Accepted, proof version, to be replaced by the final version soon

Bridging The Digital Divide: E-Commerce, Market Access, And Income Sustainability For India's Handloom Weavers

Amir Hussain[1], *Mohd. Saeem Khan[2]

[1]University of Science and Technology, Meghalaya, India.

[2]Department of Commerce, Aligarh Muslim University, Aligarh (UP), India.

***Corresponding Author**

Received: Jun 6, 2025; Revised: Jul 23; Accepted: Jul 28; Published (unedited first): Jul 31, 2025

CITATION: Hussain A, Khan MS, 2025. Bridging The Digital Divide: E-Commerce, Market Access, And Income Sustainability For India's Handloom Weavers. *Management and Economics Research Journal,* 11(3): 9900112. https://doi.org/10.18639/MERJ.2025.9900112

ABSTRACT

India's handloom sector, employing over 4.3 million rural artisans, faces challenges from mechanization, globalization, and limited market access. E-commerce platforms offer transformative potential by enabling direct-to-consumer sales, enhancing income levels, and promoting sustainability. This study investigates how e-commerce influences handloom weavers' livelihoods, focusing on market access, economic outcomes, and barriers to digital adoption in rural areas. Using secondary data from government reports, industry analyses, and case studies of online cooperatives—Banarasi Weavers Cooperative and Tamil Nadu's Co-optex—the research highlights improved market reach and income for digitally engaged weavers. However, infrastructural, educational, and socio-economic barriers limit adoption. Policy recommendations include subsidies for digital infrastructure, training programs, and partnerships with e-commerce platforms to ensure equitable benefits.

KEYWORDS: Handloom Weaving; E-Commerce; Livelihoods; Market Access; Sustainability; Digital Adoption; Rural India; Online Cooperatives.

ABBREVIATIONS: GDP: Gross Domestic Product; TAM: Technology Acceptance Model; SLF: Sustainable Livelihoods Framework; GI: Geographical Indications.

1. INTRODUCTION

India's handloom sector, renowned for Banarasi silks and Kanchipuram sarees, stands at a crossroads. While it sustains 4.3 million rural artisans and contributes 2.3% to GDP [1], mechanization and intermediary exploitation have slashed incomes to precarious levels (INR 5,000–8,000/month) [2]. E-commerce platforms like Amazon Karigar promise liberation from these constraints, but their transformative potential remains unevenly distributed. This study investigates why, leveraging case studies from Uttar Pradesh and Tamil Nadu to map e-commerce's promises and pitfalls for rural weavers.

E-commerce platforms, such as Amazon Karigar, Flipkart Samarth, and cooperative-led websites, have emerged as potential solutions to these challenges. By facilitating direct-to-consumer sales, e-commerce reduces dependency on intermediaries, expands market access to urban and international consumers, and enables weavers to command premium prices for their handcrafted products [3]. Platforms also provide tools for branding and storytelling, allowing weavers to highlight the cultural and sustainable aspects of their weaves, which resonate with global consumer trends toward ethical fashion [4]. The rise of e-commerce aligns with India's digital economy growth, with online retail projected to reach $350 billion by 2030, offering significant opportunities for artisans [1].

Despite this potential, e-commerce adoption among rural weavers remains limited due to multiple barriers. Only 34% of rural India has reliable internet access, and digital illiteracy is widespread, particularly among women and older weavers who form the backbone of the sector [5]. Logistical challenges, such as unreliable delivery systems and high shipping costs, further complicate participation in digital markets [6]. Socio-economic factors, including low incomes and cultural resistance to technology, exacerbate these issues, creating disparities in who benefits from e-commerce [7].

This research paper examines the impact of e-commerce on handloom weavers' livelihoods, focusing on three key dimensions: market access, income levels, and sustainability. It addresses the following research questions:

- How do e-commerce platforms enhance market access for handloom weavers?
- To what extent do these platforms improve weavers' income levels?
- What are the barriers to digital adoption in rural areas, and how do they affect the sector's sustainability?

Drawing exclusively on secondary data from government reports, industry analyses, academic literature, and case studies of two successful online cooperatives—Banarasi Weavers Cooperative in Uttar Pradesh and Co-optex in Tamil Nadu—the study provides a comprehensive analysis of e-commerce's transformative potential and the challenges that must be addressed to ensure inclusive benefits. By synthesizing these sources, the paper aims to contribute to policy and industry efforts to revitalize the handloom sector while preserving its cultural and economic significance.

2. LITERATURE REVIEW

The literature review synthesizes existing research to provide a theoretical and empirical foundation for understanding e-commerce's impact on handloom weavers' livelihoods, covering the handloom sector's context, e-commerce's role in artisan markets, and barriers to digital adoption.

2.1 THE HANDLOOM SECTOR IN INDIA

India's handloom sector is a critical economic and cultural institution, contributing 2.3% to the national GDP and employing 4.3 million artisans, predominantly in rural areas [1]. It produces 95% of the world's handwoven fabrics, with iconic weaves like Banarasi silk, Chanderi, and Kanchipuram sarees holding GI tags that signify their unique regional and cultural value [8]. The sector's labor-intensive, eco-friendly practices, such as hand-spinning and natural dyeing, align with global sustainability trends, positioning handlooms as a viable alternative to fast fashion [9]. Despite these strengths, weavers face persistent challenges. Average monthly incomes range from INR 5,000 to INR 8,000, significantly below the national average, due to competition from mechanized power looms that produce cheaper, mass-market textiles [10]. Intermediaries further erode profits by controlling market access, often paying weavers only 20–30% of the retail price [11]. These economic pressures contribute to weaver dropout, with younger artisans abandoning the craft for urban jobs, threatening the sector's long-term survival [12].

2.2 E-COMMERCE AND ARTISAN LIVELIHOODS

E-commerce has reshaped artisan markets by enabling direct-to-consumer sales, eliminating intermediary costs, and providing tools for branding and storytelling [13]. Platforms like Amazon Karigar, Flipkart Samarth, and Etsy have integrated artisans into national and global markets, increasing visibility and consumer engagement [14]. Studies estimate that e-commerce adoption can boost artisans' incomes by 20–30% in urban settings, driven by direct sales and the ability to command premium prices for handcrafted, GI-tagged products [5]. Digital platforms also facilitate storytelling, allowing weavers to highlight the cultural heritage and sustainable practices behind their weaves, which appeals to eco-conscious consumers [4]. For example, campaigns on Instagram and YouTube showcasing the intricate process of Banarasi weaving have driven demand among urban and international buyers [8]. However, the benefits of e-commerce are less pronounced in rural areas, where adoption rates remain low due to infrastructural and educational constraints, limiting the sector's overall transformation [3].

2.3 BARRIERS TO DIGITAL ADOPTION

Rural weavers face multiple barriers to e-commerce adoption, which can be categorized as infrastructural, educational, and socio-economic. **Infrastructural barriers** include limited internet connectivity, with only 34% of rural India having reliable access, and frequent power outages that disrupt online operations [5]. Logistical challenges, such as inadequate packaging and unreliable delivery systems, increase costs and delay orders, reducing competitiveness [6]. **Educational barriers** are significant, with digital illiteracy prevalent among weavers, particularly women, who constitute 70% of the workforce and often lack access to formal education [4]. Training programs, while available in some regions, are often inaccessible to remote communities or fail to address gender-specific needs [8]. **Socio-economic barriers** include low incomes, which restrict investment in smartphones or computers, and reliance on traditional marketing channels through intermediaries, fostering skepticism toward digital platforms [15]. Cultural resistance to technology, especially among older weavers who value traditional practices, further slows adoption, as they perceive e-commerce as a departure from their craft's heritage [7].

2.4 THEORETICAL FRAMEWORK

This study adopts two theoretical lenses to frame the analysis. The TAM posits that technology adoption depends on perceived usefulness [e.g., income improvement through e-commerce] and perceived ease of use [e.g., accessibility of digital tools] [16]. TAM helps explain why rural weavers may resist e-commerce due to low digital literacy or skepticism about its benefits. The SLF assesses how e-commerce influences weavers' economic capital [e.g., income], social capital [e.g., community networks], and environmental capital [e.g., eco-friendly practices], providing a holistic view of its impact on livelihoods [17]. Together, these frameworks guide the analysis of e-commerce's opportunities and barriers in the handloom sector.

3. METHODOLOGY

3.1 RESEARCH DESIGN

This study employs a qualitative secondary data approach to investigate e-commerce's impact on handloom weavers' livelihoods, synthesizing publicly available sources to address the research questions. The design includes three components: First, reviewing the academic studies on e-commerce, handloom weaving, and digital adoption provides theoretical and empirical insights into market access, income, and barriers. Second, analysing case of two online cooperatives—Banarasi Weavers Cooperative [Uttar Pradesh] and Co-optex [Tamil Nadu]—is analyzed to identify best practices and challenges in e-commerce adoption. Third, synthesizing by using government reports, industry analyses, and cooperative annual reports offers quantitative and qualitative data on economic and sustainability outcomes.

3.2 DATA SOURCES

The study draws on the following secondary sources: First, peer-reviewed articles from databases like Scopus and Web of Science, focusing on e-commerce and handloom weaving [3, 4, 14]. Second, the Ministry of Textiles' Handloom Census [2023] and India Brand Equity Foundation's Textile Industry Report [2023] provide sector statistics and e-commerce initiatives. Third, annual reports from Banarasi Weavers Cooperative [2023] and Co-optex [2023] detail e-commerce implementation and outcomes. Fourth, credible industry publications and news articles on platforms like Amazon Karigar and Flipkart Samarth offer insights into digital market trends.

3.3 DATA ANALYSIS

Data were analyzed using a multi-method approach. Qualitative data from literature and reports were coded using themes such as "market access," "income improvement," "digital barriers," and "sustainability impacts" to identify patterns and insights. Numerical data, such as income levels, market reach, and adoption rates, were aggregated from reports to assess e-commerce's economic impact. Cooperative reports and related literature were analyzed to extract specific outcomes [e.g., revenue growth, income changes] and challenges, ensuring triangulation with broader secondary data.

3.4 LIMITATIONS

Reliance on secondary data may limit the granularity of weaver-specific experiences, as primary data could provide deeper insights. Variations in reporting standards across sources [e.g., cooperative reports vs. academic studies] may affect data comparability. To mitigate these limitations, the study prioritizes credible, peer-reviewed, and official sources, cross-referencing data to ensure robustness.

4. CASE STUDY ANALYSIS

The case studies of Banarasi Weavers Cooperative and Co-optex illustrate how e-commerce transforms handloom weavers' livelihoods, highlighting best practices and persistent challenges.

4.1 BANARASI WEAVERS COOPERATIVE

4.1.1 BACKGROUND

The Banarasi Weavers Cooperative, based in Varanasi, Uttar Pradesh, represents over 5,000 weavers specializing in Banarasi silk sarees, a GI-tagged product renowned for its intricate gold and silver zari work [8]. Prior to e-commerce adoption, weavers relied on local markets and intermediaries, earning as little as 20% of the retail price due to exploitative supply chains [18]. Facing declining sales and competition from power looms, the cooperative launched an e-commerce initiative in 2020, partnering with Amazon Karigar and establishing a dedicated website.

4.1.2 E-COMMERCE IMPLEMENTATION

The cooperative adopted a multi-faceted strategy: Products were listed on Amazon Karigar and Flipkart Samarth, leveraging their extensive consumer base to reach urban and international markets. Government-funded workshops trained weavers in digital literacy, product photography, and inventory management, reaching over 2,000 artisans by 2023 [18]. Social media campaigns on Instagram and Facebook highlighted the cultural heritage of Banarasi weaves, using videos and weaver stories to engage consumers [13]. Partnerships with logistics firms like Delhivery ensured reliable delivery, addressing rural connectivity challenges. Standardized packaging enhanced product presentation.

4.1.3 IMPACT ON LIVELIHOODS

Online sales accounted for 60% of the cooperative's revenue by 2023, with exports to the USA, UK, and Southeast Asia increasing by 40% since 2020 [18]. The cooperative reached consumers in over 50 countries. Weavers' average monthly incomes rose from INR 6,000 to INR 10,000, as direct-to-consumer sales eliminated intermediary margins. Top-performing weavers earned up to INR 15,000 during festival seasons. Profits were reinvested into sustainable practices, such as natural dyeing and solar-powered looms, reducing environmental impact. Youth apprenticeship programs helped retain younger weavers.

4.1.4 CHALLENGES

Rural Varanasi's inconsistent connectivity hindered platform engagement. Training and equipment required significant upfront investment, excluding smaller weaver groups. Fake Banarasi sarees on e-commerce platforms undermined consumer trust, necessitating robust quality certification.

4.2 CO-OPTEX [TAMIL NADU]

4.2.1 BACKGROUND

Co-optex, the Tamil Nadu Handloom Weavers' Cooperative Society, represents over 100,000 weavers producing Kanchipuram silk, Coimbatore cotton, and Madurai sungudi sarees [19]. Established in 1935, Co-optex traditionally operated physical showrooms but faced declining sales due to competition from e-retailers and changing consumer preferences. In 2018, it launched an e-commerce platform and partnered with Amazon, Flipkart, and Myntra to expand its digital presence [4].

4.2.2 E-COMMERCE IMPLEMENTATION

Co-optex adopted a comprehensive digital strategy: The cooperative's website [www.cooptex.com] was revamped to offer a user-friendly interface, showcasing over 10,000 products. Integration with Amazon and Flipkart expanded market reach. Social media advertising and influencer collaborations promoted weaves, targeting urban millennials and non-resident Indians. State-funded programs trained over 5,000 weavers in digital skills, prioritizing women to address gender disparities [19]. Regional warehouses reduced delivery times from 10 days to 3–5 days, improving customer satisfaction.

4.2.3 IMPACT ON LIVELIHOODS

Online sales grew from 5% to 35% of Co-optex's revenue between 2018 and 2023, with exports to the USA, Canada, and Australia increasing by 25% [19]. Products have reached over 50 countries. Weavers' average monthly incomes increased from INR 7,000 to INR 12,000, with direct sales boosting margins by 30%. Women weavers reported greater financial independence. Co-optex introduced eco-friendly packaging and promoted organic cotton weaves, aligning with sustainability trends. Community programs supported weaver welfare, including healthcare and education.

4.2.4 CHALLENGES

Older weavers struggled with online tools, limiting participation. High shipping costs for international orders reduced competitiveness. Proliferation of handloom products online led to price wars, pressuring weavers to lower prices.

5. RESULTS

The results synthesize secondary data from academic literature, government reports, and cooperative analyses to address e-commerce's impact on handloom weavers' livelihoods, focusing on market access, income levels, barriers to digital adoption, and sustainability.

5.1 MARKET ACCESS

E-commerce significantly expands the market reach for handloom weavers. The Banarasi Weavers Cooperative reported that online sales, facilitated by Amazon Karigar and Flipkart Samarth, accounted for 60% of revenue by 2023, with exports to 50 countries increasing by 40% since 2020 [18]. Co-optex's online sales grew from 5% to 35% of revenue between 2018 and 2023, reaching consumers in the USA, Canada, and Australia [19]. Academic studies confirm that e-commerce enables weavers to access urban and international markets, bypassing intermediaries and targeting sustainability-conscious consumers [4, 14]. Social media platforms like Instagram and YouTube enhance consumer engagement by showcasing the cultural heritage of weaves, driving demand for GI-tagged products [13]. However, low adoption rates in rural areas, due to only 34% internet access, limit the number of weavers benefiting from these opportunities [5]. Cooperatives with established digital infrastructure dominate online markets, while independent rural weavers struggle to participate.

5.2 INCOME LEVELS

E-commerce adoption is associated with substantial income improvements. The Banarasi Weavers Cooperative reported that weavers' average monthly incomes rose from INR 6,000 to INR 10,000 after adopting e-commerce, driven by direct-to-consumer sales that eliminated intermediary margins [18]. Co-optex weavers saw incomes increase from INR 7,000 to INR 12,000, with direct sales boosting margins by 30% [19]. Literature suggests that e-commerce can increase artisans' incomes by 20–30% by enabling premium pricing and access to high-value markets [5]. Women weavers, who constitute 70% of the workforce, benefit particularly, gaining financial independence through online sales, which enables them to support family needs such as education and healthcare [4]. However, income gains are uneven, as weavers without digital access remain trapped in low-margin traditional markets, earning significantly less [3]. This disparity highlights the critical role of infrastructure and training in realizing e-commerce's economic potential.

5.3 BARRIERS TO DIGITAL ADOPTION

Secondary data identifies three primary barriers to e-commerce adoption in rural areas. Only 34% of rural India has reliable internet access, and frequent power outages disrupt online operations [5]. Logistical challenges, such as unreliable delivery systems and high shipping costs, increase operational expenses and delay orders, reducing competitiveness in digital markets [6]. Digital illiteracy is widespread, particularly among women and older weavers, who lack access to training programs [4]. Cooperative reports note that training initiatives often fail to reach remote areas or address gender-specific needs, leaving significant portions of the workforce unprepared for e-commerce [19]. Low incomes restrict investment in essential technologies like smartphones or computers, and reliance on intermediaries fosters skepticism about e-

commerce's reliability [15]. Cultural resistance to technology, especially among older weavers who prioritize traditional practices, further slows adoption [7].

5.4 SUSTAINABILITY IMPACTS

E-commerce supports the handloom sector's sustainability by promoting eco-friendly practices and community welfare. Both Banarasi and Co-optex cooperatives reinvested profits into natural dyeing, organic cotton production, and eco-friendly packaging, aligning with global sustainability trends and reducing reliance on environmentally harmful mechanized looms [9, 18, 19]. Socially, e-commerce enhances weaver welfare through higher incomes and programs like healthcare, education, and youth apprenticeships, which help retain artisans in the sector [4]. However, challenges such as counterfeit products and market saturation threaten long-term viability by undermining consumer trust and pressuring weavers to lower prices [8]. These risks highlight the need for quality assurance and market regulation to sustain e-commerce's benefits.

Secondary data indicate that e-commerce enhances market access and income levels for handloom weavers, with cooperatives like Banarasi and Co-optex achieving 35–60% online revenue and 20–30% income increases. Eco-friendly practices and welfare programs bolster the sector's sustainability. However, infrastructural, educational, and socio-economic barriers limit adoption, particularly in rural areas, restricting benefits to a minority of weavers affiliated with well-supported cooperatives.

6. DISCUSSION

The findings from secondary data align with and extend the existing literature on e-commerce's role in transforming handloom weavers' livelihoods, offering insights into market access, income levels, sustainability, and barriers to digital adoption. This section synthesizes these findings, compares them with prior research, and discusses implications for the handloom sector's future.

6.1 MARKET ACCESS AND E-COMMERCE

The significant expansion of market reach through e-commerce, as evidenced by Banarasi Weavers Cooperative [60% online revenue] and Co-optex [35% online revenue], corroborates studies highlighting digital platforms' ability to connect artisans with urban and international consumers [3, 14]. Platforms like Amazon Karigar and Flipkart Samarth enable weavers to bypass intermediaries, aligning with Podara *et al.*'s [13] emphasis on the role of storytelling in engaging sustainability-conscious consumers. The 40% export growth reported by Banarasi and Co-optex's reach to 50 countries reflects global demand for handwoven textiles, driven by the accessibility of e-commerce [18, 19]. However, the limited adoption in rural areas, due to only 34% internet access, underscores Angmo *et al.*'s [5] findings that infrastructural barriers restrict market expansion. This disparity suggests that e-commerce's benefits are concentrated among well-supported cooperatives, leaving independent rural weavers marginalized, a gap not fully addressed in prior studies. The reliance on cooperative-led platforms also raises questions about scalability for smaller, less-organized weaver groups, which warrants further exploration.

6.2 INCOME LEVELS AND ECONOMIC EMPOWERMENT

The income increases observed—INR 6,000 to INR 10,000 for Banarasi weavers and INR 7,000 to INR 12,000 for Co-optex weavers—support Angmo *et al.*'s [5] estimate of 20–30% income gains through e-commerce. Direct-to-consumer sales eliminate intermediary margins, enabling premium pricing for GI-tagged weaves, as noted by Meera and Vinodan [4]. The financial empowerment of women weavers, who dominate the sector, aligns with literature on e-commerce's role in promoting gender equity through increased financial independence [14]. However, the findings extend prior research by highlighting the uneven distribution of income gains, as non-adopters remain trapped in low-margin traditional markets, earning significantly less [3]. This disparity emphasizes the critical role of infrastructure and training in realizing e-commerce's economic potential, reinforcing the TAM's focus on perceived usefulness [e.g., income improvement] and ease of use [e.g., digital skills] as drivers of adoption [16]. The gender-specific benefits also suggest that e-commerce can address social inequalities, but only if barriers like digital illiteracy are systematically tackled.

6.3 SUSTAINABILITY AND LONG-TERM VIABILITY

E-commerce's contribution to sustainability, through eco-friendly practices like natural dyeing and organic cotton, aligns with Kopperi *et al.*'s [9] findings on the handloom sector's environmental advantages over mechanized looms. The reinvestment of profits into welfare programs, such as healthcare and education, supports the SLF's focus on social and economic capital [17]. Both Banarasi and Co-optex cooperatives demonstrate how e-commerce can enhance the sector's long-term viability by promoting sustainable practices and community welfare [18, 19]. However, challenges like counterfeit products and market saturation, noted by Saha and Sen [8], introduce risks not extensively covered in prior studies. Counterfeits undermine consumer trust in GI-tagged weaves, while price wars driven by market saturation pressure weavers to lower prices, potentially offsetting income gains. These threats underscore the importance of quality assurance and market regulation in maintaining the environmental and economic benefits of e-commerce.

6.4 BARRIERS TO DIGITAL ADOPTION

The identified barriers—infrastructural [limited internet access], educational [digital illiteracy], and socio-economic [low incomes, cultural resistance]—are consistent with Meera and Vinodan [4] and Dalal *et al*. [15]. The gender disparity in digital literacy, with women facing greater challenges, extends prior research by highlighting the need for inclusive training programs [5]. Logistical constraints, such as high shipping costs and unreliable delivery systems, align with Samadhiya and Agrawal [6], but the findings emphasize their disproportionate impact on rural weavers compared to urban cooperatives. Cultural resistance among older weavers, noted by Dhar *et al*. [7], adds a socio-cultural dimension to the TAM, suggesting that adoption requires addressing traditional mindsets alongside technical barriers. The interplay of these barriers creates a complex challenge, as infrastructural improvements alone cannot overcome educational or cultural obstacles, necessitating a multi-faceted approach.

6.5 IMPLICATIONS FOR THE HANDLOOM SECTOR

The findings have several implications for stakeholders. E-commerce can significantly improve weavers' livelihoods, but scaling benefits requires addressing rural infrastructure gaps. Government investment in internet connectivity and logistics, as suggested by Nandi [3], is critical to ensuring equitable access. Empowering women weavers through digital platforms can enhance gender equity, but training programs must prioritize female inclusion to bridge literacy gaps, as emphasized by Meera and Vinodan [4]. E-commerce's support for eco-friendly practices positions the handloom sector as a leader in sustainable fashion, but counterfeit products threaten this reputation, requiring robust regulation [9]. Public-private partnerships, such as those between cooperatives and Amazon Karigar, offer a model for scaling e-commerce adoption, but policies must ensure support for independent weavers to avoid exclusion [14].

6.6 LIMITATIONS AND FUTURE RESEARCH

The reliance on secondary data limits the depth of weaver-specific insights, as primary data could reveal nuanced experiences and perceptions. Variations in reporting standards across sources [e.g., cooperative reports vs. academic studies] may affect data consistency, though credible sources mitigate this issue. Future research should: Collect primary data to explore weavers' lived experiences with e-commerce, providing richer insights into adoption barriers and benefits. Investigate the long-term impact of counterfeit products on consumer trust and market dynamics, particularly for GI-tagged weaves. Assess the scalability of cooperative models in less-developed regions, where infrastructure and organizational support are limited.

6.7 CONCLUSION

E-commerce transforms handloom weavers' livelihoods by expanding market access, increasing incomes, and promoting sustainability, as evidenced by Banarasi and Co-optex cooperatives. However, rural barriers—limited internet, digital illiteracy, and socio-economic constraints—create disparities in benefits, restricting adoption to a minority of weavers. The findings align with the TAM and SLF, emphasizing the need for infrastructure, training, and policy support to ensure inclusive growth in the handloom sector.

7. RECOMMENDATIONS

To maximize e-commerce's potential for handloom weavers' livelihoods and ensure equitable benefits across rural and urban areas, the following recommendations target policymakers, industry stakeholders, and cooperatives. These strategies draw on secondary data insights and address the identified barriers of infrastructure, education, and socio-economic constraints [3, 4, 14].

7.1 POLICY RECOMMENDATIONS

7.1.1 SUBSIDIZE DIGITAL INFRASTRUCTURE

Limited internet access, with only 34% of rural India having reliable connectivity, is a primary barrier to e-commerce adoption [5]. To address this, governments should invest in broadband expansion, prioritizing handloom clusters such as Varanasi, Kanchipuram, and Murshidabad, to ensure stable internet access for rural weavers [3]. This could involve public-private partnerships with telecom providers to extend 4G/5G networks. Subsidize essential technologies, such as smartphones and computers, through low-interest loans or grants tailored for weavers, as low incomes restrict technology acquisition [15]. For example, a government-backed scheme could provide smartphones at 50% cost to registered weavers. Partner with telecom companies to offer affordable data plans, reducing operational costs for weavers managing online sales and customer interactions [6]. A subsidized data package for artisans could lower barriers to platform engagement.

7.1.2 FUND DIGITAL LITERACY PROGRAMS

Digital illiteracy, particularly among women and older weavers, significantly limits e-commerce participation [4]. Policymakers should establish digital training centers in rural handloom clusters, offering courses on product listing, digital marketing, inventory management, and customer service [14]. These centers could be integrated into existing community facilities, such as schools or cooperative offices, to ensure accessibility. Prioritize women weavers, who constitute 70% of the workforce, by designing gender-inclusive training programs that address their educational and time constraints [5]. For instance, mobile training units could deliver workshops in villages, accommodating women's domestic responsibilities.

Collaborate with NGOs, educational institutions, and industry partners to provide ongoing training and mentorship, ensuring programs reach remote areas and are tailored to weavers' needs [8]. Regular follow-up sessions could reinforce skills and address emerging challenges.

7.1.3 STRENGTHEN QUALITY ASSURANCE AND MARKET REGULATION

Counterfeit products undermine consumer trust in handloom weaves, particularly GI-tagged products like Banarasi and Kanchipuram sarees [8]. Governments should expand enforcement of GI tags by implementing digital certification systems, such as blockchain-based verification, to authenticate handloom products on e-commerce platforms [9]. This would ensure consumers can verify product authenticity, boosting demand. Launch public awareness campaigns to educate consumers about genuine handloom weaves, emphasizing their cultural and sustainable value [4]. Campaigns could leverage social media and e-commerce platforms to reach urban and international audiences. Regulate e-commerce platforms to remove counterfeit listings and penalize sellers of fake handloom products, protecting weavers' market share and reputation [14]. A dedicated task force could monitor platforms like Amazon and Flipkart for compliance.

7.1.4 SUPPORT LOGISTICAL INFRASTRUCTURE

Unreliable delivery systems and high shipping costs hinder e-commerce participation, particularly for international orders [6]. Policymakers should develop regional warehouses in handloom hubs, as Co-optex did, to streamline logistics and reduce delivery times [19]. Government funding could support warehouse construction and operations in key regions like Tamil Nadu and Uttar Pradesh. Subsidize shipping costs for international orders, enabling weavers to compete in global markets without compromising profits [18]. A subsidy covering 50% of export shipping costs could incentivize international sales. Partner with logistics firms, such as Delhivery or India Post, to extend reliable delivery services to rural areas, ensuring timely and cost-effective order fulfillment [3]. Negotiated rates for weavers could lower logistical barriers.

7.2 INDUSTRY AND COOPERATIVE RECOMMENDATIONS

7.2.1 EXPAND PUBLIC-PRIVATE PARTNERSHIPS

Cooperatives like Banarasi and Co-optex have benefited from partnerships with e-commerce giants like Amazon Karigar and Flipkart Samarth, which provide platform access, training, and marketing support [18, 19]. Industry stakeholders should form alliances with additional platforms, such as Etsy or international marketplaces, to diversify market access and reach niche consumers interested in handcrafted textiles [14]. Negotiate lower commission rates for handloom products on e-commerce platforms, ensuring weavers retain a higher share of profits [4]. For example, a 5% commission rate instead of the standard 10–15% could significantly boost earnings. Collaborate with platforms to provide free or subsidized training in digital skills and marketing, leveraging their expertise to upskill weavers [3]. Amazon Karigar's existing training modules could be scaled to reach more cooperatives.

7.2.2 ENHANCE DIGITAL MARKETING AND BRANDING

Storytelling is a powerful tool for engaging consumers and driving demand for handloom weaves [13]. Cooperatives should invest in social media campaigns, using platforms like Instagram, YouTube, and Pinterest to highlight the cultural heritage and craftsmanship of weaves, as Banarasi did with videos of zari weaving [8]. Professional content creators could be hired to produce high-quality visuals. Develop multilingual websites to reach diverse markets, including non-resident Indians and international buyers, as Co-optex's www.cooptex.com did [19]. Websites should support languages like Hindi, Tamil, and English to broaden their appeal. Train weavers in basic digital marketing skills, such as creating social media posts or managing online listings, to reduce dependency on cooperative-led marketing efforts [3]. Short online courses could empower weavers to promote their products independently.

7.2.3 PROMOTE SUSTAINABLE PRACTICES

E-commerce's alignment with sustainability trends offers a competitive advantage for handlooms [9]. Cooperatives should expand the use of natural dyeing and organic cotton, marketing these as eco-friendly alternatives to fast fashion to attract environmentally conscious consumers [4]. Certification from sustainability bodies could enhance credibility. Adopt eco-friendly packaging, as Co-optex did with biodegradable materials, to reduce environmental impact and appeal to green consumers [19]. Standardized packaging guidelines could be shared across cooperatives. Reinvest e-commerce profits into weaver welfare programs, such as healthcare, education, and youth apprenticeships, to enhance social sustainability and retain artisans in the sector [18]. Structured welfare funds could ensure consistent support.

7.2.4 FOSTER COMMUNITY NETWORKS AND PEER LEARNING

Peer networks strengthen resilience and knowledge-sharing among weavers [14]. Cooperatives should create online forums or WhatsApp groups for weavers to share e-commerce strategies, troubleshoot challenges, and exchange resources, building a collective knowledge base [3]. Moderated platforms could ensure active engagement. Encourage mentorship programs that pair experienced digital adopters with novices to bridge skill gaps and build confidence in using e-commerce tools [4]. Mentors could receive incentives for participation. Organize regional cooperatives to pool resources for training,

logistics, and marketing, supporting smaller weaver groups that lack the scale of Banarasi or Co-optex [8]. A federated cooperative model could enhance resource sharing.

7.3 ADDRESSING BARRIERS

The recommendations directly address the identified barriers. Subsidized technology, broadband expansion, and logistical support tackle limited internet and delivery challenges [5, 6]. Gender-inclusive training programs and ongoing mentorship address digital illiteracy, particularly for women [4]. Affordable devices, awareness campaigns, and peer networks counter low incomes and cultural resistance, encouraging adoption [7, 15].

7.4 IMPLEMENTATION CONSIDERATIONS

Infrastructure and training programs should be rolled out within 2–3 years, prioritizing high-density handloom clusters to maximize impact. Pilot projects in Varanasi and Kanchipuram could test feasibility. Government schemes, such as the National Handloom Development Programme, can finance infrastructure and training initiatives, supplemented by private sector contributions [2]. Establish metrics, such as e-commerce adoption rates, income growth, and export volumes, to evaluate program success. Annual reviews could adjust strategies based on outcomes [14]. Engage weavers, cooperatives, e-commerce platforms, and NGOs in program design to ensure relevance and buy-in. Regular stakeholder meetings could align efforts.

Implementing these recommendations could increase e-commerce adoption among rural weavers, potentially doubling participation within five years. Boost average incomes by 20–40%, aligning with cooperative case studies [18, 19]. Enhance the sector's sustainability by promoting eco-friendly practices and welfare programs, positioning handlooms as a leader in ethical fashion [9]. Reduce disparities by ensuring independent and rural weavers' access to digital markets, fostering inclusive growth [4].

8. CONCLUSIONS

This study, based exclusively on secondary data, demonstrates that e-commerce is a transformative force for India's handloom sector, significantly enhancing weavers' livelihoods by improving market access, increasing income levels, and promoting sustainability. Case studies of the Banarasi Weavers Cooperative and Co-optex illustrate the potential of digital platforms like Amazon Karigar, Flipkart Samarth, and cooperative websites to connect weavers with urban and international markets. Online sales have driven substantial revenue growth, with Banarasi achieving 60% of revenue from digital channels and Co-optex 35%, alongside export increases of 25–40% to over 50 countries [18, 19]. Income improvements, with weavers' earnings rising by 20–30% [INR 6,000–10,000 for Banarasi; INR 7,000–12,000 for Co-optex], highlight e-commerce's role in eliminating intermediary margins and enabling premium pricing for GI-tagged weaves [5]. Women weavers, in particular, benefit from greater financial independence, supporting family welfare and gender equity [4].

E-commerce also bolsters the sector's sustainability by promoting eco-friendly practices, such as natural dyeing and organic cotton, and reinvesting profits in community welfare programs, including healthcare, education, and youth apprenticeships [9]. These efforts reduce reliance on environmentally harmful mechanized looms and enhance the sector's appeal in the global sustainable fashion market. However, the benefits are not universal. Infrastructural barriers, including limited internet access [34% in rural areas] and unreliable delivery systems, restrict adoption, particularly for rural weavers [5]. Educational barriers, such as digital illiteracy among women and older weavers, and socio-economic barriers, including low incomes and cultural resistance, further limit participation, creating disparities between well-supported cooperatives and independent artisans [4, 7]. Challenges like counterfeit products and market saturation threaten consumer trust and price stability, underscoring the need for robust regulation [8].

The findings align with the TAM, which emphasizes that adoption depends on perceived usefulness [e.g., income and market gains] and ease of use [e.g., accessible digital tools] [16]. The SLF highlights e-commerce's role in enhancing economic capital [higher incomes], social capital [community welfare], and environmental capital [sustainable practices] [17]. To address barriers and scale benefits, policymakers should invest in digital infrastructure, fund gender-inclusive training, enforce GI tag certification, and support logistics, while cooperatives should expand public-private partnerships, enhance digital marketing, and promote sustainable practices [3, 14].

Future research should explore primary data to capture weavers' lived experiences, providing deeper insights into adoption barriers and personal impacts. Studies could also investigate the long-term effects of counterfeit products on market trust and the scalability of cooperative models in less-developed regions with limited infrastructure. Additionally, analyzing consumer behavior toward handloom products on e-commerce platforms could inform marketing strategies to boost demand.

In conclusion, e-commerce offers a powerful pathway to revitalize India's handloom sector, preserving its rich cultural heritage while securing economic livelihoods for millions of artisans. With targeted interventions to overcome infrastructural, educational, and socio-economic barriers, the sector can achieve inclusive growth, ensuring that all weavers—rural and urban, male and female—benefit from the opportunities of the digital economy. By positioning handlooms as a cornerstone of sustainable fashion, e-commerce can help the sector thrive in a globalized market, safeguarding a vital tradition for future generations.

AUTHOR CONTRIBUTIONS
Both authors contributed equally to this study.

CONFLICT OF INTEREST
None.

ORCID
AH (Assistant Professor): https://orcid.org/...
MSK (Assistant Professor): https://orcid.org/0000-0002-6864-8087

REFERENCES
1. India Brand Equity Foundation, 2023. Textile industry report 2023. New Delhi, India: IBEF.
2. Ministry of Textiles, Government of India, 2023. Handloom census. New Delhi, India: Ministry of Textiles.
3. Nandi A, 2021. Impact of ICT on handicrafts marketing in Delhi NCR region. Chapter in: Internet of Things (pp. 153–164). CRC Press. https://doi.org/10.1201/9781003121626-10
4. Meera S, Vinodan A, 2024. Innovative approach and marketing skill: A case study of artisan entrepreneurs of India. Journal of Entrepreneurship in Emerging Economies; 16(3), 576–601. https://doi.org/10.1108/JEEE-06-2022-0178
5. Angmo D, *et al*., 2024. Reducing market separation through e-commerce: Cases of Bottom of the Pyramid (BoP) firms in India. Information Technology for Development; 30(1), 93–113. https://doi.org/10.1080/02681102.2023.2277146
6. Samadhiya A, Agrawal R, 2022. Developing a handloom through the school's design thinking approach. Technology in Society; 71, 102134. https://doi.org/10.1016/j.techsoc.2022.102134
7. Dhar BK, *et al*., 2024. Sustainable craft culture: Socio-cultural drivers and economic impact on sustainable development. Sustainable Development; Advance online publication. https://doi.org/10.1002/sd.2900
8. Saha D, Sen J, 2023. Characterizing the geography of artisanal production: Case of handloom industry in Varanasi, India. Creative Industries Journal; 1–19. Advance online publication. https://doi.org/10.1080/17510694.2023.2202345
9. Kopperi H, *et al*., 2023. Sustainable consideration for traditional textile handloom cluster/village in pollution abatement–A case study. Environmental Pollution; 324, 121320. https://doi.org/10.1016/j.envpol.2023.121320
10. Mamidipudi A, Bijker WE, 2018. Innovation in Indian handloom weaving. Technology and Culture; 59(3), 509–545. https://doi.org/10.1353/tech.2018.0058
11. Ishrat SI, *et al*., 2020. Sustainability issues in the traditional cashmere supply chain: Empirical evidence from Kashmir, India. Sustainability; 12(24), 10359. https://doi.org/10.3390/su122410359
12. Banerjee A, Buhroy S, 2020. Majuli weaving cluster: A study on weaver dropout using industry competitive analysis and concepts of behavioral economics. Fashion Practice; 12(2), 193–218. https://doi.org/10.1080/17569370.2020.1787997
13. Podara A, *et al*., 2021. Digital storytelling in cultural heritage: Audience engagement in the interactive documentary new life. Sustainability; 13(3), 1193. https://doi.org/10.3390/su13031193
14. Yadav US, *et al*., 2023. Digital and innovative entrepreneurship in the Indian handicraft sector after the COVID-19 pandemic: Challenges and opportunities. Journal of Innovation and Entrepreneurship; 12(1), 69. https://doi.org/10.1186/s13731-023-00336-8
15. Dalal A, *et al*., 2024. Hurdles to handicraft marketing for artisan entrepreneurs in an emerging economy. Journal of Small Business and Enterprise Development; 31(1), 74–94. https://doi.org/10.1108/JSBED-03-2023-0109
16. Davis FD, 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly; 13(3), 319–340. https://doi.org/10.2307/249008
17. Scoones I, 1998. Sustainable rural livelihoods: A framework for analysis (IDS Working Paper 72). Brighton, UK: Institute of Development Studies.
18. Banarasi Weavers Cooperative, 2023. Annual report 2022-23. Varanasi, India: Banarasi Weavers Cooperative.
19. Co-optex, 2023. Annual report 2022-23. Chennai, India: Tamil Nadu Handloom Weavers' Cooperative Society.