International Journal of Advanced Engineering and Management Research

Vol. 11, No. 01; 2026

ISSN: 2456-3676

Silk Road Reimagined: Export Enhancement Strategies for Silk Industries in Developing Countries

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doi.org/10.51505/ijaemr.2026.1107 URL: http://dx.doi.org/10.51505/ijaemr.2026.1107

Received: Jan 20, 2026 Accepted: Jan 28, 2026 Online Published: Feb 05, 2026

Abstract

The silk industry can play an important role in the economies of developing countries in diversifying exports, increasing rural income opportunities and creating eco-friendly textiles, especially in the South Asian region. Although the historical importance of this industry has been established through the ancient Silk Road, it has not yet achieved the desired competitive position in the global market. This study analyzes the effective export expansion strategies of the silk industry in developing countries with special emphasis on the context of Bangladesh and South Asia. The impact of production technology, human resource efficiency, institutional support, international market access, value chain linkages, branding strategies and sustainable production practices is assessed in light of the global value chain concept and export competition analysis framework.

A mixed research method was adopted in the study. Primary data was collected through structured questionnaires conducted among silk producer exporters and related industries and stakeholders, supported by policy document review and expert interviews. Structural equation modeling was applied to verify hypothesized relationships, and qualitative data analysis provided contextual interpretation of the study. The results of this study indicate that the use of modern technology, efficiency improvement, effective linkages in the value chain and strong brand recognition significantly increase silk export performance. In addition, environmental standards and international certification play an important role in accessing high-value global markets. However, institutional constraints, lack of adequate export financing and weak branding initiatives have been identified as major constraints to export growth.

This research redefines the Silk Road concept as a new perspective on modern value chain linkages for traditional industries, enriching the existing research literature. The policy recommendations emphasize cluster-based industrial development, export incentives in specific

Vol. 11, No. 01; 2026

ISSN: 2456-3676

sectors, skill development programs and sustainable certification systems, which can be helpful in increasing the international competitiveness of artisans in Bangladesh and South Asia.

Keywords: Silk industry, export performance, developing countries, Bangladesh, global value chain, sustainability.

1. Introduction

Despite its long history along the ancient Silk Road, the industry has yet to achieve sustainable export competitiveness in many developing countries, particularly in the South Asian region. Although the region has traditional skills, readily available labor and favorable environment for production, the scope of silk exports remains limited compared to cotton and synthetic fibre-based textile products. However, low productivity, slow technological development, disorganized and fragmented value chain structure, weak brand positioning, inadequate institutional support and limited harmonization in international sustainability and quality standards – these factors significantly limit the export potential of the silk industry.

At the same time, the growing importance of product traceability, sustainable production and design innovation in the global market has increased the competitive pressure for traditional producers.

In light of the global value chain theory and export competitiveness analysis framework, this study assesses how the use of technology, human resource efficiency, institutional support systems, degree of integration in the value chain, branding initiatives and sustainability practices affect export performance has been through the application of mixed research methods and structural equation modeling, this study provides evidence-based guidelines for inclusive and environmentally friendly development of the silk industry.

2. Literature Review

Silk Industry and Export Potential: Silk is a textile product which is high in value but traded in limited quantities and which contributes significantly to rural economy and I growth. Despite a historically prosperous position, the seal industry in many developing countries has not achieved the expected export success due to structural inefficiencies, over-reliance on traditional production techniques, currency isolation and poor market linkages. Silk production in the South Asian context is mainly carried out by small-scale and cottage-based entrepreneurs, where most export activities are limited to raw or partially processed silk, and opportunities for high-value addition are not properly exploited.

Role of Manufacturing Technology: Technological development is considered as a major driving force to strengthen export competitiveness. Modern mechanized systems, advanced railing and weaving technology and application of digital design play an effective role in increasing productivity, improving product quality and reducing costs. The use of technology in the silk

Vol. 11, No. 01; 2026

ISSN: 2456-3676

industry improves the quality, consistency, durability and aesthetic properties of yarn and fabric, which has a positive impact on export value. However, high investment costs, lack of technical skills and limited supporting infrastructure in developing countries pose major barriers to technology adoption.

Human Resource and Skill Development: Skilled human resource, relevant technical training and entrepreneurial capacity plays an important role in increasing production efficiency, quality control and meeting international market standards. Small and medium entrepreneurs that are linked to training facilities and global markets are usually relatively advanced in adopting new ideas and innovative activities. But weak training systems, limited linkages between research and industry and lack of institutional support hamper skill development and value addition activities in sericulture.

Institutional Support and Policy Environment: Export incentives, easy financial facilities, effective regulatory framework and trade facilitation measures encourage export growth. However, the silk industry often receives fragmented and inadequate policy support and faces greater bureaucratic complexity and limited financing than the larger textile sector, which weakens its international competitiveness.

Value Chain Linkage: According to the Global Value Chain theory, effective linkage in production and marketing processes is essential for export development. In the silk industry, ration cultivation, railing weaving and finishing stages are managed separately and there is a lack of coordination and efficiency. Cluster-based industrial development. Strong collaboration between producers and exporters and small and large enterprise partnerships can help enhance export readiness and knowledge transfer.

Branding Innovation and Sustainable Practices: Effective brand recognition, design innovation and sustainable production certification increase product value and provide access to high-value international markets. However, many silk producers in developing countries are unable to tap the full potential of the global market due to limited branding investment, inadequate design capacity and weak certification infrastructure.

Research Gap: Most of the existing studies have analysed the above components separately. Integrated research on how the combined effects of technology, human resources, institutional support, market access, value chain linkages, branding and sustainable practices work to enhance the export potential of the silk industry is relatively limited. This study aims to address this research gap by presenting a holistic analytical framework in the context of developing countries.

3. Research Objectives

1. To examine the key factors influencing export performance of silk industries in developing countries, focusing on technology, human capital, institutional support, market access, value chain integration, branding, and sustainability.

Vol. 11, No. 01; 2026

ISSN: 2456-3676

2. To assess the relative impact of the mentioned export development strategies on increasing the international competitiveness of the silk industry in the context of Bangladesh and South Asia.
3. Formulate an integrated conceptual framework and policy recommendations for silk industry export development through strengthening value chain linkages, skill development, technological modernization, brand development and pursuing sustainable standards.

4. Hypothesis Building:

H1: Export enhancement strategies have a significant positive effect on the export performance of silk industries in developing countries. There are some categorical hypothesis have been developed based on main hypothesis.

H2: Adoption of modern production technology positively influences silk export performance.
H3: Workforce skill development has a positive effect on silk export performance.
H4: Government export support policies significantly enhance silk export performance.
H5: Strong value chain integration significantly improves export performance of silk industries.
H6: Branding and product innovation positively influence silk export performance.

5. Methodology

5.1 Research Design:

This study adopted an integrated mixed method research design for in-depth analysis of various factors affecting export performance of silk industry. Structural equation modeling was applied to verify the hypothesized relationships between the variables determined in the quantitative part of the study. Besides, qualitative data has been collected through key informant interviews and analysis of relevant policy documents to understand the context of export development strategies, policy realities and industry-based experiences. This integrated design makes the research on the one hand statistically valid and on the other hand provides thematic in-depth interpretation which is consistent with the objective of assessing the export competitiveness of the silk industry in developing countries, particularly in Bangladesh.

5.2 Source of Data:

The study used both primary and secondary festivals for data collection.
Primary Data: Data was collected through structured questionnaires from major producer exporters and related industry participants. Besides, semi-structured interviews were conducted with selected stakeholders to gain industry and policy experience.

Secondary Data: Government policies and reports, trade and export-related publications, government statistics, industry based research reports and various global databases related to silk production and international trade were used as secondary data.

Vol. 11, No. 01; 2026

ISSN: 2456-3676

5.3 Variable Identification

a) Dependent Variable: Export Performance of Silk Industries.
The main dependent variable of this study is the export performance of the silk industry, which is evaluated through multiple indicators such as total export revenue, volume of products exported, growth rate of exports over a specific period, number of export destination markets, share of other industries in overall textile exports, so many products Export price which indicates the level of value addition.

b) Independent Variables:
Production and technological capabilities: degree of mechanization in the production process, use of modern railing and weaving technology, application of CAD and other digital tools, investment in research and development and productivity per worker.

Human resource and skill development: skill level of workers, availability of training facilities in Oman, technical knowledge about international standards and management, past and entrepreneurial skills of small and medium enterprises. Institutional framework and policy support: Export credit system, access to financial institutions, efficiency of regulatory process, and quality of trade facilitation system and various support programs of the government.

Market Access and Trade Capability: Diversification of export markets, effective use of regional and international trade agreements, efficiency of transport and logistics systems, export marketing strategies and participation in international trade fairs and exhibitions.

Value chain linkages and industrial organization: the degree of vertical linkages from production to export, cooperative relationships between producers and exporters, the presence of industrial clusters, and small and large enterprise mutual partnerships.

Branding and Innovation Activities: Brand recognition based on country of origin, product differentiation, design innovation, registration of geographical indications and investments in brand development.

Sustainability and Compliance Criteria: Adopting environmentally friendly production methods, ethical practices, international certifications such as organic, fair trade, eco-level and green production technologies.

5.4: Data Collection and Analysis:

A. Survey instrument: A structured questionnaire was developed for the study, which measures all the independent and dependent variables through Likert scale-based items.
Interviews: Semi-structured interviews were conducted with key industries and stakeholders to understand the prevailing challenges, policy realities and industry-based strategies in the export development process.

Vol. 11, No. 01; 2026

ISSN: 2456-3676

Analysis Method:

Quantitative analysis: Structural equation modeling was used to verify the hypothesized relationships, using SPSS as software.

Qualitative analysis: Data collected from interviews and policy documents were reviewed through thematic analysis to identify key trends, key challenges and effective practices

5.5: Population and Sample Selection:

The population of the study included silk producers, exporters and related industry participants from Bangladesh and selected South Asian countries (eg India, Nepal, Sri Lanka). Stratified random sampling method was used to ensure a representative sample. Here is the division- on which sample are collected. Size of organization (small, medium, large). Production stage (ration farming, railing weaving finishing) and Market base (domestic or export-oriented organisation).

5.6 Determination of sample size:

The silk industry in Bangladesh and neighboring South Asian countries is relatively small, isolated and regionally concentrated. Therefore, not only the statistics but also the reality at the bottom level are given importance in determining the sample size. To ensure data quality, 300 questionnaires were distributed and approximately 210 to 225 valid responses were received with an estimated 70 to 75 per cent completeness. This provides sufficient data for hypothesis testing and industry-based generalization. This approach strikes a balance between real industry situations and procedural biases.

5.7: Subject of the Study Matter: Concept and some categories.

Silk: Silk is a natural protein that is mainly collected from the cocoons of silkworms of the Bombex mori species. Silk is highly prized around the world for its smoothness, natural luster, strength and elegant beauty.

Rajshahi Silk: As a traditional fabric of the Rajshahi region of Bangladesh, Rajshahi silk is well known for its long history and exquisite weaving technique. Use According to the type of silk fibers, Rajshahi silk can be divided into three main categories.

Vol. 11, No. 01; 2026

ISSN: 2456-3676

Rajshahi Silk

Mulberry Silk: Malbari silk is produced from the cocons of Bombix Muri silk kit. Cultivated only on mulberry leaves. It is the highest quality and most produced silk, accounting for more than 90% of the total global silk production. Its market value is relatively high as each step from silk kit rearing to cocoon processing is highly labour-intensive. It differs from tasar, erie and moga silk due to its homogeneous fiber structure and controlled production system. Mulberry Seal is extremely soft, smooth and shiny as well as a sound lasting non-allergenic and able to regulate temperature and absorb moisture. Its eco-friendly production makes the versatile usability and luxurious beauty very appealing.

Eri silk(Andy Silk):

Ere silk is a traditional and eco-friendly silk type of Bangladesh. It has evolved along with indigenous ration farming and is mainly produced on family and small scale. Compared to mulberry silk, the commercial use of this silk is limited. Its production is seen in Rajshahi, Chapainawabganj, Nator, Bogra and some rural and hilly areas. This silk is obtained from Samiya richini silkworms, which feed on reedy leaves. As Konun is open-faced, its yarn is produced by spinning, not by reeling. Erie Silk is soft but slightly crisp with a matte and natural

Vol. 11, No. 01; 2026

ISSN: 2456-3676

cream colour. A sari shawl is used to make escap winter garments and handlooms due to its warmth in winters and comfort in summers.

Tassar silk:

Industrial Production in Bangladesh is limited and isolated and mainly occurs in rural areas adjacent to forests. It is a minor silk species compared to the mulberry silk of Rajshahi. Production can be observed in some hilly and forest areas, including Dinajpur of Rajshahi, Chapainawabganj Nator. Tasar sericulture feeds on the leaves of Arjuna, Sal and Assam trees, which are naturally growing trees, encouraging forest-based sericulture. Tasar silk is relatively coarse, natural, golden brown in colour, and has a slight sheen. It is especially prized for its natural and raw beauty as it is true tethsai. Sarees, sals, stalls, handloom cloths and various handicrafts are made from Tasar silk. The sector creates low capital income opportunities for forest-dependent rural and tribal communities and is eco-friendly and biodegradable, compatible with sustainable heritage-based fashion.

5.8 Conceptual framework of the study:

The study adopts a global value chain perspective. Here, the independent variables – technology, human resources, institutional support, market access, and value chain linkage branding and sustainable practices are linked to silk industry's export performance. It is envisaged that the integration of value chains and sustainable practices will strengthen the competitive position of the industry. Firm size, establishment period and sector-based dominance are also included as control variables. Trade openness as a mediating variable influences the relationship effects of dependent drivers, including infrastructure facilities.

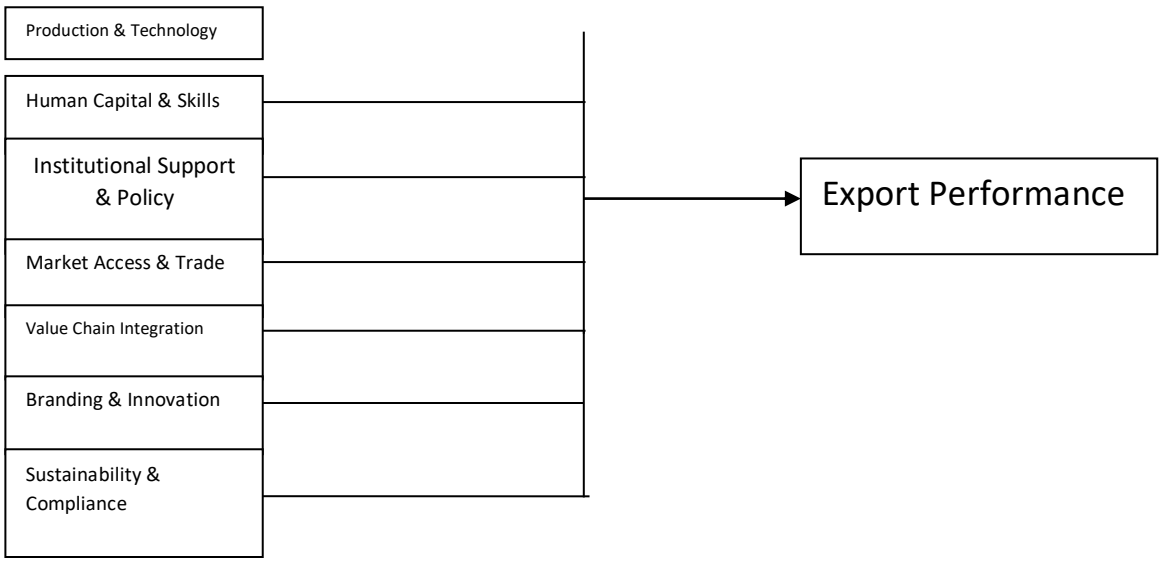
Vol. 11, No. 01; 2026

ISSN: 2456-3676

Independent Variables → Export Performance

- Production & Technology → Export Performance
- Human Capital & Skills → Export Performance
- Institutional Support & Policy → Export Performance
- Market Access & Trade → Export Performance
- Value Chain Integration → Export Performance
- Branding & Innovation → Export Performance
- Sustainability & Compliance → Export Performance.

A diagram of this conceptual framework would show arrows from each independent variable toward Export Performance, with moderators influencing the relationships and controls affecting the outcome variable.



6. Results:

6.1: Demographic Profile of the Respondents

A total of 215 participants were included in the study, who were silk-related companies and exporters from Bangladesh and selected South Asian countries. Hence, it is expected that they have sufficient knowledge about export development strategies and working processes. Table 1 shows the organization-wise demographic data of the participants. Participants work at various management levels from top to bottom and have a solid understanding of export development strategy implementation and its impact on performance. This is important in observing the main objective of the study – increasing the export performance of the silk industry.

Vol. 11, No. 01; 2026

ISSN: 2456-3676

Table 1. Demographic profile of the respondents (N = 215)

Variable	Categories	Number of respondents	Percentage (%)
	Bangladesh	148	68.8
Country	India	42	19.5
	Nepal	15	7.0
	Sri Lanka	10	4.7
Firm Size	Small (<50 employees)	79	36.7
	Medium (50–150 employees)	91	42.3
	Large (>150 employees)	45	20.9
Firm Age	<5 years	41	19.1
	5–10 years	88	40.9
	>10 years	86	40.0
Production Stage	Sericulture	39	18.1
	Reeling	54	25.1
	Weaving	72	33.5
	Finishing & Export	50	23.3
Export Orientation	Domestic-oriented	64	29.8
	Export-oriented	151	70.2

Source: Demographic components on the questionnaire.

6.2 Pearson's Correlation for Selected Independent Variables and Export Performance

To examine the direction of the relationship between each independent and dependent variables, Pearson's correlation coefficient was applied. The results have been highlighted in Table 2. This table indicates that all the six independent variables (Technology, skills, policy, market access, value chain, branding, and sustainability) Have positive relationships with Export performance. Therefore, we can declare that all independent variables show strong, positive, and significant correlations with export performance, providing preliminary support for H2–H6.

Vol. 11, No. 01; 2026

ISSN: 2456-3676

Table 2: Pearson's correlation between selected independent variables and Export performance

Independent variables	Relation
Technology Adoption **(**TECH)	0.60
Human Capital & Skills (HCS)	0.63
Institutional & Policy Support (INST)	0.56
Value Chain Integration (VCI)	0.66
Branding & Innovation (BRI)	0.62
Sustainability & Compliance (SUS)	0.59

Source: Field survey.

Note: All the values were significant. Source: Pearson's correlation coefficient (SPSS 26)

6.3: Aggregate Impact of different factors on export performance

The subsequent table (Table 3) explains the overall relationship of different factors such as Technology, skills, policy, market access, value chain, branding, sustainability (Independent variables) with export performance (Dependent variable).

Table 3. Aggregate impact of different factors on export performance

R value	R square	Adjusted R-squared	Standard error of estimate	F value
0.831	0.691	0.680	0.376	71.82

Source: Descriptive statistics (SPSS 26)

From the results, we can conclude that the 6 independent variables variables (Technology, skills, policy, market access, value chain, branding, and sustainability) together are able to explain 69 percent of the variance in export performance. The F value 71.82 is highly significant (P=0.0001), which proves that the independent variables have a significant impact on export performance.

6.4: Regression coefficients and Hypothesis tasting

The results have highlighted that overall regression model is **highly significant ($p < 0.001$)** and support H2-H6.

Vol. 11, No. 01; 2026

ISSN: 2456-3676

Table 4. Regression Coefficients (Hypothesis Testing)

Hypothesis	Predictor	β (Standardized)	t-value	Sig.	Result
H2	Technology Adoption	0.296	4.98	0.000	Supported
H3	Human Capital & Skills	0.271	4.42	0.000	Supported
H4	Institutional Support	0.218	3.86	0.000	Supported
H5	Value Chain Integration	0.331	5.58	0.000	Supported
H6	Branding & Innovation	0.292	4.91	0.000	Supported
Control	Sustainability & Compliance	0.245	4.11	0.000	Significant

Table 2 presents the Pearson correlation coefficients between selected export enhancements.

7. Discussion

This study reimagines the Silk Road as a modern global value chain framework and examines export enhancement strategies for silk industries in developing countries, with a focus on South Asia and Bangladesh.

Table 1 presents the demographic characteristics of the 215 respondents drawn from silk-related firms. Most respondents are from Bangladesh (68.8%), followed by India (19.5%), Nepal (7.0%), and Sri Lanka (4.7%), reflecting the regional concentration of silk production and export activities in South Asia. In terms of firm size, medium-sized firms (42.3%) constitute the largest group, followed by small firms (36.7%) and large firms (20.9%). Regarding firm age, a substantial proportion of firms have been operating for more than five years, with 40.9% aged between 5–10 years and 40.0% exceeding 10 years that most respondents possess adequate industry experience. The distribution across production stages shows representation from the entire silk value chain, with the highest participation from weaving units (33.5%), followed by reeling (25.1%), finishing and export (23.3%), and sericulture (18.1%). Finally, the demographic profile confirms that the sample is diverse, industry-representative, and appropriate for examining export enhancement strategies in the silk industries of Bangladesh and South Asia.

Table 2 presents the Pearson correlation coefficients between selected export enhancement strategies and export performance of silk industries. Value Chain Integration ($r = 0.66$) shows the strongest correlation with export performance, highlighting the importance of coordinated links among producers, processors, and exporters in enhancing competitiveness in international markets. Human Capital and Skills ($r = 0.63$) and Branding and Innovation ($r = 0.62$) also demonstrate strong positive relationships, emphasizing the role of skilled labor, managerial capability, product differentiation, and branding initiatives in achieving superior export results. Technology Adoption ($r = 0.60$) and Sustainability and Compliance ($r = 0.59$) exhibit substantial positive correlations, indicating that modernization of production processes. Institutional and Policy Support ($r = 0.56$) shows a significant positive association, underscoring the importance

Vol. 11, No. 01; 2026

ISSN: 2456-3676

of government incentives, trade facilitation, and regulatory efficiency in supporting silk exports. Finally, the results indicate that all independent variables are positively and strongly associated with export performance, suggesting that improvements in these strategic areas are linked with better export outcomes.

Table 3 presents the results of the multiple regression model examining the aggregate impact of export enhancement strategies on the export performance of silk industries. The reported R value of 0.831 indicates a strong overall relationship between the set of independent variables and export performance. The R^2 value of 0.691 suggests that approximately 69.1% of the variation in export performance is explained by the independent variables. The adjusted R^2 of 0.680 remains very close to the R^2 value, indicating that the model is robust and not overfitted. Furthermore, the F-value of 71.82 is highly significant, confirming that the overall regression model is statistically valid and that the independent variables jointly exert a significant influence on export performance.

Table 4 reports the standardized regression coefficients examining the impact of export enhancement strategies on the export performance of silk industries. The results indicate that all hypothesized relationships are positive and statistically significant ($p < 0.001$), providing strong empirical support for hypotheses H2–H6.

8. Limitations of the study:

Despite its contributions, this study has several limitations that should be acknowledged.

1. Data were collected from self-reported surveys, which may have biases or social expectations.
2. A focus on the silk industry of selected developing countries limits generalization to other regions or large industrialized firms.
3. Other relevant variables, such as microeconomic instability, political trade barriers, financial constraints, were not modelled.
4. Export performance is measured using the symbol index, which is not as accurate as verified secondary data.

Recommendations for future research: These limitations can be overcome by adopting mixed methods and larger geographical coverage of long-term data.

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Vol. 11, No. 01; 2026

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