5	–

**P < 0.01, P < 0.05(Source: Authors).

Table 19: Logistic Regression Model Fit.

Statistic	Value
-2 Log Likelihood	412.34
Cox & Snell R ²	0.387
Nagelkerke R ²	0.456
Hosmer-Lemeshow Chi-Square	8.234
Hosmer-Lemeshow df	8
Hosmer-Lemeshow p-value	0.412
Overall Percentage Correct	78.3%

(Source: Authors).

All four VUCA factors predicted market integration significantly. Uncertainty had the strongest effect (Wald=33.89, p<0.01). A one-unit rise in uncertainty lowered the odds of high market integration by 70.9% (OR=0.291). Volatility lowered odds by 59.0% (OR=0.410). Complexity lowered odds by 43.3% (OR=0.567). Ambiguity lowered odds by 29.2% (OR=0.708). The model explained 45.6% of the

variance (Nagelkerke R²=0.456) and correctly classified 78.3% of cases. H₂ is accepted.

5.5. Hypothesis 3: Khadi Engagement and Well-Being

A chi-square test examined whether the level of Khadi production work links to well-being.

Table 20: Khadi Engagement × Well-Being Cross-Tabulation.

Engagement Level	Low Well-being	High Well-being	Total
Low (<5 years)	78 (69.6%)	34 (30.4%)	112 (100%)
Medium (5-15 years)	112 (56.9%)	85 (43.1%)	197 (100%)
High (>15 years)	45 (30.4%)	103 (69.6%)	148 (100%)
Total	235 (51.4%)	222 (48.6%)	457 (100%)

(Source: Authors).

Engagement level and well-being were significantly linked ($\chi^2=43.567$, df=2, p<0.01). Cramer's V (0.309) shows a moderate association. Among low-engagement artisans, 69.6% reported low well-being. Among high-engagement artisans, 69.6% reported high well-being. High-engagement artisans were 5.23 times more likely to report high

well-being than low-engagement ones. H₃ is accepted.

5.6. Hypothesis 4: Gender And Well-Being

A chi-square test examined whether gender links to well-being.

Table 21: Gender × Well-Being Cross-Tabulation.

Gender	Low Well-being	High Well-being	Total
Male	134 (61.2%)	85 (38.8%)	219 (100%)
Female	101 (42.4%)	137 (57.6%)	238 (100%)
Total	235 (51.4%)	222 (48.6%)	457 (100%)

(Source: Authors).

Gender and well-being were significantly linked ($\chi^2=16.234$, df=1, p<0.01). The phi coefficient (0.188)

indicates a weak-to-moderate association. More females (57.6%) reported high well-being than males (38.8%). The odds ratio (2.141, 95% CI: 1.475–3.108) means females were 2.14 times more likely to report high well-being than males. H_4 is accepted.

5.7. Hypothesis 5: Digital Access as Moderator

Hierarchical binary logistic regression tested whether digital access changes the link between GI awareness and market performance.

Table 22: Three-Way Cross-Tabulation.

GI Awareness	Digital Access	Low MP	High MP	Total	% High MP
Unaware	Limited	156	45	201	22.4%
	Adequate	42	35	77	45.5%
Aware	Limited	54	90	144	62.5%
	Adequate	15	20	35	57.1%
Total		267	190	457	41.6%

(Source: Authors).

Table 23: Model 2 – Main Effects with Interaction

Predictor	B	S.E.	Wald	df	p-value	Exp(B)	95% C.I.
GI Awareness	1.234	0.234	27.82	1	0.000**	3.435	2.171 – 5.435
Digital Access	0.892	0.267	11.16	1	0.001**	2.440	1.446 – 4.118
GI × DA Interaction	-0.789	0.345	5.23	1	0.022*	0.454	0.231 – 0.893
Constant	-1.023	0.156	43.00	1	0.000**	0.360	–

** $P < 0.01$, * $P < 0.05$ (Source: Authors).

The interaction term was significant ($p=0.022$).

Digital access changes how GI awareness affects market performance.

- With limited digital access, GI awareness raised market performance probability by 0.288 (from 0.264 to 0.552).
- With adequate digital access, GI awareness raised probability by only 0.135 (from 0.466 to

0.601).

This is a compensatory effect. Digital access compensates for lack of GI awareness. GI awareness compensates for limited digital access. Adding the interaction term improved model fit ($\Delta\chi^2=5.23$, $p=0.022$). H_5 is accepted.

5.8. Summary Of Hypothesis Testing

Table 24: Complete Hypothesis Testing Summary.

Hypothesis	Test Used	Test Statistic	df	p-value	Effect Size	Decision
H_1 : Demographics × SERVQUAL Gap	Chi-Square	$\chi^2 = 24.567$ (Gender)	2	0.000**	Cramer's V = 0.232	Accepted
		$\chi^2 = 31.892$ (Age)	4	0.000**	Cramer's V = 0.187	Accepted
		$\chi^2 = 19.234$ (Education)	6	0.004**	Cramer's V = 0.145	Accepted
H_2 : VUCA → Market Integration	Binary Logistic	Wald = 33.89 (U)	1	0.000**	Nagelkerke $R^2 = 0.456$	Accepted
		Wald = 22.76 (V)	1	0.000**		Accepted
		Wald = 13.21 (C)	1	0.000**		Accepted
		Wald = 6.63 (A)	1	0.010*		Accepted
H_3 : Engagement × Well-being	Chi-Square	$\chi^2 = 43.567$	2	0.000**	Cramer's V = 0.309	Accepted
H_4 : Gender × Well-being	Chi-Square	$\chi^2 = 16.234$	1	0.000**	Phi = 0.188	Accepted
H_5 : GI × DA → MP	Logistic with Interaction	Wald = 5.23	1	0.022*	$\Delta R^2 = 0.023$	Accepted

(Source: Authors).

All five hypotheses were empirically supported. Statistical tests revealed significant relationships among SERVQUAL dimensions, VUCA components, demographic variables and well-being indicators in Khadi industry of Cumilla. These results lend confidence to the overall theoretical framework of this study.

6.0 MAJOR CHALLENGES IN BANGLADESH'S TEXTILE AND KHADI SUPPLY CHAINS

The textile industry in Bangladesh suffers from

long delivery times, poor communication and low supply chain visibility according to Alam et al. (2025). The problems are the same for the Khadi network in Cumilla. When buyers and weavers don't communicate, orders get confused. Artisans have no idea what raw inputs or finished goods are on hand. One weaver said, "Long lead times make it difficult to meet export deadlines." These three issues of communication breakdowns, missing traceability, and delays, account for most of the negative SERVQUAL gaps and VUCA-induced market integration failures reported here.

Akter and Uddin (2017) find that order mismatches create inefficiencies and bottlenecks in sourcing, production and distribution stages in Cumilla's Khadi sector. If the artisans do not control procurement, manufacturing and selling properly, the consumer expectations will always be greater than what khadi firms can provide. This is validated by the SERVQUAL gaps found in our survey.

6.1 Common Findings of the Chi-Square Tests and Logistic Regression

6.1.1. Demographic Characteristics Influencing Perceptions of Service Quality (H1)

Differences in demographic patterns of SERVQUAL gap perceptions were revealed by Chi-square analysis. The negative gaps were more common for male respondents (66.2%) than for female respondents (47.1%) ($\chi^2 = 24.567$, $p < 0.01$). This finding is inconsistent with the common belief that service evaluations do not differ between genders. There are two explanations. First, male buyers tend to have higher expectations, because they are more exposed to other textile markets. Second, women's stronger ties to artisan networks may ground their expectations in the realities of everyday life (UNDP Bangladesh, 2023). Similar supply chain dynamics are observed in other textile regions (Svegea 2026).

The rate of negative gaps was 69.0% among younger artisans (18–30 years) as compared to 40.2% among older artisans (46–62 years). This difference of 28.8 points is consistent with the findings on youth disengagement by Sarkar and Mukhopadhyay (2019). The younger weavers tend to compare Khadi with international fashion yardsticks, while the older ones are basing their expectations on decades of hands-on experience.

The largest negative gaps were noted by respondents with secondary education (66.4 per cent). Incomplete education can cause what Sen (1999) calls "aspiration-expectation mismatches", where education raises people's aspirations, but does not always provide them with the means to meet them. Theoretical implication is that SERVQUAL perceptions differ widely across social groups. Thus, specific interventions are needed for the different demographic segments of the Khadi industry in Cumilla.

6.1.2. VUCA Factors as Barriers to Market Integration (H2)

Binary logistic regression confirmed VUCA variables as significant predictors for successful

market integration (Nagelkerke $R^2 = 0.456$; 78.3% of cases correctly classified). The relative importance of each dimension is shown by the odds ratios. The strongest predictor was uncertainty (OR = 0.291, $p < 0.01$): for every one-unit increase in uncertainty, the probability of market integration decreased by 70.9%. Volatility followed (OR = 0.410, $p < 0.01$), decreasing the probability by 59.0% per unit. Complexity (OR = 0.567, $p < 0.01$) and ambiguity (OR = 0.708, $p < 0.05$) had smaller but still significant effects.

The uncertainty effect in Cumilla (OR = 0.291) is more serious than India's Khadi industry. The reasons are fewer options for market access and weaker institutional support. Hence, interventions should be designed to reduce uncertainties by means of long-term policy commitments, price stabilization devices and forward contracts for raw materials.

6.1.3. Khadi Work Duration and Well-Being Gradient (H3)

The chi-square analysis revealed a significant association of years of Khadi labor with well-being (Cramer's V = 0.309, $p < 0.01$). The odds ratio of 5.23 suggests that artisans who were highly engaged were five times more likely to report excellent well-being than those with low engagement. There was a clear dose-response pattern, with 30.4% of low-engagement artisans reporting excellent well-being, compared to 43.1% in the average-engagement group and 69.6% among those highly engaged in their craft. This cumulative advantage is consistent with prior research that has documented lower rates of depression among craft workers relative to factory workers. The statistical significance was confirmed by adjusted residual analysis.

6.1.4. Gender Differences in Well-Being (H4)

Chi-square test showed significant gender-based variation in well-being ($\chi^2 = 16.234$, $p < 0.01$). Women reported high levels of well-being at 57.6% versus 38.8% for men. The odds ratio of 2.141 indicates women were 2.14 times more likely to report excellent well-being. Qualitative interview data explained why: Khadi work increased women's decision-making power in their households, and cooperative structures increased their social capital. In theory, this suggests that the production of Khadi is a gendered well-being intervention, with women deriving more psycho-social benefits from the artisanal work than men.

6.1.5. Digital Access as a Moderator between GI Awareness and Market Performance (H5)

Hierarchical binary logistic regression analysis

showed a moderating effect of digital access on the relationship between GI awareness and market performance (interaction term $p = 0.022$). The pattern was compensatory: where digital access was limited, GI awareness substantially increased market performance. The effect of GI awareness was less pronounced in an environment with ample digital access. That is, digital access and GI awareness can act as substitutes; either resource will do. However, 82.7% of respondents reported limited digital access, and one artisan described it as “a big barrier for e-commerce.” Thus, GI certification support needs to be coupled with investment in digital infrastructure. Together they optimize market access for artisans.

6.2 Relating Findings to Theoretical Frameworks

6.2.1. SERVQUAL Model in Context of Khadi

The five SERVQUAL dimensions all showed negative gaps (overall mean -1.18 , $p < 0.01$). The largest gap was reliability (-0.43) that reflected a deep-rooted problem in service delivery across the Khadi supply chain.

6.2.2. Using The VUCA Framework

The VUCA framework is an excellent example of the problems faced by the Khadi business of Cumilla. The biggest challenges were uncertainty and volatility. Erratic government policies and shifting market conditions are a regular battle for artisans.

6.4. Field Visit of Corresponding Author to Rajshahi (January 28-31, 2026)

The first author did fieldwork in Rajshahi, January 28 to 31, 2026. The fieldwork was of great comparative value. The handloom sector in Rajshahi has better institutional support than Cumilla. The tour showed how better market linkages and more support from local governments increase the incomes of artisans. Cumilla needs similar institutional support to take its market visibility to the next level.

6.5. Lessons From Khadi for the Conservation of Thai Fabric

Five takeaways for Thai fabric producers from the Khadi experience in Bangladesh.

6.5.1. Use of Digital Platforms

Chai-Arayalert, Suttapong, and Kong-Rithi (2021) developed a digital platform for knowledge sharing among professionals and trainees in Thailand. These tools include synchronized apprenticeship

monitoring, real-time cultural translation, pattern libraries and, as Nonkao (2026) adds, basic marketing tools. This exemplifies the need for transparency in the supply chain, a major takeaway from Khadi.

6.5.2. Inclusive Branding And GI

McIntosh (2000) asked an important question: “Which ethnic groups are represented in ‘Thai textiles’?” To develop branding based solely on patterns that are central Thai or sanctioned by the palace would marginalize migrant artisans and hill-tribe weavers. Khadi gets GI status from Bangladesh on 30 April 2025. In this respect, Thai managers should consider GI protection for distinctive regional textiles such as “Phrae Cotton” or “Nan Indigo,” explicitly incorporating the designs of ethnic minorities into a coherent and genuinely national framework.

6.5.3. Improving Artisan Productivity and Welfare

According to khadi literature, handloom has an internal rate of return of 183% but the youth do not want to take up this trade (Islam & Lina, 2015). Thai fabric managers have similar paradoxes. Yair (2011) has identified five factors of well-being (giving, doing, learning, seeing, and connecting) that managers can use to redesign workspaces to enable self-paced, independent crafting. This approach speeds up successor training (UNDP, 2023) and reduces defects by an estimated 23% (Quality Management Journal, 2024).

6.5.4 Gender Sensitivity in Micro-Banking

Women are just 12% of business owners but 82% of spinners (BBS, 2024; UNDP Bangladesh, 2023). Thai fabric cooperatives need to offer low-collateral mobile-based loans and digital literacy training. Ali’s (2016, 2020) societal banking model, which focuses on institutional strength rather than quantitative expansion, can be easily adapted to weaving groups in northern Thailand.

6.5.5. SERVQUAL In the Craft Retail Sector

Guatuzón Maldonado et al. (2020) confirmed the application of SERVQUAL in traditional companies. Parasuraman et al. (1988) indicated that Thai fabric shop managers should focus on five factors: tangibles (atmosphere of the shop, displays of authentic items), reliability (consistent quality of patterns), responsiveness (custom orders), assurance (disclosure of ethnic origins), and empathy (prices considered fair by local weavers).

The successes and failures of Khadi might inspire Thai fabric managers to focus on artisans' psychological wellbeing, gender-aware credit, digitized knowledge transfer, inclusive branding with GI protections, and service quality metrics to heritage crafts.

6.5.6 Wider Implications for Global Happiness

The findings underscore the continuing relevance of traditional handicrafts in an increasingly interconnected world. Happiness and well-being are ever more recognized as important indicators of the health of society. The Thai textile industry is part of a global movement for ethical and environmentally sustainable products that appeal to conscientious consumers. When artisans are better off, the products they produce are of better quality, they are more likely to be exported and the craft is more likely to be passed down through generations.

7.0 CONCLUSIONS, SUGGESTIONS AND DIRECTIONS OF FUTURE RESEARCH

7.1. Conclusion

The findings of the study are relevant for the three levels of Khadi supply chain.

Customer facing points at national level (within Bangladesh) are the largest lack of SERVQUAL and VUCA pressures (local restaurants and shops do not have responsiveness and reliability). At this level, connectivity is worst with 82.7% of respondents claiming they have inadequate digital access. The essential first step is to solve the problems of domestic supply chains. The textile supply chain is complex with trade shifts and pressure to be sustainable and digital. Findings can be implemented that Milnitz & Marchi (2025) to stay competitive, it needs to have coordination, traceability and circularity.

Regional level (BIMSTEC countries): Cross border movement of raw materials (cotton from India, dyes from Nepal) is ambiguous and complicated. Regional regulations and custom delays are pricier. However, Cumilla Khadi has a natural market within BIMSTEC because of shared handloom traditions and shorter shipping distances compared to more distant destinations.

International level: GI certification enables you to access the EU, Middle East and Japan. But getting in is tough because it takes a long time, costs a lot to get certified, and buyers don't trust you much. Much like the compensatory effect seen in H_5 (i.e., digital access and GI awareness substituting for each other), enhanced digital infrastructure might help to overcome global market barriers.

Interaction of all 3 supply chain levels. Poor logistics within the country will affect competitiveness at home and abroad. In turn, regional cooperation can boost global export.

This paper investigates the influence of service quality perceptions and market integration challenges on well-being in the Khadi industry of Cumilla from the supply chain perspective. Findings show that perception of service quality differs across demographic groups and such perceptions impact their well-being. Market integration for artisans is still fragile and uncertain, and needs active responses not passive resignation.

The study has also found that the inclusion of women and young people results in improved economic and mental health of the artisan community. Happiness measurement matters. Traditional craftsmanship is not only a source of income but also a source of collective well-being. In an age of ethical production and sustainability, khadi is not less relevant, but more so. Khadi is an ethical and sustainable product, so it aligns with global movements that seek fulfillment beyond returns. Cumilla can follow the tourism model of Thailand by combining Khadi weaving with heritage tours, artisan workshops and cultural festivals. Working together would mean sharing knowledge of visitor management, product storytelling and digital marketing, turning local crafts into tourist attractions and creating new revenue streams for the weavers.

The findings support a whole community development approach. The Khadi sector becomes more resilient when social, economic and perceptual factors are in harmony. The stakeholders in Cumilla have a unique opportunity to influence economic processes and enhance local well-being. Minimum wages for artisans would ensure economic stability and increase the standard of living. Due to the cultural and economic importance of Cumilla, the Bangladesh government should think about creating a separate administrative division for the district. The next five-year plan should aim at developing a globally integrated Khadi industry with direct linkages to the international markets. This would provide the impetus for long-term growth and better livelihoods to the artisans. E-business processes can enhance the market coverage of the Khadi industry and improve the financial prospects of the craftspeople.

Lessons for Thailand's fabric industry: Youth apathy, lack of infrastructure and poor access to digital markets are a challenge for both Thai silk and hand-woven cotton. The experience of Cumilla offers some lessons for Thai textile makers. First, the GI

label enhances brand identity and access to ethical fashion markets globally. Secondly, community links in heritage tourism networks are used to preserve traditional knowledge and to create additional income. Third, digital sales platforms reduce reliance on physical markets. Fourth, small-scale mechanization with cultural preservation results in higher output, but retains the artisan identity. Fifth, Public-private partnership for weaver welfare and skill development can reverse the attrition of youth. The implication is that, like Comilla Khadi, Thai silk is a heritage textile where traditional craftsmanship, cultural identity and sustainable local production converge, but each has its own regional techniques and aesthetic signatures (Wongseelashote, 2018).

This study contributes to wider debates on the nexus between traditional crafts and contemporary markets and how heritage-led development can bring both financial gains and social welfare. The authors suggest reviving BIMSTEC and Bangladesh joining ASEAN to boost regional trade integration. They propose a three-tiered supply chain strategy for Khadi textiles: national (local production clusters), regional (BIMSTEC–ASEAN corridors) and international (ethical fashion exports). It is based on quality certification based on SERVQUAL, VUCA resilience and decentralized craft production. The main lesson is that this framework can be applied to Thai silk and cotton value chains by replacing Khadi-specific raw materials, weaving methods and export logistics with Thai counterparts. The same regional connectivity and quality control systems could help Thailand's traditional textile industries with this adaptation.

7.2. Suggestions

Best Practices for Commercial Integration and Cultural Preservation of Pakistan and India's Khadi Sectors with Reference to Regional (BIMSTEC) Supply Chain Management

Conduct longitudinal research with panel data across several years to monitor the long-term impacts of GI certification on artisan well-being and community cohesion.

Quantitatively evaluate digital skills programs by comparing market access and artisan income before and after training.

REFERENCES

- Ahmed, N. (2020). *Textile traditions of the Bengal Delta*. University Press Ltd.
- Ahmed, S., & Begum, R. (2023). Artisanal livelihoods and subjective well-being: A study of Khadi weavers in rural Bangladesh. *Journal of Happiness Studies*, 24(2), 345-361.
- Alam, MD Jobayer and Al Sany, S M Arif and Rana, Md Juyel and Oishi, Sanjeda Sarmin and Hasan, Rakibul and Chadni, Shamsunnahar and Tabassum, Marzia, Navigating the Challenges of Logistics and Supply

Design an integrated sustainability assessment framework for Khadi production to guide best practices and marketing at all three levels of the supply chain.

Use specific research with comparison groups to assess current government policies on their impact on artisan income and community cohesion.

Initiate women's empowerment programs on formal market access, skills development, leadership and entrepreneurship. Women already report greater well-being from Khadi work (57.6% vs 38.8% for men); further support will enhance these gains.

Promote heritage tourism by producing Khadi and showcasing it to international tourists through demonstrations and artisan displays, infused with cultural and historical stories.

Use known therapeutic properties of handicrafts in mental health therapy. Provide artisan communities with mental health services. The pattern of response to dose (more years involved, greater well-being) suggests that formal programs may speed this natural process.

7.3. Directions Of Future Research

International Comparative Analysis: Identify effective methods of commercial integration and cultural preservation, with emphasis on regional supply chain management under bodies such as BIMSTEC.

Longitudinal studies: Use multi-year panel data to study the longer-term influence of GI certification on artisan well-being and community cohesion.

Digital skills program evaluation: Measure market access and artisan income changes before and after training.

Sustainable metrics: Develop a holistic sustainability measurement framework for Khadi production, which can be used for marketing and best practices across all the three levels of the supply chain.

Policy framework analysis: Compare different groups to assess the effectiveness of current government initiatives and their effects on artisan income and community cohesion.

Khadi Tourism Economics: Discuss the impact of heritage tourism on the preservation of cultural heritage and community well-being.

- Chain Management in Bangladesh's Textile Industry: A Comparative Analysis (January 07, 2025). Available at SSRN: <https://ssrn.com/abstract=5190550> or <http://dx.doi.org/10.2139/ssrn.5190550>
- Akter, M., & Uddin, M. H. (2017). Supply chain operation model in terms of raw material in Bangladesh apparel industry. *International Journal of Textile Science*, 6(2), 43-48. doi:10.5923/j.textile.20170602.03
- Ali, M. (2017). *Bangladesher Sandhanya*. Student Ways.
- Ali, M. M. (2025a). Financial impact and well-being of hand-knitted Jamdani sarees and weaver lifestyles on Bangladesh's textile industry: A field investigation. *Journal of Global Economy, Trade and International Business*, 5(1), 53-82. <https://doi.org/10.47509/JGETIB.2025.v05i01.03>
- Ali, M. M. (2025b). Leveraging heritage and infrastructure for sustainable tourism development: An integrated analysis of archaeological assets, Khadi fabrics, and aviation connectivity in Cumilla, Bangladesh. *The Journal of Social, Political, and Economic Studies*, 50, 104-117. <https://doi.org/10.65767/0278-839X.2025.50.11>
- Ali, M. M. (2025c). The impact of micro banking expansion on macroeconomic outcomes: A time series and PLS-SEM analysis of unemployment and poverty in Bangladesh. *The Journal of Social, Political, and Economic Studies*, 50(2), 186-201. <https://doi.org/10.65767/0278-839X.2025.50.17>
- Ali, M. M. (2026). Investing in Heritage: A Financial Viability Framework for Eco-Innovation in Cumilla's Khadi Textile Sector in Bangladesh. *International Journal of Accounting and Economics Studies*, 13(1), 120-132. <https://doi.org/10.14419/fhb8tq10>
- Ali, M., & Ali, N. (2026). Green entrepreneurship and Industry 5.0. In V. Ratten (Ed.), *International encyclopedia of business management* (Vol. 4, pp. 189-195). Elsevier. <https://doi.org/10.1016/B978-0-443-13701-3.00587-9>
- Appadurai, A. (2013). *The future as cultural fact: Essays on the global condition*. Verso Books.
- Bangladesh Bureau of Statistics. (2024). *Cottage industries employment survey 2023*. Government Press.
- Barros, M. V., Salvador, R., do Prado, G. F., de Francisco, A. C., & Piekarski, C. M. (2021). Circular economy as a driver to sustainable businesses. *Cleaner Environmental Systems*.
- Carrà, N. (2016). The role of culture and heritage in the fight against social exclusion. *Procedia - Social and Behavioral Sciences*, 223, 583-589.
- Chai-Arayalert, S., Suttapong, K., & Kong-Rithi, W. (2021). Systematic approach to preservation of cultural handicrafts: Case study on fabrics hand-woven in Thailand. *Cogent Business & Management*, 8(1). <https://doi.org/10.1080/23311975.2021.1872889>
- Chakraborty, P. (2022). Geographical indications and cultural preservation: Case studies from South Asia. *International Journal of Cultural Property*, 29(1), 78-95.
- Chowdhary, H. J. (2019). Problems and prospects of Khadi industry in Comilla. *University of Comilla Journal*, 12(3), 45-60.
- D'Acci, L. S. (2011). Measuring well-being and progress. *Social Indicators Research*, 104(1), 47-65. <https://doi.org/10.1007/s11205-010-9717-1>
- De Silva, M. (2021). Measuring the intangible: Well-being indicators for craft communities. *World Development*, 147, 105623.
- Fashion Revolution. (2023). *Garment retention in slow fashion movement*. [Unpublished data].
- Gandhi, M. K. (1925). *Young India*. Navajivan Publishing House.
- IBEF. (2026, February 2). *Smart textiles & wearables: Weaving tech into tradition*. <https://www.ibef.org/blogs/smart-textiles-wearables-weaving-tech-into-tradition>
- Igreja, S., Teles, S., & Paúl, C. (2025). Crafts as an example of active and productive aging: Profiles of artisans and family transmission in a UNESCO Creative City of Crafts and Folk Art. *Frontiers in Psychology*, 16, Article 1651086. <https://doi.org/10.3389/fpsyg.2025.1651086>
- International Labour Organization. (2023). *Decent work in traditional crafts: Global benchmarks* (Report No. WR-2023-14). ILO Publications.
- Islam, M. T., & Lina, M. H. (2015). Cost benefit analysis of Khaddar industry: A study on Comilla District. *Journal of Economics and Business Research*.
- Jaim, J. (2021). Bank loans access for women business-owners in Bangladesh: Obstacles and dependence on husbands. *Journal of Small Business Management*, 59(sup1), S16-S41. <https://doi.org/10.1080/00472778.2020.1727233>
- Karubhoomi Fashion House. (2024). *Annual sustainability report 2023: Reviving Cumilla Khadi*.
- Kaur, S., & Kashyap, R. (2022). Problems & prospects of marketing of Khadi with special reference to Haryana

- & Punjab. *Journal of the Textile Association*, 82(5), 294. <https://doi.org/10.17605/OSF.IO/S2URV>
- Kiron, M. I. (2021, November 15). Comilla Khadi: History, types and future prospects. Textile Learner. [https://textilelearner.net/khadi-cloth-history-types-and-future-prospects/\(viewed 1st April,2025\)](https://textilelearner.net/khadi-cloth-history-types-and-future-prospects/(viewed%201st%20April,2025))
- KVIC. (2023). *Annual performance report 2022-23*. Khadi and Village Industries Commission.
- Mccabe, S., & Johnson, S. (2013). The happiness factor in tourism: Subjective well-being and social tourism. *Annals of Tourism Research*, 41, 42–65. <https://doi.org/10.1016/j.annals.2012.12.001>
- McIntosh, L. (2000). Thai textiles: The changing roles of ethnic textiles in Thailand. *Textile Society of America Symposium Proceedings*, 823. <https://digitalcommons.unl.edu/tsaconf/823>
- Mies, A., & Gold, S. (2021). Mapping the social dimension of the circular economy. *Journal of Cleaner Production*.
- Nonkaeo, N. (2026). Development of Thai fabric pattern translation from Thai to Chinese in local communities. *Kasetsart Journal of Social Sciences*, 47 (1), <https://so04.tci-thaijo.org/index.php/kjss/article/view/287993>
- Pakistan Institute of Corporate Governance. (2024). Khaadi: Sustainable growth through organizational leadership. Case Study Series No. 8.
- Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, 64(1), 12–40.
- Peterson, D. B. (2021). The DNA of VUCA: A framework for building learning agility in an accelerating world. In V. S. Harvey & K. P. De Meuse (Eds.), *The age of agility: Building learning agile leaders and organizations* (pp. 327–344). Oxford University Press; Society for Industrial and Organizational Psychology. <https://doi.org/10.1093/oso/9780190085353.003.0013>
- Prieto-Sandoval, V., Jaca, C., & Ormazábal, M. (2017). Towards a consensus on the circular economy. *Journal of Cleaner Production*.
- Rahman, S. M., Rahman, K. S., & Ahmed, K. F. (2025). BARD's intervention in Khadi revival. *BARD Quarterly*, 8(2), 112-125.
- Rattanawiboonsom, V. and Ali, M. M. (2016). Factors affecting entrepreneurial management in Bangladesh: an empirical analysis. *Problems and Perspectives in Management*, 14(3-3), 677-690. doi:10.21511/ppm.14(3-3).2016.11
- Svegea. (2026). *Textile trends in 2026: Key insights for garment and textile manufacturers*. <https://svegea.se/textile-trends-2026-garment-manufacturers/>
- Thailand Foundation. (2025, August 8). *An introduction to Thai traditional fabric and textiles*. Retrieved from <https://thailandfoundation.or.th/an-introduction-to-thai-traditional-fabric-and-textiles/> An Introduction to Thai Traditional Fabric and Textiles
- Liu, T., Lee, J. K. Q., Kanagawa, H. S., He, L., Zhang, A. Y., Lo, M. W. S., Leung, D. K. Y., Wong, G. H. Y., & Lum, T. Y. S. (2026). Impacts of participatory arts-based interventions on well-being of older adults without dementia: An umbrella review and a conceptual artistic participation framework. *The Gerontologist*, 66(1), gnaf279. <https://doi.org/10.1093/geront/gnaf279>
- Milnitz, D., & Marchi, J. (2025). Textile and apparel supply chain: Structure, complexity, and global transformation trends. In *Seven Editora*. <https://doi.org/10.56238/sevened2025.036-005>
- The Hindu. (2026, February 1). *Budget 2026: Mahatma Gandhi Gram Swaraj Initiative announced to boost Khadi production*.
- Sen, A. (1999). *Development as freedom*. Oxford University Press.
- Stiglitz, J. E., Sen, A., & Fitoussi, J. P. (2009). *Report by the commission on the measurement of economic performance and social progress*.
- The Global Economy. (2024). *Bangladesh happiness index*. Retrieved from [https://www.theglobaleconomy.com/Bangladesh/happiness/Bangladesh\(viewed on 15.01,26\)](https://www.theglobaleconomy.com/Bangladesh/happiness/Bangladesh(viewed%20on%2015.01,26))
- Textile Exchange. (2024). *Global organic textile standard annual report*.
- Textile Today. (2023). *Bangladesh Khadi gets GI status*.
- UNDP. (2022). *Human development report 2021-22: Traditional crafts as pathways to well-being*. United Nations.
- UNESCO. (2023). *Safeguarding intangible cultural heritage through economic empowerment*. Policy Paper No. 12.
- Velenturf, A., & Purnell, P. (2021). Principles for a sustainable circular economy. *Sustainable Production and Consumption*.
- World Happiness Report. (2025, March 27). *6 lessons about world happiness from the World Happiness Report*, <https://www.happierlivesinstitute.org/2025/03/27/6-lessons-about-world-happiness-from-the-world-happiness->

report/?utm_term=ways%20to%20improve%20well%20being&utm_campaign=&utm_source=adwords&utm_medium=ppc&hsa_acc=4743918760&hsa_cam=23082275037&hsa_grp=188125453644&hsa_ad=777545864145&hsa_src=g&hsa_tgt=kwd-328708234073&hsa_kw=ways%20to%20improve%20well%20being&hsa_mt=b&hsa_net=adwords&hsa_ver=3&gad_source=1&gad_campaignid=23082275037&gbraid=0AAAAAooB9aNJ-wz6XuQH2LIUwMljgDRVR&gclid=Cj0KCQjw9-PNBhDfARIsABHN6-01Uw2aQD7vxD-Mzwb-gwrEjfCNCIwTGFwo-LSfpBWxYHwfGvOADk4aApKvEALw_wcB(viewed on 12 March,2026)

- Wongseelashote, B. (2018). Thai silk. *Journal of Silk*, 55(2), 95–98. <https://doi.org/10.3969/j.issn.1001-7003.2018.02.016>
- World Trade Organization. (2023). World Trade Statistical Review 2023. https://www.wto.org/english/res_e/booksp_e/wtsr_2023_e.pdf