THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
Popular Article
December, 2025 Vol.5(12), 11277-11283

From Mulberry Leaf to Silk Thread: The Story of Sericulture

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DOI:10.5281/ScienceWorld.18119434

Abstract

Sericulture is a traditional agro based industry that integrates mulberry cultivation, silkworm rearing, cocoon production and silk processing into a sustainable rural enterprise. Rooted in ancient history and strengthened by scientific advancements, it continues to play a vital role in India's agricultural and cottage industrial sectors. India is uniquely positioned as the only country producing all four natural silks - mulberry, tasar, eri and muga supporting diverse farming and tribal communities. Scientific improvements in mulberry varieties, silkworm hybrids and disease management have significantly enhanced productivity and silk quality. Sericulture provides year-round employment with low initial investment, benefiting small and marginal farmers, women and rural youth. Its ecofriendly and renewable nature aligns well with the global demand for sustainable natural fibres. The industry also contributes to export earnings and value-added rural enterprises. Institutional support from research, extension and development agencies has strengthened its growth. Emerging technologies and improved market linkages offer new opportunities for income enhancement. Overall, sericulture remains a promising and resilient agro industry linking history, science, livelihood and sustainability.

Keywords: Mulberry, Silkworm, Voltinism, Rearing House and Silk Route

Introduction

Sericulture is the science and art of rearing silkworms for the production of silk. The term is derived from the Greek word *Sericos* (silk) and the English word *culture* (rearing). It is a traditional yet scientifically advanced agro based industry that integrates agriculture, entomology, rural development and cottage industries. Sericulture involves four major

activities *viz*., cultivation of mulberry plants, rearing of silkworms, production of cocoons and processing of silk into yarn and fabric. In India, sericulture is largely practiced by small and marginal farmers and provides year round employment to millions of farmers, women and artisans. India occupies a unique position on the world silk map as the only country producing all four commercial varieties of natural silk mulberry, tasar, eri and muga. The industry combines low investment with high employment potential, making it an ideal rural livelihood option. Mulberry and silkworm rearing form the foundation of sericulture. Mulberry leaves are the sole food for the mulberry silkworm, *Bombyx mori* and their quality directly determines cocoon yield and silk quality.

2. Sericulture as a Rural Enterprise

Sericulture is one of the most labour intensive agricultural enterprises. Every stage, from mulberry cultivation to silk weaving requires human involvement, creating abundant employment opportunities, especially for women and rural youth. Unlike seasonal crops, sericulture provides income multiple times a year. The perennial nature of mulberry ensures economic stability even in drought prone areas, as plants regenerate after rainfall. Thus, sericulture plays a significant role in poverty alleviation, rural empowerment and livelihood security. Sericulture can help keeping the rural population employed and to prevent migration to big cities and securing remunerative employment, it requires small investments while providing raw material for textile industries.

3. Economic Importance of Sericulture

Sericulture contributes substantially to national income and foreign exchange earnings. Silk garments and fabrics are major export commodities, with mulberry silk accounting for more than 90 per cent of India's total silk production. The industry is highly efficient in converting plant protein into animal protein, as nearly 70 per cent of silk protein is derived directly from mulberry leaf proteins. This close relationship between leaf quality and silk yield highlights the scientific precision of sericulture.

4. Global Status of Silk Production

Globally, China and India dominate raw silk production. China mainly produces bivoltine silk under temperate climatic conditions, while India predominantly produces multivoltine and bivoltine hybrid silk under tropical environments. The steady increase in India's silk production reflects continuous advancements in mulberry cultivation, silkworm breeding and improved rearing technologies. The major silk producing countries in the world are China, India, Uzbekistan, Brazil, Japan, Republic of Korea, Thailand, Vietnam, DPR Korea, Iran etc. The major silk consumers of the world are USA, Italy, Japan, India, France,

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Published 28/12/2025

China, United Kingdom, Switzerland, Germany, UAE, Korea, Vietnam etc. Even though silk has a small percentage of the global textile market less than 0.2%, its production base is spread over 60 countries in the world. While the major producers are in Asia (90% of mulberry production and almost 100% of non mulberry silk), sericulture industries have been lately established in Brazil, Bulgaria, Egypt and Madagascar as well. Sericulture is labour intensive. About 1 million workers are employed in the silk sector in China. Silk Industry provides employment to 7.9 million people in India and 20,000 weaving families in Thailand. Global silk production during 2023–24 stood at 93,986 metric tonnes.

5. History of Sericulture and the Silk Route

Sericulture originated in China over 3,000 years ago and remained a closely guarded secret for centuries. Silk later travelled westward through the famous Silk Route linking Asia with Europe. India adopted sericulture at an early stage, particularly in the Himalayan foothills. Ancient Indian texts, sculptures and archaeological evidence indicate the use of silk long before organized trade routes developed. Silk from India was exported to Rome as early as 58 BC.

6. Development of Sericulture in India

Modern sericulture in India gained momentum during the 20th century with the establishment of the Central Silk Board and various research institutes. These institutions strengthened research, training and extension activities. Karnataka, Andhra Pradesh, Tamil Nadu and West Bengal are the leading mulberry silk producing states. Mulberry is the largest practiced sericulture industry accounting for almost 76 per cent of the entire silk production. The industry provides employment to more than 7.6 million people across 51,000 villages who operate 3,28,627 handlooms and 4,5,867 power looms with 8,14,616 weavers. Its exports of silk are worth about US$ 360 Million of which 70 per cent comprises natural silk yarn and fabrics, 13 per cent made ups and 26 per cent garments. Domestic demand stands at 28,800 MT compared to production of 38,913 MT annually thanks to the growing demand for silk fabrics and sarees from Indian women. Aggressive promotion of the silk industry in India has attracted a large number of organized players to set up modern units for both apparel as well as home textile production.

7. Mulberry: The Backbone of Sericulture

Mulberry (*Morus* spp.) is the exclusive food plant of the mulberry silkworm (*Bombyx mori*). The quality of mulberry leaves directly influences larval growth, cocoon weight and silk filament length. Mulberry belongs to the family Moraceae and is a fast growing, deep rooted perennial plant grown either as a bush or tree. Important species include *Morus alba*,

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Published 28/12/2025

M. indica, *M. bombycis*, *M. sinensis* and *M. multicaulis*. The leaves are rich in proteins, carbohydrates, minerals, vitamins and moisture, making them ideal for silkworm nutrition. Mulberry is believed to have originated in the Himalayan region. Today, it is cultivated in more than 60 countries worldwide. In India, major mulberry growing states include Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, West Bengal and Jammu & Kashmir. Mulberry plants are perennial shrubs or trees with alternate leaves and extensive branching. Leaf size, thickness and tenderness greatly influence feeding efficiency and cocoon yield. Large leaved varieties such as V1 and DD are preferred for commercial rearing.

7.1. Ecological Requirements for Mulberry Cultivation

Mulberry can be grown upto 800m MSL. Mulberry thrives best at temperatures of 24–28°C with relative humidity of 65–80 per cent. Fertile, well drained loamy soils with good moisture holding capacity and a pH of 6.2–6.8 are ideal. It can be grown in areas with rainfall of 600 mm to 2500 mm. Adequate sunshine and regular irrigation promote vigorous leaf growth. Mulberry can be cultivated under both irrigated and rain fed conditions with planting usually done after the onset of monsoon.

7.2. Mulberry Varieties and Propagation

Mulberry varieties are classified into irrigated, semi-irrigated and rainfed types. Popular high yielding varieties include V1, S36, S13, S34, Anantha and Kanva-2. Propagation is mainly carried out through semi hardwood stem cuttings raised in nurseries to maintain uniformity. Nursery raised saplings ensure better survival and establishment in the main field.

7.3. Mulberry Nursery and Field Management

Nursery management involves bed preparation, irrigation, fertilization and disease prevention. Irrigate the nursery once in 3 days. Dust one kg of any one of the following chemicals Chlorpyriphos, Endosulfan, malathion and quinalphos around the nursery bed to avoid termite attack. To avoid root rot and collar rot, drench the soil with carbendazim (2gm/l) using rose can. Apply 100gm of urea/m2 of nursery between 55 and 60 DAP along with weeding. After 3–4 months, healthy saplings are transplanted to the main field. Proper land preparation, spacing, manuring, irrigation and pruning are essential for sustained leaf yield. Irrigated mulberry gardens generally give higher productivity than rain fed gardens. Under irrigated conditions, two to three types of spacing are commonly practiced, and when crops are grown by maintaining regular inter row spacing it is known as normal row planting, which results in a plant population of about 27,777 plants per hectare at 60 cm × 60 cm spacing, 12,345 plants per hectare at 90 cm × 90 cm spacing and 18,518 plants per hectare at 90 cm × 60 cm spacing.

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7.4. Nutritional Management of Mulberry

Mulberry cultivation plays a crucial role in silkworm rearing, as silkworms are monophagous insects that feed exclusively on mulberry leaves. During cultivation, large quantities of nutrients are removed from the soil in the form of biomass. Sixteen essential nutrient elements are required for the normal growth and development of mulberry plants. These include macronutrients such as nitrogen, phosphorus and potassium which are needed in large amounts. Secondary nutrients like calcium, magnesium and sulphur are required in moderate quantities. Micronutrients such as iron, manganese, boron, molybdenum, copper, zinc and cobalt are needed in trace amounts. Nitrogen is a vital component of chlorophyll, protoplasm, nucleic acids and proteins and it promotes vegetative growth and leaf quality. Phosphorus is essential for energy transfer, cell division, root development, flowering and seed formation. Potassium acts as an enzyme activator, aids in protein synthesis, carbohydrate translocation, and improves stress and disease resistance. Deficiency of nitrogen causes yellowing of older leaves and reduced leaf growth. Phosphorus deficiency results in purplish discoloration, necrosis and poor branching. Potassium deficiency leads to marginal chlorosis, drying and increased disease incidence. Micronutrient deficiencies cause specific symptoms such as stunted growth, chlorosis, dieback and leaf deformities. These deficiencies can be corrected through soil and foliar application of appropriate fertilizers. Biofertilizers play an important role by improving nutrient availability. Nitrogen fixing microorganisms like Azospirillum and Azotobacter enhance nitrogen supply. Azospirillum colonizes the root zone and fixes atmospheric nitrogen. It also produces plant growth hormones, vitamins and antibiotics, contributing to improved mulberry growth and leaf yield.

7.5. Water and Weed Management

Mulberry requires regular irrigation depending on soil type and season. Mulberry requires about 1250 to 1500 mm of water over a period of 12 months. Methods of irrigation, 1. Ridges and furrows 2. Flatbed method 3. Drip irrigation. Drip irrigation improves water use efficiency and allows fertigation. Integrated weed management practices reduce competition for nutrients and moisture, thereby improving leaf quality and yield.

7.6. Pruning and Harvesting of Mulberry

Pruning regulates plant height, promotes branching and synchronizes leaf supply with silkworm rearing cycles. Common systems include bottom, middle and strip pruning. Leaves are harvested through leaf picking, branch cutting or whole shoot harvesting, preferably during early morning hours to retain freshness.

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7.7. Pests and Diseases of Mulberry

Mulberry is attacked by sucking pests, foliage feeders, borers and subterranean insects such as mealy bugs, thrips, mites, Bihar hairy caterpillar and root knot nematodes. Diseases like leaf spot, powdery mildew, rust and root rot cause significant yield losses. Integrated pest and disease management practices involving resistant varieties, biological control, balanced nutrition and safe chemical use are recommended.

8. Silkworm: An Introduction

The mulberry silkworm, *Bombyx mori* is a fully domesticated insect reared exclusively for silk production. It undergoes complete metamorphosis with four stages: egg, larva, pupa and adult moth. Silkworm races are classified based on voltinism into univoltine, bivoltine and multivoltine types. India predominantly uses multivoltine and bivoltine hybrids due to their adaptability and productivity. Scientific breeding programmes have significantly improved silk yield and quality. The larval stage is the most critical for silk production. During this stage, the silk glands enlarge and synthesize silk proteins.

8.1. Silkworm Rearing Environment

Successful silkworm rearing depends on proper temperature, humidity, ventilation, hygiene and quality feeding. Young age larvae (chawki worms) require tender leaves and higher humidity, while late age larvae need mature leaves and more space. Disinfection of rearing houses and appliances with 2% formalin is essential to prevent diseases.

8.2. Silkworm Diseases and Pests

Silkworms are susceptible to diseases such as pebrine, grasserie, flacherie and muscardine which can cause heavy crop losses. Preventive measures include the use of disease free layings, strict hygiene, regular disinfection and proper environmental control. Integrated disease management ensures healthy crops and better yields.

8.3. Spinning and Cocoon Formation

At maturity, silkworm larvae spin cocoons using silk secreted from their silk glands. Each cocoon consists of a single continuous filament that may range from 300 to 1,500 metres in length. Cocoons are harvested after completion of spinning and are processed further for silk extraction.

8.4. Post Cocoon Technology

Post cocoon processes include stifling, cooking, reeling, twisting, degumming, dyeing and weaving. Modern reeling machines have improved efficiency and silk quality. Silk byproducts contribute additional income to farmers and entrepreneurs.

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9. Non-Mulberry Silks and Future Prospects

Sericulture is a unique agro based industry that harmoniously blends tradition with modern science, providing sustainable livelihoods to millions of rural families in India. By integrating mulberry cultivation, silkworm rearing and silk processing, it ensures year round employment with relatively low investment. India's strength in producing all four natural silks highlights the diversity and resilience of this sector, including non-mulberry silks such as eri, tasar and muga which support tribal and forest-based livelihoods. Scientific management of mulberry gardens and silkworm health directly enhances cocoon yield and silk quality contributing to rural development, women empowerment and export earnings. Its eco friendly and renewable nature makes silk highly relevant in the era of sustainable agriculture. With increasing global demand for natural fibres, sericulture holds immense promise by blending traditional knowledge with scientific innovations such as climate resilient mulberry varieties, disease resistant silkworm hybrids and improved market linkages. From ancient trade routes to modern rural enterprises, sericulture continues to weave history, science and livelihood into a single golden thread silk.

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