



## Smart Sericulture: Digital Tools for Silk Farmers

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### INTRODUCTION

Sericulture, the art and science of silk production, has been a cornerstone of agricultural economies for centuries, particularly in countries like India, China, and Thailand. This intricate process, involving the cultivation of mulberry plants, rearing of silkworms, and harvesting of silk cocoons, has traditionally relied on manual labor, inherited knowledge, and environmental intuition. However, in the 21st century, the advent of digital tools is revolutionizing sericulture, empowering silk farmers with precision, efficiency, and sustainability. From IoT-enabled monitoring systems to mobile apps for disease detection, smart sericulture is transforming the silk industry, making it more productive and resilient. This article explores the digital tools reshaping sericulture, their benefits, challenges, and the future of this ancient craft in a tech-driven world.

### The Digital Revolution in Sericulture

Sericulture is a labor-intensive and environmentally sensitive process. Farmers must maintain optimal conditions—temperature, humidity, and hygiene—for silkworms to thrive, while also ensuring high-quality mulberry leaves, the silkworm's primary food source. Any deviation, such as a pest outbreak or sudden weather change, can devastate yields. Traditionally, farmers relied on experience and manual checks to manage these variables, but digital tools are now automating and optimizing these tasks.

The integration of technology into sericulture aligns with the broader trend of precision agriculture, where data-driven insights enhance productivity. Smart sericulture leverages tools like sensors, drones, mobile applications, and artificial intelligence (AI) to monitor silkworm health, predict environmental risks, and streamline farm operations. These innovations are particularly impactful for smallholder farmers, who form the backbone of the silk industry in many regions, as they provide affordable, scalable solutions to age-old challenges.



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## Key Digital Tools Transforming Sericulture

### 1. IoT-Enabled Environmental Monitoring

Internet of Things (IoT) devices are at the forefront of smart sericulture. Sensors placed in silkworm rearing houses monitor critical parameters like temperature, humidity, and air quality in real time. These devices transmit data to farmers' smartphones or centralized dashboards, enabling precise control over rearing conditions.

For instance, silkworms require temperatures between 24–27°C and humidity levels of 70–85% during their larval stage. IoT sensors can alert farmers if conditions deviate, allowing them to adjust ventilation or heating systems promptly. In India, projects like the Central Silk Board's (CSB) "SilkSamagra" initiative have piloted IoT-based rearing units, resulting in a 15–20% increase in cocoon yield due to optimized conditions.

Some advanced IoT systems also integrate with automated climate control units, reducing manual intervention. These tools are particularly valuable in regions prone to erratic weather, ensuring stable conditions year-round.

### 2. Mobile Apps for Disease Detection and Management

Silkworm diseases, such as pebrine (caused by microsporidian parasites) and flacherie (bacterial infections), can wipe out entire crops. Early detection is critical but challenging, as symptoms often appear late. Mobile apps powered by AI and image recognition are changing this dynamic.

Apps like "SeriCare" and "SilkWorm Health" allow farmers to upload images of silkworms or cocoons for instant diagnosis. These apps use machine learning models trained on vast datasets of healthy and diseased silkworms to identify abnormalities with over 90% accuracy. Farmers receive recommendations for treatment or preventive measures, such as disinfecting rearing trays or isolating infected batches.

In addition to disease detection, these apps provide multilingual advisories on best practices, mulberry cultivation tips, and market prices,

making them accessible to rural farmers. In India, where over 9 million people depend on sericulture, such apps are bridging knowledge gaps and reducing crop losses by up to 25%, according to CSB reports.

### 3. Drones for Mulberry Plantation Management

Mulberry cultivation, which accounts for 60–70% of sericulture costs, is another area ripe for digital disruption. Drones equipped with multispectral cameras are being used to monitor mulberry fields, assess soil health, and detect pest infestations. These aerial surveys provide farmers with detailed maps of their plantations, highlighting areas needing irrigation, fertilization, or pest control.

In China, the world's largest silk producer, drones have reduced mulberry crop losses by 30% by enabling targeted pesticide application. This precision minimizes chemical use, lowers costs, and promotes sustainable farming. Drones also save time, covering large fields in minutes compared to hours of manual inspection.

### 4. Blockchain for Supply Chain Transparency

The silk industry faces challenges like adulteration and unfair pricing, which erode farmer incomes. Blockchain technology is addressing these issues by creating transparent, tamper-proof supply chains. Platforms like "SilkChain" record every stage of silk production—from cocoon harvesting to fabric manufacturing—on a decentralized ledger.

Farmers benefit by gaining visibility into market dynamics and receiving fair prices for their cocoons. Consumers, in turn, can verify the authenticity and origin of silk products, boosting demand for ethically produced silk. In Thailand, blockchain pilots have increased farmer revenues by 10–15% by eliminating middlemen and ensuring direct market access.

### 5. Data Analytics for Yield Prediction

Big data and predictive analytics are helping farmers anticipate cocoon yields and market trends. By analyzing historical data on weather, soil conditions, and silkworm performance, platforms like "SeriSmart" generate forecasts that guide planting and rearing decisions. These

tools also provide insights into optimal harvesting times, reducing post-harvest losses.

In India's Karnataka state, a hub of sericulture, data-driven models have improved yield predictions by 20%, enabling farmers to plan better and negotiate stronger contracts with buyers. Such platforms often integrate with weather APIs, alerting farmers to impending risks like heavy rains or heatwaves.

### Benefits of Smart Sericulture

The adoption of digital tools in sericulture offers multiple advantages:

- **Increased Productivity:** IoT and AI tools optimize rearing conditions and reduce crop losses, boosting cocoon yields by 15–30%.
- **Cost Efficiency:** Drones and data analytics minimize input costs like pesticides and labor, while blockchain ensures fair pricing.
- **Sustainability:** Precision farming reduces chemical use and water waste, aligning sericulture with eco-friendly practices.
- **Empowerment of Smallholder Farmers:** Mobile apps and affordable sensors democratize access to technology, leveling the playing field for rural farmers.
- **Market Access:** Digital platforms connect farmers directly to buyers, enhancing income security.

These benefits are critical in a world where silk demand is growing, driven by luxury fashion and sustainable textile trends. By adopting smart tools, farmers can meet this demand while improving their livelihoods.

### Challenges in Adopting Digital Tools

Despite their promise, digital tools face barriers in sericulture:

- **High Initial Costs:** IoT devices and drones require upfront investment, which may be unaffordable for smallholder farmers.
- **Digital Literacy:** Many farmers, especially in rural areas, lack the skills to use apps or interpret data dashboards.
- **Infrastructure Gaps:** Unreliable electricity and internet connectivity in remote regions hinder IoT and app functionality.

- **Scalability:** Pilot projects often struggle to scale due to funding constraints or lack of localized solutions.

Governments and NGOs are addressing these challenges through subsidies, training programs, and public-private partnerships. For example, India's CSB offers subsidized IoT kits and conducts workshops on app usage, while Thailand's Silk Development Agency provides low-cost drones to farmer cooperatives.

### The Future of Smart Sericulture

The future of sericulture lies in deeper integration of advanced technologies. AI models could evolve to predict silkworm diseases before symptoms appear, using genetic and environmental data. Robotics might automate cocoon harvesting, reducing labor costs. Meanwhile, augmented reality (AR) could train farmers by simulating rearing scenarios, enhancing skill development.

Sustainability will also shape smart sericulture. Biodegradable sensors and solar-powered IoT devices could minimize environmental impact, while gene-editing techniques might produce disease-resistant silkworms. Collaborative platforms, linking farmers, researchers, and buyers, could further streamline the silk value chain.

### CONCLUSION

Smart sericulture is ushering in a new era for silk farmers, blending tradition with technology to create a more resilient and prosperous industry. Digital tools like IoT sensors, AI apps, drones, blockchain, and data analytics are empowering farmers to overcome challenges, boost yields, and access global markets. While hurdles like cost and digital literacy remain, targeted interventions are paving the way for widespread adoption. As these technologies evolve, sericulture stands to become a model of how innovation can preserve cultural heritage while driving economic and environmental progress. For silk farmers, the future is not just bright—it's digitally woven.