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Review

Sericulture-Based Startups and Rural Innovation Ecosystems

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Abstract
Sericulture is a labour-intensive agro-based industry that plays a significant role in rural livelihood development. In recent years, the emergence of startups and agri-preneurship has transformed traditional sericulture into an innovation-driven sector. This study examines the role of sericulture-based startups in strengthening rural innovation ecosystems and promoting sustainable development. The study is based on secondary data collected from scholarly articles, reports and institutional publications. The findings reveal that startups contribute significantly to technological innovation, value chain integration, employment generation and income enhancement. However, challenges such as limited access to finance, infrastructure gaps and policy constraints continue to hinder their growth. The study suggests that strengthening rural innovation ecosystems through supportive policies and institutional frameworks can enhance the sustainability and scalability of sericulture startups.

Keywords: *Sericulture; Startups; Rural Innovation Ecosystem; Agri-preneurship; Sustainable Development.*

Introduction

Sericulture, the cultivation of silkworms for silk production, has long been recognized as a labour-intensive and agro-based rural industry that plays a significant role in socio-economic development. Particularly in developing countries such as India, China and Thailand, sericulture provides employment opportunities to small and marginal farmers, women and rural artisans, thereby contributing to income generation and poverty alleviation (Ganie et al., 2018). Unlike many other agricultural activities, sericulture offers year-round employment and requires relatively low initial investment, making it highly suitable for rural households.

Traditionally, sericulture has been practiced as a subsistence-oriented activity, characterized by fragmented production systems, limited technological adoption and weak market linkages. However, in recent years, the sector has undergone a transformation driven by agri-preneurship and startup ecosystems, which are introducing innovation across the sericulture value chain. Startups are playing a crucial role in modernizing the industry by integrating advanced technologies such as artificial intelligence (AI), Internet of Things (IoT) and digital platforms, thereby enhancing productivity and efficiency (Suarez-Sanchez et al., 2025).

The concept of sericulture-based startups refers to entrepreneurial ventures operating at different stages of the silk value chain, including input supply, silkworm rearing, cocoon processing, silk reeling, weaving and marketing. These startups not only improve production efficiency but also facilitate value addition and market expansion, enabling rural producers to access higher-value markets. According to Jayaram and Mahadev Gowda (2024), seri-entrepreneurship represents a promising pathway for transforming traditional sericulture into a competitive and innovation-driven sector.

Parallel to the emergence of startups is the growing importance of rural innovation ecosystems, which consist of interconnected stakeholders such as farmers, entrepreneurs, research institutions, government agencies and financial organizations. These ecosystems facilitate the creation, diffusion and adoption of innovations, thereby enhancing the overall performance of rural economies (Aguilar, 2021). In the context of sericulture, rural innovation ecosystems enable the integration of traditional knowledge with modern technologies, creating new opportunities for sustainable development.

The integration of startups into rural innovation ecosystems has significant implications for economic, social and environmental sustainability. Economically, startups contribute to income diversification and employment generation. Socially, they promote women empowerment and youth engagement, which are critical for inclusive development. Environmentally, startups are increasingly adopting eco-friendly and circular economy practices, such as organic silk production and waste utilization, which enhance sustainability (Kaushik et al., 2025).

Despite these opportunities, the development of sericulture-based startups faces several challenges. These include limited access to finance, inadequate infrastructure, low technology adoption and policy constraints, which hinder their growth and scalability (Dandasena et al., 2026). Additionally, the startup ecosystem in rural areas is often underdeveloped, with insufficient support in terms of incubation, mentorship, and market access.

Given this context, there is a need for comprehensive research that examines the role of sericulture-based startups within rural innovation ecosystems. While existing studies have explored sericulture from the perspectives of livelihood development and sustainability, there is limited focus on the startup-driven transformation of the sector. This study aims to fill this gap by analysing how startups contribute to innovation, value creation and rural development in the sericulture industry.

2. Conceptual Framework

The conceptual framework for Sericulture-Based Startups and Rural Innovation Ecosystems is built upon the interaction between three core components, the sericulture value chain, startup-driven innovation and the rural innovation ecosystem. This integrated framework explains how entrepreneurial interventions transform traditional sericulture into an innovation-led and sustainable rural enterprise.

At the foundation of this framework lies the sericulture value chain, which comprises multiple interdependent stages, including mulberry cultivation, silkworm rearing, cocoon production, reeling, weaving and marketing. Traditionally, these stages have functioned in a fragmented manner, often characterized by inefficiencies, limited value addition and weak coordination among stakeholders. Such fragmentation results in reduced productivity and income for rural producers (Ganie et al., 2018). However, the introduction of startups into the value chain enables vertical and horizontal integration, improving efficiency and enhancing value creation.

Startups play a central role in this framework as innovation intermediaries. They introduce technological, organizational and market innovations across the sericulture value chain. Technological innovations include the use of Internet of Things (IoT) devices for environmental monitoring, artificial intelligence (AI) for disease detection and mobile-based advisory services for farmers. These innovations enable real-time decision-making and reduce production risks (Suarez-Sannchez et al., 2025). Organizational innovations, such as cooperative models and digital platforms, improve coordination among stakeholders. Market innovations, including e-commerce and direct-to-consumer models, enhance market access and price realization.

The second major component of the framework is the rural innovation ecosystem, which provides the enabling environment for startup activities. A rural innovation ecosystem consists of a network of actors, including farmers, startups, research institutions, government agencies, financial institutions and non-governmental organizations, all interacting to promote innovation and development (Aguilar, 2021). These actors contribute resources such as knowledge, capital, infrastructure and policy support, which are essential for the growth of startups.

Within this ecosystem, knowledge flow and collaboration are critical. Research institutions develop improved silkworm breeds and sustainable farming techniques, while startups translate these innovations into commercially viable solutions. Government agencies provide policy support, subsidies, training programs, financial institutions offer credit and investment opportunities. This collaborative environment fosters innovation and accelerates the adoption of new technologies (Paramasivam & Prasanna, 2026).

An important dimension of the conceptual framework is value chain upgrading, which refers to improvements in product quality, production processes and market positioning. Startups facilitate upgrading by enabling farmers to transition from low-value raw cocoon production to high-value silk products, branded goods and export-oriented markets. This shift not only increases income but also enhances competitiveness in global markets (Bhattacharya & Goswami, 2026).

The framework also incorporates the concept of sustainability, which is increasingly important in the sericulture sector. Startups promote sustainable practices such as organic silk production, natural dyeing and waste recycling, contributing to the development of a circular economy (Kaushik et al., 2025). These practices reduce environmental impact while improving economic viability.

Another key aspect is the feedback mechanism within the ecosystem. Innovations introduced by startups lead to outcomes such as increased productivity, higher incomes and improved livelihoods. These outcomes, in turn, attract further investment and participation, creating a positive feedback loop that strengthens the ecosystem.

However, the effectiveness of this framework depends on several factors, including infrastructure, policy support and access to finance. Weak institutional linkages and socio-economic barriers can limit the adoption of innovations, highlighting the need for integrated policy interventions.

In conclusion, the conceptual framework illustrates how the integration of sericulture value chains, startups and rural innovation ecosystems drives rural development. By combining traditional knowledge with modern innovation, this framework provides a comprehensive understanding of the transformative potential of sericulture-based startups.

3. Literature Review

The literature on sericulture has evolved from a traditional focus on livelihood generation to a broader emphasis on innovation, sustainability and entrepreneurship. Early studies primarily highlighted sericulture as a labour-intensive rural industry that supports employment and income generation among small and marginal farmers (Ganie et al., 2018). It has been widely recognized for its ability to provide year-round employment, especially for women and rural households.

In recent years, the focus has shifted toward agri preneurship and startup ecosystems. Singh et al. (2022) argues that agri preneurs play a critical role in transforming traditional agricultural sectors by integrating technology, improving value chains and enhancing market access. Similarly, Jayaram et al. (2024) introduced the concept of seri-entrepreneurship, emphasizing the growing importance of startups in the silk industry.

Another important area of research is innovation in sericulture. Suarez-Sanchez et al. (2025) highlight the role of frugal innovation, which involves developing cost-effective solutions tailored to resource-constrained environments. This is particularly relevant for rural areas where access to advanced technologies may be limited. Technological advancements such as AI, IoT and mobile-based advisory systems have significantly improved productivity and risk management in sericulture.

Sustainability has also become a key theme in re-

cent literature. Kaushik et al. (2025) emphasize the importance of circular economy practices, including waste utilization and eco-friendly production methods. These practices not only reduce environmental impact but also enhance economic efficiency.

The concept of rural innovation ecosystems has gained attention as a framework for understanding how innovation occurs in rural contexts. Aguilar (2021) defines these ecosystems as networks of interconnected actors that facilitate knowledge exchange and innovation. Studies show that strong ecosystems improve technology adoption and entrepreneurial growth (Paramasivam & Prasanna, 2026).

Despite these advancements, there is a noticeable gap in the literature regarding the integration of startups within sericulture-specific innovation ecosystems. Most studies focus either on sericulture or agri preneurship independently, highlighting the need for integrated research.

4. Methodology

This study adopts a qualitative and conceptual research design, focusing on analysing the role of sericulture-based startups within rural innovation ecosystems. The research relies primarily on secondary data sources, including peer-reviewed journal articles, government reports, FAO publications and industry documents.

The choice of a qualitative approach is justified by the exploratory nature of the research topic. Since the integration of startups into sericulture ecosystems is still an emerging area, conceptual analysis provides a suitable framework for understanding underlying dynamics (Creswell, 2014).

Data collection involves a systematic review of literature using academic databases such as Google Scholar, Scopus and Web of Science. Relevant studies were selected based on startups, agri preneurship, rural innovation ecosystems and sustainable development.

The study employs several analytical tools:

Value Chain Analysis: To examine how startups influence different stages of the sericulture value chain

SWOT Analysis: To identify strengths, weaknesses, opportunities and threats

Conceptual Modelling: To develop an integrated framework linking startups and rural development

To ensure reliability, multiple sources were cross verified. Validity is maintained using peer-reviewed and credible academic sources.

The study also incorporates case-based insights from regions such as Karnataka and Assam, which are known for their strong sericulture ecosystems. These cases provide practical examples of how startups operate within rural innovation systems.

5. Current Scenario

The sericulture sector is undergoing significant transformation due to the emergence of startups and agri preneurial ventures. Traditionally dominated by small-scale producers, the sector is now experiencing increased integration of technology, innovation and market-oriented practices.

Startups are actively involved across the value chain, introducing innovations in production, processing and marketing. For instance, IoT-based monitoring systems and AI-driven tools are being used to improve silkworm health and productivity. Digital platforms enable farmers to access market information and sell their products directly to consumers.

India has emerged as a key hub for sericulture startups, particularly in states like Karnataka, Assam and Tamil Nadu. Government initiatives such as Startup India and Silk Samagra have played a crucial role in promoting entrepreneurship.

Despite these advancements, the ecosystem remains nascent, with challenges related to funding, infrastructure, and technology adoption.

6. Role of Startups in Rural Innovation Ecosystem

Startups play a pivotal role in transforming traditional sericulture into a dynamic and innovation-driven sector by acting as key agents within rural innovation ecosystems. These ecosystems consist of interconnected stakeholders, including farmers, entrepreneurs, research institutions, government agencies and financial organizations, all of whom contribute to knowledge exchange and innovation (Aguilar, 2021). Within this framework, startups function as intermediaries, bridging gaps between traditional practices and modern technological advancements.

One of the primary contributions of startups is in the domain of technological innovation. Traditional sericulture practices often rely on manual processes, making them vulnerable to inefficiencies and risks such as disease outbreaks and climate variability. Startups introduce advanced technologies such as Internet of Things (IoT)-based monitoring systems, artificial intelligence (AI) for silkworm disease detection and mobile

applications for real-time advisory services. These innovations enhance productivity, reduce losses and improve overall efficiency (Suarez-Sanchez et al., 2025).

In addition to technological contributions, startups facilitate process innovation by improving operational efficiency across the value chain. For example, automated reeling machines and improved cocoon processing techniques increase silk quality and yield. Such innovations reduce labor intensity while enhancing profitability, making sericulture more attractive to rural entrepreneurs.

Economically, startups contribute to employment generation and income diversification. By creating new business models and expanding market opportunities, they enable farmers to transition from subsistence farming to commercial production. This shift is particularly important in addressing rural unemployment and underemployment (Singh et al., 2022).

Socially, startups promote inclusive development by empowering women and engaging rural youth. Women constitute a significant portion of the sericulture workforce and startup-driven initiatives such as training programs and micro-enterprises enhance their economic participation (Lenka, 2020). Similarly, startups attract youth by introducing modern technologies and entrepreneurial opportunities.

Institutionally, startups strengthen linkages between stakeholders, facilitating knowledge transfer and collaboration. They often work closely with research institutions to develop improved silkworm breeds and sustainable farming techniques, while also collaborating with government agencies for policy support and subsidies (Paramasivam & Prasanna, 2026).

Furthermore, startups contribute to market innovation by leveraging digital platforms and e-commerce solutions. These platforms enable direct interaction between producers and consumers, reducing dependency on intermediaries and improving price realization. Bhattacharya and Goswami (2026) highlight that digital transformation in the silk industry enhances transparency and market efficiency.

Finally, startups promote environmental sustainability by adopting eco-friendly practices such as organic silk production, natural dyeing and waste recycling. These practices align with the principles of a circular economy, reducing environmental impact while improving economic viability (Kaushik et al., 2025).

In conclusion, startups play a multifaceted role in rural innovation ecosystems by driving technological, economic, social and institutional transformation in the sericulture sector. Their integration into rural systems is essential for achieving sustainable and inclusive development.

7. Challenges Faced by Sericulture Startups

Despite their transformative potential, sericulture-based startups face numerous challenges that hinder their growth and sustainability. These challenges are multidimensional, encompassing financial, infrastructural, technological, market and policy-related constraints.

One of the most significant challenges is limited access to finance. Startups in rural areas often struggle to secure funding due to a lack of collateral, high perceived risk and limited financial literacy. Financial institutions may be reluctant to invest in sericulture ventures because of uncertainties associated with agricultural production, such as climate variability and disease outbreaks (Dandasena & Bag, 2026).

Infrastructure constraints also pose major barriers. Rural areas often lack adequate transportation, storage facilities, electricity, and digital connectivity, which are essential for startup operations. Poor infrastructure increases operational costs and reduces efficiency, limiting the scalability of startups.

Another critical challenge is the low adoption of technology among farmers. While startups introduce innovative solutions, their success depends on the willingness and ability of farmers to adopt these technologies. Factors such as lack of awareness, limited technical skills and resistance to change hinder adoption (Singh et al., 2022).

Market-related challenges further complicate the situation. Startups often face price volatility, lack of standardization and limited access to high-value markets. The presence of intermediaries reduces profit margins, while competition from synthetic fibers affects demand for natural silk.

Policy and regulatory challenges also play a role. Although governments have introduced various schemes to promote entrepreneurship, their implementation is often inconsistent. Startups may face bureaucratic hurdles, lack of awareness about available schemes and delays in accessing benefits.

Human resource constraints, including the shortage of skilled labor and technical expertise, further limit startup growth. Training and capacity-building programs are essential but may not be sufficiently accessible in rural areas.

Environmental challenges such as climate change, pests and diseases also affect sericulture productivity, posing risks to startup sustainability.

In conclusion, addressing these challenges requires a holistic approach involving financial support, infrastructure development, technology dissemination and effective policy implementation.

8. Opportunities and Future Prospects

Sericulture-based startups present significant opportunities for sustainable rural development and economic growth, driven by changing market dynamics and technological advancements.

One of the most promising opportunities lies in the growing demand for eco-friendly and sustainable textiles. Silk, being a natural and biodegradable fiber, has a competitive advantage over synthetic alternatives. Consumers are increasingly seeking environmentally sustainable products, creating new market opportunities for startups (Suarez-Sanchez et al., 2025).

The export potential of silk products is another major opportunity. Countries like India have a strong presence in the global silk market and startups can leverage digital platforms to access international markets directly. This reduces dependence on intermediaries and improves profit margins.

Technological advancements offer additional opportunities. The integration of AI, IoT and blockchain technologies can enhance productivity, ensure quality control and improve supply chain transparency. These innovations enable startups to operate more efficiently and competitively.

The concept of a circular economy further expands opportunities. Waste products from sericulture, such as pupae and mulberry residues, can be utilized for producing animal feed, fertilizers and other by-products. This not only reduces waste but also creates additional revenue streams (Kaushik et al., 2025).

Government initiatives such as Startup India and Digital India provide financial and institutional support, encouraging entrepreneurship in rural areas. These programs offer funding, training and market access, enabling startups to scale their operations.

Additionally, sericulture startups contribute to inclusive development by creating employment opportunities for women and youth, reducing rural-urban migration.

In conclusion, the prospects of sericulture startups are highly promising, if they effectively leverage technological advancements and supportive policies.

9. Case Studies

Case studies of Assam and Karnataka illustrate how sericulture startups adapt to regional contexts within rural innovation ecosystems.

In Assam, startups focus on indigenous silk varieties such as Muga and Eri, combining traditional knowledge with digital marketing and e-commerce. This approach enhances market access, promotes product differentiation, and improves income levels through branding and sustainability practices (Bhattacharya & Goswami, 2026). However, infrastructure and supply chain limitations remain challenges.

In contrast, Karnataka demonstrates a technology-driven model, where startups adopt IoT, AI, and automated processing systems to improve productivity and quality. Strong institutional support and value chain integration enable better coordination and scalability (Suárez-Sánchez et al., 2025; Paramasivam & Prasanna, 2026).

Overall, Assam emphasizes market innovation and cultural value, while Karnataka focuses on technological efficiency, highlighting the importance of context-specific strategies.

10. Policy Implications

The development of sericulture startups requires a comprehensive policy framework addressing structural constraints.

Key priorities include improving access to finance through credit support and investment mechanisms (Dandasena et al., 2026) and strengthening infrastructure and digital connectivity to enhance efficiency. Policies should promote skill development and technology adoption through training and extension services (Singh et al., 2022).

Additionally, fostering rural innovation ecosystems through incubation centers and stakeholder collaboration is essential (Aguilar, 2021). Public-private partnerships can further accelerate innovation and investment.

Finally, policies must support market access, export promotion, and sustainability practices, ensuring competitiveness and long-term viability (Kaushik et al., 2025).

11. Conclusion

Sericulture-based startups represent a shift toward innovation-driven rural development, contributing to productivity, income generation, and employment. They also promote social inclusion, particularly

through women's empowerment and youth engagement (Lenka, 2020).

However, their growth is constrained by challenges such as limited finance, inadequate infrastructure, and low technology adoption (Dandasena & Bag, 2026). Addressing these issues requires coordinated efforts among policymakers, institutions, and private stakeholders.

In conclusion, sericulture startups act as catalysts for sustainable and inclusive rural transformation, bridging traditional practices with modern innovation systems.

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