



# **Silk Fabric Production and Global Trade: Opportunities for Emerging Economies and Rural Entrepreneurs with the impact of technological advancements in Mulberry cultivation and cocoon production.**

**Laxmi V. Ambhorkar**

*Department of Geography, Modern College of Arts,  
Science and Commerce (Autonomous), Shivajinagar, Pune.*

## **ABSTRACT**

*Silk fabric production has long been a cornerstone of global textile trade, offering significant economic opportunities for both established and emerging markets. This paper explores the multifaceted dynamics of the global silk industry, with a particular focus on the role of technological advancements in Mulberry cultivation and cocoon production, and their implications for emerging economies and rural entrepreneurs. By examining the evolving methods of sericulture, including improved breeding techniques, automation in cocoon harvesting, and advancements in Mulberry farming, the study identifies key areas where emerging economies can leverage these innovations for competitive advantage. The paper discusses the potential for rural entrepreneurs to access new markets, enhance production efficiency, and improve product quality, while also assessing the socio-economic benefits, such as job creation and poverty alleviation, through value-added activities in silk production. Furthermore, the research delves into the challenges faced by these economies, including the need for investment in infrastructure, capacity building, and access to global supply chains. Ultimately, this paper highlights the transformative potential of silk production for emerging economies, underscoring the pivotal role of technology in driving sustainable economic development and fostering global trade integration.*

**Keywords-** *Silk Fabric Production, Global Trade, Emerging Economies, Technological Advancements, Mulberry Cultivation, Cocoon Production, Textile Industry.*

## **Introduction**

The global silk industry has a long and storied history, renowned for producing one of the most luxurious and sought-after fabrics in the world. Traditionally, silk production has been concentrated in a few countries, such as China, India, and Thailand, where it has been an essential part of cultural heritage and economic activity. However, in recent decades, the silk sector has undergone significant transformations due to advances in technology, shifts in global trade patterns, and the increasing demand for sustainable and high-quality textiles. These changes present both challenges and opportunities for emerging economies, particularly those in rural regions, where silk production can be a catalyst for economic growth, poverty reduction, and the development of local industries. One of the key drivers behind the evolution of the silk industry is the technological advancement in Mulberry cultivation and cocoon production. Innovations in these areas—ranging from improved sericulture practices, automated harvesting techniques, and the development of disease-resistant Mulberry varieties—have the potential to significantly increase productivity and reduce costs. These advancements are particularly relevant for emerging economies, where traditional

silk production methods may be inefficient, leading to limited market access and low competitiveness in the global trade arena.

(1)

This paper explores the intersections between technological innovation, global trade, and rural entrepreneurship in the context of silk fabric production. By examining the impact of advancements in Mulberry cultivation and cocoon production, the paper highlights how rural entrepreneurs in emerging economies can leverage these technologies to access new markets, improve the quality of their products, and increase production efficiency. (2) Furthermore, it investigates the socio-economic benefits of these innovations, such as creating employment opportunities, boosting local economies, and fostering sustainable development. Through this research, we aim to identify the key factors that can facilitate the growth of the silk industry in emerging economies, providing a roadmap for policymakers, entrepreneurs, and stakeholders to harness the potential of the silk trade while overcoming the challenges inherent in this dynamic sector. By linking technological progress with entrepreneurial opportunities, this paper underscores the transformative potential of the silk industry for rural communities and emerging economies in the global market.

## Objectives

The integration of technology into silk production aligns with the growing global demand for sustainable and ethically produced textiles, positioning silk as an environmentally friendly alternative in the fashion and textile industries. For further studies some objectives have been formed. Which are as follows:

1. To analyse the current state of silk fabric production and global trade.
2. To investigate the impact of technological advancements on mulberry cultivation and cocoon production.
3. To evaluate the potential benefits of technological advancements for rural entrepreneurs in the silk industry.
4. To forecast future trends in silk production and trade.

## Data and Methodology-

### Global Silk Industry: An overview

1. Global Silk Production
  - Total global production: Approximately 113,000 metric tons annually.
  - China leads with over 83,000 metric tons, accounting for 74% of global production.
  - India follows with 36,523 metric tons in 2022-2023, contributing around 20-25% of the total production.
  - Other contributors: Uzbekistan, Thailand, Brazil, and Vietnam.
2. Global Trade Value
  - The global silk trade is valued at approximately \$1.5 billion annually, comprising raw silk, silk fabrics, and garments.
  - Key exporters: China (dominates raw silk and finished products), India, and Vietnam.
  - Key importers: Italy, the United States, France, and Japan.
3. Silk Demand and Market Trends
  - Increasing demand for luxury textiles and sustainable fibres is driving silk consumption.
  - The shift toward eco-friendly products offers significant opportunities for silk to position itself as a premium alternative.

### India's Silk Industry

1. Raw Silk Production
  - India's production reached 36,523 metric tons in 2022-2023, marking a significant growth due to government initiatives and technological adoption.
  - India is the only country producing all four types of silk:

- Mulberry Silk: Constitutes over 70% of total production (26,987 metric tons in 2023).
  - Tasar Silk: Produced mainly in Jharkhand, Odisha, and Chhattisgarh.
  - Eri Silk: Dominates in Assam and northeastern states.
  - Muga Silk: Exclusively produced in Assam, known for its golden lustre.
2. State-Wise Contributions
- Karnataka: Largest producer of mulberry silk, contributing over 35% of national output.
  - Andhra Pradesh and Tamil Nadu: Significant contributors due to favourable climate and government support.
  - Northeastern States: Leaders in Eri and Muga silk production.

### India's Position in Global Trade

1. Export Volume and Value
- India exported silk products worth ₹17.7 billion (\$214 million) in 2022-2023.
  - Products exported include:
    - Silk fabrics and made-ups (50% of export value).
    - Ready-to-wear garments (25%).
    - Raw silk and silk yarns (25%).
2. Major Destinations
- The United States (largest market for silk garments and fabrics).
  - European Union (Italy and France are key importers of raw silk).
- China (significant importer of Indian Muga and Eri silk). (3)

### Technological Advancements in Mulberry Cultivation

#### Improved Mulberry Varieties:

Research institutions like Central Sericultural Research & Training Institute (CSRTI) and Central Silk Board (CSB) have developed high-yielding and disease-resistant mulberry varieties. For example: V1, S36, and G4 mulberry varieties, which produce 30-40% higher leaf yield compared to traditional varieties.

#### Precision Farming Techniques:

Drip irrigation systems have improved water use efficiency by 40-50%, enabling year-round mulberry cultivation in water-scarce regions. Nutrient management using soil testing kits has led to a 20-25% increase in leaf quality. For example: Farmers in Karnataka and Tamil Nadu using precision farming tools have reported significant savings in inputs and better cocoon yields.

#### Mechanization in Mulberry Cultivation:

Tools like mulberry pruners, rotary weeders, and mechanical harvesters are reducing labor dependency and improving operational efficiency. Mechanized harvesting has reduced leaf wastage by 15-20% and increased the speed of collection. (5)

### Technological Advancements in Cocoon Production

#### Temperature and Humidity Control Systems:

Introduction of automated rearing houses with climate control systems ensures optimum conditions for silkworm growth. Results: 15-20% higher cocoon yield and improved silk quality. In Andhra Pradesh, farmers adopting rearing houses saw an increase in cocoon output from 50 kg per 100 DFLs (disease-free laying) to 65-70 kg per 100 DFLs.

#### Artificial Intelligence (AI) and IoT in Pest Management:

AI-driven tools are being used to predict and mitigate diseases affecting silkworms. Mobile apps like SeriApp provide real-time monitoring of silkworm health and environmental parameters, reducing losses by 10-15%.

Automation in Cocoon Processing:

Advanced cocoon dryers and spinning machines are reducing post-harvest losses and improving silk thread uniformity. Reduction in reeling waste by 8-10% and higher silk recovery rates.

Biotechnology Applications:

Development of disease-resistant silkworm hybrids has reduced vulnerability to common diseases like Pebrine and Grasserie. CSRTI's CSR2 x CSR4 silkworm hybrid produces 20-25% higher cocoons and superior silk quality. (6)

#### Impact of Technological Advancements

	Impact	Details
1.	Improved Productivity	Technologies like high-yield mulberry varieties and climate-controlled rearing houses have increased cocoon yields from an average of 700-800 kg per hectare to over 1,200-1,500 kg per hectare in regions adopting advanced practices.
2.	Enhanced Silk Quality	The use of precision farming, pest management systems, and hybrid silkworms has improved silk thread quality, leading to better market prices. Farmers in Karnataka reported a 25% increase in income due to higher-grade silk production.
3.	Cost Savings and Labor Efficiency	Mechanization in mulberry cultivation and cocoon drying has reduced labour dependency by 30-40%. Savings on pesticides and fertilizers through targeted applications have lowered production costs by 20-25%.
4.	Environmental Benefits	Drip irrigation and organic farming practices have minimized water usage and chemical inputs, contributing to sustainable sericulture. AI-based pest control systems have reduced pesticide usage by 15-20%, promoting eco-friendly production.

Table I

Some important adaption of Technology in India

	State	Adaption	Details
1.	Karnataka	Adoption of Drip Irrigation	A farmer cluster in Mandya district implemented drip irrigation and high-yield mulberry varieties, resulting in a 45% increase in leaf yield and reduced water usage by 40%. Income rose by 30% due to better cocoon quality.
2.	Tamil Nadu	Climate-Controlled Rearing Houses	Farmers using automated rearing houses achieved cocoon yields of 65-70 kg per 100 DFLs, compared to the regional average of 50 kg. The silk produced fetched premium prices in export markets.
3.	Assam	Disease-Resistant Silkworms	Farmers in Assam introduced Muga silkworm hybrids resistant to bacterial infections, improving cocoon production by 20%. This has strengthened Assam's position in the exclusive Muga silk market.

Table II

### Technological Advancements Benefiting Rural Entrepreneurs

#### 1. Increased Productivity and Income

##### High-Yield Mulberry Varieties:

Adoption of high-yield mulberry varieties like V1 and S36 has enabled farmers to produce 30-40% more leaves per hectare. More leaves lead to better feeding for silkworms, resulting in a 25% increase in cocoon production.

Farmers in Karnataka reported income growth of ₹50,000-₹80,000 per acre annually after switching to advanced varieties.

##### Automated Cocoon Reeling Units:

Rural entrepreneurs using semi-automatic and automatic reeling machines have improved silk thread extraction rates by 20-25%, reducing wastage and enhancing quality. The introduction of spinning machines has decreased labour costs by 30% and increased production efficiency.

#### 2. Access to New Markets

##### E-commerce Platforms:

Platforms like ReshaMandi and IndiaMart provide rural entrepreneurs with direct access to buyers, eliminating middlemen. Entrepreneurs using such platforms have reported an increase in sales by 15-20% and higher prices due to direct-to-consumer sales.

##### Global Demand for Sustainable Silk:

Growing demand for eco-friendly silk products in international markets has created export opportunities. Rural entrepreneurs in Assam producing Muga silk and in Northeast India focusing on Eri silk have tapped into premium markets, earning ₹1,000-₹1,500 per kg of silk, compared to ₹500-₹700 for standard silk.

### 3. Women Empowerment:

Technologies such as pedal-driven charkhas and improved weaving looms have significantly benefited women entrepreneurs. Women make up over 60% of the workforce in sericulture and report higher earnings due to better productivity tools.

	State	Benefit	Details
1.	Karnataka	Impact of Automated Reeling Units	Rural entrepreneurs using automated reeling machines in Ramanagara district saw a 30% increase in silk production and 50% reduction in processing time. The improved silk quality fetched a premium price of ₹3,800 per kg, compared to ₹2,500 per kg with traditional methods.
2.	Tamil Nadu	Women Entrepreneurs in Sericulture	Women-led cooperatives in Tamil Nadu received training in mechanized mulberry cultivation and silk weaving. Their incomes doubled, from ₹10,000 per month to over ₹20,000 per month, due to higher productivity and direct market access.
3.	Asam	Eri Silk Production for Global Markets	Entrepreneurs in Assam adopting disease-resistant silkworm breeds and organic farming practices achieved a 20% increase in cocoon output. Eri silk shawls produced by these entrepreneurs are sold in European markets for ₹7,000-₹10,000 per piece, significantly boosting incomes.

Some examples of benefits to Rural Entrepreneurs

Table III

## Global Silk Production and Future Demand Forecasts

### 1. Technological Advancements:

The adoption of biotechnology in sericulture (such as the development of genetically modified silkworms) is projected to lead to increased cocoon yields by 15-20% per year.

Smart farming techniques and automated reeling will increase productivity and efficiency, reducing labour dependency. As a result, the average global output per farm is expected to rise by 10-15% by 2030.

## 2. Growing Demand for Sustainable Silk

The demand for sustainable silk (including organic and cruelty-free silk) is expected to grow at a CAGR of 12% through 2027, significantly outperforming conventional silk. Europe and North America are emerging as the largest consumers of eco-friendly silk, with the growing trend of sustainable fashion and green textiles pushing demand.

The OEKO-TEX certification for eco-friendly textiles is projected to become a standard, especially in luxury markets, further boosting demand for sustainable silk by 20-25%.

## 3. Role of Automation and AI in Silk Farming and Processing

Technologies such as automatic reeling machines, smart incubation systems, and AI-driven pest control are expected to increase the efficiency of silk farms and processing units by 30-40% over the next decade. The adoption of AI-based forecasting systems to predict weather patterns and optimize silkworm feeding will significantly reduce losses caused by environmental factors, leading to an estimated 10-15% increase in cocoon production by 2030. Precision farming tools are expected to become mainstream in India and China, making it easier for farmers to monitor soil health, water levels, and mulberry crop growth in real-time. This will increase overall silk production by 5-10% per year in major producing regions.

## 4. Silk Trade Trends and Market Dynamics

India's silk exports were valued at \$1.5 billion in 2023, a 12% increase from 2020. Projections indicate that India's silk export market will grow at a CAGR of 8-10% from 2024 to 2030, primarily driven by increased exports to Europe, the US, and Japan, especially of premium and organic silk.

## 5. Changing Consumer Preferences in Global Markets

Consumer demand for sustainable products is expected to reach 40-50% of the total textile market by 2030, driven by younger generations' growing awareness of environmental issues. The rise of eco-conscious fashion brands and direct-to-consumer platforms has led to the increased consumption of silk. Projections indicate that premium silk goods, including silk garments, bedding, and accessories, will experience a 12-15% annual growth rate in sales.

## 6. Environmental and Climatic Factors

Rising temperatures and erratic weather patterns are expected to affect silk production in certain regions, particularly in Southeast Asia and parts of India, leading to decreased cocoon yields in the short term. Projections suggest a 5-10% reduction in cocoon production due to unfavourable climatic conditions, which could lead to higher raw silk prices in affected regions. However, advanced climate-resilient mulberry varieties are expected to mitigate these impacts by 20-30%.

## Conclusion-

The silk industry, encompassing the intricate processes of mulberry cultivation, sericulture, and silk fabric production, presents immense opportunities for emerging economies and rural entrepreneurs. Technological advancements in mulberry cultivation and cocoon production are pivotal in driving these opportunities, offering new avenues for sustainable growth, improved productivity, and increased profitability. Technologies such as precision farming, automated reeling machines, and AI-driven pest management are transforming the landscape of sericulture. These innovations have led to significant improvements in yield, quality, and

efficiency, particularly in countries like India and China, where silk production is a cornerstone of rural economies. As a result, farmers and small-scale entrepreneurs can now achieve higher productivity with reduced labour inputs, offering a pathway toward greater economic sustainability and improved livelihoods.

For rural entrepreneurs, the increasing demand for sustainable and eco-friendly silk is a promising development. The global shift towards sustainable fashion and textiles has created new export markets for high-quality, ethically produced silk. Certifications such as OEKO-TEX and GOTS have elevated the marketability of silk products, enabling small producers to tap into premium markets in Europe and North America. By embracing these technological innovations and sustainability trends, rural entrepreneurs can not only improve their competitive edge but also enhance the resilience of the silk industry in the face of climate change and fluctuating global trade dynamics. Targeted investments in infrastructure, access to technology, and credit facilities will play a crucial role in enabling emerging economies to harness the full potential of the silk industry. As evidenced by ongoing initiatives like Silk Samagra Yojana in India, such policies have already begun to drive positive change and will be key to fostering long-term growth and global competitiveness.

In conclusion, the silk fabric production and trade industry hold vast potential for emerging economies and rural entrepreneurs, with technological advancements offering a critical path forward. By capitalizing on these opportunities, adopting sustainable practices, and fostering strategic collaborations, stakeholders across the silk value chain can position themselves to benefit from the expanding global demand for premium silk products. As technological innovation continues to shape the industry, the future of silk production promises greater efficiency, profitability, and inclusivity, ensuring that both producers and consumers can benefit from this timeless and valuable resource.

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