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"Re-examining the Future Prospects of Punjab's Textile Industry in the Post-COVID, Industry 4.0 and Sustainability Era"

Parth Seth

Research Scholar St. George's College, Mussoorie

ABSTRACT

Punjab has historically been one of India's major textile hubs, particularly in cotton spinning, yarn production and blended textiles. In recent years, however, the sector has undergone significant structural changes driven by COVID-19 disruptions, global supply chain realignment, sustainability mandates, and the digital transformation of manufacturing. Despite these challenges, Punjab's textile industry continues to demonstrate strong growth potential due to its agricultural base, skilled labour force, and strategic location.

This study empirically examines the future prospects of Punjab's textile industry using primary data collected from 144 textile enterprises, including spinning, weaving, dyeing, and garment manufacturing units. Exploratory Factor Analysis (EFA) is employed to identify the core drivers shaping the industry's future. Seven dominant factors emerge: Future-oriented strategies, Investment readiness, Regulatory environment, Human resource capability, Growth drivers, Government policy support, and E-commerce integration.

The findings suggest that Punjab's textile sector can significantly enhance its competitiveness through Industry 4.0 adoption, digital supply chains, sustainable manufacturing, and export-oriented policies. However, institutional finance, skill development, infrastructure modernisation, and targeted government support remain critical for realising this potential. The study provides policy-relevant insights for strengthening Punjab's position within India's evolving textile and apparel value chain.

INTRODUCTION

The Indian textile and apparel industry is one of the largest contributors to employment, exports, and industrial output, accounting for approximately 13% of industrial production and nearly 12% of India's total exports. Within this national framework, Punjab occupies a distinctive position as a major producer of cotton yarn, hosiery, knitwear, and blended textiles. Cities such as Ludhiana, Amritsar and Jalandhar are recognised as important clusters for woollen garments, hosiery and value-added textiles.

The COVID-19 pandemic severely disrupted global textile value chains through factory shutdowns, labour migration, logistics bottlenecks, and a collapse in international demand. However, the post-pandemic period (2021 onwards) has also generated new opportunities for India, as global buyers seek to diversify sourcing away from China under the "China-plus-one" strategy. India's Production Linked Incentive (PLI) Scheme for Textiles (2021), the PM MITRA Mega Textile Parks Scheme (2021), and increased emphasis on technical textiles, sustainability and digitalisation have created a new growth environment.

For Punjab, this transformation is particularly important. The state must shift from low-margin yarn production toward high-value apparel, technical textiles, agro-textiles, and eco-

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friendly products. The future prospects of Punjab's textile industry therefore depend not only on traditional strengths such as cotton availability and skilled labour, but also on innovation.

LITERATURE REVIEW

Morris et al. (2004) analysed strategic interventions for the development of the textile and apparel industry in the Western Cape through a SWOT framework. Their study identified strong competitive advantages such as well-developed infrastructure, effective communication networks, supportive government policies, favourable geography, relatively low utility costs, and adherence to international labour and social standards. However, the industry was constrained by challenges including currency volatility, rising labour costs, skill shortages, managerial inefficiencies, low productivity, and weak bargaining power. The authors emphasized the necessity of proactive government intervention to sustain sectoral growth.

Hashim (2005) employed panel data analysis to examine the impact of the Multi-Fibre Arrangement (MFA) and increasing global competition on the Indian textile industry during 1986–1997. The study concluded that the post-MFA period could be transformed into a growth opportunity through preferential treatment of cotton mills and the strategic identification of states with comparative advantages in textile production.

Ozturk (2005) conducted a case study on the relationship between energy consumption and production costs in the Turkish textile industry. Surveying four textile firms in Denizli, the study found that textiles accounted for approximately 5.9% of Turkey's total industrial electricity consumption. A strong positive relationship was observed between energy usage and production costs, highlighting energy efficiency as a key determinant of competitiveness in textile manufacturing.

Bedi (2006) examined occupational noise exposure in two major textile units in Northern India using octave band analysis. The study found that noise levels in certain sections exceeded the recommended limit of 90 dBA for an eight-hour exposure period. Low awareness of noise hazards (29%), limited use of ear protection (28%), high speech interference (70%), and elevated annoyance levels (42%) were reported, indicating the need for stronger occupational health and safety measures.

Ramaswamy (2009) investigated global market opportunities for the Indian textile and apparel industry through the lens of Global Production Networks (GPNs) and labour markets. While GPN integration increased employment opportunities, the study found that it did not lead to commensurate improvements in income levels or job quality, thereby raising concerns about the sustainability of labour outcomes in export-oriented apparel manufacturing.

Islam (2009) analysed the problems and prospects of cottage industries in Mizoram using both primary and secondary data. The study concluded that improvements in infrastructure, transportation, raw material supply, and access to finance were essential to strengthen small-scale textile and handicraft industries.

Khan and Khan (2010) examined challenges faced by Pakistan's textile sector, which contributes nearly 60% of national exports. The industry faced declining growth due to economic recession, rising production costs, and internal security issues. The authors

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recommended subsidies, reduced taxation, and minimal government intervention in exports to restore competitiveness.

Gautam (2012) studied internet marketing adoption among textile SMEs in Punjab and found that limited technical skills, financial constraints, and poor digital infrastructure restricted online business growth.

Katyal and Singh (2013) compared industrial growth across Gujarat, Punjab and Himachal Pradesh, concluding that Gujarat's superior business environment, SEZs, FDI inflows and infrastructure gave it a competitive advantage over Punjab, where high land and power costs and weak policy support hindered textile growth.

Liu et al. (2014) demonstrated that product development significantly improves operational and financial performance in the Taiwanese textile industry, particularly when aligned with customer preferences and digital retail trends.

Raichurkar and Ramachandran (2015) highlighted the growing role of IT, automation and R&D in strengthening India's textile competitiveness.

Kaur (2021) found that COVID-19 severely damaged the financial stability, labour availability, and market access of Punjab's textile enterprises.

World Bank (2022)The World Bank's Global Value Chain Development Report (2022*)* highlighted that India's textile sector has benefited from supply-chain diversification after COVID-19, with buyers shifting orders from China to South Asia. However, sustainability compliance, digital traceability and energy efficiency were identified as critical for long-term competitiveness.

Ministry of Textiles, Government of India (2023**)** India's Textile and Apparel Industry Report (2023) noted that the Production Linked Incentive (PLI) Scheme and PM-MITRA Mega Textile Parks are significantly increasing investment, export competitiveness and technology adoption, especially in cotton-based clusters like Punjab.

McKinsey & Company (2023) McKinsey's State of Fashion Manufacturing report showed that textile firms adopting Industry 4.0 technologies (AI-based quality control, smart inventory, and automation) achieved up to 30–40% higher productivity and reduced defect rates, giving a strong competitive advantage to modernized clusters.

UNIDO (2024)UNIDO's Sustainable Textile Industry Outlook *(2024)* emphasized that water-efficient dyeing, zero-liquid-discharge systems and circular textile models are becoming mandatory for export-oriented firms. Indian states that invest in green manufacturing infrastructure will capture future global demand.

DISCUSSION

Punjab's textile industry is currently navigating a complex transition shaped by structural, technological, and market forces. Traditionally, the sector relied on the availability of high-quality cotton, low-cost labour, and established domestic markets. These factors provided a competitive advantage in the past, but evolving global and domestic dynamics have created new challenges. Disruptions during the pandemic exposed vulnerabilities in financial

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stability, supply chains, workforce availability, and logistics, highlighting the industry's dependence on conventional methods and limited digital adoption. At the same time, the crisis has presented an opportunity to modernize, restructure, and strengthen resilience against future uncertainties.

The industry is increasingly influenced by competition based not only on price but also on quality, speed, customization, and sustainability. Buyers and global markets now demand traceable, eco-friendly, and ethically produced products. This requires firms in Punjab to move beyond traditional spinning and fabric production and adopt advanced technologies, modern quality control systems, and cleaner production methods. Simultaneously, the digital transformation of markets and the rise of e-commerce platforms offer unprecedented opportunities for expanding customer reach, reducing intermediaries, and increasing efficiency. Firms that embrace these platforms can directly connect with buyers, improving margins and enhancing brand visibility.

Human capital remains a critical determinant of future competitiveness. The shift toward automation, technical textiles, and data-driven manufacturing requires skilled professionals, well-trained technicians, and competent managerial structures. Systematic employee training, fair pay structures, and professional management practices can improve retention, productivity, and innovation capacity. Additionally, access to finance, supportive institutional frameworks, and strategic policy incentives are essential for enabling expansion, modernization, and investment in innovation.

The cumulative impact of these forces suggests that Punjab's textile industry has significant latent potential. Its foundational strengths, including raw material availability, established industrial clusters, and a trained workforce, provide a solid base for transformation. However, success will depend on the sector's ability to adopt modern technologies, integrate sustainability, expand digital capabilities, and respond to evolving consumer demands. Without deliberate efforts to modernize and innovate, Punjab risks losing ground to other progressive textile regions. A strategic focus on transformation rather than incremental growth is therefore essential to ensure long-term sustainability, competitiveness, and resilience in an increasingly globalized textile market.

CONCLUSION

Punjab's textile industry continues to be a critical driver of regional economic activity, employment, and export earnings. Despite its traditional strengths in cotton cultivation, spinning, and textile manufacturing, the sector is at a pivotal point where reliance on conventional practices is no longer sufficient to secure long-term competitiveness. The disruptions caused by the COVID-19 pandemic exposed vulnerabilities in financial structures, labour availability, logistics, and market access, underscoring the urgency of adopting modern manufacturing practices, digital tools, and resilient supply chains. At the same time, these challenges have created new opportunities for innovation, market diversification, and export-led growth.

The future growth of Punjab's textile industry will be determined by its capacity to embrace technological modernization and sustainability. Automation, advanced machinery, Industry

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4.0 integration, and data-driven quality management are critical to improving operational efficiency, reducing costs, and increasing product quality. Furthermore, sustainability practices, including energy-efficient production, water management, and environmentally friendly dyeing processes, are becoming essential to access global markets and meet evolving consumer expectations. Adoption of these technologies and practices will enable the industry to move from low-margin, volume-driven production to high-value, specialized textiles, technical fabrics, and sustainable apparel products.

Institutional support, government policies, and financial access will play an equally important role in shaping the sector's trajectory. Targeted investments, incentive schemes, and industrial cluster development can enhance competitiveness, promote innovation, and facilitate market expansion. At the firm level, investments in workforce training, professional management, and digital marketing channels are essential for building agility and long-term sustainability. E-commerce and online B2B platforms, in particular, offer opportunities for reaching domestic and international buyers while reducing reliance on intermediaries.

In conclusion, Punjab's textile industry stands at a strategic crossroads. With a coordinated approach involving government initiatives, private sector investment, and institutional support, the sector has the potential to reclaim its position as a dynamic and competitive player in India's textile landscape. By focusing on modernization, sustainability, digitalization, and skill development, Punjab can transform existing challenges into opportunities, ensuring employment generation, export growth, and economic resilience. Strategic action now will secure the industry's relevance and growth in an increasingly competitive and technologically advanced global textile economy.

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