



## Current trends and developments in the sericulture industry

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### Abstract

Sericulture stands at the intersection of luxury, cultural exchange, and economic growth globally. In Jammu and Kashmir, the sericulture sector has seen significant growth, fostering entrepreneurship and employment opportunities. Dr. Rubia Bukhari's Cocoon Craft initiative exemplifies this progress by empowering women, farmers, and entrepreneurs through sericulture. Emphasizing value addition and innovation in silk production, Cocoon Craft not only boosts local economies but also preserves traditional craftsmanship. This initiative reinforces Jammu and Kashmir's role in sericulture while promoting sustainable development and cultural heritage, ensuring a prosperous future for the sector in the Union Territory. This article provides a comprehensive overview of the global sericulture industry, with a particular focus on Jammu and Kashmir's contribution in India. Balancing the preservation of tradition with the pursuit of innovation will ensure that sericulture continues to be an integral part of human history and progress for future generations.

**Keywords:** Sericulture, cultural exchange, economic development, cocoon crafts, tradition, UT Jammu and Kashmir

### Introduction

#### Sericulture or Silkworm Farming: An Overview

Sericulture, also known as silkworm farming, is a globally significant agriculture-based industry that has profoundly impacted culture and commerce, making it an integral part of human history. The origins of mulberry farming trace back to ancient China around 2600 BC (San, 2014) <sup>[60]</sup>. Over time, this industry has fostered cultural exchange and stimulated economic growth in various countries. India, with its rich history, has emerged as a leading player in silkworm farming, cultivating a legacy that spans millennia and remains deeply rooted in its cultural heritage. As the second-largest silk producer globally, India's sericulture industry employs approximately 9.76 million people in rural and semi-urban areas and is a major foreign exchange earner. Silkworm farming operations in India span over 52,360 villages (ISEPC, 2023) <sup>[39]</sup>.

India's sericulture industry thrives under diverse climatic conditions, producing various silk types, including Mulberry, Tasar, Eri, and Muga (Chand *et al.*, 2023) <sup>[19]</sup>. However, the industry faces numerous challenges both globally and in India. The gradual decline of skilled silkworm farmers threatens the industry's continuity as younger generations gravitate towards modern livelihoods (Majumdar *et al.*, 2017) <sup>[45]</sup>. Environmental concerns, climate change, and natural disasters affect silk production and cocoon quality, necessitating innovative and sustainable practices. Advances in biotechnology and genetic research offer hope for developing disease-resistant silkworms and improving overall silk yield (Nagaraju, 2002) <sup>[46]</sup>. This article explores the global and Indian status of silkworm farming, highlighting UT Jammu and Kashmir role, to ensure the industry's continued influence on cultural identity, economic prosperity, and sustainable development.

#### Global Status

Researchers worldwide have studied various aspects of sericulture. Nayar and Fraenkel (1962) <sup>[49]</sup> developed a

method for selecting host plants for silkworm farming based on chemical composition to achieve the best silk quality. Different aspects of the silkworm farming industry, such as mulberry farming, silkworm breeding, rearing, silk wrapping and weaving, and by-product processing, provide extensive employment opportunities, serving as a livelihood source for rural and tribal populations (Gregory, 1994) <sup>[32]</sup>.

In 2007, Naguku *et al.* <sup>[47]</sup> studied the effects of royal jelly-supplemented mulberry leaves on various parameters of silkworms, concluding that royal jelly could improve commercial silk quality and yield. Furdui *et al.* (2010) <sup>[29]</sup> examined seven monoclonal strains of Romanian silkworms under controlled conditions and found homogeneity in results due to genotype variability. De Bortoli *et al.* (2012) <sup>[21]</sup> evaluated the effects of different concentrations of foliar additives on the biological parameters of *Bombyx mori* L. El-Yamani *et al.* (2018) <sup>[26]</sup> verified the effectiveness of various nutritional additives on the biological properties of *B. mori*. Similar results were found in Egypt by Rateb and Abdel-Rahman (2018), who concluded that local hybrid silkworms treated with mulberry leaf water extract are easier and cheaper to raise.

To improve cocoon quality and quantity, El-Yamani *et al.* (2019) tested antibacterial and antifungal activity on larvae using extracts of *Morus alba*, *Ocimum basilicum*, and *Nigella sativa* seeds, finding that these extracts suppressed bacterial and fungal diseases. Demelash and Zemedkun (2020) presented the status, opportunities, challenges, and potential of silkworm farming in Ethiopia, which has significant potential for silk production due to favourable conditions.

Sandra *et al.* (2021) found that nanotechnology enhances silk fiber quality and increases silkworm survival rates and growth. However, while some nanomaterials have therapeutic benefits, others can be toxic. Grzeskowiak *et al.* (2022) noted that sericulture aligns with sustainable development trends due to the ecological nature of mulberry farming and waste management practices. Thus, sericulture

plays a crucial role in economic development and is considered a potential method for improving farmers' well-being worldwide.

**Sericulture: Key to Rural Economic Development**

Sericulture significantly contributes to the rural economy by ensuring consistent employment and seasonal income. Extensive research by Indian scientists has covered various aspects of sericulture, including the morphology and biology of *Bombyx mori* L. Hiware C.J. (2006) [34] explored the effects of fortifying mulberry leaves with the homeopathic drug Nux Vomica on *Bombyx mori* L., focusing on larval, cocoon, shell, and pupal weight, silk ratio, filament length and denier, and breakages during reeling. Gangopadhyay (2009) [30] reviewed the current status of India's sericulture industry, highlighting its importance in national economy, rural development, women's empowerment, and job creation, and suggesting development strategies for the industry. Naphade *et al.* (2010) [48] demonstrated that mango tree twigs are effective for cocoon mounting, being easily accessible and user-friendly for farmers.

Bhalerao *et al.* (2011) [8] conducted a survey on weed infestation in mulberry gardens across three seasons, identifying 58 weed species from 16 families. Shinde *et al.* (2012) [64] studied the impact of spacing and fertilizer on the productivity of the *Morus Alba* L. V1 variety, finding positive results with the V3 (3'x1') spacing type and T3 (NPK) fertilizer treatment. Avhad S.B. and Hiware C.J. (2013) [5] investigated the seasonal incidence of mulberry pests in Aurangabad, identifying several pests causing significant economic losses for sericulture farmers. Karthikairaj *et al.* (2013) [42] tested extracts from medicinal plants like Pakarkai, Tulasi, and Nilavembu for their potential in enhancing silk production. Avhad *et al.* (2013) [5] observed that the Giant African snail, *Achatina fulica*, caused severe cocoon loss by releasing a mucus layer that repelled silkworms, leading to significant waste of mulberry leaves. Shinde *et al.* (2014) [6] found positive results for the M5 (3'x3') spacing type and T3 (NPK) fertilizer treatment on the production of the M5 mulberry variety. Avhad *et al.* (2014) [6] studied the effect of soil abiotic factors on the population of nematodes associated with mulberry plants, concluding that temperature, soil moisture, and pH directly influence nematode populations. According to the Central Silk Board (2015) [18], India uniquely produces all five known commercial silks: mulberry, tropical tasar, oak tasar, eri, and muga, with muga silk being particularly distinctive to Indian culture.

Sericulture in Odisha offers dependable and additional income for underprivileged communities, providing a viable supplementary occupation for economic gain (Sahu, 2015) [59]. Padma Sree Vidya Devi and Ramani Bai (2015) [53] found that *O. sanctum* extract enhances silkworm growth, improving commercial silk qualities. Avhad and Hiware (2016) [2] demonstrated that feeding fifth instar larvae of *Bombyx mori* L. with mulberry leaves fortified with *Zizipus jujuba* L. extracts improved silk quality and quantity. Jadhav *et al.* (2016) [37] examined the effects of medicinal plant extracts from *Asparagus racemosus* and *Astracantha longifolia* on silkworms, observing variable consumption rates.

Sericulture requires low investment and yields high returns in a short period, making it an attractive sector for farmers

and a powerful tool for enhancing rural economies and living standards (Naik, 2017). Shinde *et al.* (2017) compared mountages' impact on *Bombyx mori* L. cocoon quality, finding positive results with Shindi branches. Buhroo *et al.* (2018) [12] highlighted the potential for additional income through the utilization of sericulture by-products and waste. Bukhari *et al.* (2020) reviewed sericulture's role in improving rural livelihoods, emphasizing its importance in job creation and social empowerment. Advanced techniques like gene therapy, gene editing, and transgenic technology are being employed to address challenges in sericulture, such as enhancing cocoon quality and quantity and using silk in medical and pharmaceutical applications (Sharma *et al.*, 2022) [62].

**Table 1:** Commercially exploited Sericigenous insects of the world and their host plants. (CSB Report, 2023)

Common Name	Scientific Name	Origin	Primary Food Plants
Mulberry Silkworm	<i>Bombyx mori</i>	China	<i>Morus indica</i>
			<i>M. alba</i>
			<i>M.multicaulis</i>
			<i>M. latifolia</i>
Tropical Tasar Silkworm	<i>Antheraea mylitta</i>	India	<i>Shorea robusta</i>
			<i>Terminalia tomentosa</i>
			<i>T. arjuna</i>
Oak Tasar Silkworm	<i>Antheraea proylei</i>	India	<i>Quercus incana</i>
			<i>Q. serrata</i>
			<i>Q. himalayana</i>
			<i>Q. leuco tricophora</i>
			<i>Q. grifithi</i>
Oak Tasar Silkworm	<i>Antheraea frithi</i>	India	<i>Q. dealdata</i>
Oak Tasar Silkworm	<i>Antheraea compta</i>	India	<i>Q. dealdata</i>
Oak Tasar Silkworm	<i>Antheraea pernyi</i>	China	<i>Q. dealdata</i>
Oak Tasar Silkworm	<i>Antheraea yamamai</i>	Japan	<i>Q. acutissima</i>
Muga Silkworm	<i>Antheraea assama</i>	India	<i>Litsea polyantha</i>
			<i>L. citrata</i>
			<i>Machilus bombycina</i>
Eri Silkworm	<i>Philosamia ricini</i>	India	<i>Ricinus communis</i>
			<i>Manihot utilisma</i>
			<i>Evodia fragrance</i>

**Sericulture: Growth and Challenges in UT Jammu and Kashmir**

**Silk Production Trends**

Over the past decade, the production of mulberry silk has increased from 19,476 MT to 27,654 MT, while tasar silk production has declined from 2,619 MT to 1,318 MT. Eri silk production has seen a rise from 4,237 MT to 7,349 MT, and muga silk production has increased from 148 MT to 261 MT. Overall, silk production has shown encouraging progress. However, the export of silk products has decreased from \$312.1 million to \$211.3 million, highlighting the need for better marketing and branding strategies to meet global demands (ISEPC, 2023) [39].

The sericulture sector has historically played a crucial role in the economy of Jammu and Kashmir, boasting a rich heritage. The favorable climate and skilled labor in the Kashmir Valley make it an ideal region for silk production. Approximately 2,800 villages and 33,000 households in the

state engage in sericulture as a key economic activity. The state has around 700,000 mulberry trees, with 53% (370,000) located in the Jammu division and 47% in the Kashmir division. Each year, about 1,022 metric tons of cocoons are produced, generating an income of approximately Rs. 2,224 lakhs for the silkworm rearers and creating about 3.5 lakh mandays of employment (3.0 lakh on-farm and 0.5 lakh off-farm).

The Department of Sericulture operates 173 mulberry nurseries covering 963 acres and 374 mulberry blocks over 2,215 acres across Jammu and Kashmir. Annually, around 6,680 quintals of raw silk are produced, valued at approximately Rs. 50 crores (500 million). Despite this, there has been a noticeable decline in silk production in Jammu and Kashmir over the past few decades, highlighting the need for renewed focus and efforts in this sector.

### **Employment and Income Generation in the Sericulture Industry of Jammu and Kashmir**

The government of Jammu and Kashmir is dedicated to revitalizing the sericulture industry, benefiting cocoon growers and creating job opportunities for the youth. Renowned for the purity of its cocoons, Kashmiri silk attracts buyers from around the world. The government has introduced several initiatives, such as providing free planting materials and rearing kits to support growers. Additionally, recent cocoon auction markets have enabled growers to sell their products to merchants from various states, including West Bengal, Karnataka, and Bhopal.

### **Sericulture as an Employment Generator**

Sericulture is a significant agro-based industry offering extensive employment opportunities in both rural and urban areas. Activities span from raising and planting mulberry trees, rearing silkworms, producing silkworm seeds, and reeling silk cocoons, to fabric production, printing, dyeing, and marketing finished silk products. The cultivation of mulberry trees is environmentally friendly and contributes to social forestry efforts. The state's XII Five-Year Plan targets generating approximately 68 lakh man-days through diverse sericulture activities.

In the context of enhancing livelihoods and promoting entrepreneurship, Dr. Rubia Bukhari initiated the Cocoon Craft initiative in UT Jammu and Kashmir. This initiative aims to empower Women's, farmers and entrepreneurs by providing them with the necessary skills and resources to start and improve their livelihoods through sericulture. By focusing on the value addition of cocoons, such as spinning, dyeing, and weaving, the initiative not only enhances the economic prospects of local communities but also preserves traditional craftsmanship.

Dr. Rubia Bukhari's initiative has been instrumental in bridging the gap between sericulture and sustainable livelihoods in the region. It encourages innovation in silk production techniques and promotes the creation of high-value cocoon products that cater to both domestic and international markets. Through training programs and workshops, the initiative equips local farmers and entrepreneurs with the knowledge and expertise needed to excel in the sericulture industry, thereby fostering economic growth and cultural sustainability.

By supporting initiatives like Cocoon Craft, UT Jammu and Kashmir not only strengthens its position in the sericulture sector but also ensures that sericulture continues to thrive as

a significant contributor to the region's economy and cultural heritage. This balanced approach, combining tradition with innovation, underscores the potential of sericulture to positively impact livelihoods and contribute to sustainable development in the Union Territory.

### **Challenges**

Despite the potential, the sericulture sector faces challenges due to the globalization of trade and the import of cheaper silk yarn from China. In an effort to reduce production costs, many small-scale farmers adopt shortcuts that negatively impact overall production quality. Additionally, sericulture farmers in Jammu and Kashmir, being part of a mono-crop producing state, often struggle to sell their produce promptly and profitably, relying on the annual cocoon auction organized by the Department.

The sericulture industry in Jammu and Kashmir faces several challenges, particularly in the post-cocoon sector. A significant issue is the lack of access to modern technology, with many farmers still relying on traditional, time-consuming, and labor-intensive methods that produce lower-quality silk. Based on our extensive analysis, the development of the post-cocoon sector, including silk reeling and weaving, significantly lags behind the pre-cocoon phase, which primarily relies on farmers. This gap limits opportunities for farmers to engage in sericulture beyond cocoon production. The region suffers from a scarcity of silk reeling and weaving units, which discourages new farmers from entering the industry. Additionally, low cocoon prices drive farmers to switch to other agricultural crops. To address these challenges, the post-cocoon sector needs significant investment to consume the entire cocoon produce within the district, thus stabilizing prices and improving marketing efficiency. Moreover, the reeling industry is hindered by the unavailability of raw materials throughout the year, inadequate infrastructural facilities, lack of proper training, limited marketing opportunities, insufficient government credit, poor extension services, low wages, and a lack of interest from the younger generation. Addressing these issues is crucial for revitalizing the sericulture industry in Jammu and Kashmir and ensuring its sustainable development.

Furthermore, there is a need for skill development and training programs tailored to the post-cocoon sectors. Many workers in silk processing lack updated skills and knowledge of modern techniques, which hampers productivity and quality consistency. Addressing this gap through targeted training initiatives could improve efficiency and product standards across the sector. Additionally, the sector faces environmental and climatic challenges, affecting silk quality and production consistency. Climate change impacts, pest infestations, and natural disasters can disrupt mulberry cultivation and silk production cycles, leading to unpredictable yields and economic losses.

### **Historical Context and Current Trends**

Historically, the silk industry was a significant source of employment for almost half of Jammu and Kashmir's population. However, the rise of other sectors such as agriculture and horticulture led to a decline in focus and development within sericulture. Nevertheless, current efforts by the Department of Sericulture have involved approximately 30,000 families in silkworm rearing, with

crop production showing an upward trend. Currently, only 20-30% of the state’s raw silk cocoons are consumed locally, with the remainder being sold to buyers from other states. Marketing challenges, coupled with competition from imported silk, continue to hinder the rapid development of the industry.

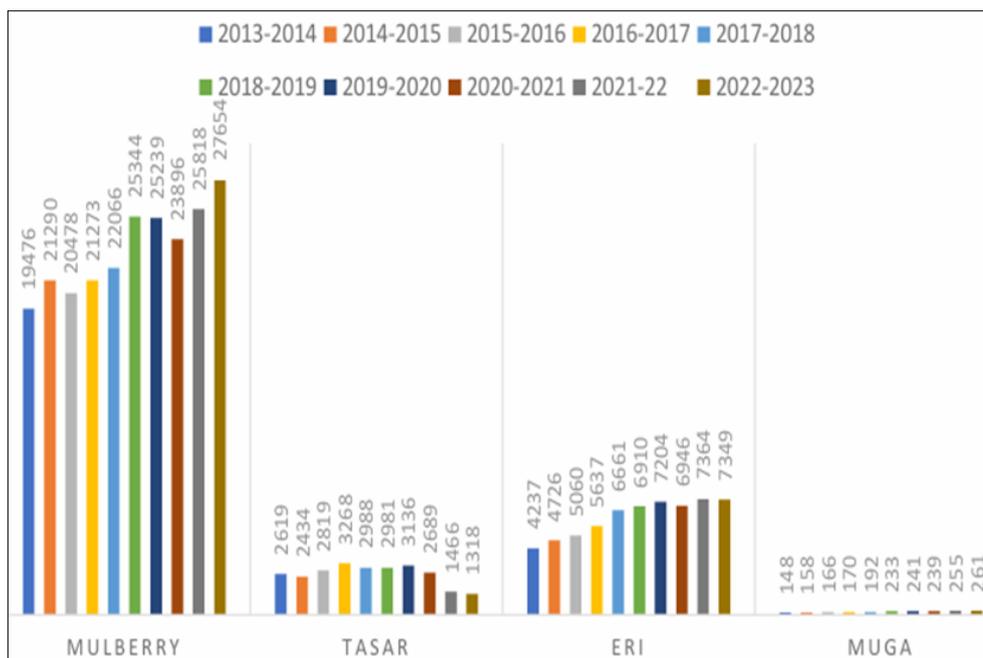
**Economic Potential and Strategic Initiatives**

Sericulture has significant potential to boost income and employment in Jammu and Kashmir, particularly for rural communities and women. Realizing this potential requires not only introducing advanced technology to primary producers but also establishing organized production and marketing systems. The state government, with support from the central government, aims to improve infrastructure and enhance the state’s productive capacity, promoting self-

sufficiency. Ambitious flagship programs have been launched to bridge the rural-urban divide and ensure equitable growth.

**SWOT Analysis**

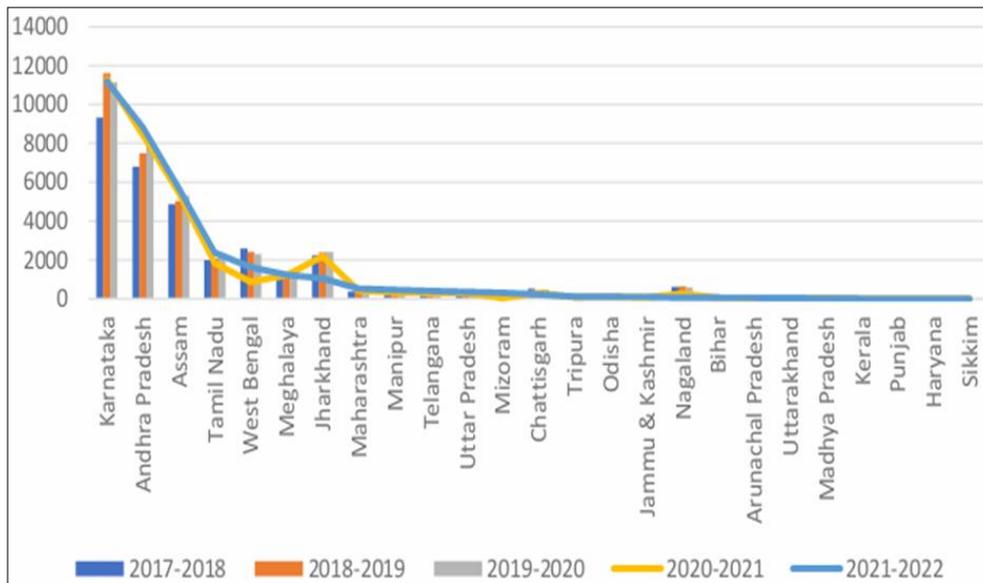
A comprehensive SWOT analysis reveals the strengths, weaknesses, opportunities, and threats associated with the sericulture industry. This strategic planning tool helps policymakers and researchers understand economic performance and reorient their strategies to address current conditions effectively. In conclusion, with the right support and strategic initiatives, the sericulture industry in Jammu and Kashmir holds the promise of significant economic and employment benefits, contributing to the overall development of the state.



**Graph 1: Silk Production in India – Last 10 Years (CSB Report, 2023)**



**Graph 2: India’s Silk & Silk products export trends in US \$ Millions, (ISEPC, 2023)**



**Fig 3:** State wise silk Production in India for during 2017-2022 in metric tons (Statista Report 2023, CSB Report 2021)

**Status and Role of Sericulture's in Rural Economy**

Sericulture is a vital agricultural enterprise that significantly influences the rural economy, especially in India, where agriculture remains a predominant industry. Figure 3 shows that Karnataka was the leading raw silk producer from 2017 to 2022. States like Andhra Pradesh, Assam, Tamil Nadu, West Bengal, and Meghalaya maintained consistent production levels, while Sikkim had the lowest production.

**Revitalizing the Sericulture Industry in Jammu and Kashmir**

The conducive climate and availability of skilled labour in the Kashmir Valley make it an ideal location for silk production. However, there is a pressing need to develop new hybrid species of silkworms that can endure adverse climatic conditions, thereby improving both the quantity and quality of raw silk produced. In Jammu and Kashmir, sericulture has become a vital economic activity for 2,800 villages and 33,000 households, with 1,500 of these villages located in the Kashmir division and 1,300 in the Jammu division. The sericulture industry, which involves the cultivation of mulberry trees and rearing of silkworms, has historically played a significant role in the rural economy of the state. Among Indian states, Karnataka, West Bengal, and Jammu and Kashmir are major producers of mulberry silk. Jammu and Kashmir, with its favourable climate during autumn and spring, specializes in producing silk through the rearing of univoltine silkworms.

The natural climate and altitude of the Kashmir Valley are exceptionally suited for mulberry cultivation, which in turn supports sericulture. This natural advantage has contributed to the long-standing tradition of silk production in the region, predating even the well-known sericulture practices of China and Tibet. Historical accounts from various travellers attest to the ancient knowledge of silk rearing, reeling, and weaving in Jammu and Kashmir.

Despite this rich heritage, silk production in the state has sharply declined over the past five decades, primarily due to government monopolies, political instability, and other adverse conditions. In 1960, Kashmir's cocoon production was at 15 lakh kilograms, but by 2009, it had plummeted to 8.32 lakh kilograms. This decline can be attributed to a

reduction in the number of silk-rearing farmers, political turmoil, and monopolistic practices. Historically, Kashmir was the primary supplier of silk within the state, producing two-thirds of the total output. However, political instability and militancy have shifted the balance, with Jammu now contributing 60% of the state's silk production, compared to Kashmir's 40%. In 1988, out of a total cocoon production of 10.36 lakh kilograms, Kashmir produced 6.65 lakh kilograms, while Jammu's share was 3.71 lakh kilograms. The short, one-month rearing period for cocoons, beginning in the first week of May, is another factor contributing to the waning interest among farmers. This limited timeframe has discouraged many from engaging in sericulture, which has suffered severe setbacks over the years. Once a significant revenue-generating industry, silk production in Jammu and Kashmir has nearly collapsed.

Efforts are underway to rejuvenate the industry. The Commissioner Secretary of the Agriculture Production Department has called on the Central Silk Board to develop comprehensive projects in partnership with the private sector. These initiatives aim to promote high-quality mulberry leaf and cocoon production, with a focus on value addition. The hope is that the Central Silk Board will provide substantial funding to support these activities and develop policies to advance the silk industry. Jammu and Kashmir's mulberry cocoons are among the highest quality in Asia, producing fine fibers that rival the best in the world. To revive the silk industry, collaboration between the sericulture department, educational institutions, NGOs, and other stakeholders is crucial. Awareness campaigns about various schemes, such as the Catalytic Development Programme (CDP), establishment of silk reeling units, and cocoon banks, can help in this effort. These centrally sponsored schemes hold significant potential for reviving the silk industry, and increasing awareness among the population is essential for their success. With concerted efforts and strategic initiatives, there is hope that the sericulture industry in Jammu and Kashmir can regain its former prominence and contribute significantly to the state's economy once again.

### Empowerment Through Sericulture

Sericulture provides high-income employment for rural populations, creating jobs from unskilled agricultural work to skilled artisanal production (Savitri *et al.*, 2013). Women significantly contribute to family income through silkworm farming, making economic self-sufficiency and job creation for rural women a priority (Prabha Sekhar and Ravi Kumar, 1988) [39]. Hiware C.J. (2016) [35] found that community participation in sericulture led to economic empowerment in Aurangabad district. Dar *et al.* (2020) [20] confirmed sericulture as a viable option for farmers in Kargil. These studies underscore the importance of sericulture in empowering rural communities and women, providing substantial side income and improving lifestyles.

### Conclusion

The sericulture industry has been integral to Jammu and Kashmir's economy, boasting a rich history and providing substantial employment opportunities, especially in rural areas. Despite challenges like political instability and resource inadequacies, the state's favourable climate and skilled labor have sustained high-quality silk production. Modernization efforts, including new techniques and government support, aim to revive and expand the industry. Sericulture offers significant potential for income generation and improving living standards, though there remains a gap between domestic production and export trends. Increasing awareness campaigns, short-term courses, training programs, technological advancements, market access initiatives, lead farmers visit from different largest producing states, guidance, and financial support can help bridge this gap and further develop the industry. These measures, combined with research and development, infrastructure improvements, and strong policy frameworks, can significantly enhance the growth and sustainability of the sericulture sector.

### References

1. Afifa K. Principles of Temperate Sericulture. Kalyani Publications, 2000.
2. Andrabi SDA. Industrial Development: Socio-Economic Changes in Kashmir Society (1339-1551. A D.). American Research Journal of History and Culture, 2017;3:1-7.
3. Avhad S, Hiware C. Studies on rearing performance of *Bombyx mori* L. (race: PM × CSR2) with fortification of mulberry leaves using plant extracts. KAAV International Journal of Science, Engineering & Technology, 2016;3:118-43.
4. Avhad S, Shinde K, Hiware C. Giant African Snail-As A Molluscan Pest Record on Mulberry from Aurangabad, (M.S), India.
5. Avhad SB, Hiware CJ. Mulberry defoliators: distribution and occurrence from Aurangabad (MS), India. J. Entomol. Zool. Stud, 2013;1(4):1-6.
6. Avhad SB, Shinde KS, Hiware CJ. Impact of soil abiotic factors on population fluctuation of soil and plant parasitic nematodes associated with mulberry, *Morus alba* L. from Gangapur, Aurangabad (MS). India. J. Zool. Biosci. Res, 2014;1(4):8-17.
7. Baqual MF. Problems that hinder the growth of Sericulture in Jammu & Kashmir State. Workshop on Development of Sericulture in Jammu & Kashmir State, its future prospects: 1995.
8. Bhalerao RS, Hiware CJ, Avhad SB. Weed infestation in mulberry garden. Bangladesh Journal of Agricultural Research, 2011;36(1):183-8.
9. Bhat TA. An analysis of public private partnership (PPP) in Sericulture in Jammu & Kashmir. Journal of Economics and Sustainable Development, 2014;5:11.
10. Bhattarcharjya D, Alam K, Bhuimali A, Saha S. Status, potentials, constraints and strategies for development of sericulture farming system in West Bengal state of India. Bulgarian Journal of Agricultural Science, 2020, 26(4).
11. Bilal AS. Structural Changes in Jammu and Kashmir Economy. P.G. Department of Economics, University of Kashmir, 2010, 1-94.
12. Buhroo ZI, Bhat MA, Kamili AS, Ganai NA, Bali GK, Khan IL, *et al.* Trend in development and utilization of sericulture resources for diversification and value addition. Journal of Entomology and Zoology Studies, 2018;6(4):601-15.
13. Bukhari R, Kour H, Aziz A. Women and the Indian Sericulture Industry. Int J Curr Microbiol App Sci, 2019;8(5):857-71.
14. Bukhari R, Singh KS, Shah HR. Non: Mulberry Sericulture. J Pharmacogn Phytochem, 2019;8(4):311-23.
15. Bukhari R, Bali RK, Bali K. Correlation analysis of quantitative traits in different breeds of silkworm, *Bombyx mori* L. Journal of Entomology and Zoology Studies, 2019;7(1):910-3.
16. Central Sericulture Board (CSB). Annual Report. Central Board of Sericulture, Bangalore, 2023.
17. Central silk board, Ministry of textiles, Govt. of India. Functioning of Central Silk Board & Performance of Indian Silk Industry, 2021.
18. Central silk board, Ministry of textiles, Govt. of India. Note on the performance of Indian silk industry and functioning of central silk board, 2015.
19. Chand S, Chand S, Raula B. Usage of Silkworm Materials in Various Ground of Science and Research. Journal 2139328. Natural Fibers, 2023, 20(1).
20. Dar KA, Ganie NA, Wani MY, Rafiq A, Khan IL, Sahaf KA, *et al.* Sericulture: A viable option for farmers of Kargil. Innovations, 2020;9(2):288-9. The Pharma
21. De Bortoli SA, Takahashi R, Miranda JE, Dias LS, De Bortoli CP, De Bortoli SLP. Effects of mulberry leaves treated with vitamin and esterol affect biological parameters of *Bombyx mori* L. Comunicata Scientiae, 2012;3(4):316-20.
22. Dewangan SK. Livelihood opportunities through sericulture a model of Gharghoda tribal block, Raigarh dist. American Journal of Environmental Science, 2013;9(4):343-7.
23. Dhar A, Farooq M, Mir Nisar. Recent Trends in Development of Bivoltine Sericulture in Jammu and Kashmir. Technical Compendium, Workshop held at SKICC, Srinagar, 2011.
24. Directorate of Economics and Statistics. Digest of Statistics, for different years, Govt. of J&K state. Economic Survey (2010-11), 2017, 1-2.
25. Directorate of Economics and Statistics, Govt. of Jammu and Kashmir.
26. El Yamani EM, Saad MSI, Hassan EM. Studying the effect of some botanical extracts of the Aveloz plant

- (*Euphorbia tirucalli* L.) on biological and productive characters of the mulberry silkworm (*Bombyx mori* L.). Archives of Agricultural Sciences Journals,2018:1(3):1-13.
27. Farhat IQS, Malik MA, Awquib Sabhat, Firdose Ahmad Malik. Adoption of Improved Sericulture Practices by Sericulturists in Border Area of Kashmir. International Journal of Agricultural Statistics and Science,2010:6(1):197-201.
  28. Fometu SS, Wu G, Ma L, Davids JS. A review on the biological effects of nanomaterials on silkworm (*Bombyx mori*). Beilstein J Nanotechnol,2021:12:190-202.
  29. Furdui EM, Marghitaş LA, Dezmirean D, Mihai CM, Bobiş O, Paşca I. Comparative Study of Biological Characteristics of Larvae, Crude and Dried Cocoon in 7 Races of Silkworm *Bombyx mori* L., Raised in Transylvania Area. Scientific Papers: Animal Science and Biotechnologies,2010:43(1):490-3.
  30. Gangopadhyay D. Sericulture Industry in India – A Review (September 14, 2009). India Science and Technology (Online), 2008. Available from: <https://ssrn.com/abstract=1473049>.
  31. Ganie NA, Dar KA, Khan IL, Sharma RK, Sahaf KA. Sericulture- A viable option for sustainable livelihood and employment generation for rural population of J & K. Global Journal of Bioscience and Biotechnology,2018:(1):200-3.
  32. Gregory S. Rural Labour and Sericulture: Typology, Strategies and Prospects. Indian Journal of Industrial Relations, 1994, 365-76.
  33. Grześkowiak J, Łochyńska M, Frankowski J. Sericulture in Terms of Sustainable Development in Agriculture. Problems of sustainable development,2022:17(2):210-7.
  34. Hiware CJ. Effect of fortification of Mulberry leaves with homeopathic drug *Nux Vomica* on *Bombyx mori* L. Homeopathy,2006:95(3):148-50.
  35. Hiware CJ. Farmer's empowerment through sericulture industry from Aurangabad District, Maharashtra State, India. Entomology and Applied Science Letters,2016:3(2):22-8.
  36. Hiware CJ. Scenario of sericulture industry in Maharashtra State, India. Journal of Entomology and Zoology Studies,2016:4(1):601-5.
  37. Hugar IL, Jadhav DV, Kalyankar A, Pande AB. Tasar For Tribal Prosperity—An Experience of Baif in Promotion of Tasar Sericulture Based Livelihood Promotion in Maharashtra, 2016.
  38. Hussain M. Geography of Jammu & Kashmir. Rajesh Publications, 2002.
  39. Indian Silk Export Promotion Council (ISEPC), India Brand Equity Foundation, 2023.
  40. Jakkawad SR, Patange NR, Ahire RD. Adoption of sericultural practices by the sericulturists. Journal of Entomology and Zoology Studies,2019:7(3):1363-6.
  41. Kaneez F. Trends in cocoon and silk production in Jammu and Kashmir State—a case of concern. International Journal of Recent Scientific Research,2018:4(11):1826-30.
  42. Karthikairaj K, Prasannakumar, Isaiarasu L. Use of Plant Extracts for the Control of Flacherie Disease in Silkworm, *Bombyx mori* L. (Lepidoptera: Bombycidae). International Journal of Microbiological Research,2013:4(2):158-61.
  43. Khade AN, Hiware CJ, Khade SN. Effect of Methanolic Extract of *Achyranthes Aspera* Linn on the Larvae of Silkworm, *Bombyx mori* L. International Journal of Scientific Research in Science and Technology,2021:8(1):70-74.
  44. Mahareshim Campaign. Department of Sericulture, Government of Maharashtra, India, 2020.
  45. Majumdar M, Sarkar K, Sinha S. A Critical Analysis on Major Problems Faced by Reelers and Weavers of Silk Industry at Field Level in Murshidabad District of West Bengal. International Journal of Social Sciences,2017:6(3):199-210.
  46. Nagaraju J. Application of genetic principles for improving silk production. Current Science, 2002, 409-414.
  47. Naguku EK, Muli EM, Raina SK. Larvae, cocoon and post-cocoon characteristics of *Bombyx mori* L. (Lepidoptera: Bombycidae) fed on mulberry leaves fortified with Kenyan royal jelly. Journal of Applied Sciences and Environmental Management,2007:11(4):85-89.
  48. Naphade ST, Hiware CJ, Avhad SB. Development of improved mountage using mango plant twigs during lack of sufficient number or absence of mountages on field for silkworm cocoon. Recent Research in Science and Technology, 2010, 2(7).
  49. Nayar JK, Fraenkel G. The chemical basis of hostplant selection in the silkworm, *Bombyx mori* (L.). Journal of Insect Physiology,1962:8:505-525.
  50. Nimgare SS, Fule UW, Telkhade PM. Present status and future of sericulture in Maharashtra State, India. International Journal of Research in Biosciences, Agriculture and Technology,2017:5(1):41-43.
  51. Nisar AG, Afifa SK, Baqual MF, Sharma RK, Dar KA, Khan IL. Indian Sericulture Industry with particular reference to Jammu and Kashmir. International Journal of Advanced Biological Research,2012:2(2):194-202.
  52. Nisar GK, Afifa K. Indian Sericulture Industry with particular reference to Jammu and Kashmir. International Journal of Advanced Biological Research,2012:2(2):194-202.
  53. Padma Sree Vidya Devi P, Ramani Bai M. Effect of *Ocimum sanctum* L. plant extract on the economic parameters of silkworm, *Bombyx mori* L. Journal of Entomology and Zoology Studies,2015:3(2):62-64.
  54. Pathare PP, Hiware CJ. Participation of women in Sericulture Activities of Ahmednagar District (M. S) India. IOSR Journal of Humanities and Social Science,2017:22(8):90-93.
  55. Prabha Sekhar, Ravikumar C. Role of rural women in Indian sericulture. Proceedings of the International Congress on Tropical Sericulture Practices, 1991, 65-71.
  56. Qadri S. Farhat, Malik MA. Sericultural practices by sericulturists in border area of Kashmir. International Journal of Agricultural Statistics and Science,2010:6(1):197-201.
  57. Rateb SH, Abdel Rahman YA. Effects of some extracts on growth characters of mulberry silkworm "*Bombyx mori* L.". Assiut Journal of Agricultural Sciences,2015:46(5):58-71.

58. Ravikumar A. Status of silk industry in India. Published in *Kisan World*,2011:38(2):45-49.
59. Sahu KK. Status and performance of sericulture in Odisha. *Odisha Review*, 2015, 37-42.
60. San TK. *Dynastic China: an elementary history*. The Other Press, 2014.
61. Savithri G, Sujathamma P, Neeraja P. Indian Sericulture Industry for Sustainable Rural Economy. *International Journal of Economics, Commerce and Research (IJEER)*,2013:3(2):73-78.
62. Sharma A, Gupta RK, Sharma P, Qadir J, Bandral RS, Bali K. Technological innovations in sericulture. *International Journal of Entomology Research*,2022:7(1):7-15.
63. Shinde KS, Avhad SB, Hiware CJ. Impact of spacing and fertilizers on the production of M5 Mulberry variety. *International Journal of Interdisciplinary and Multidisciplinary Studies*,2014:1(5):344-8.
64. Shinde KS, Avhad SB, Jamdar SV, Hiware CJ. Comparative studies on the performance of mountages on cocoon quality of *Bombyx mori* L. *Trends in Life Sciences*,2012:1:8-11.
65. Shinde KS, Avhad SB, Jamdar SV, Hiware CJ. Impact of spacing, fertilizer on the productivity of mulberry (*Morus alba* L.) V1 variety. *Life Science Bulletin*,2012:9(2):276-280.
66. Sime D, Siraj Z. Sericulture in Ethiopia: Production status, opportunities, challenges and potential areas. A review. *Journal of Entomology and Zoology Studies*,2020:8(6):01-10.
67. Singh H, Andrabi RH. Spatial differentiation in agricultural development in Jammu and Kashmir: A geographical approach. *International Journal of Scientific and Research Publications*,2015:5(8):1-9.
68. Statista Report, 2023. Available from: <https://www.statista.com/statistics/622953/raw-silk-production-by-state-India>.
69. Bhat TA. An analysis of public private partnership in sericulture in Jammu and Kashmir State (India). *Journal of Economics and Sustainable Development*,2014:5(11):121-127.