

# INTRODUCTION TO SERICULTURE

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Silkworm and cocoon

## What is Sericulture?

Sericulture is an agro-based industry. It involves rearing of silkworms for the production of raw silk, which is the yarn obtained out of cocoons spun by certain species of insects. The major activities of sericulture comprises of food-plant cultivation to feed the silkworms which spin silk cocoons and reeling the cocoons for unwinding the silk filament for value added benefits such as processing and weaving.

Although there are several commercial species of silkworms, *Bombyx mori* is the most widely used and intensively studied. According to Confucian texts, the discovery of silk production by *B. mori* dates to about 2700 BC, although archaeological records point to silk cultivation as early as the Yangshao period (5000 – 10,000 BCE). By the first half of the 1st century AD it had reached ancient Khotan, and by AD 140 the practice had been established in India. Later it was introduced to Europe, the Mediterranean and other Asiatic countries. Sericulture has become one of the most important cottage industries in a number of countries like China, Japan, India, Korea, Brazil, Russia, Italy and France. Today, China and

India are the two main producers, together manufacturing more 90% the world production each year.

**What is Silk -** Man is always inquisitive for silk products. SILK - The Queen of Textiles, spells luxury, elegance, class and comfort. Mankind has always loved this shimmering fibre of unparalleled grandeur from the moment Chinese Empress Shiling Ti discovered it in her tea cup. It withstood many a daunting challenges from other natural and artificial fibres and yet, remained the undisputed Queen of Textiles since centuries. Exquisite qualities like the natural sheen, inherent affinity for dyes and vibrant colours, high absorbance, light weight, resilience and excellent drape etc. have made silk, the irresistible and inevitable companion of the eve, all over the world.



Chemically speaking, silk is made of proteins secreted in the fluid state by a caterpillar, popularly known as 'silkworm'. These silkworms feed on the selected food plants and spin cocoons as a 'protective shell' to perpetuate the life. Silkworm has four stages in its life cycle viz., egg, caterpillar, pupa and moth. Man interferes this life cycle at the cocoon stage to obtain the silk, a continuous filament of commercial importance, used in weaving of the dream fabric.

**Why Sericulture?** The major benefit of the sericulture especially Tasar is the employment generation to the people specially in forest areas like tribal. Income from the forests leads to sense of protection and conservation of areas.



## 1. High employment potential

About 60-100 lakh persons are engaged in various sericulture activities in the country

It is estimated that Sericulture can generate employment @ 11 man days per kg of raw silk production (in on-farm and off-farm activities) throughout the year. This potential is par-excellence and no other industry generates this kind of employment, specially in rural areas, hence, sericulture is used as a tool for rural economy upliftment .

Provides vibrancy to village economies

About 57 % of the gross value of silk fabrics flows back to the cocoon growers with share of income to different groups.

56.8 % to cocoon grower

6.8% to the reeler

9.1% to the twister

10.7% to the weaver

16.6% to the trade Thus, large chunk of income goes back to the villages from the cities.



## 2. Low Gestation, High Returns

Mulberry takes only six months to grow for commencement of silkworm rearing. Mulberry once planted will go on supporting silkworm rearing year after year for 15-20 years depending on inputs and management provided.



## 3. Five crops can be taken in one year under tropical conditions.

By adopting stipulated package of practices, a farmer can attain net income levels up to Rs.50000 per acre per annum. hardworking farmers with proper maintenance and inputs can reach up to an income of 2 lac per year from one acre.

#### 4. Women friendly Occupation

Women constitute over 60 % of those employed in down-stream activities of sericulture in the country. This is possible because sericulture activities starting from mulberry garden management, leaf harvesting and silkworm rearing is more effectively taken up by the women folk. Even silk reeling industry including weaving is 100% supported by them.



#### 5. Ideal Program for Weaker Sections of the Society

6. Sericulture can be practiced even with very low land holding.

One acre of mulberry garden and silkworm rearing can support a family of five without hiring labour.



7. Features such as low gestation, high returns make sericulture an ideal program for weaker sections of the society.

8. Vast tracts of forest based tasar food plantations available in the country, if judiciously exploited for rearing tasar silkworms, can offer supplementary gainful employment for tribals.

#### 9. Eco-friendly Activity

10. As a perennial crop with good foliage and root-spread, mulberry contributes to soil conservation and provides green cover.

Waste from silkworm rearing can be recycled as inputs to garden.



Dried mulberry twigs and branches are used as fuel in place of firewood and therefore reduce the pressure on vegetation/forest.

11. Being a labour intensive and predominantly agro-based activity, involvement of smoke-emitting machinery is minimal.

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12. Developmental program initiated for mulberry plantation are mainly in upland areas where un-used cultivable land is made productive.

13. Mulberry can also be cultivated as intercrop with numerous plantations.

14. Mulberry being a deep-rooted perennial plant can be raised in vacant lands, hill slopes and watershed areas.

15. Currently, only about 0.1 % of the arable land in the country is under mulberry cultivation.

16. Satisfies Equity Concerns

Benefits of sectoral value-addition primarily accrue to rural households. As the end-product users are mostly from the higher economic groups, the money flows from high end groups to low end groups.

Cases of landless families engaged in cocoon production using mulberry contracted from local farmers are common in some states.



Mulberry farming is also done on community, government lands where the landless are given limited rights to cultivate mulberry.

### **Where do we find Silk**

Geographically, Asia is the main producer of silk in the world and produces over 95 % of the total global output. Though there are over 40 countries on the world map of silk, bulk of it is produced in China and India, followed by Japan, Brazil and Korea. China is the leading supplier of silk to the world.

India is the second largest producer of silk and also the largest consumer of silk in the world. It has a strong tradition and culture bound domestic market of silk. In India, mulberry silk is produced mainly in the states of Karnataka, Andhra Pradesh, Tamil Nadu, Jammu & Kashmir and West Bengal, while the non-mulberry silks are produced in Jharkhand, Chattisgarh, Orissa and north-eastern states.

Silkworm larvae are fed mulberry leaves, and, after the fourth moult, climb a twig placed near them and spin their silken cocoons. The silk is a continuous-filament fiber consisting of fibroinprotein, secreted from two salivary glands in the head of each larva, and a gum called sericin, which cements the two filaments together.

The sericin is removed by placing the cocoons in hot water, which frees the silk filaments and readies them for reeling. The immersion in hot water also kills the silkworm pupae.

Single filaments are combined to form thread. This thread is drawn under tension through several guides and wound onto reels. The threads may be plied together to form yarn. After drying the raw silk is packed according to quality.

## Types of Silk

There are four major types of silk of commercial importance, obtained from different species of silkworms which in turn feed on a number of food plants. These are:

A. Classification based on species. All are different species.

1. Mulberry
2. Oak Tasar & Tropical Tasar
3. Muga
4. Eri

Commercially exploited sericigenous insects of the world and their food plants			
Common Name	Scientific Name	Origin	Primary Food Plant(s)
Mulberry Silkworm	<i>Bombyx mori</i>	China	Morus indica M. alba M. multicaulis M. bombycis
Tropical Tasar Silkworm	<i>Antheraea mylitta</i>	India	Shorea robusta Terminalia tomentosa T. arjuna
Oak Tasar Silkworm	<i>Antheraea proylei</i>	India	Quercus incana Q. serrata Q. himalayana

## Commercially exploited sericigenous insects of the world and their food plants

Common Name	Scientific Name	Origin	Primary Food Plant(s)
			Q. leuco tricophora Q. semicarpifolia Q. grifithi
Oak Tasar Silkworm	Antheraea frithi	India	Q. dealdata
Oak Tasar Silkworm	Antheraea compta	India	Q. dealdata
Oak Tasar Silkworm	Antheraea pernyi	China	Q. dendata
Oak Tasar Silkworm	Antheraea yamamai	Japan	Q. acutissima
Muga Silkworm	Antheraea assama	India	Litsea polyantha L. citrata Machilus bombycine
Eri Silkworm	Philosamia ricini	India	Ricinus communis Manihot utilisma Evodia fragrance

### B. Classification based on occurrence .

1. Domesticated – Mulberry, Reared tasar
2. Wild- Tasar Muga and Eri. Wild silks are also called Vanya Silk.

### C. Classification based on Ecoraces

1. Mulberry – Various geographic varieties.
2. Tasar- Natural , reared,

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**D. Classification based on life cycles per year.**

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1. Multi Voltine – More than 2 lifecycles per year. Mulberry and tasar in central and south India.
  2. Bi Voltine – Two life cycles per year. Tasar in Tropical areas. Mulberry in tropical areas as an improved variety.
  3. Uni Voltine- One life cycles per year. Oak tasar and Mulberry in temperate areas. Kashmir, Himachal and China
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## SILK PRODUCTION IN THE WORLD AND INDIA

Annexure Attached

## Stages of production

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Though all four types of silkworms have different food plants and agro-climatic zone but the basic life cycle is almost the same.

The stages of production are as follows:

The silk moth lays eggs.

When the eggs hatch, the caterpillars are fed food plants leaves.

When the silkworms are about 25 days old, they are 10,000 times heavier than when they hatched. During the feeding period the silk worm goes 4 to five times in molt which is its property to shed its skin as it grows alarmingly fast in size.

They are now ready to spin a silk cocoon.

The silk is produced in two glands in the silkworm's head and then forced out in liquid form through openings called spinnerets.

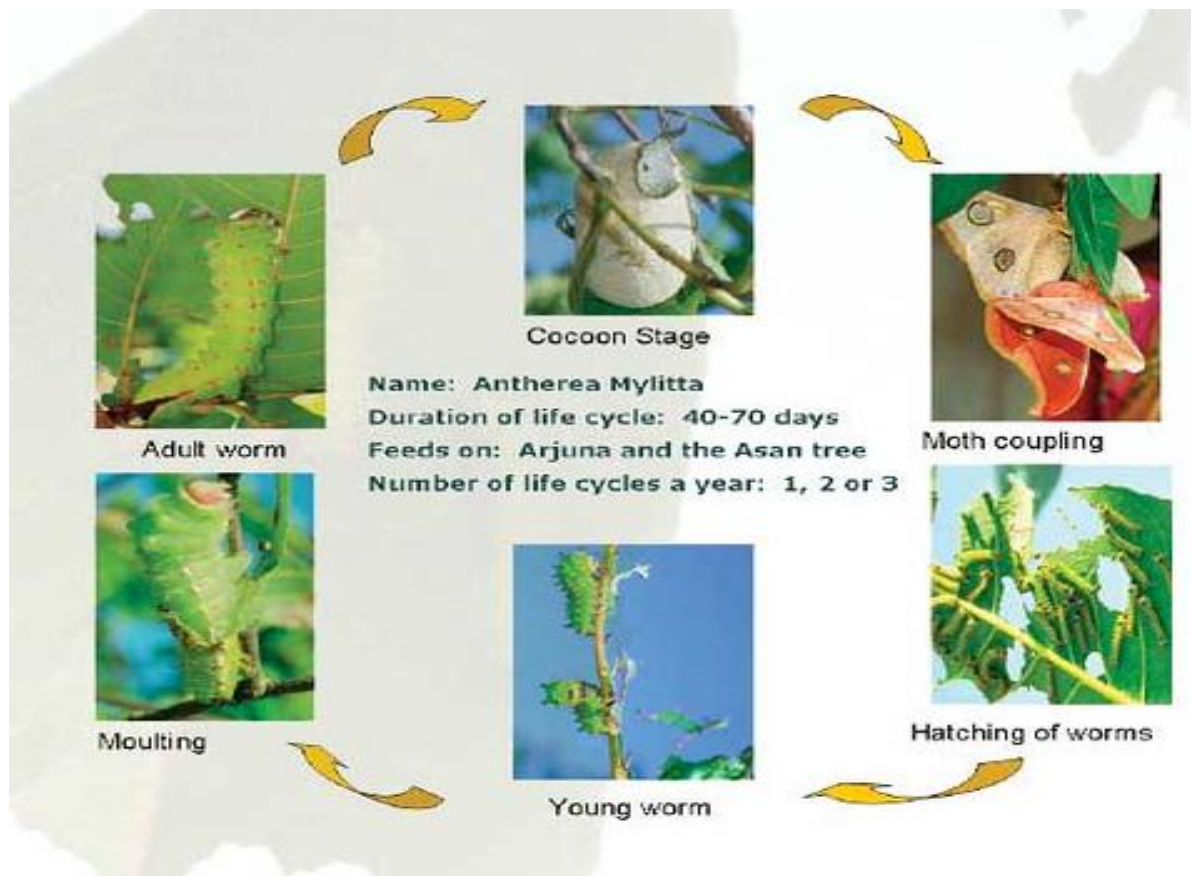
The silk solidifies when it comes in contact with the air.

The silkworm spins approximately 0.8 Km to 1.5 km of filament and completely encloses itself in a cocoon in about two or three days .The silk is obtained from the undamaged cocoons by boiling the cocoon to find the outside end of the filament. The live pupa inside the cocoon dies due to boiling.

The silk filaments are then wound on a reel. The silk at this stage is known as raw silk.

In order to continue the life cycle not all cocoons are boiled and reeled. some good cocoons are preserved and the moth is allowed to come out and lay eggs so that the life cycles is continued for the next crop are season.

## LIFE CYCLE OF TASAR WORM



Third stage of silkworm

Silkworms on to Modern Rotary montage



Silk cocoon in mountages

### **Sericulture Industry**

If fashion is a fine art,  
silk is the canvas, then



### **in India**

then silk is its biggest canvas, and if  
all its weavers, dyers, designers,

embroiderers are the greatest artists. Indian silk has enthralled fashion watchers and all categories of consumers across the world with its vast repertoire of motifs, techniques and brilliant hues. India's traditional and culture bound domestic market and an amazing diversity of silk garments that reflect 'geographic specificity' has helped the country to achieve a leading position in silk industry.

***Present status:*** India is the second largest producer of raw silk after China and the biggest consumer of raw silk and silk fabrics. An analysis of trends in international silk production suggests that sericulture has better prospects for growth in the developing countries rather than in the advanced countries. Silk production in temperate countries like Japan, South Korea, USSR etc., is declining steadily not only because of the high cost of labour and heavy industrialization in these countries, but also due to climatic restrictions imposed on mulberry leaf availability that allows only two cocoon crops per annum. Thus, India has a distinct advantage of practicing sericulture all through the year, yielding a stream of about 4 – 6 crops as a result of its tropical climate.

In India, sericulture is not only a tradition but also a living culture. It is a farm-based, labour intensive and commercially attractive economic activity falling under the cottage and small-scale sector. It particularly suits rural-based farmers, entrepreneurs and artisans, as it requires low investment but, with potential for relatively higher returns. It provides income and employment to the rural poor especially farmers with small land-holdings and the marginalized and weaker sections of the society. Several socio-economic studies have affirmed that the benefit-cost ratio in sericulture is highest among comparable agricultural crops

Currently, the domestic demand for silk, considering all varieties, is nearly 30,000 MTs, of which only around 23,000 MTs (2012-13) is getting produced in the country and the rest being imported mainly from China. Indian domestic silk market has over the years been basically driven by multivoltine mulberry silk. Due to inferior quality of the silk produced, India could not meet the international quality standard. Though, R&D efforts have been made to improve the quality of multivoltine silk, even the best of multivoltine silk produced could not match the bivoltine silk in quality. Therefore, it is essential to enlarge the production base and improve current productivity levels of bivoltine silk to meet the international standards and quality demands of the power loom sector. Steps need to be taken to ensure

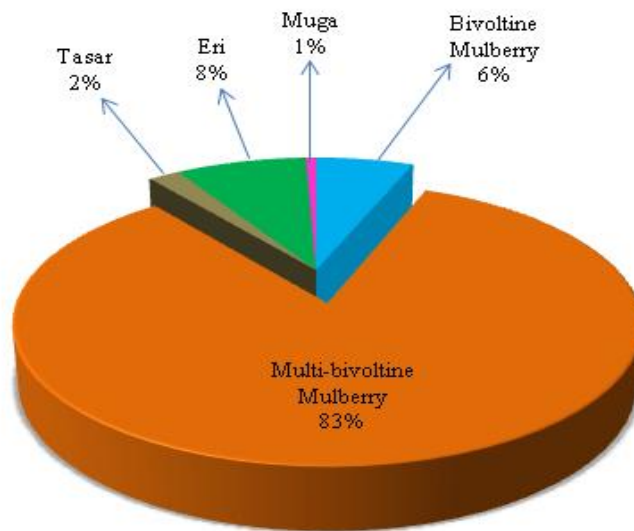
that export oriented units having automatic state of the art weaving machinery.

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Except mulberry, other non-mulberry varieties of silks are generally termed as vanya silks. India has the unique distinction of producing all these commercial varieties of silk.

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Variety-wise share of raw silk production has been depicted in Figure 1.



**Fig 1:** Variety-wise raw silk production (2007-08)

*Source:* Indian Silk 47(5), 2008

***Trends in Indian sericulture:***Over the last six decades Indian silk industry has registered an impressive growth, both horizontally and vertically. Plans and schemes implemented by central and state agencies and relentless efforts of thousands of dedicated persons in the fields of research and extension have helped in this context. For instance, the age old multivoltine hybrids have been replaced by multivoltine × bivoltine and bivoltine hybrids. The sericulture industry has witnessed a quantum jump in raw silk productivity. The average yield of 25 kgs of cocoons/100 dfls in the recent past has increased and currently the average yields are in the range of 60 – 65 kgs/100 dfls. The new technology, besides doubling yields has also led to qualitative improvements in cocoon production with considerably reduced renditta and has also helped break the climate barrier.

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The market share of Indian silk exports in the global silk trade is 4 – 5 % which is not significant considering the fact that India is the second largest producer of raw silk. This is because India has a large domestic market for silk goods and about 85 % of silk goods produced are sold in the domestic market. However, India exports approximately 15 % of its output of all types of silk goods (including value-added items). The export of Indian silk products consists of finished goods like fabrics, made-ups, ready-made garments and furnishing materials like curtains, carpets, bed spreads, cushion covers etc. The export of silk products has been showing a steady growth and the export earnings showed a rapid increase during the last decade

#### **Comparative mulberry sericulture statistics- China vis-à-vis India**

<b>Parameter</b>	<b>China*</b>	<b>India</b>
Area under mulberry (lakd ha.)	7.36	1.79
Leaf yield (MTs/ha/yr)	25-30	30-50
Races reared	All bivoltine	Mostly cross breeds
Egg production (croredfls)	75.962	25.65
Supply syste,	Majority chawki reared	Majority supplied as eggs
Time of supply	Batch-wise	Throughout the year
No. of crops per yea	2-3: Temperate 6-8: Tropical	5-6-8-12 (Split plot system)
Dfls brushed / ha / yr	1050	1492
Cocoon yield (kg / 100 dfls) (2 boxes)	75.92	51.0
Leaf cocoon raio (kg)	16-18	20-22

Cocoon yield (kg / ha)	736.89	698.0
Cocoon weight (g)	1.9-2.0	1.6-1.8
Cocoon shell percentage (%)	21-23	CB: 17-19 BV: 20-22
Filament length (m)	>1000	<1000
Renditta	6.4	8.2 (6.9 for bivoltine)
Grade of silk	A – 4A	Un-graded to A grade
Cost of cocoon production (Rs. / kg)	40-45	65-70
Prevailing cocoon price (Rs)	100-120	120-300
Raw silk production (kg/ha/yr)	114.87	85.02
Av. Crop loss / year (%)	3-5	10-15
Demand and supply position	90% Export	Self consumption 30 % deficit
Raw silk produced (MTs / yr)	86500	15445

***Source:** \*Li Long and Hu Zhuozhong, Indian Silk, May 2006.*

### **Potential, strengths and challenges of sericulture industry in India**

R&D achievements like development of indigenous mulberry varieties with highest leaf yields in the world, new bivoltine silkworm hybrids eminently suited to the tropical regions of the country, farmer-friendly technologies, cost-effective new package of practices for cultivation of food plants, rearing and reeling coupled with huge natural and man-made resources and trained manpower clearly indicates the future prospects of sericulture industry to emerge as a promising indicator of economic development for the upliftment of the socially deprived communities and



the downtrodden. The strengths, weakness, opportunities and challenges (SWOT analysis) of Indian silk industry have been given in Table 5.

**Table 5: SWOT analysis of the Indian silk industry**

<b>Strengths</b>	<b>Weakness</b>	<b>Opportunities</b>	<b>Threats</b>
Large production base, availability of skills, land and labour.	Gaps in technology transfer and extension support.	Generation of rural employment and reduction of migration to urban areas.	Heavy dumping from China at low prices.
Established infrastructure, availability of silkworm breeds / hybrids.	Inadequate market accessibility, poor linkage among different stake holders.	Liberalization policies of Govt. of India in line with WTO Agreements.	Unpredictability of China's silk policies.
Low investment, short gestation period and higher returns.	De-centralized nature of the industry inhibits financial institute from extending financial support to the sector.	Reduction of production of silk even by traditional silk countries like Japan, USSR etc.	Inability of the silk industry to react and adopt to the changing needs in terms of quality both for the domestic and export markets.
Easily adoptable technologies and strong domestic demand-pull.	Lack of quality based pricing system in the market, frequent price fluctuations and large scale imports from China at low prices.	Garment exports are on a steady increase with huge employment opportunities.	Lack of awareness in the domestic market to respond to the demand-driven milieu.

***Seri-bio-diversity:*** Among 34 mega biodiversity countries in the world, India is home to many species of insects with a diverse silk moth fauna. In addition to the diverse silkworm races, there are vast genetic resources of mulberry, tasar, muga and eri host plants spread over diverse geographical locations. This offers a great opportunity for economic utilization of the natural flora and fauna. However, due to deforestation and destruction of habitats, there is a challenge to bring about development without disturbing the ecological balance.

***Sericulture and national economy:*** In India, sericulture related activities ensure the livelihood security of over six million families spread over in some 59,000 villages across the country. The silk sector is also a valuable foreign exchange earner for the country. The export earnings stood at Rs. 2,353 crores during 2011-12. In addition, there is an opportunity to double the export earnings with the free trade atmosphere in Europe and USA. It is estimated that India needs 25,000 MT of raw silk per year to meet its domestic requirement. The growing demand of silk in the domestic market can make the industry a valuable enterprise which in turn can provide employment for the rural masses ensuring assured economic returns at the individual family level.

***Sericulture and women empowerment:*** Women contribute to a little less than 50 % of the country's population and most of them are largely rural based, deriving their livelihood through agriculture and other land based activities, either as family members or wage earners. As a cottage industry, sericulture provides ample work for women in the rural areas particularly in silkworm rearing and reeling, while men, largely work in the field and in weaving. The involvement of women in different activities of sericulture is about 53 % and their contribution in the on-farm activities understandably is lower than that in post-cocoon activities. Sericulture is an ideal avocation for women because of the following facts-

Being rural based, sericulture needs less specialized skill and hence, suits women well.

Involves mostly indoor activities, less physical energy and manual labour.

Work is evenly spread over during the day, with intermittent gaps, offering leisure time and proximity to living place.

Minimum investment with long life and short gestation period.

Continuous job with frequent income and scope for utilizing several by-products for value addition.

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**Sericulture and rural development:** Sericulture being a farm-based enterprise is highly suited for both large and small land holdings, with low capital investment. The very nature of this industry with its rural based on-farm and off-farm activities and enormous employment generation potential has attracted the attention of many planners and policy makers to recognize the industry as one of the most appropriate avenues for socio-economic development of a largely agrarian economy like ours. Generally, silk goods are purchased by the urban rich and middle-class consumers and it is estimated that around 57 % of the final value of silk fabrics flows back to the primary producers in rural areas. Sericulture can also play a very vital role in alleviating rural poverty due to its high work participation rate and thereby can check migration from rural to urban areas.

**Sericulture and employment generation:** Raw silk production is the most appropriate tool to provide gainful employment to these poorer sections of the society, as net incomes range from Rs. 12,000 to 70, 000 per annum depending upon the variety of the silk to be produced and the unit area (under host plants). It is estimated that sericulture can generate employment @ 11 man-days per kg of mulberry raw silk production (in on-farm and off-farm activities) throughout the year (Table 6).

**Table 6:** Activity-wise employment generation in Mulberry sericulture (per ha.)

Activity	Employment generation	
	Man-days	Man-years
<b>A. Mulberry cultivation and silkworm rearing</b>		
a. Mulberry cultivation	585	
b. Leaf / shoot harvesting	320	
c. Silkworm rearing	350	
Sub-total	1255	5.020
<b>B. Reeling of silk cocoons</b>		
@ 300 mandays per 1000 kgs of reeling cocoons (@ 8.0 renditta; 760 kgscocon / ha.; 95 kgs raw silk / ha.)	2250	9.120

Total (A + B)	3535	14.140
<b>C. Twisting</b>		
@ 220 g of silk per mandays	432	1.727
<b>D. Weaving</b>		
Handloom @ 0.13 kg per manday	438	1.752
Powerloom @ 0.3125 kg per manday	122	0.486
Sub-total (Weaving)	560	2.238
<b>E. Printing and Dyeing</b>		
@ 40 mandays for 40 kg of raw silk	95	0.380
<b>F. Finishing</b>		
@ 751 mandays for 40 kf of raw silk	1784	7.135
<b>G. Silk waste processing</b>		
@ 18.775 mandays per kg of raw silk	26	0.104
Total (C to G)	2896	11.58
<b>Grand Total</b>	6431	26

*Source: Central Silk Board, Bangalore.*

### **Steps to improve productivity and quality.**

1. Evolution of appropriate cost-effective technologies through focused research projects addressing constraints and maximizing the production of quality eggs.
2. Teaming up of sericulture scientists with molecular biologists, bio-engineers, immunologists, textile technologists, clinicians, experts from industry and a host of other stakeholders in charting out a new road map.
3. Adoption of region and season specific approaches in the development of superior breeds / hybrids and feed package of practices.

4. Establishment of close linkage between forward and backward sub-systems for greater efficiency and synergy as sericulture and silk industry is highly scattered and unorganized.
  5. Identification and promotion of potential clusters for Bivoltine and Vanya silk production in potential traditional and non-traditional areas.
  6. Skill up-gradation through structured and specially designed training programs.
  7. Establishment of linkages among the four identified production sub-systems viz., seed, cocoon, yarn and fabric.
  8. Capacity building for production and supply of adequate quality planting material, silkworm seed, reeling cocoons and silk yarn through promotion of large-scale production units with required techno-financial support.
  9. Development and promotion of participatory extension system for effective adoption of technologies by similar stakeholders.
  10. Protection to some extent of Indian silk market from Chinese cheap raw silk and fabrics by implementation of anti-dumping duty.
  11. Effective utilization of by-products for value addition.
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## **Vanya Silks - The Wild Silks of India**

### **INTRODUCTION**

**Natural Silk:** Natural Silk is insect fiber. It comes from the silkworm cocoon that the silkworm spins around itself to form its cocoon. A single filament from a cocoon can be as long as 1600 meters. It is considered an animal fiber because it has a protein structure. Just like other animal fibers silk does not conduct heat, and acts as an excellent insulator to keep our bodies warm in the cold weather and cool in the hot weather.

Silk has luster, drape and strength. There are three grades of silk; each is a product of the three different stages of silk processing. The unwound filament makes the finest quality silk, and is referred to as reeled silk. It is satiny smooth and pure white. Remaining silk from the reeling process becomes the raw material for carded or combed, spun silk yarn. The short fibres left behind after the carding or combing process are used to make noil yarn, a richly textured nubby silk.

India produces all three varieties of natural silks viz silk, Tasar silk, Muga silk and Eri silk. The Tasar, Eri and Muga silk are non mulberry silks which are wild silks and also known as Vanya Silks.

### **THE WILD SILKS OF INDIA - TASAR, ERI and MUGA**

Vanya silks arouse the creative passion in designers for innovation, ingenuity and exclusively – naturally and spontaneously. Vanya silks portray the rich crafts, culture and folklore of the North Eastern and tribal zones of Central, eastern India and sub Himalayan region. They are distinguish in looks and feel as they are procured from the wild silkworms that feed on leaves of castor, kesseru, payam, som, sualu, oak, arjun, asan, sal etc... in the open jungles, imbibing the unevenness of nature, and reflecting it in the silks they produce.

In unparallel textures, with natural sheen, easy affinity for natural dyes, light in weight and high in moisture absorbency, and with baffling thermal properties...warm in winter and cool in summer, products of rich, salubrious climate and nourishing vegetation, each of the Vanya silks has its own unique beauty and ethnic culture. They are distinguished in four different forms: muga, tropical tasar, oak tasar and eri. They are the magnificent gifts of nature to genius of global designers, to explore and create various designs for garments, life style

products and home furnishings for sophisticated homes, haute couture as far as artistic imagination can stretch.

### **Eri Silk:**

Also known as endi or errandi, this silk is produced by the eri silkworm (*Philosamia ricini*).



These worms feed mainly on Castor and Kesseru. As eri cocoons are open ended, the yarn is spun. Interestingly, in many parts of the North-East, eri cocoons are produced for their edible pupae and silk is the by-product. Elegantly designed eri shawls and chaddars are quite popular because of their thermal properties. They can be blended with cotton, wool, jute or even mulberry silk to create exotic fabrics for use in jackets, or suiting material, or for producing a variety of furnishings, making it an interior decorator's delight. It is also called Non-Violent silk as the pupa is allowed to develop and come out as moth because eri is spun and not reeled.

**Tasar:** Tasar silk is produced by tasar silkworms (*Antheraea mylitta* and *Antheraea proylei*) that feed mainly on the leaves of Asan, Arjun and Oak. India is the second largest producer of tasar silk and the exclusive producer of Indian tasar (also known as tropical tasar)



which is largely tended by tribals in the Gondwana belt. Oak tasar (also known as temperate tasar) is mainly used for furnishing, dress materials and sarees. Bomkai, Paithani, Ikkat (tie & dye) and Katki are some popular fabrics produced using tasar silks. Bafta is a popular blend of tasar and cotton. Shawls and mufflers are also produced using a blend of oak tasar and other natural fibers like wool, cotton, etc.

Tasar silk is ideal for making jackets for men and women or traditional costumes like the 'salwar-kurta'. This silk can be styled into beautiful dresses, stoles and scarves. Tasar fabric can also be printed, hand-painted, or, even embroidered into traditional sarees and beautiful dress-materials. In fact, in India, it is said that a bride's trousseau is never complete without a saree made of Tasar Silk!

**Muga Silk:** The pride of India, muga silk is known for its natural shimmering golden colour.



Its production is confined to Assam, border areas of neighboring Northeastern states and Cooch Bihar in West Bengal. It is produced by the muga silkworms (*Antheraea assamensis*), which feed on Som and Sualu. The most expensive of silks, muga is intrinsically woven into the cultural traditions of the people of Assam. The vibrant Sualkuchisarees and mekhla-chaddars are the traditional items made from muga silk. In recent times, fashion designers have found exciting prospects in using muga silk for developing new products and designs. Use of muga yarn as a substitute for 'zari' in sarees is finding favor with reputed weavers.

## VANYA SILK INDUSTRY IN INDIA

### History:

Vanya sericulture remained obscure for a long time as an exclusive craft of tribal and hill folks inhabiting the Central and North Eastern India. It is in the recent past that this tribal tradition assumed importance and attracted attention at National level. The rich production potentialities within the country, steady demand for vanya silk products outside, eco-friendly nature of the production and processing activities, women participation, promoted commercial exploitation of this craft, which culminated in the transformation of this age old tradition to an industry of immense potentiality. Vanya silks have been commercially exploited way back in 17th Century. The Western World gained an appetite for these alien shaded silks in mid 1800 when a rampant silkworm disease destroyed the European sericulture industry. Asia could not supply enough mulberry silk to cater to the needs of Europe and North America, thus creating a market for vanya silks.

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**Tasar:** Though there is no recorded document available regarding the origin of tasar in India, one can find the mention of tasar silk in ancient epic Ramayana "Ram's nuptial gift to Sita includes tasar silk". Temperate tasar is of recent origin and was introduced during mid 1960's.

**Muga:** The silk of Assam (Muga) was made known to the World during 1662 through a famous European traveler Jean Joseph Tavenier. Sericulture was exempted from payment of land revenue as the Kings of Assam patronized the development of sericulture. Around 1950, there was a great earth quake in Upper Assam and the large number of muga plantations was destroyed, which hampered the growth of muga industry.

**Eri:** The word eri means castor plant, is derived from the word "eranda" of Sanskrit origin. The advent of Ericulture is lost into the antiquity but, the fact remains that Assam was the original home of eri silk from time immemorial, with the earliest reference documented in 1779. The British called it as "Palma Christi" silk. The eri silk was woven into heavy clothes known as "Bar Kapoor". Captain Jenkins (1771) remarked that eri silk was of incredible durability.

#### **Distribution of Vanya Silk Industry in India:**

**Tasar:** Tropical Tasar growing area forms a distinct belt of humid and dense forest sprawling over the Central and Southern plateau, covering the traditional states of Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Orissa and touching the fringes of West Bengal, Andhra Pradesh, Uttar Pradesh and Maharashtra. Temperate tasar (oak tasar) extends from the sub-Himalayan region of Jammu and Kashmir in the West to Manipur in the East covering Himachal Pradesh, Uttarkhand, Assam, Mizoram, Arunachal Pradesh and Nagaland.

**Muga:** Assam accounts for more than 95% of the muga silk production. The culture is also spread in different districts neighboring Assam in Meghalaya, Nagaland, Manipur, Mizoram, Arunachal Pradesh and West Bengal.

**Eri:** Eri culture was mostly confined to the Brahmaputra valley of Assam in the tribal inhabited districts, followed by Meghalaya, Nagaland, Mizoram, Manipur and Arunachal Pradesh. Ericulture is introduced on a pilot scale in States like Andhra Pradesh, Tamil Nadu, West Bengal, Bihar, Chhattisgarh, Madhya Pradesh, Orissa etc.

#### **Status of Vanya Silks in India:**

**1. Production trends:** Of the total raw silk production during 2012-13 (18715 Metric Tonnes) Vanya silk contributes to around 26 % (4963 metric Tonnes MT). Of the total vanya silk production, contribution of Eri, Tasar and Muga silks are 63%, 35% and 2% respectively. Vanya silk production which was around 254 MT during 1950 gradually increased to 4963 MT during 2012-13 registering about 19 fold increase over 6 decades.

**2. Marketing of Vanya silk cocoons and yarn and products:** Though the marketing of Vanya cocoons in general and tasar cocoons in particular is monopolized by the cocoon traders. In the last two decades establishment of Raw Material Banks (RMB) in Vanya sector by CSB, Cocoon markets by Dept. of Sericulture and State government marketing agencies viz., Sericulture Federation (SERIFED), Khadi Village Industries Commission (KVIC), Tribal Federation (TRIFED) etc., have helped in marketing of cocoons. Establishment of these agencies has resulted in improvement in the bargaining power of primary cocoon producers. The Vanya silk products mainly saris and fabrics for dress material and furnishings are being marketed mainly by manufacturers and traders by participating in various exhibitions all over India.

**3. Export of Vanya silk products:** The Vanya silk fabrics are being exported mainly from Kolkata, Bhagalpur New Delhi, Mumbai and Bangalore by the established exporters. The share of export earnings by Vanya silk products is approximately 10% out of total export of natural silk goods.

## **TASAR CULTIVATION IN FOREST AREAS**

Tasar areas are primarily classified as follows

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1. **Traditional** – Areas where tasar cultivation has been done by the local population specially Tribals for a very long time. For example tasar cultivation is a regular feature of tribal population in Jharkhand, Chhattisgarh, Odisha . Similarly Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal and Jammu Kashmir are traditional Mulberry states.
  2. **Non- traditional**- Areas where there is sufficient food plants to introduce such as Madhya Pradesh, Uttar Pradesh etc but have not been doing Tasar cultivation historically.
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The traditional tasar areas have an advantage that they already have technologies well established with the local population and the government has to play only a proactive role. In case of non-traditional states selection of forest areas , identification of beneficiaries, training and motivation has to be done from the start.

### **Following steps are involved in Tasar cultivation**

**Process in Nutshell-** The beneficiaries are given a certain quantity of eggs which they nurture (rear) in selected forest areas. After the silkworms form a cocoon the cocoons are collected and bought by the department or an outside agency. The whole cycle takes about 40 to 45 days. The process starts immediately with the onset of monsoon as the humidity builds .During the period the beneficiaries protect the larvae from parasites such as birds, monkeys, snakes and diseases. The second crop starts immediately after the first crop is over as there is enough humidity left .Process in detail is as follows. In various parts of the country the process is adopted by joint forest management committees.

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- 1. Selection of forest areas.** – Forest areas where a certain minimum of 500-1000 tasar food tree like *saja* and *arjun* should be selected. Care should be taken that there is enough tree leaves in the crop. In order to manage larvae transfer large tree should be avoided.

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  - 2. Selection of Beneficiary-** beneficiaries should be selected from local villages who know the topography and the forest. They should be willing to invest their whole time for 45 days in the forests. Every beneficiary is given 200DFLs for rearing. A normal dense forest with about 3000-4000 trees per hectare is sufficient for 200DFLs. But in case of acres of scares patches the area allotted to a beneficiary for 200DFls should be increased by equivalent proportion.

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  - 3. Training-** The beneficiaries have to be trained as Tasar rearing is an specialized process. normally the beneficiaries are trained in the first crop.

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  - 4. Preparing the site.** – Then forest area which is selected has to be cleaned for bushes and weeds so that insects and other fauna are minimized. The



ground has to be disinfected for disease and the leaves are also disinfected for disease like *gall* .

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5. **Inoculation of eggs.** - Every beneficiary is given 200 DFL,s. A DFL is a defined as Disease Free Laying that is a group of eggs laid out by a moth which has been certified as disease free. Normally it consists of 200 healthy eggs. These eggs are initially put over a small shrub of tasar food tree and are covered by net for protection from predators. After a week of hatching they are transferred and spread to other tasar food trees. The process of initial hatching and rearing of tasar eggs is called *Chawkie rearing*.

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6. **Food Plant Management.**- The larvae are transferred from tree to tree as they continue to feed. A typical larva eats up to 30 times of its final weight.

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7. **Spinning**- After about 30 to 35 days the larvae starts to make cocoon. This process is called spinning. it takes about 2 to 3 days. It then settles inside the cocoon as a pupa. The cocoons are collected and are ready for either reeling or for next crop.

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8. **Grainage** .- Since there is enough humidity in the atmosphere the pupa after 7 days comes out as moth and the cycle is repeated. By the end of the second crop the winter season begins hence there is not enough humidity and temperature for next cycle to begin. Hence in this case the pupa inside goes for diapauses till next monsoon. Good quality cocoons depending upon next year requirement are stored as seed cocoons rest are used for reeling to be converted into thread and raw silk.

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9. **Seed Crop and commercial crop**- The first crop with the onset of monsoon is called *Seed Crop* as it provides eggs for the next crop. The quality of the cocoon is poor and has lot of moisture. The second crop is called *Commercial Crop* as the quality is good.

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## **GRAIANGE**

The process of Tasar egg making in lay mans term is called *grainage*. It involves storage of eggs, facilitating of male female coupling, washing cleaning of eggs and disease checking. After the first crop the pupa inside the cocoon goes into diapauses that is hibernation till next cycle. Good quality of cocoon are selected and stored in the grainage houses where temperature and humidity are maintained and controlled.

with the onset of monsoon the moths start coming out of cocoon. The moth immediately start coupling with opposite sex and within 3 days of coupling start laying eggs. These eggs are collected washed with soap and other chemicals and are examined under a microscope for diseases primarily for *Pebrine* which is a protozoan disease capable of destroying whole crop.

Once the samples are certified as disease free they are labeled as DFL and are sent to the fields where they are supposed to be reared. Each DFL has a fixed date for hatching hence each DFL group is labeled properly with the date of hatching so that they reach the site and inoculated before hatching.

## **ECONOMICS OF TATSAR CULTIVATION**

1. A beneficiary is given one hectare of forest land or an equivalent area for 200DFLs. An equivalent area for Tasar cultivation is about 5000 tasar trees per hectare. If suppose there are 2500 trees per hectare then 100 Dfls will be used and it will be half hectare in equivalency.
  2. Each DFL contains 200 healthy disease free eggs.
  3. Each egg has the potential to become full grown cocoon. Therefore theoretically a group of 200 DFLs can gives 40,000 cocoons.
  4. But actually there are hatching losses about 10% and depending upon the care taken by beneficiary losses due to predators and weather losses.
  5. Normally in traditional areas the out put is about 50 cocoons per 200DFLs.
  6. Normally the price of a cocoon varies from lowest grade 30 paisa to 2 Rupees. Therefore the average cost of the produce is about 1 Rupee.
  7. Therefore a beneficiary in one crop gets about Rs 10000 in 45 days.
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8. The yield in the second crop is higher and the beneficiary may earn up to 15-25000 in second crop.
9. Therefore a beneficiary in two crops may earn between 25,000 to 50,000.
10. In traditional areas some beneficiaries earn up to between 1 to 2 lacks working in family groups.
11. Due to the presence of the beneficiaries the forests are protected as the income of the beneficiaries depend upon the abundance of food plants.
12. The production of cocoons in the forest areas leads to development of other decentralized cottage industries like reeling, dyeing and weaving.

#### TECHNICAL TERMS ASSOCIATED WITH SILK CULTIVATION

1. **Voltism-** .It refers to number of life cycles per year. Depending upon ecorace a typical silkworm may have one (Uni), two(Bi), three (Tri) or Multi(more than three) life cycles.
2. **DFL-** Disease free laying. . A DFL is a defined as Disease Free Laying that is a group of eggs laid out by a moth which has been certified as disease free. Normally it consists of 200 healthy eggs. After emergence from the cocoon male moths immediately couple with female moths. After a period of 24-36 hours female moth lays eggs in about three batches. These eggs are cleaned washed and examined under the microscope for diseases specially pebrine. After a batch ic certified as disease free then only it is used for rearing in the field.
3. **Chawkie rearing.** Initially laid eggs when transferred in the field are hatched under supervision in few selected shrubs for a week. This natal stage rearing is called Chawkie rearing. After a week the one week old larvae are spread all over the forest areas.
4. **Pebrine.-** Pébrine is a disease of silkworms, which is caused by microsporidian parasites, mainly Nosema bombycis and to a lesser

extent Variomorpha, Pleistophora and Thelophania species. The silkworm larvae infected by pébrine are usually covered in brown dots and are unable to spin silkworm thread. Louis Pasteur was the first one to recognize the cause of this disease when a plague of the disease spread across France. It is the most dangerous silkworm disease and often leads to epidemic form there by destroying crops not only at local level but at state and even national level. Precaution includes disinfection and burning of the ground soil surface.

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5. **Diapause-** After the cocoon has been spun and the pupa sets inside the cocoon it goes into hibernation or diapauses. In case of Tasar during the first crop at the onset of monsoon the pupa goes into diapause for one week. Since there is still sufficient humidity it emerges as a moth and the lifecycle is repeated. After the second crop winter sets in and there is not sufficient humidity. Therefore the pupa remains in the cocoon in the diapauses state for about six months till the next onset of monsoon.
  6. **Grainage-** The process of Tasar egg making in lay mans term is called *grainage*. It involves storage of eggs, facilitating of male female coupling, washing cleaning of eggs and disease checking.
  7. **Molt** . A silkworm goes into molt phase five times in its life cycle of 30-35 days. During this process it sheds its skin and does not eat. This is because there is enormous enlargement in its size. During this process the old skin is shed and new skin comes up.
  8. **Ecorace-** Due to agro climatic variations in the country various silkworm have adopted to local conditions and have evolved into distinct ecoraces. For example *daba, modal, rally, laria* are ecoraces of Tasar. Similarly in case of Mulberry ecoraces are developed by Central Silk Board to get maximum productivity for a particular area.
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